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INEEL Offsite Environmental Surveillance Program Report: First Quarter of 1997

Ron Brooks
Don Peterson
Donny Roush

Environmental Science and Research Foundation
September 1997

P.O. Box 51838 • Idaho Falls, ID 83405-1838

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Ron Brooks
Don Peterson
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Doyle Markham, Executive Director

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101 S. Park Avenue, Suite 2
P.O. Box 51838
Idaho Falls, Idaho 83405-1838

Executive Summary

The Environmental Science and Research Foundation conducts the Idaho National Engineering and Environmental Laboratory (INEEL) Offsite Environmental Surveillance Program. The Foundation's environmental surveillance program is designed to monitor the effects, if any, of Department of Energy (DOE) 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 1997 includes the results of analyses conducted on samples of air, water, and milk. A total of 519 samples were collected and analyzed. All concentrations of radioactivity found in these samples were consistent with historical levels. No evidence of radionuclides from the INEEL 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 (EPA) for radiation protection of the public.

Program Description

The Foundation collected filters weekly from low-volume air samplers at 12 offsite locations. Five were at distant locations and seven at INEEL boundary locations. An additional three samplers were operated on the INEEL. 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 INEEL. All milk samples were analyzed for Iodine-131.

Summary of First Quarter 1997 Results

During the first quarter of 1997, most of the gross alpha and all of the gross beta concentrations in low-volume air samples were within the expected range of values for background radioactivity. Air filters from the third and sixth week's of the quarter showed elevated levels of gross alpha. Due to time conflicts with other sample analysis, the filters collected during the third week were analyzed 11 days later than normal, allowing accumulation of naturally occurring radon daughters (alpha emitters). Investigation of weather data for the sixth week of the quarter showed evidence of an extended temperature inversion. During inversions, air movement is minimal, causing contaminants such as alpha particles to be trapped near the ground. 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. No Cesium-137 or Plutonium-238 was detected in samples from any location. Results of Plutonium-239/40 were not available due to accidental contamination of the samples during analysis. Concentrations just above detection limits of Strontium-90 were detected in composites from Atomic City and FAA Tower. However, the uncertainty for these concentrations did not exceed 3s, making the detections questionable. Strontium-90 was not detected in the replicate sample from FAA Tower. The composite sample from the Experimental Field Station (EFS) also had detectable Strontium-90, yet within the range of concentrations observed in recent years and attributed to worldwide fallout. Americium-241 was detected in all of the quarterly composite samples. The concentrations of Americium-241 found in the composites were consistent with historic findings for this radionuclide. Although it is possible these detections were due to INEEL operations, they are just as likely, evidenced by the uniform distribution of the sample concentrations among distant, boundary, and onsite locations, due to residual levels from historic nuclear weapons testing.

Tritium was detected in one distant and two boundary atmospheric moisture samples. The detected concentrations were consistent with results generally attributed to contributions from natural tritium-producing processes in the earth's atmosphere, nuclear power, historic nuclear weapons testing, and spent nuclear fuels handling.

Tritium was detected in one of six precipitation samples. The concentration measured in this onsite sample was consistent with offsite results from recent years and was within the range attributed to natural atmospheric processes, historic nuclear weapons testing, nuclear power, and spent nuclear fuels handling.

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

None of the five water samples collected in February showed detectable concentrations of tritium or gross alpha. As observed in the past, all of the water samples had measurable concentrations of gross beta, all of which were at levels attributed to naturally-occurring radionuclides in the earth's crust.

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, six). The number thus becomes 0.0000013.

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

Unit Prefixes

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

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 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). Concentrations in water samples are expressed as picocuries per liter (pCi/l); federal standards are expressed in these units. Radioactivity in foodstuffs are given in microcuries per gram (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

Negative values can occur when a measured result is less than a pre-established average background level for the instrument 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 U.S. 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 which verifies 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 INEEL Offsite Environmental Surveillance Program during the period January 1 through March 31, 1997. 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 Assessment Laboratory. Other analyses were performed by Quanterra Laboratory, a commercial laboratory located in Richland, Washington.

Nearly all of the reported 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 "not detected." For results greater than 2s (the 95% confidence level), but not exceeding 3s (the 99% confidence interval), detection of the radioactivity is questionable. Results may exceed the 2s level simply due to the inherent random nature of radioactive decay events. This is expected to occur approximately 2.5% of the time. Results exceeding 3s are interpreted as indicating 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 Guides. 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’s 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	INEEL
Air				
Gross Alpha	weekly	Blackfoot, Craters of the Moon, Idaho Falls, Mountain View Middle School, Rexburg	Arco, Atomic City, FAA Tower, Howe, Monteview, Mud Lake, Reno Ranch	Main Gate, EFS, Van Buren
Gross Beta ^{131}I	weekly	Blackfoot, Craters of the Moon, Idaho Falls, Mountain View Middle School, 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, Mountain View Middle School, 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
PM-10				
	every six days	Rexburg, Mountain View	Boundary	None
Air Moisture				
Tritium	4 to 13 weeks	Idaho Falls, Rexburg, Mtn. View	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	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	INEEL grazing areas
Waterfowl				
Gamma Spec ^{90}Sr Transuranics	annually	Fort Hall, Heise	None	Waste disposal ponds
Game				
Gamma Spec	varies	None	None	INEEL roads
Soil				
Gamma Spec ^{90}Sr Transuranics	biennially	Carey, Crystal Ice Caves, Blackfoot, St. Anthony	Butte City, 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 1997)

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 25 m^3, assuming an average sampling period of eight weeks.

2. Air Sampling

2.1 Sampling Methods

2.1.1 Low-Volume Air

Airborne particulate radioactivity was continuously monitored by 15 air samplers (Figure 1), designed to provide an effective network to detect INEEL releases of radioactivity. Five offsite air samplers were designated as distant, or background, stations and seven were designated as boundary stations. Three air samplers were situated on the INEEL. Distant locations were used to make comparisons of airborne concentrations of radioactivity with boundary and onsite locations. As part of the quality assurance program, two replicate samplers, moved to new locations in Monteview and the FAA Tower, 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. These filters 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 ^{131}I activity. If activity was detected in any batch that was greater than a preset action level, cartridges were then analyzed individually. Particulate filters were counted each week for gross (nonspecific) beta activity in a low-background beta counter after waiting a minimum of four days for the naturally occurring 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).

2.1.2 Atmospheric Moisture

Four air samplers, located in Atomic City, Idaho Falls, Blackfoot, and Rexburg, collected atmospheric moisture for tritium analysis. Air was passed through a column of silica gel, which absorbs the water vapor in the air. Tritium concentrations were determined by extracting water from the silica gel and counting the water sample by liquid scintillation.

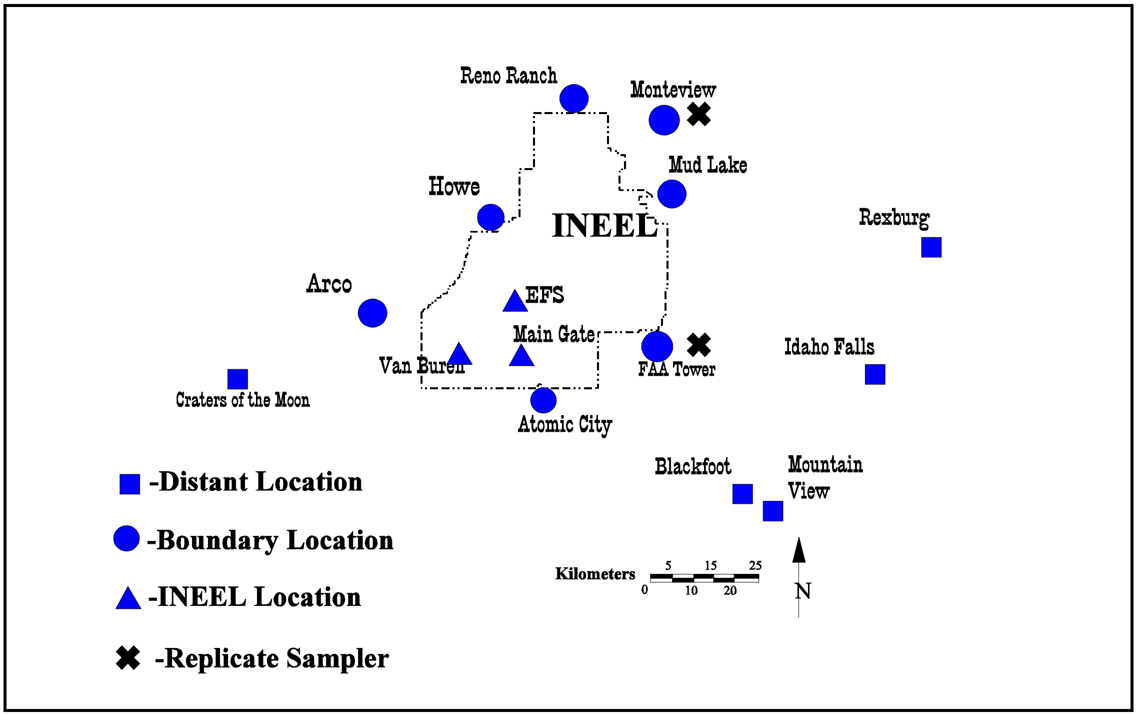

Figure 1. Air Sampling Location Map

2.1.3 Precipitation

When available, weekly precipitation samples were collected at the Experimental Field Station (EFS) on the INEEL. Monthly samples were collected from both Idaho Falls and Central Facilities Area on the INEEL. All precipitation samples were analyzed for tritium by liquid scintillation.

2.1.4 PM-10

PM-10 samplers run for a 24-hour period every six days. Throughout the first quarter, filters were collected weekly from PM-10 samplers in Rexburg and Blackfoot. The sampler in Atomic City began operation in early March. Each filter was weighed and compared to its original weight to determine total concentration of airborne particulate matter below 10 microns in size. Filters collected from PM-10 samplers are not analyzed for radionuclides. These samplers specifically quantify the airborne particulate smaller than 10 microns in size, a size that can readily bypass the body's natural air filtering system and enter the lungs.

2.2 Results

2.2.1 Low-Volume Air

No ^{131}I was detected in any of the weekly charcoal cartridge batches collected during the first quarter, thus no analyses of individual cartridges were required. The minimum detectable concentration was approximately 4 x 10^{-15} µCi/ml.

Most of the gross alpha concentrations were within the expected range of background levels. Samples collected during the third and sixth weeks of the quarter showed elevated concentrations of gross alpha. Due to time conflicts among different sample types, there was an 11 day delay in analysis of filters collected during the third week, causing an accumulation of naturally occurring radon daughters. Elevated concentrations measured in the filters from the sixth week were attributed to, upon investigation of past weather data, a temperature inversion period. During inversions, radon, which is constantly emitted from the earth’s surface, gets trapped near the ground. Mean gross alpha concentrations of boundary and INEEL stations were not statistically different from distant stations (Figure 2, Table 3, and Table A-1).

All gross beta concentrations were consistent with expected background ranges. The quarterly mean gross beta concentrations for INEEL and boundary stations were not statistically different from the distant stations (Figure 3, Table 4, Table A-2).

Quarterly average gross alpha and gross beta concentrations from the replicate samplers at the FAA Tower and Monteview stations showed no statistical difference in comparison to their respective test samplers (Tables 3, 4).

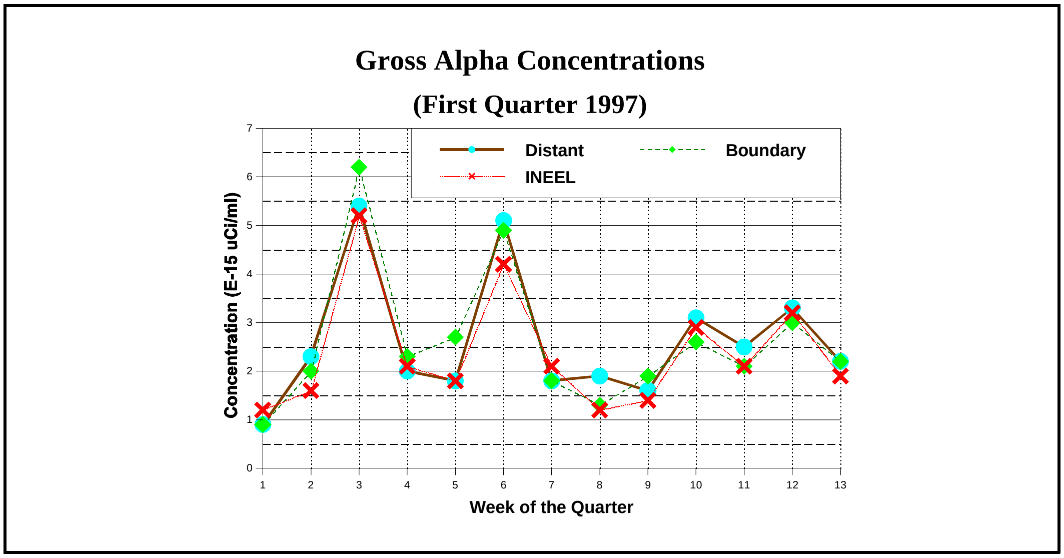

Figure 2. Weekly Gross Alpha Concentrations

Table 3.
Gross Alpha Concentrations in Air
(First Quarter 1997)

Group	Location	Number of Samples	Gross Alpha Concentration ($\times 10^{-15}$ µCi/ml) Range of Samples	Mean with 95% Confidence Interval
Distant	Blackfoot	13	1.0 - 5.6	2.6 ± 0.8
	Craters of the Moon	13	0.4 - 6.1	2.2 ± 0.9
	Idaho Falls	13	0.7 - 5.6	2.4 ± 0.8
	Rexburg	13	1.2 - 4.5	2.7 ± 0.6
	Mtn.View Mdl. School	13	1.0 - 6.7	3.1 ± 0.9
			Group Mean	**2.6 ± 0.3**
Boundary	Arco	13	0.7 - 8.6	2.8 ± 1.2
	Atomic City	13	1.0 - 4.7	2.4 ± 0.6
	FAA Tower (Replicate)	13 (13)	0.1 - 4.3 (0.4 - 9.5)	2.0 ± 0.7 (2.3 ± 1.4)
	Howe	13	0.8 - 7.9	2.8 ± 1.2
	Monteview (Replicate)	13 (13)	1.0 - 6.0 (0.6 - 5.3)	2.6 ± 0.8 (2.4 ± 0.8)
	Mud Lake	13	1.2 - 5.8	2.8 ± 0.8
	Reno Ranch	13	1.4 - 6.7	3.0 ± 0.9
			Group Mean	**2.6 ± 0.3**
INEEL	EFS	13	0.8 - 6.0	2.7 ± 0.8
	Main Gate	13	0.9 - 4.8	2.2 ± 0.6
	Van Buren	13	0.7 - 4.8	2.3 ± 0.7
			Group Mean	**2.4 ± 0.4**
			DOE Derived Concentration Guide	20

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.

Several composite samples were also analyzed for ^{90}Sr and transuranics of interest (^{241}Am, ^{238}Pu, and $^{239/240}$Pu). As displayed in Table 5, all of the composite samples showed detectable concentrations of Am-241 ranging from (0.005 ± 0.002) x 10^{-15} to (0.009 ± 0.003) x 10^{-15} µCi/ml. Concentrations of Am-241 within this range are consistent with results found in recent years and, due to the even distribution of Am-241 levels in these samples among distant, boundary, and onsite locations, are most likely due to worldwide fallout.

Concentrations of Strontium-90 slightly above detection limits were measured in the composites from Atomic City and FAA Tower, although no Sr-90 was detected in the FAA Tower replicate composite. The onsite composite from the EFS also showed a concentration of Sr-90 slightly higher than normal, but not exceeding concentrations seen in past composite samples (Table 5).

Unfortunately, analysis results for Plutonium-239/240 could not be obtained due to a laboratory contamination of the samples during analysis.

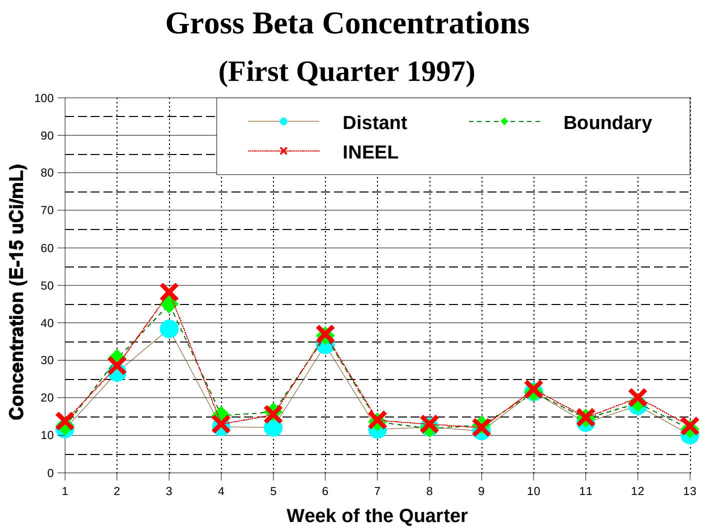

Figure 3. Weekly Gross Beta Concentrations

2.2.2 Atmospheric Moisture

Atmospheric moisture samples were collected from Idaho Falls, Atomic City, Rexburg, and Blackfoot in February 1997. Tritium was not detected in the sample from Rexburg. Detectable concentrations of tritium were observed in the samples from Atomic City (13.4 ± 9.0) x 10^{-14}, Idaho Falls (19.0 ± 9.4) x 10^{-14}, and Blackfoot (4.8 ± 4.0) x 10^{-14} µCi/ml. These concentrations are consistent with past results and are within the range attributed to natural atmospheric processes, historic nuclear weapons testing, nuclear power, and statistical variations in the analysis.

2.2.3 Precipitation

Ten precipitation samples were collected during the first quarter and analyzed for tritium. Detectable concentrations were measured in one sample from Central Facilities Area [(1.7 ± 1.2) x 10^{-7} µCi/ml], and in one sample from the Experimental Field Station [(1.9 ± 1.1) x 10^{-7} µCi/ml]. These levels are consistent with those attributed to cosmic ray interactions in the earth's atmosphere, nuclear power and historic weapons testing, and statistical variations in the analysis.

Table 4.
Gross Beta Concentrations in Air
(First Quarter 1997)

			Gross Beta Concentration (x 10^{-15} µCi/ml)	
Group	**Location**	**Number of Samples**	**Range of Samples**	**Mean with 95% Confidence Interval**
Distant	Blackfoot	13	11 - 47	20 ± 6
	Craters of the Moon	13	9 - 36	16 ± 5
	Idaho Falls	13	9 - 38	17 ± 5
	Rexburg	13	12 - 37	20 ± 5
	Mountain View Middle School	13	10 - 38	17 ± 6
			Group Mean	**20 ± 2**
Boundary	Arco	13	11 - 47	19 ± 6
	Atomic City	13	11 - 45	20 ± 6
	FAA Tower (Replicate)	13 (13)	7 - 42 (8 - 54)	18 ± 6 (18 ± 6)
	Howe	13	7 - 46	21 ± 6
	Monteview (Replicate)	13 (13)	12 - 44 (10 - 36)	21 ± 6 (19 ± 5)
	Mud Lake	13	11 - 46	21 ± 6
	Reno Ranch	13	12 - 45	22 ± 7
			Group Mean	**20 ± 2**
INEEL	EFS	13	9 - 22	22 ± 7
	Main Gate	13	11 - 42	20 ± 6
	Van Buren	13	8 - 50	20 ± 8
			Group Mean	**21 ± 4**
			DOE Derived Concentration Guide	3000

2.2.4 PM-10

During the first quarter, eight PM-10 samples from Blackfoot, 10 PM-10 samples from Rexburg, and three PM-10 samples from Atomic City were collected and weighed. The mean concentration of airborne particulate smaller than 10 microns was measured at 12 µg/m^3 in Blackfoot, 10 µg/m^3 in Rexburg, and 7 µg/m^3 in Atomic City. The maximum concentration measured for Blackfoot was 26.0 µg/m^3, compared to 25.0 µg/m^3 measured in Rexburg and 19 µg/m^3 in Atomic City.

Table 5.
Manmade Radionuclides in Particulate Filter Quarterly Composites
(First Quarter 1997)

Strontium-90

Location	Strontium-90 (10^{-15} µCi/ml ± 2s)
Distant Locations	
Not Detected: Idaho Falls, Mountain View Middle School, Rexburg	
Boundary Locations	
Atomic City	0.06 ± 0.05
FAA Tower	0.06 ± 0.05
Replicate	Not Detected
Mud Lake	Not Detected
INEEL Location	
EFS	0.1 ± 0.06
DOE Derived Concentration Guide	9000

Transuranic Radionuclides

Location	Americium-241 (10^{-15} µCi/ml ± 2s)	Plutonium-238 (10^{-15} µCi/ml ± 2s)	Plutonium-239/240 (10^{-15} µCi/ml ± 2s)
Distant Locations			
Arco	0.006 ± 0.003	Not Detected	N/A
Blackfoot	0.009 ± 0.003	Not Detected	N/A
Craters of the Moon	0.009 ± 0.003	Not Detected	N/A
Boundary Locations			
Monteview	0.008 ± 0.003	Not Detected	N/A
Replicate	0.006 ± 0.003	Not Detected	N/A
INEEL Location			
Main Gate	0.005 ± 0.002	Not Detected	N/A
DOE Derived Concentration Guide	20	30	20

3.0 Foodstuff Sampling

3.1 Sampling Methods

3.1.1 Milk

Milk samples were collected weekly in Idaho Falls and monthly at eight other locations around the INEEL (Figure 5). Two types of locations were sampled: single family dairies and large commercial dairies. Each milk sample was analyzed for ^{131}I using gamma spectrometry.

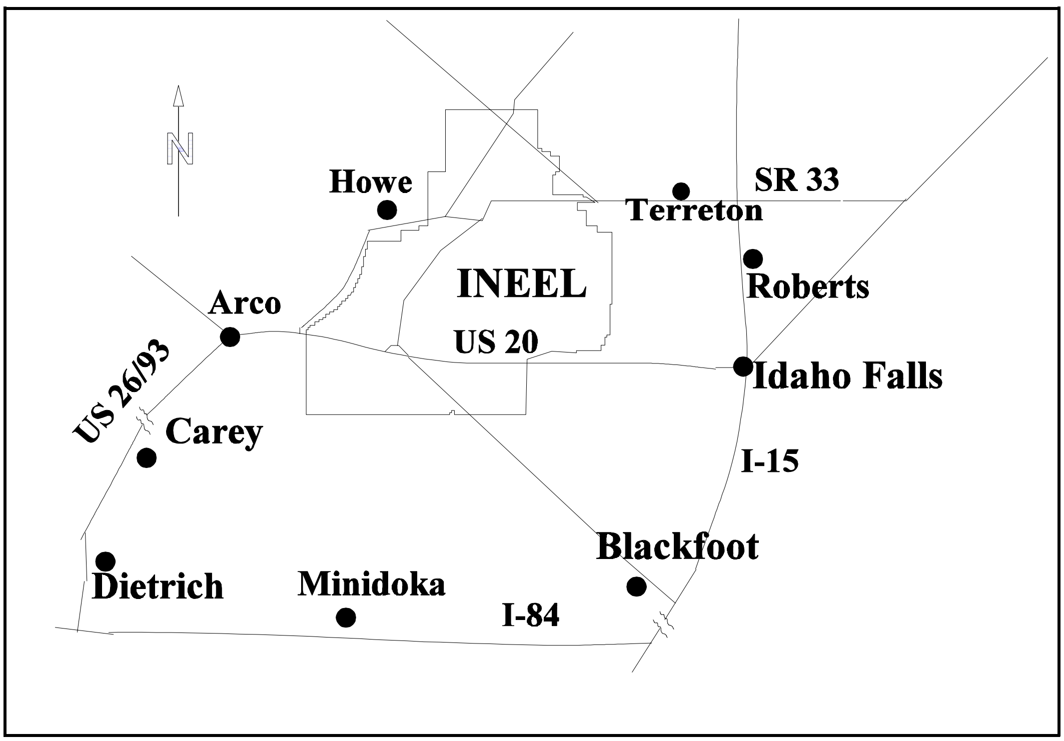

Figure 4. Milk Sampling Locations

3.2 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.

4. Water Sampling

4.1 Methods

Two drinking water samples were collected from local businesses in Shoshone and Minidoka. Three surface water samples were collected in the Magic Valley from the Thousand Springs area, outlets for the Snake River Plain Aquifer, which flows beneath the INEEL (Figure 5). 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 in each sample using liquid scintillation.

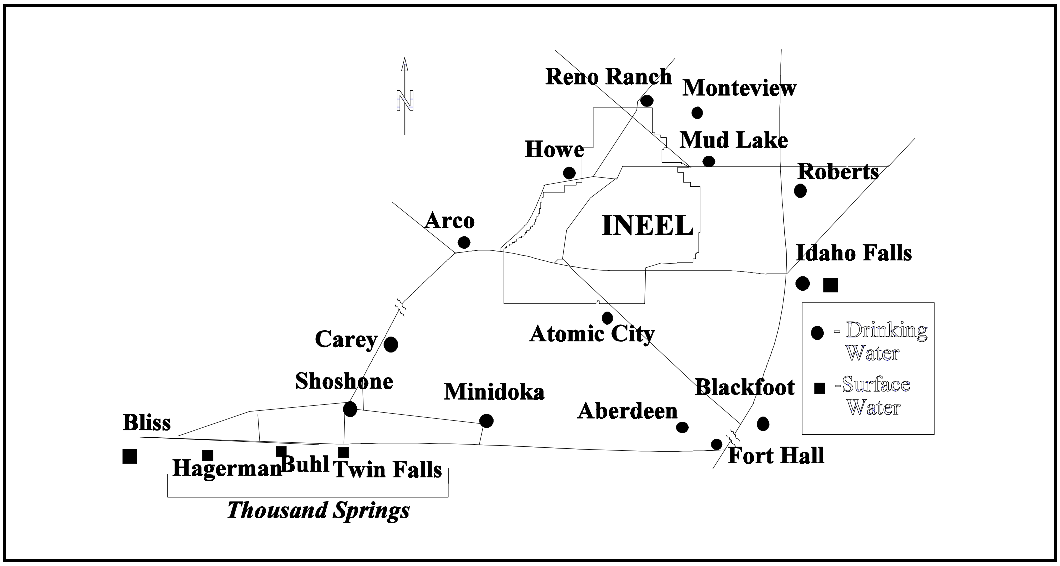

Figure 5. Water Sampling Locations

4.2 Results

As Table 8 indicates, tritium and gross alpha were not above detection limits in any of the water samples. Detectable gross beta concentrations were measured in samples from all locations. Within the range detected in these samples, 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 1997)

Location	^{3}H (pCi/l ± 2s)	Gross Alpha (pCi/l ± 2s)	Gross Beta (pCi/l ± 2s)
Drinking Water			
Minidoka	12 ± 113	0 ± 1	4 ± 3
Shoshone	52 ± 57	0 ± 2	4 ± 2
Surface Water			
Alpheus Spring (Twin Falls)	37 ± 93	0 ± 2	7 ± 3
Bill Jones Hatchery (Hagerman)	30 ± 110	0 ± 1	3 ± 2
Clear Spring (Buhl)	30 ± 110	0 ± 1	6 ± 2
EPA Maximum Contaminant Level (MCL)	20,000	15	50

Appendix

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	01/08	1.0 ± 0.7
	01/15	1.9 ± 0.8
	01/22	5.6 ± 1.3
	01/29	2.7 ± 0.9
	02/05	1.0 ± 0.7
	02/12	5.0 ± 1.2
	02/19	1.7 ± 0.8
	02/26	2.0 ± 0.8
	03/05	1.9 ± 0.8
	03/12	2.6 ± 0.9
	03/19	2.8 ± 0.9
	03/26	3.3 ± 1.0
	04/02	2.3 ± 0.8
Craters of the Moon	01/08	0.4 ± 0.6
	01/15	1.6 ± 0.7
	01/22	6.1 ± 1.2
	01/29	1.5 ± 0.7
	02/05	1.2 ± 0.6
	02/12	5.0 ± 1.1
	02/19	1.3 ± 0.6
	02/26	1.7 ± 0.7
	03/05	1.4 ± 0.7
	03/12	2.3 ± 0.8
	03/19	2.0 ± 0.7
	03/26	2.5 ± 0.8
	04/02	1.6 ± 0.7
Idaho Falls	01/08	0.7 ± 0.6
	01/15	2.1 ± 0.7
	01/22	5.6 ± 1.2
	01/29	2.3 ± 0.8
	02/05	1.6 ± 0.7
	02/12	4.6 ± 1.1
	02/19	1.8 ± 0.7
	02/26	1.7 ± 0.7
	03/05	1.2 ± 0.6
	03/12	2.8 ± 0.9
	03/19	1.6 ± 0.7
	03/26	3.4 ± 0.9
	04/02	1.9 ± 0.7

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
Mountain View	01/08	1.0 ± 0.6
	01/15	2.4 ± 0.7
	01/22	5.3 ± 1.0
	01/29	2.4 ± 0.8
	02/05	2.4 ± 0.7
	02/12	6.7 ± 1.6
	02/19	2.3 ± 0.7
	02/26	2.0 ± 0.7
	03/05	1.5 ± 0.6
	03/12	4.5 ± 1.0
	03/19	3.2 ± 0.8
	03/26	3.9 ± 0.9
	04/02	3.0 ± 0.8
Rexburg	01/08	1.2 ± 0.7
	01/15	3.3 ± 0.9
	01/22	4.5 ± 1.1
	01/29	1.4 ± 0.7
	02/05	2.6 ± 0.8
	02/12	4.3 ± 1.1
	02/19	1.8 ± 0.7
	02/26	2.4 ± 0.8
	03/05	1.9 ± 0.7
	03/12	3.3 ± 0.8
	03/19	2.9 ± 0.8
	03/26	3.4 ± 0.9
	04/02	2.4 ± 0.8
Boundary Locations		
Arco	01/08	0.7 ± 0.6
	01/15	2.5 ± 0.8
	01/22	8.6 ± 1.5
	01/29	2.3 ± 0.8
	02/05	2.8 ± 0.8
	02/12	5.3 ± 1.1
	02/19	2.0 ± 0.7
	02/26	1.4 ± 0.7
	03/05	2.2 ± 0.7
	03/12	2.4 ± 0.8
	03/19	2.1 ± 0.8
	03/26	2.7 ± 0.9
	04/02	2.0 ± 0.7

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
Atomic City	01/08	1.0 ± 0.7
	01/15	2.5 ± 0.8
	01/22	4.7 ± 1.2
	01/29	2.0 ± 0.8
	02/05	2.3 ± 0.8
	02/12	3.8 ± 1.1
	02/19	1.6 ± 0.7
	02/26	1.5 ± 0.7
	03/05	1.5 ± 0.7
	03/12	2.3 ± 0.8
	03/19	1.9 ± 0.8
	03/26	3.3 ± 1.0
	04/02	2.0 ± 0.7
FAA Tower	01/08	0.1 ± 0.6 (0.4 ± 0.6)
(Replicate)	01/15	1.2 ± 0.7 (1.5 ± 0.7)
	01/22	4.3 ± 1.2 (9.5 ± 4.5)
	01/29	1.2 ± 0.7 (1.8 ± 0.8)
	02/05	2.3 ± 0.9 (1.6 ± 0.8)
	02/12	3.7 ± 1.1 (4.2 ± 1.1)
	02/19	1.2 ± 0.7 (1.4 ± 0.7)
	02/26	1.0 ± 0.7 (0.8 ± 0.6)
	03/05	1.3 ± 0.7 (1.2 ± 0.7)
	03/12	3.0 ± 1.0 (1.9 ± 0.8)
	03/19	1.8 ± 0.8 (1.2 ± 0.7)
	03/26	2.9 ± 0.9 (1.9 ± 0.8)
	04/02	1.4 ± 0.7 (2.1 ± 0.8)
Howe	01/08	1.0 ± 0.6
	01/15	1.7 ± 0.7
	01/22	7.9 ± 1.3
	01/29	2.6 ± 0.8
	02/05	3.6 ± 0.9
	02/12	6.1 ± 1.2
	02/19	2.0 ± 0.7
	02/26	0.8 ± 0.5
	03/05	1.6 ± 0.7
	03/12	2.0 ± 0.8
	03/19	1.9 ± 0.7
	03/26	2.6 ± 0.9
	04/02	2.3 ± 0.8

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
Monteview	01/08	1.0 ± 0.7 (0.6 ± 0.6)
(Replicate)	01/15	2.1 ± 0.8 (1.8 ± 0.7)
	01/22	6.0 ± 1.3 (5.3 ± 1.2)
	01/29	2.4 ± 0.8 (3.2 ± 0.9)
	02/05	2.5 ± 0.8 (1.5 ± 0.7)
	02/12	4.9 ± 1.1 (5.1 ± 1.1)
	02/19	1.5 ± 0.7 (2.1 ± 0.8)
	02/26	1.1 ± 0.6 (1.3 ± 0.7)
	03/05	2.3 ± 0.8 (1.4 ± 0.7)
	03/12	3.0 ± 0.9 (2.4 ± 0.8)
	03/19	2.1 ± 0.8 (1.9 ± 0.8)
	03/26	3.0 ± 0.9 (2.2 ± 0.8)
	04/02	2.3 ± 0.8 (2.3 ± 0.8)
Mud Lake	01/08	1.2 ± 0.7
	01/15	1.7 ± 0.7
	01/22	5.2 ± 1.1
	01/29	2.7 ± 0.8
	02/05	2.4 ± 0.8
	02/12	5.8 ± 1.1
	02/19	2.0 ± 0.7
	02/26	1.7 ± 0.7
	03/05	2.6 ± 0.8
	03/12	3.1 ± 0.8
	03/19	2.2 ± 0.8
	03/26	3.7 ± 0.9
	04/02	2.1 ± 0.7
Reno Ranch	01/08	1.5 ± 0.6
	01/15	2.1 ± 0.8
	01/22	6.7 ± 1.3
	01/29	3.2 ± 0.9
	02/05	3.2 ± 0.9
	02/12	5.0 ± 1.1
	02/19	2.6 ± 0.8
	02/26	1.4 ± 0.7
	03/05	1.7 ± 0.7
	03/12	2.9 ± 0.9
	03/19	2.4 ± 0.8
	03/26	3.2 ± 1.0
	04/02	3.4 ± 1.2

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
		INEEL Locations
EFS	01/08	0.8 ± 0.7
	01/15	2.1 ± 0.8
	01/22	6.0 ± 1.3
	01/29	2.6 ± 0.9
	02/05	1.9 ± 0.8
	02/12	4.7 ± 1.2
	02/19	3.0 ± 0.9
	02/26	1.5 ± 0.8
	03/05	1.2 ± 0.7
	03/12	3.0 ± 1.0
	03/19	2.2 ± 0.9
	03/26	3.5 ± 1.0
	04/02	2.0 ± 0.8
Main Gate	01/08	2.0 ± 1.4
	01/15	1.0 ± 0.6
	01/22	4.8 ± 1.2
	01/29	1.9 ± 0.8
	02/05	2.1 ± 0.8
	02/12	3.8 ± 1.1
	02/19	1.9 ± 0.8
	02/26	0.9 ± 0.6
	03/05	1.4 ± 0.7
	03/12	2.7 ± 1.1
	03/19	1.7 ± 0.6
	03/26	3.0 ± 0.9
	04/02	1.7 ± 0.7
Van Buren	01/08	0.7 ± 0.6
	01/15	1.8 ± 0.8
	01/22	4.8 ± 1.1
	01/29	1.9 ± 0.7
	02/05	1.5 ± 0.7
	02/12	4.0 ± 1.1
	02/19	1.5 ± 0.7
	02/26	1.2 ± 0.7
	03/05	1.5 ± 0.7
	03/12	3.0 ± 0.9
	03/19	2.2 ± 0.9
	03/26	3.3 ± 1.1
	04/02	2.0 ± 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	01/08	13 ± 2
	01/15	30 ± 2
	01/22	47 ± 3
	01/29	15 ± 2
	02/05	12 ± 2
	02/12	33 ± 2
	02/19	12 ± 2
	02/26	14 ± 2
	03/05	13 ± 2
	03/12	24 ± 2
	03/19	14 ± 2
	03/26	19 ± 2
	04/02	11 ± 1
Craters of the Moon	01/08	9 ± 1
	01/15	22 ± 2
	01/22	36 ± 2
	01/29	10 ± 1
	02/05	11 ± 1
	02/12	32 ± 2
	02/19	10 ± 1
	02/26	12 ± 2
	03/05	9 ± 1
	03/12	20 ± 2
	03/19	13 ± 1
	03/26	16 ± 2
	04/02	9 ± 1
Idaho Falls	01/08	11 ± 1
	01/15	24 ± 2
	01/22	38 ± 2
	01/29	13 ± 2
	02/05	12 ± 2
	02/12	32 ± 2
	02/19	11 ± 1
	02/26	12 ± 2
	03/05	11 ± 1
	03/12	20 ± 2

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
Idaho Falls (cont.)	03/19	13 ± 2
	03/26	17 ± 2
	04/02	9 ± 1
Mountain View	01/08	12 ± 1
	01/15	24 ± 2
	01/22	35 ± 2
	01/29	11 ± 1
	02/05	11 ± 1
	02/12	38 ± 3
	02/19	11 ± 1
	02/26	11 ± 1
	03/05	10 ± 1
	03/12	23 ± 2
	03/19	12 ± 1
	03/26	17 ± 2
	04/02	10 ± 1
Rexburg	01/08	14 ± 2
	01/15	34 ± 2
	01/22	37 ± 2
	01/29	12 ± 2
	02/05	15 ± 2
	02/12	35 ± 2
	02/19	14 ± 2
	02/26	13 ± 1
	03/05	14 ± 1
	03/12	22 ± 2
	03/19	16 ± 2
	03/26	21 ± 2
	04/02	12 ± 1
	Boundary Locations	
Arco	01/08	12 ± 1
	01/15	23 ± 2
	01/22	47 ± 3
	01/29	13 ± 2
	02/05	14 ± 2
	02/12	34 ± 2
	02/19	11 ± 1
	02/26	13 ± 2

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
Arco (cont.)	03/05	13 ± 2
	03/12	19 ± 2
	03/19	15 ± 2
	03/26	18 ± 2
	04/02	11 ± 1
Atomic City	01/08	12 ± 1
	01/15	30 ± 2
	01/22	45 ± 3
	01/29	13 ± 2
	02/05	14 ± 2
	02/12	36 ± 2
	02/19	16 ± 2
	02/26	13 ± 2
	03/05	12 ± 2
	03/12	21 ± 2
	03/19	15 ± 2
	03/26	18 ± 2
	04/02	11 ± 1
FAA Tower (Replicate)	01/08	13 ± 2 (11 ± 2)
	01/15	23 ± 2 (23 ± 3)
	01/22	42 ± 3 (54 ± 9)
	01/29	7 ± 1 (8 ± 1)
	02/05	14 ± 2 (13 ± 2)
	02/12	35 ± 3 (33 ± 2)
	02/19	11 ± 2 (13 ± 2)
	02/26	13 ± 2 (13 ± 2)
	03/05	11 ± 2 (11 ± 2)
	03/12	20 ± 2 (18 ± 2)
	03/19	13 ± 2 (14 ± 2)
	03/26	18 ± 2 (17 ± 2)
	04/02	12 ± 2 (9 ± 2)
Howe	01/08	14 ± 1
	01/15	30 ± 2
	01/22	46 ± 3
	01/29	17 ± 2
	02/05	18 ± 2
	02/12	38 ± 2
	02/19	13 ± 2
	02/26	7 ± 1

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
Howe (cont.)	03/05	14 ± 2
	03/12	21 ± 2
	03/19	15 ± 2
	03/26	20 ± 2
	04/02	13 ± 2
Monteview	01/08	13 ± 2 (12 ± 2)
(Replicate)	01/15	35 ± 2 (32 ± 2)
	01/22	44 ± 3 (36 ± 2)
	01/29	18 ± 2 (15 ± 2)
	02/05	18 ± 2 (16 ± 2)
	02/12	38 ± 2 (31 ± 2)
	02/19	15 ± 2 (15 ± 2)
	02/26	12 ± 2 (13 ± 2)
	03/05	13 ± 2 (11 ± 2)
	03/12	22 ± 2 (19 ± 2)
	03/19	14 ± 2 (13 ± 2)
	03/26	17 ± 2 (17 ± 2)
	04/02	12 ± 2 (10 ± 1)
Mud Lake	01/08	13 ± 1
	01/15	34 ± 2
	01/22	46 ± 3
	01/29	19 ± 2
	02/05	18 ± 2
	02/12	36 ± 2
	02/19	14 ± 2
	02/26	13 ± 2
	03/05	13 ± 1
	03/12	23 ± 2
	03/19	15 ± 2
	03/26	20 ± 2
	04/02	11 ± 1
Reno	01/08	12 ± 1
Ranch	01/15	39 ± 3
	01/22	45 ± 3
	01/29	21 ± 2
	02/05	19 ± 2
	02/12	38 ± 2
	02/19	16 ± 2

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
Reno Ranch (cont.)	02/26	12 ± 1
	03/05	15 ± 2
	03/12	24 ± 2
	03/19	15 ± 2
	03/26	20 ± 2
	04/02	13 ± 2
	INEEL Locations	
EFS	01/08	9 ± 1
	01/15	32 ± 2
	01/22	52 ± 3
	01/29	16 ± 2
	02/05	18 ± 2
	02/12	38 ± 3
	02/19	15 ± 2
	02/26	13 ± 2
	03/05	13 ± 2
	03/12	24 ± 2
	03/19	16 ± 2
	03/26	22 ± 2
	04/02	15 ± 2
Main Gate	01/08	21 ± 3
	01/15	27 ± 2
	01/22	42 ± 3
	01/29	15 ± 2
	02/05	13 ± 2
	02/12	37 ± 3
	02/19	14 ± 2
	02/26	14 ± 2
	03/05	11 ± 2
	03/12	19 ± 2
	03/19	13 ± 2
	03/26	20 ± 2
	04/02	12 ± 2
Van Buren	01/08	11 ± 1
	01/15	27 ± 2
	01/22	50 ± 3
	01/29	8 ± 1
	02/05	16 ± 2

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml**
Van Buren (cont.)	02/12	39 ± 3
	02/19	14 ± 2
	02/26	12 ± 2
	03/05	12 ± 2
	03/12	24 ± 2
	03/19	16 ± 2
	03/26	20 ± 3
	04/02	11 ± 2

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