Idaho National Engineering and Environmental Laboratory Offsite Environmental Surveillance Program Report: Fourth Quarter 1998

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August 1999

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ENVIRONMENTAL SCIENCE & RESEARCH FOUNDATION REPORT SERIES:
NUMBER ESRF-029(4QT98)
ISSN NUMBER 1089-5469

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Program conducted for the U.S. Department of Energy, Idaho Operations Office
Under Contract DE-AC07-94ID13268
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Executive Summary

The Environmental Science and Research Foundation conducts the Offsite Environmental Surveillance Program at the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory (INEEL). 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 fourth quarter 1998 is based on 622 samples collected of air, fine particulates, atmospheric moisture, precipitation, water, milk, potatoes, 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 radioactivity, 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, although statistical differences did exist between on-site and distant gross beta concentrations. No evidence could be found to link these differences with a specific INEEL source. 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).

PM_{10} samplers were operated at three offsite locations 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.

Atmospheric moisture and precipitation samples were collected to monitor for tritium. Atmospheric moisture samples were collected by sampling continuously for 13 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.

Water samples were collected in November from 14 drinking water locations and four surface water locations in the Magic valley and in Idaho Falls. Gross alpha and gross beta activities and tritium concentrations were determined for all samples.

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.

Potatoes were collected from area farms surrounding the INEEL and tested for gamma-emitting radionuclides. Selected samples were analyzed for strontium-90.

Seven big game animals were killed accidentally on INEEL roads during the quarter, and tissue samples of muscle, thyroid, and liver were collected from each of these animals and subjected to gamma spectroscopic analysis.

The Foundation collected 14 offsite TLDs (thermoluminescent dosimeters) to determine environmental radiation levels around the INEEL.

For more information concerning the contents of this report, contact the Foundation at (208) 525-7102, or visit the Foundation's web page (http://esrf.org).

Summary of Fourth Quarter 1998 Results

During the fourth quarter of 1998, gross alpha and gross beta activities in low-volume air samples were within the expected range of values for background radioactivity. Although the quarterly mean of gross beta activities in air observed at stations on the INEEL was higher than that observed at distant stations, the difference between INEEL stations and boundary staions was not significant. No statistically significant differences were observed in the quarterly mean of gross alpha activities measured at INEEL stations as compared with those distant and boundary stations. Iodine-131 was not found in any air sample. No specific radionuclide was detected in selected composite samples with either gamma spectroscopy or radiochemical analyses. The higher gross beta concentrations on the INEEL were probably attributable to normal fluctuations in concentrations of naturally-occurring radionuclides rather than to INEEL operations.

PM_{10} sampling for respirable particulates continued in three locations: Atomic City, Rexburg, and Mountain View Middle School in Blackfoot. Twenty-four-hour samples were collected once every six days throughout the fourth 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.

Tritium was detected in one atmospheric moisture sample and in one weekly precipitation sample. However, tritium was not detected in any of the surface or drinking water samples. The observed tritium concentrations in precipitation samples were well below DOE derived guidelines for the general public and can probably be attributed to cosmic ray bombardment of the atmosphere.

Gross alpha activity was detected in one of the 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.

No detectable concentrations of iodine-131 were reported in the 38 milk samples collected during the fourth quarter. A low concentration of strontium-90 was detected in a milk sample from Dietrich. Of seven potato samples collected and analyzed during the fourth quarter, three contained low concentrations of strontium-90. Of two elk and five mule deer killed accidentally on INEEL roads during the quarter, muscle samples from one elk and four deer exhibited low but detectable concentrations of cesium-137, and a liver sample from one deer also contained a detectable concentration of cesium-137. All of these concentrations were in the range of concentrations which have been observed in similar samples in the past and which can probably be attributed to worldwide fallout from above-ground nuclear weapons testing.

TLD measurements were comparable to data from past years and exhibited no statistically significant difference between distant and boundary locations.

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1. Introduction

This quarterly report summarizes data collected by the Foundation's Idaho National Engineering and Environmental Laboratory (INEEL) Offsite Environmental Surveillance Program during the period October 7 to December 30,1998. 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. 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 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. The Derived Concentration Guide 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), located 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. Two replicate samplers are also operated for quality control purposes. Distant locations were used to make comparisons of airborne concentrations of radioactivity with boundary and onsite locations. 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.

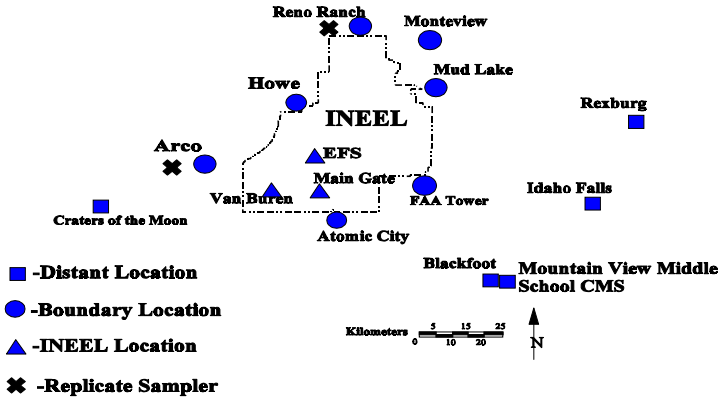

Figure 1 Weekly Air Sampling

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 daughter products of radon and thoron 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 fourth quarter.

Figure 2 shows the weekly gross alpha activities measured throughout the quarter. All measured gross alpha activities were within the expected range of background levels and were generally lower at the INEEL than at boundary or distant stations. Table 1 summarizes the gross alpha measurements for the quarter. There were no statistically significant differences between the quarterly mean of the gross alpha activities observed at stations on the INEEL and the means observed at distant and boundary stations.

Figure 3 shows gross beta activities over the 13-week quarter. All measured beta activities were also within the range of expected background values. At the 95% confidence interval, the mean of the weekly gross beta activities observed at stations on the INEEL was significantly higher than that of the distant stations. However, there was no statistically significant difference between the mean of weekly gross beta activities observed at stations on the INEEL and that of the boundary stations. No man-made radionuclides were detected either by gamma spectroscopic analyses of the quarterly composite samples or by radiochemical analyses of selected composites for ^{90}Sr, ^{241}Am, ^{238}Pu, and $^{239/240}Pu$. The difference between INEEL and distant stations in mean gross beta concentrations is therefore unlikely to be attributable to INEEL operations and is probably due to normal fluctuations in concentrations of naturally-occurring radionuclides.

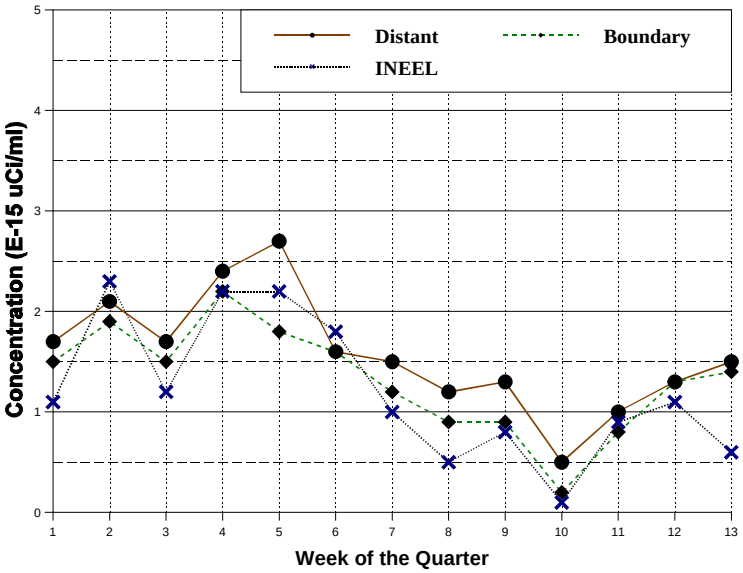

Figure 2 Gross Alpha Activity in Air

Replicate low-volume samplers were operated at Arco and at Reno Ranch 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.

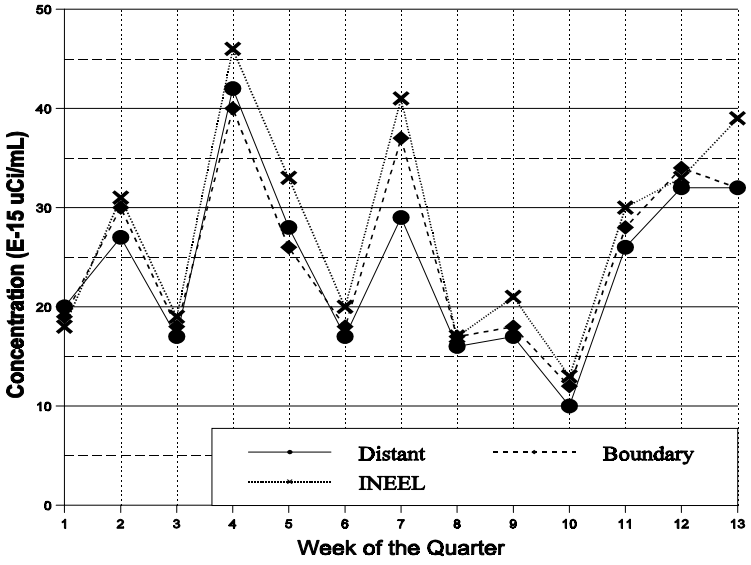

Figure 3 Gross Beta Activity in Air

Table 1
Gross Alpha Concentrations in Air
Fourth Quarter 1998

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	0.4-2.6	1.6 ± 0.5
	Craters of the Moon	13	0.1-1.7	0.8 ± 0.4
	Idaho Falls	13	0.9-2.7	1.7 ± 0.7
	Rexburg	13	0.3-2.7	1.7 ± 0.6
	Mountain View Middle School	13	0.7-4.5	2.1 ± 0.7
			Group Mean	**1.6 ± 0.6**
Boundary	Arco (Replicate)	13 (12)	0.0-3.3 (0.1-5.3)	1.8 ± 0.7 (1.6 ± 0.8)
	Atomic City	13	-0.3-2.6	1.2 ± 0.6
	FAA Tower	13	0.3-1.7	1.0 ± 0.5
	Howe	13	0.2-2.5	1.4 ± 0.6
	Monteview	13	0.4-2.4	1.4 ± 0.7
	Mud Lake	13	0.4-2.3	1.4 ± 0.6
	Reno Ranch (Replicate)	13 (13)	0.1-2.3 (0.2-2.2)	1.2 ± 0.6 (1.1 ± 0.6)
			Group Mean	**1.3 ± 0.6**
INEEL	EFS	13	0.1-2.5	1.3 ± 0.6
	Main Gate	13	0.3-2.6	1.4 ± 0.6
	Van Buren	13	-0.4-2.4	1.0 ± 0.5
			Group Mean	**1.2 ± 0.5**
			DOE Derived Concentration Guide	20

Table 2
Gross Beta Concentrations in Air
Fourth Quarter 1998

Group	Location	Number of Samples	Gross Beta Concentration ($\times 10^{-15}$ µCi/ml) Range of Samples	Gross Beta Concentration ($\times 10^{-15}$ µCi/ml) Mean with 95% Confidence Interval
Distant	Blackfoot	13	9-37	22 ± 2
	Craters of the Moon	13	8-40	22 ± 2
	Idaho Falls	13	12-44	27 ± 2
	Rexburg	13	12-40	25 ± 2
	Mountain View Middle School	13	8-47	24 ± 2
			Group Mean	**24 ± 2**
Boundary	Arco (Replicate)	13 (12)	11-43 (12-40)	25 ± 2 (22 ± 2)
	Atomic City	13	1-49	22 ± 2
	FAA Tower	13	11-43	20 ± 2
	Howe	13	14-48	29 ± 2
	Monteview	13	11-41	27 ± 2
	Mud Lake	13	15-48	29 ± 2
	Reno Ranch (Replicate)	13 (13)	11-45 (9-39)	24 ± 2 (25 ± 2)
			Group Mean	**25 ± 2**

Table 2 (continued)
Gross Beta Concentrations in Air
Fourth Quarter 1998

Group	Location	Number of Samples	Gross Beta Concentration ($\times 10^{-15}$ µCi/ml) Range of Samples	Mean with 95% Confidence Interval
INEEL	EFS	13	14-48	28 ± 2
	Main Gate	13	13-44	29 ± 2
	Van Buren	13	12-45	26 ± 2
			Group Mean	**28 ± 2**
			DOE Derived Guideline	3000

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 4 to 92 µg/m^3, with an average of 26 µg/m^3. At the Blackfoot location, values ranged from 2 to 26 µg/m^3 with an average concentration of 11 µg/m^3. In Atomic City the concentrations ranged from 3 to 92 µg/m^3 with an average concentration of 18 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.

2.3 Atmospheric Moisture Sampling

Four atmospheric moisture samples were obtained from Idaho Falls, Rexburg, Blackfoot and 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. One sample from Idaho Falls contained a detectable level of tritium of 3.5 ± 3.4 µCi/ml of air. Detections at this low level can be attributed to worldwide cosmic tritium production or statistical fluctuations.

2.4 Precipitation Sampling

Thirteen precipitation samples were collected in the fourth quarter from Idaho Falls and from onsite locations at the Central Facilities Area (CFA) and the Experimental Field Station (EFS), and analyzed for tritium. Tritium was detected in one sample from EFS at a concentration of 1.1×10^{-7} µCi/mL. These low concentrations may have been from INEEL operations, although they were consistent with concentrations attributed to natural causes.

3. Water Sampling

Water samples were collected in November from 14 drinking water locations and four surface water locations in the Magic Valley area and Idaho Falls (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 were analyzed for gross alpha and gross beta activity by residue counting techniques. No samples showed measurable concentrations of tritium. A sample from Arco had detectable gross alpha activity. All of the samples contained detectable gross beta activity. Table 3 summarizes these findings. At these levels, radioactivity in water samples is generally attributed to naturally occurring decay products, sorbed by water as it flows through the earth's crust.

Table 3
Radioactivity in Offsite Water Samples
Fourth Quarter 1998

Location	Tritium (pCi/l ± 2s)	Gross Alpha (pCi/l ± 2s)	Gross Beta (pCi/l ± 2s)
Drinking Water			
Aberdeen	-46 ± 100	1 ± 1	8 ± 2
Arco	80 ± 100	1 ± 1	2 ± 2
Atomic City	-53 ± 100	0 ± 1	3 ± 2
Blackfoot	-15 ± 100	0 ± 1	3 ± 2
Carey	-53 ± 100	1 ± 1	3 ± 2
Fort Hall	-52 ± 100	0 ± 1	7 ± 2
Howe	-55 ± 100	-1 ± 1	2 ± 2
Idaho Falls	-80 ± 100	0 ± 1	3 ± 2
Minidoka	-50 ± 100	0 ± 1	4 ± 2
Monteview	-69 ± 100	0 ± 1	10 ± 2
Mud Lake	-46 ± 100	0 ± 1	3 ± 2
Roberts	-93 ± 100	0 ± 1	4 ± 2
Shoshone	13 ± 100	0 ± 1	3 ± 2
Surface Water			
Alpheus Spring (Twin Falls)	40 ± 100	1 ± 1	9 ± 2
Bliss	-100 ± 100	0 ± 1	4 ± 2
Bill Jones Hatchery (Hagerman)	-38 ± 100	0 ± 1	4 ± 2
Clear Spring (Buhl)	-100 ± 100	-1 ± 1	6 ± 2
Idaho Falls	48 ± 100	0 ± 1	4 ± 2
EPA Maximum Contaminant Level	20,000	15	50

4. Foodstuff Sampling

Foodstuff sampling locations are shown in Figure 4. 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 fourth quarter. None of the

samples exhibited detectable concentrations of ^{131}I. Of four samples selected for radiochemical analysis, strontium-90 was found only in the Dietrich area at a concentration of $(6.8 \pm 3.3) \times 10^{-4}$ pCi/mL. This concentration is consistent with concentrations found in milk throughout the world. Sources include fallout from historic above ground nuclear testing, and past nuclear accidents such as Chernobyl.

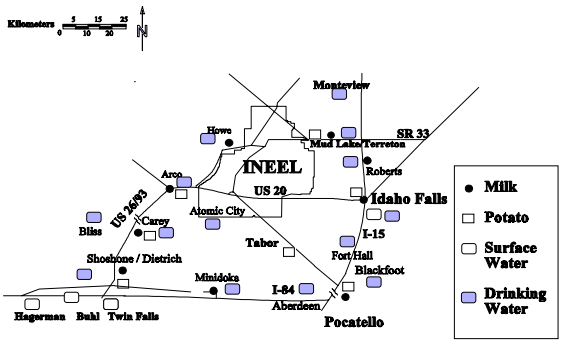

Figure 4 Water and Foodstuff Sampling Locations

Seven potato samples were collected during the fourth quarter of 1998, four from distant locations and three from boundary locations. Strontium-90 was detected in the sample from Monteview at a concentration of $(5.8 \pm 5.1) \times 10^{-3}$ pCi/g, the sample from Blackfoot at $(3.2 \pm 2.6) \times 10^{-3}$ pCi/g and in the sample from Arco at a concentration of $(5.4 \pm 3.6) \times 10^{-3}$ pCi/g. These concentrations are consistent with past results seen in potatoes and are likely due to historic worldwide fallout from nuclear weapons testing and reactor accidents.

Two elk and five mule deer were killed accidentally on INEEL roads during the fourth quarter of 1998, and tissue samples of muscle, thyroid, and liver were collected from each of these animals and subjected to gamma spectroscopic analysis. Muscle samples from one of the elk and four of the mule deer contained low but detectable concentrations of cesium-137, and a liver sample from one mule deer also contained detectable cesium-137. No iodine-137 was found in any of the thyroid samples. Table 4 shows the detectable concentrations of radionuclides found in these animals. These small concentrations are within the range of values observed in past wild game samples and can be attributed to the ingestion of radionuclides from worldwide fallout from above-ground nuclear weapons testing.

Table 4
Cesium-137 Concentrations in Road-Killed Wild Game
Fourth Quarter 1998

Collection Date	Species	Tissue	Cs-137 Concentration ($\mu Ci/g \times 10^{-8} \pm 2s$)
10/05/98	Mule Deer	Muscle	1.2 ± 0.3
10/15/98	Mule Deer	Muscle	1.6 ± 0.3
11/30/98	Mule Deer	Muscle	1.7 ± 0.3
11/30/98	Mule Deer	Liver	1.3 ± 0.4
12/10/98	Elk	Muscle	0.2 ± 0.2
12/15/98	Mule Deer	Muscle	0.4 ± 0.2

5. Environmental Radiation

Thermoluminescent dosimeters (TLDs), changed semiannually, were collected from six boundary and eight distant locations (Figure 5). TLD measurements for the second half of 1998 (May 1998-October 1998) show similar exposure levels to the previous six-month interval (Table 5). There were no statistically significant differences between the distant and boundary groups.

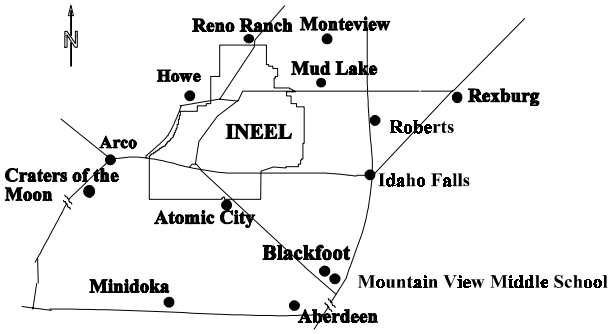

Figure 5 TLD Locations

Table 5
Radiation Exposures at Distant and Boundary Locations (1998)

Location	Exposure (mR ± 2s)		
	Nov. 1997-May 1998	May 1998-Oct. 1998	Annual Total
Distant Locations			
Aberdeen	62 ± 7	66 ± 3	128 ± 8
Blackfoot	65 ± 4	65 ± 4	130 ± 6
Craters of the Moon	56 ± 4	66 ± 5	122 ± 6
Idaho Falls	64 ± 5	60 ± 4	124 ± 6
Minidoka	57 ± 5	59 ± 5	116 ± 7
Rexburg	71 ± 6	73 ± 3	144 ± 7
Roberts	61 ± 4	69 ± 4	130 ± 6
Mountain View Middle School	56 ± 2	57 ± 4	113 ± 4
Group Mean	**62 ± 9**	**64 ± 8**	**126 ± 12**
Boundary Locations			
Arco	65 ± 6	63 ± 3	128 ± 7
Atomic City	66 ± 4	66 ± 4	132 ± 6
Howe	62 ± 2	63 ± 5	125 ± 5
Monteview	61 ± 2	63 ± 3	124 ± 4
Mud Lake	69 ± 6	68 ± 3	137 ± 7
Reno Ranch	61 ± 4	56 ± 5	117 ± 6
Group Mean	**64 ± 9**	**63 ± 8**	**127 ± 12**