U.S. DEPARTMENT OF ENERGY

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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 2010

SF Snyder
JM Barnett
K Rhoads
LE Bisping

June 2011

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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). Several PSF radiological laboratories at the PNNL Site became operational in 2010. This is the first Air Emissions Report for the PNNL Site since the start of PSF radiological operations in 2010. Prior to 2010, the PNNL Site reports have not reported any emissions and have only included EMSL.

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 2010 from PNNL Site sources was 8E-06 mrem (8E-8 mSv) EDE. No radon was emitted from the PNNL Site in 2010. No nonroutine emissions occurred in 2010. The total radiological dose for 2010 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 Ms. 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-20436-1

DOE-SC PNNL Site
Radionuclide Air Emissions Report
Calendar Year 2010

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)]

Julie K. Erickson, Acting Manager
U.S. Department of Energy
Pacific Northwest Site Office

6-21-11
Date

Acronyms and Abbreviations

CAP-88	Clean Air Act Assessment Package-1988
CAP88-PC	Clean Air Act Assessment Package 1988-Personal Computer
CFR	Code of Federal Regulations
Ci	curie
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOE-ORP	U.S. Department of Energy, Office of River Protection
DOE-SC	U.S. Department of Energy, Office of Science
EDE	effective dose equivalent
EM	environmental management
EMSL	Environmental Molecular Sciences Laboratory
ENW CGS	Energy Northwest Columbia Generating Station
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
MOU	Memorandum of Understanding
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
RAEL	Radioactive Air Emissions License
QA	quality assurance
rem	roentgen equivalent man
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

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1.0 Introduction

This report documents calendar year 2010 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." The report also is compatible with the quality principles of 10 CFR 830, *Nuclear Safety Management;* DOE Order 414.1C, *Quality Assurance;* NQA-1, *Quality Assurance Requirements for Nuclear Facility Application;* and 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 1.3). The PNNL Site occupies an area of 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 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 PNSO in December 2003 under the Office of Science. The Battelle Memorial Institute is contracted to the Department of Energy to operate the Pacific Northwest National Laboratory (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.

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 were constructed in 2009-2010 to replace aging laboratory infrastructure on the Hanford Site. The PSF facility consists of the five buildings listed in Table 1.1. 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 feet 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.

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 close proximity 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 were determined during the process. 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 1.2).

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 1.2. Physical Sciences Facility on the PNNL Site

Notable events in calendar year 2010 relevant to radioactive airborne emissions monitoring and reporting are summarized as follows:

- PSF facilities were occupied and began radiological operations in July 2010.
- Three ambient air monitoring stations began operations in 2010.
- A Data Quality Objectives report and an Implementation Plan for PNNL Site environmental air surveillance were published (Barnett et al. 2010; Snyder et al. 2010).

1.1.3 Prime Contractor

Battelle Memorial Institute[1] is contracted to operate PNNL for DOE-SC. PNNL manages operations at the PNNL Site, as well as operations 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] Battelle Memorial Institute, Pacific Northwest Division, Richland, WA 99352.

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 1.3); 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 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 2010:

- 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
- effluent sampling was the monitoring method used.

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).

Figure 1.3. Location of the Hanford Site in Relation to the PNNL Site

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	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[(b)]	EP-3430-01-S	Major point source. Main Stack	Continuous sampling
	EP-3430-02-S	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	Point source. Room 1606 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1608P-S	Point source. Room 1608 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1610P-S	Point source. Room 1610 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1612P-S	Point source. Room 1612 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1614P-S	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[(c)]

(a) Values are calculated from in-facility material inventories and estimates and Appendix D method of 40 CFR 61.
(b) The five perchloric acid hoods in the 3430 Building were not used for radiological operations in calendar year 2010.
(c) 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

Radionuclide air emissions from point sources generally are discharged from stacks and vents. Discharge heights for PSF stack and fugitive emission points range from nearly ground level to 51 ft (15.5 m), and flow rates range from less than 13,700 ft^3/min (6.5 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 2010 was high-efficiency particulate air (HEPA) filters. In general, one stage of HEPA filtration was used as the final particulate-removal method before an air emission stream was exhausted to the atmosphere (see Table 1.4 for a listing of emission abatement technology at each stack).

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

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	13700 ft^3/min (6.47 m^3/s)	45 ft (13.7 m)	2.7 ft (0.81 m)	94.5 ft (28.8 m)	Single-stage HEPA filter
Major EP-3420-01-S	53625 ft^3/min (25.31 m^3/s)	50.9 ft (15.5 m)	4.3ft (1.3 m)	145.1 ft (44.2 m)	Single-stage HEPA filter
Major EP-3430-01-S	38600 ft^3/min (18.22 m^3/s)	44.4 ft (13.5 m)	3.7 ft (1.1 m)	122.5 ft (37.3 m)	Single-stage HEPA filter
Minor					
EP-3420-02-S	61200 ft^3/min (28.9 m^3/s)	45.9 ft (14 m)	3.7 ft (1.1 m)	150 ft (46 m)	None
EP-3430-02-S	66500 ft^3/min (31 m^3/s)	45.9 ft (14 m)	3.2 ft (1.0 m)	163 ft(50 m)	None
EP-3430-1606P-S[(a)] EP-3430-1608P-S[(a)] EP-3430-1610P-S[(a)] EP-3430-1612P-S[(a)] EP-3430-1614P-S[(a)]	NA	NA	NA	NA	None
Fugitive					
J-3425	NA	NA		NA	None
J-3020	NA	NA		NA	None

(a) These stacks did not have radiological operations during 2010.
NA = Not Applicable

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 emitted from PNNL Site point sources that operated in 2010 are shown in Table 2.1 and Table 2.2. Emissions from minor and fugitive emissions units (Table 2.2) were calculated using the Appendix D method of 40 CFR 61.[1] All permitted major emission units operated at least some portion of the year; not all minor and fugitive emission points were subject to radiological operations. No emission unit operated the entire year.

Table 2.1. PNNL Site Radionuclide Emissions (Ci) from Major Point Sources in 2010

Radionuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	Total
gross α (a)	1.64E-8	2.55E-8	1.23E-8	5.4E-8
gross β (a)	1.37E-7	2.11E-7	1.27E-7	4.8E-7
^{3}H	2.53E-6	NA	NA	2.5E-6
^{60}Co	ND	ND	9.96E-10	1.0E-9
^{133}Xe	NA	2.70E-10	NA	2.7E-10
$^{233/234}U$	NA	NA	ND	ND
^{238}Pu	ND	2.36E-10	ND	2.4E-10
$^{239/240}Pu$	2.82E-9	3.12E-9	1.59E-9	7.5E-9
^{241}Am	ND	2.36E-10	ND	2.4E-10
^{243}Am	1.04E-8	1.82E-8	9.27E-9	3.8E-8
^{244}Cm	ND	ND	ND	ND

(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 2010[(a)]

Nuclide	EP-3420-02-S 3420 Building	EP-3430-02-S 3430 Building	J-3425 3440 Building	Total
^{24}Na	NA	1.3E-8	NA	1.3E-8
^{82}Br	NA	1.3E-8	NA	1.3E-8
^{131m}Xe	2.7E-8	NA	NA	2.7E-8
^{133}Xe	2.0E-5	NA	NA	2.0E-5
^{133m}Xe	5.4E-9	NA	NA	5.4E-9
^{135}Xe	2.7E-8	NA	NA	2.7E-8
^{241}Am	NA	NA	6.0E-13	6.0E-13

(a) Values are not from actual measurements, but calculated from in-facility material inventories and estimates and Appendix D method of 40 CFR 61.
NA = Not Applicable

Table 2.3. PNNL Site Total Radionuclide Emissions (Ci) in 2010

Radionuclide	Major Emissions Units	Minor and Fugitive Emissions Units	Total (Ci)
gross α (a)	5.4E-8	NA	5.4E-8
gross β (a)	4.8E-7	NA	4.8E-7
^{3}H	2.5E-6	NA	2.5E-6
^{24}Na	NA	1.3E-8	1.3E-8
^{60}Co	1.0E-9	NA	1.0E-9
^{82}Br	NA	1.3E-8	1.3E-8
^{131m}Xe	NA	2.7E-8	2.7E-8
^{133}Xe	2.7E-10	2.0E-5	2.0E-5
^{133m}Xe	NA	5.4E-9	5.4E-9
^{135}Xe	NA	2.7E-8	2.7E-8
$^{233/234}$U	ND	NA	ND
^{238}Pu	2.4E-10	NA	2.4E-10
$^{239/240}$Pu	7.5E-9	NA	7.5E-9
^{241}Am	2.4E-10	6.0E-13	2.4E-10
^{243}Am	3.8E-8	NA	3.8E-8
^{244}Cm	ND	NA	ND

(a) Maximum of the biweekly or semi-annual average measurement.
ND = not detected
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 U.S. Environmental Protection Agency (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 maximally exposed individual (MEI) from PNNL Site radionuclide emissions (see Table 2.3).

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 fenceline location was not considered because no one 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 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 2010, the PNNL Site MEI was located 480 m SSE of the PSF 3410 Building. 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.

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	0.48 (0.30) 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 (Barnett et al. 2010).

When the potential MEI locations of Table 3.1, as well as year 2010 annual meteorological data (see Appendix A) were evaluated with CAP88-PC v3 models, the 2010 receptor of maximum impact from PSF emissions (i.e., the MEI) was determined to be 0.48 km (0.30 mi) SSE of PSF.

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 2.3) were used in the dose calculations. The 3410 Building major emission point has been determined to impose the greatest impact on 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-meter 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 (e.g., 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/cubic meter per Ci/second (or s/m^3). Applying these factors to annual average release rates yields predictions 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 1.3, Figure 5.1) and represent the average of hourly data recorded in 2010. Meteorological data for 2010 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 Code of Federal Regulations 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 2010, the PNNL Site MEI location was 0.30 mi (0.48 km) SSE of the PNNL Site. The dose to the PNNL Site MEI from routine and non-routine point source emissions was 8E-6 mrem (8E-8 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 CY2010 were reviewed. Both PNNL and Hanford (Rokkan et al. 2011) are in compliance with the 10 mrem/yr regulatory standard for CY2010 radiological emissions.

The CY2010 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 2E-6 mrem (2E-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. 2011), was estimated to be 6E-2 mrem (6E-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 (99.6%).[1]

[1] Exclusion of Hanford Site 300 Area tritium emissions results in an estimated dose to the PNNL Site MEI of 6E-5 mrem (6E-7 mSv), the majority of that dose is from ^{238}Pu and $^{239\text{-}240}Pu$.

Table 3.2. PNNL Site 2010 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 $\alpha^{(a)}$	5.4E-08	4E-6	46%
gross $\beta^{(a)}$	4.8E-07	2E-6	20%
^{3}H(HTO)	2.5E-06	9E-10	<1%
^{24}Na	1.3E-8	2E-10	<1%
^{60}Co	1.0E-09	7E-10	<1%
^{82}Br	1.3E-8	4E-10	<1%
^{131m}Xe	2.7E-8	3E-13	<1%
^{133}Xe	2.0E-5	8E-10	<1%
^{133m}Xe	5.4E-9	2E-13	<1%
^{135}Xe	2.7E-8	9E-12	<1%
^{233}U	ND	NA	NA
^{238}Pu	2.4E-10	2E-8	<1%
$^{239/240}$Pu	7.5E-09	5E-7	6%
^{241}Am	2.4E-10	1E-8	<1%
^{243}Am	3.8E-08	2E-6	27%
^{244}Cm	ND	NA	NA
Total	2.3E-5	8E-6	100%

(a) Alphas assumed to be ^{239}Pu for dose calculation purposes; betas assumed to be ^{90}Sr.
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 2010 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 their MEIs. In Figure 3.2, MEI_Hanford is the Hanford Site's Sagemoor Road MEI and MEI_PNNL is the PNNL Site's MEI located 0.48 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 1E-9 mrem (1E-11 mSv) EDE (see Table 3.2) to the 8E-6 mrem (8E-8 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 Section 3.6.3) or non-routine emissions (refer to Section 3.5) from the PNNL Site during 2010 that would contribute to dose that is considered for compliance determination with the WAC 246-247 standard.

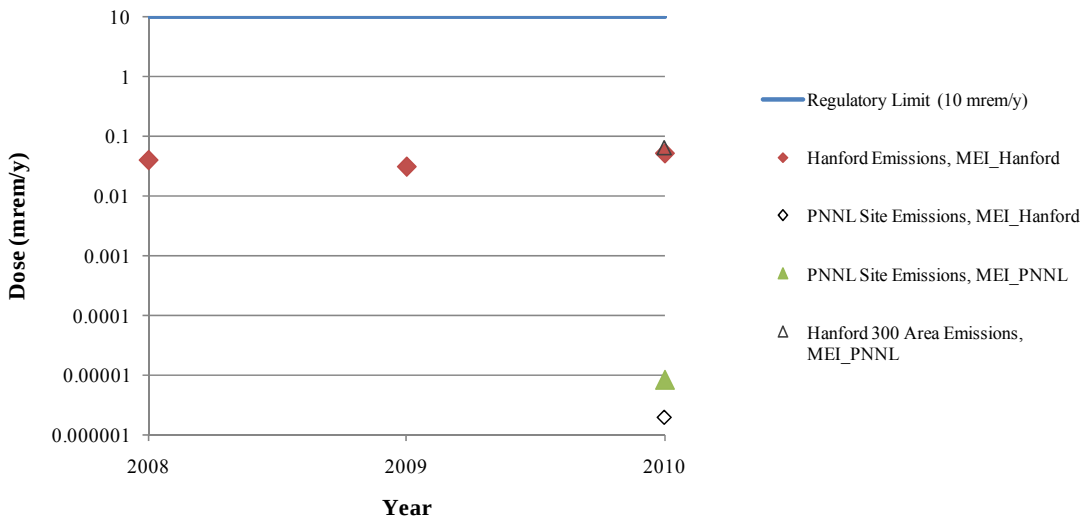

Figure 3.2. Doses to the PNNL Site and Hanford Site MEIs Due to Emissions of Radionuclides from the PNNL Site, 2010, and the Hanford Site, 2008 through 2010

3.5 Nonroutine Releases of Radionuclides to the Atmosphere

No known instances of significant nonroutine emissions were reported in 2010.

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. An Implementation Plan for the PNNL Site air monitoring program was developed in late 2010 (Snyder et al. 2010).

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 2010.

3.6.3 Radon-220 and Radon-222 Emissions

^{220}Radon and ^{222}Rn were not emitted from PNNL Site operations in 2010. 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 2010 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. 2011). The PNNL Site contains no comparable non-facility-specific fugitive emission sources.

The PNNL Site has two sources characterized as fugitive sources from Site facilties, 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 1E-9 mrem (1E-11 mSv) EDE.

5.0 Supplemental Information

This section provides supplemental information related to PNNL Site radionuclide air emissions in 2010 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 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 2010 was calculated using a simplified method that overestimates the population dose. The population consists of approximately 350,000 people residing within a 50-mi (80-km) radius of the 300 Area (Elliott et al. 2004). 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 (8E-6 mrem) times the 50-mi population (349,067). The 2010 total population dose from radionuclide air emissions estimated in this very conservative manner from nuclides that originate from the PNNL Site was 2.8 person-rem (0.028 person-Sv).

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 CY 2010 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. Sampling data are collected at three ambient air samplers (Barnett et al. 2010) 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 2010, the Hanford Site 300 Area would have contributed most of the non-PNNL particulates detected from offsite facilities. The offsite air surveillance program commenced in 2010; therefore, more details are provided in this initial report than will be included in reports for subsequent years.

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.

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 2010 include ^{60}Co. In addition, americium isotopes (^{241}Am and ^{243}Am) and ^{243}Cm are analyzed. Also, the US DOE 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. Data from the Hanford Site monitoring program are reported in the Hanford Site Annual Environmental Report each year (e.g., Bisping 2010).

5.3.2 Air Sampling Results for Calendar Year 2010 Operations

The particulate air sampling results are provided in Appendix C, Table C.2, for the PNNL Site radiological operations period that started in July 2010, as well as the Yakima background station for CY2010. 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. However, no ^{233}U or ^{234}U was emitted from the PNNL Site in 2010 and the reported concentrations are considered background. All other average air concentrations are at or near detection limits. There was no indication of substantially elevated levels of 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.

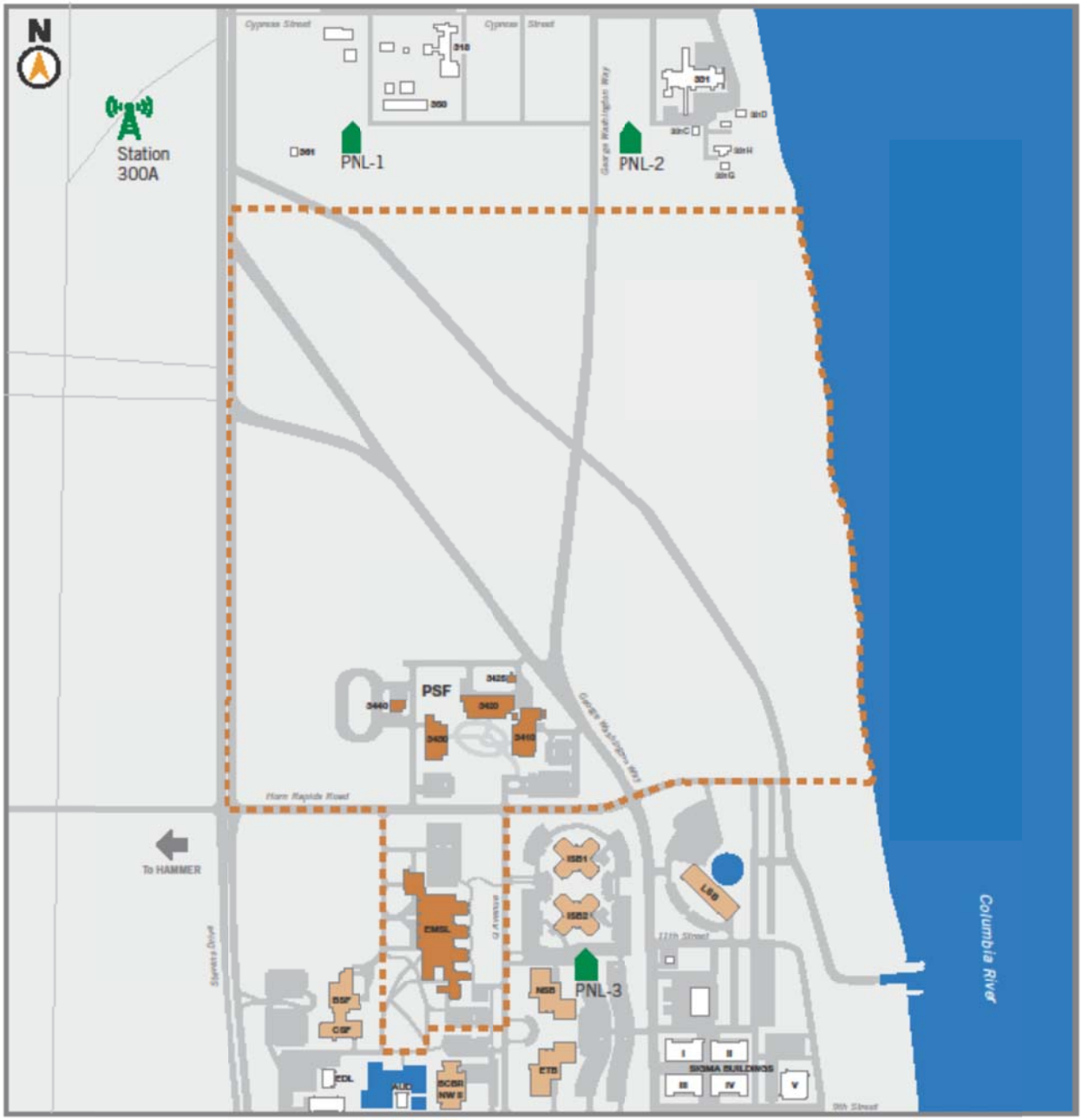

Figure 5.1. Offsite Air Surveillance Locations for the PNNL Site (⌂)

Table 5.1. Summary of 2010 Air Sampling Results

Nuclide	Location	No. of Samples	No. of Detections	Average ± 2 sd (pCi/m^3)
^{60}Co	PNL-1	2	0	-0.00025 ± 0.0017
	PNL-2	2	0	0.00016 ± 0.000031
	PNL-3	2	0	0.00062 ± 0.0014
	Yakima	4	0	-0.000058 ± 0.00083
$^{233/234}$U	PNL-1	2	2	0.000069 ± 0.000037
	PNL-2	2	2	0.000048 ± 0.0000089
	PNL-3	2	2	0.000068 ± 0.000019
	Yakima	4	4	0.000040 ± 0.0000073
^{238}Pu	PNL-1	2	0	-0.0000017 ± 0.0000033
	PNL-2	2	0	-0.0000031 ± 0.000013
	PNL-3	2	0	-0.0000012 ± 0.0000033
	Yakima	4	0	-0.00000047 ± 0.0000012
$^{239/240}$Pu	PNL-1	2	0	-0.0000072 ± 0.000012
	PNL-2	2	0	-0.0000043 ± 0.0000095
	PNL-3	2	1	-0.0000027 ± 0.000019
	Yakima	4	0	-0.00000074 ± 0.0000014
^{241}Am[(a)]	PNL-1	2	0	-0.00000054 ± 0.0000026
	PNL-2	2	0	-0.0000025 ± 0.00000064
	PNL-3	2	0	0.0000019 ± 0.0000043
	Yakima	0	0	NA
^{243}Am	PNL-1	2	2[(b)]	0.000028 ± 0.000024
	PNL-2	2	2[(b)]	0.00014 ± 0.00034
	PNL-3	2	0	0.0000011 ± 0.000023
	Yakima	0	0	NA
$^{243/244}$Cm	PNL-1	2	0	0.0000017 ± 0.0000021
	PNL-2	2	0	-0.0000011 ± 0.0000032
	PNL-3	2	0	0.00000019 ± 0.00000055
	Yakima	0	0	NA
Gross alpha	PNL-1	13	13	0.00089 ± 0.00063
	PNL-2	13	11	0.00058 ± 0.00047
	PNL-3	13	12	0.00076 ± 0.00051
	Yakima	24	20	0.00062 ± 0.00065
Gross beta	PNL-1	13	13	0.021 ± 0.015
	PNL-2	13	13	0.017 ± 0.011
	PNL-3	13	13	0.022 ± 0.016
	Yakima	24	24	0.016 ± 0.013

(a) ^{241}Am values reported are for the analyses done by the more sensitive alpha spectroscopy method.
(b) Values may be biased high due to detection overlap of ^{244}Cm tracer used by analytical laboratory.
NA = Not Available

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 quality assurance plans (PNNL 2011) and in the PNNL Site Environmental Monitoring Plan currently in preparation. The effluent monitoring quality assurance elements described in PNNL 2011 are compatible with one or more of the documents shown in Table 5.2 during calendar year 2010. 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 414.1C, *Quality Assurance* (2005)
DOE Order 450.1A, *Environmental Protection Program* (2008)
DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (1993)
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.

40 CFR 61, *National Emission Standards for Hazardous Air Pollutants* (NESHAP), Subpart T, - National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings," Title 40, *Code of Federal Regulations*, Part 61.

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

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

Barnett JM, KM Meier, SF Snyder, BG Fritz, TM Poston, K Rhoads. 2010. *Data Quality Objectives Supporting Radiological Emissions Monitoring for the PNNL Site*, PNNL-19427, Pacific Northwest National Laboratory, Richland, Washington.

Bisping, LE. , 2010. *Hanford Site Environmental Surveillance Data Report for Calendar Year 2009,* PNNL-19455, APP. 1, Pacific Northwest National Laboratory, Richland, Washington.

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

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

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

DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* U.S. Department of Energy, Washington, D.C.

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

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

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

Elliot, DB, MJ Scott, EJ Antonio, K Rhoads. 2004. *Hanford Area 2000 Population,* PNNL-14428, Pacific Northwest National Laboratory, Richland, Washington.

EPA 2007, *CAP88-PC Version 3.0 User Guide,* U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C.

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

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

Pacific Northwest National Laboratory (PNNL). 2011. *Effluent Management Quality Assurance Plan,* EM-QA-1 <current revision>, Pacific Northwest National Laboratory, Richland, Washington.

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

Rokkan, DJ, RH Anderson, CJ Perkins, K Rhoads, SF Snyder. 2011. *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2010*, DOE/RL-2011-12, Revision 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Snyder, SF, KM Meier, JM Barnett, BG Fritz, TM Poston, K Rhoads. 2010. *Implementation Plan for Air Surveillance of DOE-SC PNNL Site Radionuclide Emissions*, PNNL-20032, Pacific Northwest National Laboratory, Richland, Washington.

WAC 246-247, "Radiation Protection – Air Emissions." Washington Administrative Code.

Appendix A

Dose Modeling and Meteorological Data

Appendix A

Dose Modeling and Meteorological Data

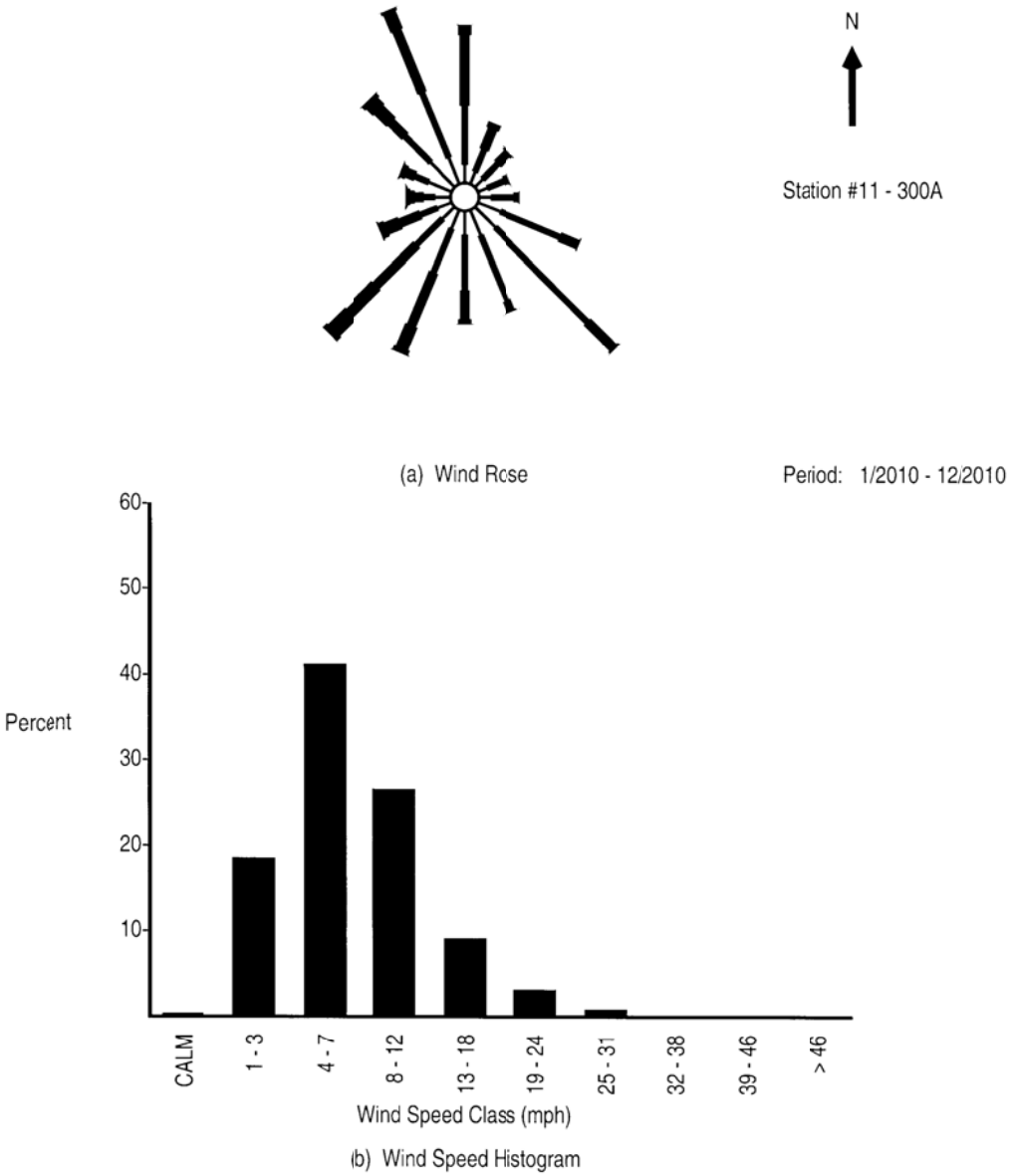

Figure A.1. 300 Area Wind Rose and Histogram Applied to PNNL Site Modeling

Table A.1. Annual Average Joint Frequency during 2010 (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	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.05
	B	0.00	0.03	0.06	0.02	0.03	0.05	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.03	0.00	0.01	0.38
	C	0.03	0.06	0.07	0.08	0.08	0.11	0.05	0.10	0.07	0.04	0.04	0.03	0.03	0.01	0.06	0.09	0.95
	D	0.22	0.21	0.13	0.15	0.18	0.26	0.37	0.22	0.23	0.28	0.15	0.20	0.22	0.27	0.31	0.31	3.71
	E	0.44	0.26	0.17	0.18	0.20	0.65	0.64	0.63	0.70	0.50	0.42	0.37	0.41	0.65	0.81	0.54	7.57
	F	0.26	0.13	0.11	0.11	0.16	0.25	0.53	0.46	0.32	0.29	0.23	0.23	0.19	0.39	0.58	0.45	4.69
	G	0.09	0.04	0.10	0.04	0.03	0.12	0.08	0.19	0.07	0.08	0.12	0.04	0.05	0.10	0.24	0.21	1.6
	Total	1.04	0.73	0.64	0.58	0.7	1.45	1.71	1.63	1.41	1.21	0.98	0.89	0.91	1.45	2.01	1.61	18.95
2.65	A	0.03	0.04	0.29	0.29	0.34	0.39	0.28	0.23	0.14	0.22	0.15	0.05	0.02	0.02	0.04	0.01	2.54
	B	0.1	0.12	0.33	0.36	0.38	0.38	0.38	0.3	0.2	0.18	0.25	0.07	0.03	0.05	0.07	0.05	3.25
	C	0.25	0.23	0.26	0.19	0.23	0.23	0.65	0.18	0.17	0.23	0.22	0.05	0	0	0.05	0.12	3.06
	D	0.91	0.38	0.26	0.16	0.25	0.59	1.13	0.61	0.65	0.56	0.53	0.24	0.22	0.18	0.48	0.92	8.07
	E	1.36	0.44	0.08	0.06	0.16	1.13	2.18	1.31	1.18	1.04	0.75	0.48	0.31	0.44	0.87	1.64	13.43
	F	0.56	0.1	0.01	0	0.06	0.85	2.41	1.17	0.76	0.45	0.23	0.17	0.09	0.09	0.45	0.96	8.36
	G	0.2	0.06	0.02	0	0.02	0.3	0.74	0.28	0.12	0.05	0.01	0.01	0.01	0.08	0.16	0.37	2.43
	Total	3.41	1.37	1.25	1.06	1.44	3.87	7.77	4.08	3.22	2.73	2.14	1.07	0.68	0.86	2.12	4.07	41.14
4.70	A	0.14	0.31	0.52	0.14	0.15	0.23	0.44	0.11	0.18	0.54	0.49	0.18	0.05	0.08	0.03	0.06	3.65
	B	0.14	0.13	0.15	0.08	0.06	0.11	0.28	0.06	0.09	0.43	0.3	0.09	0.02	0.02	0.01	0.06	2.03
	C	0.28	0.17	0.06	0.04	0.03	0.11	0.19	0.06	0.22	0.44	0.39	0.22	0.03	0.05	0.09	0.19	2.57
	D	0.54	0.2	0.03	0.01	0.03	0.24	0.26	0.19	0.41	0.81	0.84	0.29	0.15	0.12	0.52	1.26	5.9
	E	1.6	0.22	0.05	0.02	0.03	0.12	0.42	0.15	0.45	0.84	1.1	0.45	0.25	0.27	0.41	1.63	8.01
	F	0.96	0.19	0.01	0.03	0.01	0.18	0.33	0.07	0.29	0.29	0.23	0.07	0.02	0	0.07	0.47	3.22
	G	0.42	0.08	0	0	0	0.16	0.21	0.03	0.03	0.04	0.03	0	0	0	0.04	0.19	1.23
	Total	4.08	1.3	0.82	0.32	0.31	1.15	2.13	0.67	1.67	3.39	3.38	1.3	0.52	0.54	1.17	3.86	26.61

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	0.08	0.19	0.04	0	0.05	0.02	0.02	0	0.06	0.31	0.51	0.25	0.03	0.07	0.03	0.03	1.69
	B	0.04	0.09	0	0	0	0.03	0.03	0	0.02	0.15	0.19	0.08	0.02	0.01	0.07	0.03	0.76
	C	0.05	0.02	0.01	0	0	0.01	0	0	0.05	0.16	0.26	0.13	0.02	0.01	0.03	0.06	0.81
	D	0.2	0.04	0.03	0	0	0.02	0.06	0.06	0.1	0.29	0.63	0.17	0.1	0.14	0.42	0.49	2.75
	E	0.14	0.01	0.04	0.03	0	0	0.03	0.03	0.05	0.39	0.61	0.22	0.08	0.05	0.43	0.41	2.52
	F	0.04	0.02	0.02	0.04	0	0	0	0	0.02	0.07	0.05	0.01	0	0	0.02	0.08	0.37
	G	0.05	0	0	0	0	0	0	0	0	0.05	0.05	0	0	0	0	0	0.15
	Total	0.60	0.37	0.14	0.07	0.05	0.08	0.14	0.09	0.3	1.42	2.3	0.86	0.25	0.28	1	1.1	9.05
9.80	A	0.01	0.01	0	0	0	0	0	0	0	0.02	0.19	0.13	0.01	0.01	0.02	0	0.4
	B	0	0	0	0	0	0	0	0	0	0.01	0.12	0.03	0.03	0.01	0	0	0.2
	C	0	0	0	0	0	0.01	0	0	0	0.01	0.12	0.05	0.01	0	0.02	0	0.22
	D	0	0	0	0.01	0	0	0.01	0.01	0.01	0.08	0.35	0.09	0.06	0.03	0.34	0.12	1.11
	E	0.01	0	0.04	0.01	0	0	0	0	0.02	0.13	0.56	0.01	0.03	0.03	0.16	0.08	1.08
	F	0	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0	0	0	0.05
	G	0	0	0	0	0	0	0	0	0	0.04	0.04	0	0	0	0	0	0.08
	Total	0.02	0.01	0.04	0.02	0	0.01	0.01	0.01	0.03	0.3	1.4	0.33	0.14	0.08	0.54	0.2	3.14
12.70	A	0	0	0	0	0	0	0	0	0	0	0.02	0.02	0.04	0	0.01	0	0.09
	B	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0.01	0.01	0.05
	C	0	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0	0.01	0.01	0	0.05
	D	0	0	0	0	0	0	0	0.01	0	0.01	0.16	0.05	0.01	0.01	0.12	0.01	0.38
	E	0	0	0	0	0	0	0	0	0	0.02	0.14	0.01	0.01	0	0.1	0	0.28
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0.01	0	0.04	0.36	0.09	0.06	0.02	0.25	0.02	0.85

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	
15.60	A	0	0	0	0	0	0	0	0	0	0	0	0.01	0.04	0	0	0	0.05
	B	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0.01
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0.03
	E	0	0	0	0	0	0	0	0	0	0	0.01	0	0.02	0	0.01	0	0.04
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.07	0	0.04	0	0.13
19.00	A	0	0	0	0	0	0	0	0	0	0	0	0.01	0.04	0	0	0	0.05
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0.01	0.04	0	0	0	0.05
Total	A	0.26	0.55	0.85	0.43	0.56	0.65	0.74	0.34	0.38	1.09	1.36	0.66	0.23	0.18	0.14	0.1	8.52
	B	0.28	0.37	0.54	0.46	0.47	0.57	0.73	0.39	0.33	0.79	0.91	0.28	0.12	0.12	0.16	0.16	6.68
	C	0.61	0.48	0.4	0.31	0.34	0.47	0.89	0.34	0.51	0.89	1.04	0.49	0.09	0.08	0.26	0.46	7.66
	D	1.87	0.83	0.45	0.33	0.46	1.11	1.83	1.1	1.4	2.03	2.66	1.04	0.76	0.75	2.22	3.11	21.95
	E	3.55	0.93	0.38	0.3	0.39	1.9	3.27	2.12	2.4	2.92	3.59	1.54	1.11	1.44	2.79	4.3	32.93
	F	1.82	0.44	0.15	0.18	0.23	1.28	3.27	1.7	1.39	1.11	0.76	0.5	0.3	0.48	1.12	1.96	16.69
	G	0.76	0.18	0.12	0.04	0.05	0.58	1.03	0.5	0.22	0.26	0.25	0.05	0.06	0.18	0.44	0.77	5.49
	Total	9.15	3.78	2.89	2.05	2.50	6.56	11.76	6.49	6.63	9.09	10.57	4.56	2.67	3.23	7.13	10.86	99.92

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).

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

Radionuclide	Concentration uptake factor		GI uptake fraction	
	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 2010

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Site in 2010

Table B.1. Radionuclides Used and/or Potentially Used at the PNNL Site in 2010 (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 2010

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 Operations Period (July–December) and the Yakima Background Station for 2010

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	257799001	30-Jun-10	15-Jul-10	ALPHA	0.000751	pCi/m^3	0.000298	0.000302				
PNL-1	257423001	15-Jul-10	28-Jul-10	ALPHA	0.00131	pCi/m^3	0.000447	0.000466				
PNL-1	258907001	28-Jul-10	11-Aug-10	ALPHA	0.000902	pCi/m^3	0.000375	0.000381				
PNL-1	259789001	11-Aug-10	26-Aug-10	ALPHA	0.000725	pCi/m^3	0.000298	0.000304				
PNL-1	260595001	26-Aug-10	10-Sep-10	ALPHA	0.000935	pCi/m^3	0.000324	0.000331				
PNL-1	261396001	10-Sep-10	22-Sep-10	ALPHA	0.000693	pCi/m^3	0.000314	0.000322		Replaced totalizer.		
PNL-1	264409001	22-Sep-10	07-Oct-10	ALPHA	0.000517	pCi/m^3	0.000247	0.00025				
PNL-1	265044001	07-Oct-10	18-Oct-10	ALPHA	0.000903	pCi/m^3	0.000407	0.000412				
PNL-1	266438001	18-Oct-10	03-Nov-10	ALPHA	0.00081	pCi/m^3	0.00032	0.000331				
PNL-1	267456001	03-Nov-10	18-Nov-10	ALPHA	0.000293	pCi/m^3	0.000223	0.000225				
PNL-1	268281001	18-Nov-10	30-Nov-10	ALPHA	0.00138	pCi/m^3	0.000468	0.000474				
PNL-1	268786001	30-Nov-10	14-Dec-10	ALPHA	0.00129	pCi/m^3	0.000442	0.000461				
PNL-1	269407001	14-Dec-10	28-Dec-10	ALPHA	0.000997	pCi/m^3	0.000408	0.000414				
PNL-1	266233002	30-Jun-10	07-Oct-10	Am-241	0.000000385	pCi/m^3	0.00000095	0.000000951	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Am-241	-0.00000147	pCi/m^3	0.00000676	0.00000676	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Am-241 gamma	-0.000289	pCi/m^3	0.00126	0.00126	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Am-241 gamma	-0.00184	pCi/m^3	0.00431	0.00439	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Am-243	0.0000199	pCi/m^3	0.00000916	0.00000931	X		Results may be biased high due to tailing from the Cm-244 tracer ROI.	Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Am-243	0.0000366	pCi/m^3	0.0000277	0.000028	X		Results may be biased high due to tailing from the Cm-244 tracer ROI.	Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Be-7	0.0671	pCi/m^3	0.016	0.0161				Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Be-7	0.042	pCi/m^3	0.019	0.019				Y
PNL-1	257799001	30-Jun-10	15-Jul-10	BETA	0.0108	pCi/m^3	0.000837	0.000958				
PNL-1	257423001	15-Jul-10	28-Jul-10	BETA	0.0179	pCi/m^3	0.00122	0.00139				
PNL-1	258907001	28-Jul-10	11-Aug-10	BETA	0.0193	pCi/m^3	0.00115	0.00135				

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	259789001	11-Aug-10	26-Aug-10	BETA	0.0171	pCi/m^3	0.0011	0.0013				
PNL-1	260595001	26-Aug-10	10-Sep-10	BETA	0.0122	pCi/m^3	0.000898	0.000981				
PNL-1	261396001	10-Sep-10	22-Sep-10	BETA	0.0164	pCi/m^3	0.00118	0.00131		Replaced totalizer.		
PNL-1	264409001	22-Sep-10	07-Oct-10	BETA	0.02	pCi/m^3	0.0011	0.00127				
PNL-1	265044001	07-Oct-10	18-Oct-10	BETA	0.0229	pCi/m^3	0.00146	0.00164				
PNL-1	266438001	18-Oct-10	03-Nov-10	BETA	0.0209	pCi/m^3	0.00117	0.00147				
PNL-1	267456001	03-Nov-10	18-Nov-10	BETA	0.0225	pCi/m^3	0.00126	0.00145				
PNL-1	268281001	18-Nov-10	30-Nov-10	BETA	0.0385	pCi/m^3	0.00174	0.00236				
PNL-1	268786001	30-Nov-10	14-Dec-10	BETA	0.0308	pCi/m^3	0.00154	0.00202				
PNL-1	269407001	14-Dec-10	28-Dec-10	BETA	0.0274	pCi/m^3	0.00148	0.0017				
PNL-1	266233002	30-Jun-10	07-Oct-10	Cm-243/244	0.000000976	pCi/m^3	0.00000135	0.00000136	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Cm-243/244	0.00000246	pCi/m^3	0.00000481	0.00000482	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Co-60	0.00033	pCi/m^3	0.000439	0.000439	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Co-60	-0.000839	pCi/m^3	0.000923	0.000998	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Cs-134	-0.000223	pCi/m^3	0.000538	0.000538	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Cs-134	0.000226	pCi/m^3	0.000773	0.000779	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Cs-137	0.00008	pCi/m^3	0.000445	0.000445	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Cs-137	-0.000366	pCi/m^3	0.000766	0.000783	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Eu-152	0.00014	pCi/m^3	0.00132	0.00132	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Eu-152	-0.00108	pCi/m^3	0.00235	0.0024	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Eu-154	-0.000702	pCi/m^3	0.00128	0.00128	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Eu-154	0.00225	pCi/m^3	0.00239	0.0026	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Eu-155	0.000198	pCi/m^3	0.00118	0.00118	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Eu-155	0.00036	pCi/m^3	0.00233	0.00233	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	K-40	0.0000525	pCi/m^3	0.00585	0.00585	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	K-40	0.00826	pCi/m^3	0.00936	0.0101	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Pu-238	-0.000000486	pCi/m^3	0.00000457	0.00000457	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Pu-238	-0.00000285	pCi/m^3	0.00000522	0.00000522	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Pu-239/240	-0.00000291	pCi/m^3	0.00000659	0.00000659	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Pu-239/240	-0.0000114	pCi/m^3	0.00000858	0.00000858	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Ru-106	0.000666	pCi/m^3	0.00439	0.00439	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	271319001	07-Oct-10	28-Dec-10	Ru-106	0.000803	pCi/m^3	0.00785	0.00785	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	Sb-125	-0.000533	pCi/m^3	0.00136	0.00136	U			Y
PNL-1	271319001	07-Oct-10	28-Dec-10	Sb-125	0.000359	pCi/m^3	0.00229	0.0023	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	U-234	0.0000562	pCi/m^3	0.0000103	0.0000126				Y
PNL-1	271319001	07-Oct-10	28-Dec-10	U-234	0.0000827	pCi/m^3	0.0000582	0.0000601				Y
PNL-1	266233002	30-Jun-10	07-Oct-10	U-235	0.00000975	pCi/m^3	0.00000464	0.00000481				Y
PNL-1	271319001	07-Oct-10	28-Dec-10	U-235	0	pCi/m^3	0.0000234	0.0000235	U			Y
PNL-1	266233002	30-Jun-10	07-Oct-10	U-238	0.0000487	pCi/m^3	0.00000959	0.0000115				Y
PNL-1	271319001	07-Oct-10	28-Dec-10	U-238	0.0000482	pCi/m^3	0.0000423	0.0000432				Y
PNL-2	257799002	30-Jun-10	15-Jul-10	ALPHA	0.000217	pCi/m^3	0.000247	0.000247	U			
PNL-2	257423002	15-Jul-10	28-Jul-10	ALPHA	0.00039	pCi/m^3	0.000243	0.000246				
PNL-2	258907002	28-Jul-10	11-Aug-10	ALPHA	0.000789	pCi/m^3	0.000298	0.000308				
PNL-2	259789002	11-Aug-10	26-Aug-10	ALPHA	0.000767	pCi/m^3	0.000262	0.00027				
PNL-2	260595002	26-Aug-10	10-Sep-10	ALPHA	0.000937	pCi/m^3	0.000382	0.000386				
PNL-2	261396002	10-Sep-10	22-Sep-10	ALPHA	0.000152	pCi/m^3	0.000164	0.000165	U			
PNL-2	264409002	22-Sep-10	07-Oct-10	ALPHA	0.000471	pCi/m^3	0.000254	0.000257				
PNL-2	265044002	07-Oct-10	18-Oct-10	ALPHA	0.000857	pCi/m^3	0.000396	0.0004				
PNL-2	266438002	18-Oct-10	03-Nov-10	ALPHA	0.000661	pCi/m^3	0.000271	0.000277				
PNL-2	267456002	03-Nov-10	18-Nov-10	ALPHA	0.000603	pCi/m^3	0.0003	0.000303				
PNL-2	268281002	18-Nov-10	30-Nov-10	ALPHA	0.000696	pCi/m^3	0.000332	0.000336				
PNL-2	268786002	30-Nov-10	14-Dec-10	ALPHA	0.000498	pCi/m^3	0.000253	0.000257				
PNL-2	269407002	14-Dec-10	28-Dec-10	ALPHA	0.000564	pCi/m^3	0.000256	0.000258				
PNL-2	266233003	30-Jun-10	07-Oct-10	Am-241	-0.0000023	pCi/m^3	0.0000032	0.0000032	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Am-241	-0.00000275	pCi/m^3	0.0000112	0.0000112	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Am-241 gamma	0.0000222	pCi/m^3	0.00126	0.00126	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Am-241 gamma	-0.000101	pCi/m^3	0.000848	0.000849	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Am-243	0.0000238	pCi/m^3	0.0000103	0.0000104	X		Results may be biased high due to tailing from the Cm-244 tracer ROI.	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	271319002	07-Oct-10	28-Dec-10	Am-243	0.000266	pCi/m^3	0.0000873	0.0000919	X		Results may be biased high due to tailing from the Cm-244 tracer ROI.	Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Be-7	0.0552	pCi/m^3	0.0158	0.0159				Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Be-7	0.0311	pCi/m^3	0.0142	0.0142				Y
PNL-2	257799002	30-Jun-10	15-Jul-10	BETA	0.00863	pCi/m^3	0.000718	0.000745				
PNL-2	257423002	15-Jul-10	28-Jul-10	BETA	0.0144	pCi/m^3	0.00103	0.00119				
PNL-2	258907002	28-Jul-10	11-Aug-10	BETA	0.0166	pCi/m^3	0.00102	0.0012				
PNL-2	259789002	11-Aug-10	26-Aug-10	BETA	0.0147	pCi/m^3	0.000868	0.00103				
PNL-2	260595002	26-Aug-10	10-Sep-10	BETA	0.0116	pCi/m^3	0.000864	0.000903				
PNL-2	261396002	10-Sep-10	22-Sep-10	BETA	0.0146	pCi/m^3	0.00108	0.00122				
PNL-2	264409002	22-Sep-10	07-Oct-10	BETA	0.0166	pCi/m^3	0.00101	0.00113				
PNL-2	265044002	07-Oct-10	18-Oct-10	BETA	0.0193	pCi/m^3	0.00128	0.00141				
PNL-2	266438002	18-Oct-10	03-Nov-10	BETA	0.0184	pCi/m^3	0.001	0.00117				
PNL-2	267456002	03-Nov-10	18-Nov-10	BETA	0.0173	pCi/m^3	0.00108	0.00121				
PNL-2	268281002	18-Nov-10	30-Nov-10	BETA	0.0313	pCi/m^3	0.00151	0.00192				
PNL-2	268786002	30-Nov-10	14-Dec-10	BETA	0.0235	pCi/m^3	0.00118	0.00141				
PNL-2	269407002	14-Dec-10	28-Dec-10	BETA	0.0187	pCi/m^3	0.00103	0.0013				
PNL-2	266233003	30-Jun-10	07-Oct-10	Cm-243/244	-0.00000228	pCi/m^3	0.00000323	0.00000323	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Cm-243/244	0	pCi/m^3	0.0000113	0.0000113	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Co-60	0.00017	pCi/m^3	0.000416	0.000416	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Co-60	0.000148	pCi/m^3	0.000793	0.000796	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Cs-134	0.000221	pCi/m^3	0.00057	0.00057	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Cs-134	0.000108	pCi/m^3	0.000716	0.000718	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Cs-137	0.000437	pCi/m^3	0.000472	0.000472	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Cs-137	0.000227	pCi/m^3	0.000687	0.000695	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Eu-152	-0.000471	pCi/m^3	0.00121	0.00121	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Eu-152	-0.000495	pCi/m^3	0.00162	0.00164	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Eu-154	0.000954	pCi/m^3	0.00141	0.00141	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Eu-154	-0.00208	pCi/m^3	0.00173	0.00197	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Eu-155	-0.000132	pCi/m^3	0.00122	0.00122	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	271319002	07-Oct-10	28-Dec-10	Eu-155	-0.000239	pCi/m^3	0.00136	0.00137	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	K-40	-0.00418	pCi/m^3	0.00625	0.00625	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	K-40	0.0061	pCi/m^3	0.00975	0.0101	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Pu-238	0.00000142	pCi/m^3	0.00000359	0.00000359	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Pu-238	-0.00000767	pCi/m^3	0.00000578	0.00000578	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Pu-239/240	-0.000000944	pCi/m^3	0.0000037	0.0000037	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Pu-239/240	-0.00000766	pCi/m^3	0.00000678	0.00000678	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Ru-106	0.00311	pCi/m^3	0.00403	0.00403	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Ru-106	0.00156	pCi/m^3	0.00599	0.00603	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	Sb-125	0.000132	pCi/m^3	0.00114	0.00114	U			Y
PNL-2	271319002	07-Oct-10	28-Dec-10	Sb-125	-0.000196	pCi/m^3	0.00152	0.00152	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	U-234	0.0000511	pCi/m^3	0.0000097	0.0000118				Y
PNL-2	271319002	07-Oct-10	28-Dec-10	U-234	0.0000448	pCi/m^3	0.0000194	0.0000204				Y
PNL-2	266233003	30-Jun-10	07-Oct-10	U-235	0.00000753	pCi/m^3	0.00000471	0.00000481				Y
PNL-2	271319002	07-Oct-10	28-Dec-10	U-235	0.00000624	pCi/m^3	0.0000108	0.0000108	U			Y
PNL-2	266233003	30-Jun-10	07-Oct-10	U-238	0.0000479	pCi/m^3	0.00000918	0.0000111				Y
PNL-2	271319002	07-Oct-10	28-Dec-10	U-238	0.0000286	pCi/m^3	0.0000158	0.0000163				Y
PNL-3	257799003	30-Jun-10	15-Jul-10	ALPHA	0.000965	pCi/m^3	0.000398	0.000403				
PNL-3	257423003	15-Jul-10	28-Jul-10	ALPHA	0.000953	pCi/m^3	0.000449	0.000454				
PNL-3	258907003	28-Jul-10	11-Aug-10	ALPHA	0.000427	pCi/m^3	0.000249	0.00025				
PNL-3	259789003	11-Aug-10	26-Aug-10	ALPHA	0.000422	pCi/m^3	0.000312	0.000313	U			
PNL-3	260595003	26-Aug-10	10-Sep-10	ALPHA	0.000646	pCi/m^3	0.000306	0.000308				
PNL-3	261396003	10-Sep-10	22-Sep-10	ALPHA	0.000598	pCi/m^3	0.00029	0.000295		Replaced totalizer.		
PNL-3	264409003	22-Sep-10	07-Oct-10	ALPHA	0.000612	pCi/m^3	0.000297	0.000299				
PNL-3	265044003	07-Oct-10	18-Oct-10	ALPHA	0.000802	pCi/m^3	0.000454	0.000456				
PNL-3	266438003	18-Oct-10	03-Nov-10	ALPHA	0.00113	pCi/m^3	0.00038	0.000393				
PNL-3	267456003	03-Nov-10	18-Nov-10	ALPHA	0.00063	pCi/m^3	0.000319	0.000322				
PNL-3	268281003	18-Nov-10	30-Nov-10	ALPHA	0.00127	pCi/m^3	0.000534	0.000542				
PNL-3	268786003	30-Nov-10	14-Dec-10	ALPHA	0.000652	pCi/m^3	0.000329	0.000334				
PNL-3	269407003	14-Dec-10	28-Dec-10	ALPHA	0.000745	pCi/m^3	0.000423	0.000427				
PNL-3	266233001	27-May-10	07-Oct-10	Am-241	0.00000337	pCi/m^3	0.00000289	0.00000291	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-3	271319003	07-Oct-10	28-Dec-10	Am-241	0.000000356	pCi/m^3	0.00000429	0.00000429	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Am-241 gamma	0.000015	pCi/m^3	0.00108	0.00108	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Am-241 gamma	0.00061	pCi/m^3	0.000663	0.000718	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Am-243	0.00000931	pCi/m^3	0.00000626	0.00000632	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Am-243	-0.00000716	pCi/m^3	0.0000176	0.0000176	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Be-7	0.055	pCi/m^3	0.0109	0.011				Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Be-7	0.0484	pCi/m^3	0.0286	0.0286				Y
PNL-3	257799003	30-Jun-10	15-Jul-10	BETA	0.0116	pCi/m^3	0.000888	0.000922				
PNL-3	257423003	15-Jul-10	28-Jul-10	BETA	0.0157	pCi/m^3	0.00114	0.00127				
PNL-3	258907003	28-Jul-10	11-Aug-10	BETA	0.0179	pCi/m^3	0.0011	0.00133				
PNL-3	259789003	11-Aug-10	26-Aug-10	BETA	0.0176	pCi/m^3	0.00111	0.00118				
PNL-3	260595003	26-Aug-10	10-Sep-10	BETA	0.0132	pCi/m^3	0.00094	0.000991				
PNL-3	261396003	10-Sep-10	22-Sep-10	BETA	0.017	pCi/m^3	0.0013	0.00144		Replaced totalizer.		
PNL-3	264409003	22-Sep-10	07-Oct-10	BETA	0.0217	pCi/m^3	0.00122	0.00153				
PNL-3	265044003	07-Oct-10	18-Oct-10	BETA	0.0232	pCi/m^3	0.0015	0.0018				
PNL-3	266438003	18-Oct-10	03-Nov-10	BETA	0.0226	pCi/m^3	0.00121	0.00139				
PNL-3	267456003	03-Nov-10	18-Nov-10	BETA	0.0232	pCi/m^3	0.00135	0.00168				
PNL-3	268281003	18-Nov-10	30-Nov-10	BETA	0.0405	pCi/m^3	0.00192	0.00243				
PNL-3	268786003	30-Nov-10	14-Dec-10	BETA	0.0322	pCi/m^3	0.0016	0.00188				
PNL-3	269407003	14-Dec-10	28-Dec-10	BETA	0.0269	pCi/m^3	0.00149	0.00183				
PNL-3	266233001	27-May-10	07-Oct-10	Cm-243/244	0.000000387	pCi/m^3	0.000000758	0.000000759	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Cm-243/244	0	pCi/m^3	0.00000288	0.00000289	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Co-60	0.000121	pCi/m^3	0.000395	0.000395	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Co-60	0.00111	pCi/m^3	0.00111	0.00121	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Cs-134	0.000237	pCi/m^3	0.000448	0.000448	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Cs-134	0.000322	pCi/m^3	0.00108	0.00109	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Cs-137	0.0000795	pCi/m^3	0.000356	0.000356	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Cs-137	0.0000764	pCi/m^3	0.000766	0.000766	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Eu-152	-0.000269	pCi/m^3	0.00113	0.00113	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-3	271319003	07-Oct-10	28-Dec-10	Eu-152	-0.000424	pCi/m^3	0.00146	0.00147	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Eu-154	-0.00042	pCi/m^3	0.00101	0.00101	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Eu-154	0.00163	pCi/m^3	0.00297	0.00306	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Eu-155	-0.000457	pCi/m^3	0.000995	0.000995	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Eu-155	-0.0000102	pCi/m^3	0.000955	0.000955	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	K-40	-0.00244	pCi/m^3	0.00511	0.00511	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	K-40	0.00804	pCi/m^3	0.0111	0.0117	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Pu-238	-0.00000231	pCi/m^3	0.00000272	0.00000272	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Pu-238	0	pCi/m^3	0.00000153	0.00000153	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Pu-239/240	0.00000384	pCi/m^3	0.00000238	0.0000024				Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Pu-239/240	-0.00000933	pCi/m^3	0.00000835	0.00000835	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Ru-106	0.00186	pCi/m^3	0.00367	0.00367	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Ru-106	-0.00101	pCi/m^3	0.00781	0.00782	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	Sb-125	0.000251	pCi/m^3	0.00114	0.00114	U			Y
PNL-3	271319003	07-Oct-10	28-Dec-10	Sb-125	-0.0000952	pCi/m^3	0.00187	0.00187	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	U-234	0.0000612	pCi/m^3	0.00000954	0.0000124				Y
PNL-3	271319003	07-Oct-10	28-Dec-10	U-234	0.0000744	pCi/m^3	0.0000268	0.0000288				Y
PNL-3	266233001	27-May-10	07-Oct-10	U-235	0.00000738	pCi/m^3	0.00000424	0.00000435				Y
PNL-3	271319003	07-Oct-10	28-Dec-10	U-235	0.0000106	pCi/m^3	0.0000128	0.0000128	U			Y
PNL-3	266233001	27-May-10	07-Oct-10	U-238	0.0000616	pCi/m^3	0.00000956	0.0000125				Y
PNL-3	271319003	07-Oct-10	28-Dec-10	U-238	0.0000494	pCi/m^3	0.0000202	0.0000213				Y
YAKIMA	244823012	30-Dec-09	13-Jan-10	ALPHA	0.000902	pCi/m^3	0.000474	0.000485				
YAKIMA	245784013	13-Jan-10	27-Jan-10	ALPHA	-0.0000734	pCi/m^3	0.000306	0.000306	U			
YAKIMA	246970013	27-Jan-10	10-Feb-10	ALPHA	0.000887	pCi/m^3	0.000423	0.000448				
YAKIMA	248282013	10-Feb-10	25-Feb-10	ALPHA	0.000523	pCi/m^3	0.000353	0.000354				
YAKIMA	249270005	25-Feb-10	10-Mar-10	ALPHA	0.000705	pCi/m^3	0.000347	0.000354				
YAKIMA	249965010	10-Mar-10	22-Mar-10	ALPHA	0.000477	pCi/m^3	0.000315	0.000316				
YAKIMA	250889004	22-Mar-10	07-Apr-10	ALPHA	0.000421	pCi/m^3	0.000273	0.000277				
YAKIMA	251653005	07-Apr-10	21-Apr-10	ALPHA	0.00102	pCi/m^3	0.000415	0.000419				
YAKIMA	252532011	21-Apr-10	06-May-10	ALPHA	0.000444	pCi/m^3	0.00028	0.000284				
YAKIMA	253375011	06-May-10	19-May-10	ALPHA	0.000624	pCi/m^3	0.000361	0.000366				

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	254955012	03-Jun-10	16-Jun-10	ALPHA	0.000416	pCi/m^3	0.000324	0.000325	U			
YAKIMA	255832005	16-Jun-10	30-Jun-10	ALPHA	0.000127	pCi/m^3	0.000175	0.000176	U			
YAKIMA	256712005	30-Jun-10	15-Jul-10	ALPHA	0.00056	pCi/m^3	0.000357	0.000358		Replaced totalizer.		
YAKIMA	257428005	15-Jul-10	28-Jul-10	ALPHA	0.000467	pCi/m^3	0.000285	0.000286				
YAKIMA	258777005	28-Jul-10	11-Aug-10	ALPHA	0.000914	pCi/m^3	0.000387	0.000392				
YAKIMA	259787005	11-Aug-10	26-Aug-10	ALPHA	0.000366	pCi/m^3	0.000289	0.00029	U			
YAKIMA	260506004	26-Aug-10	09-Sep-10	ALPHA	0.000479	pCi/m^3	0.000271	0.000275				
YAKIMA	261447009	09-Sep-10	22-Sep-10	ALPHA	0.000821	pCi/m^3	0.000387	0.000391				
YAKIMA	265039005	22-Sep-10	18-Oct-10	ALPHA	0.000647	pCi/m^3	0.000215	0.000219				
YAKIMA	266449005	18-Oct-10	03-Nov-10	ALPHA	0.00103	pCi/m^3	0.00041	0.000414				
YAKIMA	267458013	03-Nov-10	18-Nov-10	ALPHA	0.000381	pCi/m^3	0.000231	0.000233				
YAKIMA	268243004	18-Nov-10	30-Nov-10	ALPHA	0.00147	pCi/m^3	0.000574	0.00058				
YAKIMA	268778004	30-Nov-10	14-Dec-10	ALPHA	0.000751	pCi/m^3	0.000299	0.000301				
YAKIMA	269622005	14-Dec-10	03-Jan-11	ALPHA	0.000458	pCi/m^3	0.000214	0.000218		Observed high flow rate, adjusted to 1.5 cfm.		
YAKIMA	252290008	30-Dec-09	07-Apr-10	Am-241 gamma	-0.00227	pCi/m^3	0.00317	0.00317	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Am-241 gamma	-0.000743	pCi/m^3	0.00504	0.00504	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Am-241 gamma	-0.000726	pCi/m^3	0.00442	0.00442	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Am-241 gamma	0.0000957	pCi/m^3	0.00267	0.00267	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Be-7	0.0648	pCi/m^3	0.0204	0.0205				Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Be-7	0.0935	pCi/m^3	0.0261	0.0262				Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Be-7	0.0719	pCi/m^3	0.0223	0.0224				Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Be-7	0.0465	pCi/m^3	0.0128	0.0128				Y
YAKIMA	244823012	30-Dec-09	13-Jan-10	BETA	0.0313	pCi/m^3	0.00158	0.0016				
YAKIMA	245784013	13-Jan-10	27-Jan-10	BETA	0.017	pCi/m^3	0.00122	0.00122				
YAKIMA	246970013	27-Jan-10	10-Feb-10	BETA	0.0242	pCi/m^3	0.00143	0.00148				
YAKIMA	248282013	10-Feb-10	25-Feb-10	BETA	0.0241	pCi/m^3	0.00143	0.00153				
YAKIMA	249270005	25-Feb-10	10-Mar-10	BETA	0.0127	pCi/m^3	0.00112	0.00122				
YAKIMA	249965010	10-Mar-10	22-Mar-10	BETA	0.0101	pCi/m^3	0.00104	0.00113				

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	250889004	22-Mar-10	07-Apr-10	BETA	0.00896	pCi/m^3	0.000851	0.000933				
YAKIMA	251653005	07-Apr-10	21-Apr-10	BETA	0.0159	pCi/m^3	0.00114	0.0012				
YAKIMA	252532011	21-Apr-10	06-May-10	BETA	0.00812	pCi/m^3	0.000843	0.000911				
YAKIMA	253375011	06-May-10	19-May-10	BETA	0.0168	pCi/m^3	0.00123	0.00137				
YAKIMA	254955012	03-Jun-10	16-Jun-10	BETA	0.00907	pCi/m^3	0.000958	0.00102				
YAKIMA	255832005	16-Jun-10	30-Jun-10	BETA	0.0112	pCi/m^3	0.00101	0.00109				
YAKIMA	256712005	30-Jun-10	15-Jul-10	BETA	0.0104	pCi/m^3	0.000913	0.00094		Replaced totalizer.		
YAKIMA	257428005	15-Jul-10	28-Jul-10	BETA	0.0146	pCi/m^3	0.00103	0.00109				
YAKIMA	258777005	28-Jul-10	11-Aug-10	BETA	0.0168	pCi/m^3	0.00106	0.00123				
YAKIMA	259787005	11-Aug-10	26-Aug-10	BETA	0.0151	pCi/m^3	0.00101	0.00107				
YAKIMA	260506004	26-Aug-10	09-Sep-10	BETA	0.00972	pCi/m^3	0.000859	0.000935				
YAKIMA	261447009	09-Sep-10	22-Sep-10	BETA	0.0153	pCi/m^3	0.00106	0.0012				
YAKIMA	265039005	22-Sep-10	18-Oct-10	BETA	0.0155	pCi/m^3	0.000754	0.001				
YAKIMA	266449005	18-Oct-10	03-Nov-10	BETA	0.0192	pCi/m^3	0.00111	0.0012				
YAKIMA	267458013	03-Nov-10	18-Nov-10	BETA	0.0154	pCi/m^3	0.00101	0.00112				
YAKIMA	268243004	18-Nov-10	30-Nov-10	BETA	0.0341	pCi/m^3	0.00171	0.00188				
YAKIMA	268778004	30-Nov-10	14-Dec-10	BETA	0.0222	pCi/m^3	0.00113	0.00146				
YAKIMA	269622005	14-Dec-10	03-Jan-11	BETA	0.0175	pCi/m^3	0.0009	0.00131		Observed high flow rate, adjusted to 1.5 cfm.		
YAKIMA	252290008	30-Dec-09	07-Apr-10	Co-60	0.000549	pCi/m^3	0.000804	0.000805	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Co-60	-0.000389	pCi/m^3	0.000928	0.000928	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Co-60	-0.000172	pCi/m^3	0.000808	0.000808	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Co-60	-0.000219	pCi/m^3	0.000423	0.000434	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Cs-134	0.000134	pCi/m^3	0.000867	0.000867	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Cs-134	0.00126	pCi/m^3	0.00115	0.00115	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Cs-134	0.00047	pCi/m^3	0.000774	0.000774	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Cs-134	0.000524	pCi/m^3	0.000616	0.00066	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Cs-137	0.000535	pCi/m^3	0.000626	0.000626	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Cs-137	-0.000212	pCi/m^3	0.000848	0.000848	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Cs-137	0.000516	pCi/m^3	0.000704	0.000704	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Cs-137	0.000217	pCi/m^3	0.000503	0.000512	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	252290008	30-Dec-09	07-Apr-10	Eu-152	0.00044	pCi/m^3	0.00204	0.00204	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Eu-152	-0.000864	pCi/m^3	0.00236	0.00236	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Eu-152	0.000439	pCi/m^3	0.00192	0.00192	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Eu-152	-0.000754	pCi/m^3	0.00176	0.00179	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Eu-154	0.00109	pCi/m^3	0.00209	0.00209	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Eu-154	0.000234	pCi/m^3	0.00254	0.00254	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Eu-154	0.0015	pCi/m^3	0.00206	0.00206	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Eu-154	0.000901	pCi/m^3	0.00171	0.00176	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Eu-155	0.000843	pCi/m^3	0.00182	0.00182	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Eu-155	-0.00132	pCi/m^3	0.00248	0.00248	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Eu-155	-0.00218	pCi/m^3	0.00208	0.00208	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Eu-155	-0.000595	pCi/m^3	0.00174	0.00176	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	K-40	-0.00128	pCi/m^3	0.00945	0.00945	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	K-40	0.00102	pCi/m^3	0.0117	0.0117	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	K-40	0.00346	pCi/m^3	0.00982	0.00982	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	K-40	0.00982	pCi/m^3	0.00643	0.00643	X		Data rejected due to no valid peak.	Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Pu-238	-0.00000119	pCi/m^3	0.00000114	0.00000114	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Pu-238	0	pCi/m^3	0.000000731	0.000000732	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Pu-238	0	pCi/m^3	0.000000738	0.000000739	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Pu-238	-0.00000067	pCi/m^3	0.00000186	0.00000186	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Pu-239/240	0	pCi/m^3	0.00000132	0.00000132	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Pu-239/240	-0.000000744	pCi/m^3	0.00000126	0.00000126	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Pu-239/240	-0.000000531	pCi/m^3	0.00000128	0.00000128	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Pu-239/240	-0.00000167	pCi/m^3	0.00000197	0.00000197	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Ru-106	0.00294	pCi/m^3	0.00617	0.00617	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Ru-106	-0.00345	pCi/m^3	0.00808	0.00808	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Ru-106	-0.00392	pCi/m^3	0.0073	0.0073	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Ru-106	0.00186	pCi/m^3	0.00501	0.00508	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Sb-125	0.00148	pCi/m^3	0.00191	0.00191	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Sb-125	0.00105	pCi/m^3	0.00237	0.00237	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	266312008	30-Jul-10	22-Sep-10	Sb-125	-0.000663	pCi/m^3	0.00173	0.00173	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Sb-125	0.000652	pCi/m^3	0.00145	0.00148	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	Sr-90	-0.0000309	pCi/m^3	0.0000408	0.0000408	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	Sr-90	0.0000437	pCi/m^3	0.0000561	0.0000561	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	Sr-90	0.0000416	pCi/m^3	0.0000346	0.0000347	U			Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	Sr-90	-0.000036	pCi/m^3	0.0000259	0.0000259	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	U-234	0.0000403	pCi/m^3	0.000008	0.00000978				Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	U-234	0.0000415	pCi/m^3	0.00000985	0.0000115				Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	U-234	0.0000432	pCi/m^3	0.00000877	0.0000107				Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	U-234	0.0000348	pCi/m^3	0.0000169	0.0000181				Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	U-235	0.00000153	pCi/m^3	0.00000173	0.00000174	U			Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	U-235	0.00000146	pCi/m^3	0.00000352	0.00000352	U			Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	U-235	0.00000344	pCi/m^3	0.00000275	0.0000028				Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	U-235	0.00000133	pCi/m^3	0.00000528	0.0000053	U			Y
YAKIMA	252290008	30-Dec-09	07-Apr-10	U-238	0.0000499	pCi/m^3	0.00000904	0.0000114				Y
YAKIMA	257617009	07-Apr-10	30-Jun-10	U-238	0.0000504	pCi/m^3	0.000011	0.000013				Y
YAKIMA	266312008	30-Jul-10	22-Sep-10	U-238	0.0000394	pCi/m^3	0.00000848	0.0000101				Y
YAKIMA	271354008	22-Sep-10	03-Jan-11	U-238	0.0000222	pCi/m^3	0.0000134	0.0000141				Y

Table C.3. Air Sampling Results for the PNNL Site Pre-operations Period (prior to July 2010)

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	COMPOSITE_ FLAG
PNL-1	253795001	27-Apr-10	05-May-10	ALPHA	0.000498	pCi/m^3	0.000432	0.000432	U		
PNL-1	253383001	05-May-10	20-May-10	ALPHA	0.00114	pCi/m^3	0.000391	0.000408			
PNL-1	254095001	20-May-10	02-Jun-10	ALPHA	0.000655	pCi/m^3	0.000375	0.000377			
PNL-1	254965001	02-Jun-10	16-Jun-10	ALPHA	0.000526	pCi/m^3	0.000349	0.000352			
PNL-1	255829001	16-Jun-10	30-Jun-10	ALPHA	0.000395	pCi/m^3	0.000259	0.000262			
PNL-1	257245001	27-Apr-10	30-Jun-10	Am-241	0.000026	pCi/m^3	0.000015	0.0000152			Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Am-241 gamma	-0.000865	pCi/m^3	0.00447	0.00447	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Am-243	0.0000119	pCi/m^3	0.0000135	0.0000135	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Be-7	0.0572	pCi/m^3	0.0265	0.0266			Y
PNL-1	253795001	27-Apr-10	05-May-10	BETA	0.00912	pCi/m^3	0.00112	0.00115			
PNL-1	253383001	05-May-10	20-May-10	BETA	0.0165	pCi/m^3	0.00109	0.0013			
PNL-1	254095001	20-May-10	02-Jun-10	BETA	0.00941	pCi/m^3	0.000971	0.000994			
PNL-1	254965001	02-Jun-10	16-Jun-10	BETA	0.00894	pCi/m^3	0.0012	0.00125			
PNL-1	255829001	16-Jun-10	30-Jun-10	BETA	0.0135	pCi/m^3	0.00107	0.00121			
PNL-1	257245001	27-Apr-10	30-Jun-10	Cm-243/244	0.0000181	pCi/m^3	0.0000107	0.0000108			Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Co-60	0.00194	pCi/m^3	0.00108	0.00108	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Cs-134	0.0000241	pCi/m^3	0.00107	0.00107	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Cs-137	0.00046	pCi/m^3	0.000989	0.000989	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Eu-152	-0.00153	pCi/m^3	0.00268	0.00268	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Eu-154	0.00129	pCi/m^3	0.00292	0.00292	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Eu-155	0.00118	pCi/m^3	0.00269	0.00269	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	K-40	0.0114	pCi/m^3	0.0123	0.0123	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Pu-238	-0.00000819	pCi/m^3	0.00000827	0.00000827	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Pu-239/240	-0.00000102	pCi/m^3	0.00000825	0.00000825	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Ru-106	0.00311	pCi/m^3	0.00885	0.00885	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	Sb-125	-0.000865	pCi/m^3	0.00271	0.00271	U		Y
PNL-1	257245001	27-Apr-10	30-Jun-10	U-234	0.0000536	pCi/m^3	0.0000235	0.0000247			Y

Table C.3. (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	COMPOSITE_ FLAG
PNL-1	257245001	27-Apr-10	30-Jun-10	U-235	0.0000114	pCi/m^3	0.0000111	0.0000112			Y
PNL-1	257245001	27-Apr-10	30-Jun-10	U-238	0.0000666	pCi/m^3	0.0000242	0.0000259			Y
PNL-2	253795002	27-Apr-10	05-May-10	ALPHA	0.000801	pCi/m^3	0.00042	0.000424			
PNL-2	253383002	05-May-10	20-May-10	ALPHA	0.000375	pCi/m^3	0.000226	0.000228			
PNL-2	254095002	20-May-10	02-Jun-10	ALPHA	0.000367	pCi/m^3	0.000245	0.000246			
PNL-2	254965002	02-Jun-10	16-Jun-10	ALPHA	0.000319	pCi/m^3	0.00027	0.000271			
PNL-2	255829002	16-Jun-10	30-Jun-10	ALPHA	0.000274	pCi/m^3	0.000192	0.000193			
PNL-2	257245002	27-Apr-10	30-Jun-10	Am-241	0.0000155	pCi/m^3	0.0000119	0.0000121	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Am-241 gamma	-0.00261	pCi/m^3	0.00421	0.00421	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Am-243	0.00000411	pCi/m^3	0.0000146	0.0000146	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Be-7	0.0372	pCi/m^3	0.0194	0.0194			Y
PNL-2	253795002	27-Apr-10	05-May-10	BETA	0.011	pCi/m^3	0.00118	0.00123			
PNL-2	253383002	05-May-10	20-May-10	BETA	0.0105	pCi/m^3	0.000803	0.000872			
PNL-2	254095002	20-May-10	02-Jun-10	BETA	0.0075	pCi/m^3	0.000739	0.000756			
PNL-2	254965002	02-Jun-10	16-Jun-10	BETA	0.00818	pCi/m^3	0.00109	0.00114			
PNL-2	255829002	16-Jun-10	30-Jun-10	BETA	0.00949	pCi/m^3	0.000756	0.000816			
PNL-2	257245002	27-Apr-10	30-Jun-10	Cm-243/244	0.0000118	pCi/m^3	0.00000927	0.00000936	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Co-60	-0.000183	pCi/m^3	0.000676	0.000676	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Cs-134	0.00066	pCi/m^3	0.000965	0.000965	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Cs-137	-0.000162	pCi/m^3	0.000744	0.000744	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Eu-152	-0.00238	pCi/m^3	0.00236	0.00237	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Eu-154	0.0000396	pCi/m^3	0.0024	0.0024	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Eu-155	-0.00122	pCi/m^3	0.00228	0.00228	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	K-40	0.00326	pCi/m^3	0.00944	0.00944	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Pu-238	-0.00000488	pCi/m^3	0.00000676	0.00000676	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Pu-239/240	-0.000000811	pCi/m^3	0.00000656	0.00000656	U		Y

Table C.3. (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	COMPOSITE_ FLAG
PNL-2	257245002	27-Apr-10	30-Jun-10	Ru-106	-0.00556	pCi/m^3	0.00602	0.00602	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	Sb-125	-0.000599	pCi/m^3	0.00196	0.00196	U		Y
PNL-2	257245002	27-Apr-10	30-Jun-10	U-234	0.0000462	pCi/m^3	0.0000187	0.0000198			Y
PNL-2	257245002	27-Apr-10	30-Jun-10	U-235	0.00000907	pCi/m^3	0.00000889	0.00000898			Y
PNL-2	257245002	27-Apr-10	30-Jun-10	U-238	0.0000569	pCi/m^3	0.00002	0.0000215			Y
PNL-3	254965003	02-Jun-10	16-Jun-10	ALPHA	0.000655	pCi/m^3	0.000531	0.000533	U		
PNL-3	255829003	16-Jun-10	30-Jun-10	ALPHA	0.000477	pCi/m^3	0.00031	0.000313			
PNL-3	254965003	02-Jun-10	16-Jun-10	BETA	0.0094	pCi/m^3	0.00131	0.00133			
PNL-3	255829003	16-Jun-10	30-Jun-10	BETA	0.0123	pCi/m^3	0.000955	0.00103			

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