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

Environmental Science and Research Foundation

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Idaho National Engineering Laboratory

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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 first quarter of 1995 includes the results of analyses conducted on samples of air, water, and milk. All concentrations of radioactivity found in these samples were consistent with historical levels, and no evidence of the presence of radionuclides from the INEL was found in offsite samples.

Program Description

The Foundation collected filters weekly from low-volume air samplers at 11 offsite locations (four at distant or background 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 over a period of approximately 10 weeks, on average. The Foundation collected two precipitation samples monthly (one onsite and one offsite) as well as a weekly onsite sample.

Quarterly drinking water samples were collected from six sites in the Magic Valley (in south-central Idaho), including the Thousand Springs area where the Snake River Plain Aquifer emerges. 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.

Summary of First Quarter Results

During the first 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 not found in any air samples. Some of the air filter composites indicated the presence of ^{90}Sr; one composite, from a distant station, indicated the presence of ^{137}Cs. These radionuclides are sometimes detected in trace amounts in air samples at INEL, boundary, and distant locations, and their origin is attributed to fallout from historic above-ground nuclear weapons tests. No transuranic radionuclides were detected on the composites. Tritium was found in some of the atmospheric moisture samples. The data indicate that the INEL is probably not the source, since tritium in atmospheric moisture samples was detected at similar levels at both a boundary and a distant location. Elevated atmospheric tritium is likely due to contributions from historic nuclear weapons tests and natural atmospheric processes. Tritium was found in detectable amounts in one of thirteen precipitation samples (collected onsite at EFS). The result was within historical levels for environmental tritium, and is likely due to contributions from nuclear weapons tests and natural atmospheric processes.

One of the seven water samples (drinking water sample from Minidoka) indicated a level of tritium just above the minimum detectable concentration. Gross alpha concentrations were below the minimum detectable concentration in all water samples. Three samples, from springs in the Thousand Springs area, contained detectable concentrations of gross beta. This is attributed to naturally occurring radionuclides in the earth’s crust.

None of the milk samples collected during the first quarter contained detectable concentrations of Iodine-131.

All of the results were consistent with previously reported data and indicate no detectable levels of radioactivity from INEL activities at the offsite locations. 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 members of the public.

Helpful Information for the General Reader

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	^{137}Cs	Cesium-137
^{7}Be	Beryllium-7	^{238}Pu	Plutonium-238
^{90}Sr	Strontium-90	$^{239/240}Pu$	Plutonium-239/240
^{131}I	Iodine-131	^{241}Am	Americium-241

Scientific Notation

Scientific notation is used to express numbers which are very small or 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 or 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 is expressed 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 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 or bias 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 activities conducted, and sample data collected and analyzed, by the Foundation's INEL offsite environmental surveillance program during the period January 1 through March 31, 1995. The scope of the Foundation's sampling program is outlined in Table 1.

Beginning in January, 1995, most analyses for the surveillance program were performed by Idaho State University's Environmental Monitoring Laboratory. Some analyses were performed by Quanterra Laboratory in Richland, Washington.

A significant portion of environmental results are near background levels of radioactivity. The Foundation has adopted the following method for interpreting analytical results near background levels. Results less than or equal to the 2s ("two sigma") 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 five percent of the time. Results exceeding 3s are interpreted to indicate that radioactivity was detected.

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 public 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
Moisture (Air)				
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, Minidoka, Roberts, Shoshone	Arco, Atomic City, Howe, Monteview, Mud Lake	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 (First Quarter 1995)

Sample Type	**Analysis**	**Approximate Minimum Detectable Concentration[a] (MDC)**	**Derived Concentration Guide[b] (DCG)**	**Drinking Water Detection Limits[c]**
Air[d] (particulate filter)	Gross alpha	8×10^{-16} 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	3×10^{-18} µCi/ml	3×10^{-14} µCi/ml	--
	$^{239/240}Pu$	3×10^{-18} µCi/ml	2×10^{-14} µCi/ml	--
	^{241}Am	3×10^{-18} µCi/ml	2×10^{-14} µCi/ml	--
	^{90}Sr	3×10^{-17} µCi/ml	9×10^{-12} µCi/ml	--
Air[d] (charcoal cartridge)	^{131}I	3×10^{-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	1.2×10^{-7} µCi/ml	2×10^{-3} µCi/ml	--
Water (drinking & surface)	Gross alpha	1 pCi/l	30 pCi/l	1.5 pCi/l
	Gross beta	1 pCi/l	100 pCi/l	4 pCi/l
	^{3}H	120 pCi/l	2×10^{6} pCi/l	1000 pCi/l
Milk	^{131}I	1×10^{-9} µCi/ml	--	--

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 percent 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 a nominal 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 a nominal filtered air volume (pressure corrected) of 20 m^3, assuming a nominal 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 a network of 14 air samplers (Figure 1), designed to provide adequate coverage in the event of an INEL release 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 (or about 7000 ft^3). Filters nominally sample an air volume of about 570 m^3 (20,000 ft^3).

Charcoal cartridges were screened weekly for gross (nonspecific) gamma activity. 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 Strontium-90 or transuranic radionuclides (Plutonium-238, Plutonium-239/240, and Americium-241).

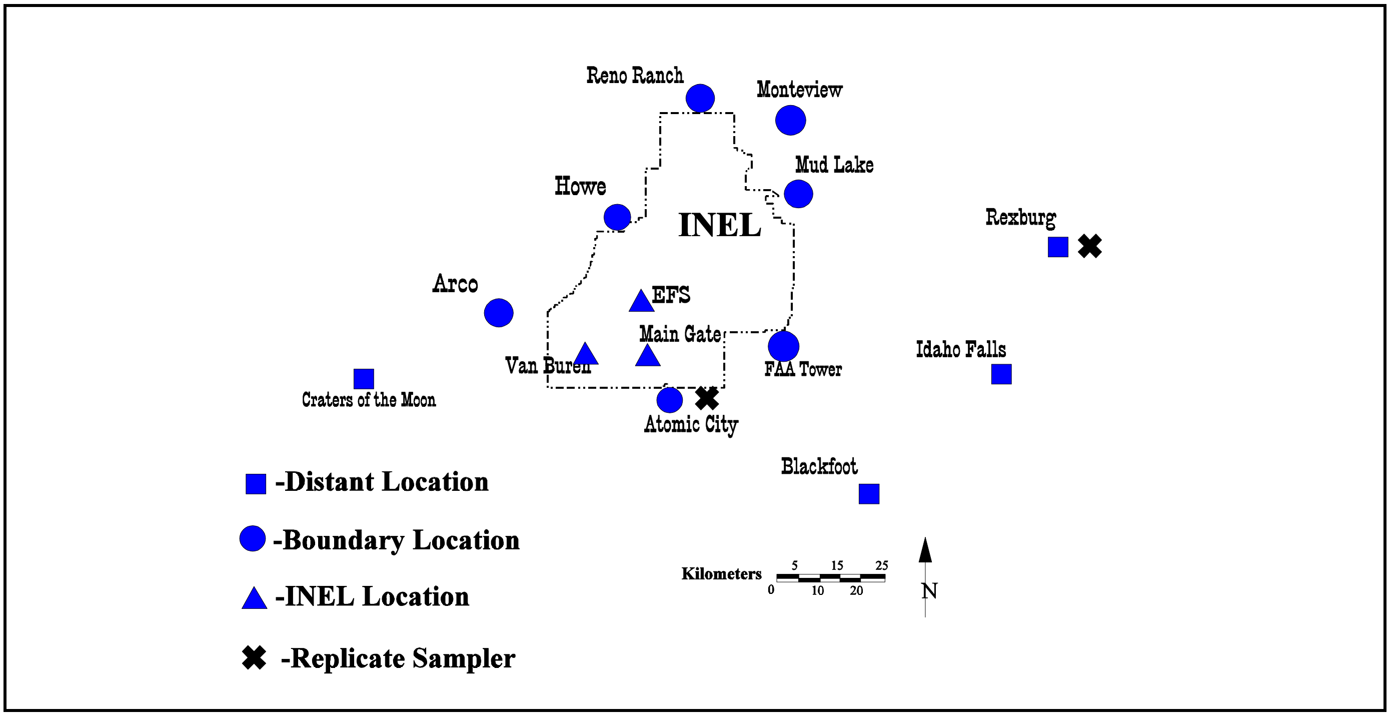

Figure 1 Air Sampling Location Map

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

No Iodine-131 was detected in any of the charcoal cartridges analyzed during the first quarter. The minimum detectable concentration for these analyses was approximately 3 x 10^{-15} µCi/ml.

Except for data from Mud Lake, all gross alpha concentrations were within the expected range of background levels (Figure 2 and Table A-1, Appendix A). Consistently low concentrations (including gross alpha, gross beta, and specific radionuclides) were noted for the Mud Lake station beginning during the fourth quarter of 1994. The Foundation is currently investigating possible causes, including investigation of possible leaks in the sampling system or intermittent flow meter malfunctions, for these low concentrations. Gross alpha concentrations ranged from -2.9 x 10^{-15} µCi/ml during the week of February 8-15 at Reno Ranch to 4.2 x 10^{-15} µCi/ml during the week of February 22 to March 1 at Monteview and Rexburg. The quarterly mean gross alpha concentrations for the onsite and boundary locations were not statistically

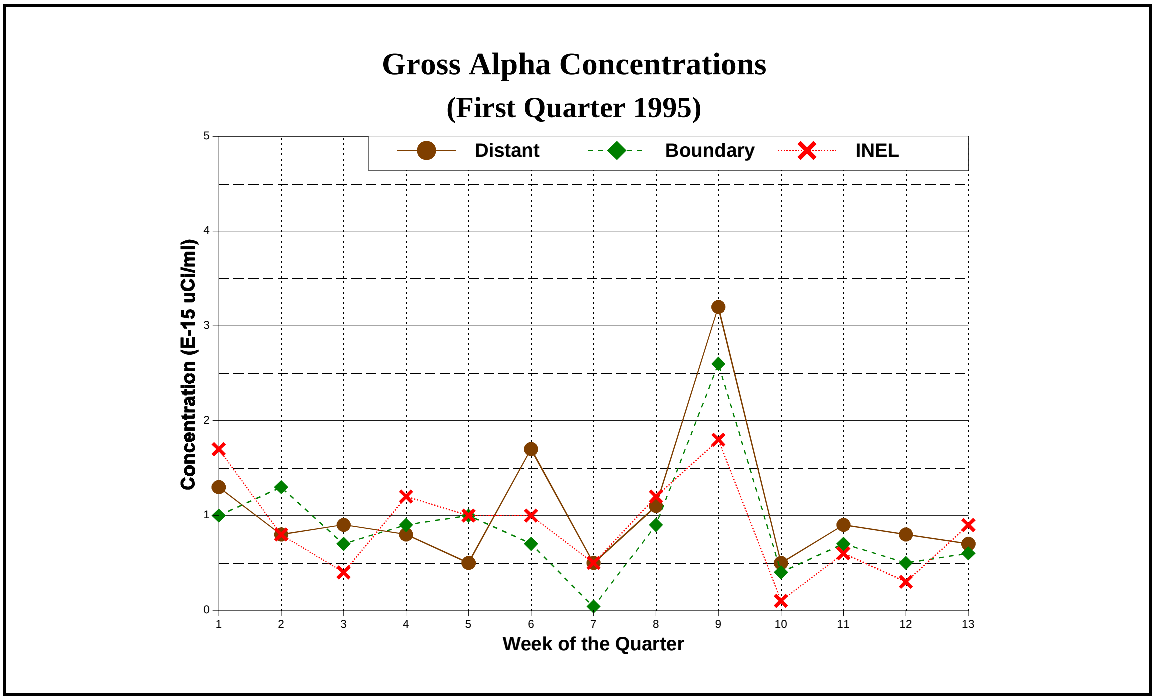

Figure 2 Weekly Gross Alpha Concentrations

higher than the mean for the distant locations: 0.9 x 10^{-15} µCi/ml (onsite), 0.9 x 10^{-15} µCi/ml (boundary), and 1.1 x 10^{-15} µCi/ml (distant). These results are summarized in Table 3. (A Student's unpaired, one-tailed t-test showed the Mud Lake mean to be statistically different from the mean of all other boundary stations grouped together. This is the reason for not including the Mud Lake data in the boundary group mean.)

Except for low gross beta concentrations found at Mud Lake (see explanation in text above), all gross beta concentrations were also within the expected range of background levels (Figure 3 and Table A-2, Appendix A). Gross beta concentrations ranged from 6 x 10^{-15} µCi/ml during the week of January 11-18 at Mud Lake to 53 x 10^{-15} µCi/ml, which occurred in several instances: during the week of January 5-11 at Monteview, and during the week of February 22 to March 1 at Blackfoot and Reno Ranch. Quarterly means of gross beta concentrations for the onsite and boundary locations were not statistically higher than the mean for the distant locations: 29 x 10^{-15} µCi/ml (onsite), 26 x 10^{-15} µCi/ml (boundary), and 27 x 10^{-15} µCi/ml (distant). The results are summarized in Table 4. (The Mud Lake values were included with the group mean, as the Mud Lake mean was not statistically different from the mean of all other boundary stations grouped together.)

The gross beta data for the Rexburg and Atomic City quality assurance replicates assisted data validation for those locations. Student's t-tests (two-tailed) indicated the Rexburg and Atomic City mean values were statistically the same as their respective replicate mean values. Correlation tests showed the Rexburg and Atomic City data correlated well with their respective replicate data.

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

Group	Location	Number of Samples	Gross Alpha Concentration ($\times 10^{-15}$ µCi/ml) Range of Samples	Mean with 95% Confidence Interval
Distant	Blackfoot	13	0.1 - 2.8	1.2 ± 0.5
	Craters of the Moon	13	-0.9 - 3.2	0.6 ± 0.6
	Idaho Falls	13	-0.5 - 2.8	1.1 ± 0.5
	Rexburg (Replicate)	13 (13)	0.5 - 4.2 (0.1 - 2.1)	1.4 ± 0.6 (1.2 ± 0.4)
			Group Mean	1.1 ± 0.3
Boundary	Arco	13	0.0 - 1.8	0.8 ± 0.3
	Atomic City (Replicate)	13 (13)	-0.3 - 2.2 (-0.3 - 1.7)	0.7 ± 0.4 (0.8 ± 0.4)
	FAA Tower	13	-0.1 - 2.1	0.8 ± 0.4
	Howe	13	-0.1 - 3.5	1.0 ± 0.6
	Monteview	13	-0.5 - 4.2	1.4 ± 0.7
	Mud Lake[a]	13	-0.2 - 1.9	0.5 ± 0.3
	Reno Ranch	12[b]	-2.9 - 2.4	0.8 ± 0.8
			Group Mean[c]	0.9 ± 0.2
INEL	EFS	13	0.3 - 2.3	1.1 ± 0.4
	Main Gate	13	-0.2 - 2.0	0.8 ± 0.4
	Van Buren	13	-0.5 - 1.9	0.8 ± 0.5
			Group Mean	0.9 ± 0.2
			DOE Derived Concentration Guide	20

a. Low values noted during quarter; see text for explanation.
b. The sample collected during January 5-11 was invalid due to insufficient sample volume. The air sampler's fuse was blown.
c. Excludes Mud Lake data; see text for explanation.

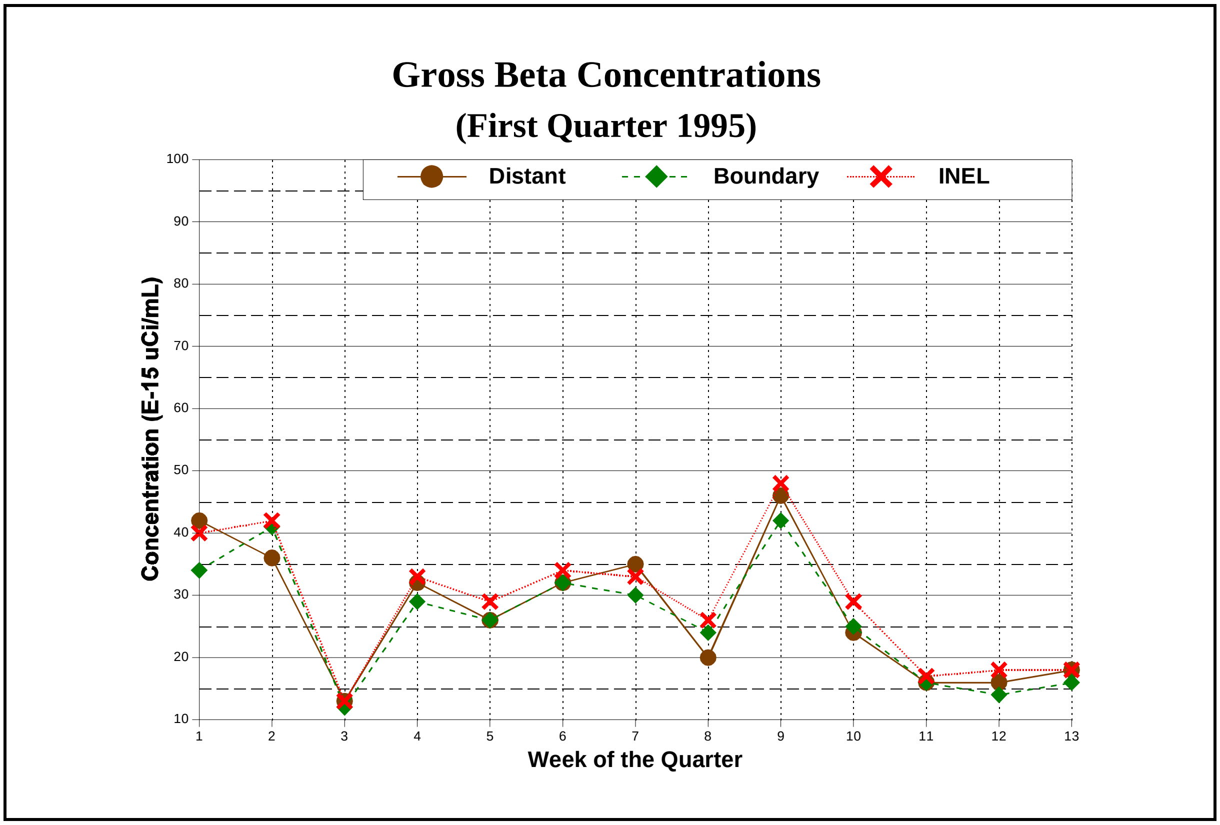

Figure 3 Weekly Gross Beta Concentrations

Beryllium-7, a naturally-occurring gamma-emitting radionuclide produced by cosmic rays in the atmosphere, was found on all but one of the quarterly composites (Table 5). Cesium-137 was detected on one composite sample from a distant station (Idaho Falls). Strontium-90 was detected on some of the samples from distant, boundary, and INEL locations (Table 5). There is no difference in ^{90}Sr levels between the distant, boundary, and INEL groups. Both Cesium-137 and Strontium-90 are sometimes detected in air samples, and their origin is attributed to residual radioactivity from above-ground nuclear weapons tests that occurred primarily in the 1950s and 1960s.

No transuranic radionuclides were detected on any of the quarterly composites. Minimum detectable concentrations were approximately 3 x 10^{-18} μCi/ml.

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

Group	Location	Number of Samples	Gross Beta Concentration ($x 10^{-15}$ µCi/ml) Range of Samples	Mean with 95% Confidence Interval
Distant	Blackfoot	13	12 - 53	30 ± 7
	Craters of the Moon	13	15 - 46	28 ± 6
	Idaho Falls	13	12 - 49	27 ± 7
	Rexburg (Replicate)	13 (13)	11 - 42 (11 - 46)	24 ± 6 (28 ± 6)
			Group Mean	27 ± 3
Boundary	Arco	13	12 - 42	24 ± 5
	Atomic City (Replicate)	13 (13)	11 - 42 (12 - 49)	28 ± 7 (28 ± 7)
	FAA Tower	13	9 - 42	25 ± 7
	Howe	13	15 - 49	31 ± 7
	Monteview	13	11 - 53	29 ± 7
	Mud Lake[a]	13	6 - 31	17 ± 4
	Reno Ranch	12[b]	14 - 53	29 ± 8
			Group Mean	26 ± 2
INEL	EFS	13	16 - 46	29 ± 6
	Main Gate	13	13 - 49	29 ± 6
	Van Buren	13	12 - 49	30 ± 7
			Group Mean	29 ± 3
			DOE Derived Concentration Guide	3000

a. Low values noted during quarter; see text for explanation.
b. The sample collected during January 5-11 was invalid due to insufficient sample volume. The sampler's fuse was blown.

2.2.2 Atmospheric Moisture Samplers

Two atmospheric moisture samples were collected during the first quarter of 1995 from both Idaho Falls and Atomic City. Tritium was detected in one sample from Idaho Falls and one from Atomic City. The tritium concentrations in air were $(6.0 \pm 1.5) \times 10^{-13}$ µCi/ml and $(8.1 \pm 2.6) \times 10^{-13}$ µCi/ml, respectively (the DCG is 1×10^{-7} µCi/ml). Since Atomic City (a boundary station) is not statistically higher than Idaho Falls (a distant station), the source is not likely from the INEL.

Tritium (mostly as tritiated water) arises from natural (cosmic ray interactions in the atmosphere) and man-made sources.

Table 5
Radionuclide Analyses for Particulate Filter Quarterly Composites[a]
(First Quarter 1995)

Location	Beryllium-7 (10^{-15} µCi/ml ± 2s)	Others Gamma Emitters Detected (10^{-15} µCi/ml ± 2s)	Strontium-90 (10^{-15} µCi/ml ± 2s)
Distant Locations			
Blackfoot	146 ± 36	None	NA[b]
Craters of the Moon	138 ± 25	None	NA
Idaho Falls	141 ± 52	Cs-137: 0.3 ± 0.2	0.02 ± 0.03
Rexburg	131 ± 55	None	0.04 ± 0.04
Rexburg Replicate	147 ± 10	None	0.05 ± 0.04
Boundary Locations			
Arco	117 ± 56	None	NA
Atomic City	130 ± 26	None	0.04 ± 0.04
Atomic City Replicate	153 ± 26	None	0.09 ± 0.04
FAA Tower	109 ± 27	None	NA
Howe	154 ± 34	None	NA
Monteview	127 ± 31	None	NA
Mud Lake	83 ± 20	None	0.04 ± 0.03
Reno Ranch	129 ± 29	None	NA
INEL Locations			
EFS	131 ± 178	None	0.06 ± 0.04
Main Gate	144 ± 26	None	NA
Van Buren	118 ± 25	None	NA
DOE Derived Concentration Guide	40,000,000	N/A	9000

a. Concentrations decay-corrected to mid-point of the quarter.
b. Not analyzed for ^{90}Sr.

2.2.3 Precipitation Samplers

Thirteen precipitation samples were collected in the first quarter. Tritium, just above the minimum detectable concentration, was detected in one of the samples from EFS, located onsite.

The result was $(1.9 \pm 1.7) \times 10^{-7}$ μCi/ml. This is within historical levels of environmental tritium, and is due primarily to contributions from nuclear weapons tests and natural atmospheric processes.

3. Water Sampling

3.1 Methods

Water samples were collected in early February from two drinking water locations and from four surface water locations in the Magic Valley area (Figure 4). Drinking water sampling locations were local businesses. Surface water locations included four springs in the Thousand Springs area--some of the outlets for the Snake River Plain Aquifer, which flows beneath the INEL (Figure 4). Each water sample was analyzed for gross (nonspecific) 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.

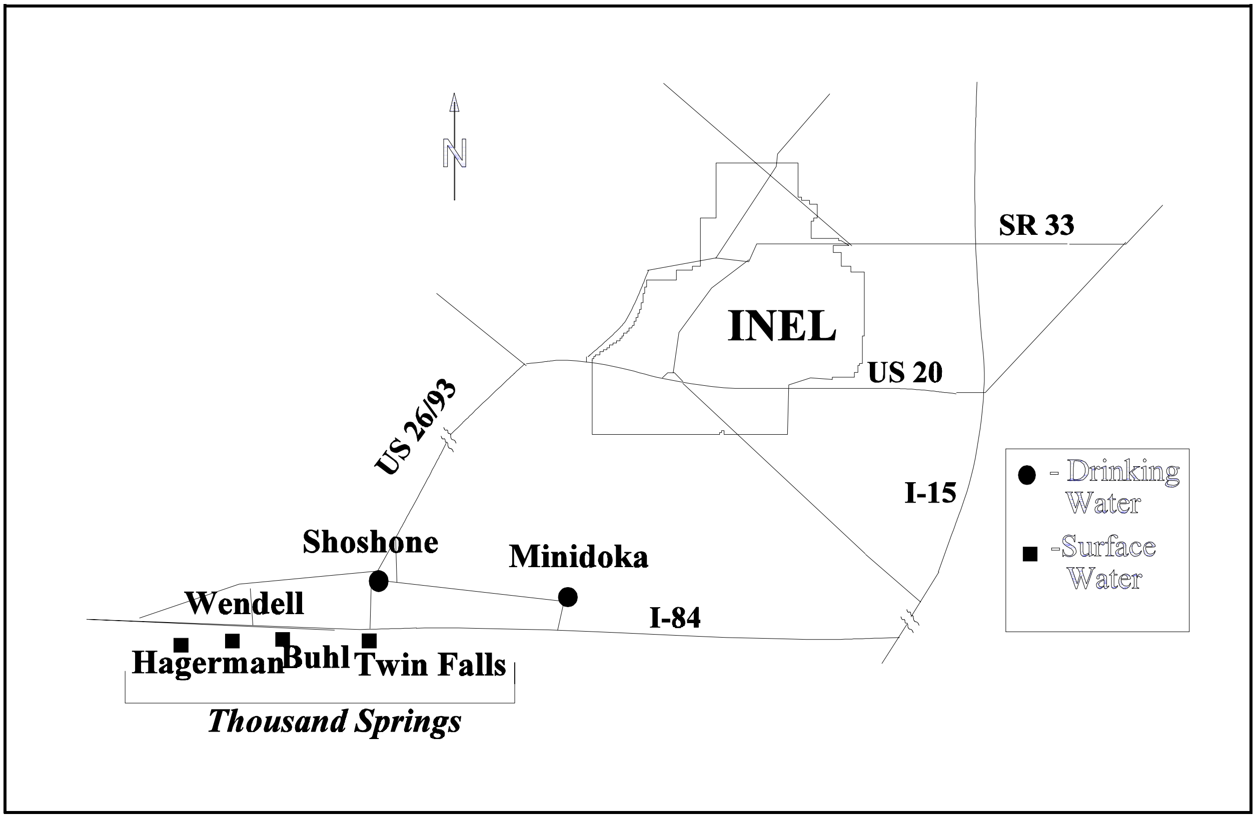

Figure 4 Quarterly Water Sampling Locations

3.2 Results

One drinking water sample, from Minidoka, showed a measurable level of tritium (Table 6). This result is just above the minimum detectable concentration (MDC) and within historical levels of tritium. Environmental tritium is due primarily to contributions from historic nuclear weapons tests and natural processes. The result is one percent of the Environmental Protection Agency's (EPA) Maximum Contaminant Level (MCL) for tritium. (Table 6 lists the MCL for each analyte of concern.) None of the water samples contained detectable concentrations of gross alpha. Concentrations of gross beta slightly above the MDC were detected at Alpheus, Hagerman, and Buhl springs. This radioactivity is attributed to naturally occurring radionuclides (primarily from the uranium and thorium decay chains) picked up by water as it travels through the earth's crust.

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

Location	Tritium (pCi/l ± 2s)	Gross Alpha (pCi/l ± 2s)	Gross Beta (pCi/l ± 2s)
Drinking Water			
Minidoka	200 ± 170	2 ± 3	1 ± 2
Shoshone	82 ± 170	2 ± 3	2 ± 2
Surface Water			
Alpheus Spring (Twin Falls)	55 ± 170	2 ± 3	3 ± 2
Alpheus Spring Replicate	-160 ± 160	4 ± 4	4 ± 2
Bill Jones Hatchery (Hagerman)	-100 ± 170	1 ± 2	5 ± 2
Clear Spring (Buhl)	-360 ± 160	1 ± 2	4 ± 2
Thousand Springs Hydro (Wendell)	-6 ± 170	1 ± 2	2 ± 2
EPA Maximum Contaminant Level (MCL)	20,000	15	50

4. Milk 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 ^{131}I energy peak.

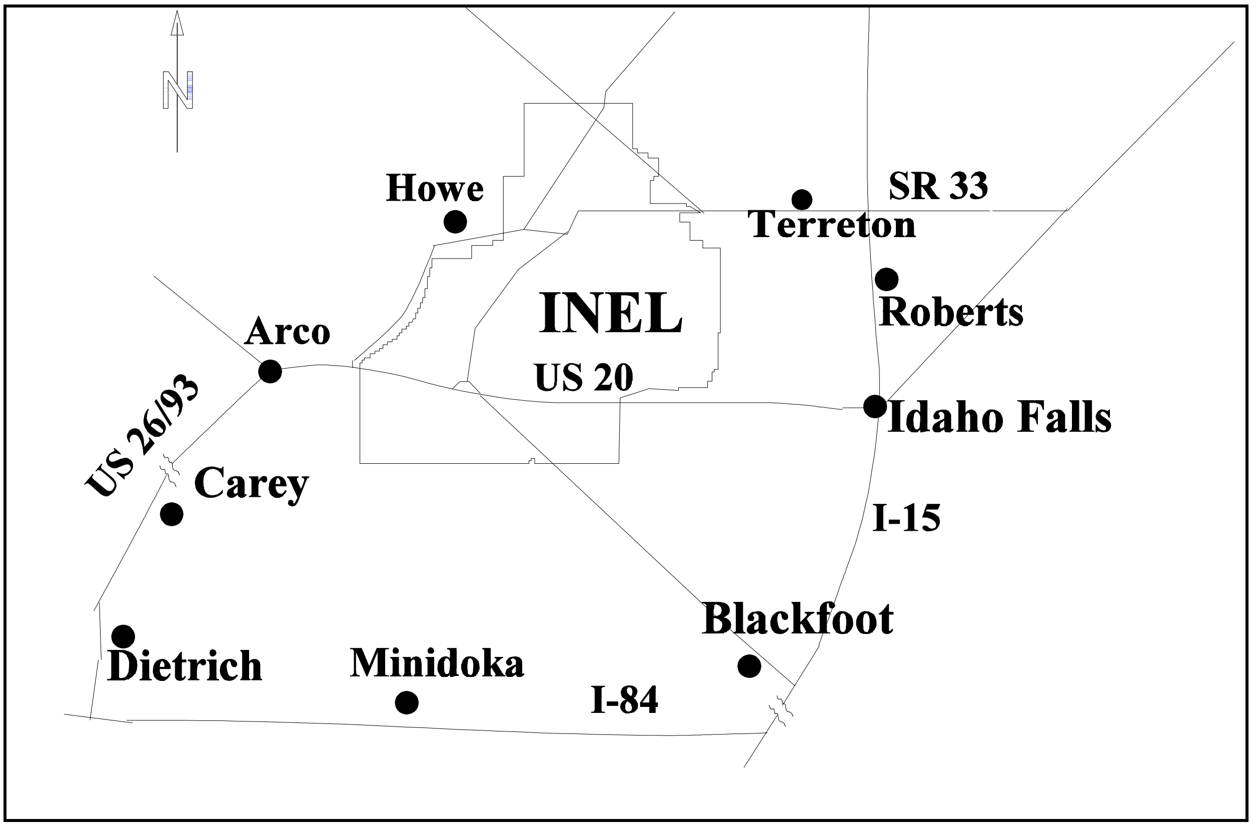

Figure 5 Milk Sampling Locations

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 1×10^{-9} μCi/ml.

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	01/05	2.5 ± 2.4
	01/11	0.4 ± 1.4
	01/18	1.7 ± 1.2
	01/25	0.1 ± 1.4
	02/01	1.5 ± 1.8
	02/08	1.1 ± 1.8
	02/15	1.3 ± 2.0
	02/22	1.0 ± 1.4
	03/01	2.8 ± 1.8
	03/08	0.1 ± 1.8
	03/15	1.2 ± 1.8
	03/22	0.2 ± 1.4
	03/29	0.3 ± 1.0
Craters of the Moon	01/05	1.2 ± 1.2
	01/11	0.7 ± 1.2
	01/18	0.3 ± 0.7
	01/25	-0.7 ± 1.4
	02/01	-0.3 ± 1.2
	02/08	1.5 ± 1.6
	02/15	0.0 ± 1.3
	02/22	1.1 ± 1.3
	03/01	3.2 ± 1.8
	03/08	-0.9 ± 1.4
	03/15	-0.1 ± 1.1
	03/22	0.3 ± 1.3
	03/29	-0.1 ± 0.8
Idaho Falls	01/05	1.0 ± 1.1
	01/11	1.1 ± 1.3
	01/18	0.7 ± 0.7
	01/25	-0.8 ± 1.6
	02/01	-0.1 ± 1.3
	02/08	1.4 ± 1.5
	02/15	-0.5 ± 1.0
	02/22	1.3 ± 1.2
	03/01	2.8 ± 1.6
	03/08	2.3 ± 1.8
	03/15	1.3 ± 1.5

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/22	1.5 ± 1.5
	03/29	0.8 ± 1.1
Rexburg (Replicate)	01/05	0.6 ± 1.0 (1.8 ± 1.4)
	01/11	1.2 ± 1.4 (1.3 ± 1.6)
	01/18	1.0 ± 0.8 (0.7 ± 0.8)
	01/25	0.1 ± 1.5 (1.3 ± 2.4)
	02/01	0.8 ± 1.6 (0.5 ± 1.5)
	02/08	2.7 ± 1.9 (1.8 ± 1.8)
	02/15	1.1 ± 1.4 (1.6 ± 1.7)
	02/22	1.1 ± 1.2 (0.9 ± 1.3)
	03/01	4.2 ± 1.9 (2.1 ± 1.5)
	03/08	0.5 ± 1.8 (2.0 ± 2.3)
	03/15	1.1 ± 1.3 (0.1 ± 1.1)
	03/22	1.1 ± 1.3 (0.1 ± 1.2)
	03/29	1.9 ± 1.3 (1.0 ± 1.1)
	Boundary Locations	
Arco	01/05	1.2 ± 1.1
	01/11	0.9 ± 1.3
	01/18	0.6 ± 0.7
	01/25	0.4 ± 1.2
	02/01	1.0 ± 1.4
	02/08	-0.03 ± 1.1
	02/15	1.1 ± 1.3
	02/22	0.3 ± 0.8
	03/01	1.8 ± 1.3
	03/08	0.05 ± 1.1
	03/15	0.6 ± 1.0
	03/22	0.2 ± 0.9
	03/29	1.1 ± 1.0
Atomic City (Replicate)	01/05	0.8 ± 1.1 (1.6 ± 1.4)
	01/11	0.8 ± 1.3 (1.3 ± 1.4)
	01/18	1.0 ± 0.9 (0.2 ± 0.6)
	01/25	0.3 ± 1.3 (-0.5 ± 1.6)
	02/01	0.8 ± 1.5 (-0.1 ± 1.0)
	02/08	0.5 ± 1.3 (0.5 ± 1.2)
	02/15	1.2 ± 1.6 (0.5 ± 1.3)
	02/22	0.3 ± 0.9 (1.4 ± 1.6)
	03/01	2.2 ± 1.5 (1.7 ± 1.3)

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/08	-0.1 ± 1.5 (-0.3 ± 1.3)
	03/15	0.8 ± 1.3 (1.3 ± 1.4)
	03/22	0.2 ± 1.2 (0.0 ± 1.1)
	03/29	-0.3 ± 0.6 (1.3 ± 1.3)
FAA Tower	01/05	0.5 ± 1.1
	01/11	0.8 ± 1.4
	01/18	1.0 ± 0.9
	01/25	0.1 ± 1.8
	02/01	-0.1 ± 1.4
	02/08	0.6 ± 1.6
	02/15	0.4 ± 1.5
	02/22	0.6 ± 1.0
	03/01	2.1 ± 1.5
	03/08	0.3 ± 2.0
	03/15	1.3 ± 1.8
	03/22	0.2 ± 1.6
	03/29	1.3 ± 1.6
Howe	01/05	1.1 ± 1.6
	01/11	1.9 ± 2.0
	01/18	0.6 ± 1.1
	01/25	-0.3 ± 1.4
	02/01	0.4 ± 1.8
	02/08	0.9 ± 1.4
	02/15	0.7 ± 1.5
	02/22	1.7 ± 1.3
	03/01	3.5 ± 1.8
	03/08	0.2 ± 1.5
	03/15	-0.1 ± 1.1
	03/22	1.0 ± 1.4
	03/29	0.4 ± 1.0
Monteview	01/05	1.4 ± 1.3
	01/11	1.9 ± 1.7
	01/18	0.8 ± 0.8
	01/25	-0.6 ± 1.1
	02/01	2.7 ± 2.1
	02/08	1.7 ± 1.6
	02/15	-0.5 ± 1.0
	02/22	2.2 ± 1.3

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/01	4.2 ± 1.8
	03/08	1.3 ± 1.6
	03/15	0.7 ± 1.2
	03/22	1.0 ± 1.3
	03/29	0.5 ± 0.9
Mud Lake	01/05	0.4 ± 0.8
	01/11	1.3 ± 1.3
	01/18	0.1 ± 0.5
	01/25	0.1 ± 1.6
	02/01	0.5 ± 1.1
	02/08	0.3 ± 1.1
	02/15	0.3 ± 1.1
	02/22	-0.1 ± 0.6
	03/01	1.9 ± 1.3
	03/08	0.3 ± 1.3
	03/15	0.4 ± 1.1
	03/22	-0.2 ± 0.9
	03/29	0.5 ± 0.9
Reno Ranch	01/05	1.4 ± 1.3
	01/11	invalid sample
	01/18	0.7 ± 0.8
	01/25	0.1 ± 1.3
	02/01	1.4 ± 1.6
	02/08	0.7 ± 1.3
	02/15	-2.9 ± 3.1
	02/22	1.6 ± 1.4
	03/01	2.4 ± 1.5
	03/08	0.4 ± 1.4
	03/15	1.2 ± 1.9
	03/22	0.8 ± 1.3
	03/29	0.6 ± 1.1
	INEL Locations	
Main Gate	01/05	2.0 ± 1.4
	01/11	0.5 ± 1.1
	01/18	0.3 ± 0.7
	01/25	0.7 ± 1.6
	02/01	0.5 ± 1.3
	02/08	0.7 ± 1.4

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	02/15	0.3 ± 1.2
	02/22	1.3 ± 1.2
	03/01	1.9 ± 1.3
	03/08	0.4 ± 1.4
	03/15	0.8 ± 1.3
	03/22	-0.2 ± 1.0
	03/29	0.2 ± 0.8
EFS	01/05	1.7 ± 1.3
	01/11	0.3 ± 1.0
	01/18	0.7 ± 0.8
	01/25	0.5 ± 1.7
	02/01	0.6 ± 1.3
	02/08	1.7 ± 1.6
	02/15	0.5 ± 1.2
	02/22	2.3 ± 1.3
	03/01	1.7 ± 1.2
	03/08	0.4 ± 1.4
	03/15	1.2 ± 1.3
	03/22	0.8 ± 1.3
	03/29	0.8 ± 1.1
Van Buren	01/05	1.5 ± 1.4
	01/11	1.6 ± 1.7
	01/18	0.2 ± 0.7
	01/25	0.3 ± 1.3
	02/01	1.8 ± 1.8
	02/08	0.6 ± 1.6
	02/15	0.6 ± 1.6
	02/22	0.1 ± 1.0
	03/01	1.9 ± 1.6
	03/08	-0.5 ± 1.6
	03/15	-0.1 ± 1.3
	03/22	0.4 ± 1.5
	03/29	1.6 ± 1.5

Table A-2
Weekly Gross Beta Concentrations in Air

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	Distant Locations	
Blackfoot	01/05	39 ± 8
	01/11	33 ± 6
	01/18	12 ± 4
	01/25	33 ± 3
	02/01	30 ± 6
	02/08	35 ± 6
	02/15	42 ± 6
	02/22	24 ± 5
	03/01	53 ± 7
	03/08	25 ± 5
	03/15	22 ± 5
	03/22	16 ± 4
	03/29	22 ± 5
Craters of the Moon	01/05	46 ± 6
	01/11	31 ± 6
	01/18	16 ± 4
	01/25	36 ± 5
	02/01	25 ± 5
	02/08	30 ± 5
	02/15	35 ± 5
	02/22	19 ± 4
	03/01	46 ± 6
	03/08	25 ± 5
	03/15	16 ± 4
	03/22	15 ± 4
	03/29	22 ± 4
Idaho Falls	01/05	49 ± 6
	01/11	39 ± 6
	01/18	13 ± 3
	01/25	44 ± 12
	02/01	25 ± 5
	02/08	35 ± 5
	02/15	35 ± 5
	02/22	18 ± 4
	03/01	42 ± 6
	03/08	23 ± 5
	03/15	12 ± 4

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} μCi/ml)
	03/22	16 ± 4
	03/29	14 ± 4
Rexburg (Replicate)	01/05	32 ± 5 (28 ± 5)
	01/11	39 ± 6 (46 ± 7)
	01/18	11 ± 3 (11 ± 3)
	01/25	22 ± 4 (32 ± 5)
	02/01	24 ± 5 (23 ± 5)
	02/08	26 ± 5 (35 ± 6)
	02/15	28 ± 4 (35 ± 5)
	02/22	20 ± 4 (20 ± 4)
	03/01	42 ± 6 (42 ± 6)
	03/08	24 ± 5 (35 ± 6)
	03/15	15 ± 4 (20 ± 4)
	03/22	18 ± 4 (22 ± 4)
	03/29	16 ± 4 (18 ± 4)
	Boundary Locations	
Arco	01/05	31 ± 5
	01/11	42 ± 6
	01/18	15 ± 3
	01/25	17 ± 4
	02/01	30 ± 5
	02/08	28 ± 5
	02/15	28 ± 4
	02/22	23 ± 4
	03/01	30 ± 5
	03/08	20 ± 4
	03/15	12 ± 3
	03/22	15 ± 3
	03/29	13 ± 3
Atomic City (Replicate)	01/05	35 ± 5 (35 ± 6)
	01/11	42 ± 6 (42 ± 6)
	01/18	11 ± 3 (12 ± 3)
	01/25	28 ± 5 (37 ± 5)
	02/01	29 ± 5 (24 ± 4)
	02/08	39 ± 5 (33 ± 5)
	02/15	39 ± 5 (31 ± 5)
	02/22	28 ± 5 (35 ± 6)
	03/01	42 ± 6 (49 ± 6)

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/08	24 ± 5 (25 ± 4)
	03/15	15 ± 4 (13 ± 4)
	03/22	17 ± 4 (16 ± 4)
	03/29	14 ± 4 (19 ± 4)
FAA	01/05	35 ± 6
Tower	01/11	39 ± 6
	01/18	11 ± 3
	01/25	41 ± 5
	02/01	28 ± 5
	02/08	31 ± 6
	02/15	9 ± 3
	02/22	21 ± 4
	03/01	42 ± 6
	03/08	25 ± 6
	03/15	15 ± 5
	03/22	16 ± 5
	03/29	15 ± 4
Howe	01/05	42 ± 7
	01/11	46 ± 8
	01/18	15 ± 4
	01/25	26 ± 6
	02/01	31 ± 6
	02/08	33 ± 5
	02/15	42 ± 6
	02/22	26 ± 5
	03/01	49 ± 6
	03/08	31 ± 5
	03/15	18 ± 4
	03/22	16 ± 22
	03/29	20 ± 4
Monteview	01/05	33 ± 5
	01/11	53 ± 7
	01/18	14 ± 3
	01/25	18 ± 4
	02/01	25 ± 6
	02/08	35 ± 5
	02/15	30 ± 5
	02/22	25 ± 4

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/01	46 ± 6
	03/08	32 ± 5
	03/15	22 ± 4
	03/22	11 ± 3
	03/29	19 ± 4
Mud Lake	01/05	23 ± 4
	01/11	25 ± 4
	01/18	6 ± 2
	01/25	25 ± 5
	02/01	13 ± 3
	02/08	21 ± 4
	02/15	22 ± 4
	02/22	14 ± 3
	03/01	31 ± 5
	03/08	16 ± 4
	03/15	12 ± 3
	03/22	9 ± 3
	03/29	12 ± 3
Reno	01/05	39 ± 5
Ranch	01/11	invalid sample
	01/18	14 ± 3
	01/25	26 ± 4
	02/01	26 ± 5
	02/08	35 ± 5
	02/15	42 ± 11
	02/22	32 ± 5
	03/01	53 ± 6
	03/08	27 ± 5
	03/15	20 ± 6
	03/22	14 ± 4
	03/29	16 ± 4
	INEL Locations	
Main Gate	01/05	42 ± 6
	01/11	35 ± 6
	01/18	13 ± 3
	01/25	38 ± 6
	02/01	31 ± 5
	02/08	35 ± 5

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml
	02/15	30 ± 5
	02/22	23 ± 4
	03/01	49 ± 6
	03/08	26 ± 4
	03/15	20 ± 4
	03/22	20 ± 4
	03/29	19 ± 4
EFS	01/05	39 ± 6
	01/11	46 ± 6
	01/18	16 ± 3
	01/25	39 ± 5
	02/01	27 ± 5
	02/08	33 ± 5
	02/15	34 ± 5
	02/22	29 ± 5
	03/01	46 ± 6
	03/08	31 ± 5
	03/15	16 ± 4
	03/22	17 ± 4
	03/29	17 ± 4
Van Buren	01/05	39 ± 6
	01/11	46 ± 7
	01/18	12 ± 3
	01/25	26 ± 4
	02/01	29 ± 5
	02/08	35 ± 6
	02/15	34 ± 5
	02/22	27 ± 5
	03/01	49 ± 7
	03/08	30 ± 5
	03/15	16 ± 4
	03/22	17 ± 4
	03/29	17 ± 4