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INEL Offsite Environmental Surveillance Program Report for the Fourth Quarter of 1995

Environmental Science and Research Foundation

Russell Mitchell
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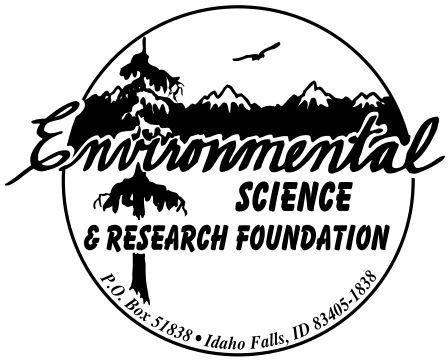
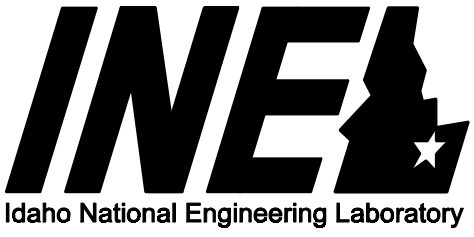
September 1996





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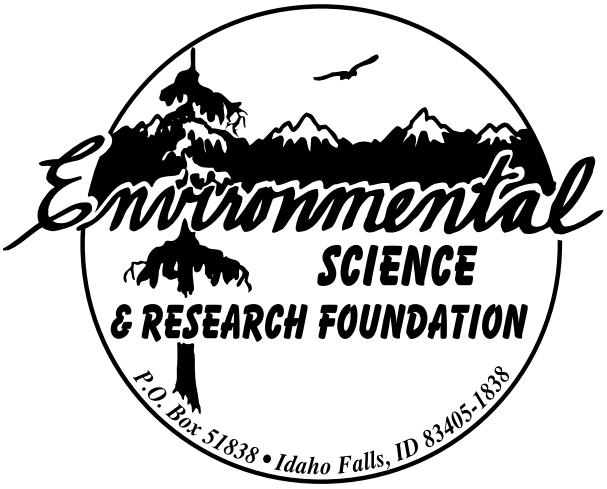

Doyle Markham,
Executive Director

This Program is Conducted for the
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Executive Summary

The Environmental Science and Research Foundation conducts the Idaho National Engineering Laboratory (INEL) offsite environmental surveillance program. The Foundation's environmental surveillance program is designed to monitor the effects, if any, of Department of Energy activities on the offsite environment, to confirm compliance with applicable environmental laws and regulations, and to observe any trends in environmental levels of radioactivity. This report for the fourth quarter of 1995 includes the results of analyses conducted on samples of air, water, and foodstuffs, including milk, potatoes, and game animals. Environmental radiation measurements using thermoluminescent dosimeters were also made. All concentrations of radioactivity found in these samples were consistent with historical levels, and no evidence of radionuclides from the INEL was found in offsite samples. Concentrations of radionuclides found in all samples were below the guidelines set by both the Department of Energy and the Environmental Protection Agency for radiation protection of the public.

Program Description

The Foundation collected filters weekly from low-volume air samplers at 11 offsite locations (four at distant locations and seven at INEL boundary locations). An additional three samplers were operated on the INEL. Weekly measurements were made of gross alpha and gross beta concentrations 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 each location. These composites were then analyzed for gamma-emitting radionuclides. Selected composites were also submitted for Strontium-90 and transuranic analyses (Plutonium-238, Plutonium-239/240, and Americium-241).

Atmospheric moisture and precipitation samples were collected to monitor for tritium. Atmospheric moisture samples were collected for a period of

approximately 10 weeks. The Foundation collected two precipitation samples monthly (one onsite and one offsite) as well as a weekly onsite sample.

Drinking water samples were collected from 13 offsite locations and surface water samples were obtained from five sites. All water samples were analyzed for gross alpha, gross beta, and tritium concentrations.

The Foundation collected a weekly milk sample from a dairy in Idaho Falls and collected monthly milk samples from eight additional dairies around the INEL. All milk samples were analyzed for Iodine-131. November milk samples were analyzed either for Strontium-90 or tritium. Potato samples were collected from five local warehouses and analyzed for gamma-emitting radionuclides and Strontium-90. Tissue samples, including thyroid, muscle, and liver were obtained from game animals accidentally killed on INEL roads. Waterfowl were collected from waste disposal ponds at four INEL facilities and a control area as part of a cooperative project between the Foundation's surveillance and research programs.

Environmental dosimeters were collected from 13 sites in the INEL vicinity to measure levels of environmental radiation.

Summary of Fourth Quarter Results

During the fourth quarter of 1995, gross alpha and gross beta concentrations in low-volume air samples were within the expected range of values for natural background radioactivity. Mean concentrations of both gross alpha and gross beta were similar at onsite, distant, and boundary locations. Iodine-131 was found in one set of air samples near the minimum detectable concentration. Cesium-137 in air was found at three distant and three boundary locations, but at none of the air samplers situated on the INEL. No Strontium-90 was found on air filter composites. Plutonium-238 was found at one location just above the minimum detectable concentration, and Americium-241 was detected at several offsite locations. Higher concentrations of americium were found at distant locations than from samplers near to, or on, the INEL, indicating that a Site origin is not likely for this radionuclide.

Tritium was found in six precipitation samples. The data indicate that the INEL is not likely the source, since similar concentrations of tritium were detected at onsite and distant locations. Elevated atmospheric tritium is likely due to historic nuclear weapons tests and natural atmospheric processes.

Tritium was found in one of the offsite water samples from Arco at a concentration near the detection limit. Gross alpha concentrations were detected in one surface water sample; most samples had detectable gross beta concentrations. One sample had a gross beta concentration that was higher than the range normally seen, but may have contained excess sediment. Second and third fractions of the same sample were analyzed and did not contain elevated gross beta. Gross alpha and gross beta radioactivity in water samples are attributed to naturally-occurring radionuclides in the earth's crust.

None of the milk samples collected during the fourth quarter contained detectable concentrations of Iodine-131. Tritium was found in all five samples analyzed, with similar concentrations reported for distant and boundary locations. Strontium-90 found in milk from one location was consistent with values reported nationwide by the Environmental Protection Agency that are attributed to worldwide fallout from historic weapons testing.

No manmade gamma-emitting radionuclides were found in potato samples. Strontium-90, likely resulting from the presence of this radionuclide in soil, was reported in four potato samples. Similar concentrations were found at distant and boundary locations.

Cesium-137 was found in the muscle tissue of two mule deer, and in the liver of one deer collected on the INEL. In addition, Cobalt-60 was detected in the muscle of one deer near the minimum detectable concentration. These radionuclides may have resulted from ingestion of contaminated soil from the vicinity of INEL facilities.

Waterfowl collected from onsite liquid waste disposal ponds and a distant location contained several manmade gamma-emitting radionuclides in the edible portions. Concentrations of Cesium-137 were at above-background concentrations

in the ducks collected at Test Area North. An estimate of the total potential dose to a hunter who consumed this duck was made and represented 0.005% of the dose received from all sources by a person living in Idaho.

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 (the number of protons and neutrons in its nucleus). Radionuclides which may be used in this report are shown in the following table:

Symbol	Radionuclide	Symbol	Radionuclide
^{3}H	Tritium	^{131}I	Iodine-131
^{7}Be	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	$^{239/240}Pu$	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 a number of places equal to the exponent (in this case 6). 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:

Prefix	Abbreviation	Meaning
milli	m	1/1,000 (=1 x 10^{-3})
micro	µ	1/1,000,000 (=1 x 10^{-6})
pico	p	1/1,000,000,000,000 (=1 x 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 based on the radionuclide Radium-226, of which one gram decays at the rate of 37 billion disintegrations per second. 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 is expressed in units of microcuries per milliliter (µCi/mL) of air or milk. Concentrations in water samples are expressed as picocuries per liter (pCi/l) of water (federal standards are expressed in these units). Radioactivity in foodstuffs are given in microcuries per gram (µCi/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). (NOTE: Not all of the above sample types may appear in this particular report.)

Uncertainty of Measurements

Due to a variety of 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 "±" (uncertainty) term. This report follows convention in reporting the uncertainty as a 95% confidence limit (or interval), designated in the tables as "±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 (MDC), 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.

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1. Introduction

Consistent with requirements of applicable Department of Energy (DOE) Orders, the Foundation's environmental surveillance program is designed to monitor the effects, if any, of DOE activities on the offsite environment, to collect data to verify compliance with applicable environmental laws and regulations, and to observe trends in environmental levels of radioactivity. This work is performed under DOE Contract DE-AC07-ID13268.

This quarterly report summarizes the data collected by the Foundation's INEL offsite environmental surveillance program during the period October 1 through December 31, 1995. The scope of the Foundation's sampling program is outlined in Table 1.

Most analyses for the surveillance program were performed by Idaho State University's Environmental Monitoring Laboratory. Some analyses were performed by Quanterra Laboratory, a commercial laboratory located in Richland, Washington.

A significant portion of environmental results are near background levels of radioactivity. All results are reported with an associated 2s ("two sigma") uncertainty term. The Foundation has adopted the following method for interpreting analytical results near background levels. Results less than or equal to the 2s uncertainty term, which includes some results that are negative, are considered as zero or "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. These results may exceed the 2s level simply due to random statistical fluctuations. This is expected to occur approximately 2.5 % of the time. Results exceeding 3s are interpreted as indicating that radioactivity was detected.

Table 2 summarizes the approximate minimum detectable concentrations (MDC) of radioactivity that the laboratories can detect and quantify for a given sample type and analysis.

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

- For air, concentrations are compared to the DOE Derived Concentration Guide. This is the concentration of a radionuclide that, under conditions of continuous exposure, 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 Maximum Contaminant Level. This is the maximum permissible level of a contaminant in water that is delivered to any user of a community water system.

Table 1
Summary of the Foundation's Environmental Surveillance Program

Sample Type Analysis	Collection Frequency	Locations		
		Distant	Boundary	INEL
Air				
Gross Alpha	weekly	Blackfoot, Craters of the Moon	Arco, Mud Lake	Main Gate, EFS
Gross Beta ^{131}I	weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	Arco, Atomic City, FAA Tower, Howe, Monteview, 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, Monteview, Mud Lake, Reno Ranch	Main Gate, EFS, Van Buren
^{90}Sr Transuranics	quarterly	Rotating schedule	Rotating schedule	Rotating schedule
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 H_2O				
Gross Alpha, Gross Beta, ^{3}H	quarterly→ semiannually→	Twin Falls, Buhl, Hagerman Idaho Falls, Bliss	None	None
Drinking H_2O				
Gross Alpha Gross Beta, ^{3}H	semiannually	Aberdeen, Blackfoot, Carey, Idaho Falls, Fort Hall, Minidoka, Roberts, Shoshone	Arco, Atomic City, Howe, Monteview, 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, Monteview, 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	INEL grazing areas
Waterfowl				
Gamma Spec ^{90}Sr Transuranics	annually	Fort Hall	None	Waste disposal ponds
Game				
Gamma Spec	Varies	None	None	INEL roads
Soil				
Gamma Spec ^{90}Sr Transuranics	biennially	Carey, Crystal Ice Caves, Blackfoot, St. Anthony	Butte City, Monteview, 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, Monteview, Mud Lake, Reno Ranch	None

Table 2
Summary of Minimum Detectable Concentrations for Radiological Analyses
(Fourth Quarter 1995)

Sample Type	Analysis	Approximate Minimum Detectable Concentration[a] (MDC)	Derived Concentration Guide[b] (DCG)	Drinking Water Detection Limits[c]
Air (particulate filter)[d]	Gross alpha	1×10^{-15} µCi/ml	2×10^{-14} µCi/ml	--
	Gross beta	4×10^{-15} µCi/ml	3×10^{-12} µCi/ml	--
	Specific gamma (^{137}Cs)	2×10^{-15} µCi/ml	4×10^{-10} µCi/ml	--
	^{238}Pu	2×10^{-18} µCi/ml	3×10^{-14} µCi/ml	--
	$^{239/240}$Pu	3×10^{-18} µCi/ml	2×10^{-14} µCi/ml	--
	^{241}Am	2×10^{-18} µCi/ml	2×10^{-14} µCi/ml	--
	^{90}Sr	3×10^{-17} µCi/ml	9×10^{-12} µCi/ml	--
Air (charcoal cartridge)[d]	^{131}I	4×10^{-15} µCi/ml	4×10^{-10} µCi/ml	--
Air (atmospheric moisture)[e]	^{3}H	4×10^{-12} µCi/ml	1×10^{-7} µCi/ml	--
Air (precipitation)	^{3}H	1×10^{-7} µCi/ml	2×10^{-3} µCi/ml	--
Water (drinking & surface)	Gross alpha	4 pCi/l	30 pCi/l	1.5 pCi/l
	Gross beta	2 pCi/l	100 pCi/l	4 pCi/l
	^{3}H	100 pCi/l	2×10^{6} pCi/l	1000 pCi/l
Milk	^{131}I	2×10^{-9} µCi/ml	--	--
	^{3}H	1×10^{-7} µCi/ml	--	--
	^{90}Sr	5×10^{-10} µCi/ml	--	--
Potatoes	Specific gamma (^{137}Cs)	3×10^{-9} µCi/g	--	--
	^{90}Sr	2×10^{-9} µCi/g	--	--
Muscle tissue	Specific gamma (^{137}Cs)	4×10^{-9} µCi/g	--	--
Liver tissue	Specific gamma (^{137}Cs)	3×10^{-9} µCi/g	--	--
Thyroid tissue	Specific gamma (^{137}Cs)	3×10^{-7} µCi/g	--	--

a. The minimum detectable concentration (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 m^3/week.
e. The approximate MDC is expressed for tritium (as tritiated water) in air, and is based on an average filtered air volume of 20 m^3, assuming an average sampling period of eight weeks.

2. Air Sampling

2.1 Sampling Methods

2.1.1 Low-Volume Air Samplers

Airborne particulate radioactivity was continuously monitored by 14 air samplers (Figure 1), designed to provide an effective network to detect INEL releases of radioactivity. Four offsite air samplers are designated as distant (or background) stations and seven are designated as boundary stations. Three air samplers are situated on the INEL. Distant locations are used to make comparisons of airborne concentrations of radioactivity with boundary and onsite locations. Two replicate samplers, located in Rexburg and Atomic City, were operated adjacent to regular air samplers to provide quality assurance information.

Each air sampler averaged a flow of approximately 50 l/min (2 ft^3/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. In order to be considered a valid sample, each filter must sample a pressure-corrected air volume of at least 200 m^3 (about 7000 ft^3). Filters sample an average air volume of about 570 m^3 (20,000 ft^3).

Charcoal cartridges were screened in batches weekly for Iodine-131 activity. If activity is detected that is greater than a preset action level, individual cartridges are then analyzed further. 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 decay products of radon and thoron to decay. The particulate filters were also counted for gross (nonspecific) 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 ^{90}Sr or transuranic radionuclides (^{238}Pu, $^{239/240}Pu$, and ^{241}Am).

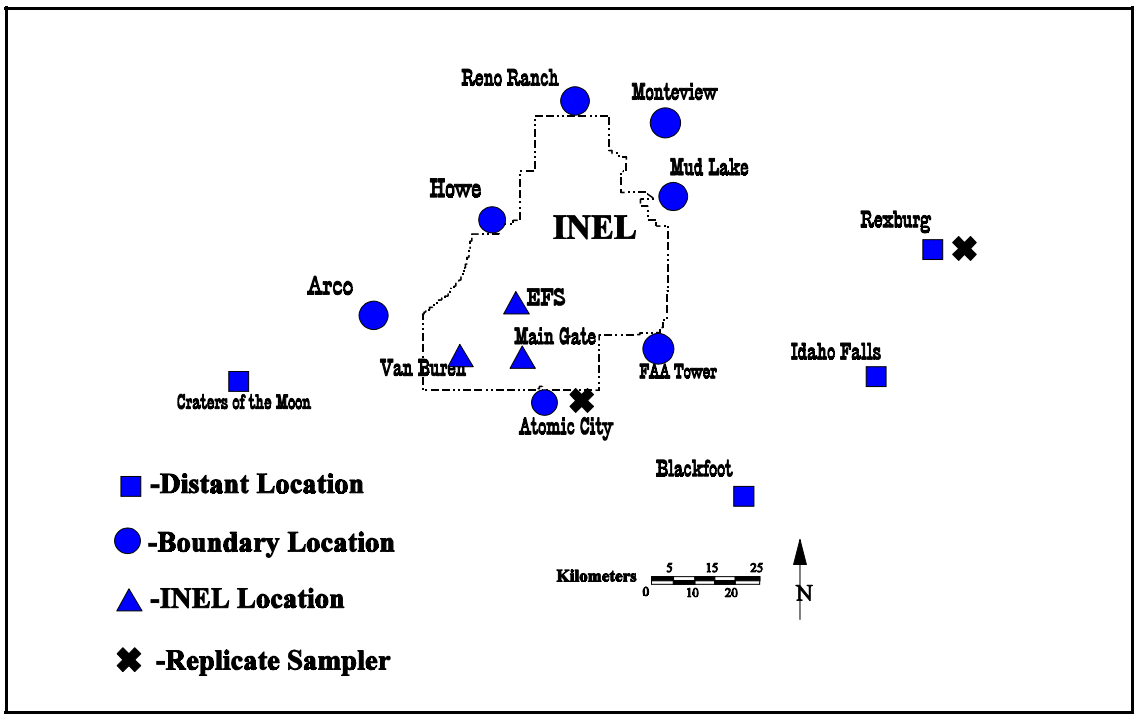

Figure 1 Air Sampling Location Map

2.1.2 Atmospheric Moisture Samplers

Two air samplers, located in Atomic City and Idaho Falls, were used to collect atmospheric moisture for tritium analysis. Air was passed through a column of silica gel that absorbs water vapor in the air. Tritium concentrations were determined by extracting water from the silica gel and counting it by liquid scintillation.

2.1.3 Precipitation Samplers

When available, weekly precipitation samples were collected at the Experimental Field Station (EFS) on the INEL. In addition, two samples were collected monthly: one at the Central Facilities Area on the INEL and one in Idaho Falls. All precipitation samples were analyzed for tritium by liquid scintillation.

2.2 Results

2.2.1 Low-Volume Air Samplers

Iodine-131 was found in one of the weekly charcoal cartridge batches analyzed during the fourth quarter. The concentration of Iodine-131 found was below the action level used during 1995 that requires filters to be counted individually; therefore, each filter was not analyzed separately. For 1996, the Foundation surveillance program has lowered the action level to require individual analysis if any activity greater than the minimum detectable concentration of approximately 1×10^{-15} µCi/ml is found on a batch. If all the Iodine-131 activity detected in the batch (collected October 19) is assumed to have been on one cartridge, the concentration would have been $(4.4 \pm 4.2) \times 10^{-15}$ µCi/ml, or 0.0011% of the annual derived concentration guide for Iodine-131.

All gross alpha concentrations were within the expected range of background levels (Figure 2 and Table A-1, Appendix A). Gross alpha concentrations ranged

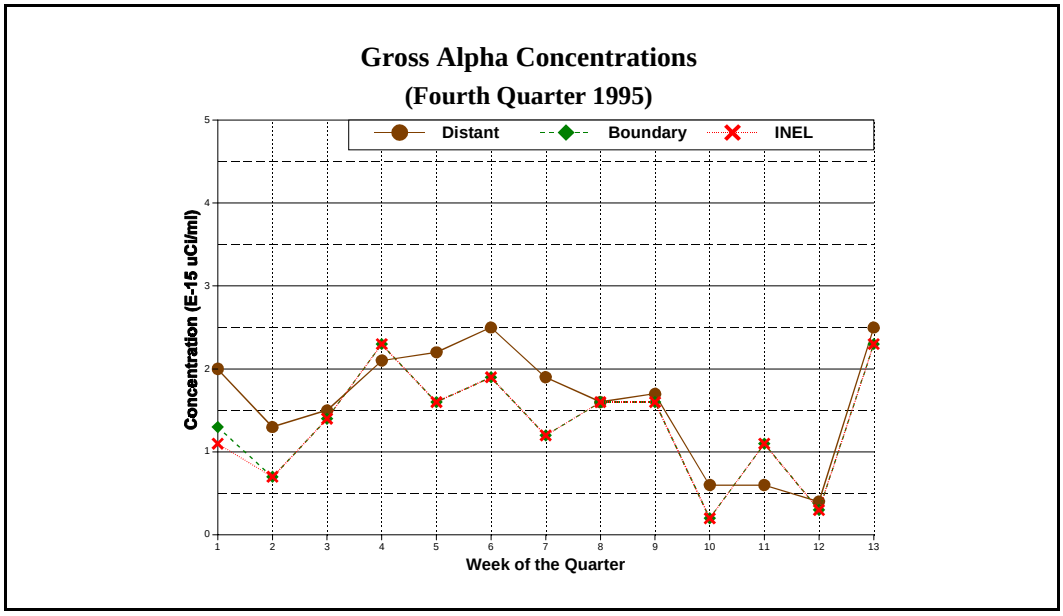

Figure 2 Weekly Gross Alpha Concentrations

from (0.0 ± 0.9) x 10^{-15} µCi/ml during the week of December 6 to 13 at Craters of the Moon and the week of December 13 to 20 at Craters of the Moon and Atomic City to (3.7 ± 1.7) x 10^{-15} µCi/ml during the week of November 1 to 8 at Mud Lake. The quarterly mean gross alpha concentrations for the onsite and boundary locations were not statistically higher than the mean for the distant locations: (1.3 ± 0.3) x 10^{-15} µCi/ml (onsite), (1.4 ± 0.2) x 10^{-15} µCi/ml (boundary), and (1.6 ± 0.3) x 10^{-15} µCi/ml (distant). These results are summarized in Table 3.

Table 3
Gross Alpha Concentrations in Air
(Fourth Quarter 1995)

			Gross Alpha Concentration (x 10^{-15} µCi/ml)	
Group	**Location**	**Number of Samples**	**Range of Samples**	**Mean with 95% Confidence Interval**
Distant	Blackfoot	13	0.3 - 3.2	1.6 ± 0.5
	Craters of the Moon	13	0.0 - 3.1	1.1 ± 0.6
	Idaho Falls	13	0.2 - 3.1	1.8 ± 0.6
	Rexburg (Replicate)	13 (13)	0.1 - 3.3 (0.4 - 4.0)	1.9 ± 0.6 (2.0 ± 0.6)
			Group Mean	**1.6 ± 0.3**
Boundary	Arco	13	0.3 - 2.1	1.3 ± 0.4
	Atomic City (Replicate)	13 (13)	0.0 - 2.6 (0.1 - 3.4)	1.4 ± 0.5 (1.6 ± 0.6)
	FAA Tower	13	0.2 - 3.2	1.2 ± 0.6
	Howe	13	0.3 - 2.9	1.4 ± 0.5
	Monteview	13	0.5 - 2.6	1.4 ± 0.4
	Mud Lake	13	0.1 - 3.7	1.6 ± 0.7
	Reno Ranch	13	0.2 - 2.7	1.6 ± 0.5
			Group Mean	**1.4 ± 0.2**
INEL	EFS	13	0.1 - 3.1	1.2 ± 0.5
	Main Gate	13	0.1 - 3.0	1.4 ± 0.5
	Van Buren	13	0.1 - 2.6	1.4 ± 0.5
			Group Mean	**1.3 ± 0.3**
			DOE Derived Concentration Guide	20

All gross beta concentrations were also within the expected range of background levels (Figure 3 and Table A-2, Appendix A). The final week of the quarter showed a peak typical of those seen during wintertime inversion periods. Gross beta concentrations ranged from (6 ± 5) x 10^{-15} µCi/ml during the week of November 29

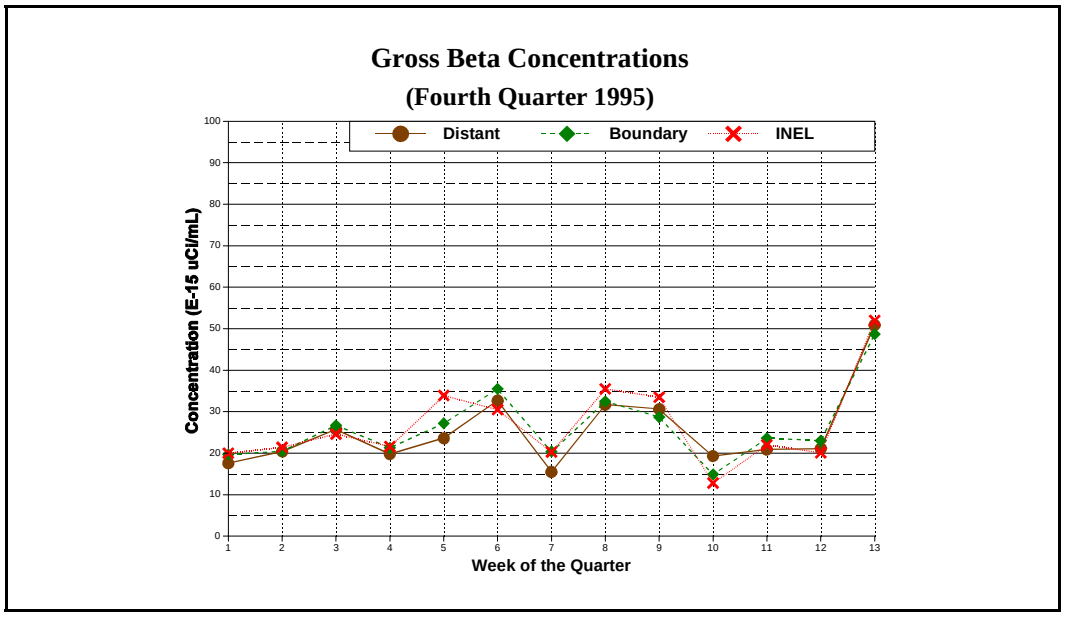

Figure 3 Weekly Gross Beta Concentrations

to December 6 at FAA Tower to (61 ± 6) x 10^{-15} µCi/ml during the last week of the year at Mud Lake. Quarterly means of gross beta concentrations for the onsite and boundary locations were not statistically higher than the mean for the distant locations: (27 ± 3) x 10^{-15} µCi/ml (onsite), (26 ± 2) x 10^{-15} µCi/ml (boundary), and (25 ± 3) x 10^{-15} µCi/ml (distant). The results are summarized in Table 4.

The gross beta data for the Rexburg and Atomic City quality assurance replicates assisted in data validation. The Rexburg and Atomic City mean values were not statistically different from their respective replicate mean values. Correlation tests indicated the Rexburg and Atomic City weekly gross beta results correlated well with their respective replicate results (to a 95% confidence level).

Beryllium-7, a naturally-occurring gamma-emitting radionuclide produced by cosmic rays in the atmosphere, was detected in all of the quarterly composites. Cesium-137 was found on composites from three distant locations, three boundary locations, and none of the INEL locations. Because it is present only offsite, an INEL origin is unlikely for this radionuclide, which is universally present in soil as a result of fallout from nuclear weapons testing.

Table 4
Gross Beta Concentrations in Air
(Fourth Quarter 1995)

Group	Location	Number of Samples	Gross Beta Concentration ($\times 10^{-15}$ µCi/ml) Range of Samples	Mean with 95% Confidence Interval
Distant	Blackfoot	13	17 - 57	27 ± 7
	Craters of the Moon	13	15 - 41	25 ± 5
	Idaho Falls	13	13 - 51	24 ± 6
	Rexburg (Replicate)	13 (13)	14 - 59 (15 - 53)	26 ± 7 (26 ± 6)
			Group Mean	**25 ± 3**
Boundary	Arco	13	16 - 38	26 ± 4
	Atomic City (Replicate)	13 (13)	13 - 54 (9 - 58)	27 ± 7 (25 ± 8)
	FAA Tower	13	6 - 43	21 ± 6
	Howe	13	18 - 47	27 ± 5
	Monteview	13	13 - 49	27 ± 6
	Mud Lake	13	20 - 61	33 ± 7
	Reno Ranch	13	13 - 53	26 ± 6
			Group Mean	**26 ± 2**
INEL	EFS	13	10 - 57	28 ± 7
	Main Gate	13	12 - 55	27 ± 7
	Van Buren	13	16 - 44	25 ± 4
			Group Mean	**27 ± 3**
		DOE Derived Concentration Guide		3000

Strontium-90 was not detected on any of the composite samples from distant, boundary, or INEL locations.

Plutonium-238 at just above the minimum detectable concentration was indicated on one composite (Table 5). Americium-241 was found on several sets of composites. Higher concentrations were seen at distant and boundary locations than on the INEL, where no americium was detected. No source has been identified for the americium, but its presence at distant locations suggests an INEL origin is not likely. Quarterly concentrations are being monitored for trends.

Table 5
Manmade Radionuclides in Particulate Filter Quarterly Composites
(Fourth Quarter 1995)

Gamma-emitting Radionuclides

Location	Cesium-137 (10^{-15} µCi/ml ± 2s)
Distant Locations	
Craters of the Moon	1.0 ± 0.4
Idaho Falls	0.5 ± 0.4
Rexburg	0.11 ± 0.07
Not Detected: Blackfoot, Rexburg Replicate	
Boundary Locations	
Arco	0.11 ± 0.08
Atomic City	0.17 ± 0.07
Replicate	4.3 ± 0.6
Howe	1.2 ± 0.4
Not Detected: FAA Tower, Monteview, Mud Lake, Reno Ranch	
INEL Locations	
Not Detected: EFS, Main Gate, Van Buren	
DOE Derived Concentration Guide	400000

Transuranic Radionuclides

Location	Americium-241 (10^{-18} µCi/ml ± 2s)	Plutonium-238 (10^{-18} µCi/ml ± 2s)	Plutonium-239/240 (10^{-18} µCi/ml ± 2s)
Distant Locations			
Craters of the Moon	10 ± 4	Not Detected	Not Detected
Idaho Falls	5 ± 2	Not Detected	Not Detected
Boundary Locations			
Atomic City	1.4 ± 1.2	Not Detected	Not Detected
Replicate	5 ± 2	Not Detected	Not Detected
Mud Lake	1.8 ± 1.6	1.6 ± 1.4	Not Detected
INEL Location			
EFS	Not Detected	Not Detected	Not Detected
DOE Derived Concentration Guide	20000	30000	20000

2.2.2 Atmospheric Moisture Samplers

Two samples covering the fourth quarter were collected from each location. Neither of the first set of samples contained a detectable concentration of tritium. The analysis for the second set, which extended into February 1996, was not yet

completed. Tritium arises in the atmosphere from both natural (cosmic ray interactions in the atmosphere) and manmade sources.

2.2.3 Precipitation Samplers

Nine precipitation samples were collected in the fourth quarter and analyzed for tritium. Tritium was detected in six samples, two from each of the three sampling locations. Detectable concentrations ranged from $(1.5 \pm 1.0) \times 10^{-7}$ µCi/ml to $(1.8 \pm 1.0) \times 10^{-7}$ µCi/ml. Although tritium attributable to the INEL has been found in isolated onsite precipitation samples during the past few years, the similar concentrations found at distant and INEL locations indicates that it is more likely that these concentrations are due to environmental tritium from natural atmospheric processes and historic nuclear weapons testing.

3. Water Sampling

3.1 Methods

Water samples were collected in early November from 13 drinking water locations and five surface water locations (Figure 4). Drinking water sampling locations were local businesses. Surface water locations included three springs in the Thousand Springs area; this area is one of the outlets for the Snake River Plain Aquifer, which flows beneath the INEL (Figure 4). Each water sample was analyzed for gross alpha and gross beta activity by evaporating a portion of the sample on a stainless steel plate and counting the residue. Tritium concentrations were determined by analyzing samples using liquid scintillation.

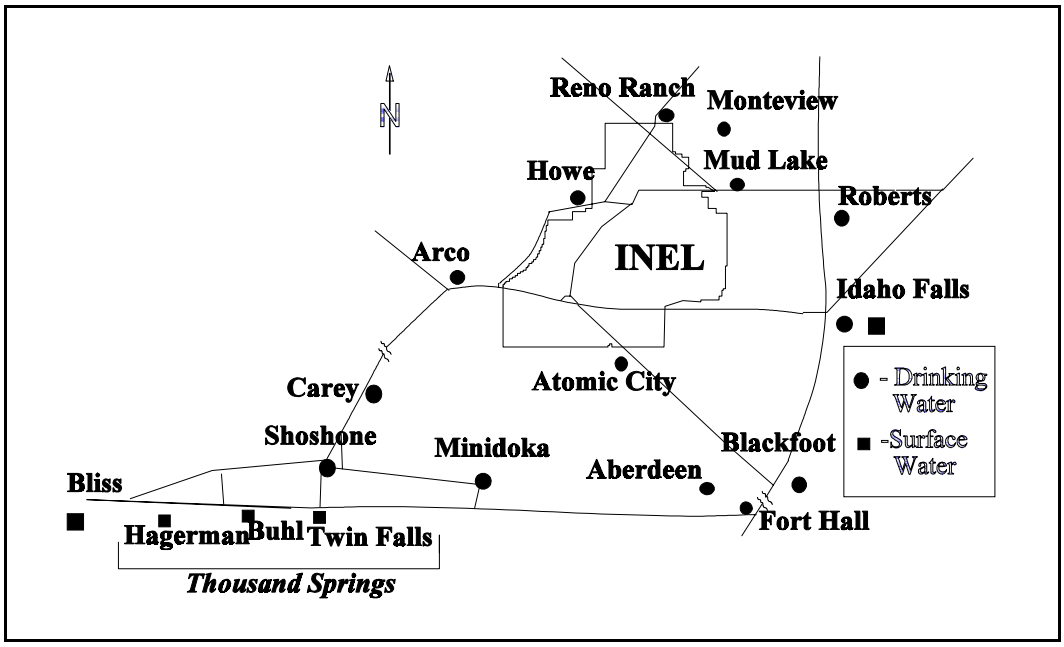

Figure 4 Water Sampling Locations

3.2 Results

One of the drinking water samples (Arco) showed a measurable concentration of tritium just above the minimum detectable concentration (Table 6). One of the water samples contained a detectable concentration of gross alpha, and most contained detectable gross beta concentrations. The sample from Monteview showed a high residue weight after the first evaporation, resulting in a large reported uncertainty. This sample was reanalyzed and gross alpha activity was below the detection limit. The gross alpha concentration reported for Bliss was outside the range normally seen for gross alpha in water that is attributed to naturally-occurring decay products (primarily from the uranium and thorium series) picked up by water as it travels through the earth's crust. A recount failed to confirm this activity, however, and a second sample fraction also did not contain a detectable concentration of gross alpha.

The gross beta concentration in the sample from the Snake River at Idaho Falls was also outside the range normally found for natural activity. The value indicated in Table 6 was verified by recounting the sample. Examination of the planchet used for the evaporation revealed some mineral residue from the sample. It is possible that the sample contained excess sediment. A second fraction of the sample was analyzed and no gross beta activity was detected.

Table 6
Radionuclide Concentrations in Offsite Water Samples
(Fourth Quarter 1995)

Location	^{3}H (pCi/l ± 2s)	Gross Alpha (pCi/l ± 2s)	Gross Beta (pCi/l ± 2s)
Drinking Water			
Aberdeen	-140 ± 100	3 ± 7	7 ± 2
Aberdeen Replicate	-160 ± 100	-1 ± 7	5 ± 2
Arco	100 ± 90	1 ± 5	2 ± 2
Atomic City	10 ± 90	-1 ± 4	4 ± 2
Blackfoot	70 ± 90	3 ± 7	5 ± 2
Carey	-180 ± 100	-1 ± 4	3 ± 2
Fort Hall	-20 ± 90	0 ± 6	5 ± 2
Howe	30 ± 90	-1 ± 4	0 ± 2
Idaho Falls	-210 ± 90	2 ± 6	4 ± 2
Minidoka	30 ± 90	-3 ± 4	3 ± 2
Monteview	-230 ± 90	19 ± 25[a]	9 ± 3
Monteview Reanalysis		8 ± 9	8 ± 3
Mud Lake	-210 ± 90	-1 ± 3	7 ± 2
Roberts	-70 ± 90	-6 ± 4	3 ± 2
Shoshone	-80 ± 110	4 ± 5	3 ± 2
Surface Water			
Alpheus Spring (Twin Falls)	30 ± 90	1 ± 4	2 ± 2
Bill Jones Hatchery (Hagerman)	0 ± 90	0 ± 4	3 ± 2
Bill Jones Replicate	60 ± 90	3 ± 5	2 ± 2
Clear Spring (Buhl)	10 ± 90	1 ± 5	6 ± 2
Bliss	0 ± 90	11 ± 7	2 ± 2
Bliss Reanalysis		4 ± 6	5 ± 2
Idaho Falls	-200 ± 100	1 ± 4	30 ± 3[b]
Idaho Falls Reanalysis		5 ± 7	-1 ± 5
EPA Maximum Contaminant Level	20,000	15	50

a. High residue upon first evaporation of sample. Second fraction analyzed.

b. Possible excess sediment in sample fraction. Second fraction analyzed.

4. Foodstuff Sampling

4.1 Methods

Milk samples were collected weekly in Idaho Falls and monthly at eight other locations around the INEL (Figure 5). Two types of locations were sampled: single family dairies and large commercial dairies. Each milk sample was analyzed for Iodine-131 by placing the sample in a gamma spectrometer calibrated for the Iodine-131 energy peak. Samples from November were analyzed either for tritium or for Strontium-90.

Potato samples were collected from five local warehouses and processed with skins included. Potatoes were analyzed for gamma-emitting radionuclides and Strontium-90.

Samples of thyroids, and muscle and liver tissue were taken from game animals accidentally killed on the INEL. Analyses were performed by gamma spectrometry on these samples.

As part of a cooperative project between the Foundation's research and surveillance programs, waterfowl were collected from four waste disposal ponds on the INEL, and from an offsite control area. All samples were analyzed for gamma-emitting radionuclides, and some of the samples also received analysis for Strontium-90 and transuranic radionuclides.

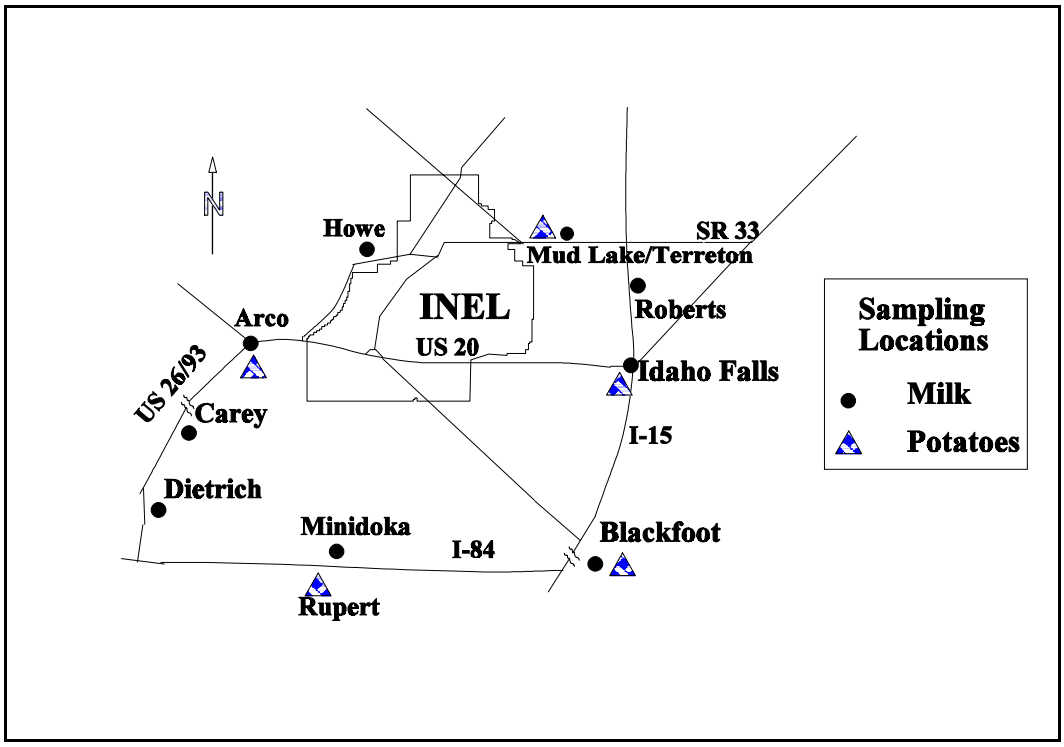

Figure 5 Fourth Quarter Foodstuff Sampling Locations

4.2 Results

A total of 37 milk samples were collected during the fourth quarter. Iodine-131 was not detected in any of the samples at a minimum detectable concentration of approximately 2×10^{-9} µCi/ml.

Tritium was detected in all five samples analyzed in November. The minimum detectable concentration achieved in November (about 1×10^{-7} µCi/ml) was lower than in May when samples from the other four sampling locations were analyzed (about 5×10^{-7} µCi/ml), due to use of a new counting system. Concentrations were similar at all five locations, ranging from $(1.3 \pm 0.9) \times 10^{-7}$ µCi/ml at Minidoka to $(2.0 \pm 0.9) \times 10^{-7}$ µCi/ml at Blackfoot. Strontium-90 was detected in one of two samples; two other samples were lost in analysis. The concentration measured at Dietrich, a distant location was $(1.3 \pm 0.7) \times 10^{-9}$ µCi/ml, which is typical of values reported nationwide in milk by the Environmental Protection Agency.

No manmade gamma-emitting radionuclides were detected in potato samples. Strontium-90 was found in four of the five samples, including one of two boundary locations and all three distant locations. Detectable concentrations ranged from $(1.0 \pm 0.6) \times 10^{-8}$ µCi/g at Idaho Falls to $(1.7 \pm 0.7) \times 10^{-8}$ µCi/g at Mud Lake. These concentrations are similar to those reported in wheat samples from distant and boundary locations during the past several years, and are attributed to the worldwide presence of Strontium-90 in soil as a result of fallout from nuclear weapons testing.

Two game animals, both mule deer, were sampled during the fourth quarter. Both contained Cesium-137 in the muscle tissues. A deer collected near the Idaho Chemical Processing Plant had a concentration of $(1.8 \pm 0.6) \times 10^{-8}$ µCi/g. Another deer sampled near the Central Facilities Area contained a concentration of $(6 \pm 5) \times 10^{-9}$ µCi/g . In addition, the deer collected near the Central Facilities Area had Cobalt-60 in the muscle at $(4.3 \pm 4.2) \times 10^{-9}$ µCi/ml, or just above the minimum detectable concentration, and Cesium-137 in the liver at $(4 \pm 3) \times 10^{-9}$ µCi/ml. Soil contaminated with both of these radionuclides is present around some INEL facilities, and it is possible that they were present in game animals due to ingestion of soil, or ingestion of plants growing in contaminated soil. The Cesium-137 concentrations found, however, were similar to those found in sheep collected onsite and offsite during recent years, and since this radionuclide is also present in background soil, may have been the result of worldwide fallout.

Waterfowl were collected from a control location in the Fort Hall area, from liquid radioactive waste disposal ponds at the Idaho Chemical Processing Plant and Test Reactor Area, from a pond at Test Area North that does not currently receive radioactive liquids but had during previous years, and from nonradioactive disposal ponds at Argonne National Laboratory-West and the Test Reactor Area. Several manmade gamma-emitting radionuclides were found in both control and INEL samples (Table 7). Cesium-137 was found at above-background concentrations in the samples from the Test Area North pond. While this pond is not currently used for disposal of radioactive liquids, it is located within an area of soil slightly

contaminated with Cesium-137. For perspective, an estimate was made of the potential dose to a hunter who consumed the entire edible portion of the duck with the highest concentration. The estimated dose was 0.018 mrem, and can be compared to the 360 mrem per year that is received from all sources (including cosmic radiation, radon, and medical procedures) by the average person living in Idaho.

Table 7

Manmade Gamma-emitting Radionuclides in Edible Portions of Waterfowl (1995)

Radionuclide	Location	Concentration (x 10^{-6} µCi/g) Minimum[a]	Maximum[a]	Mean[b]
^{51}Cr	Control	<mdc[c]	2.8 ± 2.1	1.0 ± 0.9
	ANL-W	<mdc	<mdc	-----[d]
	ICPP	<mdc	<mdc	-----
	TAN	<mdc	3.7 ± 2.4	1.2 ± 4.3
	TRA	<mdc	<mdc	-----
^{54}Mn	Control	<mdc	0.07 ± 0.06	0.01 ± 0.01
	ANL-W	<mdc	<mdc	-----
	ICPP	<mdc	0.02 ± 0.02	0.01 ± 0.02
	TAN	<mdc	0.06 ± 0.04	0.02 ± 0.07
	TRA	<mdc	0.08 ± 0.08	0.02 ± 0.03
^{58}Co	Control	<mdc	0.6 ± 0.5	0.10 ± 0.15
	ANL-W	<mdc	<mdc	-----
	ICPP	<mdc	0.07 ± 0.06	0.02 ± 0.07
	TAN	<mdc	<mdc	-----
	TRA	<mdc	0.14 ± 0.14	0.03 ± 0.06
^{60}Co	Control	<mdc	<mdc	-----
	ANL-W	<mdc	<mdc	-----
	ICPP	0.02 ± 0.02	0.16 ± 0.04	0.07 ± 0.02
	TAN	<mdc	<mdc	-----
	TRA	<mdc	0.17 ± 0.08	0.04 ± 0.07
^{65}Zn	Control	<mdc	0.18 ± 0.18	0.02 ± 0.03
	ANL-W	<mdc	<mdc	-----
	ICPP	0.06 ± 0.06	0.10 ± 0.06	0.08 ± 0.05
	TAN	<mdc	<mdc	-----
	TRA	<mdc	<mdc	-----
^{95}Nb	Control	<mdc	<mdc	-----
	ANL-W	<mdc	<mdc	-----
	ICPP	<mdc	<mdc	-----
	TAN	<mdc	0.4 ± 0.3	0.1 ± 0.4
	TRA	<mdc	<mdc	-----
^{134}Cs	Control	<mdc	0.08 ± 0.04	0.02 ± 0.01
	ANL-W	<mdc	<mdc	-----
	ICPP	<mdc	0.04 ± 0.02	0.01 ± 0.05
	TAN	<mdc	<mdc	-----
	TRA	<mdc	<mdc	-----
^{137}Cs	Control	<mdc	0.08 ± 0.06	0.01 ± 0.01
	ANL-W	<mdc	0.03 ± 0.02	0.02 ± 0.05
	ICPP	<mdc	0.57 ± 0.08	0.21 ± 0.65
	TAN	<mdc	1.8 ± 0.2	1.0 ± 1.4
	TRA	<mdc	<mdc	-----
^{144}Ce	Control	<mdc	<mdc	-----
	ANL-W	<mdc	<mdc	-----
	ICPP	<mdc	0.16 ± 0.10	0.05 ± 0.02
	TAN	<mdc	<mdc	-----
	TRA	<mdc	<mdc	-----
^{181}Hf	Control	<mdc	2.6 ± 2.2	0.3 ± 0.5
	ANL-W	<mdc	<mdc	-----
	ICPP	<mdc	0.15 ± 0.14	0.07 ± 0.17
	TAN	<mdc	<mdc	-----
	TRA	<mdc	<mdc	-----

[a] Concentration ± 2 standard deviations.
[b] Mean with 95% confidence interval.
[c] Less than minimum detectable concentration.
[d] There were no detectable concentrations for this radionuclide at this location.

5. Environmental Radiation

5.1 Methods

Environmental radiation is monitored at six boundary and seven distant stations (Figure 6). Environmental radiation is monitored with the use of thermoluminescent dosimeters (TLDs) made of lithium fluoride crystals. The TLDs are placed on posts one meter (3.3 feet) above the ground at field locations and changed every six months in May and November. The crystals detect beta and gamma radiation and store this information in the form of "excited" electrons within the crystals. The TLDs are analyzed by an instrument which heats them under precisely controlled conditions and detects the light they give off. The amount of light is a measure of the amount of environmental radiation.

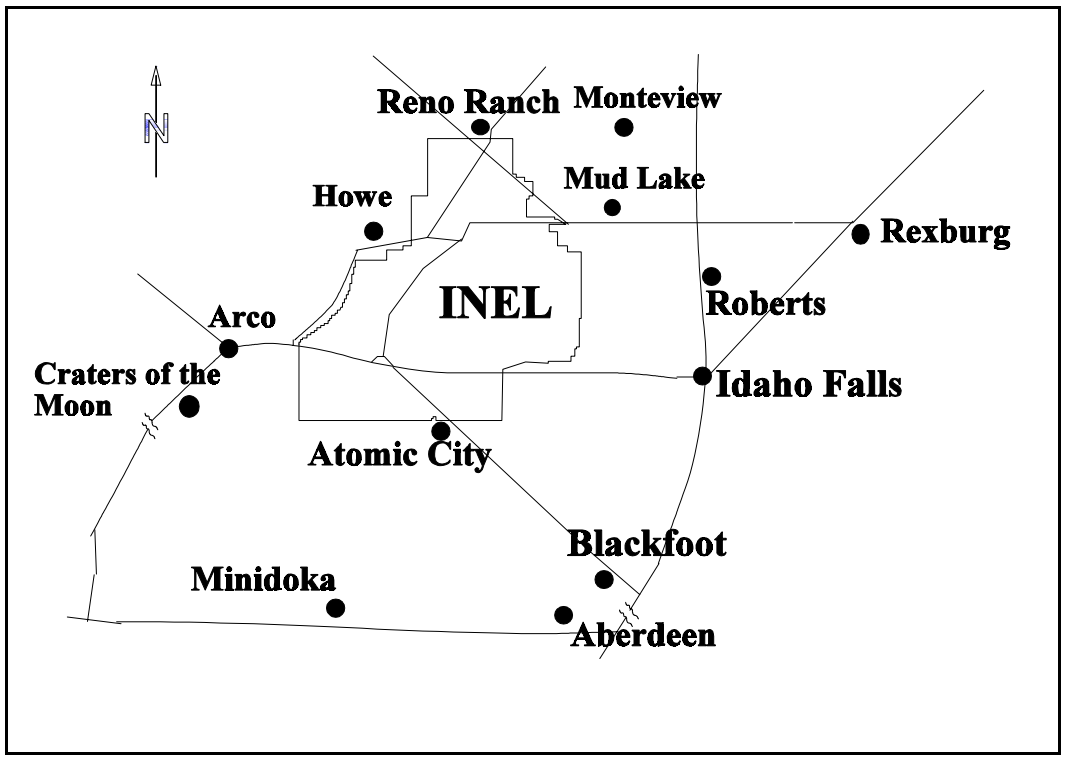

Figure 6 TLD Locations

6.2 Results

The environmental radiation results for the second sampling period of 1995 (May through November) are shown in Table 8, along with the results for the previous two sampling periods. The results show that the exposure levels were lower during the November 1994 through May 1995 period than the preceding and following six-month periods. This is consistent with the approximately 10% reduction expected for this period due to the amount of snow cover on the ground. Snow cover shields the dosimeter from radiation exposure from natural radionuclides in the soil. A one-tailed Student's t-test indicated that the exposure levels at the boundary stations were not statistically greater than exposure levels at the distant stations.

Table 8
Environmental Radiation Exposure (mR) for May 1994 to November 1995

Location	5/94-11/94 Exposure (mR ± 2s)	11/94-5/95 Exposure (mR ± 2s)	5/95-11/95 Exposure (mR ± 2s)
Distant Locations			
Aberdeen	60 ± 3	49 ± 2	59 ± 2
Blackfoot	62 ± 3	54 ± 3	63 ± 2
Craters of the Moon	62 ± 3	52 ± 2	62 ± 3
Idaho Falls	---[a]	57 ± 4	63 ± 3
Minidoka	57 ± 3	51 ± 1	54 ± 2
Rexburg	56 ± 4	50 ± 1	59 ± 3
Roberts	70 ± 4	59 ± 3	59 ± 4
Group Mean[b]	**61 ± 5**	**53 ± 3**	**60 ± 3**
Boundary Locations			
Arco	66 ± 3	55 ± 2	63 ± 2
Atomic City	64 ± 4	59 ± 2	65 ± 4
Howe	55 ± 2	54 ± 3	58 ± 3
Monteview	55 ± 4	56 ± 3	62 ± 3
Mud Lake	62 ± 3	59 ± 3	58 ± 6
Reno Ranch	57 ± 3	55 ± 2	58 ± 3
Group Mean[b]	**60 ± 5**	**56 ± 2**	**61 ± 3**

a. TLD could not be read due to damage to the chips.
b. Mean ± 95% confidence interval.

Appendix A

Weekly Gross Alpha and Gross Beta

Concentrations in Air

Table A-1
Weekly Gross Alpha Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
		Distant Locations
Blackfoot	10/04	2.1 ± 1.3
	10/11	0.5 ± 1.3
	10/18	1.7 ± 1.4
	10/25	2.6 ± 1.4
	11/01	1.9 ± 1.2
	11/08	1.4 ± 1.1
	11/15	1.9 ± 1.1
	11/22	2.1 ± 1.7
	11/29	1.4 ± 1.6
	12/06	0.3 ± 1.0
	12/13	0.5 ± 0.9
	12/20	0.7 ± 1.0
	12/27	3.2 ± 1.4
Craters of the Moon	10/04	0.6 ± 1.0
	10/11	1.3 ± 1.6
	10/18	0.4 ± 1.2
	10/25	0.8 ± 1.1
	11/01	2.2 ± 1.4
	11/08	3.1 ± 1.6
	11/15	1.1 ± 1.0
	11/22	0.4 ± 1.4
	11/29	2.0 ± 1.7
	12/06	0.8 ± 1.2
	12/13	0.0 ± 0.9
	12/20	0.0 ± 0.8
	12/27	1.5 ± 1.2
Idaho Falls	10/04	1.9 ± 1.3
	10/11	0.8 ± 1.3
	10/18	2.7 ± 1.8
	10/25	2.1 ± 1.3
	11/01	2.2 ± 1.2
	11/08	3.1 ± 1.5
	11/15	1.9 ± 1.1
	11/22	2.7 ± 1.8
	11/29	2.1 ± 1.1
	12/06	0.2 ± 0.9
	12/13	0.2 ± 0.7

Table A-1 (Cont.)
Weekly Gross Alpha Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	12/20	0.9 ± 1.0
	12/27	2.7 ± 1.4
Rexburg	10/04	3.3 ± 1.6 (2.3 ± 1.5)
(Replicate)	10/11	2.6 ± 1.7 (0.8 ± 1.4)
	10/18	1.2 ± 1.3 (1.9 ± 1.6)
	10/25	2.9 ± 1.5 (3.0 ± 1.7)
	11/01	2.4 ± 1.3 (4.0 ± 1.7)
	11/08	2.3 ± 1.3 (2.8 ± 1.5)
	11/15	2.7 ± 1.3 (1.7 ± 1.1)
	11/22	1.3 ± 1.7 (1.8 ± 1.8)
	11/29	1.0 ± 1.5 (0.4 ± 1.4)
	12/06	0.9 ± 1.0 (1.6 ± 1.2)
	12/13	1.7 ± 1.3 (1.0 ± 1.2)
	12/20	0.1 ± 0.8 (1.6 ± 1.2)
	12/27	2.7 ± 1.4 (2.7 ± 1.5)
		Boundary Locations
Arco	10/04	2.0 ± 1.4
	10/11	0.6 ± 1.2
	10/18	0.9 ± 1.2
	10/25	1.2 ± 1.2
	11/01	2.1 ± 1.2
	11/08	2.0 ± 1.2
	11/15	1.8 ± 1.1
	11/22	0.6 ± 1.3
	11/29	1.3 ± 1.7
	12/06	1.2 ± 1.1
	12/13	1.2 ± 1.2
	12/20	0.3 ± 0.8
	12/27	1.6 ± 1.1
Atomic City	10/04	1.7 ± 1.2 (1.7 ± 1.5)
(Replicate)	10/11	1.4 ± 1.5 (1.0 ± 1.7)
	10/18	0.9 ± 1.3 (2.0 ± 1.9)
	10/25	1.8 ± 1.3 (0.8 ± 1.2)
	11/01	1.7 ± 1.1 (2.9 ± 1.6)
	11/08	2.6 ± 1.4 (2.0 ± 1.4)
	11/15	0.4 ± 0.6 (3.4 ± 1.7)
	11/22	1.4 ± 1.6 (1.7 ± 1.9)
	11/29	2.1 ± 1.7 (2.6 ± 2.0)

Table A-1 (Cont.)
Weekly Gross Alpha Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	12/06	0.2 ± 0.8 (0.1 ± 1.1)
	12/13	1.1 ± 1.0 (0.1 ± 1.0)
	12/20	0.0 ± 0.7 (1.3 ± 0.9)
	12/27	2.2 ± 1.2 (2.0 ± 1.4)
FAA Tower	10/04	0.2 ± 0.8
	10/11	0.3 ± 1.3
	10/18	1.6 ± 1.6
	10/25	1.5 ± 1.3
	11/01	0.3 ± 0.7
	11/08	1.8 ± 1.2
	11/15	1.1 ± 1.0
	11/22	0.9 ± 1.6
	11/29	2.7 ± 1.8
	12/06	0.7 ± 1.2
	12/13	0.3 ± 0.9
	12/20	0.5 ± 1.0
	12/27	3.2 ± 1.6
Howe	10/04	0.5 ± 0.8
	10/11	0.4 ± 1.2
	10/18	1.1 ± 1.2
	10/25	2.3 ± 1.4
	11/01	2.9 ± 1.4
	11/08	1.2 ± 1.0
	11/15	0.9 ± 0.8
	11/22	2.0 ± 1.7
	11/29	0.9 ± 1.6
	12/06	0.3 ± 0.9
	12/13	2.3 ± 1.2
	12/20	0.5 ± 0.9
	12/27	2.3 ± 1.2
Monteview	10/04	1.1 ± 1.3
	10/11	0.6 ± 1.4
	10/18	1.4 ± 1.5
	10/25	2.6 ± 1.6
	11/01	1.8 ± 1.2

Table A-1 (Cont.)
Weekly Gross Alpha Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	11/08	1.8 ± 1.2
	11/15	1.7 ± 1.1
	11/22	1.4 ± 1.8
	11/29	0.6 ± 1.3
	12/06	0.6 ± 1.0
	12/13	2.1 ± 1.3
	12/20	0.5 ± 0.9
	12/27	1.6 ± 1.2
Mud Lake	10/04	1.3 ± 1.2
	10/11	1.2 ± 1.3
	10/18	1.8 ± 1.6
	10/25	2.9 ± 1.6
	11/01	0.7 ± 0.9
	11/08	3.7 ± 1.7
	11/15	1.8 ± 1.2
	11/22	1.5 ± 1.8
	11/29	0.9 ± 1.5
	12/06	1.1 ± 1.2
	12/13	1.1 ± 1.1
	12/20	0.2 ± 0.8
	12/27	3.3 ± 1.5
Reno Ranch	10/04	2.4 ± 1.6
	10/11	1.3 ± 1.5
	10/18	1.2 ± 1.5
	10/25	2.6 ± 1.5
	11/01	2.0 ± 1.3
	11/08	2.7 ± 1.4
	11/15	1.2 ± 0.9
	11/22	1.0 ± 1.5
	11/29	1.7 ± 1.9
	12/06	0.2 ± 0.9
	12/13	1.9 ± 1.2
	12/20	0.3 ± 0.8
	12/27	1.8 ± 1.2
	INEL Locations	
EFS	10/04	1.3 ± 1.2
	10/11	0.4 ± 1.2
	10/18	0.8 ± 1.3

Table A-1 (Cont.)
Weekly Gross Alpha Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	10/25	3.1 ± 1.7
	11/01	0.8 ± 0.9
	11/08	1.1 ± 1.0
	11/15	1.8 ± 1.1
	11/22	1.4 ± 1.6
	11/29	1.4 ± 1.8
	12/06	0.2 ± 0.9
	12/13	0.7 ± 0.9
	12/20	0.1 ± 0.8
	12/27	1.9 ± 1.2
Main Gate	10/04	1.6 ± 1.3
	10/11	1.7 ± 1.7
	10/18	1.2 ± 1.3
	10/25	1.8 ± 1.3
	11/01	1.6 ± 1.3
	11/08	2.4 ± 1.4
	11/15	0.8 ± 0.8
	11/22	0.9 ± 1.5
	11/29	1.5 ± 1.8
	12/06	1.6 ± 0.9
	12/13	0.8 ± 1.0
	12/20	0.8 ± 1.0
	12/27	3.0 ± 1.4
Van Buren	10/04	0.4 ± 1.0
	10/11	0.1 ± 1.4
	10/18	2.1 ± 1.8
	10/25	2.0 ± 1.5
	11/01	2.2 ± 1.4
	11/08	2.1 ± 1.4
	11/15	1.0 ± 0.9
	11/22	2.6 ± 2.0
	11/29	1.8 ± 1.8
	12/06	0.3 ± 1.1
	12/13	1.8 ± 1.2
	12/20	0.1 ± 0.8
	12/27	2.1 ± 1.3

Table A-2
Weekly Gross Beta Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
		Distant Locations
Blackfoot	10/04	17 ± 4
	10/11	20 ± 4
	10/18	24 ± 5
	10/25	20 ± 4
	11/01	28 ± 4
	11/08	32 ± 5
	11/15	17 ± 4
	11/22	31 ± 10
	11/29	40 ± 11
	12/06	20 ± 4
	12/13	19 ± 5
	12/20	21 ± 5
	12/27	57 ± 6
Craters of	10/04	15 ± 4
the Moon	10/11	22 ± 4
	10/18	26 ± 5
	10/25	18 ± 4
	11/01	23 ± 4
	11/08	33 ± 5
	11/15	17 ± 4
	11/22	32 ± 11
	11/29	41 ± 11
	12/06	17 ± 5
	12/13	19 ± 6
	12/20	21 ± 5
	12/27	36 ± 6
Idaho Falls	10/04	20 ± 4
	10/11	19 ± 4
	10/18	28 ± 5
	10/25	24 ± 5
	11/01	20 ± 4
	11/08	36 ± 5
	11/15	14 ± 3
	11/22	27 ± 10
	11/29	13 ± 4
	12/06	22 ± 5

Table A-2 (Cont.)
Weekly Gross Beta Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	12/13	22 ± 5
	12/20	22 ± 5
	12/27	51 ± 6
Rexburg	10/04	19 ± 4 (20 ± 4)
(Replicate)	10/11	21 ± 4 (23 ± 4)
	10/18	25 ± 4 (25 ± 5)
	10/25	17 ± 4 (30 ± 5)
	11/01	24 ± 4 (28 ± 5)
	11/08	31 ± 5 (32 ± 5)
	11/15	14 ± 3 (15 ± 3)
	11/22	37 ± 11(28 ± 11)
	11/29	29 ± 10 (32 ± 11)
	12/06	18 ± 4 (17 ± 5)
	12/13	23 ± 6 (20 ± 6)
	12/20	20 ± 5 (19 ± 5)
	12/27	59 ± 6 (53 ± 6)
	Boundary Locations	
Arco	10/04	18 ± 4
	10/11	19 ± 4
	10/18	25 ± 4
	10/25	24 ± 5
	11/01	25 ± 4
	11/08	38 ± 5
	11/15	20 ± 4
	11/22	22 ± 9
	11/29	37 ± 11
	12/06	16 ± 4
	12/13	30 ± 6
	12/20	24 ± 5
	12/27	34 ± 5
Atomic	10/04	16 ± 4 (20 ± 4)
City	10/11	22 ± 4 (31 ± 6)
(Replicate)	10/18	30 ± 5 (31 ± 6)
	10/25	23 ± 5 (26 ± 5)
	11/01	22 ± 4 (25 ± 5)
	11/08	39 ± 5 (39 ± 6)
	11/15	17 ± 3 (14 ± 4)
	11/22	30 ± 10 (16 ± 11)

Table A-2 (Cont.)
Weekly Gross Beta Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	11/29	31 ± 10 (30 ± 11)
	12/06	13 ± 4 (9 ± 5)
	12/13	21± 5 (26 ± 6)
	12/20	26 ± 5 (11 ± 5)
	12/27	54 ± 6 (58 ± 7)
FAA	10/04	17 ± 4
Tower	10/11	9 ± 3
	10/18	18 ± 4
	10/25	15 ± 4
	11/01	22 ± 4
	11/08	27 ± 5
	11/15	17 ± 4
	11/22	33 ± 11
	11/29	27 ± 10
	12/06	6 ± 5
	12/13	17 ± 5
	12/20	18 ± 5
	12/27	43 ± 6
Howe	10/04	20 ± 4
	10/11	21 ± 4
	10/18	26 ± 4
	10/25	23 ± 5
	11/01	28 ± 4
	11/08	34 ± 5
	11/15	20 ± 3
	11/22	41 ± 11
	11/29	33 ± 11
	12/06	18 ± 4
	12/13	23 ± 5
	12/20	21 ± 5
	12/27	47 ± 5
Monteview	10/04	20 ± 5
	10/11	26 ± 4
	10/18	28 ± 5
	10/25	19 ± 5
	11/01	33 ± 5
	11/08	38 ± 5

Table A-2 (Cont.)
Weekly Gross Beta Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	11/15	28 ± 4
	11/22	31 ± 11
	11/29	22 ± 9
	12/06	13 ± 4
	12/13	23 ± 5
	12/20	18 ± 5
	12/27	49 ± 6
Mud Lake	10/04	20 ± 4
	10/11	23 ± 4
	10/18	37 ± 6
	10/25	24 ± 5
	11/01	33 ± 5
	11/08	40 ± 6
	11/15	23 ± 4
	11/22	42 ± 12
	11/29	36 ± 11
	12/06	25 ± 5
	12/13	29 ± 5
	12/20	31 ± 5
	12/27	61 ± 6
Reno	10/04	27 ± 5
Ranch	10/11	25 ± 4
	10/18	23 ± 5
	10/25	22 ± 5
	11/01	28 ± 5
	11/08	33 ± 5
	11/15	19 ± 4
	11/22	29 ± 10
	11/29	16 ± 11
	12/06	13 ± 4
	12/13	22 ± 5
	12/20	24 ± 5
	12/27	53 ± 6
	INEL Locations	
EFS	10/04	21 ± 4
	10/11	22 ± 4
	10/18	27 ± 5
	10/25	21 ± 5

Table A-2 (Cont.)
Weekly Gross Beta Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml
	11/01	37 ± 5
	11/08	35 ± 5
	11/15	19 ± 4
	11/22	40 ± 11
	11/29	31 ± 11
	12/06	10 ± 4
	12/13	26 ± 5
	12/20	19 ± 5
	12/27	57 ± 6
Main Gate	10/04	18 ± 4
	10/11	24 ± 4
	10/18	22 ± 4
	10/25	23 ± 5
	11/01	35 ± 6
	11/08	30 ± 5
	11/15	20 ± 4
	11/22	36 ± 11
	11/29	42 ± 12
	12/06	12 ± 5
	12/13	16 ± 5
	12/20	20 ± 5
	12/27	55 ± 6
Van Buren	10/04	22 ± 4
	10/11	18 ± 4
	10/18	24 ± 5
	10/25	20 ± 5
	11/01	29 ± 5
	11/08	27 ± 5
	11/15	22 ± 4
	11/22	30 ± 11
	11/29	28 ± 11
	12/06	16 ± 5
	12/13	24 ± 5
	12/20	21 ± 5
	12/27	44 ± 6