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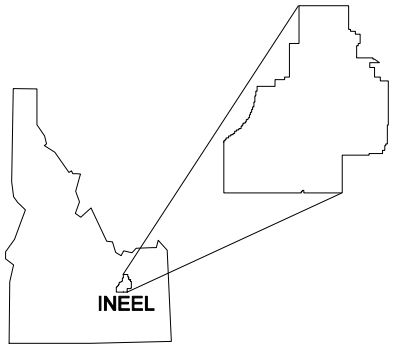

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Executive Summary

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 monitors the effects, if any, of U.S. Department of Energy (DOE) activities on the offsite environment, collects data to confirm compliance with applicable environmental laws and regulations, and observes any trends in environmental levels of radioactivity. This report for the third quarter of 1997 is based on 618 analyses conducted on 588 samples of air, water, milk, lettuce, wheat, and game animals. All concentrations of radioactivity found in these samples were consistent with concentrations which have been found in sampling during recent quarters and which have been attributed in the past to natural background, worldwide fallout from past nuclear weapons testing, and nuclear operations around the world. No measured concentrations could be directly attributed to operations at the INEEL. Concentrations in all samples were below the guidelines set by both the DOE and the U.S. Environmental Protection Agency (EPA) for 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 were near the INEEL boundary. An additional three air samplers were operated on the INEEL. Replicate samplers were operated at two offsite boundary locations for quality assurance purposes. Weekly measurements were made of gross alpha and gross beta activity 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 that location. These composites were then analyzed for gamma-emitting radionuclides. Selected composites were also submitted for analyses for strontium-90 and transuranics (plutonium-238, plutonium-239/240, and americium-241).

Atmospheric moisture and precipitation samples were collected to monitor for tritium. Atmospheric moisture samples were collected by sampling continuously for 12 weeks at each of four locations. The Foundation collected monthly precipitation samples at one onsite location and one offsite location, as well as a weekly precipitation sample at a second onsite location.

Drinking water samples were collected from two offsite locations, and surface water samples were obtained from three sites; all five sites were in the Magic Valley. All water samples were analyzed for gross alpha and gross beta activities and for 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. Selected samples were analyzed for strontium-90.

Lettuce and wheat were collected from areas surrounding the INEEL. The lettuce was sampled from local gardens, while wheat was sampled from commercial grain elevators.

Thyroid, liver, and muscle samples were taken from two game animals, a mule deer and a pronghorn antelope, and tested for gamma-emitting radionuclides. These animals had been accidentally killed on INEEL roads or highways.

A complete description of the methods and techniques used by the Foundation for sample collection and analysis can be found in previous Foundation quarterly reports, by contacting the Foundation at (208) 525-7052, or on the Foundation's web page (http://esrf.org).

Summary of Third Quarter 1997 Results

During the third quarter of 1997, gross alpha and gross beta activities in low-volume air samples were within the expected range of values for background radioactivity. During the third quarter, mean values for 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 detected in the quarterly composite sample from Blackfoot. Low concentrations of americium-241 were found in composites from Craters of the Moon, Mud Lake, Reno Ranch, and the Mountain View Community Monitoring Station, as well as onsite at the Experimental Field Station (EFS). These concentrations were consistent with past values observed throughout the network and were probably caused by continuing worldwide fallout and resuspension of fallout from nuclear weapons testing in the 1950's and 1960's.

PM_{10} sampling for respirable particulates continued in three locations: Atomic City, Rexburg, and Mountain View Middle School in Blackfoot. 24-hour samples were collected once every six days throughout the third quarter. Observed concentrations at the three stations were all below the short-term EPA standard of 150 $\mu g/m^3$ averaged over 24 hours. The average fine particulate concentrations were slightly elevated at all locations because of windy weather and agricultural activities.

Low concentrations of tritium were detected in atmospheric moisture samples from the Idaho Falls and Atomic City stations. Tritium was also found in the weekly onsite precipitation samples. However, tritium was not detected in atmospheric moisture samples from the distant locations or in the five water samples taken from the Magic Valley. The observed tritium concentrations in both atmospheric moisture and precipitation were well below DOE derived guidelines for the general public and can probably be attributed to comic ray bombardment of the atmosphere and to past nuclear weapons testing.

Gross alpha activity was not detected in any of the five water samples taken from the Magic Valley. All of the samples contained detectable gross beta activity, consistent with levels measured previously and probably attributable to natural radioactivity.

Detectable concentrations of iodine-131 were reported in two of the 38 milk samples collected during the third quarter (from Arco and Idaho Falls). The detection of these low concentrations is questionable because of the statistical variability inherent in radionuclide analyses.

Cesium-137 was detected in two of 10 lettuce samples from boundary and distant stations. Strontium-90 was also found in two boundary and three distant lettuce samples. Strontium-90 was also found in eight of 11 wheat samples, four from boundary stations and four from distant stations. The observed concentrations of strontium-90 in both lettuce and wheat are consistent with historical and expected ranges attributable to atmospheric nuclear weapons testing.

Cesium-137 was found in the muscle tissue of the pronghorn antelope; no other radionuclides were found in antelope samples. No detectable concentrations of radionuclides were found in the mule deer.

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1. Introduction

Consistent with requirements of applicable Department of Energy (DOE) Orders, the Foundation's environmental surveillance program monitors the effects, if any, of DOE activities on the offsite environment, collects data to verify compliance with applicable environmental laws and regulations, and observes trends in environmental levels of radioactivity. This quarterly report summarizes the data collected by the Foundation's INEEL Offsite Environmental Surveillance Program during the period July 1 through September 30, 1997. Appendix A summarizes the Foundation's surveillance program. Information useful in understanding this report is given in Appendix B.

Most of the reported environmental concentrations are at or near background levels of radioactivity; many results are near the detection limits of the laboratory procedures. Appendix A summarizes the approximate minimum detectable concentrations (MDC) of radioactivity which can be detected and quantified for a given sample type and analysis. All results are reported with an associated 2s ("two sigma") uncertainty term. The Foundation uses the following method for interpreting analytical results near the minimum detectable concentration: results less than or equal to the 2s uncertainty, which includes some negative values, 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 the detection of radioactivity.

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

- For air, concentrations are compared to the DOE Derived Concentration Guides (DCG). The DCG is the concentration of a radionuclide which, under conditions of continuous exposure for a year, 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 which is delivered to any user of a community water system.

2. Air Sampling

2.1. Low-Volume Air Sampling

Airborne particulate radioactivity was continuously monitored by 17 air samplers (Figure 1), designed to provide an effective network to detect INEEL releases of radioactivity. Five offsite air samplers are designated as distant, or background, stations and seven are designated as boundary stations. Three air samplers are situated on the INEEL. Distant locations were used to make comparisons of airborne concentrations of radioactivity with boundary and onsite locations.

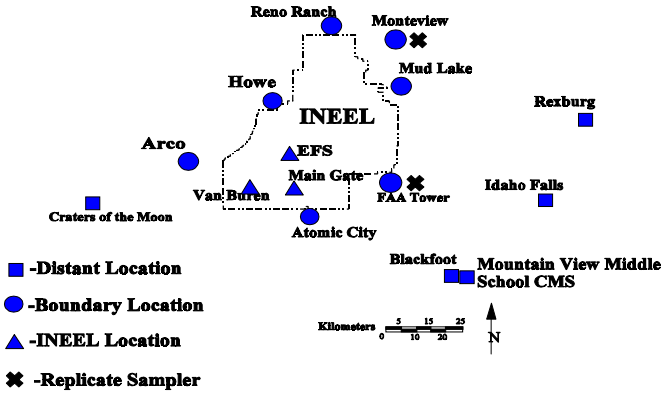

Figure 1 Weekly Air Sampling

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.

Various screening analyses were performed weekly. Charcoal cartridges were screened weekly in batches for ^{131}I activity. If activity was detected in any batch 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).

No ^{131}I was detected in any of the weekly charcoal cartridges during the third quarter.

All measured gross alpha activities were within the expected range of background levels. Gross alpha activities were generally greater at the distant stations than at boundary or INEEL stations. Figure 2 shows the weekly gross alpha activities measured throughout the quarter. Over the quarter, the difference between the mean of gross alpha activities at the onsite and boundary locations and the mean of gross alpha activities at the distant locations was not statistically significant. Table 1 summarizes the gross alpha measurements for the quarter. All measured beta activities were also within the range of expected background levels. Figure 3 shows gross beta activities over the 13-week quarter. Table 2 shows mean gross beta activities for the onsite and

boundary locations. The difference between the mean of these values and the mean for the distant locations was not statistically significant.

Replicate low-volume samplers were operated at the EFS and at Monteview for quality assurance purposes. There were no statistically significant differences between the mean values for gross alpha and gross beta at each of these sites and the means of their respective replicates. Appendix C contains the observed values of gross alpha and gross beta activities found in weekly air samples.

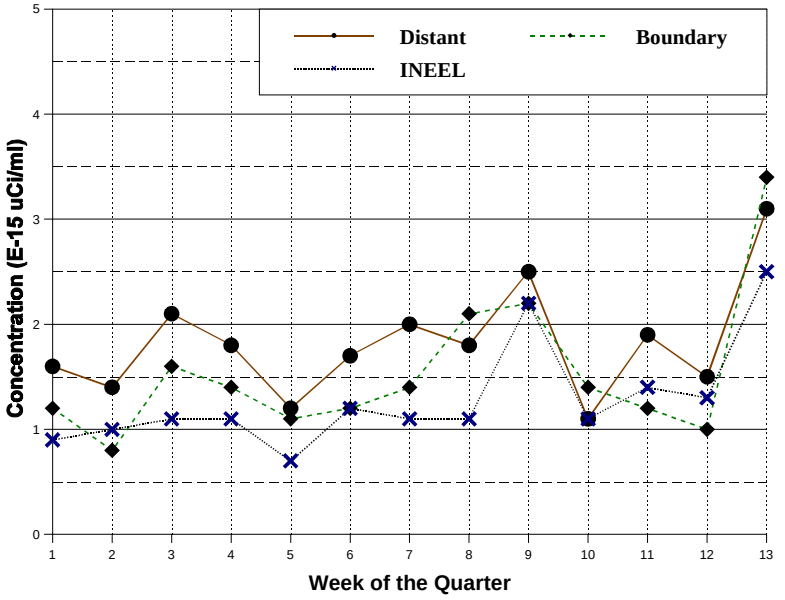

Figure 2 Gross Alpha Concentrations in Air

Selected quarterly composite samples were analyzed for transuranics of interest (^{241}Am, ^{238}Pu, and $^{239/240}$Pu). Low concentrations of ^{241}Am were detected at five of the sampling stations. Table 3 shows the locations and concentrations of the detected ^{241}Am. These values are consistent with concentrations found in recent composite samples and are probably attributable to worldwide fallout from atmospheric weapons testing. No other transuranics were detected at any of the stations.

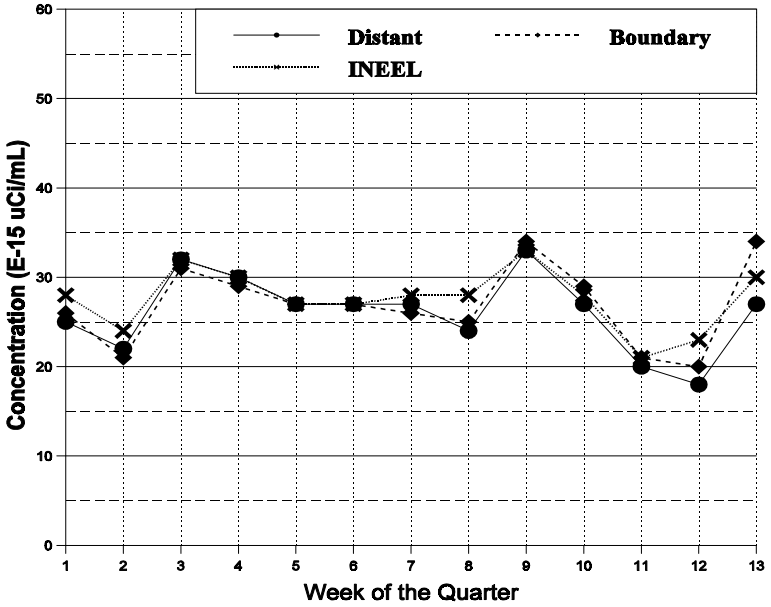

Figure 3 Gross Beta Activity in Air

Several composite samples were also selected for ^{90}Sr analysis. One sample from Blackfoot had a detectable concentration of $(1.1 \pm 0.9) \times 10^{-10}$ pCi/ml, probably attributable to worldwide fallout from atmospheric weapons testing and from the 1986 accident at Chernobyl.

Table 1
Gross Alpha Concentrations in Air
Third Quarter 1997

Group	Location	Number of Samples	Gross Alpha Concentration ($\times 10^{-15}$ µCi/ml) Range of Samples	Gross Alpha Concentration ($\times 10^{-15}$ µCi/ml) Mean with 95% Confidence Interval
Distant	Blackfoot	13	0.7-4.0	2.1 ± 0.5
	Craters of the Moon	13	0.1-2.4	1.1 ± 0.3
	Idaho Falls	12	1.0-3.1	2.0 ± 0.4
	Rexburg	13	0.7-3.0	1.9 ± 0.5
	Mountain View Middle School	13	0.7-3.6	2.0± 0.5
			Group Mean	**1.8 ± 0.2**
Boundary	Arco	13	1.0-4.7	1.9 ± 0.6
	Atomic City	13	0.9-2.6	1.5 ± 0.3
	FAA Tower (Replicate)	13 (13)	0.6-2.0 (0.2-1.9)	1.1 ± 0.3 (1.0 ± 0.3)
	Howe	13	0.8-3.6	1.4 ± 0.4
	Monteview (Replicate)	13 (13)	0.5-2.7 (0.5-1.9)	1.5 ± 0.3 (1.3 ± 0.3)
	Mud Lake	11	0.5-2.7	1.6 ± 0.4
	Reno Ranch	12	0.4-2.9	1.3 ± 0.4
			Group Mean	**1.5 ± 0.1**
INEEL	EFS	12	0.3-2.7	1.2 ± 0.4
	Main Gate	13	0.5-2.6	1.2 ± 0.3
	Van Buren	13	0.5-3.5	1.4 ± 0.4
			Group Mean	**1.3 ± 0.2**
			DOE Derived Concentration Guide	20

2.2 PM_{10} Air Sampling

Air sampling for respirable particulates continued at Madison Middle School (Rexburg), Mountain View Middle School (Blackfoot), and Atomic City. PM_{10} samplers were used to sample airborne particulates with an aerodynamic diameter smaller than 10 microns. Particles this size can penetrate the body's natural air filtering system and enter the lungs. These filters are not analyzed for radionuclides.

Samples were collected every sixth day from Rexburg, Blackfoot, and Atomic City. Concentrations at Rexburg ranged from 7 to 46 µg/m^3, with an average of 19 µg/m^3. At the Blackfoot location, values ranged from 8 to 53 µg/m^3 with an average concentration of 23 µg/m^3. In Atomic City the concentrations ranged from 13 to 121 µg/m^3 with an average concentration of 39 µg/m^3. The EPA standard is 150 µg/m^3 averaged over 24 hours, and 50 µg/m^3 averaged over the entire year. Fine particulate concentrations were above normal because of windy weather and agricultural activities.

2.3 Atmospheric Moisture Sampling

Ten atmospheric moisture samples were obtained from Idaho Falls, Rexburg, Blackfoot and

2. Air Sampling

Atomic City during this reporting period. Samples were collected by passing air through a column of silica gel which absorbed water vapor. Tritium concentrations were determined by extracting water from the silica gel and counting the water sample by liquid scintillation. Two of the samples, one from Idaho Falls ((5.6 ± 2.2) x 10^{-13} µCi/ml) and another from Atomic City ((2.7 ± 1.4) x 10^{-13} µCi/ml), contained low but detectable concentrations of tritium. This level of tritium is often attributed to cosmic interactions with the atmosphere, as well as fallout from atmospheric nuclear weapons testing. These concentrations are well below DOE derived guidelines for the general public.

Table 2
Gross Beta Concentrations in Air
Third 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	16-32	25 ± 3
	Craters of the Moon	13	18-32	24 ± 2
	Idaho Falls	12	19-34	27 ± 3
	Rexburg	13	17-38	28 ± 4
	Mountain View Middle School	13	19-31	26 ± 3
			Group Mean	**26 ± 1**
Boundary	Arco	13	18-37	25 ± 3
	Atomic City	13	21-33	26 ± 2
	FAA Tower (Replicate)	13 (13)	14-31 (19-34)	23 ± 3 (24 ±3)
	Howe	13	21-33	27 ± 2
	Monteview (Replicate)	13 (13)	22-37 (20-36)	28 ± 3 (28 ±3)
	Mud Lake	11	21-36	28 ± 3
	Reno Ranch	12	21-34	28 ± 2
			Group Mean	**26 ± 1**
INEEL	EFS	12	23-34	29 ± 2
	Main Gate	13	19-32	26 ± 2
	Van Buren	13	21-34	28 ± 2
			Group Mean	**28 ±1**
			DOE Derived Guideline	3000

Table 3
Americium-241 Concentrations in Air
Third Quarter 1997

Location of Americium-241	Concentration (10^{-18} µCi/ml ± 2s Uncertainty)
Craters of the Moon	5.4 ± 2.6
Mud Lake	5.1 ± 2.6
Reno Ranch	1.5 ± 1.5
Mountainview CMS	3.5 ± 2.0
EFS	3.5 ± 2.4
EFS Replicate	3.6 ± 2.2

2.4 Precipitation Sampling

Thirteen precipitation samples were collected in the third quarter from Idaho Falls, and from onsite locations at the Central Facilities Area and EFS, and analyzed for tritium. On three separate occasions, tritium was detected in the EFS samples. These low concentrations may be from INEEL operations, although they are not inconsistent with natural causes and past tests of nuclear weapons. Table 4 shows the date and concentrations of the detected tritium at EFS.

Table 4
Tritium Concentrations in Precipitation Samples at EFS

Date	Tritium Concentrations ± 2s Uncertainty (10^{-7} µCi/ml)
06/17/97	1.9 ± 1.0
08/12/97	1.5 ± 1.2
09/23/97	1.9 ± 1.2

3. Water Sampling

Water samples were collected in 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, while surface water locations included springs in the Thousand Springs area. These springs are some of the outlets for the Snake River Plain Aquifer, which flows beneath the INEEL. Samples was analyzed for gross alpha and gross beta activity by residue counting techniques. Tritium concentrations were determined by using liquid scintillation. None of the water samples showed measurable concentrations of ^{3}H or gross alpha. All of the samples contained detectable gross beta activity. Table 5 summarizes these findings. At these levels, radioactivity in water samples is generally attributed to naturally occurring decay products, primarily from uranium and thorium, sorbed by water as it flows through the earth's crust.

Table 5
Radioactivity in Offsite Water Samples
Third Quarter 1997

Location	^{3}H (pCi/l ± 2s)	Gross Alpha (pCi/l ± 2s)	Gross Beta (pCi/l ± 2s)
Drinking Water Sampling			
Minidoka	14 ±100	0 ± 1	3 ± 2
Shoshone	-47 ±100	0 ± 1	2 ± 2
Surface Water Sampling			
Alpheus Springs	35 ±100	0 ± 1	7 ± 2
Clear Spring	14 ±100	0 ± 1	5 ± 2
Bill Jones Hatchery	-35 ±100	0 ± 1	3 ± 2
Bill Jones Hatchery Replicate	20 ±100	0 ± 1	3 ± 2
EPA Maximum Contaminant Level	20,000	15	50

4. Foodstuff Sampling

Foodstuff sampling locations are shown in Figure 4. Samples of milk, lettuce, wheat, and big game animals were collected and analyzed. Milk samples were collected weekly in Idaho Falls and monthly at eight other locations around the INEEL (Figure 4). Two types of locations were sampled: single family dairies and large commercial dairies. Each milk sample was analyzed for ^{131}I by gamma spectrometry. Results were decay-corrected to the time of sample collection. A total of 38 milk samples were collected during the third quarter. Two of the samples exhibited detectable concentrations of ^{131}I. A sample for Idaho Falls had a concentration of $(1.9 \pm 1.6) \times 10^{-9}$ µCi/ml, and one sample from Arco had a concentration of $(2.4 \pm 2.3) \times 10^{-9}$ µCi/ml. However, these values are very low, with a concentration in each case only slightly greater than twice the sample standard deviation; normal statistical fluctuations in gamma spectroscopy can be expected to indicate such low positive concentrations in about 2.5% of samples when in fact no radioactivity is present.

Ten lettuce samples, including one duplicate, were collected from nine private gardens. All samples were analyzed for manmade gamma-emitting radionuclides and for ^{90}Sr. Cesium-137 was detected in two lettuce samples from boundary stations (Atomic City and Monteview). Lettuce samples from three distant stations and two boundary stations showed detectable levels of ^{90}Sr (Table 6). The mean boundary station ^{90}Sr concentration in lettuce did not exceed the mean distant ^{90}Sr concentration.

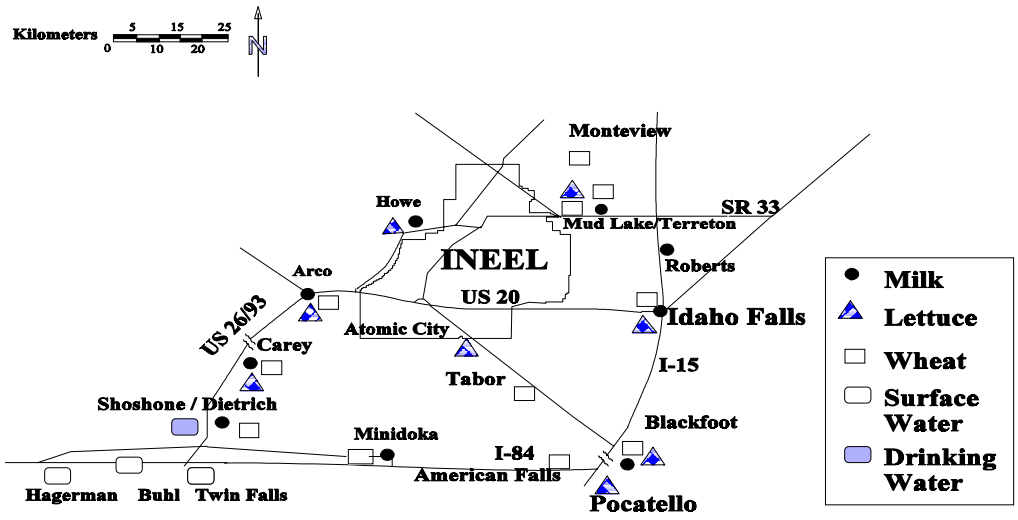

Figure 4 Water and Foodstuff Sampling Locations

Table 6
^{90}Sr Concentrations in Lettuce

Location	^{90}Sr Concentration (10^{-2} pCi/g)
Carey	7.2 ± 5.2
Idaho Falls	5.0 ± 1.3
Idaho Falls Replicate	5.0 ± 4.0
Mud Lake	17 ± 8.0
Monteview	9.4 ± 2.0
Blackfoot	8.5 ± 6.8

Eleven wheat samples, including one duplicate, were obtained from 10 local elevators. All samples were analyzed for manmade gamma-emitting radionuclides and for ^{90}Sr. Cesium-137 occurred in one wheat sample from Idaho Falls at $(2.7 \pm 2.5) \times 10^{-6}$ µCi/g. Detectable ^{90}Sr concentrations were found at four distant stations and at four boundary stations (Table 7).

The concentrations of ^{90}Sr in lettuce and wheat are consistent with both historical and expected ranges. The uncertainties of these values were somewhat elevated due to the small sample size collected. Both ^{137}Cs and ^{90}Sr are found in soil as a result of fallout from historic nuclear weapons testing

Two big game animals, a pronghorn antelope and a mule deer accidentally killed on INEEL roads during the quarter, were collected and analyzed. One muscle sample from a pronghorn antelope contained a cesium-137 concentration of $(6.8 \pm 3.3) \times 10^{-9}$ µCi/g. None of the other samples from the antelope or the mule deer contained detectable ^{90}Sr or ^{131}I.

Table 7
^{90}Sr Concentrations in Wheat

Location	^{90}Sr Concentration (10^{-3} pCi/g)
American Falls	9.4 ± 3.0
Carey	5.3 ± 2.2
Idaho Falls	4.2 ± 3.6
Rupert	4.6 ± 4.4
Arco	3.9 ± 3.4
Monetview	5.5 ± 4.6
Terreton	6.0 ± 4.2
Tabor	5.4 ± 5.0