ESRF-016(1QT96)

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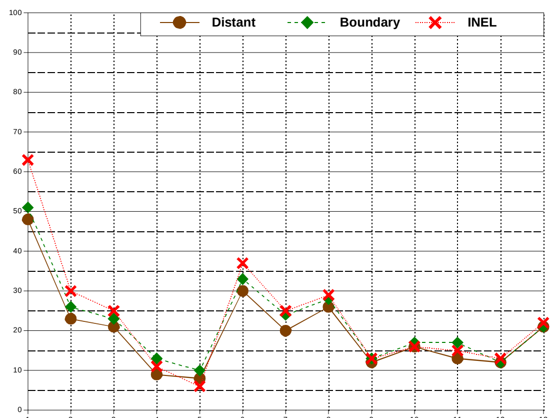

Environmental Science and Research Foundation
November 1996

ENVIRONMENTAL SCIENCE & RESEARCH FOUNDATION REPORT SERIES, NUMBER 016(1QT96)
ISSN 1089-5469

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Program conducted for the U.S. Department of Energy, Idaho Operations Office
Under Contract DE-AC07-94ID13268 by the
Environmental Science and Research Foundation
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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 collect data 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 1996 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. 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 are 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 eight 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 two offsite locations and surface water samples were obtained from three 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.

Summary of First Quarter 1996 Results

During the first quarter of 1996, gross alpha and gross beta concentrations in low-volume air samples were within the expected range of values for 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 sample. Strontium-90 was found on air filter composites at three offsite locations. The presence of Strontium-90 is attributed to historic, above-ground nuclear weapons testing. Americium-241 was detected at one onsite location at just above the minimum detectable concentration. No Plutonium-238 or Plutonium-239/240 were detected at any location.

Tritium was detected in one of four atmospheric moisture samples. The tritium, detected in a sample from a distant station, was attributed to historic, above-ground nuclear weapons tests and natural atmospheric processes.

Tritium, just above the minimum detectable concentration, was found in two of 10 precipitation samples. Both samples were from an onsite location. A potential source from the INEL was not identified.

Tritium was not found in any of the five offsite water samples. None of the samples contained detectable levels of gross alpha. Some of the samples contained levels of gross beta just above the minimum detectable concentration. Gross beta radioactivity in these water samples 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.

Helpful Information for Readers

Radionuclide Nomenclature

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

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 defined as the amount of radioactivity equivalent to 37 billion nuclear transformations per second. Historically, this was based upon the radioactivity from one gram of the radionuclide Radium-226. For any other radionuclide, one curie is the amount of that radionuclide that decays at this same rate.

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

Units of Environmental Concentrations

Concentration of radioactivity in air and milk samples 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). Not all of the above sample types may appear in this particular report.

Uncertainty of Measurements

Due to many variables, there is always an uncertainty associated with the measurement of environmental contaminants. For radioactivity, the predominant source of uncertainty is due to the inherent statistical nature of radioactive decay events, particularly at the low activity levels encountered in environmental samples. The uncertainty of a measurement is denoted by following the result with a "±" (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, 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 January 1 through March 31, 1996. 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 large portion of environmental results are near background levels of radioactivity; many results are near the detection limits of the laboratory procedures. [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.] All results are reported with an associated 2s ("two sigma") uncertainty term. The Foundation has adopted the following method for interpreting analytical results near the minimum detectable concentration. 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.

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 Approximate Minimum Detectable Concentrations for Radiological Analyses
(First Quarter 1996)

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	3 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	--	--

a. The MDC is an estimate of the concentration of radioactivity in a given sample type that can be identified with a 95% level of confidence and a precision of plus or minus 100% under a specified set of typical laboratory measurement conditions.
b. DCGs, set by the DOE, represent reference values for radiation exposure. They are based on a radiation dose of 100 mrem/yr for exposure through a particular exposure mode such as direct exposure, inhalation, or ingestion of water.
c. These limits are required by the National Primary Drinking Water Regulations (40 CFR 141). The "detection limit" is the terminology used by the EPA and means the same as the MDC defined above.
d. The approximate MDC is based on an average filtered air volume (pressure corrected) of 570 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 Mud Lake and the INEL Main Gate, were operated adjacent to regular air samplers to provide data comparison as a check on data quality. At the end of 1995, the replicate samplers were moved from their former locations at Rexburg and Atomic City.

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 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 was detected in any batch that was greater than a preset action level, individual cartridges were 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 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).

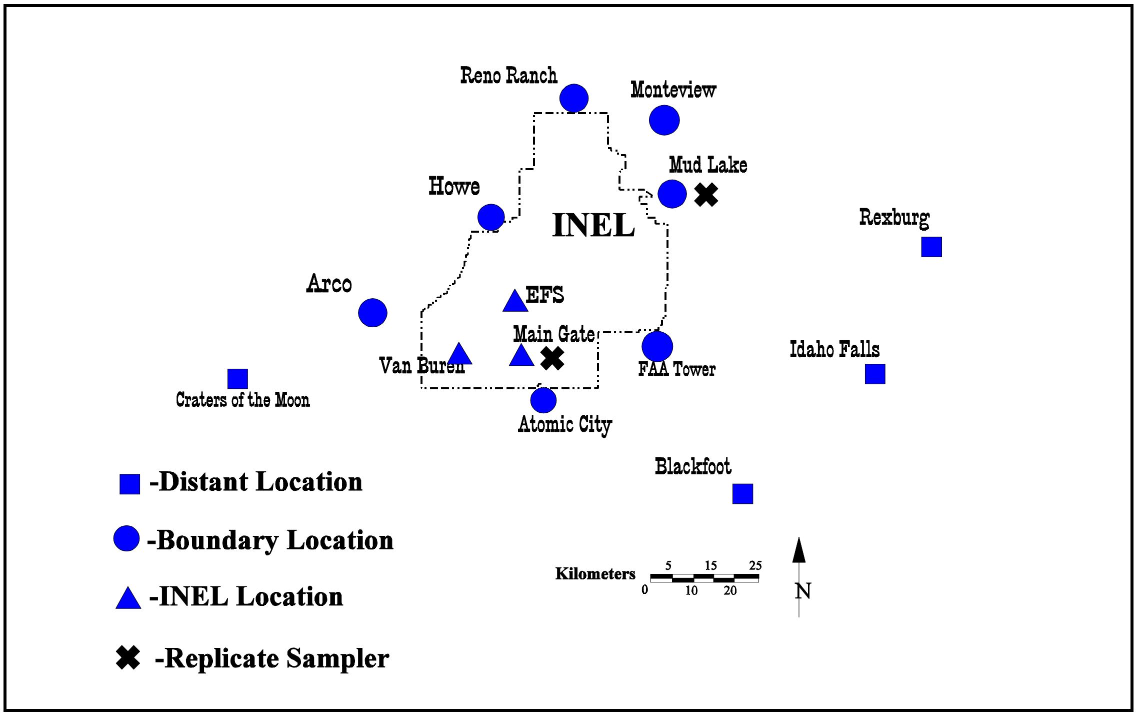

Figure 1 Air Sampling Location Map

2.1.2 Atmospheric Moisture Samplers

Two air samplers, located in Atomic City and Idaho Falls, collected 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 the water sample 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 ^{131}I was detected in any of the weekly charcoal cartridge batches analyzed during the first quarter, thus no analyses of individual cartridges were required. The minimum detectable concentration was approximately 3 x 10^{-15} µCi/ml.

All gross alpha concentrations were within the expected range of background levels (data summaries are presented in Figure 2, Table 3, and Table A-1). Figure 2 indicates that the levels of airborne radioactivity for the three groups of stations (distant, boundary, and INEL) are similar, within uncertainty limits, and track each other quite closely over the 13 weeks. This is an indication that the fluctuations occurred over the entire sampling network and are therefore not likely caused by a localized source such as a facility at the INEL. Table 3 indicates the mean gross alpha concentration for Mud Lake and the replicate are higher than for the other boundary stations. However, comparison with the distant stations, particularly Rexburg, indicates background levels of gross alpha were not exceeded 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 (see Table 3).

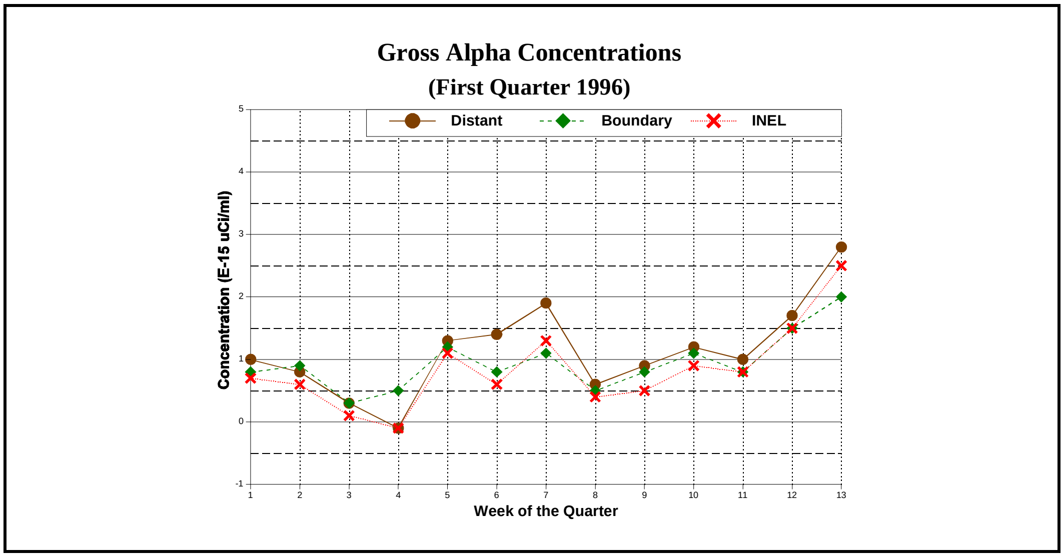

Figure 2 Weekly Gross Alpha Concentrations

Table 3
Gross Alpha Concentrations in Air
(First Quarter 1996)

Group	Location	Number of Samples	Gross Alpha Concentration ($x 10^{-15}$ µCi/ml) Range of Samples	Mean with 95% Confidence Interval
Distant	Blackfoot	13	-0.2 - 2.0	1.2 ± 0.3
	Craters of the Moon	12	0.0 - 2.1	0.7 ± 0.4
	Idaho Falls	13	-0.2 - 3.2	1.1 ± 0.5
	Rexburg	13	-0.2 - 3.7	1.5 ± 0.6
			Group Mean	**1.1 ± 0.2**
Boundary	Arco	13	0.0 - 2.2	0.9 ± 0.3
	Atomic City	13	0.0 - 2.6	0.9 ± 0.4
	FAA Tower	13	0.0 - 2.3	0.9 ± 0.4
	Howe	13	-0.1 - 1.9	0.9 ± 0.4
	Monteview	13	-0.1 - 2.0	0.8 ± 0.4
	Mud Lake (Replicate)	13 (13)	0.4 - 2.6 (-0.3 - 3.0)	1.4 ± 0.4 (1.2 ± 0.5)
	Reno Ranch	13	0.1 - 1.8	0.9 ± 0.3
			Group Mean	**1.0 ± 0.1**
INEL	EFS	13	-0.2 - 2.7	0.9 ± 0.5
	Main Gate (Replicate)	13 (13)	-0.2 - 2.0 (-0.5 - 2.0)	0.8 ± 0.4 (0.7 ± 0.4)
	Van Buren	13	-0.4 - 2.8	0.8 ± 0.4
			Group Mean	**0.8 ± 0.2**
		DOE Derived Concentration Guide		20

All gross beta concentrations were also within the expected range of background levels (data summaries are presented in Figure 3, Table 4, and Table A-2). Figure 3 indicates that the levels of airborne radioactivity for the three groups of stations (distant, boundary, and INEL) are similar, within uncertainty limits, and closely track each other over the 13 weeks. This is an indication that the fluctuations occurred over the entire sampling network and are therefore not likely caused by a localized source such as a facility at the INEL. Table 4, however, indicates a possible localized impact in the Mud Lake area, since the mean gross beta concentration for Mud Lake and the replicate are higher than for the other boundary stations and the distant stations. This was confirmed, at the 95% confidence level, by a one-tailed Student's t-test. However, the quarterly composite results, described below, do not give a definitive indication of the presence of beta-emitting radionuclides, such as ^{90}Sr, at higher concentrations at Mud Lake, since the replicate sample yielded no detectable ^{90}Sr (see Table 5). In addition, ^{137}Cs, a contributor to beta radiation, was not dectectable in either the Mud Lake or replicate samples. Quarterly means of gross beta concentrations for

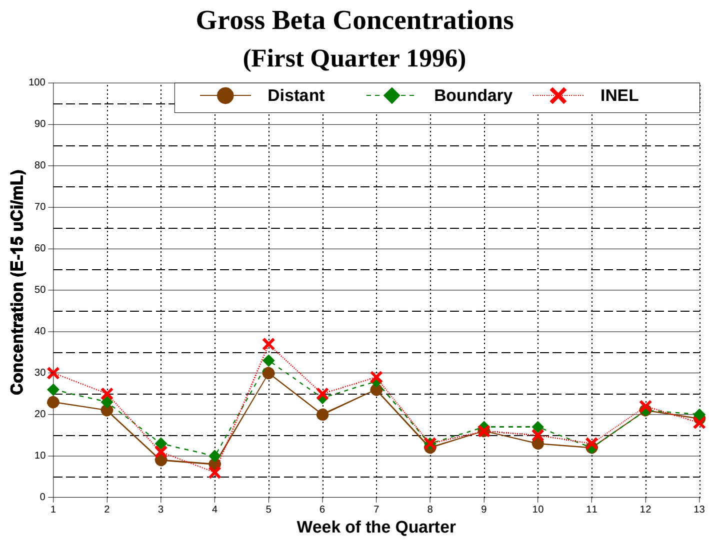

Figure 3 Weekly Gross Beta Concentrations

the onsite and boundary locations were not statistically higher than the mean for the distant locations (see Table 4).

Both the gross alpha and gross beta data for the Mud Lake and Main Gate quality assurance replicates assisted in data validation. The Mud Lake and Main Gate mean values were not statistically different from their respective replicate mean values (see Tables 3 and 4). Linear correlation tests indicated the Mud Lake and Main Gate weekly gross alpha and gross beta results correlated well at the 95% confidence level with their respective replicate results[1].

Quarterly composite samples from all sampling stations were analyzed for gamma-emitting radionuclides. Beryllium-7, a naturally-occurring gamma-emitting radionuclide produced by cosmic rays in the atmosphere, was detected in all of the composites. Cesium-137, sometimes detected on composite samples and whose presence is generally attributed to fallout from nuclear weapons, was not detected in any of the samples.

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[1] For Mud Lake, $r_\alpha = 0.67$ and $r_\beta = 0.90$ (n = 13); for the Main Gate, $r_\alpha = 0.81$ and $r_\beta = 0.88$ (n = 13).

Table 4
Gross Beta Concentrations in Air
(First Quarter 1996)

Group	Location	Number of Samples	Gross Beta Concentration ($x 10^{-15}$ µCi/ml) Range of Samples	Mean with 95% Confidence Interval
Distant	Blackfoot	13	9 - 27	18 ± 4
	Craters of the Moon	12	5 - 33	15 ± 5
	Idaho Falls	13	4 - 39	19 ± 5
	Rexburg	13	9 - 32	18 ± 4
			Group Mean	**18 ± 2**
Boundary	Arco	13	9 - 29	17 ± 4
	Atomic City	13	8 - 30	19 ± 4
	FAA Tower	13	8 - 32	17 ± 4
	Howe	13	12 - 39	21 ± 5
	Monteview	13	4 - 29	19 ± 4
	Mud Lake (Replicate)	13 (13)	13 - 47 (13 - 44)	25 ± 6 (24 ± 5)
	Reno Ranch	13	9 - 30	19 ± 4
			Group Mean	**20 ± 2**
INEL	EFS	13	8 - 41	20 ± 6
	Main Gate (Replicate)	13 (13)	6 - 32 (11 - 37)	20 ± 5 (20 ± 5)
	Van Buren	13	2 - 37	20 ± 6
			Group Mean	**20 ± 3**
			DOE Derived Concentration Guide	3000

Several composite samples were also selected for analysis of ^{90}Sr and transuranics of interest (^{241}Am, ^{238}Pu, and $^{239/240}$Pu). As Table 5 indicates, ^{90}Sr was detected at one distant and two boundary stations. The highest level occurred at Mud Lake; however, no ^{90}Sr was detected in the Mud Lake replicate sample. Since ^{90}Sr occurs at widespread locations, including distant stations, these results, at these levels, are likely due to fallout from historic, above-ground nuclear weapons tests.

Americium-241 was found, at a barely detectable concentration, at one INEL location (Table 5). No ^{241}Am was detected in the replicate sample. These results would indicate that the positive result may be due to statistical variations which are always present in radiological analyses. Detectable concentrations of ^{241}Am were also seen in some samples in the third and fourth quarters of 1995, although

Table 5
Manmade Radionuclides in Particulate Filter Quarterly Composites
(First Quarter 1996)

^{90}Sr	
Location	**(10^{-17} µCi/ml ± 2s)**
Distant Locations	
Rexburg	6.8 ± 5.0
Not Detected: Idaho Falls	
Boundary Locations	
Atomic City	9.2 ± 4.4
Mud Lake	16.4 ± 6.0
Not Detected: Mud Lake replicate	
INEL Locations	
Not Detected: EFS	
DOE Derived Concentration Guide	900,000

Transuranic Radionuclides

Location	**^{241}Am (10^{-18} µCi/ml ± 2s)**	**^{238}Pu (10^{-18} µCi/ml ± 2s)**	**$^{239/240}Pu$ (10^{-18} µCi/ml ± 2s)**
Distant Locations			
Craters of the Moon	Not Detected	Not Detected	Not Detected
Blackfoot	Not Detected	Not Detected	Not Detected
Boundary Locations			
Arco	Not Detected	Not Detected	Not Detected
Monteview	Not Detected	Not Detected	Not Detected
INEL Location			
Main Gate	2.5 ± 2.4	Not Detected	Not Detected
Replicate	Not Detected	Not Detected	Not Detected
DOE Derived Concentration Guide	20,000	30,000	20,000

only at boundary and distant stations. The ^{241}Am results will continue to be monitored to identify any trends.

No ^{238}Pu or $^{239/240}Pu$ were detected on any of the first quarter composite samples.

2.2.2 Atmospheric Moisture Samplers

Two samples, collected during the last portion of the fourth quarter of 1995 and the first portion of the first quarter of 1996, were obtained from each sampling location: Idaho Falls and Atomic City. Neither sample contained a detectable concentration of tritium. Atmospheric moisture samples were also obtained from these same two locations in April 1996, representing moisture collected between February and April. The sample from Idaho Falls contained detectable tritium: $(1.0 \pm 0.8) \times 10^{-13}$ µCi/ml. Atmospheric tritium detected at stations distant from the INEL, such as Idaho Falls, is likely due to both natural sources (cosmic ray interactions in the atmosphere) and manmade sources (historic nuclear weapons testing).

2.2.3 Precipitation Samplers

Ten precipitation samples were collected in the first quarter and analyzed for tritium. Tritium was detected in two samples, both from the onsite sampling location at EFS (Experimental Field Station). Detectable concentrations were $(2.4 \pm 1.0) \times 10^{-7}$ µCi/ml (collected in January) and $(1.4 \pm 1.0) \times 10^{-7}$ µCi/ml (collected in March). Although tritium attributable to airborne releases from ICPP operations at the INEL was found in several onsite precipitation samples a few years ago, no INEL source was confirmed for these occurrences of detectable tritium. Environmental tritium may also be due to natural atmospheric processes and historic nuclear weapons testing.

Environmental Technician Larry Ingram (l) collects a water sample in the Thousand Springs area with Flint Hall of the State's Oversight Program.

3. Water Sampling

3.1 Methods

Water samples were collected in early February from two drinking water locations and three surface water locations in the Magic Valley area (see Figure 4). Drinking water sampling locations were local businesses. Surface water locations included three springs in the Thousand Springs area. These springs are 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.

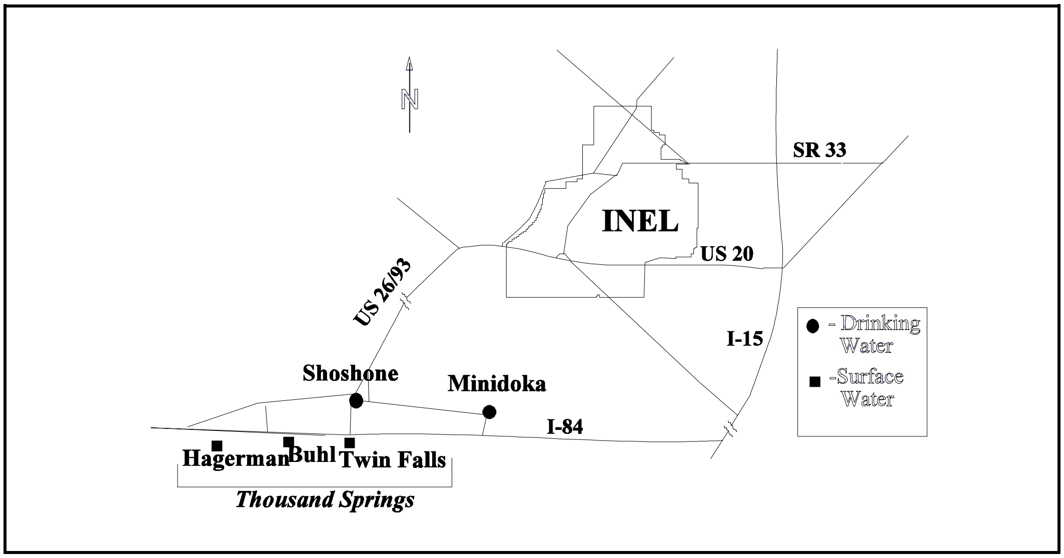

Figure 4 Water Sampling Locations

3.2 Results

None of the water samples showed a measurable concentration of tritium (Table 6). None of the water samples contained a detectable concentration of gross alpha; half of the samples contained detectable gross beta concentrations. At these levels, radioactivity in water samples is generally attributed to naturally occurring decay products, primarily from primordial deposits of uranium and thorium, picked up by water as it travels through the earth's crust.

Table 6
Radionuclide Concentrations in Offsite Water Samples
(First Quarter 1996)

Location	^{3}H (pCi/l ± 2s)	Gross Alpha (pCi/l ± 2s)	Gross Beta (pCi/l ± 2s)
Drinking Water			
Minidoka	-80 ± 100	-0.6 ± 1.0	1.8 ± 1.4
Shoshone	-30 ± 100	-0.6 ± 1.0	2.3 ± 1.5
Surface Water			
Alpheus Spring (Twin Falls)	20 ± 100	0.0 ± 1.1	1.8 ± 1.4
Bill Jones Hatchery (Hagerman)	-110 ± 100	-0.4 ± 1.0	0.8 ± 1.4
Bill Jones replicate	-50 ± 100	0.6 ± 1.2	0.0 ± 1.4
Clear Spring (Buhl)	-100 ± 100	-0.1 ± 1.1	0.7 ± 1.4
EPA Maximum Contaminant Level	20,000	15	50

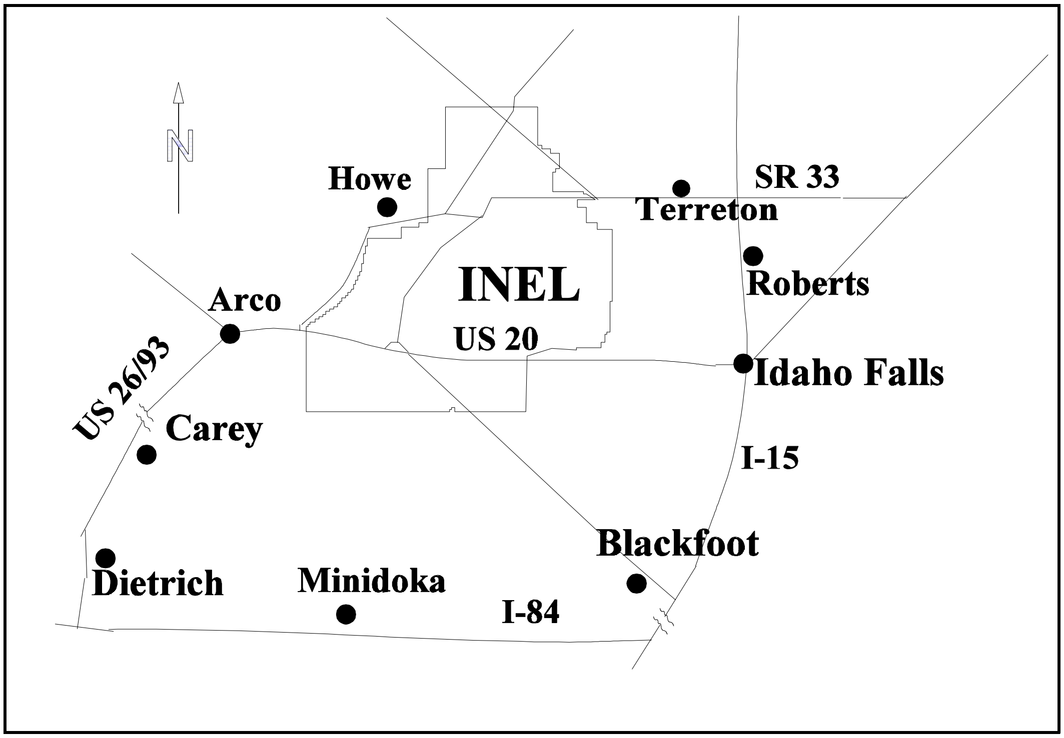

Figure 5 Milk Sampling Locations

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 ^{131}I by placing the sample in a gamma spectrometer calibrated for the ^{131}I energy peak. Since ^{131}I has a short half-life (eight days), results are decay-corrected to the time of sample collection.

4.2 Results

A total of 37 milk samples were collected during the first quarter. Iodine-131 was not detected in any of the samples, at a minimum detectable concentration of about 2×10^{-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	01/10	1.0 ± 1.0
	01/17	1.3 ± 1.1
	01/24	0.9 ± 0.9
	01/31	-0.2 ± 0.6
	02/07	0.8 ± 1.0
	02/14	1.4 ± 1.1
	02/21	1.4 ± 1.1
	02/28	0.8 ± 0.4
	03/06	1.1 ± 0.4
	03/13	1.2 ± 0.4
	03/20	1.5 ± 0.4
	03/27	1.7 ± 0.7
	04/03	2.0 ± 0.6
Craters of the Moon	01/10	0.5 ± 1.0
	01/17	0.0 ± 0.8
	01/24	0.0 ± 0.8
	01/31	0.1 ± 0.8
	02/07	1.5 ± 1.2
	02/14	0.9 ± 1.1
	02/21	invalid result (insufficient sample)
	02/28	0.4 ± 0.4
	03/06	0.2 ± 0.3
	03/13	0.9 ± 0.4
	03/20	0.7 ± 0.4
	03/27	1.2 ± 0.7
	04/03	2.1 ± 0.7
Idaho Falls	01/10	1.2 ± 1.0
	01/17	0.6 ± 0.9
	01/24	0.0 ± 0.9
	01/31	-0.2 ± 1.3
	02/07	1.5 ± 1.1
	02/14	1.7 ± 1.2
	02/21	1.4 ± 1.1
	02/28	0.5 ± 0.3
	03/06	0.9 ± 0.4
	03/13	1.3 ± 0.4
	03/20	1.0 ± 0.4

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/27	1.8 ± 0.7
	04/03	3.2 ± 0.7
Rexburg	01/10	1.4 ± 1.3
	01/17	1.4 ± 1.1
	01/24	0.3 ± 0.9
	01/31	-0.2 ± 0.9
	02/07	1.5 ± 1.8
	02/14	1.5 ± 1.2
	02/21	2.8 ± 1.4
	02/28	0.7 ± 0.4
	03/06	1.4 ± 0.4
	03/13	1.7 ± 0.4
	03/20	0.9 ± 0.4
	03/27	2.1 ± 0.8
	04/03	3.7 ± 0.7
Boundary Locations		
Arco	01/10	0.0 ± 0.8
	01/17	1.1 ± 1.0
	01/24	0.6 ± 0.9
	01/31	0.7 ± 1.3
	02/07	0.7 ± 1.7
	02/14	0.9 ± 1.0
	02/21	2.2 ± 1.3
	02/28	0.6 ± 0.3
	03/06	0.8 ± 0.4
	03/13	1.3 ± 0.4
	03/20	0.7 ± 0.3
	03/27	1.1 ± 0.6
	04/03	1.5 ± 0.5
Atomic City	01/10	0.6 ± 0.9
	01/17	0.3 ± 0.8
	01/24	0.0 ± 0.7
	01/31	0.3 ± 0.8
	02/07	1.1 ± 1.0
	02/14	1.6 ± 1.1
	02/21	0.5 ± 0.9
	02/28	0.5 ± 0.3
	03/06	0.6 ± 0.3

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/13	1.2 ± 0.4
	03/20	1.1 ± 0.4
	03/27	1.0 ± 0.7
	04/03	2.6 ± 0.7
FAA Tower	01/10	1.2 ± 1.2
	01/17	1.6 ± 1.3
	01/24	0.0 ± 0.9
	01/31	0.5 ± 1.0
	02/07	1.4 ± 1.2
	02/14	0.7 ± 1.1
	02/21	0.4 ± 1.0
	02/28	0.4 ± 0.4
	03/06	0.8 ± 0.4
	03/13	0.5 ± 0.4
	03/20	0.6 ± 0.4
	03/27	1.6 ± 0.8
	04/03	2.3 ± 0.7
Howe	01/10	1.3 ± 1.0
	01/17	0.4 ± 0.8
	01/24	-0.1 ± 0.6
	01/31	0.2 ± 0.7
	02/07	1.7 ± 1.1
	02/14	0.3 ± 0.8
	02/21	0.9 ± 1.0
	02/28	0.5 ± 0.3
	03/06	0.9 ± 0.4
	03/13	1.2 ± 0.4
	03/20	0.9 ± 0.4
	03/27	1.9 ± 0.8
	04/03	1.0 ± 0.6
Monteview	01/10	0.7 ± 1.0
	01/17	1.6 ± 1.2
	01/24	0.5 ± 0.9
	01/31	-0.1 ± 0.7
	02/07	0.6 ± 1.0

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	02/14	0.4 ± 0.9
	02/21	0.1 ± 0.9
	02/28	0.5 ± 0.3
	03/06	1.0 ± 0.4
	03/13	1.0 ± 0.4
	03/20	0.9 ± 0.4
	03/27	1.4 ± 0.7
	04/03	2.0 ± 0.7
Mud Lake	01/10	1.6 ± 1.3 (1.4 ± 1.3)
(Replicate)	01/17	0.4 ± 1.0 (1.4 ± 1.2)
	01/24	1.0 ± 1.2 (-0.3 ± 0.7)
	01/31	1.5 ± 1.2 (0.9 ± 1.0)
	02/07	1.7 ± 1.3 (0.9 ± 1.1)
	02/14	0.7 ± 1.1 (0.4 ± 0.9)
	02/21	2.4 ± 1.4 (3.0 ± 1.6)
	02/28	0.6 ± 0.4 (0.6 ± 0.3)
	03/06	1.2 ± 0.4 (1.1 ± 0.4)
	03/13	1.3 ± 0.5 (1.7 ± 0.5)
	03/20	0.8 ± 0.4 (0.8 ± 0.4)
	03/27	2.4 ± 0.8 (1.7 ± 0.8)
	04/03	2.6 ± 0.7 (1.9 ± 0.6)
Reno Ranch	01/10	0.3 ± 0.8
	01/17	1.0 ± 1.0
	01/24	0.1 ± 0.8
	01/31	0.3 ± 0.8
	02/07	1.3 ± 1.1
	02/14	0.8 ± 0.9
	02/21	1.4 ± 1.1
	02/28	0.6 ± 0.4
	03/06	0.7 ± 0.4
	03/13	1.0 ± 0.4
	03/20	0.5 ± 0.4
	03/27	1.3 ± 0.7
	04/03	1.8 ± 0.7
	INEL Locations	
EFS	01/10	1.2 ± 1.0
	01/17	0.8 ± 0.9
	01/24	-0.2 ± 0.6

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	01/31	0.0 ± 0.7
	02/07	1.1 ± 1.1
	02/14	0.6 ± 0.9
	02/21	1.7 ± 1.2
	02/28	0.4 ± 0.3
	03/06	0.5 ± 0.3
	03/13	1.1 ± 0.4
	03/20	0.7 ± 0.4
	03/27	1.2 ± 0.7
	04/03	2.7 ± 0.7
Main Gate	01/10	0.2 ± 0.8 (1.1 ± 1.3)
(Replicate)	01/17	0.8 ± 1.0 (1.0 ± 1.2)
	01/24	-0.2 ± 0.7 (-0.5 ± 0.8)
	01/31	0.1 ± 0.8 (0.0 ± 0.9)
	02/07	1.1 ± 1.0 (0.9 ± 1.2)
	02/14	0.7 ± 1.0 (0.1 ± 0.9)
	02/21	1.4 ± 1.1 (1.8 ± 1.3)
	02/28	0.5 ± 0.4 (0.3 ± 0.4)
	03/06	0.7 ± 0.4 (0.3 ± 0.4)
	03/13	0.9 ± 0.4 (1.0 ± 0.5)
	03/20	0.9 ± 0.4 (0.4 ± 0.4)
	03/27	1.7 ± 0.8 (1.2 ± 0.8)
	04/03	2.0 ± 0.7 (2.0 ± 0.7)
Van Buren	01/10	0.6 ± 1.0
	01/17	0.1 ± 0.8
	01/24	0.7 ± 1.0
	01/31	-0.4 ± 1.0
	02/07	1.0 ± 1.1
	02/14	0.5 ± 1.0
	02/21	0.9 ± 1.1
	02/28	0.3 ± 0.3
	03/06	0.5 ± 0.4
	03/13	0.6 ± 0.4
	03/20	0.8 ± 0.4
	03/27	1.5 ± 0.8
	04/03	2.8 ± 0.8

Table A-2
Weekly Gross Beta Concentrations in Air

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	Distant Locations	
Blackfoot	01/10	22 ± 5
	01/17	23 ± 5
	01/24	9 ± 4
	01/31	9 ± 4
	02/07	27 ± 5
	02/14	21 ± 5
	02/21	24 ± 5
	02/28	10 ± 4
	03/06	17 ± 2
	03/13	12 ± 2
	03/20	10 ± 2
	03/27	20 ± 4
	04/03	21 ± 4
Craters of the Moon	01/10	14 ± 5
	01/17	23 ± 5
	01/24	10 ± 5
	01/31	6 ± 4
	02/07	33 ± 6
	02/14	19 ± 5
	02/21	invalid result (insufficient sample)
	02/28	5 ± 5
	03/06	11 ± 2
	03/13	13 ± 3
	03/20	13 ± 2
	03/27	20 ± 4
	04/03	15 ± 4
Idaho Falls	01/10	39 ± 5
	01/17	20 ± 5
	01/24	4 ± 5
	01/31	8 ± 8
	02/07	26 ± 5
	02/14	21 ± 5
	02/21	26 ± 5
	02/28	15 ± 4
	03/06	19 ± 2
	03/13	14 ± 2

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	03/20	14 ± 2
	03/27	24 ± 4
	04/03	20 ± 4
Rexburg	01/10	18 ± 6
	01/17	18 ± 5
	01/24	11 ± 5
	01/31	9 ± 5
	02/07	32 ± 9
	02/14	20 ± 5
	02/21	28 ± 5
	02/28	16 ± 4
	03/06	19 ± 2
	03/13	14 ± 2
	03/20	12 ± 2
	03/27	21 ± 4
	04/03	19 ± 4
	Boundary Locations	
Arco	01/10	19 ± 5
	01/17	25 ± 5
	01/24	10 ± 4
	01/31	9 ± 6
	02/07	24 ± 9
	02/14	22 ± 5
	02/21	29 ± 5
	02/28	11 ± 4
	03/06	11 ± 2
	03/13	16 ± 2
	03/20	13 ± 2
	03/27	16 ± 4
	04/03	19 ± 4
Atomic City	01/10	27 ± 5
	01/17	19 ± 5
	01/24	12 ± 4
	01/31	8 ± 4
	02/07	30 ± 5
	02/14	29 ± 5
	02/21	26 ± 5
	02/28	16 ± 4

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	03/06	18 ± 2
	03/13	15 ± 2
	03/20	12 ± 2
	03/27	22 ± 4
	04/03	18 ± 4
FAA	01/10	22 ± 5
Tower	01/17	15 ± 5
	01/24	9 ± 5
	01/31	9 ± 5
	02/07	32 ± 6
	02/14	21 ± 5
	02/21	26 ± 5
	02/28	8 ± 5
	03/06	15 ± 3
	03/13	15 ± 3
	03/20	11 ± 3
	03/27	18 ± 5
	04/03	20 ± 4
Howe	01/10	28 ± 5
	01/17	26 ± 5
	01/24	12 ± 4
	01/31	16 ± 4
	02/07	39 ± 5
	02/14	22 ± 5
	02/21	29 ± 5
	02/28	13 ± 4
	03/06	18 ± 2
	03/13	17 ± 2
	03/20	12 ± 2
	03/27	19 ± 4
	04/03	18 ± 4
Monteview	01/10	25 ± 5
	01/17	22 ± 5
	01/24	17 ± 5
	01/31	4 ± 4
	02/07	29 ± 5
	02/14	23 ± 5

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	02/21	28 ± 5
	02/28	15 ± 5
	03/06	18 ± 2
	03/13	16 ± 3
	03/20	11 ± 2
	03/27	27 ± 4
	04/03	18 ± 4
Mud Lake	01/10	33 ± 6 (32 ± 6)
(Replicate)	01/17	31 ± 6 (25 ± 6)
	01/24	21 ± 6 (14 ± 5)
	01/31	14 ± 5 (21 ± 5)
	02/07	47 ± 7 (44 ± 6)
	02/14	29 ± 6 (28 ± 5)
	02/21	29 ± 6 (35 ± 6)
	02/28	15 ± 5 (14 ± 4)
	03/06	21 ± 3 (18 ± 2)
	03/13	23 ± 3 (18 ± 3)
	03/20	13 ± 2 (13 ± 2)
	03/27	24 ± 4 (24 ± 4)
	04/03	23 ± 4 (23 ± 4)
Reno Ranch	01/10	24 ± 5
	01/17	21 ± 5
	01/24	12 ± 4
	01/31	9 ± 4
	02/07	30 ± 5
	02/14	21 ± 5
	02/21	28 ± 5
	02/28	11 ± 4
	03/06	20 ± 2
	03/13	16 ± 2
	03/20	11 ± 2
	03/27	23 ± 4
	04/03	22 ± 4
	INEL Locations	
EFS	01/10	33 ± 5
	01/17	25 ± 5
	01/24	10 ± 4
	01/31	11 ± 4

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml
	02/07	41 ± 6
	02/14	21 ± 5
	02/21	29 ± 5
	02/28	8 ± 4
	03/06	16 ± 2
	03/13	15 ± 2
	03/20	11 ± 2
	03/27	23 ± 4
	04/03	19 ± 4
Main Gate	01/10	32 ± 5 (31 ± 6)
(Replicate)	01/17	21 ± 5 (24 ± 6)
	01/24	9 ± 4 (11 ± 6)
	01/31	6 ± 4 (13 ± 5)
	02/07	32 ± 5 (37 ± 6)
	02/14	30 ± 5 (21 ± 6)
	02/21	25 ± 5 (27 ± 6)
	02/28	14 ± 5 (14 ± 5)
	03/06	16 ± 2 (18 ± 3)
	03/13	16 ± 2 (14 ± 3)
	03/20	13 ± 2 (11 ± 3)
	03/27	24 ± 4 (21 ± 5)
	04/03	17 ± 4 (18 ± 4)
Van Buren	01/10	24 ± 5
	01/17	28 ± 5
	01/24	13 ± 5
	01/31	2 ± 6
	02/07	37 ± 6
	02/14	24 ± 5
	02/21	33 ± 6
	02/28	16 ± 5
	03/06	17 ± 2
	03/13	13 ± 2
	03/20	14 ± 2
	03/27	21 ± 4
	04/03	18 ± 4