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Idaho National Engineering and Environmental Laboratory Offsite Environmental Surveillance Program Report: Fourth Quarter 1998

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Executive Summary

The Environmental Science and Research Foundation conducts the Offsite Environmental Surveillance Program at the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory (INEEL). The Foundation's environmental surveillance program monitors the effects, if any, of U.S. Department of Energy (DOE) activities on the offsite environment, collects data to confirm compliance with applicable environmental laws and regulations, and observes any trends in environmental levels of radioactivity. This report for the fourth quarter 1998 is based on 622 samples collected of air, fine particulates, atmospheric moisture, precipitation, water, milk, potatoes, and game animals. All concentrations of radioactivity found in these samples were consistent with concentrations which have been found in sampling during recent quarters and which have been attributed in the past to natural background radioactivity, worldwide fallout from past nuclear weapons testing, and nuclear operations around the world. No measured concentrations could be directly attributed to operations at the INEEL, although statistical differences did exist between on-site and distant gross beta concentrations. No evidence could be found to link these differences with a specific INEEL source. Concentrations in all samples were below the guidelines set by both the DOE and the U.S. Environmental Protection Agency (EPA) for protection of the public.

Program Description

The Foundation collected filters weekly from low-volume air samplers at 12 offsite locations. Five were at distant locations and seven were near the INEEL boundary. An additional three air samplers were operated on the INEEL. Replicate samplers were operated at two offsite boundary locations for quality assurance purposes. Weekly measurements were made of gross alpha and gross beta activity in airborne particulates. Charcoal cartridges were screened weekly for the presence of iodine-131. At the end of the quarter, weekly filters from each location were combined to form a composite sample for that location. These composites were then analyzed for gamma-emitting radionuclides. Selected composites were also submitted for analyses for strontium-90 and transuranics (plutonium-238, plutonium-239/240, and americium-241).

PM₁₀ samplers were operated at three offsite locations to sample airborne particulates with an aerodynamic diameter smaller than 10 microns. Particles this size can penetrate the body's natural air filtering system and enter the lungs.

Atmospheric moisture and precipitation samples were collected to monitor for tritium. Atmospheric moisture samples were collected by sampling continuously for 13 weeks at each of four locations. The Foundation collected monthly precipitation samples at one onsite location and one offsite location, as well as a weekly precipitation sample at a second onsite location.

Water samples were collected in November from 14 drinking water locations and four surface water locations in the Magic valley and in Idaho Falls. Gross alpha and gross beta activities and tritium concentrations were determined for all samples.

The Foundation collected a weekly milk sample from a dairy in Idaho Falls and collected monthly milk samples from eight additional dairies around the INEEL. All milk samples were analyzed for iodine-131. Selected samples were analyzed for strontium-90.

Potatoes were collected from area farms surrounding the INEEL and tested for gamma-emitting radionuclides. Selected samples were analyzed for strontium-90.

Seven big game animals were killed accidentally on INEEL roads during the quarter, and tissue samples of muscle, thyroid, and liver were collected from each of these animals and subjected to gamma spectroscopic analysis.

The Foundation collected 14 offsite TLDs (thermoluminescent dosimeters) to determine environmental radiation levels around the INEEL.

For more information concerning the contents of this report, contact the Foundation at (208) 525-7102, or visit the Foundation's web page (<http://esrf.org>).

Summary of Fourth Quarter 1998 Results

During the fourth quarter of 1998, gross alpha and gross beta activities in low-volume air samples were within the expected range of values for background radioactivity. Although the quarterly mean of gross beta activities in air observed at stations on the INEEL was higher than that observed at distant stations, the difference between INEEL stations and boundary stations was not significant. No statistically significant differences were observed in the quarterly mean of gross alpha activities measured at INEEL stations as compared with those distant and boundary stations. Iodine-131 was not found in any air sample. No specific radionuclide was detected in selected composite samples with either gamma spectroscopy or radiochemical analyses. The higher gross beta concentrations on the INEEL were probably attributable to normal fluctuations in concentrations of naturally-occurring radionuclides rather than to INEEL operations.

PM₁₀ sampling for respirable particulates continued in three locations: Atomic City, Rexburg, and Mountain View Middle School in Blackfoot. Twenty-four-hour samples were collected once every six days throughout the fourth quarter. Observed concentrations at the three stations were all below the short-term EPA standard of 150 µg/m³ averaged over 24 hours.

Tritium was detected in one atmospheric moisture sample and in one weekly precipitation sample. However, tritium was not detected in any of the surface or drinking water samples. The observed tritium concentrations in precipitation samples were well below DOE derived guidelines for the general public and can probably be attributed to cosmic ray bombardment of the atmosphere.

Gross alpha activity was detected in one of the water samples taken from the Magic Valley. All of the samples contained detectable gross beta activity, consistent with levels measured previously and probably attributable to natural radioactivity.

No detectable concentrations of iodine-131 were reported in the 38 milk samples collected during the fourth quarter. A low concentration of strontium-90 was detected in a milk sample from Dietrich. Of seven potato samples collected and analyzed during the fourth quarter, three contained low concentrations of strontium-90. Of two elk and five mule deer killed accidentally on INEEL roads during the quarter, muscle samples from one elk and four deer exhibited low but detectable concentrations of cesium-137, and a liver sample from one deer also contained a detectable concentration of cesium-137. All of these concentrations were in the range of concentrations which have been observed in similar samples in the past and which can probably be attributed to worldwide fallout from above-ground nuclear weapons testing.

TLD measurements were comparable to data from past years and exhibited no statistically significant difference between distant and boundary locations.

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1. Introduction

This quarterly report summarizes data collected by the Foundation's Idaho National Engineering and Environmental Laboratory (INEEL) Offsite Environmental Surveillance Program during the period October 7 to December 30, 1998. Consistent with requirements of applicable Department of Energy (DOE) Orders, the Foundation's environmental surveillance program monitors the effects, if any, of DOE activities on the offsite environment, collects data to verify compliance with applicable environmental laws and regulations, and observes trends in environmental levels of radioactivity. Appendix A summarizes the Foundation's surveillance program. Information useful in understanding this report is given in Appendix B.

Most of the reported environmental concentrations are at or near background levels of radioactivity; many results are near the detection limits of the laboratory procedures. Appendix A summarizes the approximate minimum detectable concentrations of radioactivity which can be detected and quantified for a given sample type and analysis. All results are reported with an associated 2s ("two sigma") uncertainty term. The Foundation uses the following method for interpreting analytical results near the minimum detectable concentration: results less than or equal to the 2s uncertainty, which includes some negative values, are considered as "not detected." For results greater than 2s (the 95% confidence level), but not exceeding 3s (the 99% confidence interval), detection of the radioactivity is questionable. Results may exceed the 2s level simply due to the inherent random nature of radioactive decay events. This is expected to occur approximately 2.5% of the time. Results exceeding 3s are interpreted as indicating the detection of radioactivity.

Where appropriate, the results in this report are compared to the following:

- ▶ For air, concentrations are compared to the DOE Derived Concentration Guides. The Derived Concentration Guide is the concentration of a radionuclide which, under conditions of continuous exposure for a year, would result in an effective dose equivalent of 100 mrem (the DOE standard for members of the public);
- ▶ For drinking water, concentrations are compared to the Environmental Protection Agency's Maximum Contaminant Level. This is the maximum permissible level of a contaminant in water which is delivered to any user of a community water system.

2. Air Sampling

2. Air Sampling

2.1. Low-Volume Air Sampling

Airborne particulate radioactivity was continuously monitored by 17 air samplers (Figure 1), located to provide an effective network to detect INEEL releases of radioactivity. Five offsite air samplers are designated as distant, or background, stations and seven are designated as boundary stations. Three air samplers are situated on the INEEL. Two replicate samplers are also operated for quality control

purposes. Distant locations were used to make comparisons of airborne concentrations of radioactivity with boundary and onsite locations. Each air sampler averaged a flow of approximately 50 l/min (2 ft³/min) through a filter head consisting of two types of filters—a 1.2-micrometer pore size particulate filter and a charcoal cartridge for the monitoring of radioactive iodine. Filters on each sampler were changed weekly.

Various screening analyses were performed weekly. Charcoal cartridges were screened weekly in batches for ¹³¹I activity. If activity was detected in any batch greater than a preset action level, cartridges were then analyzed individually. Particulate filters were counted each week for gross (nonspecific) beta activity in a low-background beta counter after waiting a minimum of four days for the naturally occurring daughter products of radon and thoron decay. The particulate filters were also counted for gross alpha activity. At the end of the quarter, weekly filters from each location were combined to form a composite. All composites were then analyzed by gamma spectrometry for specific radionuclides. Selected composites were also analyzed for ⁹⁰Sr or transuranic radionuclides (²³⁸Pu, ^{239/240}Pu, and ²⁴¹Am).

No ¹³¹I was detected in any of the weekly charcoal cartridges during the fourth quarter.

Figure 2 shows the weekly gross alpha activities measured throughout the quarter. All measured gross alpha activities were within the expected range of background levels and were generally lower at the INEEL than at boundary or distant stations. Table 1 summarizes the gross alpha measurements for the quarter. There were no statistically significant differences between the quarterly mean of the gross alpha activities observed at stations on the INEEL and the means observed at distant and boundary stations.

Figure 1 Weekly Air Sampling

2. Air Sampling

Figure 3 shows gross beta activities over the 13-week quarter. All measured beta activities were also within the range of expected background values. At the 95% confidence interval, the mean of the weekly gross beta activities observed at stations on the INEEL was significantly higher than that of the distant stations. However, there was no statistically significant difference between the mean of weekly gross beta activities observed at stations on the INEEL and that of the boundary stations. No man-made radionuclides were detected either by gamma spectroscopic analyses of the quarterly composite samples or by radiochemical analyses of selected composites for ^{90}Sr , ^{241}Am , ^{238}Pu , and $^{239/240}\text{Pu}$. The difference between INEEL and distant stations in mean gross beta concentrations is therefore unlikely to be attributable to INEEL operations and is probably due to normal fluctuations in concentrations of naturally-occurring radionuclides.

Replicate low-volume samplers were operated at Arco and at Reno Ranch for quality assurance purposes. There were no statistically significant differences between the mean values for gross alpha and gross beta at each of these sites and the means of their respective replicates. Appendix C contains the observed values of gross alpha and gross beta activities found in weekly air samples.

Figure 2 Gross Alpha Activity in Air

Figure 3 Gross Beta Activity in Air

2. Air Sampling

Table 1
Gross Alpha Concentrations in Air
Fourth Quarter 1998

<u>Group</u>	<u>Location</u>	<u>Number of Samples</u>	<u>Gross Alpha Concentration</u> ($\times 10^{-15}$ $\mu\text{Ci/ml}$)	
			<u>Range of Samples</u>	<u>Mean with 95% Confidence Interval</u>
Distant	Blackfoot	13	0.4-2.6	1.6 ± 0.5
	Craters of the Moon	13	0.1-1.7	0.8 ± 0.4
	Idaho Falls	13	0.9-2.7	1.7 ± 0.7
	Rexburg	13	0.3-2.7	1.7 ± 0.6
	Mountain View Middle School	13	0.7-4.5	2.1 ± 0.7
	Group Mean			1.6 ± 0.6
Boundary	Arco (Replicate)	13 (12)	0.0-3.3 (0.1-5.3)	1.8 ± 0.7 (1.6 ± 0.8)
	Atomic City	13	-0.3-2.6	1.2 ± 0.6
	FAA Tower	13	0.3-1.7	1.0 ± 0.5
	Howe	13	0.2-2.5	1.4 ± 0.6
	Montevieu	13	0.4-2.4	1.4 ± 0.7
	Mud Lake	13	0.4-2.3	1.4 ± 0.6
	Reno Ranch (Replicate)	13 (13)	0.1-2.3 (0.2-2.2)	1.2 ± 0.6 (1.1 ± 0.6)
	Group Mean			1.3 ± 0.6
INEEL	EFS	13	0.1-2.5	1.3 ± 0.6
	Main Gate	13	0.3-2.6	1.4 ± 0.6
	Van Buren	13	-0.4-2.4	1.0 ± 0.5
	Group Mean			1.2 ± 0.5
DOE Derived Concentration Guide 20				

Table 2
Gross Beta Concentrations in Air
Fourth Quarter 1998

<u>Group</u>	<u>Location</u>	<u>Number of Samples</u>	<u>Gross Beta Concentration</u> ($\times 10^{-15}$ $\mu\text{Ci/ml}$)	
			<u>Range of Samples</u>	<u>Mean with 95% Confidence Interval</u>
Distant	Blackfoot	13	9-37	22 ± 2
	Craters of the Moon	13	8-40	22 ± 2
	Idaho Falls	13	12-44	27 ± 2
	Rexburg	13	12-40	25 ± 2
	Mountain View Middle School	13	8-47	24 ± 2
	Group Mean			24 ± 2
Boundary	Arco (Replicate)	13 (12)	11-43 (12-40)	25 ± 2 (22 ± 2)
	Atomic City	13	1-49	22 ± 2
	FAA Tower	13	11-43	20 ± 2
	Howe	13	14-48	29 ± 2
	Montevieu	13	11-41	27 ± 2
	Mud Lake	13	15-48	29 ± 2
	Reno Ranch (Replicate)	13 (13)	11-45 (9-39)	24 ± 2 (25 ± 2)
	Group Mean			25 ± 2

3. Water Sampling

Table 2 (continued) Gross Beta Concentrations in Air Fourth Quarter 1998				
Group	Location	Number of Samples	Range of Samples	Gross Beta Concentration ($\times 10^{-15}$ μ Ci/ml)
				Mean with 95% Confidence Interval
INEEL	EFS	13	14-48	28 ± 2
	Main Gate	13	13-44	29 ± 2
	Van Buren	13	12-45	26 ± 2
			Group Mean	28 ± 2
DOE Derived Guideline				3000

2.2 PM₁₀ Air Sampling

Air sampling for respirable particulates continued at Madison Middle School (Rexburg), Mountain View Middle School (Blackfoot), and Atomic City. PM₁₀ samplers were used to sample airborne particulates with an aerodynamic diameter smaller than 10 microns. Particles this size can penetrate the body's natural air filtering system and enter the lungs. These filters are not analyzed for radionuclides.

Samples were collected every sixth day from Rexburg, Blackfoot, and Atomic City. Concentrations at Rexburg ranged from 4 to 92 μ g/m³, with an average of 26 μ g/m³. At the Blackfoot location, values ranged from 2 to 26 μ g/m³ with an average concentration of 11 μ g/m³. In Atomic City the concentrations ranged from 3 to 92 μ g/m³ with an average concentration of 18 μ g/m³. The EPA standard is 150 μ g/m³ averaged over 24 hours, and 50 μ g/m³ averaged over the entire year.

2.3 Atmospheric Moisture Sampling

Four atmospheric moisture samples were obtained from Idaho Falls, Rexburg, Blackfoot and Atomic City during this reporting period. Samples were collected by passing air through a column of silica gel which absorbed water vapor. Tritium concentrations were determined by extracting water from the silica gel and counting the water sample by liquid scintillation. One sample from Idaho Falls contained a detectable level of tritium of 3.5 ± 3.4 μ Ci/ml of air. Detections at this low level can be attributed to worldwide cosmic tritium production or statistical fluctuations.

2.4 Precipitation Sampling

Thirteen precipitation samples were collected in the fourth quarter from Idaho Falls and from onsite locations at the Central Facilities Area (CFA) and the Experimental Field Station (EFS), and analyzed for tritium. Tritium was detected in one sample from EFS at a concentration of 1.1×10^{-7} μ Ci/mL. These low concentrations may have been from INEEL operations, although they were consistent with concentrations attributed to natural causes.

3. Water Sampling

Water samples were collected in November from 14 drinking water locations and four surface water locations in the Magic Valley area and Idaho Falls (Figure 4). Drinking water sampling locations were local businesses, while surface water locations included springs in the Thousand Springs area. These springs are some of the outlets for the Snake River Plain Aquifer, which flows beneath the INEEL. Samples were analyzed for gross alpha and gross beta activity by residue counting techniques. No samples showed measurable concentrations of tritium. A sample from Arco had detectable gross alpha activity. All of the samples contained detectable gross beta activity. Table 3 summarizes these findings. At these levels, radioactivity in water samples is generally attributed to naturally occurring decay products, sorbed by water as it flows through the earth's crust.

Table 3 Radioactivity in Offsite Water Samples Fourth Quarter 1998			
Location	Tritium (pCi/l $\pm$ 2s)	Gross Alpha (pCi/l $\pm$ 2s)	Gross Beta (pCi/l $\pm$ 2s)
Drinking Water			
Aberdeen	-46 $\pm$ 100	1 $\pm$ 1	8 $\pm$ 2
Arco	80 $\pm$ 100	1 $\pm$ 1	2 $\pm$ 2
Atomic City	-53 $\pm$ 100	0 $\pm$ 1	3 $\pm$ 2
Blackfoot	-15 $\pm$ 100	0 $\pm$ 1	3 $\pm$ 2
Carey	-53 $\pm$ 100	1 $\pm$ 1	3 $\pm$ 2
Fort Hall	-52 $\pm$ 100	0 $\pm$ 1	7 $\pm$ 2
Howe	-55 $\pm$ 100	-1 $\pm$ 1	2 $\pm$ 2
Idaho Falls	-80 $\pm$ 100	0 $\pm$ 1	3 $\pm$ 2
Minidoka	-50 $\pm$ 100	0 $\pm$ 1	4 $\pm$ 2
Montevieu	-69 $\pm$ 100	0 $\pm$ 1	10 $\pm$ 2
Mud Lake	-46 $\pm$ 100	0 $\pm$ 1	3 $\pm$ 2
Roberts	-93 $\pm$ 100	0 $\pm$ 1	4 $\pm$ 2
Shoshone	13 $\pm$ 100	0 $\pm$ 1	3 $\pm$ 2
Surface Water			
Alpheus Spring (Twin Falls)	40 $\pm$ 100	1 $\pm$ 1	9 $\pm$ 2
Bliss	-100 $\pm$ 100	0 $\pm$ 1	4 $\pm$ 2
Bill Jones Hatchery (Hagerman)	-38 $\pm$ 100	0 $\pm$ 1	4 $\pm$ 2
Clear Spring (Buhl)	-100 $\pm$ 100	-1 $\pm$ 1	6 $\pm$ 2
Idaho Falls	48 $\pm$ 100	0 $\pm$ 1	4 $\pm$ 2
EPA Maximum Contaminant Level	20,000	15	50

4. Foodstuff Sampling

Foodstuff sampling locations are shown in Figure 4. Milk samples were collected weekly in Idaho Falls and monthly at eight other locations around the INEEL (Figure 4). Two types of locations were sampled: single family dairies and large commercial dairies. Each milk sample was analyzed for ^{131}I by gamma spectrometry. Results were decay-corrected to the time of sample collection. A total of 38 milk samples were collected during the fourth quarter. None of the

samples exhibited detectable concentrations of ^{131}I . Of four samples selected for radiochemical analysis, strontium-90 was found only in the Dietrich area at a concentration of $(6.8 \pm 3.3) \times 10^{-4}$ pCi/mL. This concentration is consistent with concentrations found in milk throughout the world. Sources include fallout from historic above ground nuclear testing, and past nuclear accidents such as Chernobyl.

Seven potato samples were collected during the fourth quarter of 1998, four from distant locations and three from boundary locations. Strontium-90 was detected in the sample from Montevideo at a concentration of $(5.8 \pm 5.1) \times 10^{-3}$ pCi/g, the sample from Blackfoot at $(3.2 \pm 2.6) \times 10^{-3}$ pCi/g and in the sample from Arco at a concentration of $(5.4 \pm 3.6) \times 10^{-3}$ pCi/g. These concentrations are consistent with past results seen in potatoes and are likely due to historic worldwide fallout from nuclear weapons testing and reactor accidents.

Two elk and five mule deer were killed accidentally on INEEL roads during the fourth quarter of 1998, and tissue samples of muscle, thyroid, and liver were collected from each of these animals and subjected to gamma spectroscopic analysis. Muscle samples from one of the elk and four of the mule deer contained low but detectable concentrations of cesium-137, and a liver sample from one mule deer also contained detectable cesium-137. No iodine-137 was found in any of the thyroid samples. Table 4 shows the detectable concentrations of radionuclides found in these animals. These small concentrations are within the range of values observed in past wild game samples and can be attributed to the ingestion of radionuclides from worldwide fallout from above-ground nuclear weapons testing.

Figure 4 Water and Foodstuff Sampling Locations

Table 4 Cesium-137 Concentrations in Road-Killed Wild Game Fourth Quarter 1998			
<u>Collection Date</u>	<u>Species</u>	<u>Tissue</u>	<u>Cs-137 Concentration</u> <u>($\mu\text{Ci/g} \times 10^{-3} \pm 2\sigma$)</u>
10/05/98	Mule Deer	Muscle	1.2 ± 0.3
10/15/98	Mule Deer	Muscle	1.6 ± 0.3
11/30/98	Mule Deer	Muscle	1.7 ± 0.3
11/30/98	Mule Deer	Liver	1.3 ± 0.4
12/10/98	Elk	Muscle	0.2 ± 0.2
12/15/98	Mule Deer	Muscle	0.4 ± 0.2

5. Environmental Radiation

5. Environmental Radiation

Thermoluminescent dosimeters (TLDs), changed semiannually, were collected from six boundary and eight distant locations (Figure 5). TLD measurements for the second half of 1998 (May 1998-October 1998) show similar exposure levels to the previous six-month interval (Table 5). There were no statistically significant differences between the distant and boundary groups.

Figure 5 TLD Locations

Table 5 Radiation Exposures at Distant and Boundary Locations (1998)			
Location	Exposure (mR $\pm$ 2s)		
	Nov. 1997- May 1998	May 1998- Oct. 1998	Annual Total
Distant Locations			
Aberdeen	62 $\pm$ 7	66 $\pm$ 3	128 $\pm$ 8
Blackfoot	65 $\pm$ 4	65 $\pm$ 4	130 $\pm$ 6
Craters of the Moon	56 $\pm$ 4	66 $\pm$ 5	122 $\pm$ 6
Idaho Falls	64 $\pm$ 5	60 $\pm$ 4	124 $\pm$ 6
Minidoka	57 $\pm$ 5	59 $\pm$ 5	116 $\pm$ 7
Rexburg	71 $\pm$ 6	73 $\pm$ 3	144 $\pm$ 7
Roberts	61 $\pm$ 4	69 $\pm$ 4	130 $\pm$ 6
Mountain View Middle School	56 $\pm$ 2	57 $\pm$ 4	113 $\pm$ 4
Group Mean	62 $\pm$ 9	64 $\pm$ 8	126 $\pm$ 12
Boundary Locations			
Arco	65 $\pm$ 6	63 $\pm$ 3	128 $\pm$ 7
Atomic City	66 $\pm$ 4	66 $\pm$ 4	132 $\pm$ 6
Howe	62 $\pm$ 2	63 $\pm$ 5	125 $\pm$ 5
Montevue	61 $\pm$ 2	63 $\pm$ 3	124 $\pm$ 4
Mud Lake	69 $\pm$ 6	68 $\pm$ 3	137 $\pm$ 7
Reno Ranch	61 $\pm$ 4	56 $\pm$ 5	117 $\pm$ 6
Group Mean	64 $\pm$ 9	63 $\pm$ 8	127 $\pm$ 12

Appendix A

Summary

of

Environmental Surveillance Networks

Table A-1
Summary of the Foundation's Environmental Surveillance Program

Sample Type Analysis	Collection Frequency	Locations		
		Distant	Boundary	INEEL
Air				
Gross Alpha	weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	Arco, Atomic City, FAA Tower, Howe, Montevieu, Mud Lake, Reno Ranch	Main Gate, EFS, Van Buren
Gross Beta ¹³¹ I	weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	Arco, Atomic City, FAA Tower, Howe, Montevieu, Mud Lake, Reno Ranch	Main Gate, EFS, Van Buren
Gamma Spec Particulate Mass	quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	Arco, Atomic City, FAA Tower, Howe, Montevieu, Mud Lake, Reno Ranch	Main Gate, EFS, Van Buren
⁹⁰ Sr Transuranics	quarterly	Rotating schedule	Rotating schedule	Rotating schedule
PM-10	every sixth day	Rexburg, Blackfoot	Atomic City	None
Air Moisture				
Tritium	4 to 13 weeks	Idaho Falls	Atomic City	None
Precipitation				
Tritium	monthly	Idaho Falls	None	CFA
Tritium	weekly	None	None	EFS
Surface H₂O				
Gross Alpha, Gross Beta, ³ H	semiannually	Twin Falls, Buhl, Hagerman Idaho Falls, Bliss	None	None
Drinking H₂O				
Gross Alpha Gross Beta, ³ H	semiannually	Aberdeen, Blackfoot, Carey, Idaho Falls, Fort Hall, Minidoka, Roberts, Shoshone	Arco, Atomic City, Howe, Montevieu, Mud Lake, Reno Ranch	None
Milk				
¹³¹ I	weekly	Idaho Falls	None	None
¹³¹ I	monthly	Blackfoot, Carey, Dietrich, Minidoka, Roberts	Howe, Terreton, Arco	None
Tritium ⁹⁰ Sr	annually	Blackfoot, Carey, Dietrich, Idaho Falls, Minidoka, Roberts	Howe, Terreton, Arco	None
Potatoes				
Gamma Spec ⁹⁰ Sr	annually	Blackfoot, Idaho Falls, Rupert	Arco, Mud Lake	None
Wheat				
Gamma Spec ⁹⁰ Sr	annually	American Falls, Blackfoot, Dietrich, Idaho Falls, Minidoka, Carey	Arco, Montevieu, Mud Lake, Tabor, Terreton	None
Lettuce				
Gamma Spec ⁹⁰ Sr	annually	Blackfoot, Carey, Idaho Falls, Pocatello	Arco, Atomic City, Howe, Mud Lake	None
Fish				
Gamma Spec	annually	None	None	Big Lost River
Sheep				
Gamma Spec	annually	Blackfoot	None	INEEL grazing areas
Waterfowl				
Gamma Spec ⁹⁰ Sr Transuranics	annually	Fort Hall	None	Waste disposal ponds
Game				
Gamma Spec	varies	None	None	INEEL roads
Soil				
Gamma Spec ⁹⁰ Sr Transuranics	biennially	Carey, Crystal Ice Caves, Blackfoot, St. Anthony	Butte City, Montevieu, Atomic City, FAA Tower, Howe, Mud Lake (2), Reno Ranch	None
TLDS				
Gamma Radiation	semiannual	Aberdeen, Blackfoot, Craters of the Moon, Idaho Falls, Minidoka, Rexburg, Roberts	Arco, Atomic City, Howe, Montevieu, Mud Lake, Reno Ranch	None

Table A-2
Summary of Approximate Minimum Detectable Concentrations for Radiological Analyses

<u>Sample Type</u>	<u>Analysis</u>	<u>Approximate Minimum Detectable Concentration^a</u> <u>(MDC)</u>	<u>Derived Concentration Guide^b</u> <u>(DCG)</u>	<u>Drinking Water Detection Limits^c</u>
Air (particulate filter) ^d	Gross alpha	$1 \times 10^{-15} \mu\text{Ci/ml}$	$2 \times 10^{-14} \mu\text{Ci/ml}$	--
	Gross beta	$3 \times 10^{-15} \mu\text{Ci/ml}$	$3 \times 10^{-12} \mu\text{Ci/ml}$	--
	Specific gamma (^{137}Cs)	$3 \times 10^{-16} \mu\text{Ci/ml}$	$4 \times 10^{-10} \mu\text{Ci/ml}$	
	^{238}Pu	$2 \times 10^{-18} \mu\text{Ci/ml}$	$3 \times 10^{-14} \mu\text{Ci/ml}$	
	$^{239/240}\text{Pu}$	$3 \times 10^{-18} \mu\text{Ci/ml}$	$2 \times 10^{-14} \mu\text{Ci/ml}$	
	^{241}Am	$2 \times 10^{-18} \mu\text{Ci/ml}$	$2 \times 10^{-14} \mu\text{Ci/ml}$	--
	^{90}Sr	$3 \times 10^{-17} \mu\text{Ci/ml}$	$9 \times 10^{-12} \mu\text{Ci/ml}$	--
Air (charcoal cartridge) ^d	^{131}I	$4 \times 10^{-15} \mu\text{Ci/ml}$	$4 \times 10^{-10} \mu\text{Ci/ml}$	--
Air (atmospheric moisture) ^e	^3H	$4 \times 10^{-12} \mu\text{Ci/ml}$	$1 \times 10^{-7} \mu\text{Ci/ml}$	--
Air (precipitation)	^3H	$1 \times 10^{-7} \mu\text{Ci/ml}$	$2 \times 10^{-3} \mu\text{Ci/ml}$	--
Water (drinking & surface)	Gross alpha	3 pCi/l	30 pCi/l	3 pCi/l
	Gross beta	2 pCi/l	100 pCi/l	4 pCi/l
	^3H	100 pCi/l	$2 \times 10^6 \text{ pCi/l}$	1000 pCi/l
Milk	^{131}I	$3 \times 10^{-9} \mu\text{Ci/ml}$	--	--
Wheat	Specific gamma (^{137}Cs)	$4 \times 10^{-9} \mu\text{Ci/g}$	--	--
	^{90}Sr	$5 \times 10^{-9} \mu\text{Ci/g}$	--	--
Lettuce	Specific gamma (^{137}Cs)	$1 \times 10^{-7} \mu\text{Ci/g}$	--	--
	^{90}Sr	$2 \times 10^{-7} \mu\text{Ci/g}$	--	--

a. The MDC is an estimate of the concentration of radioactivity in a given sample type that can be identified with a 95% level of confidence and a precision of plus or minus 100% under a specified set of typical laboratory measurement conditions.

b. DCGs, set by the DOE, represent reference values for radiation exposure. They are based on a radiation dose of 100 mrem/yr for exposure through a particular exposure mode such as direct exposure, inhalation, or ingestion of water.

c. These limits are required by the National Primary Drinking Water Regulations (40 CFR 141). The "detection limit" is the terminology used by the EPA and means the same as the MDC defined above.

d. The approximate MDC is based on an average filtered air volume (pressure corrected) of 570 m³/week

e. The approximate MDC is expressed for tritium (as tritiated water) in air, and is based on an average filtered air volume of 25 m³, assuming an average sampling period of eight weeks.

Appendix B

Helpful Information for Readers

Radionuclide Nomenclature

Radionuclides are sometimes expressed with the one- or two-letter chemical symbol for the element. A radionuclide is an unstable, or radioactive, form of an element. A given element may have many different radionuclides. Each is designated by a superscript number to the left of the chemical symbol. This number is the atomic weight of the radionuclide, equal to the number of protons and neutrons in its nucleus. Radionuclides which may be used in this report are shown in the following table:

<u>Symbol</u>	<u>Radionuclide</u>	<u>Symbol</u>	<u>Radionuclide</u>
^3H	Tritium	^{131}I	Iodine-131
^7Be	Beryllium-7	^{134}Cs	Cesium-134
^{51}Cr	Chromium-51	^{137}Cs	Cesium-137
^{54}Mn	Manganese-54	^{144}Ce	Cerium-144
^{58}Co	Cobalt-58	^{181}Hf	Hafnium-181
^{60}Co	Cobalt-60	^{238}Pu	Plutonium-238
^{65}Zn	Zinc-65	$^{239/240}\text{Pu}$	Plutonium-239/240
^{90}Sr	Strontium-90	^{241}Am	Americium-241
^{95}Nb	Niobium-95		

Scientific Notation

Scientific notation is used to express numbers which are very small and very large. A very small number will be expressed with a negative exponent, e.g., 1.3×10^{-6} . To convert this number to the more commonly used form, the decimal point must be moved left by the number of places equal to the exponent (in this case, six). The number thus becomes 0.0000013.

For large numbers, those with a positive exponent, the decimal point is moved to the right by the number of places equal to the exponent. The number 1,000,000 (or one million) can be written as 1.0×10^6 .

Unit Prefixes

Units for very small and very large numbers are commonly expressed with a prefix. One example is the prefix *kilo*, abbreviated k, which means 1,000 of a given unit. A kilometer is therefore equal to 1,000 meters. Prefixes that may be used in this report are:

<u>Prefix</u>	<u>Abbreviation</u>	<u>Meaning</u>
milli	m	$1/1,000 (=1 \times 10^{-3})$
micro	μ	$1/1,000,000 (=1 \times 10^{-6})$
pico	p	$1/1,000,000,000,000 (=1 \times 10^{-12})$

Units of Radioactivity and Radiation Exposure and Dose

The basic unit of radioactivity used in this report is the curie, abbreviated Ci. The curie is defined as the amount of radioactivity equivalent to 37 billion nuclear transformations per second.

Historically, this was based upon the radioactivity from one gram of the radionuclide Radium-226. For any other radionuclide, one curie is the amount of that radionuclide that decays at this same rate.

Radiation exposure is expressed in terms of the Roentgen (R), the amount of ionization produced by gamma radiation in air. Dose is given in units of "Roentgen equivalent man," or "rem," which takes into account the effect of radiation on tissues. For the types of environmental radiation generally encountered, the unit of Roentgen is approximately numerically equal to the unit of rem.

Units of Environmental Concentrations

Concentration of radioactivity in air and milk samples are expressed in units of microcuries per milliliter ($\mu\text{Ci/ml}$). Concentrations in water samples are expressed as picocuries per liter (pCi/l); federal standards are expressed in these units. Radioactivity in foodstuffs are given in microcuries per gram ($\mu\text{Ci/g}$), dry weight. Radioactivity in soil samples is expressed as picocuries per gram (pCi/g), dry weight. Annual human radiation exposure, measured by environmental dosimeters, is expressed in units of milliRoentgens (mR). This is sometimes expressed in terms of dose as millirem (mrem).

Uncertainty of Measurements

Due to many variables, there is always an uncertainty associated with the measurement of environmental contaminants. For radioactivity, the predominant source of uncertainty is due to the inherent statistical nature of radioactive decay events, particularly at the low activity levels encountered in environmental samples. The uncertainty of a measurement is denoted by following the result with a " $\pm$ " (uncertainty) term. This report follows convention in reporting the uncertainty as a 95% confidence limit (or interval), designated in the tables as " $\pm 2s$." That means there is approximately a 95% level of confidence that the real concentration in the sample lies somewhere between the measured (reported) concentration minus the uncertainty term and the measured (reported) concentration plus the uncertainty term.

Negative Numbers as Results

Environmental measurements are frequently conducted at levels where the contaminant, such as radioactivity, cannot be distinguished from natural background levels. In this case, the result will still be reported by the analytical laboratory, even though it is below the measurement system's approximate minimum detectable concentration, or is less than zero. Negative values occur when the measured result is less than a pre-established average background level for the particular system and procedure used. These values, rather than "not detectable" or "zero," are reported to better enable statistical analyses and to observe trends in the data.

Gross versus Specific Analyses

Many of the radiological analyses of environmental samples yield information only about the overall, or gross, amount of a particular type of radiation (e.g., gross beta), rather than identifying and quantifying specific radionuclides. For example, rather than performing an analysis for particular gamma-emitting radionuclides, called gamma spectroscopy, one can do a gross gamma or, more commonly, a gross beta analysis, since gamma-emitting radionuclides also emit beta particles. This type of analysis is an effective screening tool and is much quicker and less costly than specific radionuclide analyses.

Appendix C **Weekly Gross Alpha and Gross Beta Concentrations in Air** **4th Quarter 1998**

Location	Collection Date	Gross Alpha Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)	Gross Beta Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)
Blackfoot NOAA	10/07/98	2.1 $\pm$ 0.6	18 $\pm$ 1
	10/14/98	2.6 $\pm$ 0.7	27 $\pm$ 2
	10/21/98	1.5 $\pm$ 0.5	15 $\pm$ 1
	10/28/98	2.3 $\pm$ 0.6	37 $\pm$ 2
	11/04/98	2.5 $\pm$ 0.6	25 $\pm$ 2
	11/11/98	1.6 $\pm$ 0.8	13 $\pm$ 2
	11/18/98	1.1 $\pm$ 0.5	23 $\pm$ 2
	11/24/98	1.1 $\pm$ 0.5	15 $\pm$ 2
	12/02/98	1.8 $\pm$ 0.5	16 $\pm$ 1
	12/09/98	0.4 $\pm$ 0.5	9 $\pm$ 1
	12/16/98	0.6 $\pm$ 0.4	22 $\pm$ 2
	12/23/98	1.5 $\pm$ 0.6	33 $\pm$ 2
	12/30/98	1.6 $\pm$ 0.5	29 $\pm$ 2
Craters of the Moon	10/07/98	1.1 $\pm$ 0.5	20 $\pm$ 2
	10/14/98	1.4 $\pm$ 0.5	22 $\pm$ 2
	10/21/98	0.7 $\pm$ 0.4	17 $\pm$ 1
	10/28/98	1.7 $\pm$ 0.6	40 $\pm$ 2
	11/04/98	1.0 $\pm$ 0.4	26 $\pm$ 2
	11/11/98	1.2 $\pm$ 0.8	14 $\pm$ 2
	11/18/98	0.5 $\pm$ 0.4	24 $\pm$ 2
	11/24/98	0.2 $\pm$ 0.3	11 $\pm$ 1
	12/02/98	0.5 $\pm$ 0.3	15 $\pm$ 1
	12/09/98	0.1 $\pm$ 0.3	8 $\pm$ 1
	12/16/98	0.5 $\pm$ 0.4	25 $\pm$ 2
	12/23/98	0.4 $\pm$ 0.4	33 $\pm$ 2
	12/30/98	1.2 $\pm$ 0.5	27 $\pm$ 2
Idaho Falls	10/07/98	1.6 $\pm$ 0.7	21 $\pm$ 2
	10/14/98	1.6 $\pm$ 0.6	28 $\pm$ 2
	10/21/98	2.2 $\pm$ 0.7	18 $\pm$ 2
	10/28/98	2.6 $\pm$ 0.8	44 $\pm$ 3
	11/04/98	2.7 $\pm$ 0.8	28 $\pm$ 2
	11/11/98	1.8 $\pm$ 1.1	19 $\pm$ 2
	11/18/98	1.7 $\pm$ 0.7	35 $\pm$ 3
	11/24/98	0.9 $\pm$ 0.6	18 $\pm$ 2
	12/02/98	1.0 $\pm$ 0.5	18 $\pm$ 2
	12/09/98	1.1 $\pm$ 0.6	12 $\pm$ 2
	12/16/98	1.1 $\pm$ 0.7	32 $\pm$ 3
	12/23/98	1.6 $\pm$ 0.7	35 $\pm$ 3

Appendix C **Weekly Gross Alpha and Gross Beta Concentrations in Air** **4th Quarter 1998**

Location	Collection Date	Gross Alpha Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)	Gross Beta Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)
Rexburg	12/30/98	1.9 $\pm$ 0.7	43 $\pm$ 3
	10/07/98	2.1 $\pm$ 0.6	23 $\pm$ 2
	10/14/98	2.1 $\pm$ 0.6	27 $\pm$ 2
	10/21/98	2.7 $\pm$ 0.7	18 $\pm$ 2
	10/28/98	2.2 $\pm$ 0.7	40 $\pm$ 2
	11/04/98	2.6 $\pm$ 0.7	28 $\pm$ 2
	11/11/98	1.5 $\pm$ 0.9	19 $\pm$ 2
	11/18/98	1.8 $\pm$ 0.6	28 $\pm$ 2
	11/24/98	1.0 $\pm$ 0.6	16 $\pm$ 2
	12/02/98	1.6 $\pm$ 0.5	19 $\pm$ 2
	12/09/98	0.3 $\pm$ 0.4	12 $\pm$ 1
	12/16/98	1.0 $\pm$ 0.5	28 $\pm$ 2
	12/23/98	1.7 $\pm$ 0.6	33 $\pm$ 2
Mountain View Middle School (Blackfoot)	12/30/98	1.3 $\pm$ 0.6	28 $\pm$ 2
	10/07/98	1.8 $\pm$ 0.6	18 $\pm$ 2
	10/14/98	2.9 $\pm$ 0.7	28 $\pm$ 2
	10/21/98	1.4 $\pm$ 0.5	14 $\pm$ 2
	10/28/98	2.9 $\pm$ 0.8	47 $\pm$ 3
	11/04/98	4.5 $\pm$ 0.9	30 $\pm$ 2
	11/11/98	1.9 $\pm$ 1.0	18 $\pm$ 2
	11/18/98	2.6 $\pm$ 0.8	32 $\pm$ 2
	11/24/98	2.6 $\pm$ 0.7	19 $\pm$ 2
	12/02/98	1.6 $\pm$ 0.5	16 $\pm$ 1
	12/09/98	0.7 $\pm$ 0.5	8 $\pm$ 1
	12/16/98	1.8 $\pm$ 0.6	24 $\pm$ 2
	12/23/98	1.4 $\pm$ 0.6	35 $\pm$ 2
Arco	12/30/98	1.4 $\pm$ 0.5	26 $\pm$ 2
	10/07/98	2.2 $\pm$ 0.7	17 $\pm$ 2
	10/14/98	2.7 $\pm$ 0.8	30 $\pm$ 2
	10/21/98	1.5 $\pm$ 0.6	16 $\pm$ 2
	10/28/98	3.3 $\pm$ 0.9	43 $\pm$ 3
	11/04/98	2.7 $\pm$ 0.8	33 $\pm$ 2
	11/11/98	2.2 $\pm$ 1.2	20 $\pm$ 2
	11/18/98	1.7 $\pm$ 0.7	31 $\pm$ 2
	11/24/98	1.7 $\pm$ 0.8	16 $\pm$ 2
	12/02/98	0.4 $\pm$ 0.4	18 $\pm$ 2
	12/09/98	0.0 $\pm$ 0.4	11 $\pm$ 1
	12/16/98	1.4 $\pm$ 0.6	27 $\pm$ 2

Appendix C **Weekly Gross Alpha and Gross Beta Concentrations in Air** **4th Quarter 1998**

Location	Collection Date	Gross Alpha Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)	Gross Beta Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)
Arco	12/23/98	1.4 $\pm$ 0.6	25 $\pm$ 2
(cont.)	12/30/98	1.8 $\pm$ 0.7	40 $\pm$ 3
Arco	10/07/98	0.9 $\pm$ 0.4	13 $\pm$ 1
Replicate	10/14/98	1.5 $\pm$ 0.6	27 $\pm$ 2
	10/21/98	1.4 $\pm$ 0.5	16 $\pm$ 1
	10/28/98	2.1 $\pm$ 0.7	40 $\pm$ 2
	11/04/98	1.7 $\pm$ 0.5	14 $\pm$ 1
	11/11/98	5.3 $\pm$ 2.1	20 $\pm$ 3
	11/18/98	Invalid sample due to pump failure	
	11/24/98	0.4 $\pm$ 0.6	22 $\pm$ 2
	12/02/98	0.8 $\pm$ 0.4	16 $\pm$ 1
	12/09/98	0.1 $\pm$ 0.3	12 $\pm$ 1
	12/16/98	1.2 $\pm$ 0.5	31 $\pm$ 2
	12/23/98	1.8 $\pm$ 0.6	32 $\pm$ 2
	12/30/98	1.6 $\pm$ 0.5	26 $\pm$ 2
Atomic City	10/07/98	1.1 $\pm$ 0.5	18 $\pm$ 2
	10/14/98	1.9 $\pm$ 0.7	33 $\pm$ 2
	10/21/98	1.1 $\pm$ 0.5	18 $\pm$ 2
	10/28/98	2.6 $\pm$ 0.8	49 $\pm$ 3
	11/04/98	1.0 $\pm$ 0.8	17 $\pm$ 3
	11/11/98	1.5 $\pm$ 0.9	19 $\pm$ 2
	11/18/98	0.9 $\pm$ 0.5	32 $\pm$ 2
	11/24/98	1.3 $\pm$ 0.6	21 $\pm$ 2
	12/02/98	1.1 $\pm$ 0.5	18 $\pm$ 2
	12/09/98	-0.3 $\pm$ 0.8	6 $\pm$ 2
	12/16/98	0.3 $\pm$ 0.4	27 $\pm$ 2
	12/23/98	1.6 $\pm$ 0.6	32 $\pm$ 2
	12/30/98	1.0 $\pm$ 0.5	1 $\pm$ 1
Howe	10/07/98	1.0 $\pm$ 0.5	18 $\pm$ 2
	10/14/98	1.8 $\pm$ 0.5	26 $\pm$ 2
	10/21/98	1.2 $\pm$ 0.5	18 $\pm$ 2
	10/28/98	2.5 $\pm$ 0.6	41 $\pm$ 2
	11/04/98	1.7 $\pm$ 0.6	35 $\pm$ 2
	11/11/98	2.1 $\pm$ 1.0	22 $\pm$ 2
	11/18/98	1.5 $\pm$ 0.6	45 $\pm$ 3
	11/24/98	0.2 $\pm$ 0.4	14 $\pm$ 2
	12/02/98	0.8 $\pm$ 0.4	20 $\pm$ 2
	12/09/98	0.5 $\pm$ 0.4	15 $\pm$ 1

Appendix C Weekly Gross Alpha and Gross Beta Concentrations in Air 4th Quarter 1998

Location	Collection Date	Gross Alpha Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)	Gross Beta Concentration $\pm 2s$ ($\mu\text{Ci/ml} \times 10^{-15}$)
Howe (cont.)	12/16/98	0.8 ± 0.5	36 ± 2
	12/23/98	1.5 ± 0.6	38 ± 2
	12/30/98	2.1 ± 0.7	48 ± 3
FAA Tower	10/07/98	1.1 ± 0.5	14 ± 1
	10/14/98	1.7 ± 0.6	30 ± 2
	10/21/98	0.7 ± 0.4	12 ± 1
	10/28/98	1.7 ± 0.6	43 ± 2
	11/04/98	1.6 ± 0.5	16 ± 2
	11/11/98	0.9 ± 0.8	15 ± 2
	11/18/98	0.8 ± 0.4	24 ± 2
	11/24/98	0.6 ± 0.5	16 ± 2
	12/02/98	0.7 ± 0.4	13 ± 1
	12/09/98	0.3 ± 0.4	11 ± 1
	12/16/98	0.9 ± 0.4	13 ± 1
	12/23/98	1.0 ± 0.5	26 ± 2
	12/30/98	0.4 ± 0.4	27 ± 2
Montevue	10/07/98	1.9 ± 0.9	27 ± 3
	10/14/98	1.3 ± 0.6	30 ± 2
	10/21/98	2.4 ± 0.7	20 ± 2
	10/28/98	1.7 ± 1.3	30 ± 5
	11/04/98	2.0 ± 0.6	32 ± 2
	11/11/98	1.5 ± 1.0	18 ± 2
	11/18/98	1.5 ± 0.6	41 ± 2
	11/24/98	0.5 ± 0.5	18 ± 2
	12/02/98	0.8 ± 0.4	20 ± 2
	12/09/98	0.4 ± 0.4	11 ± 1
	12/16/98	1.1 ± 0.5	31 ± 2
	12/23/98	1.2 ± 0.6	36 ± 2
	12/30/98	1.8 ± 0.6	38 ± 2
Mud Lake	10/07/98	1.7 ± 0.6	21 ± 2
	10/14/98	2.0 ± 0.6	29 ± 2
	10/21/98	2.2 ± 0.6	22 ± 2
	10/28/98	0.9 ± 1.1	33 ± 5
	11/04/98	2.3 ± 0.6	34 ± 2
	11/11/98	1.5 ± 0.9	19 ± 2
	11/18/98	1.2 ± 0.6	48 ± 3
	11/24/98	1.0 ± 0.6	16 ± 2
	12/02/98	1.3 ± 0.5	20 ± 2

Appendix C

Weekly Gross Alpha and Gross Beta Concentrations in Air

4th Quarter 1998

Location	Collection Date	Gross Alpha Concentration $\pm 2s$ ($\mu\text{Ci}/\text{ml} \times 10^{-15}$)	Gross Beta Concentration $\pm 2s$ ($\mu\text{Ci}/\text{ml} \times 10^{-15}$)
Mud Lake (cont.)	12/09/98	0.4 $\pm$ 0.4	15 $\pm$ 2
	12/16/98	1.0 $\pm$ 0.5	38 $\pm$ 2
	12/23/98	1.4 $\pm$ 0.6	37 $\pm$ 2
	12/30/98	1.5 $\pm$ 0.6	46 $\pm$ 2
Reno Ranch	10/07/98	1.5 $\pm$ 0.6	20 $\pm$ 2
	10/14/98	2.1 $\pm$ 0.7	31 $\pm$ 2
	10/21/98	1.3 $\pm$ 0.6	16 $\pm$ 2
	10/28/98	2.3 $\pm$ 0.8	45 $\pm$ 3
	11/04/98	1.1 $\pm$ 0.5	23 $\pm$ 2
	11/11/98	1.7 $\pm$ 1.1	18 $\pm$ 2
	11/18/98	1.2 $\pm$ 0.6	33 $\pm$ 2
	11/24/98	0.6 $\pm$ 0.6	18 $\pm$ 2
	12/02/98	1.0 $\pm$ 0.5	17 $\pm$ 2
	12/09/98	0.1 $\pm$ 0.4	11 $\pm$ 2
	12/16/98	0.4 $\pm$ 0.4	21 $\pm$ 2
	12/23/98	1.0 $\pm$ 0.6	35 $\pm$ 2
	12/30/98	0.8 $\pm$ 0.5	32 $\pm$ 2
Reno Ranch Replicate	10/07/98	1.0 $\pm$ 0.5	19 $\pm$ 2
	10/14/98	1.4 $\pm$ 0.6	29 $\pm$ 2
	10/21/98	1.3 $\pm$ 0.5	17 $\pm$ 2
	10/28/98	2.2 $\pm$ 0.7	39 $\pm$ 2
	11/04/98	2.0 $\pm$ 0.6	31 $\pm$ 2
	11/11/98	1.4 $\pm$ 0.9	17 $\pm$ 2
	11/18/98	1.0 $\pm$ 0.5	34 $\pm$ 2
	11/24/98	0.6 $\pm$ 0.5	15 $\pm$ 2
	12/02/98	1.0 $\pm$ 0.5	17 $\pm$ 2
	12/09/98	0.2 $\pm$ 0.4	9 $\pm$ 1
	12/16/98	0.7 $\pm$ 0.4	26 $\pm$ 2
	12/23/98	0.8 $\pm$ 0.5	32 $\pm$ 2
	12/30/98	0.8 $\pm$ 0.5	34 $\pm$ 2
INEEL Main Gate	10/07/98	1.4 $\pm$ 0.5	21 $\pm$ 2
	10/14/98	1.9 $\pm$ 0.6	29 $\pm$ 2
	10/21/98	1.2 $\pm$ 0.4	19 $\pm$ 2
	10/28/98	2.5 $\pm$ 0.7	44 $\pm$ 3
	11/04/98	2.6 $\pm$ 0.7	36 $\pm$ 2
	11/11/98	2.5 $\pm$ 1.0	19 $\pm$ 2
	11/18/98	0.9 $\pm$ 0.5	39 $\pm$ 2
	11/24/98	0.3 $\pm$ 0.4	19 $\pm$ 2

Appendix C **Weekly Gross Alpha and Gross Beta Concentrations in Air** **4th Quarter 1998**

Location	Collection Date	Gross Alpha Concentration $\pm 2s$ ($\mu\text{Ci}/\text{ml} \times 10^{-15}$)	Gross Beta Concentration $\pm 2s$ ($\mu\text{Ci}/\text{ml} \times 10^{-15}$)
INEEL	12/02/98	0.9 $\pm$ 0.4	21 $\pm$ 2
Main	12/09/98	0.4 $\pm$ 0.4	13 $\pm$ 1
Gate	12/16/98	1.1 $\pm$ 0.5	30 $\pm$ 2
(cont.)	12/23/98	0.9 $\pm$ 0.5	38 $\pm$ 2
	12/30/98	1.2 $\pm$ 0.5	43 $\pm$ 2
EFS	10/07/98	1.2 $\pm$ 0.5	20 $\pm$ 2
	10/14/98	2.5 $\pm$ 0.7	32 $\pm$ 2
	10/21/98	1.3 $\pm$ 0.5	19 $\pm$ 2
	10/28/98	1.8 $\pm$ 0.6	48 $\pm$ 3
	11/04/98	2.2 $\pm$ 0.7	34 $\pm$ 2
	11/11/98	2.0 $\pm$ 1.0	21 $\pm$ 2
	11/18/98	1.0 $\pm$ 0.5	45 $\pm$ 2
	11/24/98	0.6 $\pm$ 0.5	16 $\pm$ 2
	12/02/98	1.0 $\pm$ 0.4	21 $\pm$ 2
	12/09/98	0.1 $\pm$ 0.3	14 $\pm$ 1
	12/16/98	0.7 $\pm$ 0.4	31 $\pm$ 2
	12/23/98	1.3 $\pm$ 0.6	25 $\pm$ 2
	12/30/98	1.0 $\pm$ 0.5	42 $\pm$ 2
Van Buren	10/07/98	0.7 $\pm$ 0.3	13 $\pm$ 1
Avenue	10/14/98	2.4 $\pm$ 0.6	31 $\pm$ 2
	10/21/98	1.1 $\pm$ 0.5	19 $\pm$ 2
	10/28/98	2.3 $\pm$ 0.6	45 $\pm$ 2
	11/04/98	1.8 $\pm$ 0.6	30 $\pm$ 2
	11/11/98	0.9 $\pm$ 0.8	20 $\pm$ 2
	11/18/98	1.2 $\pm$ 0.5	38 $\pm$ 2
	11/24/98	0.6 $\pm$ 0.4	17 $\pm$ 2
	12/02/98	0.3 $\pm$ 0.3	21 $\pm$ 2
	12/09/98	-0.1 $\pm$ 0.3	12 $\pm$ 1
	12/16/98	0.9 $\pm$ 0.5	29 $\pm$ 2
	12/23/98	1.2 $\pm$ 0.5	35 $\pm$ 2
	12/30/98	-0.4 $\pm$ 0.2	34 $\pm$ 2