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Idaho National Engineering And Environmental Laboratory Offsite Environmental Surveillance Program Report: Second Quarter 2001

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EXECUTIVE SUMMARY

This report for the second quarter, 2001, consists of results from the Environmental Surveillance, Education, and Research (ESER) Program's monitoring of the Department of Energy's Idaho National Engineering and Environmental Laboratory's (INEEL) offsite environment. All sample types (media) and the sampling schedule followed during 2001 are listed in Appendix A. This report contains results for the following:

- Air sampling, including air filters, charcoal cartridges, and atmospheric moisture,
- Precipitation,
- Drinking and surface water,
- Foodstuff sampling, including milk, sheep, large game animals, and marmots, and
- Environmental radiation.

During two weeks, those ending April 11, and May 23, the average gross beta concentration for INEEL locations was significantly higher than at Distant locations. Also during two weeks, those ending April 18 and May 23, the average gross beta concentration for INEEL locations was significantly higher than at Boundary locations. During one week (April 11), the average gross beta concentration was higher at Boundary locations than at Distant locations.

The average gross alpha concentration for INEEL locations was significantly higher than at Distant locations during two weeks, those ending April 4, and June 20. During those same weeks, the average gross alpha concentration at Boundary locations was significantly higher than Distant locations. There were no consistent trends (for either gross alpha or gross beta) over time where INEEL was higher than Boundary, which was higher than Distant locations as one would expect if the INEEL was the source of radionuclide contamination. Gross alpha and gross beta results for individual filters are listed in Table C-1 of Appendix C.

Monthly average gross alpha and beta concentrations in air at each sampling location are shown in Figures 10 – 15. No ^{131}I was detected in any of the weekly charcoal cartridges during the second quarter. Weekly ^{131}I results for each location are listed in Table C-2 of Appendix C.

Weekly filters for the second quarter of 2001 were composited by location. Selected locations were analyzed for the gamma emitting radionuclides, ^{90}Sr , ^{238}Pu , $^{239/240}\text{Pu}$, and ^{241}Am . No ^{238}Pu or ^{137}Cs were detected on any of the composite samples. Of the nine samples submitted for analysis, ^{241}Am was detected in five of them. Four of the five samples had levels greater than their respective 2s and minimum detectable concentrations (MDC) (see Table 2). One sample, from the Arco QA-1 station, had an ^{241}Am result greater than 2s, but less than the MDC. $^{239/240}\text{Pu}$ was detected in four of the samples submitted. Three of the four samples had levels greater than their respective 2s and MDCs (see Table 2). One sample, from the Main Gate location, had a result greater than 2s, but less than the MDC. ^{90}Sr was detected in two of the samples submitted at a level greater than their associated 2s values, but less than the MDCs, indicating they are most likely false positives. Concentrations were within the range of values measured throughout the World. In addition, detected values in composite samples for ^{241}Am ranged from 5,100 to over 10,500 times smaller than the derived concentration guide (DCG) value. Values detected in composite samples for $^{239/240}\text{Pu}$ ranged from 5,800 to over 17,500 times smaller than the DCG value. Details of both weekly and quarterly analyses can be found in section 3.1.

Nine atmospheric moisture samples were obtained during the second quarter of 2001 - three from Rexburg CMS, three from Blackfoot CMS, two from Atomic City and one from Idaho Falls. Five samples were greater than their associated 2s uncertainty and MDC (Table 3). For comparison, the results measured at these locations during the second quarter of 2001 were between 87,000 and 225,000 times lower than the DCG value for tritium in air (as atmospheric moisture) of 1×10^{-7} $\mu\text{Ci/mL}$ (3.7×10^{-3} Bq/mL) (see Table B-1). Tritium results for all atmospheric moisture samples are listed in Table C-4 (Appendix C).

PM_{10} concentrations for the second quarter of 2001 were well below all air quality standard levels. The maximum 24-hour concentration was $44.9 \mu\text{g/m}^3$ on April 18, at Rexburg CMS. Results for all PM_{10} samples are listed in Table C-5, Appendix C.

For the second quarter of 2001, there was enough precipitation for a total of six samples – two monthly composites from Idaho Falls, two monthly composites from the Central Facilities Area (CFA), and two weekly samples from the Experimental Field Station (EFS). Of the precipitation samples collected, two EFS samples (collected on April 4 and April 18) yielded tritium results greater than the 2s uncertainty. The sample collected on April 4 did not exceed the MDC, while the sample collected on April 18 did exceed the MDC (see table B-1 for MDC values). Tritium was also detected above the 2s level in the Idaho Falls sample in May and the duplicate sample from Idaho Falls in June. However, neither of these samples exceeded their associated MDC, indicating false positives. While there are no specific limits on the amount of tritium in precipitation, as a comparison the Safe Drinking Water Act (SDWA) limits tritium in drinking water to 2×10^4 pCi/L (Appendix B-1). The level of tritium detected in the sample from EFS that was above its associated 2s and MDC value was 140 times lower than the SDWA limit.

Fourteen drinking water samples were collected from selected taps throughout southeast Idaho (Figure 16). Samples were analyzed for gross alpha, gross beta, and tritium (^3H). Only the water samples from Fort Hall and Moreland were above 2s and above the MDC for tritium. All drinking water samples had gross beta results above 2s, and all but four (those from Carey, Arco, Howe and Idaho Falls) were greater than their associated MDCs. Of the samples analyzed for gross alpha, four, those from Minidoka, Arco, Atomic City, and Monteview, were greater than 2s and their associated MDCs.

The level of tritium detected in the samples from Fort Hall and Moreland that were above 2s and the MDC were 155 to 179 times lower than the SDWA limit. The measured levels were also within the range of background tritium that exists throughout the world. The level of gross beta detected in the samples that were above 2s and the MDC were between 4 to 18 times lower than the SDWA limit. The level of gross beta detected in the samples that were above 2s and the MDC were between 7 to 20 times lower than the SDWA limit. Levels of gross alpha and gross beta observed are not unusual given the basaltic terrain (USGS 1991). All values are similar to those recorded in previous years, and are well below the levels outlined for drinking water.

Five surface water samples and one duplicate sample were collected from locations throughout southeast Idaho and analyzed for tritium, gross alpha, and gross beta. Results for tritium analyses showed that only one sample (Idaho Falls) was above its 2s and MDC. At the reported level, the tritium result is 83 times smaller than the SDWA limit, and 333 times smaller than the DCG value. Analytical results for gross alpha showed that the samples from Bliss and Buhl exceeded their 2s and MDC values (Table 6). At reported levels, the gross alpha values are between 13.6 and 16.5 times lower than the SDWA limit and between 27.3 to 33.0 times

lower than the DCG value. Results for gross beta for all five surface water samples, and the duplicate from Buhl, were greater than their associated 2s and MDC values (Table 6). The gross beta values are between 7.7 and 16.8 times lower than the SDWA levels, and between 15.4 to 33.6 times lower than DCG values (Table B-1).

Milk samples were collected weekly in Idaho Falls and monthly at nine other locations around the INEEL (Figure 17), and analyzed for gamma emitting radionuclides. No samples had a ^{137}Cs concentration greater than the 2s uncertainty. One sample from Rupert (dated April 3) had an ^{131}I result greater than the 2s and MDC, however, an immediate recount showed the sample did not exceed either the 2s or MDC, thus indicating a false positive. Of the six samples submitted for ^{90}Sr analysis, all of them had concentrations of ^{90}Sr greater than the 2s level, and three were above their associated MDC (Carey, Rupert, Blackfoot). Of the four samples submitted for tritium analysis only one had a concentration greater than its associated 2s (Roberts).

While there are no specific regulatory limits for ^{90}Sr in milk, as a comparison, the DCG for ^{90}Sr of $1.0 \times 10^{-6} \mu\text{Ci/ml}$ in water can be used. Samples that exceeded both the 2s and MDC were from 1,209 to 1,330 times smaller than the DCG value. Further information on second quarter milk samples can be found in section 5.1.

Individual sheep from three separate flocks were sampled including a control flock in Dubois from the Experimental Sheep Station, a flock from a southern INEEL allotment, and a flock from a northern INEEL allotment. Two sheep were taken from each flock. Thyroid, muscle, and liver tissue were collected and analyzed for gamma emitting radionuclides. No ^{131}I was found in any of the samples. Analysis for ^{137}Cs showed results greater than 2s in three samples from two separate sheep: one muscle and one liver sample collected from the same lamb on the Northern allotment on May 18, and one muscle sample collected May 9, from a lamb on the Southern allotment. All concentrations of ^{137}Cs were similar to those found in both onsite and offsite sheep samples during recent years.

Environmental dosimeter locations are divided into Boundary and Distant groupings. Boundary exposure rates ranged from 0.33 to 0.37 mR/day. The overall average was 0.35 mR/day. The Distant set ranged from 0.32 to 0.41 mR/day. The average Distant value was 0.36 mR/day. No statistical difference existed between Boundary and Distant locations. Furthermore, all values are in line with past readings. Table 5 lists the range and average for both groups.

All concentrations of radioactivity found in samples collected by the ESER program during the second quarter, 2001 were consistent with concentrations that have been found in samples taken during recent years. The ESER program could not directly attribute measured concentrations to operations at the INEEL. Radionuclide concentrations in all of the samples collected and analyzed were below guidelines set by both the DOE and the Environmental Protection Agency (EPA) for protection of human health.

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LIST OF ABBREVIATIONS

AEC	Atomic Energy Commission
Bq	becquerel
CFA	Central Facilities Area
CMS	community monitoring station
Ci	curie
DCG	Derived Concentration Guide
DOE – ID	U.S. Department of Energy - Idaho Operations Office
EAL	Environmental Assessment Laboratory
EFS	Experimental Field Station
EML	Environmental Measurements Laboratory
EPA	Environmental Protection Agency
ERAMS	Environmental Radiation Ambient Monitoring System
ESER Program	Environmental Surveillance, Education and Research Program
g	gram
INEEL	Idaho National Engineering and Environmental Laboratory
ISU	Idaho State University
L	liter
MDA	minimum detectable activity
MDC	minimum detectable concentration
mi	mile
mL	milliliter (0.001 liters)
mR	milliroentgens (0.001 roentgens)
mrem	millirem (0.001 rem)
NRTS	National Reactor Testing Station
pCi	picocurie (10^{-12} curies)
PM ₁₀	particulate matter less than 10 micrometers in diameter
R	roentgen
rem	roentgen-equivalent-man
s	standard deviation
SASP	Surface Air Sampling Program
SDWA	Safe Drinking Water Act
SI	Systeme International d'Unites

LIST OF ABBREVIATIONS (cont.)

Sv	seivert
μCi	microcurie (10^{-6} curies)
μSv	microseiverts (10^{-6} seivert)
UI	University of Idaho
WSU	Washington State University

HELPFUL INFORMATION

Elements That Make Up Our World

Atoms make up everything in our world. The basic parts of an atom are protons, neutrons, and electrons (Figure 1). Different atoms may have different numbers of each of these parts. An element is a substance that is made up of only atoms with the same number of protons. Elements with different numbers of neutrons are referred to as isotopes of that element. Elements are sometimes expressed with the one- or two-letter chemical symbol for that element. The atomic weight, shown as a superscript number, is equal to the number of protons and neutrons in its nucleus and is used to identify the isotope of that element. Some isotopes of some elements are radioactive, including many naturally occurring elements. Radioactive isotopes, when taken as a whole for more than one element, are collectively referred to as radionuclides. All human-made radionuclides detected during this quarter are listed in this report. A list of common, human-made radionuclides along with their chemical symbol, are listed below.

<u>Symbol</u>		<u>Radionuclide</u>
^3H	-	Tritium
^{90}Sr	-	Strontium-90
^{131}I	-	Iodine-131
^{137}Cs	-	Cesium-137
^{238}Pu	-	Plutonium-238
$^{239/240}\text{Pu}$	-	Plutonium-239/240
^{241}Am	-	Americium-241

Helium Atom

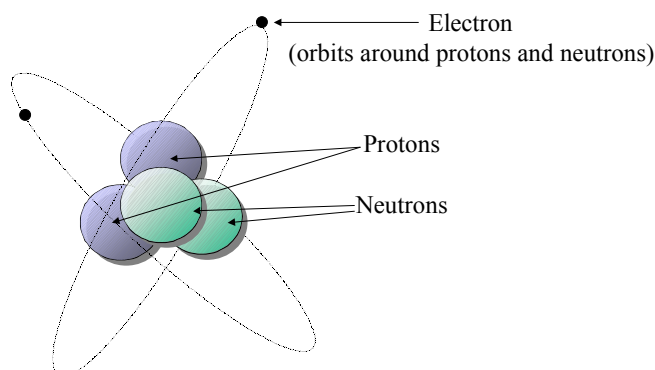


FIGURE 1. An atom of the element Helium. An element is a substance that is made up of only atoms with the same number of protons.

Radiation

Radioactive atoms are unstable and, in an effort to become stable, release energy. This release of energy comes from the release of particles or electromagnetic waves as the radioactive atom “decays,” or “disintegrates.” The three main types of radiation are alpha, beta, and gamma radiation (Figure 2). Alpha and beta are two types of particles emitted from an atom. Alpha particles consist of two protons and two neutrons (equal to the nucleus of a helium atom). Alpha particles do not travel very far (only centimeters in air) and are easily stopped. They will not penetrate paper or the outer layer of your skin so they are not an external hazard to the body. Internally, however, they are of more concern. Beta particles are electrons emitted from the nucleus of an atom. Beta particles can have enough energy to penetrate paper or skin but not materials like wood or plastic. Gamma rays are short-wavelength electromagnetic waves (photons) emitted from the nucleus of an atom following radioactive decay. Gamma ray radiation has a penetration ability greater than alpha or beta radiation. In fact, X-rays are the same as gamma radiation except they are produced from the orbital electrons of atoms rather than the nucleus. The rate at which a given amount of a particular radioactive isotope decays is measured by its half-life. The half-life is the time required for half of the amount present to decay.

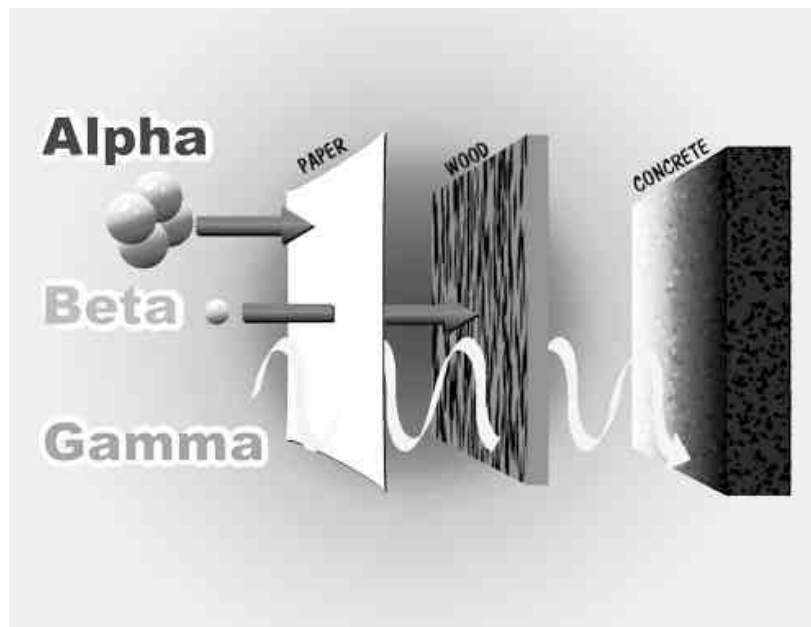


FIGURE 2. Three main types of radiation are alpha, beta, & gamma. Alpha and beta are particles emitted from an atom. Gamma radiation is short-wavelength electromagnetic waves (photons) emitted from atoms.

Units Used to Express the Amount of Radioactivity

Radioactivity is measured by the number of atoms that disintegrate per unit time. The conventional unit for activity is the curie (Ci). A curie is defined as the activity in one gram of naturally occurring Radium-226 and equals 37,000,000,000 disintegrations per second (Figure 3). The Systeme International d'Unites (SI) is the recognized international standard for describing measurable quantities and their units. The standard SI unit for radioactivity is the becquerel (Bq). A becquerel is equal to one disintegration per second (Figure 3).

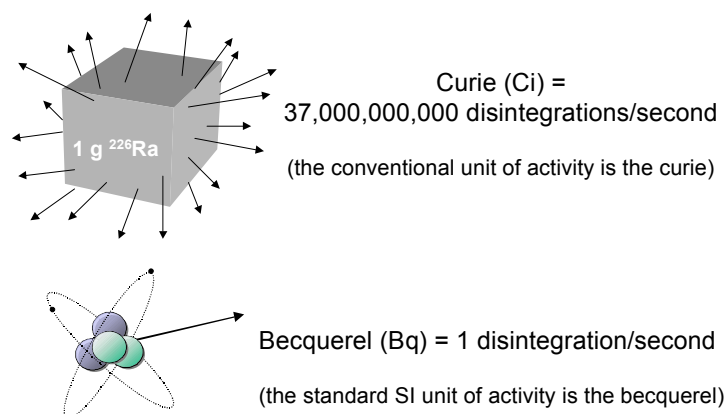


FIGURE 3. Units used to express the amount of radioactivity.

Radiation Exposure and Dose

The primary concern regarding radioactivity is the amount of energy deposited by particles or gamma radiation to the surrounding environment. It is possible that the energy from radiation may damage living tissue. When radiation interacts with the atoms of a given substance, it can alter the number of electrons associated with those atoms (usually removing orbital electrons). This is called ionization.

The term “exposure” is used to express the amount of ionization produced in air by electromagnetic (gamma and X-ray) radiation. The unit of exposure from gamma or X-ray radiation is the roentgen (R). The average exposure rate from natural radioactivity in southeast Idaho is about 0.130 R per year.

Radiation absorbed dose describes the amount of energy from ionizing radiation absorbed by any kind of matter. When absorbed dose is adjusted to account for the amount of biological damage a particular type of radiation causes, it is known as dose equivalent. The unit for dose equivalence is called the rem (“roentgen-equivalent-man”). The SI unit for dose equivalent is called the seivert (Sv). One seivert is equivalent to 100 rem.

Unit Prefixes

The range of numbers experienced in many scientific fields, like that of environmental monitoring for radioactivity, is huge and scientists commonly express units for very small and very large numbers as a prefix that modifies the unit of measure. 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 used in this report may include:

<u>Prefix</u>	<u>Abbreviation</u>	<u>Meaning</u>
Mega	M	1,000,000 (= 1×10^6)
milli	m	0.001 (= 1×10^{-3})
micro	μ	0.000001 (1×10^{-6})
pico	p	0.000000000001 (= 1×10^{-12})

Scientific Notation

Scientific notation is used to express numbers that are very small or very large. A very small number will be expressed with a negative exponent, e.g., 1.2×10^{-6} . To convert this number to the more commonly used form, the decimal point must be moved left by the number of places equal to the exponent (in this case, six). Thus the number 1.2×10^{-6} is equal to 0.0000012. A large number will be expressed with a positive exponent, e.g. 1.2×10^6 . To convert this number, the decimal point must be moved right by the number of places equal to the exponent. For example, the number 1.2×10^6 is equal to 1,200,000.

Concentrations of Radioactivity

The amount of radioactivity in a substance of interest is described by its concentration. The concentration is the amount of radioactivity per unit volume or weight of that substance. Air, milk, and atmospheric moisture samples are expressed as activity per milliliter (mL). Concentrations in surface water, drinking water, and precipitation samples are expressed as activity per liter (L). Radioactivity in foodstuff and soil are expressed as activity per gram (g). Exposure, as measured by environmental dosimeters, is expressed in units of milliroentgens (mR). This is sometimes expressed in terms of dose as millirem (mrem) or microsieverts (μSv).

Gross versus Specific Analyses

Some analyses are designed to detect specific radionuclides (specific analyses) while other analyses are designed to measure radiation from a large number of sources (gross analyses). Gamma emitting radionuclides are determined by a specific analytical technique called gamma spectroscopy. Analyses for specific alpha and beta emitting radionuclides, on the other hand, require more difficult and expensive radiochemical analyses. Low cost, but very sensitive, gross measurements are often substituted for the more expensive specific analyses as a screening procedure. The gross analyses are generally made first to determine the total amount of radioactivity that is present. The more expensive specific analyses of beta and alpha emitting radionuclides are only made if the gross measurements are above background levels. When gross beta or gross alpha measurements are made, it simply means all beta activity or all alpha activity is measured. There is no distinction between which beta-emitting or alpha-emitting radionuclides are present, just how much beta or alpha activity there is present. Gross measurements are used as a method to screen samples for relative levels of radioactivity.

Detecting Radioactivity

All measurements have uncertainties. Uncertainty associated with measurements of radioactivity arises from many sources including: variations in detection equipment and the number of particles/energy that actually strike the detector, analysis procedures, natural background radiation, the random nature of radioactive decay and variances in the distribution of the targeted compound in the media being analyzed. The level of uncertainty from many of these sources is reported with each radioactive analysis presented here. If the number of radioactive disintegrations from one sample is counted multiple times, each for the same duration, that number will vary around an average value. Background radiation makes this true even for a sample that has no radioactivity. If a sample containing no radioactivity was analyzed multiple times, the net result should vary around an average of zero after correction for background radiation (Figure 4). Therefore, samples with radioactivity levels very close to zero will have negative values approximately 50% of the time. In order to avoid censoring data, these negative values, rather than “not detectable” or “zero,” are reported for radionuclides of interest. This provides more information than merely truncating to the detection limits for results near background activities and allows for statistical analyses and measures of trends in data.

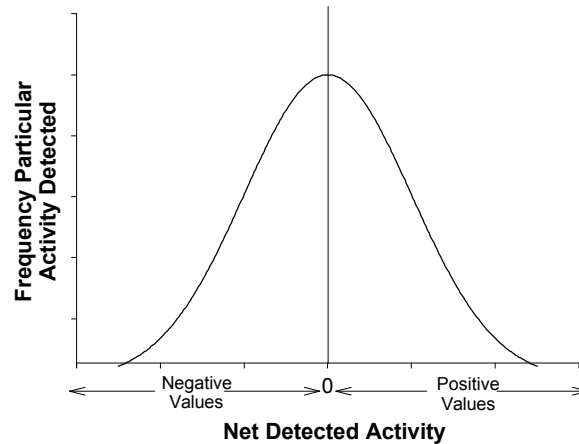


FIGURE 4. Expected frequency distribution for a sample with no radioactivity. If a sample containing no radioactivity was analyzed multiple times, a distribution of net values with an average of zero would result. Samples with radioactivity levels very close to zero are expected to have net results that are negative values approximately 50% of the time after background is subtracted.

Confidence in Detections

There are two main types of errors that may be made when reporting levels of contaminants:

- Reporting something as not present when it actually is (false negative error), and;
- Reporting something as present when it actually is not (false positive error).

It is the goal of the ESER program to minimize the error of saying something is not present when it actually is, to the extent that is reasonable practicable. To do this, a two standard deviation (2s) reporting level is used. The standard deviation is a measurement of the variation about the mean. In a distribution of results for one sample, the average result, plus or minus (\pm) two standard deviations (2s) of that average, approximates the 97.5% confidence interval for that average. When a net sample result is more than 2s above zero, more than 97.5% of the time the value will have come from a distribution with an average greater than zero (Figure 5). The uncertainty of measurements in this report are denoted by following the result with a " \pm " 2s uncertainty term and all results that are greater than 2s from zero are reported in the text (all data are reported in Appendix C).

Samples with true values at or barely above the 2s limit have a high probability that the level of radioactivity will be reported as less than 2s (false negative results; Figure 5). Results at or barely about the 2s-reporting limit have a relatively low probability of reporting radioactivity above zero when it actually is not (false positive results; Figure 5). The probability that a sample will be reported as not being radioactive when it actually is radioactive falls as the level of radioactivity increases. The level of radioactivity at which the sample will have a less than 5% possibility of being reported as not being detectably radioactive is the "minimum detectable activity" (Figure 6). The MDA per sample weight or volume is called the MDC. All results with measured levels greater than 2s and the MDC will be specifically highlighted in this report.

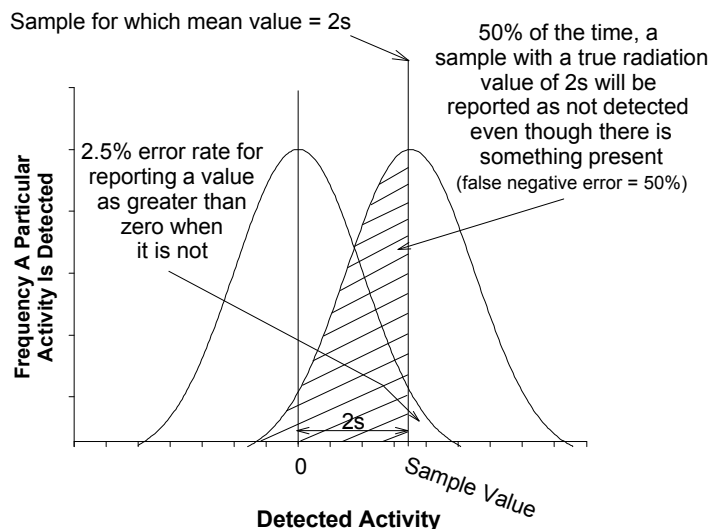


FIGURE 5. Radioactivity is considered a positive detect when the result is greater than $2s$ from a net activity of zero. However, because there is variability around a net activity of zero for a sample with no radioactivity, approximately 2.5% of the time radioactivity will be reported for samples that are not radioactive. Samples with mean values near this limit have a high probability of being reported as non-detects.

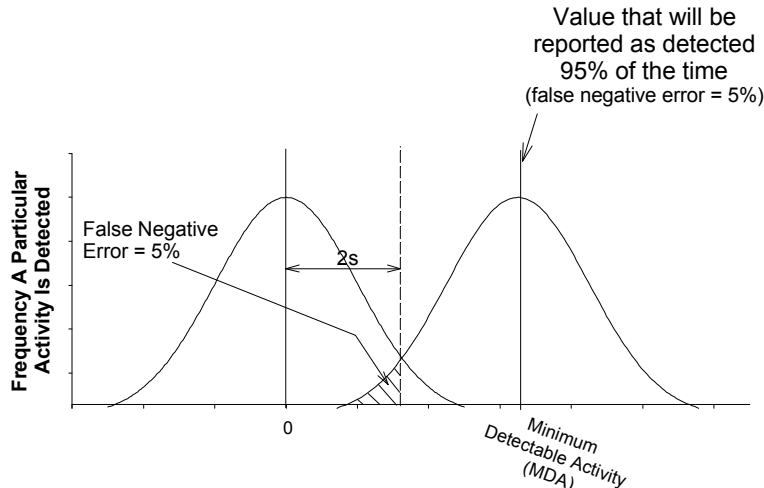


FIGURE 6. The value at which there is less than a 5% chance that the result will be reported as not-detected when it is actually present is called the minimum detectable activity (MDA).

Determining Statistical Differences

When radiological measurements are made, it is often of interest to determine whether concentrations are different between locations or periods of time. For example, if the INEEL were a significant source of offsite contamination, concentrations of contaminants would be higher at INEEL locations compared to Boundary locations which, in turn, would be higher than Distant locations due to dispersal. To investigate this, statistical tests are used. Specifically, an independent samples t-test is used to determine if there are significant differences between the average gross alpha and gross beta concentrations at INEEL, Boundary, and Distant locations. Groups are considered significantly different if the 95% confidence interval for their averages overlap (t-test with $\alpha = 0.05$).

Radioactivity In Our World

Radiation has always been a part of the natural environment in the form of cosmic radiation, cosmogenic radionuclides [carbon-14 (^{14}C), Beryllium-7 (^7Be), and tritium (^3H)], and naturally occurring radionuclides, such as potassium-40 (^{40}K), and the thorium, uranium, and actinium series radionuclides which have very long half lives. Additionally, human-made radionuclides were distributed throughout the world beginning in the early 1940s. Atmospheric testing of nuclear weapons from 1945 through 1980 and nuclear power plant accidents, such as the Chernobyl accident in the former Soviet Union during 1986, have resulted in fallout of detectable radionuclides around the world. This natural and manmade global fallout radioactivity is referred to as background radiation.

The radionuclides present in our environment can give both internal and external doses (Table 1). Internal dose is received as a result of the intake of radionuclides. The major routes of intake of radionuclides for members of the public are ingestion and inhalation. Ingestion includes the intake of the radionuclides from drinking milk and water, and consumption of food products. Inhalation includes the intake of radionuclides through breathing dust particles containing radioactive materials.

Regulatory Limits

During the last 100 years, research has been conducted in an attempt to understand the effects of radiation on humans and the environment. Much of this research was done using standard epidemiological and toxicological approaches to characterize the response of populations and individuals to high radiation doses. A good understanding of risks associated with high radiation doses was achieved. At low exposures to radiation, however, cells heal, so the risks from these levels are less known. This problem is compounded because scientists are searching for effects from exposure to low levels of radiation in the midst of exposure to much larger amounts of background radiation. The only measurable increased cancer incidence has occurred following high radiation doses. Mathematical models have been used to predict risks from low radiation doses.

Regulatory dose limits are set well below levels where measurable health effects have been observed. The total radiation dose limit for individual members of the public as defined by the Code of Federal Regulations (10 CFR 20.1301) is 1 mSv/y (100 mrem/y), not including the dose contribution from background radiation. Limits on emissions of radionuclides to the air from DOE facilities are set such that they will not result in a dose greater than 0.1 mSv/y (10 mrem/y) to any member of the public (40 CFR 61.92). DOE drinking water criterion have set limits of 0.04 mSv/y (4 mrem/y) for the ingestion of drinking water (DOE Order 5400.5,), and EPA limits on drinking water supplies specify low allowable limits for radioactive constituents (40 CFR Parts 9, 141, and 142). DOE Order 5400.5 lists DCG values which are the concentrations

in air and water that if a person is exposed to continuously (ingested and inhaled given certain assumptions) will result in the dose limit. DCG values are used as a reference to ensure observed concentrations are lower than concentrations that would result in a dose near the limit. ESER Program laboratories analyze for radionuclides at levels ranging from 10 to over one million times lower than those that would result in a dose near the limits (Table B-1, Appendix B).

TABLE 1. Annual estimated average dose received by a member of the population of the United States from natural radiation sources. (data source NCRP 1987)^a.

SOURCE	<i>Average Annual Effective Dose Equivalent</i>	
	(mSv)^b	(mrem)^c
Inhaled (Radon and Decay Products)	2	200
Other Internally Deposited Radionuclides	0.39	39
Terrestrial Radiation	0.28	28
Cosmic Radiation	0.27	27
Cosmogenic Radioactivity	0.01	1
Rounded Total From Natural Sources	3	300

^a Natural radiation doses vary based on local geology and elevation.

^b milliseiverts

^c millirem

1. ESER PROGRAM DESCRIPTION

Operations at the INEEL are conducted under requirements imposed by the U.S. Department of Energy (DOE) under authority of the Atomic Energy Act, and the EPA under a number of acts (e.g. the Clean Air Act and Clean Water Act). The requirements imposed by DOE are specified in DOE Orders. These requirements include those to monitor the effects, of DOE activities onsite and offsite of the INEEL (DOE Order 5400.1). During calendar year 2001, environmental monitoring within the INEEL boundaries was primarily the responsibility of the INEEL Management and Operating (M&O) contractor, while monitoring outside the INEEL boundaries was conducted under the ESER Program. The ESER Program is led by the S.M. Stoller Corporation in cooperation with its team members, including: the University of Idaho (UI) and Washington State University (WSU) for research, Montgomery Watson Harza and North Wind Environmental for technical support. This report contains the monitoring results from the ESER Program for the second quarter of 2001 (April 1 – June 30).

The surveillance portion of the ESER Program is designed to satisfy the following program objectives:

- Verify compliance with applicable environmental laws, regulations, and DOE Orders;
- Characterize and define trends in the physical, chemical, and biological condition of environmental media on and around the INEEL;
- Assess the potential radiation dose to members of the public from INEEL effluents, and;
- Present program results clearly and concisely through the use of reports, presentations, newsletter articles, and press releases.

The goal of the surveillance program is to monitor several different media points within these potential pathways, including air, water, foodstuff, and soil, that could potentially contribute to the dose received by the public.

Air samples are taken at 16 locations on and around the INEEL; surface water at 5 locations on the Snake River; drinking water at 14 locations around the INEEL; foodstuff which includes milk at 9 dairies around the INEEL, potatoes from at least 5 local producers, wheat from approximately 10 local producers, lettuce from approximately 9 home-owned gardens around the INEEL, sheep from 2 operators which graze their sheep on the INEEL, and various numbers of wildlife including big game (pronghorn, mule deer, and elk), marmots, waterfowl, and fish sampled on and near the INEEL. Table A-1 in Appendix A lists samples, sampling locations and collection frequency for the ESER Program.

Once samples have been collected and analyzed, the ESER Program has the responsibility for quality control of the data and preparing quarterly reports on results from the environmental surveillance program. The quarterly reports are then summarized in the *INEEL Annual Site Environmental Report* for each calendar year. Annual reports also include data collected by other INEEL contractors.

The ESER Program used two laboratories to perform analyses on environmental samples for the quarter reported here. The Idaho State University (ISU) Environmental Assessment Laboratory (EAL) performed routine gross alpha, gross beta, tritium, and gamma spectrometry

analyses. Severn-Trent, Inc. performed analyses requiring radiochemistry, including analysis for ^{90}Sr , ^{238}Pu , $^{239/240}\text{Pu}$, and ^{241}Am . The Operational Dosimetry unit of the INEEL M&O contractor evaluates environmental dosimeters. Samples collected by the ESER Program on behalf of the EPA (detailed in the next paragraph) are sent to the EPA's Eastern Environmental Radiation Facility. Any data found to be outside historical norms in the ESER Program are thoroughly investigated to determine if an INEEL origin is likely. Investigation may include re-sampling and/or re-analysis of prior samples.

In the event of non-routine occurrences, such as suspected releases of radioactive material, the ESER Program may increase the frequency of sampling and/or the number of sampling locations based on the nature of the release and wind distribution patterns. In the event of any suspected worldwide nuclear incidents, like the Chernobyl accident, the EPA may request additional sampling be performed through the Environmental Radiation Ambient Monitoring System (ERAMS) network, of which the ESER Program operates air and precipitation sampling equipment in Idaho Falls. The EPA established the ERAMS network in 1973 with an emphasis on identifying trends in the accumulation of long-lived radionuclides in the environment. ERAMS is comprised of a nationwide network of sampling stations that provide air, precipitation, surface water, drinking water, and milk samples.

For more information concerning the ESER Program, contact the S.M. Stoller Corporation at (208) 525-9358, or visit the Program's web page (<http://www.stoller-eser.com>).

2. THE INEEL

The INEEL is a nuclear energy research and environmental management facility. It is owned and administered by the U.S. Department of Energy, Idaho Operations Office (DOE-ID) and occupies about 2,300 km² (890 mi²) of the upper Snake River Plain in Southeastern Idaho. The history of the INEEL began during World War II when the U.S. Naval Ordnance Station was located in Pocatello, Idaho. This station, one of two such installations in the U.S., retooled large guns from U.S. Navy ships. The facility tested the retooled guns on the nearby-uninhabited plain, known as the Naval Proving Ground. In the aftermath of the war, as the nation worked to develop nuclear power, the Atomic Energy Commission (AEC), predecessor to the DOE, became interested in the Naval Proving Ground and made plans for a facility to build, test, and perfect nuclear power reactors.

The Naval Proving Ground became the National Reactor Testing Station (NRTS) in 1949, under the AEC. By the end of 1951, a reactor at the NRTS became the first to produce useful electricity. The facility evolved into an assembly of 52 reactors, associated research centers, and waste handling areas. The NRTS was renamed the Idaho National Engineering Laboratory in 1974 and INEEL in January 1997. Only two reactors are operable today with most activities on the INEEL centered on environmental restoration and waste management activities.

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3. AIR SAMPLING

Groundwater is a potential migration pathway and is monitored by the U.S. Geological Survey, as well as the M&O contractor. Surface water does not flow off of the INEEL so the primary pathway by which radionuclides can move off-site is through the air. Consequently, air is a primary focus of ESER monitoring on and around the INEEL. Particulates and ^{131}I in air were measured weekly at 15 locations using low-volume air samplers for the duration of the quarter. Moisture in the atmosphere is sampled at four locations around the INEEL and analyzed for tritium. Concentrations of particulates in the air are obtained using PM_{10} samplers at three locations. Air sampling activities and results for the second quarter, 2001 are discussed below.

3.1 Low-Volume Air Sampling

Radioactivity associated with airborne particulates was monitored continuously by 17 ESER Program air samplers at 15 locations during the second quarter of 2001 (Figure 7). Three of these samplers were located on the INEEL, seven were located off the INEEL near the boundary, and five were at locations distant to the INEEL. One replicate sampler was located at Arco and one at Howe during the second quarter of 2001. On June 13th a new distant sampler was added in Jackson, Wyoming based on the concerns of local residents. This additional sampler brought the total number to 18 samplers at 16 locations. An average of 13,337 ft^3 (578 m^3) of air was sampled at each location, each week, at an average flow rate of 1.32 ft^3/min (0.04 m^3/min). Particulates in air were collected on filters (1.2 μm pore size), while gases were pulled through activated charcoal cartridges. Samplers are divided into INEEL, Boundary and Distant groups to determine if there is a gradient of radionuclide concentrations, increasing towards the INEEL.

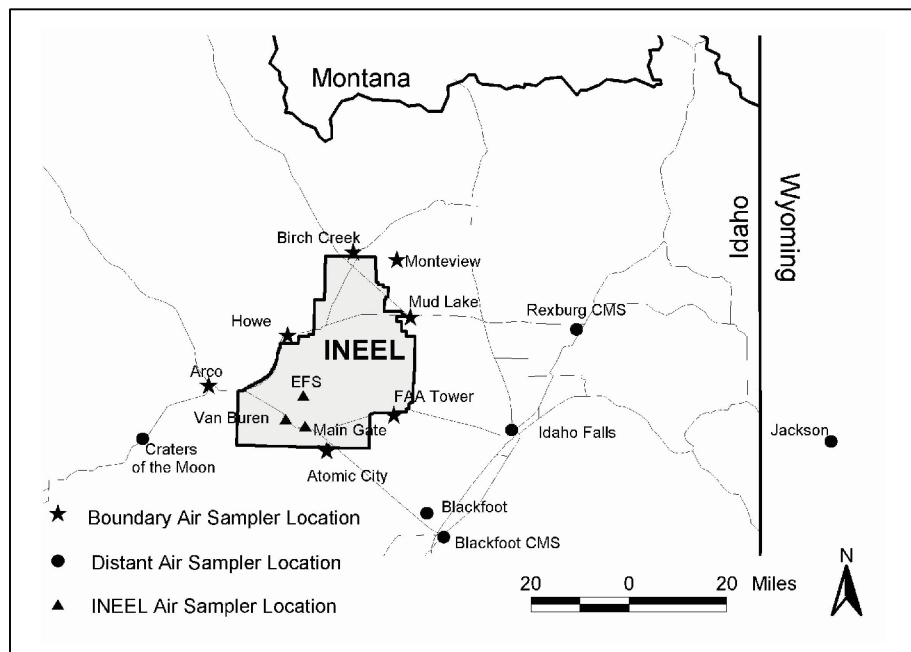


FIGURE 7. Continuous air sampling locations.

Filters and charcoal cartridges were changed weekly at each station. Each filter was screened for gross alpha and gross beta radioactivity using thin-window gas flow proportional counting systems after waiting about four days for naturally-occurring daughter products of radon and thorium to decay. For more information concerning gross alpha and beta radioactivity, see the *Gross versus Specific Analyses* (page xiv) portion of the *Helpful Information* section of this report. Charcoal cartridges were analyzed for gamma emitting radionuclides, specifically ^{131}I . Iodine-131 is of great interest because it is produced in relatively large quantities by nuclear fission and has a half-life of only eight days. This means any ^{131}I that is detected would be from a recent release of fission products. Finally, a composite of 13 filters, one for each week of the quarter, for each location was analyzed for gamma-emitting radionuclides with a subset analyzed for ^{90}Sr , ^{238}Pu , $^{239/240}\text{Pu}$, and ^{241}Am .

If the INEEL was a significant source of offsite contamination, concentrations of contaminants would be higher at INEEL locations compared to Boundary locations which, in turn, would be higher than Distant locations. An independent samples t-test ($\alpha=0.05$) was used to determine if there were statistically significant differences between the average gross alpha and gross beta concentrations at INEEL, Boundary, and Distant locations.

INEEL, Boundary, and Distant location weekly average gross alpha concentrations in air are shown in Figure 8. Weekly average gross beta concentrations are shown in Figure 9. During two separate weeks (ending April 11, and May 23), the average gross beta concentration for INEEL locations was significantly higher than at Distant locations. Also during two separate weeks (ending April 18 and May 23), the average gross beta concentration for INEEL locations was significantly higher than at Boundary locations. During the week of April 11, the average gross beta concentration was higher at Boundary locations than at Distant locations.

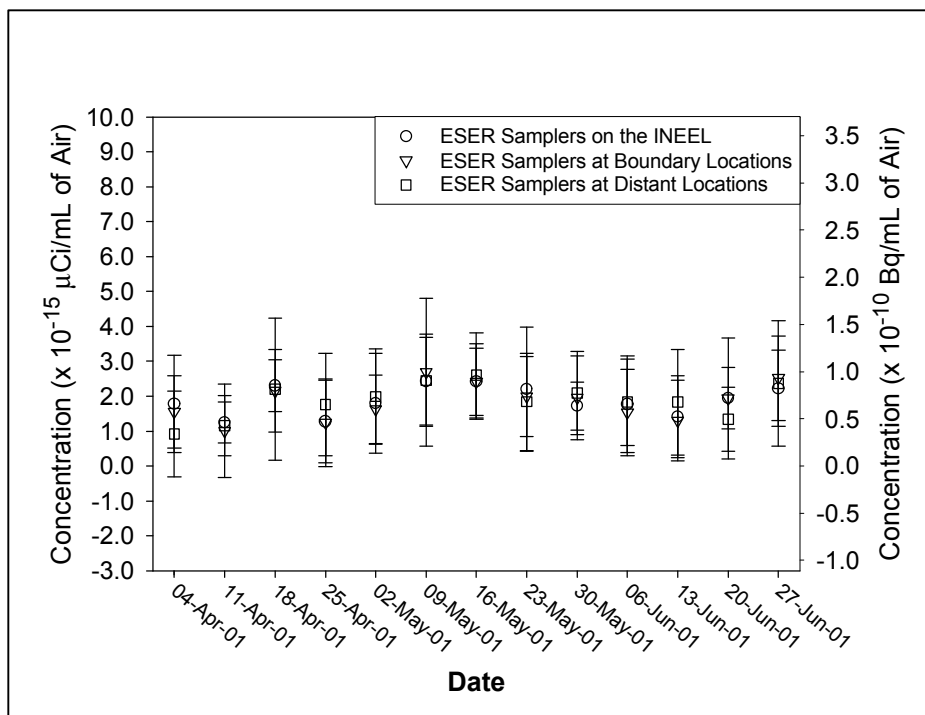


FIGURE 8. Weekly average gross alpha concentrations in air at INEEL, Boundary, and Distant locations (error bars equal ± 2 standard deviations)

During two separate weeks, those ending April 4, and June 20, the average gross alpha concentration for INEEL locations was significantly higher than at Distant locations. During those same weeks, the average gross alpha concentration at Boundary locations was significantly higher than Distant locations.

There were no consistent trends over time of INEEL locations being higher than Boundary locations, being higher than Distant locations as one would expect if the INEEL was the source of radionuclide contamination. Gross alpha and gross beta results for individual filters are listed in Table C-1 of Appendix C. Monthly average gross alpha and beta concentrations in air at each sampling location are shown in Figures 10 – 15.

No ^{131}I was detected in any of the weekly charcoal cartridges during the second quarter, 2001. Weekly ^{131}I results for each location are listed in Table C-2 of Appendix C.

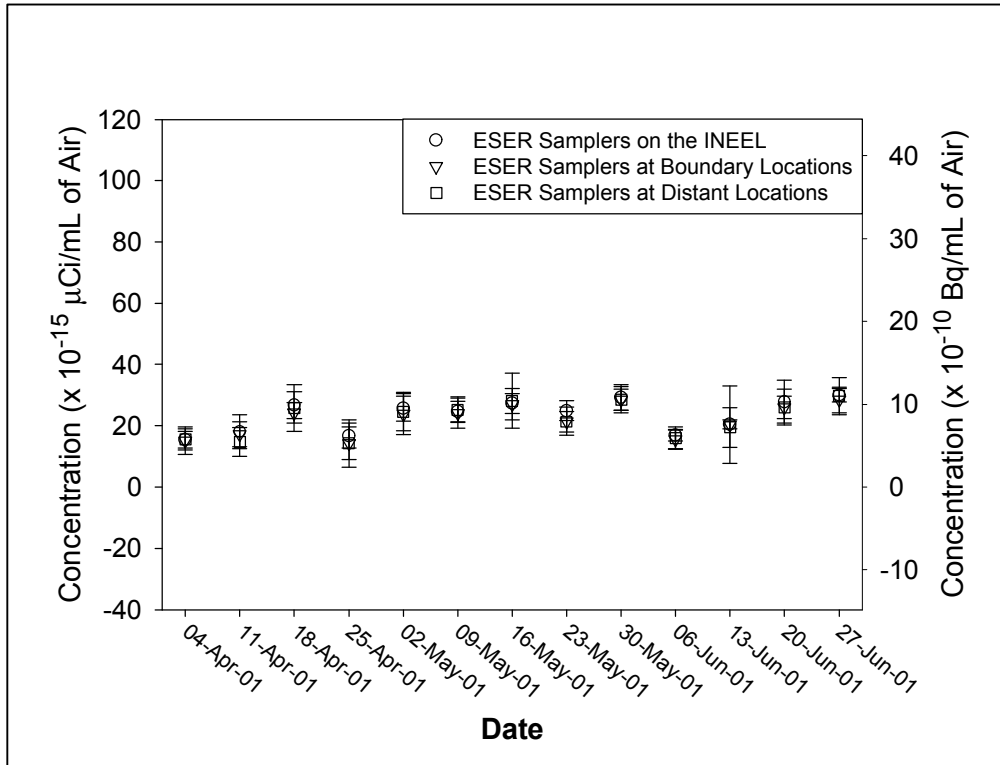


FIGURE 9. Average gross beta concentrations in air at INEEL, Boundary, and Distant locations (error bars equal ± 2 standard deviations).

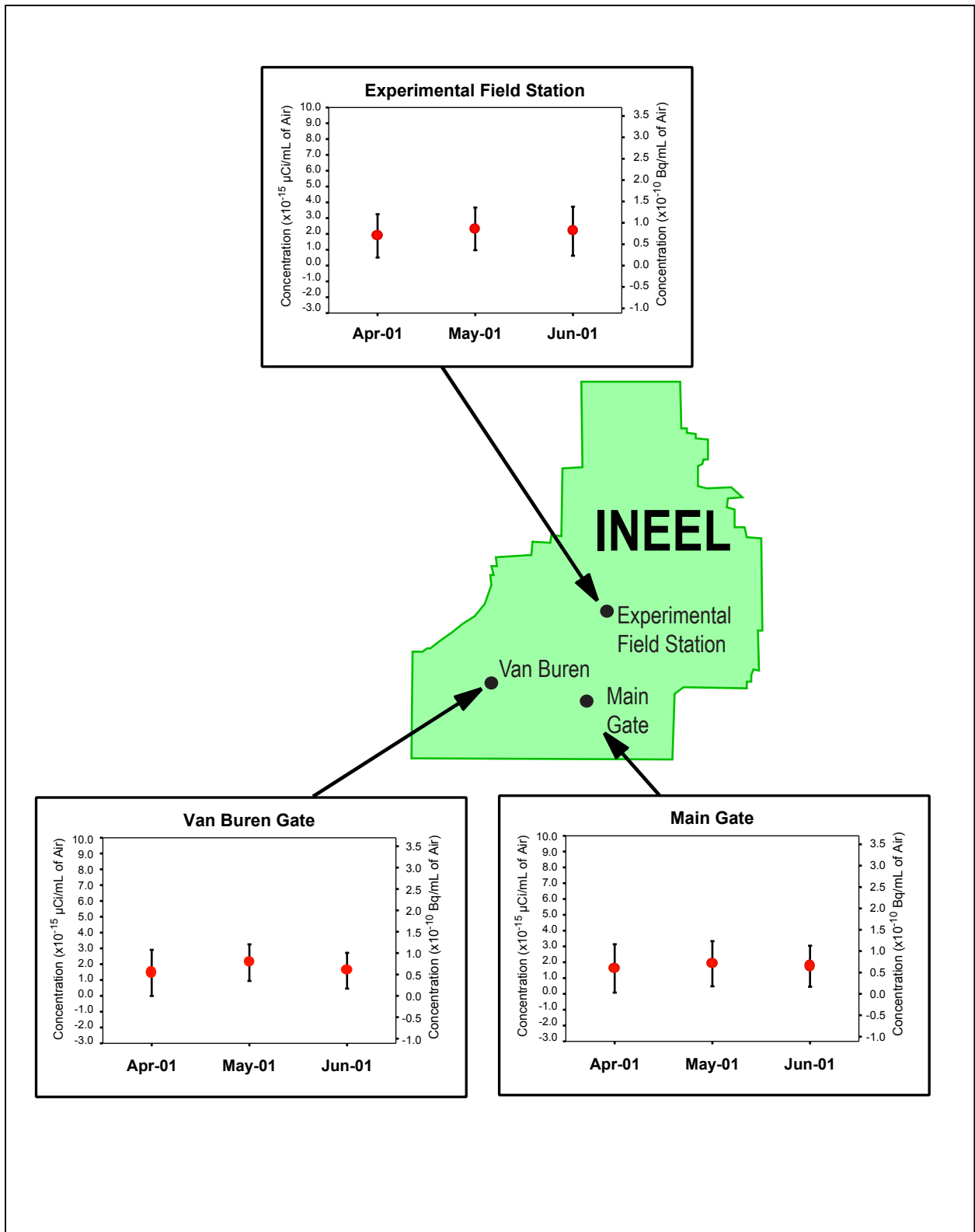


FIGURE 10. Monthly average gross alpha concentrations in air at INEEL locations.

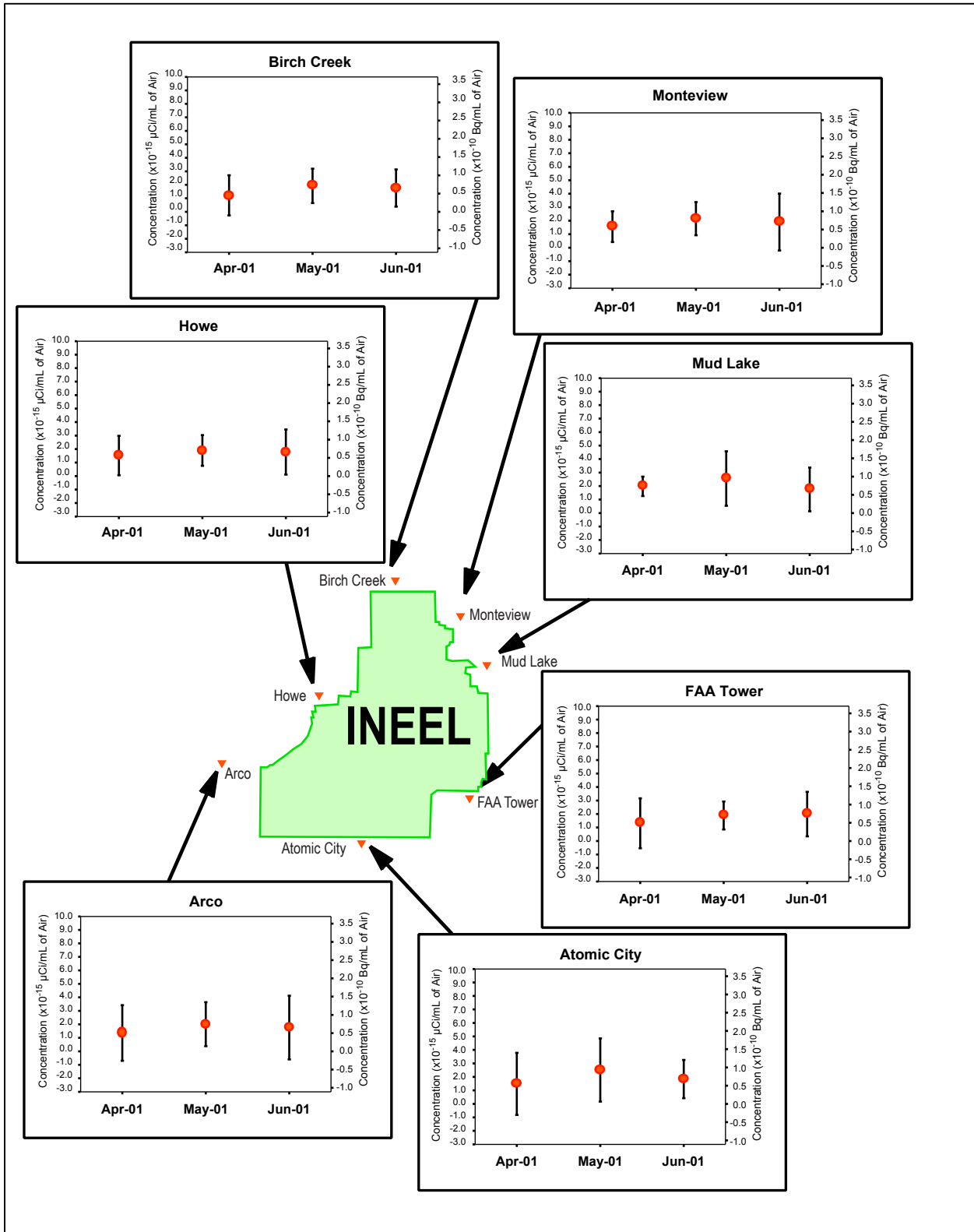


FIGURE 11. Monthly average gross alpha concentrations in air at Boundary locations.

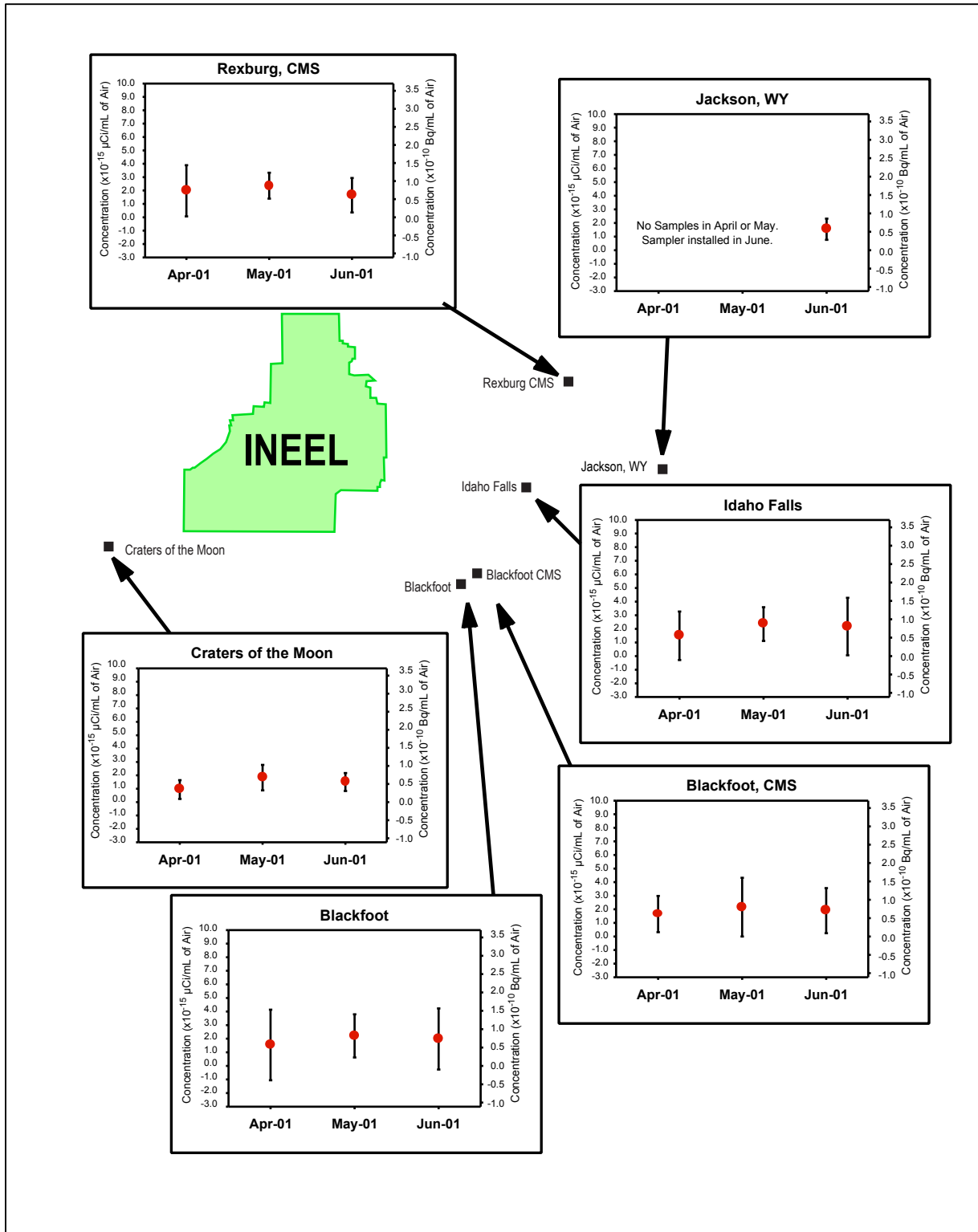


FIGURE 12. Monthly average gross alpha concentrations in air at Distant locations.

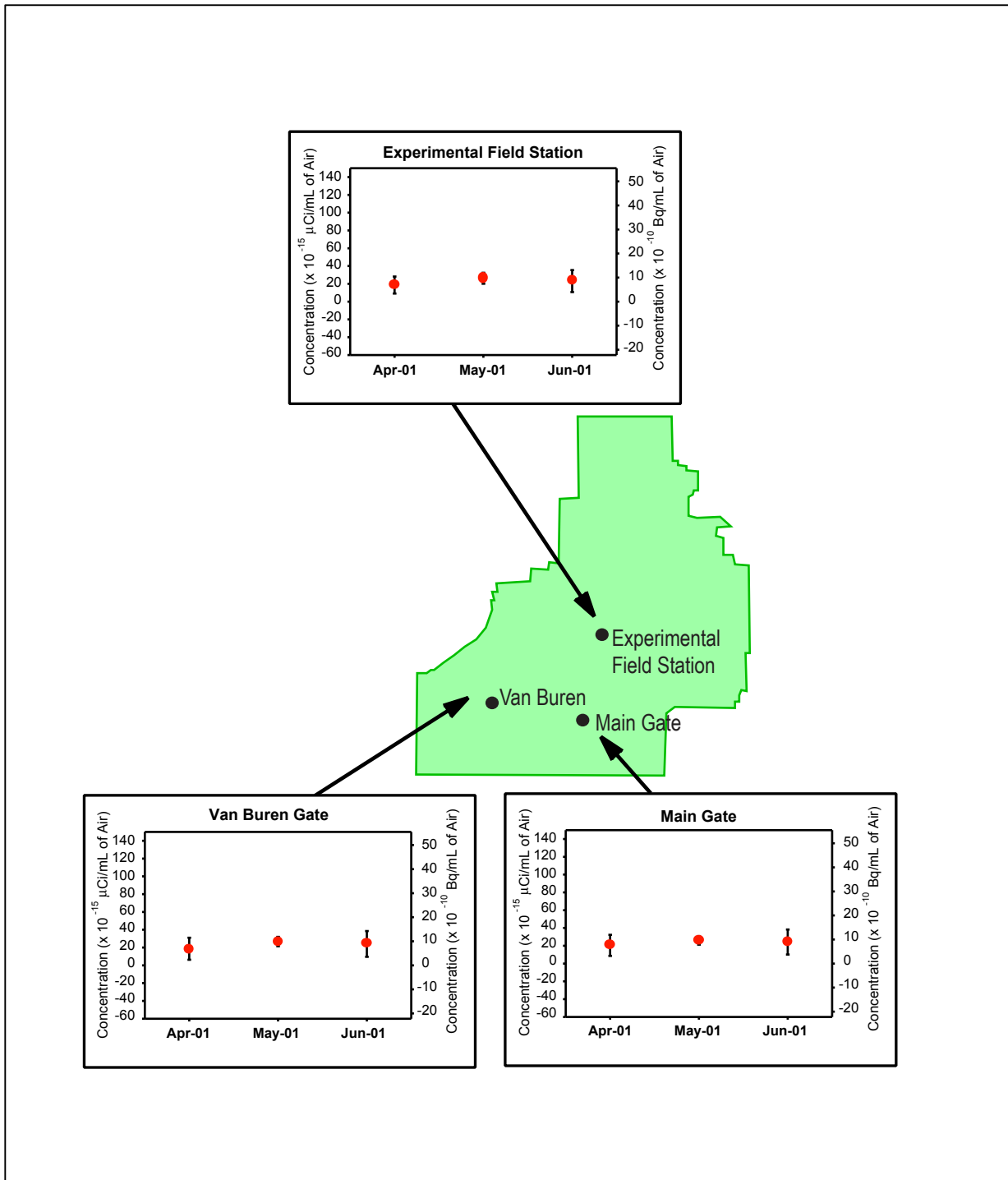


FIGURE 13. Monthly average gross beta concentrations in air at INEEL locations.

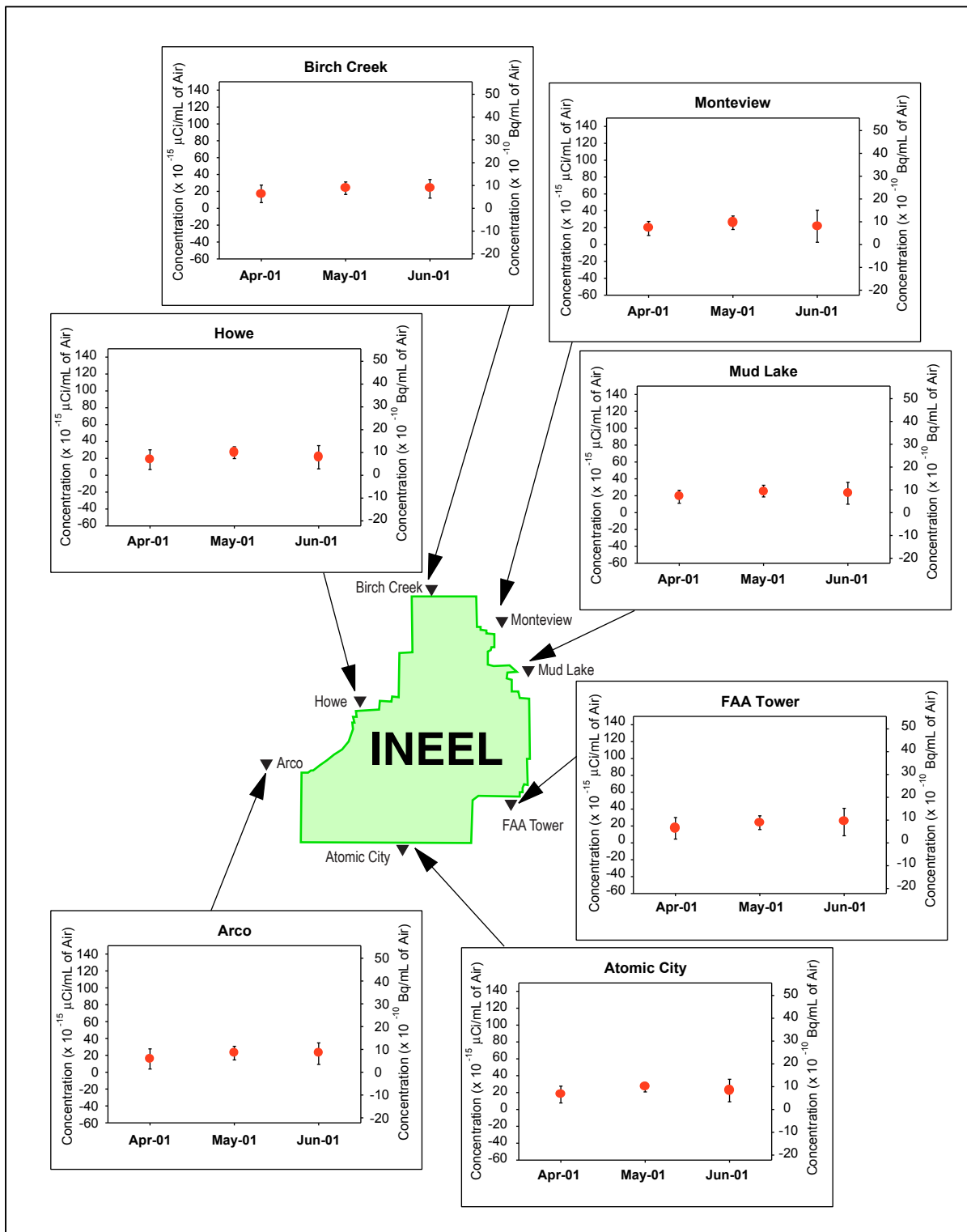


FIGURE 14. Monthly average gross beta concentrations in air at Boundary locations.

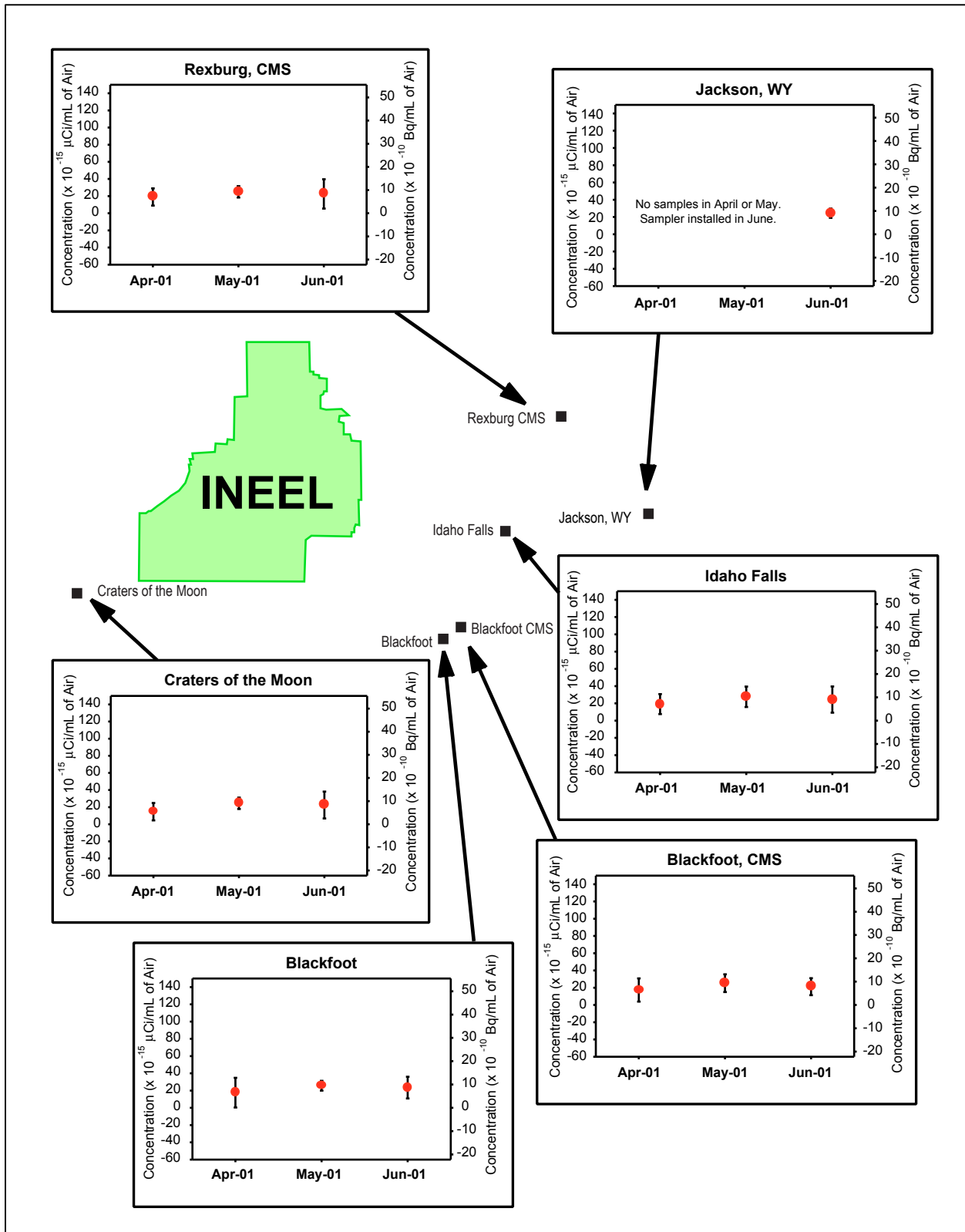


FIGURE 15. Monthly average gross beta concentrations in air at Distant locations.

Weekly filters for the second quarter of 2001 were composited by location. All samples were analyzed for gamma emitting radionuclides, with a subset from several locations selected on a rotating basis and analyzed for ^{90}Sr , ^{238}Pu , $^{239/240}\text{Pu}$, and ^{241}Am . No ^{238}Pu , or ^{137}Cs were detected on any of the composite samples.

Of the nine samples submitted for analysis, ^{241}Am was detected in five of them. Four of the five samples had levels greater than their respective two standard deviation (2s) and MDC (see Table 2). One sample, from the Arco (QA-1) station, had an ^{241}Am result greater than 2s, but less than the MDC, indicating it is most likely a false positive.

$^{239/240}\text{Pu}$ was detected in four of the samples submitted. Three of the four samples had levels greater than their respective 2s and MDCs (see Table 2). One sample, from the Main Gate location, had a result greater than 2s, but less than the MDC, indicating it is most likely a false positive.

^{90}Sr was detected in two of the samples submitted at a level greater than their associated 2s values. However, both were less than the MDCs, indicating they are most likely false positives.

Since $^{239/240}\text{Pu}$ and ^{241}Am were deposited around the world from atmospheric nuclear weapons testing the detected amounts do not necessarily indicate inputs from the INEEL, though this cannot be ruled out. However, concentrations are within the range of values measured throughout the World (EPA, 2002). In addition, detected values in composite samples for ^{241}Am ranged from 5,100 to over 10,500 times smaller than the DCG value of 2×10^{-14} i Ci/mL. Values detected in composite samples for $^{239/240}\text{Pu}$ ranged from 5,800 to over 17,500 times smaller than the DCG value of 2×10^{-14} i Ci/mL. Results for composite filter samples from the second quarter, 2001, are shown in Table C-3 of Appendix C.

TABLE 2. Specific radionuclides with results > 2s and > MDC in composite air filters.

Location	Radionuclide	Sample Results		MDC	
		$\times 10^{-16}$ $\mu\text{Ci/mL} \pm 2\text{s}$	$\times 10^{-12}$ $\text{Bq/mL} \pm 2\text{s}$	$\times 10^{-16}$ $\mu\text{Ci/mL}$	$\times 10^{-12}$ Bq/mL
Mud Lake	^{241}Am	0.0216 ± 0.018	0.080 ± 0.067	0.0097	0.036
Atomic City	^{241}Am	0.0390 ± 0.028	0.144 ± 0.104	0.0132	0.049
Main Gate	^{241}Am	0.0190 ± 0.014	0.070 ± 0.052	0.0064	0.024
Blackfoot	^{241}Am	0.0330 ± 0.025	0.122 ± 0.093	0.0128	0.047
Mud Lake	$^{239/240}\text{Pu}$	0.0114 ± 0.011	0.042 ± 0.041	0.0077	0.028
Blackfoot, CMS	$^{239/240}\text{Pu}$	0.0342 ± 0.025	0.126 ± 0.093	0.0116	0.043
Blackfoot, CMS**	$^{239/240}\text{Pu}$	0.0096 ± 0.008	0.035 ± 0.029	0.0082	0.030

** This result is for an individual filter that was sent in after the composite sample due to an operator error. The composite sample result does not include the value for the individual sample result.

3.2 Atmospheric Moisture Sampling

Nine atmospheric moisture samples were obtained during the second quarter of 2001 - three from Rexburg CMS, three from Blackfoot CMS, two from Atomic City and one from Idaho Falls. Atmospheric moisture was collected by continuously drawing air through a column of silica gel that absorbed water vapor. Each sample was collected after 3-13 weeks, depending on when an adequate amount of moisture had been extracted. The water was then extracted from the silica gel by distillation. The resulting atmospheric moisture samples were analyzed for tritium using liquid scintillation.

Five samples were greater than their associated 2s uncertainty and MDC (Table 3). For comparison, the results measured at these locations during the second quarter of 2001 were between 87,000 and 225,000 times lower than the DCG value for tritium in air (as atmospheric moisture) of 1×10^{-7} $\mu\text{Ci/mL}$ (3.7×10^{-3} Bq/mL) (see Table B-1). Tritium results for all atmospheric moisture samples are listed in Table C-4 (Appendix C).

TABLE 3. Atmospheric moisture samples with tritium > 2s and > MDC.

Location	Collection Date	Result \pm 2s x 10^{-14} ($\mu\text{Ci/mL}$)	MDC ($\mu\text{Ci/mL}$)	DCG Value x 10^{-14} ($\mu\text{Ci/mL}$)
Atomic City	4/25/01	71.2 ± 22.4	0.0012	10,000,000
Blackfoot CMS	4/19/01	113.8 ± 24.9	0.0012	10,000,000
	5/9/01	110.1 ± 24.7	0.0012	10,000,000
Rexburg CMS	4/23/01	44.4 ± 9.9	0.0012	10,000,000
	5/23/01	94.7 ± 20.3	0.0012	10,000,000

3.3 PM₁₀ Air Sampling

In 1987, the EPA began using a standard (40 CFR 50.6) for concentrations of airborne particulate matter less than 10 micrometers in diameter (PM₁₀). Particles of this size can reach the lungs and are considered to be responsible for most of the adverse health effects associated with airborne particulate pollution.

ESER Program personnel operate three PM₁₀ samplers, one at Rexburg CMS, one at Blackfoot CMS, and one at Atomic City. A sample is collected for 24 hours, every sixth day. This interval yields 15 samples per location, per quarter. However due to equipment failures, insufficient run time (24 hrs \pm 1 hour), and/or filter problems, several samples were invalid. These included three samples from the Atomic City location (April 6, April 13, and June 23), and six samples from the Rexburg CMS location (April 6, April 12, May 12, June 11, June 23 and June 29).

The air quality standards for PM₁₀, are an annual average of 50 $\mu\text{g}/\text{m}^3$, with a maximum 24-hour concentration of 150 $\mu\text{g}/\text{m}^3$. PM₁₀ concentrations for the second quarter of 2001 were well below all air quality standard levels (Table 4). The maximum 24-hour concentration was 44.9 $\mu\text{g}/\text{m}^3$ on April 18, at Rexburg CMS. Results for all PM₁₀ samples are listed in Table C-5, Appendix C.

TABLE 4. Summary of 24-hour PM₁₀ Values ($\mu\text{g}/\text{m}^3$) for each station.

	Average	Maximum	Minimum
Atomic City	24.3	44.4	8.8
Blackfoot CMS	18.7	33.7	2.2
Rexburg CMS	23.4	44.9	11.1

Air quality PM₁₀ standards permit an annual average of 50 $\mu\text{g}/\text{m}^3$, and a maximum 24-hour concentration of 150 $\mu\text{g}/\text{m}^3$.

4. WATER SAMPLING

Water that is sampled by the ESER program includes precipitation, surface water and drinking water. Monthly, composite precipitation samples are collected from Idaho Falls and the CFA at the INEEL. Weekly precipitation samples are collected from the EFS on the INEEL. Surface and drinking water are sampled twice each year in the second and fourth quarters at 18 locations around the INEEL (Appendix A).

4.1 Precipitation Sampling

When adequate precipitation occurred, samples were taken on a monthly interval from Idaho Falls and CFA, and on a weekly interval from the EFS. A minimum sample volume of 20 mL of precipitation is needed for a single sample. Precipitation samples are analyzed for tritium. For the second quarter of 2001, there was enough precipitation for a total of six samples – two monthly composites from Idaho Falls, two monthly composites from CFA, and two weekly samples from EFS.

Of the precipitation samples collected, two EFS samples (collected on April 4 and April 18) yielded tritium results greater than the 2s uncertainty. The sample collected on April 4 did not exceed the MDC, while the sample collected on April 18 did exceed the MDC (see table B-1 for MDC values). Tritium was also detected above the 2s level in the Idaho Falls sample in May and the duplicate sample from Idaho Falls in June. However, neither of these samples exceeded their associated MDC, indicating false positives.

While there are no specific limits on the amount of tritium in precipitation, the SDWA limits tritium in drinking water to 2×10^4 pCi/L (Appendix B-1). The level of tritium detected in the sample from EFS that was above its associated 2s and MDC value was 140 times lower than the SDWA limit.

Although tritium was detected (above its associated 2s and MDC) in precipitation from EFS and an INEEL source cannot be completely discounted for contributing to this, the measured level was within the range of background tritium that exists throughout the world. Low levels of tritium exist in the environment at all times. The major natural source of tritium is cosmic ray reactions in the upper atmosphere. From 1978 to 2001 the EPA, as part of its ERAMS, measured tritium from -2.00×10^2 to 7.38×10^6 pCi/L in precipitation samples across the United States (EPA, 2002). Data for all precipitation samples collected by the ESER Program during the second quarter of 2001, are listed in Table C-6 (Appendix C).

4.2 Drinking Water

Fourteen drinking water samples and one duplicate were collected from selected taps throughout southeast Idaho (Figure 16). Samples were analyzed for gross alpha, gross beta, and tritium (^3H). Only the water samples from Fort Hall and Moreland exceeded their 2s and MDC values (Table 5).

All drinking water samples had gross beta results above 2s, and all but four (those from Carey, Arco, Howe and Idaho Falls) were greater than their associated MDCs.

Of the samples analyzed for gross alpha, four, those from Minidoka, Arco, Atomic City, and Montevieu, were greater than 2s and their associated MDCs.

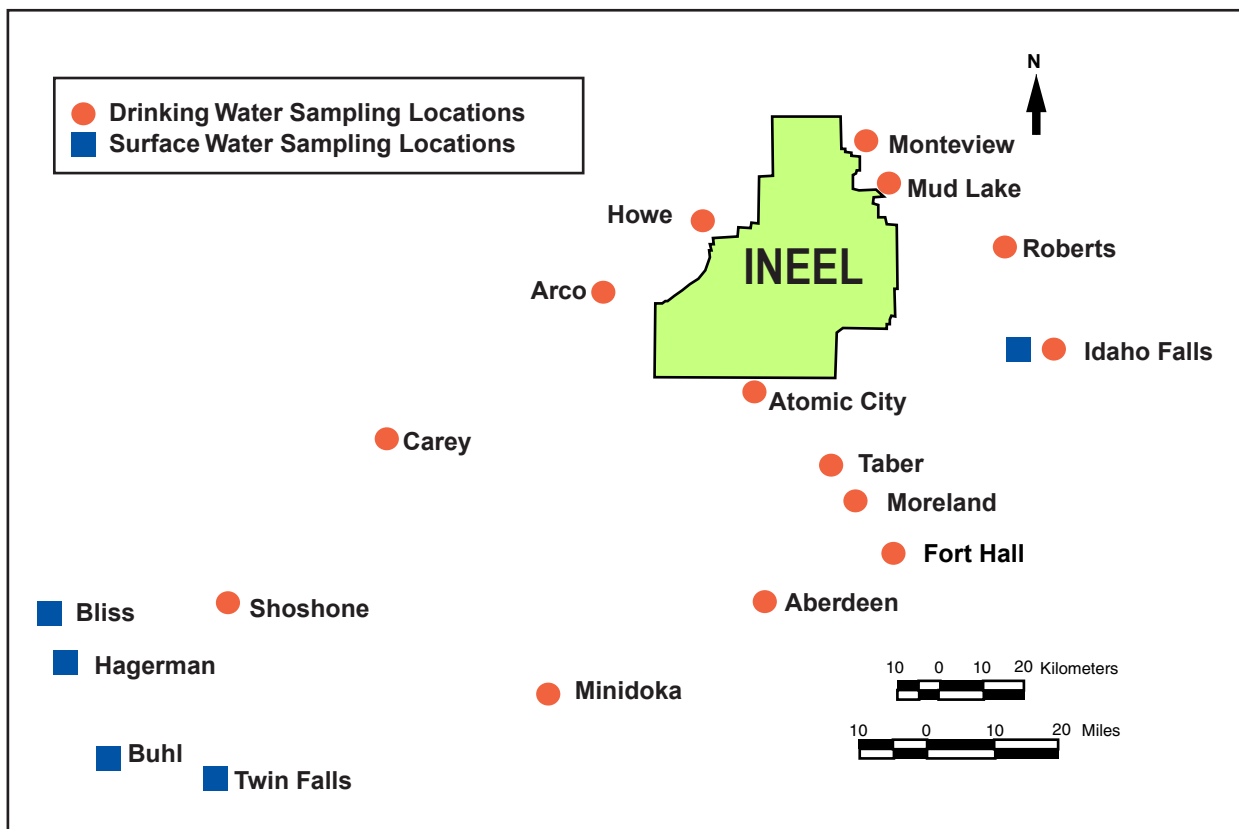


FIGURE 16. Drinking and Surface Water Sampling locations.

The SDWA limits tritium in drinking water to 2×10^4 pCi/L (Appendix B-1). The level of tritium detected in the samples from Fort Hall and Moreland that were above 2s and the MDC were 155 to 179 times lower than the SDWA limit. The measured levels were also within the range of background tritium that exists throughout the world. Low levels of tritium exist in the environment at all times. The major natural source of tritium is cosmic ray reactions in the upper atmosphere. From 1978 to 2001 the EPA, as part of its ERAMS, measured tritium from -9.00×10^1 to 1.00×10^3 pCi/L in drinking water samples across the United States (EPA, 2002).

The SDWA limits gross beta in drinking water to 50 pCi/L (Appendix B-1). The level of gross beta detected in the samples that were above 2s and the MDC were between 4 to 18 times lower than the SDWA limit.

The SDWA also limits gross alpha in drinking water to 15 pCi/L (Appendix B-1). The level of gross alpha detected in the samples that were above 2s and the MDC were between 7 to 20 times lower than the SDWA limit.

Levels of gross alpha and gross beta observed in drinking water are not unusual given the basaltic terrain (USGS 1991). All values are similar to those recorded in previous years, and are well below the levels outlined for drinking water (Table B-1). All drinking water sample results may be found in Appendix C, Table C-7.

TABLE 5. Drinking water results > 2s and > MDC.

Location	Sample Results		Values for Comparison	
	Result (pCi/L) \pm 2s	MDC (pCi/L)	SDWA (pCi/L)	DCG (pCi/L)
	Tritium			
Fort Hall	129.3 \pm 74.0	104.8	2 x 10 ⁴	8 x 10 ⁴
Moreland	111.8 \pm 72.0	104.8	2 x 10 ⁴	8 x 10 ⁴
	Gross Beta			
Aberdeen	5.00 \pm 2.06	2.33	50	100
Taber	4.10 \pm 1.92	2.33	50	100
Fort Hall	6.94 \pm 2.07	2.33	50	100
Minidoka	2.72 \pm 1.75	2.33	50	100
Roberts	4.54 \pm 1.89	2.33	50	100
Shoshone	3.62 \pm 1.80	2.33	50	100
Atomic City	3.75 \pm 1.70	2.33	50	100
Montevieu	11.02 \pm 2.58	2.33	50	100
Mud Lake	4.65 \pm 1.59	2.33	50	100
Moreland	5.94 \pm 2.36	2.33	50	100
	Gross Alpha			
Minidoka	1.32 \pm 0.96	0.57	15	30
Arco	0.94 \pm 0.87	0.57	15	30
Atomic City	0.75 \pm 0.74	0.57	15	30
Montevieu	1.99 \pm 1.41	0.57	15	30

4.3 Surface Water

Five surface water samples and one duplicate sample were collected from locations throughout southeast Idaho and analyzed for tritium, gross alpha, and gross beta.

Results for tritium analyses showed that only one sample (Idaho Falls) was above its 2s and MDC. At the reported level, the tritium result is 83 times smaller than the SDWA limit, and 333 times smaller than the DCG value.

Analytical results for gross alpha showed that the samples from Bliss and Buhl exceeded their 2s and MDC values (Table 6). At reported levels, the gross alpha values are between 13.6 and 16.5 times lower than the SDWA limit and between 27.3 to 33.0 times lower than the DCG value.

Results for gross beta for all five surface water samples, and the duplicate from Buhl, were greater than their associated 2s and MDC values (Table 6). Even at reported levels, the gross beta values are between 7.7 and 16.8 times lower than the SDWA levels, and between 15.4 to 33.6 times lower than DCG values (Table B-1).

The presence of gross alpha and gross beta in surface water (particularly the springs) is typically related to dissolution of naturally occurring radionuclides (i.e., uranium, radium, potassium) by groundwater as it flows through the surrounding basalts (USGS, 1991). Levels of gross alpha and gross beta in all samples are similar to results from recent years. All gross alpha and gross beta results can be found in Appendix C, Table C-7.

TABLE 6. Surface water results > 2s and > MDC.

Location	Sample Results		Values for Comparison	
	Result (pCi/L) ± 2s	MDC (pCi/L)	SDWA (pCi/L)	DCG (pCi/L)
Gross Alpha				
Buhl	1.10 ± 0.90	0.57	15	30
Bliss	0.91 ± 0.89	0.57	15	30
Gross Beta				
Bliss	5.83 ± 1.98	2.33	50	100
Buhl	5.49 ± 1.86	2.33	50	100
Buhl (duplicate)	5.12 ± 1.94	2.33	50	100
Hagerman	3.63 ± 1.76	2.33	50	100
Idaho Falls	2.98 ± 1.73	2.33	50	100
Twin Falls	6.50 ± 2.06	2.33	50	100
Tritium				
Idaho Falls	240.39 ± 72.61	104.81	2 x 10 ⁴	8 x 10 ⁴

5. FOODSTUFF SAMPLING

Another potential pathway for contaminants to reach humans is through the food chain. ESER Program personnel sample multiple agricultural products and game animals around the INEEL and Southeast Idaho. Specifically, milk, wheat, potatoes, garden lettuce, sheep, big game, waterfowl, marmots, and fish (if available) are sampled. Milk is sampled throughout the year. Sheep are sampled during the second quarter. Lettuce and wheat are sampled during the third quarter, while potatoes and waterfowl are collected during the fourth quarter. Big game and fish are sampled as they come available. See Table A-1, Appendix A, for more details on foodstuff sampling. All samples are analyzed by gamma spectrometry for any gamma emitting radionuclides.

5.1 Milk Sampling

Milk samples were collected weekly in Idaho Falls and monthly at nine additional locations around the INEEL (Figure 17). All samples were analyzed for gamma emitting radionuclides. A total of 27 monthly and 13 weekly milk samples were collected during the second quarter of 2001.

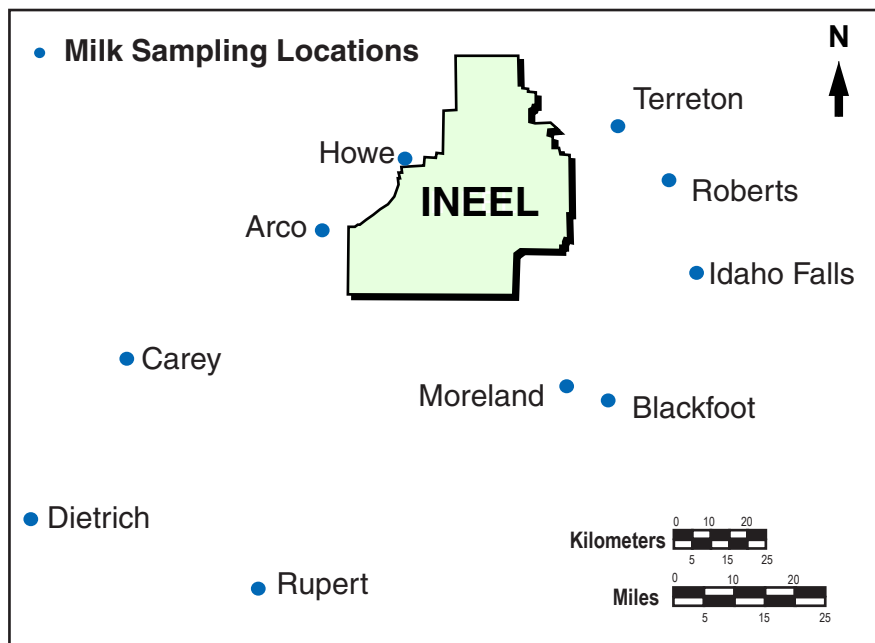


FIGURE 17. Milk sampling locations.

No samples had a ^{137}Cs concentration greater than the 2s uncertainty. One sample from Rupert (April 3) had an ^{131}I result greater than the 2s and MDC, however, an immediate recount of the sample showed that it did not exceed either the 2s or MDC, thus indicating a false positive.

Of the four samples submitted for tritium analysis, one (Roberts) had a concentration greater than 2s. However, the sample blank also had tritium results greater than 2s. Therefore,

there is a high probability that this result is a false positive. All tritium, ^{137}Cs , and ^{131}I results can be found in Appendix C in Table C-8.

Six samples were submitted for ^{90}Sr analysis. All of them had concentrations of ^{90}Sr greater than the 2s level, and three (Carey, Rupert, Blackfoot) were above the MDC.

While there are no specific regulatory limits for ^{90}Sr in milk, as a comparison, the DCG for ^{90}Sr of 1.0×10^{-6} $\mu\text{Ci/ml}$ in water can be used. None of the samples exceeded the DCG for ^{90}Sr in water. In fact, the samples that exceeded both the 2s and MDC were from 1,209 to 1,330 times smaller than the DCG value (Table B-1). Results for ^{90}Sr analyses are located in Table C-9, Appendix C.

As discussed in the *Helpful Information* section, ^{90}Sr exists as a remnant of atmospheric testing of nuclear weapons and nuclear accidents. Because of this fact, detections of ^{90}Sr cannot automatically be attributed to the INEEL. From 1978 to 2001 the EPA, as part of its ERAMS program, measured ^{90}Sr from 4.9×10^0 to -2.8×10^{-1} pCi/L in milk samples across the United States (EPA, 2002). The measured values for this quarter are well within range of these observed values.

5.2 Large Game Animal Sampling

No large game animals were sampled during the Second Quarter of 2001.

5.3 Sheep Sampling

Certain areas of the INEEL are open to grazing under lease agreements managed by the Bureau of Land Management. Every year ESER Program personnel collect samples of sheep that have grazed on these leased areas, either just before or shortly after the sheep leave the INEEL. This occurs during the second quarter of the year. For the calendar year 2001, sheep were collected from the selected INEEL allotments before they were moved off site. Three flocks were sampled, including a control flock in Dubois from the Experimental Sheep Station, a flock from a southern INEEL allotment, and a flock from a northern INEEL allotment. Two sheep were taken from each flock and sampled. Thyroid, muscle, and liver tissue were collected and analyzed for gamma emitting radionuclides.

Levels of ^{131}I are of particular interest in thyroids because of this organ's ability to accumulate iodine. No ^{131}I was found in any of the samples.

Analysis for ^{137}Cs showed results greater than 2s in three samples from two separate sheep: one muscle and one liver sample collected from the same lamb on the Northern allotment on May 18, and one muscle sample collected May 9, from a lamb on the Southern allotment. All concentrations of ^{137}Cs were similar to those found in both onsite and offsite sheep samples during recent years. Data for all sheep samples are listed in Appendix C, Table C-10.

6. ENVIRONMENTAL RADIATION

An array of thermoluminescent dosimeters (TLDs) is distributed throughout the Eastern Snake River Plain to monitor for environmental radiation (Figure 18). TLDs are changed out in May and again in November after six months in the field. The results of the May sampling (the period from November 2000 to May 2001) are discussed below.

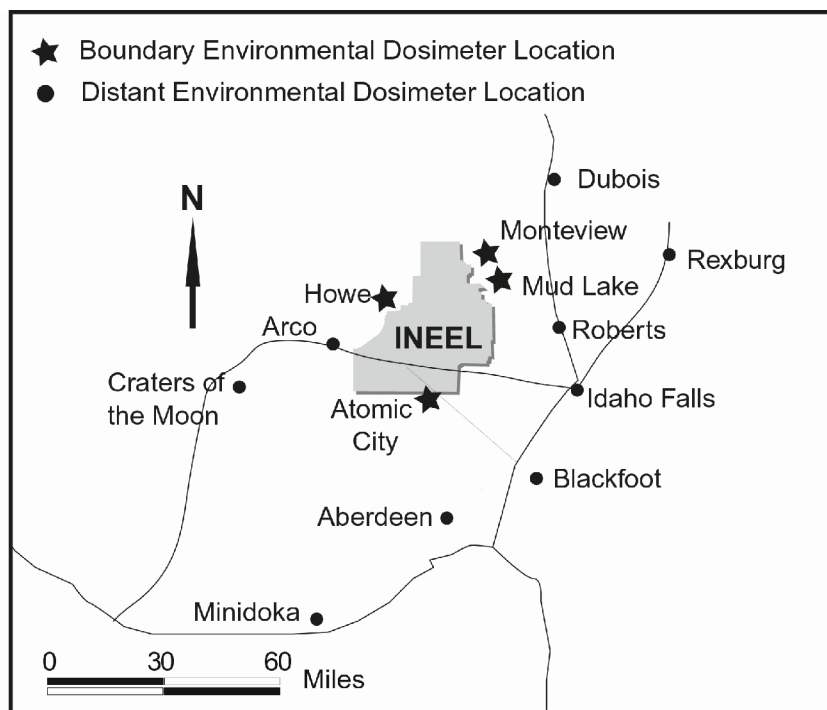


FIGURE 18. TLD sampling locations.

Dosimeter locations are divided into Boundary and Distant groupings. Boundary average exposure rates ranged from a low of 0.33 mR/day at Birch Creek and Howe to a high of 0.37 mR/day at Mud Lake. The overall average was 0.35 mR/day. The Distant group had a high of 0.41 mR/day at Aberdeen and a low of 0.32 mR/day at the Blackfoot CMS location. The overall average Distant value was 0.36 mR/day. There was no statistical difference between Boundary and Distant locations. Furthermore, all values are in line with past readings. Table 5 lists the range and average for both groups over a six-month period. All results are listed in Appendix C, Table C-11.

TABLE 7. TLD Exposures from November 2000 to May 2001.

Location	Total Exposure (mR)	
	Boundary	Distant
Average	60.68	63.28
Maximum	64.70	71.60
Minimum	57.50	55.70

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7. SUMMARY AND CONCLUSIONS

There were no radionuclides measured in second quarter, 2001, ESER samples that could be directly linked with INEEL activities. There were no observed gradients of gross alpha or beta concentrations in air increasing towards the INEEL from Distant locations. Levels of detected radionuclides were below regulatory limits and were not different from values measured at other locations across the United States. Based on these results, it can be concluded that the INEEL did not measurably contribute to offsite radionuclide concentrations during the second quarter of 2001 for constituents sampled.

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