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

Environmental Science and Research Foundation

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July 1996

Idaho National Engineering Laboratory

Envir

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Executive Director

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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 necessary to confirm compliance with applicable environmental laws and regulations, and to observe any trends in environmental levels of radioactivity. This report for the third quarter of 1995 includes the results of analyses conducted on samples of air, water, and foodstuffs, including milk, wheat, lettuce, and fish. All concentrations of radioactivity found in these samples were consistent with those seen during the previous several years, and no indication of the presence 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 members of the public.

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

Two drinking water samples and three surface water samples were collected in the Magic Valley area. Each water sample was 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. Lettuce samples were collected from eight private gardens surrounding the INEL, and wheat samples were obtained from 10 grain elevators in communities around the INEL. Lettuce and wheat were analyzed for gamma-emitting radionuclides and Strontium-90. Fish were collected from the Big Lost River, which flowed onto the INEL during a portion of the spring and summer, and analyzed for gamma-emitting radionuclides.

Summary of Third Quarter Results

During the third 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 sample. No Strontium-90 or manmade gamma-emitting radionuclides were found on air filter composites. Plutonium-239/240 and Americium-241 were detected at several locations, both onsite and offsite. Higher concentrations of these two transuranic radionuclides were found at distant locations than at samplers located on the INEL.

Tritium was found in two atmospheric moisture samples and three precipitation samples. The data indicate that the INEL is not likely the source, since a higher concentration of tritium was detected at a distant location. Detectable atmospheric tritium is likely due to contributions from historic nuclear weapons tests and natural atmospheric processes. Tritium was not found in any of the offsite water samples. Gross alpha concentrations were detected in one surface water and one drinking water sample, and all samples had detectable gross beta concentrations. Gross alpha and gross beta radioactivity in water samples are attributed to naturally occurring radionuclides in the earth's crust.

None of the milk samples collected during the third quarter contained detectable concentrations of Iodine-131. Cesium-137 and Strontium-90, two components of soil resulting from historic nuclear weapons testing fallout, were found in wheat and lettuce samples from both distant and boundary locations. No manmade radionuclides were found in a composite fish sample.

Helpful Information for Readers

Radionuclide Nomenclature

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

Symbol	Radionuclide	Symbol	Radionuclide
^{3}H	Tritium	^{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 the normal background levels of the instrument used for the measurement. In this case, the result will still be reported by the analytical laboratory, even though it is below the measurement system's approximate minimum detectable concentration (MDC), or is less than zero. Negative values occur when the measured result is less than a pre-established average background level for the particular system and procedure used. These values, rather than "not detectable" or "zero," are reported to allow better 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 data collected by the Foundation's INEL offsite environmental surveillance program during the period July 1 through September 30, 1995. The scope of the Foundation's sampling program is outlined in Table 1.

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

A significant portion of environmental results are near background concentrations of radioactivity. All results are reported with an associated 2s ("two sigma") uncertainty term. The Foundation has adopted the following method for interpreting analytical results near background levels. Results less than or equal to the 2s uncertainty term, which includes 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 due to fluctuations in the background of the instrument used in counting the sample. This is expected to occur approximately 2.5% of the time. Results exceeding 3s are interpreted as indicating that radioactivity was detected.

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

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

- For air, concentrations are compared to the DOE Derived Concentration Guide. This is the concentration of a radionuclide that, under conditions of continuous exposure, would result in an effective dose equivalent of 100 mrem in a year (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 (Third Quarter 1995)

Sample Type	Analysis	Approximate Minimum Detectable Concentration[a] (MDC)	Derived Concentration Guide[b] (DCG)	Drinking Water Detection Limits[c]
Air (particulate filter)[d]	Gross alpha	1×10^{-15} µCi/ml	2×10^{-14} µCi/ml	--
	Gross beta	4×10^{-15} µCi/ml	3×10^{-12} µCi/ml	--
	Specific gamma (^{137}Cs)	4×10^{-16} µCi/ml	4×10^{-10} µCi/ml	--
	^{238}Pu	1×10^{-18} µCi/ml	3×10^{-14} µCi/ml	--
	$^{239/240}Pu$	2×10^{-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 (charcoal cartridge)[d]	^{131}I	3×10^{-15} µCi/ml	4×10^{-10} µCi/ml	--
Air (atmospheric moisture)[e]	^{3}H	2×10^{-13} µCi/ml	1×10^{-7} µCi/ml	--
Air (precipitation)	^{3}H	1.6×10^{-7} µCi/ml	--	--
Water (drinking & surface)	Gross alpha	3 pCi/l	30 pCi/l	3 pCi/l
	Gross beta	2 pCi/l	100 pCi/l	4 pCi/l
	^{3}H	160 pCi/l	2×10^{6} pCi/l	1000 pCi/l
Milk	^{131}I	2×10^{-9} µCi/ml	--	--
Wheat	Specific gamma (^{137}Cs)	3×10^{-9} µCi/g	--	--
Wheat	^{90}Sr	5×10^{-9} µCi/g	--	--
Lettuce	Specific gamma (^{137}Cs)	2×10^{-7} µCi/g	--	--
Lettuce	^{90}Sr	1×10^{-7} µCi/g	--	--

a. The minimum detectable concentration (MDC) is an estimate of the concentration of radioactivity in a given sample type that can be identified with a 95% level of confidence and a precision of plus or minus 100 % under a specified set of typical laboratory measurement conditions.
b. DCGs, set by the DOE, represent reference values for radiation exposure. They are based on a radiation dose of 100 mrem/yr for exposure through a particular exposure mode such as direct exposure, inhalation, or ingestion of water.
c. These limits are required by the National Primary Drinking Water Regulations (40 CFR 141). The “detection limit” is the terminology used by the EPA and means the same as the MDC defined above.
d. The approximate MDC is based on an average filtered air volume (pressure corrected) of 570 m^3/week.
e. The approximate MDC is expressed for tritium (as tritiated water) in air, and is based on an average filtered air volume of 20 m^3, assuming an average sampling period of eight weeks.

2. Air Sampling

2.1 Sampling Methods

2.1.1 Low-Volume Air Samplers

Airborne particulate radioactivity was continuously monitored by a network of 14 air samplers (Figure 1), designed to provide effective 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 sample an average air volume of about 570 m^3 (20,000 ft^3).

Charcoal cartridges were screened weekly for Iodine-131 activity in batches of six to eight cartridges. Particulate filters were counted each week for gross (nonspecific) beta activity in a low-background beta counter after waiting a minimum of four days for the naturally occurring decay products of radon and thoron to decay. The particulate filters were also counted for gross (nonspecific) alpha activity.

At the end of the quarter, weekly filters from each location were combined to form a composite. All composites were then analyzed by gamma spectrometry for specific radionuclides. Selected composites were also analyzed for ^{90}Sr or transuranic radionuclides (^{238}Pu, $^{239/240}$Pu, and ^{241}Am).

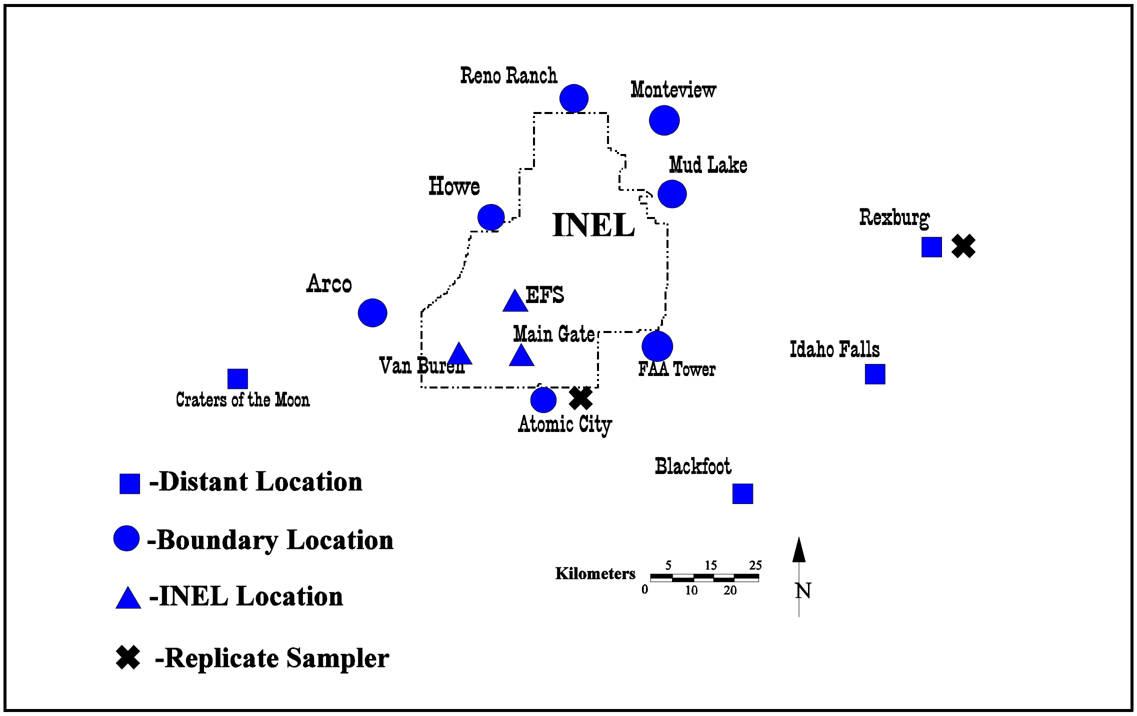

Figure 1 Air Sampling Location Map

2.1.2 Atmospheric Moisture Samplers

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

2.1.3 Precipitation Samplers

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

2.2 Results

2.2.1 Low-Volume Air Samplers

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

All gross alpha concentrations were within the expected range of background levels (Figure 2 and Table A-1, Appendix A). Gross alpha concentrations ranged from (0.2 ± 0.7) x 10^{-15} µCi/ml during the week of August 16-23 at Rexburg to (4.5 ± 1.9) x 10^{-15} µCi/ml during the week of September 20-27 at Atomic City. The quarterly mean gross alpha concentrations were nearly the same for the three sampling groups: (2.0 ± 0.3) x 10^{-15} µCi/ml (onsite group), (1.9 ± 0.2) x 10^{-15} µCi/ml (boundary group), and (2.0 ± 0.2) x 10^{-15} µCi/ml (distant group). These results are summarized in Table 3.

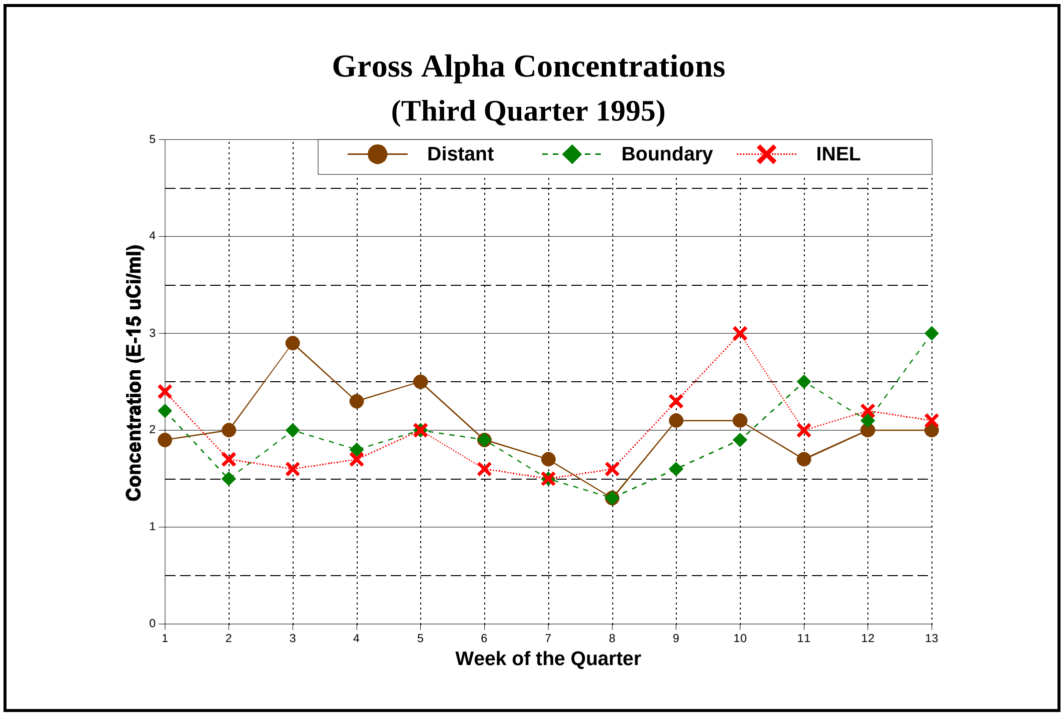

Figure 2 Weekly Gross Alpha Concentrations

Table 3 Gross Alpha Concentrations in Air (Third Quarter 1995)				
			Gross Alpha Concentration ($\times 10^{-15}$ µCi/ml)	
Group	**Location**	**Number of Samples**	**Range of Samples**	**Mean with 95% Confidence Interval**
Distant	Blackfoot	13	1.2 - 3.8	2.6 ± 0.5
	Craters of the Moon	13	0.8 - 2.9	1.6 ± 0.4
	Idaho Falls	13	0.9 - 3.3	1.9 ± 0.5
	Rexburg (Replicate)	13 (13)	0.2 - 3.5 (0.6 - 3.3)	2.1 ± 0.6 (2.0 ± 0.5)
			Group Mean	**2.0 ± 0.2**
Boundary	Arco	13	0.9 - 2.4	1.7 ± 0.3
	Atomic City (Replicate)	12 (13)	1.3 - 4.5 (0.3 - 4.3)	2.4 ± 0.6 (2.2 ± 0.6)
	FAA Tower	13	1.0 - 2.9	2.0 ± 0.3
	Howe	13	0.5 - 3.7	1.6 ± 0.5
	Monteview	13	1.0 - 3.6	2.2 ± 0.5
	Mud Lake	13	0.4 - 3.7	1.6 ± 0.6
	Reno Ranch	13	0.6 - 3.2	2.0 ± 0.5
			Group Mean	**1.9 ± 0.2**
INEL	EFS	13	0.9 - 2.8	1.6 ± 0.4
	Main Gate	11	0.9 - 3.0	2.0 ± 0.4
	Van Buren	13	0.8 - 3.9	2.3 ± 0.5
			Group Mean	**2.0 ± 0.3**
			DOE Derived Concentration Guide	20

All gross beta concentrations were also within the expected range of background levels (Figure 3 and Table A-2, Appendix A). The peak for week nine of the quarter (August 23-30) indicated elevated (relative to other weeks of the quarter) concentrations of gross beta at nearly all of the stations. A Student t-test indicated that the onsite concentrations were not statistically greater than at the boundary or distant stations for that week. The cause of the brief but widespread increase in gross beta concentrations is uncertain but may be related to greater airborne dust concentrations occurring at that time of year. This is due to a variety of factors such as agricultural activities, high winds, and dry surface soils.

Gross beta concentrations ranged from $(-1 \pm 2) \times 10^{-15}$ µCi/ml during the week of July 12-19 at Arco to $(81 \pm 9) \times 10^{-15}$ µCi/ml during the week of August 23-30 at the Main Gate. Quarterly means of gross beta concentrations for the onsite and

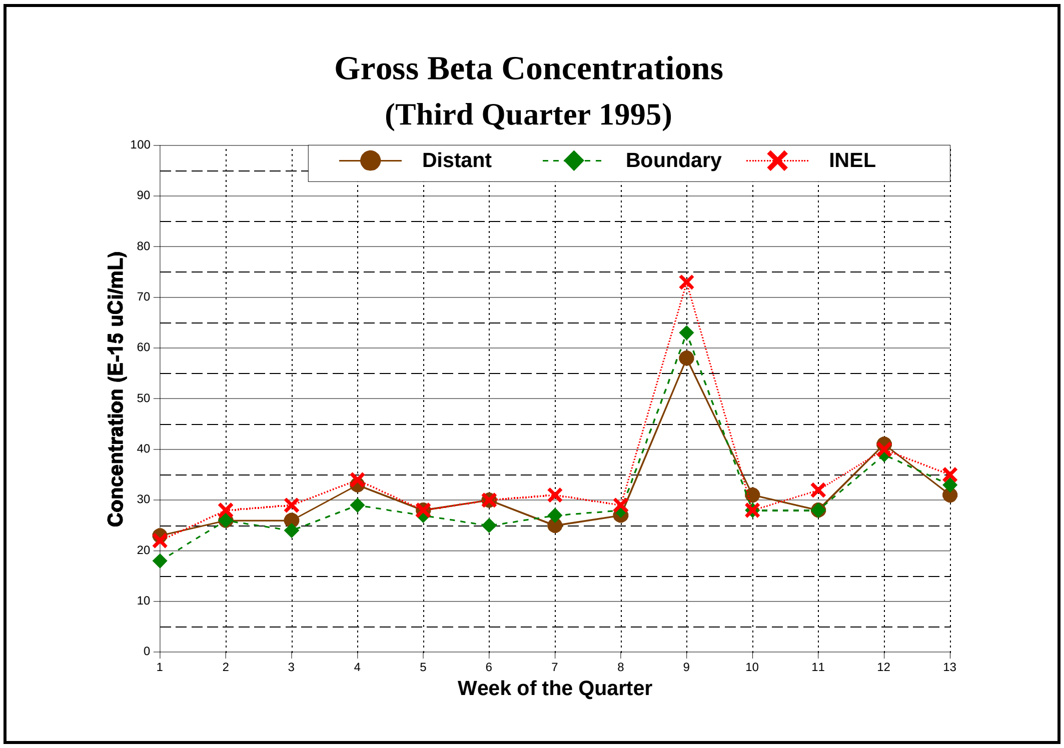

Figure 3 Weekly Gross Beta Concentrations

boundary locations were not statistically higher than the mean for the distant locations: (34 ± 4) x 10^{-15} µCi/ml (onsite), (30 ± 3) x 10^{-15} µCi/ml (boundary), and (31 ± 3) x 10^{-15} µCi/ml (distant). The results are summarized in Table 4.

The gross beta data for the Rexburg and Atomic City quality assurance replicates assisted data validation for those locations. The Rexburg and Atomic City mean values were statistically no different from their respective replicate mean values. Correlation tests indicated the Rexburg and Atomic City weekly gross beta results correlated well with their respective replicate results (to a 95% confidence level).

Beryllium-7, a naturally-occurring gamma-emitting radionuclide produced by cosmic rays in the atmosphere, was detected in all of the quarterly composites. No other gamma-emitting radionuclides were found on any of the composite samples. Strontium-90 was also not detected on any of the composite samples from distant, boundary, and INEL locations.

Table 4
Gross Beta Concentrations in Air
(Third 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	23 - 72	33 ± 8
	Craters of the Moon	13	20 - 41	31 ± 3
	Idaho Falls	13	17 - 63	29 ± 7
	Rexburg (Replicate)	13 (13)	24 - 61 (24 - 68)	32 ± 6 (32 ± 7)
			Group Mean	**31 ± 3**
Boundary	Arco	13	-1 - 67	26 ± 10
	Atomic City (Replicate)	12 (13)	24 - 69 (21 - 89)	32 ± 8 (35 ± 11)
	FAA Tower	13	20 - 67	34 ± 7
	Howe	13	15 - 37	27 ± 3
	Monteview	13	20 - 70	31 ± 8
	Mud Lake	13	12 - 67	30 ± 10
	Reno Ranch	13	19 - 73	33 ± 8
			Group Mean	**30 ± 3**
INEL	EFS	13	24 - 66	33 ± 7
	Main Gate	11	21 - 81	35 ± 11
	Van Buren	13	21 - 72	34 ± 8
			Group Mean	**34 ± 4**
		DOE Derived Concentration Guide		3000

Both Americium-241 and Plutonium-239/240 were detected on the quarterly composites (Table 5). Higher concentrations were seen at distant and boundary locations than on the INEL. Some of these filters were recounted to verify the presence of the two radionuclides. The recount failed to confirm the detection of Plutonium-239/240, but did indicate that Americium-241 was present on the filters. Upon review of the spectrum for the Craters of the Moon composite, the laboratory indicated that an electrical fault in the detector resulted in counts for naturally-occurring Polonium-210 being shifted into the region of the expected peak for Plutonium-239/240. The laboratory indicated that the recount value reflects the true amount of activity found in the sample.

Table 5
Transuranic Results for Particulate Filter Quarterly Composites
(Third Quarter 1995)

Location	Americium-241 (10^{-18} µCi/ml ± 2s)	Plutonium-238 (10^{-18} µCi/ml ± 2s)	Plutonium-239/240 (10^{-18} µCi/ml ± 2s)
Distant Locations			
Blackfoot	4 ± 2	Not Detected	2.2 ± 1.8
Craters of the Moon	9 ± 3 [12 ± 4][a]	Not Detected	34 ± 8 [Not Detected][b]
Boundary Locations			
Arco	23 ± 5 [14 ± 4][a]	Not Detected	5 ± 2 [Not Detected][b]
FAA Tower[c]	Not Detected	Not Detected	Not Detected
Howe[c]	3 ± 2	Not Detected	Not Detected
Monteview	4 ± 3	Not Detected	Not Detected
Reno Ranch[c]	Not Detected	Not Detected	Not Detected
INEL Locations			
Main Gate	Not Detected	Not Detected	1.8 ± 1.6 [Not Detected][b]
Van Buren[c]	Not Detected	Not Detected	Not Detected
DOE Derived Concentration Guide	2000	3000	2000

a. Americium activity confirmed by recount. Recount value in brackets.
b. No plutonium activity indicated by sample recounts. Recount value in brackets.
c. Additional composites submitted for analysis .

Additional composites from other locations were sent for transuranic analysis to gain further information on the possible distribution of plutonium and americium. Of the four sets of composites analyzed, none contained a detectable concentration of plutonium, and americium was found at one boundary location at just above the minimum detectable concentration. Although both plutonium and americium are present in soil, the concentrations obtained for the filters appear higher than would be expected if due to soil alone. The origin of the transuranic radionuclides has not been determined, but the lack of detectable concentrations on the filters taken from onsite stations suggests that an INEL source is not likely. Further investigation is being conducted on this set of results, and transuranic concentrations will be monitored to determine if trends are present in the concentrations detected.

2.2.2 Atmospheric Moisture Samplers

Two samples covering the third quarter were collected from each location. One of the samples, from the distant location of Idaho Falls, contained a detectable concentration of tritium at $(2.5 \pm 0.6) \times 10^{-13}$ µCi/ml. Tritium arises in the atmosphere from both natural (cosmic ray interactions with the atmosphere) and manmade sources. An INEL origin is not indicated for the tritium found in the third quarter, which was only found at the distant location and not at the INEL boundary sampling station.

2.2.3 Precipitation Samplers

Eight precipitation samples were collected in the third quarter. Each sample was analyzed for ^{3}H. Tritium was detected in three samples, one from each of the three sampling locations. The highest concentration was found in the September sample from the Idaho Falls location at $(1.7 \pm 1.0) \times 10^{-7}$ µCi/ml. While tritium attributable to the INEL has been found in isolated onsite precipitation samples during the past few years, the higher concentration at the distant location indicates that it is more likely that these concentrations are due to environmental tritium from natural atmospheric processes and historic nuclear weapons testing.

3. Water Sampling

3.1 Methods

Water samples were collected in early August from two drinking water locations and three surface water locations in the Magic Valley area (Figure 4). Drinking water sampling locations were local businesses. Surface water locations included three 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.

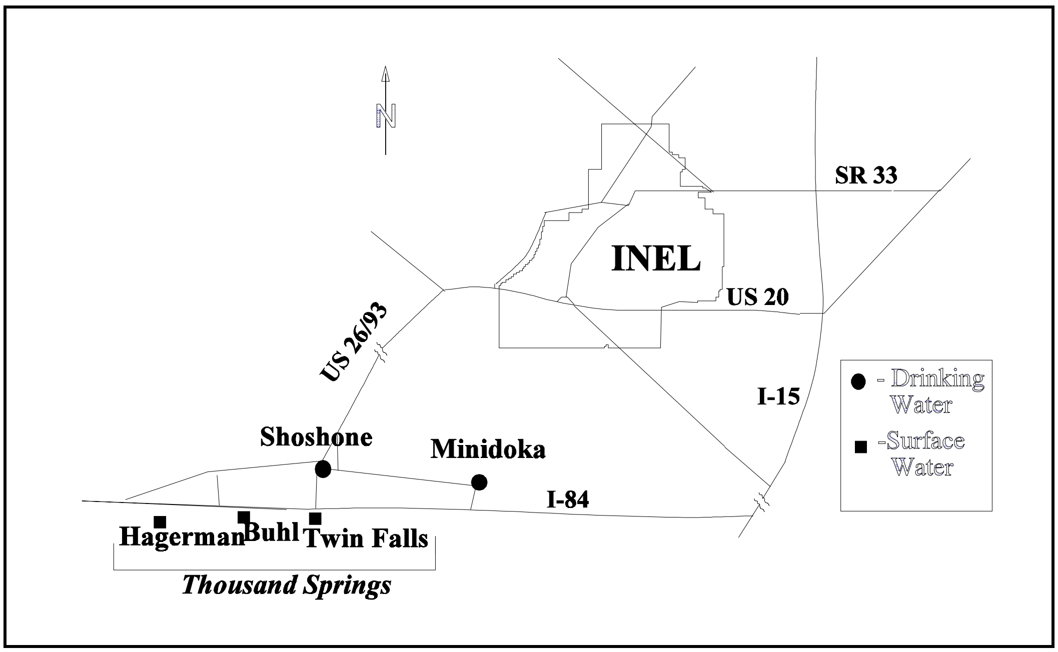

Figure 4 Quarterly Water Sampling Locations

3.2 Results

No drinking or surface water samples showed a measurable concentration of ^{3}H (Table 6). Two of the water samples contained detectable concentrations of gross alpha and all contained detectable gross beta concentrations. Gross alpha and gross beta radioactivity in water samples is generally attributed to naturally occurring decay products (primarily from the uranium and thorium series) obtained by water as it travels through the earth's crust.

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

Location	^{3}H (pCi/l ± 2s)	Gross Alpha (pCi/l ± 2s)	Gross Beta (pCi/l ± 2s)
Drinking Water			
Minidoka	0 ± 160	1 ± 3	3 ± 2
Shoshone	0 ± 160	3 ± 4	3 ± 2
Shoshone Replicate	0 ± 160	7 ± 4	4 ± 2
Surface Water			
Alpheus Spring (Twin Falls)	-10 ± 160	2 ± 4	6 ± 2
Bill Jones Hatchery (Hagerman)	0 ± 160	4 ± 3	1.8 ± 1.6
Clear Spring (Buhl)	0 ± 160	4 ± 4	2.4 ± 1.8
EPA Maximum Contaminant Level	20,000	15	50

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.

Lettuce samples were collected from eight private gardens and wheat samples were obtained from 10 local growers. All samples were analyzed by gamma spectrometry and for Strontium-90.

A fish sample was collected from the Big Lost River, which flowed through the INEL during late spring and early summer. An analyses was performed on this sample by gamma spectrometry.

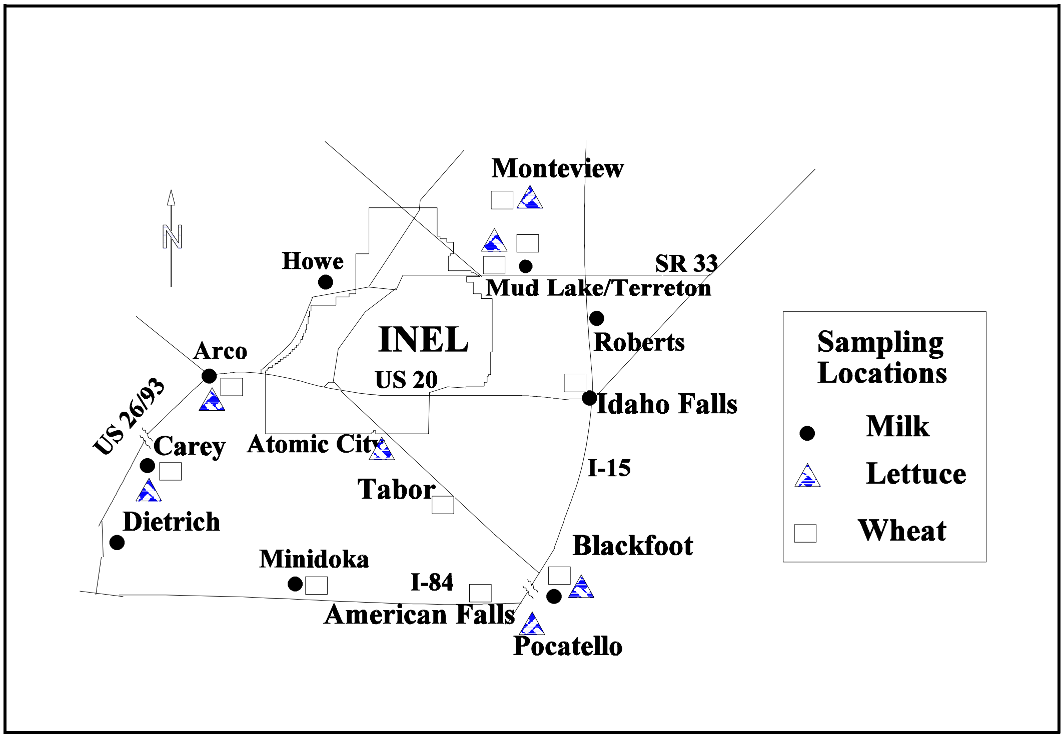

Figure 5 Foodstuff Sampling Locations

4.2 Results

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

Cesium-137 was detected in three of nine lettuce samples (Arco, Blackfoot, and a replicate sample from Pocatello), and Strontium-90 in all but one sample. Both the highest concentration of Cesium-137 [(4.8 ± 0.2) x 10^{-6} µCi/g] and Strontium-90 (Table 7) were found at the distant location of Blackfoot. The mean Strontium-90 concentration was greater at the distant than at boundary locations, although the range of values is quite large. Both Cesium-137 and Strontium-90 are found in soil as a result of worldwide fallout from historic nuclear weapons testing.

No manmade gamma-emitting radionuclides were found in the wheat samples at a minimum detectable concentration of 3 x 10^{-9} µCi/g. Strontium-90 was detected in most of the samples (Table 7). Results from an initial set of wheat samples were reported, but were rejected due to low chemical yields in the analysis and a low recovery obtained for the spike analyzed with the samples. Values in Table 7 represent those obtained from reanalysis of the samples, in which yields and the spike recovery were acceptable. Because one sample in the initial set, from Mud Lake, contained a Strontium-90 concentration that was outside the range normally seen, an additional fraction was analyzed and confirmed the value reported with the second set.

Three small fish were collected from the Big Lost River in the sourthern portion of the INEL. Due to the small size of the fish collected, the three fish were composited into one sample. No manmade gamma-emitting radionuclides were found in the fish sample.

Table 7
Strontium-90 Concentrations in Wheat and Lettuce (1995)

Location	Lettuce ($\times 10^{-9}$ µCi/g)	Wheat ($\times 10^{-9}$ µCi/g)
Distant Locations		
American Falls	No Sample	8 ± 4
Blackfoot	740 ± 200	4 ± 4
Carey	-50 ± 80	11 ± 7
Idaho Falls	170 ± 100	9 ± 5
Minidoka	No Sample	3 ± 5
Pocatello	Lost in Analysis	No Sample
Distant Group Mean	250 ± 1050	7 ± 4
Boundary Locations		
Arco	140 ± 50	5 ± 6
Atomic City	300 ± 120	No Sample
Monteview	100 ± 90	4 ± 4
Mud Lake	80 ± 40	4 ± 5
Terreton	No Sample	7 ± 5
Tabor	No Sample	12 ± 6
Boundary Group Mean	160 ± 160	6 ± 4

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	7/05	1.2 ± 1.1
	7/12	2.3 ± 1.4
	7/19	3.5 ± 1.6
	7/26	3.0 ± 1.5
	8/02	3.6 ± 1.7
	8/09	2.8 ± 1.5
	8/16	2.6 ± 1.5
	8/23	2.0 ± 1.3
	8/30	1.5 ± 1.2
	9/06	3.8 ± 1.7
	9/13	1.6 ± 1.2
	9/20	2.9 ± 1.6
	9/27	2.9 ± 1.5
Craters of the Moon	7/05	2.9 ± 2.1
	7/12	1.4 ± 1.4
	7/19	1.4 ± 1.1
	7/26	1.8 ± 1.3
	8/02	2.0 ± 1.4
	8/09	2.0 ± 1.4
	8/16	1.2 ± 1.1
	8/23	0.8 ± 1.0
	8/30	0.8 ± 1.0
	9/06	1.5 ± 1.4
	9/13	1.2 ± 1.3
	9/20	2.0 ± 1.5
	9/27	2.1 ± 1.4
Idaho Falls	7/05	1.3 ± 1.1
	7/12	1.8 ± 1.2
	7/19	3.3 ± 1.7
	7/26	2.6 ± 1.4
	8/02	1.4 ± 1.1
	8/09	1.0 ± 1.0
	8/16	0.9 ± 0.9
	8/23	2.4 ± 1.3
	8/30	2.7 ± 1.4
	9/06	2.1 ± 1.3
	9/13	1.1 ± 1.1

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	9/20	2.4 ± 1.5
	9/27	1.4 ± 1.1
Rexburg	7/05	2.3 ± 1.5 (2.6 ± 1.7)
(Replicate)	7/12	2.7 ± 1.5 (1.6 ±1.3)
	7/19	3.4 ± 1.6 (3.1 ± 1.6)
	7/26	2.0 ± 1.3 (1.5 ± 1.0)
	8/02	3.1 ± 1.5 (2.1 ± 1.4)
	8/09	1.8 ± 1.2 (2.4 ± 1.5)
	8/16	2.2 ± 1.4 (1.5 ± 1.2)
	8/23	0.2 ± 0.7 (1.2 ± 1.1)
	8/30	3.5 ± 1.7 (1.7 ± 1.3)
	9/06	1.3 ± 1.1 (0.6 ± 0.9)
	9/13	2.8 ± 1.5 (3.3 ± 1.7)
	9/20	0.6 ± 0.9 (3.0 ± 1.6)
	9/27	1.6 ± 1.2 (2.0 ± 1.3)
	Boundary Locations	
Arco	7/05	1.8 ± 1.2
	7/12	1.6 ± 1.2
	7/19	1.8 ± 1.2
	7/26	1.7 ± 1.2
	8/02	2.1 ± 1.3
	8/09	1.8 ± 1.2
	8/16	1.3 ± 1.1
	8/23	0.9 ± 0.9
	8/30	0.9 ± 1.0
	9/06	1.6 ± 1.2
	9/13	2.4 ± 1.4
	9/20	2.2 ± 1.4
	9/27	1.5 ± 1.2
Atomic City	7/05	3.2 ± 1.6 (2.1 ± 1.5)
(Replicate)	7/12	1.3 ± 1.2 (2.4 ± 1.8)
	7/19	2.4 ± 1.4 (2.8 ± 1.8)
	7/26	2.0 ± 1.4 (1.7 ± 1.5)
	8/02	invalid sample (4.3 ± 3.5)
	8/09	2.8 ± 1.5 (3.0 ± 1.9)
	8/16	1.6 ± 1.2 (2.0 ± 1.6)
	8/23	1.5 ± 1.2 (0.8 ± 1.2)
	8/30	2.8 ± 1.6 (2.2 ± 2.2)

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	9/06	1.6 ± 1.2 (3.1 ± 1.9)
	9/13	2.7 ± 1.5 (0.3 ± 1.0)
	9/20	2.1 ± 1.3 (1.9 ± 1.6)
	9/27	4.5 ± 1.9 (1.6 ± 1.4)
FAA Tower	7/05	2.9 ± 1.9
	7/12	1.9 ± 1.5
	7/19	1.7 ± 1.4
	7/26	2.7 ± 1.8
	8/02	1.3 ± 1.4
	8/09	2.5 ± 1.6
	8/16	1.8 ± 1.5
	8/23	2.3 ± 1.6
	8/30	1.0 ± 1.3
	9/06	2.4 ± 1.6
	9/13	2.1 ± 1.6
	9/20	2.2 ± 1.5
	9/27	1.8 ± 1.4
Howe	7/05	2.1 ± 1.5
	7/12	1.1 ± 1.1
	7/19	1.4 ± 1.1
	7/26	1.6 ± 1.1
	8/02	1.3 ± 1.1
	8/09	1.6 ± 1.1
	8/16	0.9 ± 1.0
	8/23	0.5 ± 0.8
	8/30	1.5 ± 1.1
	9/06	1.0 ± 1.0
	9/13	2.2 ± 1.3
	9/20	2.5 ± 1.4
	9/27	3.7 ± 1.7
Monteview	7/05	1.6 ± 1.3
	7/12	3.0 ± 1.6
	7/19	2.7 ± 1.5
	7/26	1.3 ± 1.1
	8/02	2.7 ± 1.5
	8/09	1.4 ± 1.2
	8/16	2.6 ± 1.5
	8/23	1.0 ± 1.0

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	8/30	1.6 ± 1.2
	9/06	2.9 ± 1.8
	9/13	2.2 ± 1.6
	9/20	1.6 ± 1.1
	9/27	3.6 ± 1.9
Mud Lake	7/05	0.4 ± 0.7
	7/12	0.6 ± 0.9
	7/19	1.7 ± 1.1
	7/26	0.8 ± 0.8
	8/02	1.8 ± 1.2
	8/09	2.0 ± 1.3
	8/16	1.0 ± 1.0
	8/23	1.3 ± 1.1
	8/30	1.5 ± 1.1
	9/06	2.1 ± 1.4
	9/13	3.7 ± 2.5
	9/20	1.2 ± 1.5
	9/27	2.8 ± 1.9
Reno Ranch	7/05	3.2 ± 1.8
	7/12	0.6 ± 1.1
	7/19	1.9 ± 1.4
	7/26	2.5 ± 1.5
	8/02	3.1 ± 1.6
	8/09	1.0 ± 1.1
	8/16	1.4 ± 1.2
	8/23	1.8 ± 1.3
	8/30	1.7 ± 1.3
	9/06	1.6 ± 1.3
	9/13	1.9 ± 1.4
	9/20	3.0 ± 1.7
	9/27	2.9 ± 1.6
	INEL Locations	
Main Gate	7/05	2.2 ± 1.4
	7/12	0.9 ± 1.0
	7/19	1.2 ± 1.1
	7/26	2.5 ± 1.5
	8/02	1.9 ± 1.3
	8/09	3.0 ± 2.9

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	8/16	invalid sample
	8/23	invalid sample
	8/30	2.1 ± 1.5
	9/06	2.7 ± 1.6
	9/13	2.6 ± 1.6
	9/20	1.5 ± 1.2
	9/27	1.7 ± 1.3
EFS	7/05	2.8 ± 1.6
	7/12	1.0 ± 1.2
	7/19	1.2 ± 1.1
	7/26	1.6 ± 1.2
	8/02	1.2 ± 1.1
	8/09	0.9 ± 1.0
	8/16	0.9 ± 1.0
	8/23	1.2 ± 1.1
	8/30	2.3 ± 1.5
	9/06	2.8 ± 1.6
	9/13	2.0 ± 1.4
	9/20	1.2 ± 1.1
	9/27	2.2 ± 1.4
Van Buren	7/05	2.0 ± 1.5
	7/12	3.1 ± 2.0
	7/19	2.5 ± 1.7
	7/26	0.9 ± 1.2
	8/02	2.8 ± 1.9
	8/09	0.8 ± 1.2
	8/16	2.0 ± 1.6
	8/23	2.1 ± 1.8
	8/30	2.5 ± 1.8
	9/06	3.3 ± 1.9
	9/13	1.4 ± 1.4
	9/20	3.9 ± 2.0
	9/27	2.3 ± 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	7/05	27 ± 5
	7/12	29 ± 5
	7/19	27 ± 5
	7/26	36 ± 5
	8/02	29 ± 5
	8/09	31 ± 5
	8/16	24 ± 5
	8/23	23 ± 5
	8/30	72 ± 7
	9/06	28 ± 5
	9/13	27 ± 5
	9/20	42 ± 6
	9/27	32 ± 5
Craters of the Moon	7/05	20 ± 6
	7/12	28 ± 5
	7/19	29 ± 5
	7/26	31 ± 5
	8/02	29 ± 5
	8/09	34 ± 5
	8/16	26 ± 5
	8/23	29 ± 5
	8/30	36 ± 6
	9/06	34 ± 6
	9/13	34 ± 6
	9/20	41 ± 7
	9/27	31 ± 5
Idaho Falls	7/05	17 ± 4
	7/12	22 ± 4
	7/19	22 ± 5
	7/26	28 ± 5
	8/02	27 ± 4
	8/09	23 ± 4
	8/16	27 ± 5
	8/23	21 ± 4
	8/30	63 ± 7
	9/06	31 ± 5
	9/13	25 ± 5

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	9/20	37 ± 6
	9/27	32 ± 5
Rexburg	7/05	26 ± 5 (24 ± 5)
(Replicate)	7/12	27 ± 5 (32 ± 5)
	7/19	25 ± 4 (24 ± 5)
	7/26	36 ± 5 (25 ± 4)
	8/02	28 ± 5 (31 ± 5)
	8/09	32 ± 5 (26 ± 5)
	8/16	24 ± 5 (29 ± 5)
	8/23	34 ± 5 (28 ± 5)
	8/30	61 ± 7 (68 ± 7)
	9/06	31 ± 5 (27 ± 5)
	9/13	26 ± 5 (31 ± 6)
	9/20	42 ± 6 (40 ± 6)
	9/27	29 ± 5 (35 ± 6)
Boundary Locations		
Arco	7/05	15 ± 3
	7/12	17 ± 4
	7/19	-1 ± 2
	7/26	23 ± 4
	8/02	26 ± 5
	8/09	17 ± 4
	8/16	22 ± 4
	8/23	29 ± 5
	8/30	67 ± 7
	9/06	23 ± 5
	9/13	27 ± 5
	9/20	42 ± 6
	9/27	29 ± 5
Atomic	7/05	25 ± 5 (21 ± 5)
City	7/12	29 ± 5 (26 ± 6)
(Replicate)	7/19	27 ± 5 (34 ± 6)
	7/26	33 ± 5 (41 ± 6)
	8/02	invalid sample (27 ± 9)
	8/09	28 ± 5 (31 ± 6)
	8/16	30 ± 5 (26 ± 6)
	8/23	24 ± 5 (33 ± 6)
	8/30	69 ± 8 (89 ± 12)

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	9/06	27 ± 5 (28 ± 6)
	9/13	9 ± 5 (23 ± 5)
	9/20	35 ± 5 (40 ± 7)
	9/27	30 ± 5 (40 ± 6)
FAA	7/05	22 ± 5
Tower	7/12	32 ± 6
	7/19	38 ± 6
	7/26	37 ± 6
	8/02	36 ± 6
	8/09	30 ± 5
	8/16	33 ± 6
	8/23	39 ± 7
	8/30	67 ± 8
	9/06	33 ± 6
	9/13	26 ± 6
	9/20	27 ± 5
	9/27	20 ± 5
Howe	7/05	15 ± 4
	7/12	25 ± 4
	7/19	28 ± 4
	7/26	26 ± 4
	8/02	28 ± 4
	8/09	21 ± 4
	8/16	29 ± 5
	8/23	24 ± 4
	8/30	31 ± 5
	9/06	30 ± 5
	9/13	25 ± 5
	9/20	37 ± 5
	9/27	34 ± 5
Monteview	7/05	20 ± 4
	7/12	28 ± 5
	7/19	27 ± 5
	7/26	32 ± 5
	8/02	22 ± 4
	8/09	26 ± 4
	8/16	25 ± 5

	8/23	29 ± 5

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

Location	**Weekly Collection Date**	**Concentration ± 2s Uncertainty (10^{-15} µCi/ml)**
	8/30	70 ± 7
	9/06	32 ± 6
	9/13	26 ± 6
	9/20	25 ± 4
	9/27	41 ± 7
Mud Lake	7/05	12 ± 3
	7/12	22 ± 4
	7/19	16 ± 4
	7/26	21 ± 4
	8/02	20 ± 4
	8/09	22 ± 4
	8/16	20 ± 4
	8/23	22 ± 4
	8/30	62 ± 7
	9/06	22 ± 5
	9/13	34 ± 8
	9/20	67 ± 9
	9/27	42 ± 7
Reno Ranch	7/05	19 ± 5
	7/12	26 ± 5
	7/19	30 ± 5
	7/26	31 ± 5
	8/02	27 ± 5
	8/09	31 ± 5
	8/16	32 ± 5
	8/23	29 ± 5
	8/30	73 ± 8
	9/06	31 ± 5
	9/13	29 ± 5
	9/20	42 ± 6
	9/27	33 ± 6
	INEL Locations	
Main Gate	7/05	21 ± 4
	7/12	27 ± 5
	7/19	32 ± 5
	7/26	31 ± 5
	8/02	29 ± 5

	8/09	34 ± 9

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

Location	Weekly Collection Date	Concentration ± 2s Uncertainty (10^{-15} µCi/ml)
	8/16	invalid sample
	8/23	invalid sample
	8/30	81 ± 9
	9/06	27 ± 5
	9/13	32 ± 6
	9/20	37 ± 6
	9/27	36 ± 6
EFS	7/05	24 ± 5
	7/12	28 ± 5
	7/19	27 ± 4
	7/26	34 ± 5
	8/02	29 ± 5
	8/09	27 ± 4
	8/16	29 ± 5
	8/23	27 ± 5
	8/30	66 ± 7
	9/06	28 ± 5
	9/13	32 ± 6
	9/20	42 ± 6
	9/27	35 ± 6
Van Buren	7/05	21 ± 5
	7/12	30 ± 6
	7/19	28 ± 6
	7/26	37 ± 6
	8/02	28 ± 6
	8/09	28 ± 5
	8/16	33 ± 6
	8/23	31 ± 7
	8/30	73 ± 9
	9/06	29 ± 6
	9/13	31 ± 6
	9/20	40 ± 7
	9/27	34 ± 6