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Idaho National Engineering and Environmental Laboratory Offsite Environmental Surveillance Program Report: Third Quarter 2002

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EXECUTIVE SUMMARY

None of the radionuclides detected in any of the samples collected during the third quarter of 2002 could be directly linked with INEEL activities. Levels of detected radionuclides were no different than values measured at other locations across the United States or were consistent with levels measured historically at the INEEL. All detected radionuclide concentrations were well below guidelines set by the U.S. Department of Energy (DOE) and regulatory standards established by the U.S. Environmental Protection Agency (EPA) for protection of the public. (See Table ES-1.)

This report for the third quarter, 2002, contains 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, July 1 through September 30, 2002. All sample types (media) and the sampling schedule followed during 2002 are listed in Appendix A. Specifically, this report contains the results for the following:

- Air sampling, including air filters and charcoal cartridges, atmospheric moisture, and 10-micron particulate matter (PM_{10}) (Section 3);
- Water sampling, specifically collection of precipitation (Section 4);
- Agricultural product sampling, including milk, lettuce, wheat, and large game animals (Section 5); and
- Soils (section6).

Gross alpha and gross beta measurements are used as general indicators of the presence of alpha-emitting and beta-emitting radionuclides in air. Gross alpha and gross beta results were found to have no discernable statistical distribution during the third quarter of 2002. Because of this, these data were statistically analyzed using nonparametric methods, including the use of the median to represent central tendency. At no time during the third quarter were gross alpha or gross beta concentrations from Boundary locations statistically higher than corresponding data sets for Distant locations, as one would expect if the INEEL were a significant source of radionuclide contamination. There were no statistical differences between gross alpha or gross beta results when grouped by location on a quarterly basis. Statistical analysis by month also showed no statistical difference between locations for gross alpha or gross beta.

Weekly comparisons of gross alpha and gross beta concentrations at Distant and Boundary locations showed statistical differences for two weeks each. Gross alpha had a statistical difference between Boundary locations and Distant locations for the weeks of September 4 and September 18, 2002. For both weeks the Distant locations were higher than the Boundary locations, suggesting natural variations, probably due to atmospheric conditions (i.e., an inversion or resuspended particulates from harvesting/plowing). Gross beta statistical analysis had significant deviations for the weeks of July 10, and August 28, 2002. Analysis of stations within each group showed no statistical difference. As with the gross alpha result, gross beta concentrations at the Distant locations were higher than the Boundary locations, again suggesting natural variations.

During the third quarter, analysis of one six-cartridge batch detected iodine-131 (^{131}I) greater than the associated 2s value. Immediate reanalysis of each individual cartridge yielded

results below the 2s values. Because initial counting is done as a batch sample, it appears that the cumulative activity for these six cartridges was above the 2s value but was not attributable to any single location (cartridge).

Selected quarterly composite filter samples were analyzed for gamma emitting radionuclides, strontium-90 (^{90}Sr), plutonium-238 (^{238}Pu), plutonium-239/240 ($^{239/240}$Pu), and americium-241 (^{241}Am). Nine samples collected from air monitoring stations located at Craters of the Moon, the Blackfoot and Rexburg Community Monitoring Stations (CMS), the Experimental Field Station (EFS), FAA Tower, both the Howe and the Howe QA (Q/A-2) samplers, Idaho Falls, and Monteview showed at least one human-made radionuclide (^{241}Am, ^{239,240}Pu or cesium-137 [^{137}Cs]) greater than their related 2s values. These values are within the range of those measured in the past and are likely due to resuspension of particulates associated with fallout from past nuclear weapons testing. All results were far less than their respective DOE Derived Concentration Guide (DCG) values.

The ESER Program operates three PM_{10} samplers, one each at Rexburg, Blackfoot, and Atomic City. Sampling of PM_{10} is informational as no analyses are conducted for contaminants. PM_{10} concentrations were well below all health standard levels for all samples. The maximum 24-hour concentration was 79.0 µg/m^3 on July 12, 2002, from Blackfoot.

Twenty-one atmospheric moisture samples were obtained during the third quarter of 2002: two from Rexburg, four from Blackfoot, six from Atomic City, and nine from Idaho Falls. A total of eleven samples (one from Rexburg, two from Blackfoot, three from Atomic City, and five from Idaho Falls) exceeded their respective 2s values. Of these detections, five samples are questionable due to small sample size (less than 9 mL). All sample results were well below the DOE DCG for tritium in air of 1×10^{-7} µCi/mL (3.7×10^{-3} Bq/mL). The maximum value was 6.6×10^{-12} µCi/mL of air (2.6×10^{-7} Bq/mL of air).

Sufficient precipitation occurred to allow collection of 14 samples (11 samples and two splits) – three and two splits from Idaho Falls, three from CFA, and five and a split from the EFS. Tritium was detected above the samples' 2s values in all the CFA and EFS samples, and two of the Idaho Falls samples. While there is no regulatory limit for tritium in precipitation, the DOE DCG and maximum contaminant level set by EPA for tritium in drinking water can be used as screening values. The highest tritium concentration was many times lower than the DCG value (2×10^6 pCi/L) and the Safe Drinking Water Act limit (20,000 pCi/L) for tritium in drinking water.

Milk samples were collected weekly in Idaho Falls and monthly at nine other locations around the INEEL. All samples were analyzed for gamma emitting radionuclides. No ^{131}I or ^{137}Cs was measured in any of the samples collected during the quarter. Four samples had ^{90}Sr concentrations greater than their 2s values. There are no established limits for ^{90}Sr in milk but, for comparison, the EPA has set the limit for ^{90}Sr in drinking water at 8 pCi/L (0.3 Bq/L). The Safe Drinking Water limit is based on a 4 mrem per year maximum allowable dose and the assumption that two liters per day are consumed. The maximum ^{90}Sr concentration measured in milk during the third quarter, 2002 was many times lower than the 8-pCi/L limit.

Seven lettuce samples were collected from area gardens around the INEEL. No man-made gamma-emitting radionuclides were measured. Five samples detectable ^{90}Sr concentrations above the 2s and 3s values. The maximum concentration is consistent with concentrations seen in the recent past.

Wheat samples were obtained from 15 area grain elevators. The man-made radionuclides ^{137}Cs and ^{90}Sr were measured in one sample each.Again these concentrations were

consistent with those measured in the recent past and are attributable to plant uptake of fallout derived radionuclides.

Four large game animals were sampled during the third quarter of 2002. All were killed as a result of vehicular collisions. These accidents involved three mule deer (*Odocoileus hemionus*) and one pronghorn antelope (*Antilocapra americana*). Every effort was made to collect thyroid, liver, and muscle tissue from each animal. However, certain tissues could not be collected from all animals due to their condition at the time of collection. Only a single mule deer had results greater than their 2s value for any radionuclide. Cesium-137 appeared in all tissues (muscle, liver and thyroid) above the 2s value.

Soil samples were collected from four distant and eight boundary locations. Soil samples are composites of five 5-cm by 5-cm cores collected within a 10-m square grid. Americium-241, $^{239/240}$Pu, and ^{137}Cs were detected in all samples above their respective 2s values. Plutonium-238 and ^{90}Sr were also detected above their respective 2s values in ten and three samples, respectively. There were also two samples each with ^{238}Pu and ^{60}Co measured above the 2s value. All values were within the range of historical measurements.

Table ES-1 Summary of results for the third quarter of 2002.

Media	Sample Type	Analysis	Results
Air	Filters	Gross alpha, gross beta	Independent statistical comparisons of gross alpha and gross beta data indicate no differences between INEEL, Boundary, and Distant locations. Statistical differences in both gross alpha and gross beta results were observed in two separate weeks for each constituent. However, these differences can be attributed to natural variation in the data. All gross alpha and gross beta results were within historical levels and were far less than applicable DOE DCGs.
		Gamma emitting radionuclides (including ^{137}Cs), select actinides (^{238}Pu, ^{239,240}Pu, & ^{241}Am) and ^{90}Sr	Quarterly composite samples had levels of ^{241}Am, and/or $^{239/240}$Pu greater than 2s in samples collected from Craters of the Moon, EFS, FAA Tower, Howe and Howe Q/A-2, Idaho Falls, Monetview, and Rexburg. Cesium-137 was measured above the 2s value at Blackfoot. The results were well below DOE DCGs and within historical measurements.
	Charcoal Cartridge	Iodine-131	One 6-cartridge batch, collected on July 24, had an initial detection of ^{131}I. Immediate recounts of individual cartridges resulted in no measurable ^{131}I.
	PM10	Particulate matter	No regulatory limits were exceeded for atmospheric particulates.
Atmospheric Moisture	Liquid	Tritium	Eleven of 21 atmospheric moisture samples had tritium measured in them above their respective 2s values. Five of these results are questionable due to small sample size. No sample result exceeded the DCG for tritium in air.
Precipitation	Liquid	Tritium	Twelve of 14 samples had detectable concentrations of tritium. All samples were well below regulatory limits for tritium in drinking water.

Media	Sample Type	Analysis	Results
Milk	Liquid	Iodine-131, gamma emitting radionuclides (including ^{137}Cs)	No ^{131}I or ^{137}Cs was measured in any sample. Four of five samples had concentrations of ^{90}Sr greater than their 2s values. The detected concentrations were below the regulatory limit for ^{90}Sr in drinking water.
Lettuce	Solid	Gamma emitting radionuclides (including ^{137}Cs), and ^{90}Sr	No gamma emitting radionuclides were measured in any of the seven samples collected. Strontium-90 was detected in five samples above the 2s value. All values were within the range of historical concentrations.
Wheat	Solid	Gamma emitting radionuclides (including ^{137}Cs), and ^{90}Sr	Cesium-137 was detected in one sample above the 2s value. Strontium-90 was measured in another single sample also above the 2s value. All values were within the range of historical concentrations.
Game Animals	Tissue	Iodine-131, gamma emitting radionuclides (including ^{137}Cs)	Cesium-137 was reported above the 2s value in all tissues (muscle, liver, thyroid) taken from a single mule deer. No man-made radionuclides were measured in any of the other three animals sampled. All concentrations were within the range of historical values for game animals.
Marmots	Tissue	Gamma emitting radionuclides (including ^{137}Cs), select actinides (^{238}Pu, ^{239,240}Pu, & ^{241}Am) and ^{90}Sr	
Soil	Solid	Gamma emitting radionuclides (including ^{137}Cs), select actinides (^{238}Pu, ^{239,240}Pu, & ^{241}Am) and ^{90}Sr	All samples contained detectable concentrations of at least one of the analyzed radionuclides. All concentrations were consistent with those expected from background worldwide fallout and were within the range of past measurements.

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LIST OF ABBREVIATIONS

AEC	Atomic Energy Commission
CFA	Central Facilities Area
CMS	community monitoring station
DCG	Derived Concentration Guide
DOE	Department of Energy
DOE – ID	Department of Energy Idaho Operations Office
EAL	Environmental Assessment Laboratory
EFS	Experimental Field Station
EPA	Environmental Protection Agency
ERAMS	Environmental Radiation Ambient Monitoring System
ESER	Environmental Surveillance, Education and Research
INEL	Idaho National Engineering Laboratory
INEEL	Idaho National Engineering and Environmental Laboratory
ISU	Idaho State University
MDC	minimum detectable concentration
M&O	Management and Operating
NRTS	National Reactor Testing Station
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter
TLDs	thermoluminescent dosimeters
UI	University of Idaho
WSU	Washington State University

LIST OF UNITS

Bq	becquerel
cm	centimeters
Ci	curie
g	gram
in.	inch
L	liter
µCi	microcurie
m	meter
mL	milliliter
mR	milliroentgens
mrem	millirem
mSv	millisieverts
pCi	picocurie
R	Roentgen
µSv	microseiverts

1. ESER PROGRAM DESCRIPTION

Operations at the Idaho National Engineering and Environmental Laboratory (INEEL) are conducted under requirements imposed by the U.S. Department of Energy (DOE) under authority of the Atomic Energy Act, and the U.S. Environmental Protection Agency (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 both inside and outside the boundaries of DOE facilities (DOE 1988). During calendar year 2002, 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 Environmental Surveillance, Education and Research (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, and MWH Global, Inc., and North Wind Environmental, Inc. for technical support. This report contains monitoring results from the ESER Program for samples collected during the third quarter of 2002 (July 1 – September 30, 2002).

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 different media at a number of potential exposure points within the various exposure pathways, including air, water, agricultural products, wildlife, and soil, that could possibly contribute to the radiation dose received by the public.

Environmental samples collected include:

- air at 16 locations on and around the INEEL;
- moisture in air at four locations around the INEEL;
- surface water at five locations on the Snake River;
- drinking water at 14 locations around the INEEL;
- agricultural products, including milk at 10 dairies around the INEEL, potatoes from at least five local producers, wheat from approximately 10 local producers, lettuce from approximately nine home-owned gardens around the INEEL, and sheep from two operators which graze their sheep on the INEEL;
- soil from 12 locations around the INEEL biennially;
- environmental dosimeters from 15 locations semi-annually; and
- various numbers of wildlife including big game (pronghorn, mule deer, and elk), waterfowl, doves, and marmots sampled on and near the INEEL. Fish are also sampled as available (i.e., when there is flow in the Big Lost River).

Table A-1 in Appendix A lists samples, sampling locations and collection frequency for the ESER Program.

The ESER Program used two laboratories to perform analyses on routine environmental samples collected during the quarter reported here. The Idaho State University (ISU) Environmental Assessment Laboratory (EAL) performed routine gross alpha, gross beta, tritium, and gamma spectrometry analyses. Analyses requiring radiochemistry, including strontium-90 (^{90}Sr), plutonium-238 (^{238}Pu), plutonium-239/240 ($^{239/240}$Pu), and americium-241 (^{241}Am) were performed by Severn-Trent, Inc of Richland, WA.

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. Any data found to be outside historical norms in the ESER Program is 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 any suspected worldwide nuclear incidents, like the 1986 Chernobyl accident, the EPA may request additional sampling be performed through the Environmental Radiation Ambient Monitoring System (ERAMS) network (EPA 2002). 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. The ESER Program currently operates a high-volume air sampler and collects precipitation and drinking water in Idaho Falls for this national program and routinely sends samples to EPA's Eastern Environmental Radiation Facility for analyses. The ERAMS data collected at Idaho Falls are not reported by the ESER Program but are available through the EPA ERAMS website (http://www.epa.gov/enviro/html/erams/).

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

The results reported in the quarterly and annual reports are assessed in terms of data quality and statistical significance with respect to laboratory analytical uncertainties, sample locations, reported INEEL releases, meteorological data, and worldwide events that might conceivably have an effect on the INEEL environment. First, field collection and laboratory information are reviewed to determine identifiable errors that would invalidate or limit use of the data. Examples of such limitations include insufficient sample volume, torn filters, evidence of laboratory cross-contamination or quality control issues. Data that pass initial screening are further evaluated using statistical methods. Statistical tools are necessary for data evaluation particularly since environmental measurements typically involve the determination of minute concentrations, which are difficult to detect and even more difficult to distinguish from other measurements.

The term "measurable" as used for the discussion of results in this report does not imply any degree of risk to the public or environment but rather indicates that the radionuclide was detected at a concentration sufficient for the analytical instrument to record a value. The minimum detectable concentration (MDC) is used to assess measurement process capabilities. The MDC indicates the ability of the laboratory to detect an analyte in a sample at desired concentration levels. The ESER requires that the laboratory be able to detect radionuclides at levels normally expected in environmental samples, as observed historically in the region.

These levels are typically well below regulatory limits. The MDC is instrument and analysis specific, and is established by the analytical laboratory at the beginning of each analytical run.

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 and practicable. This is accomplished through the use of the uncertainty term, which is reported by the analytical laboratory with the sample result. Results are presented in this report with an analytical uncertainty term, 2s, where "s" is an estimate of the population standard deviation (σ), assuming a Guassian or normal distribution. The result plus or minus ($\pm$) the uncertainty term (2s) represents the 95 confidence interval for the measurement. That is, there is 95 percent confidence that the real concentration in the sample lies somewhere between the measured concentration minus the uncertainty term and the measured concentration plus the uncertainty term. By using a 2s value as a reporting level, the error rate for saying something is not there when it is, is kept to less than 5 percent. However, there may be a relatively high error rate for false detections (reporting something as present when it actually is not) for results near their 2s uncertainty levels. This is because the variability around the sample result may substantially overlap the variability around a net activity of zero for samples with no radioactivity. Analyses with results in the questionable range (2s to 3s) are thus presented in this report with the understanding that the radionuclide may not actually be present in the sample. If a result exceeds three times its estimated uncertainty (3s), there is confidence that the radionuclide is present in the sample. If a result is less than or equal to 2s there is little confidence that the radionuclide is present in the sample. A more detailed discussion about confidence in detections may be found in Confidence in Detections under Helpful Information.

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 890 mi^2 (2,300 km^2) 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 warships. The retooled guns were tested on the nearby, uninhabited plain, known as the Naval Proving Ground. In the years following 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 amounts of electricity. Over time the site evolved into an assembly of 52 reactors, associated research centers, and waste handling areas. The NRTS was renamed the Idaho National Engineering Laboratory (INEL) in 1974 and the INEEL in January 1997. With renewed interest in nuclear power the DOE announced in 2002 that Argonne National Laboratory and the INEEL would be the lead laboratories for development of the next generation of power reactors. Other activities at the INEEL include environmental cleanup, subsurface research, and technology development.

3. AIR SAMPLING

The primary pathway by which radionuclides can move off the INEEL is through the air and for this reason the air pathway is the primary focus of monitoring on and around the INEEL. Samples for particulates and iodine-131 (^{131}I) gas in air were collected weekly for the duration of the quarter at 16 locations using low-volume air samplers. Moisture in the atmosphere was sampled at four locations around the INEEL and analyzed for tritium. Concentrations of airborne particulates less than 10 micrometers in diameter (PM_{10}) were measured for comparison with EPA standards at three locations. Air sampling activities and results for the third quarter, 2002 are discussed below. A summary of approximate minimum detectable concentrations (MDCs) for radiological analyses and DOE Derived Concentration Guide (DCG) (DOE 1993) values is provided in Appendix B.

LOW-VOLUME AIR SAMPLING

Radioactivity associated with airborne particulates was monitored continuously by 18 low-volume air samplers (two of which are used as replicate samplers) at 16 locations during the third quarter of 2002 (Figure 1). Three of these samplers are located on the INEEL, nine are situated off the INEEL near the boundary, and six have been placed at locations distant to the INEEL. Samplers are divided into INEEL, Boundary, and Distant groups to determine if there is a gradient of radionuclide concentrations, increasing towards the INEEL. Each replicate sampler is relocated every year to a new location. One replicate sampler was placed at Arco (Boundary location) and one at Howe (Boundary location) during 2002. An average of 14,347 ft^3 (406 m^3) of air was sampled at each location, each week, at an average flow rate of 1.3 ft^3/min (0.04 m^3/min). Particulates in air were collected on glass fiber particulate filters (1.2-µm pore size). Gases passing through the filter were collected with an activated charcoal cartridge.

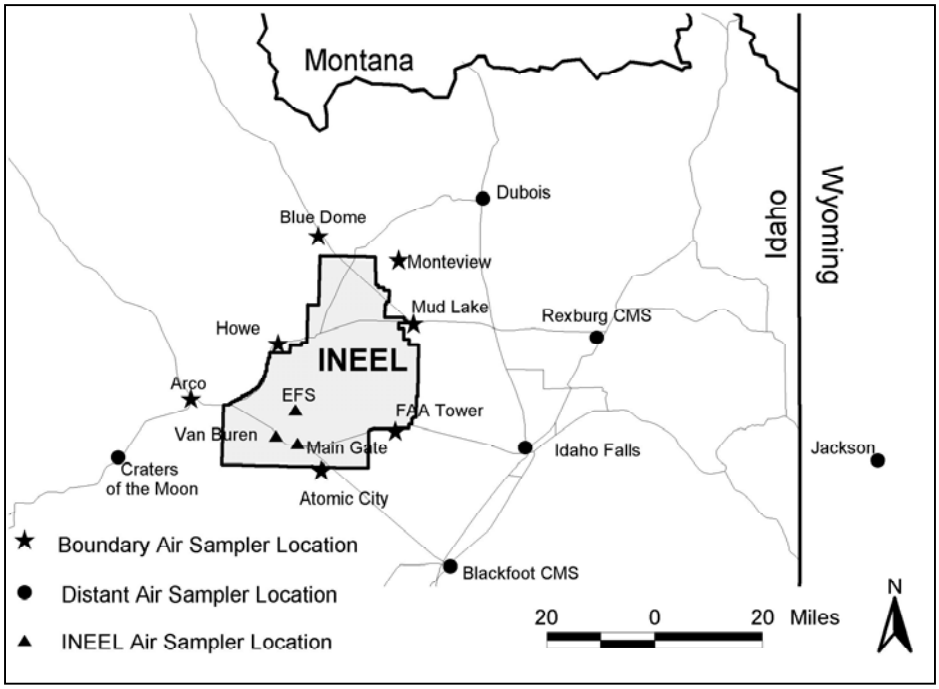


Figure 1. Low-volume air sampler locations.

Filters and charcoal cartridges were changed weekly at each station during the quarter. Each particulate filter was analyzed 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. More information concerning gross alpha and beta radioactivity can be found in Gross versus Specific Analyses under Helpful Information.

The weekly particulate filters collected during the quarter for each location were composited and analyzed for gamma-emitting radionuclides. Composites were also analyzed by location for ^{90}Sr, or ^{238}Pu, $^{239/240}$Pu, and ^{241}Am as determined by a rotating quarterly schedule.

Charcoal cartridges were analyzed for gamma-emitting radionuclides, specifically for ^{131}I. Iodine-131 is of particular interest because it is produced in relatively large quantities by nuclear fission, is readily accumulated in human and animal thyroids, and has a half-life of eight days. This means that any elevated level of ^{131}I in the environment could be from a recent release of fission products.

Gross alpha results are reported in Table C-1. Median gross alpha concentrations in air for INEEL, Boundary, and Distant locations for the third quarter of 2002 are shown in Figure 2. The data were tested for normality prior to statistical analyses. For the most part the data showed no discernable distribution. Box and whisker plots are commonly used when there is no assumed distribution. Each data group in Figure 2 is presented as a box and whisker plot, with a median, a box enclosing values between the 25th and 75th percentiles, and whiskers representing the non-outlier range. Note that outliers and extreme values are identified separately from the box and whiskers. Outliers and extreme values are atypical, infrequent, data points that are far from the middle of the data distribution. For this report, outliers are defined as values that are greater than 1.5 times the height of the box, above or below the box. Extreme values are greater than 2 times the height of the box, above or below the box. Outliers and extreme values may reflect inherent variability, may be due to errors associated with transcription or measurement, or may be related to other anomalies. A careful review of the data collected during the third quarter indicates that the outliers and extreme values were not due to mistakes in collection, analysis, or reporting procedures, but rather reflect natural variability in the measurements. The outliers and extreme values lie within the range of measurements made within the past five years. Thus, rather than dismissing the outliers, they were included in the subsequent statistical analyses. Further discussion of box plots may be found in Determining Statistical Differences under Helpful Information.

Figure 2 graphically shows that the gross alpha measurements made at INEEL, Boundary, and Distant locations are similar for the third quarter. If the INEEL were a significant source of offsite contamination, concentrations of contaminants should be statistically greater at Boundary locations than at Distant locations. Because there is no discernable distribution of the data, the nonparametric Kruskal-Wallis test of multiple independent groups was used to test for statistical differences between INEEL, Boundary, and Distant locations. The use of nonparametric tests, such as Kruskal-Wallis, gives less weight to outliers and extreme values thus allowing a more appropriate comparison of data groups. A statistically significant difference exists between data groups if the (p) value is less than 0.05. Values greater than 0.05 translate into a 95 percent confidence that the medians are statistically the same. The p-value for each comparison is shown in Table D-1. There were no statistical differences in gross alpha concentrations between groups for the third quarter.

Comparisons of gross alpha concentrations were made for each month of the quarter (Figures 3 – 5). Again the Kruskal-Wallis test of multiple independent groups was used to determine if statistical differences exist between INEEL, Boundary, and Distant data groups. There were no statistical differences in gross alpha between groups for any month (Table D-1).

As a further check, comparisons between gross alpha concentrations measured at Boundary and Distant locations were made on a weekly basis. The Mann-Whitney U test was

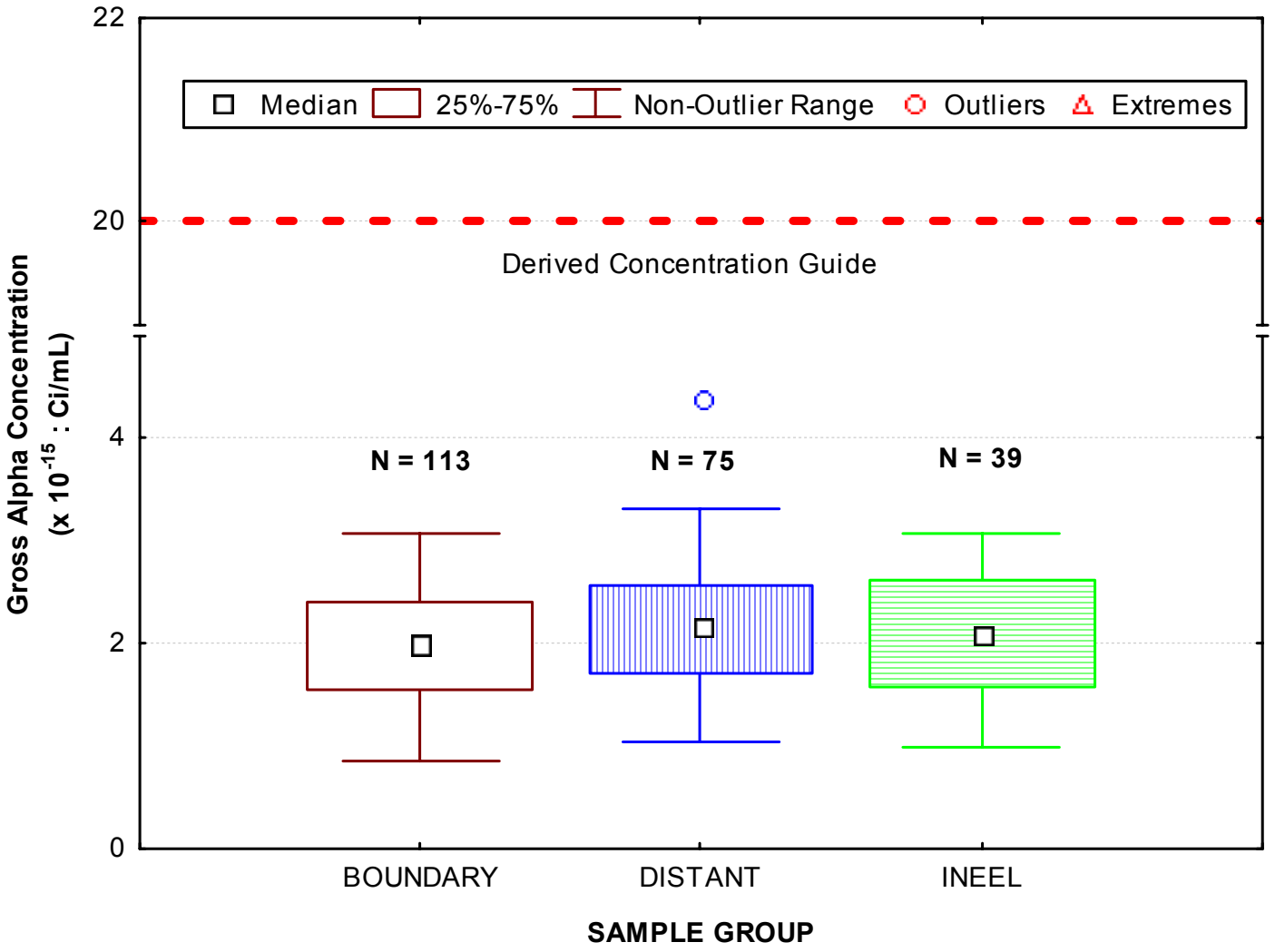


Figure 2. **Gross alpha concentrations in air at ESER Program Boundary, Distant, and INEEL locations for the third quarter of 2002.**

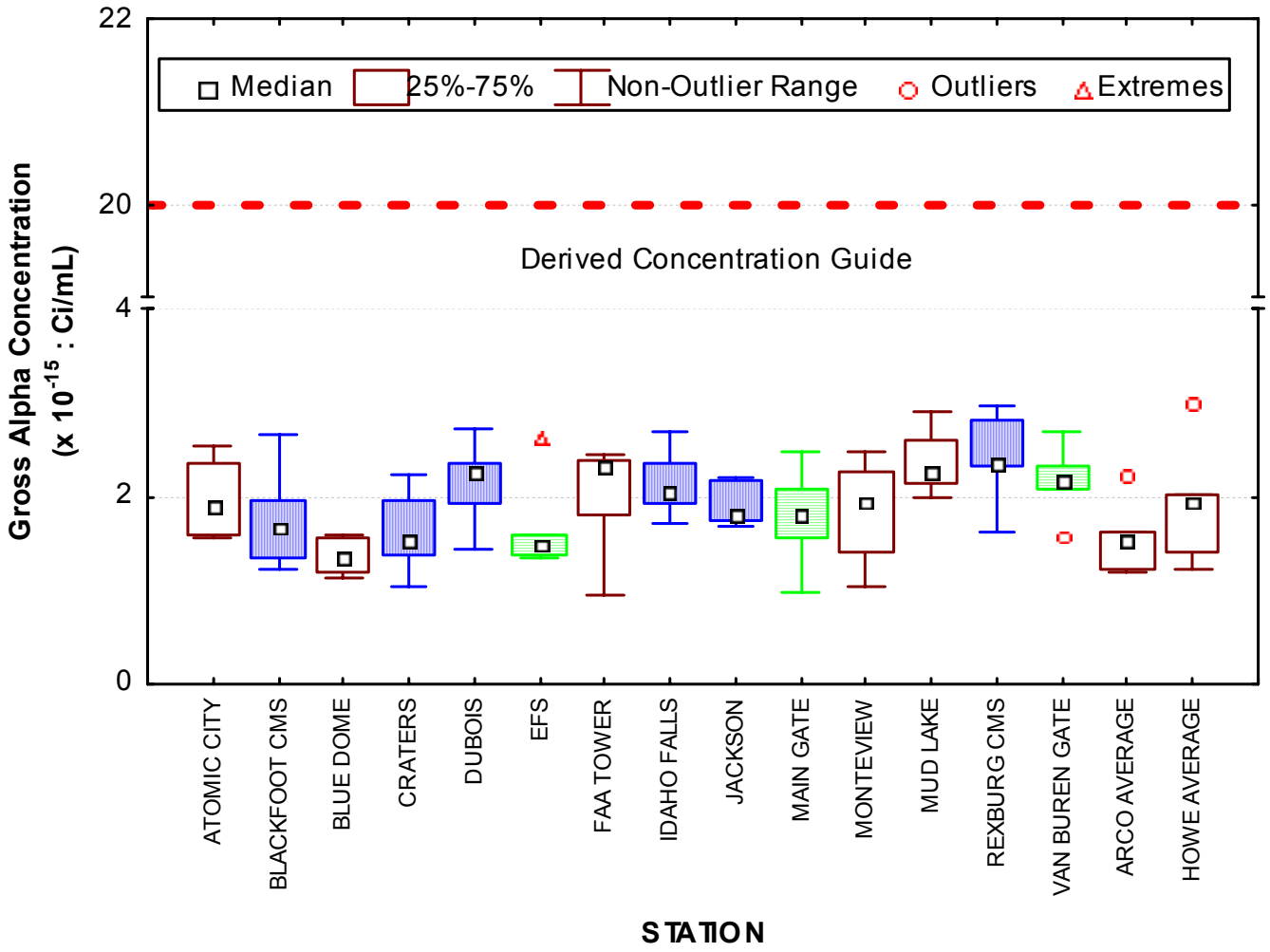


Figure 3. **July gross alpha concentrations in air at ESER Program INEEL, Boundary, and Distant locations**. Stations belonging to INEEL, Boundary, or Distant locations are represented by boxes that are patterned with vertical green stripes, no fill, or horizontal blue stripes, respectively. [Number of samples (N) = 5 for each location except for Atomic City and Howe (Q/A-2), where N = 4.]

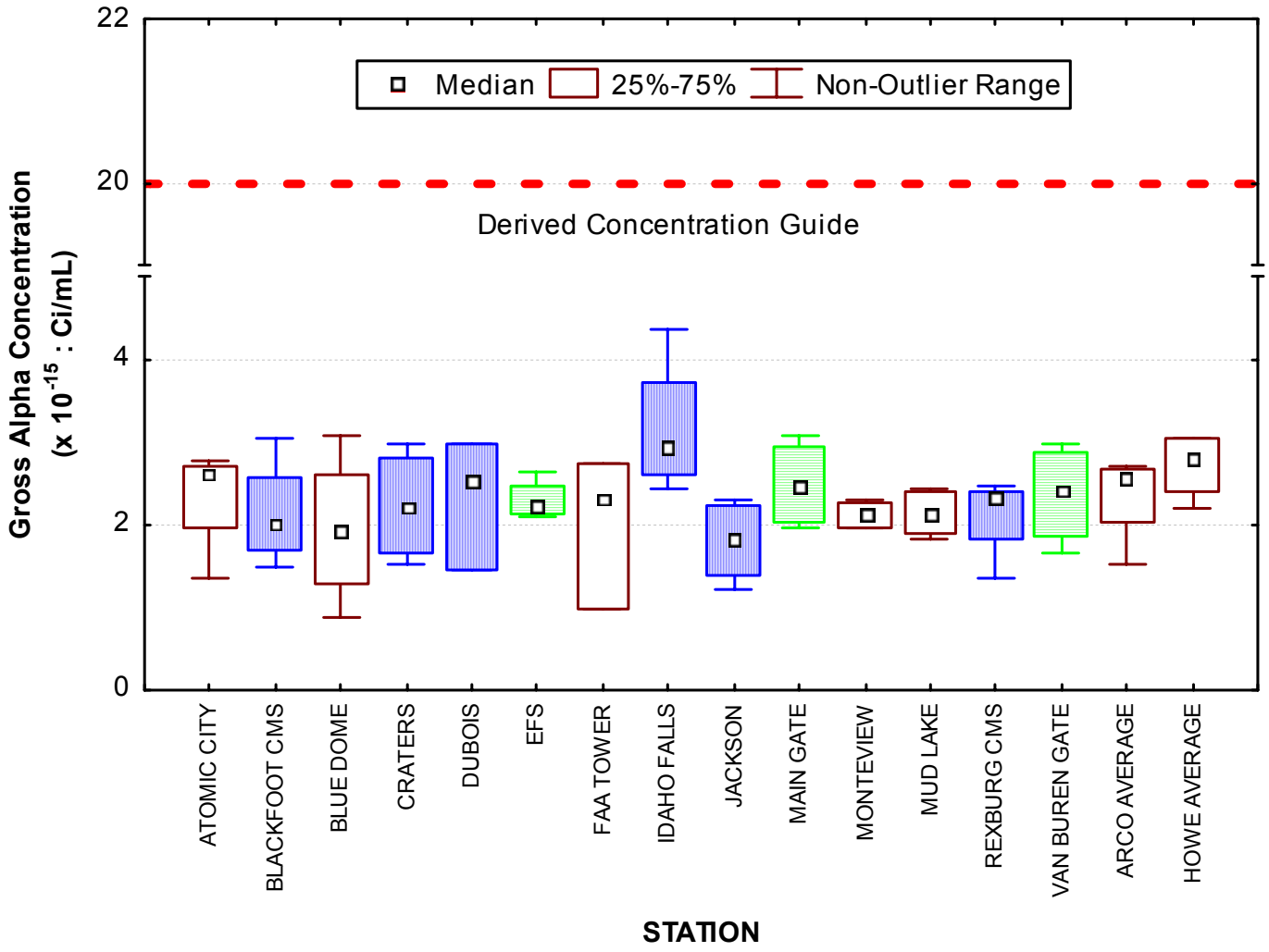


Figure 4. **August gross alpha concentrations in air at ESER Program INEEL, Boundary, and Distant locations.** Stations belonging to INEEL, Boundary, or Distant locations are represented by boxes that are patterned with vertical green stripes, no fill, or horizontal blue stripes, respectively. Number of samples (N) = 4 at each location except for Dubois and FAA Tower where N = 3.

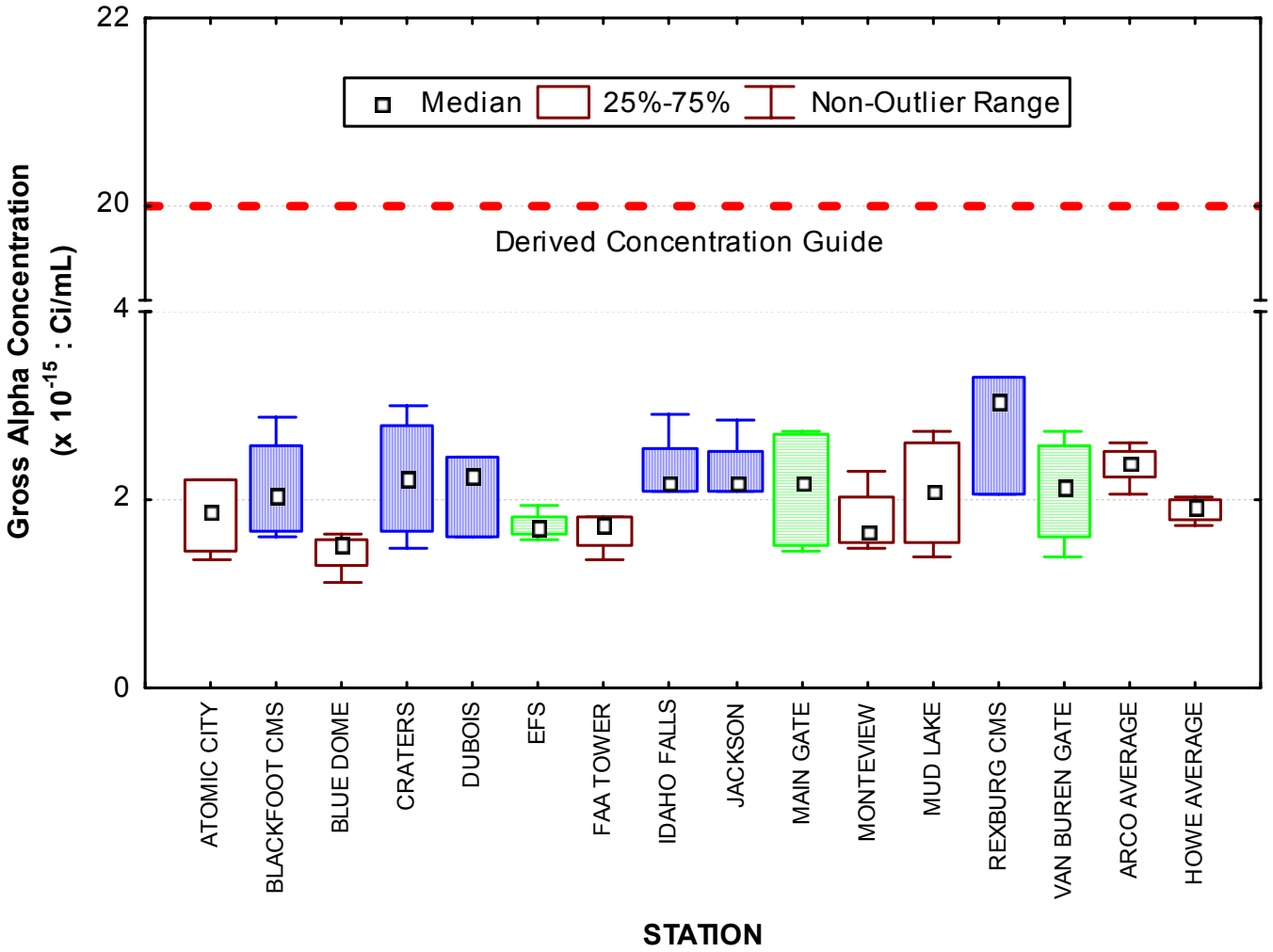


Figure 5. **September gross alpha concentrations in air at ESER Program INEEL, Boundary, and Distant locations.** Stations belonging to INEEL, Boundary, or Distant locations are represented by boxes that are patterned with vertical green stripes, no fill, or horizontal blue stripes, respectively. Number of samples (N) = 4 at each location except for ARCO (Q/A-1), Dubois, and Rexburg CMS, where N=3.

used to compare the Boundary and Distant data because it is the most powerful nonparametric alternative to the t-test for independent samples. INEEL sample results were not included in this analysis because the onsite data, collected at only three locations, are not representative of the entire INEEL and would not aid in determining offsite impacts. The gross alpha concentrations measured at Boundary locations were statistically different than those measured at Distant locations for the week of September 4 and September 18, 2002 (Table D-2). Additional analysis of results for the week of September 4 showed no statistical difference between Boundary locations or between Distant locations. Review of the box and whisker plot reveals that the Distant location group is higher than the Boundary location group. For this reason it is believed that the values reflect natural variability and not a potential release from the INEEL. Analysis for the week of September 18 showed a statistical difference between stations of the Distant location group. Review showed the Blackfoot CMS, Rexburg CMS and Idaho Falls locations were all significantly greater than the remaining stations (Craters of the Moon, Dubois and Jackson WY). Again review of the box and whisker plot showed the Distant location group to be higher than the Boundary location group. This also is interpreted as natural variability. More detail on the statistical tests used can be found in Determining Statistical Differences under Helpful Information.

Gross beta results are also presented in Table C-1. Gross beta concentrations in air for INEEL, Boundary, and Distant locations for the third quarter of 2002 are shown in Figure 6. The data were tested and found to be neither normally nor log-normally distributed. Box and whiskers plots were used for presentation of the data. Outliers and extreme values were retained in subsequent statistical analyses because they are within the range of measurements made in the past five years, and because these values could not be attributed to mistakes in collection, analysis, or reporting procedures. As in the case of alpha activity, the quarterly data for each group appear to be similar and were determined, using the Kruskal-Wallace test, to be statistically the same (Table D-1).

Monthly median gross beta concentrations in air for each sampling group are shown in Figures 7 – 9. Statistical data are presented in Table D-1. There were no statistical differences in gross beta between groups for any month during the quarter (Table D-1).

Comparison of weekly Boundary and Distant data sets, using the Mann Whitney U test, indicates a difference between the two location groups for the weeks of July 10 and August 28, 2002 (Table D-2). As with gross alpha the Distant group was statistically greater than the Boundary group for these two weeks. No statistical difference was found between stations of either the Boundary or Distant location groups.

Iodine-131 was measured above the 2s value in one batch of six charcoal cartridges. No ^{131}I was measured above the respective 2s for individual cartridge recounts. Weekly ^{131}I results for each location are listed in Table C-2 of Appendix C.

Weekly filters for the third quarter of 2002 were composited by location and analyzed for gamma-emitting radionuclides, including cesium-137 (^{137}Cs). Selected composites were also analyzed for ^{90}Sr, ^{238}Pu, $^{239/240}Pu$, and ^{241}Am.

Composite samples from nine air monitoring stations (Blackfoot CMS, Craters, EFS, FAA Tower, Howe, Howe Q/A-2, Idaho Falls, Monteview, and Rexburg CMS) showed at least one human-made radionuclide (^{241}Am, $^{239/240}Pu$, or ^{137}Cs) greater than its related 2s value. Plutonium-238 was not detected in any sample. Occasional detection of human-made radionuclides is not unusual and represents natural variations in concentrations of radionuclides introduced by historical nuclear weapons testing. The concentrations measured during this

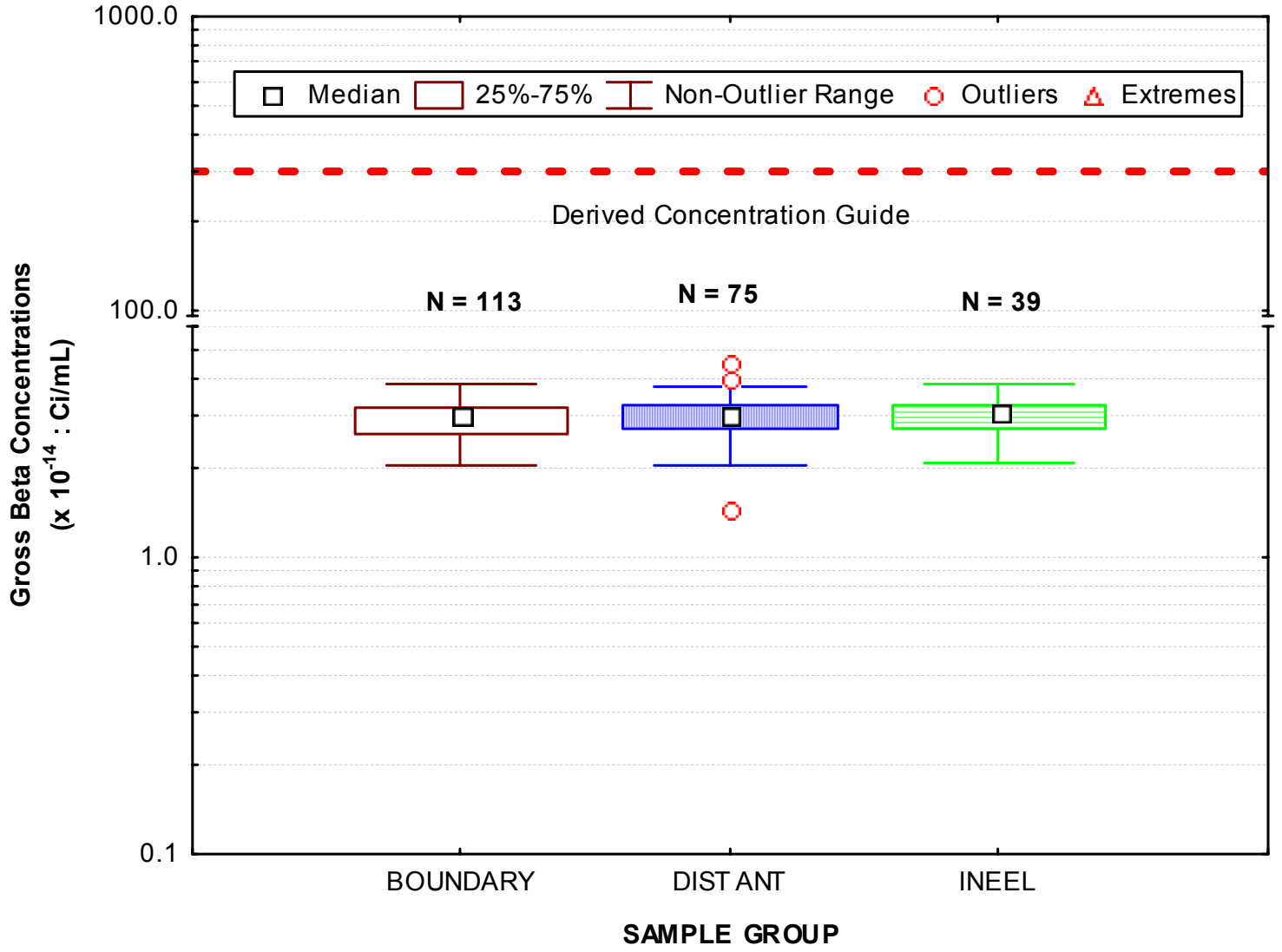


Figure 6. **Gross beta concentrations in air at ESER Program INEEL, Boundary, and Distant locations for the third quarter 2002.**

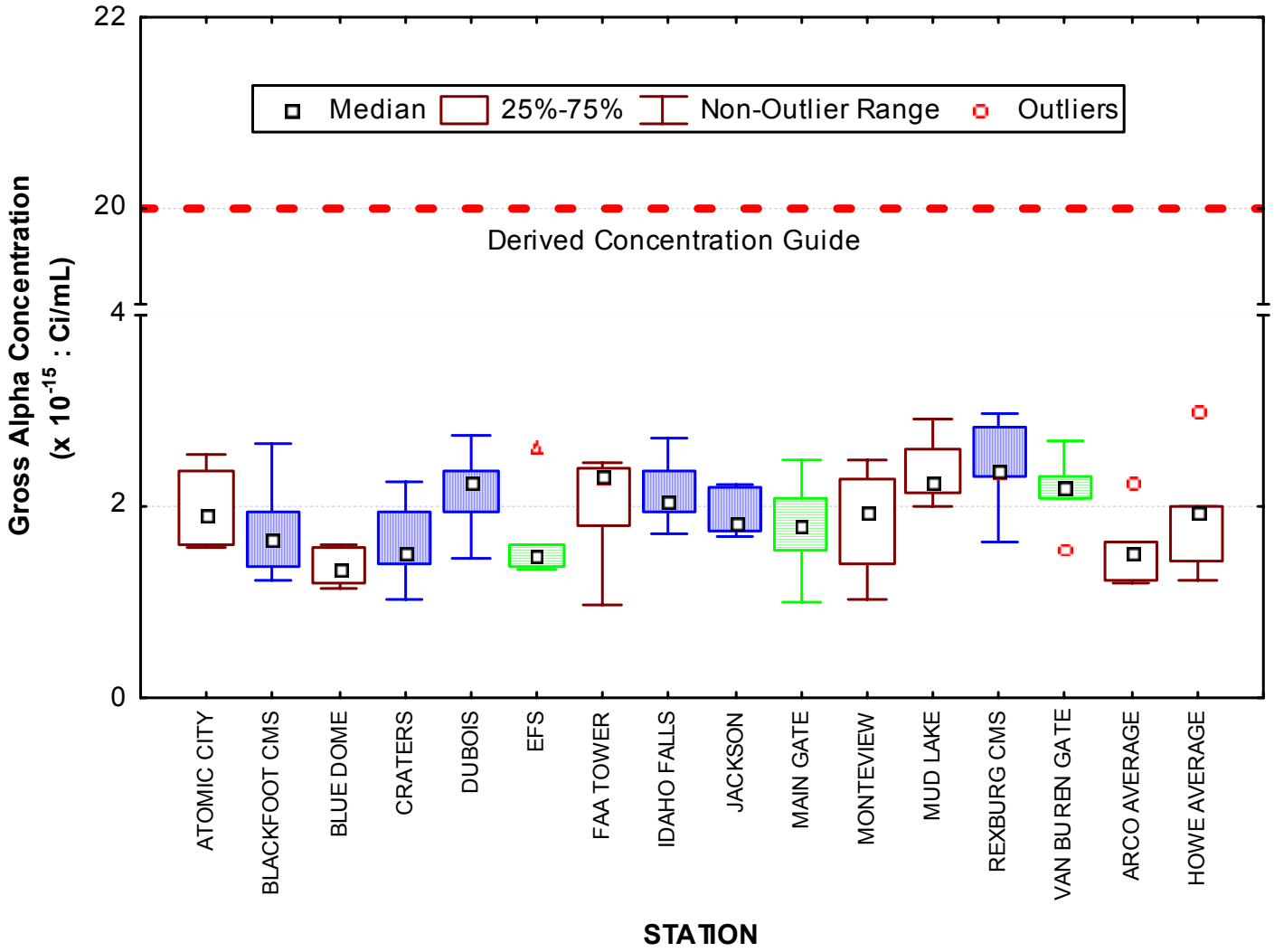


Figure 7. **July gross beta concentrations in air at ESER Program stations**. Stations belonging to INEEL, Boundary, or Distant locations are represented by boxes that are patterned with vertical green stripes, no fill, or horizontal blue stripes, respectively. [Number of samples (N) = 5 for each location except for Atomic City and Howe (Q/A-2), where N = 4.]

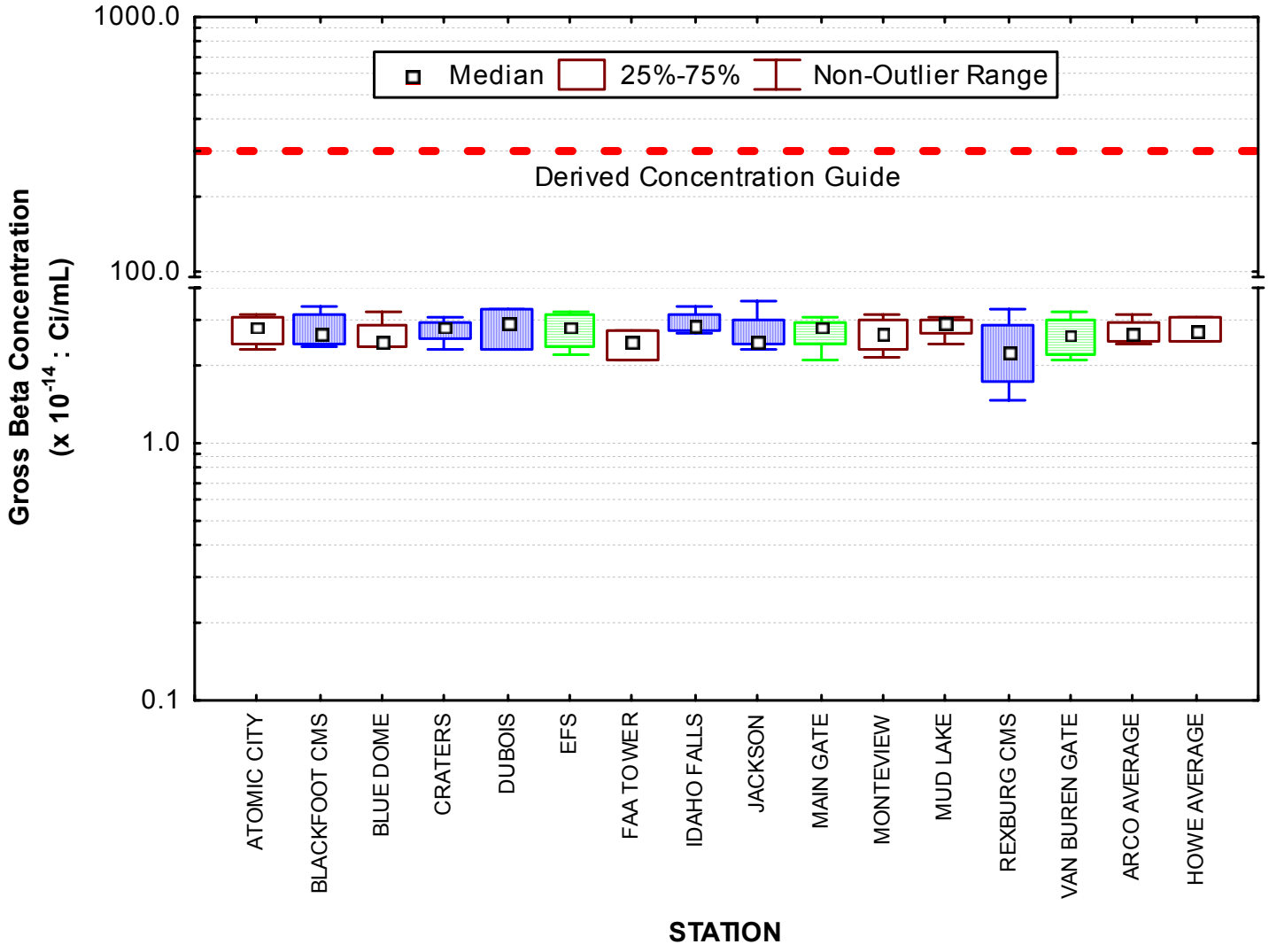


Figure 8. **August gross beta concentrations in air at ESER Program INEEL, Boundary, and Distant locations.** Stations belonging to INEEL, Boundary, or Distant locations are represented by boxes that are patterned with vertical green stripes, no fill, or horizontal blue stripes, respectively. Number of samples (N) = 4 at each location except for Dubois and FAA Tower where N = 3.

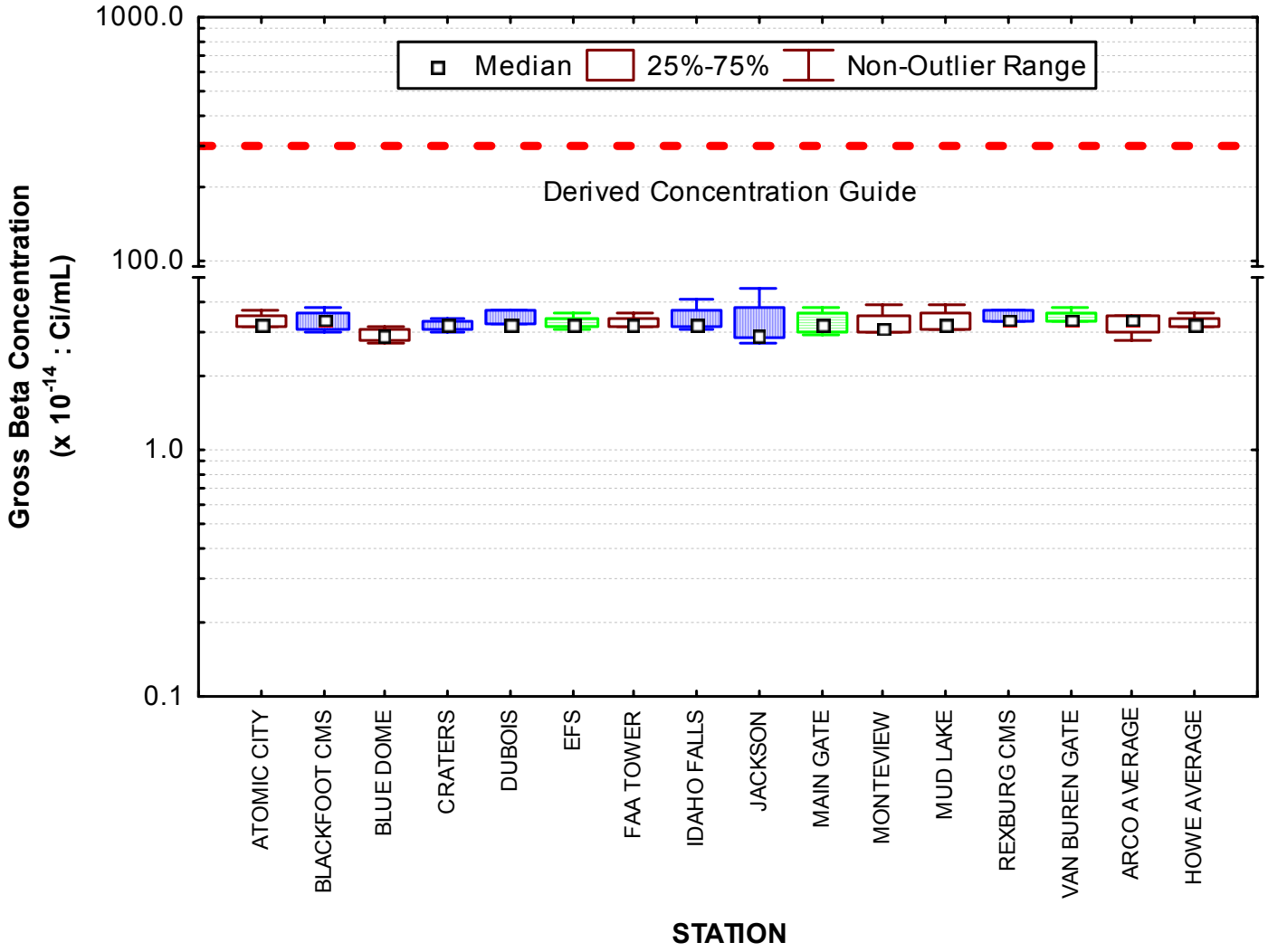


Figure 9. **September gross beta concentrations in air at ESER Program INEEL, Boundary, and Distant locations.** Stations belonging to INEEL, Boundary, or Distant locations are represented by boxes that are patterned with vertical green stripes, no fill, or horizontal blue stripes, respectively. Number of samples (N) = 4 at each location except for ARCO (Q/A-1), Dubois, and Rexburg CMS, where N=3.

quarter are consistent with those recorded in the past. All results were far less than their respective DCGs. Only the Blackfoot CMS composite had ^{137}Cs measured above the 2s value. Figure 10 shows the ^{241}Am and $^{239/240}$Pu composite results that were greater than their 2s values. All results for composite filter samples are shown in Table C-3, Appendix C.

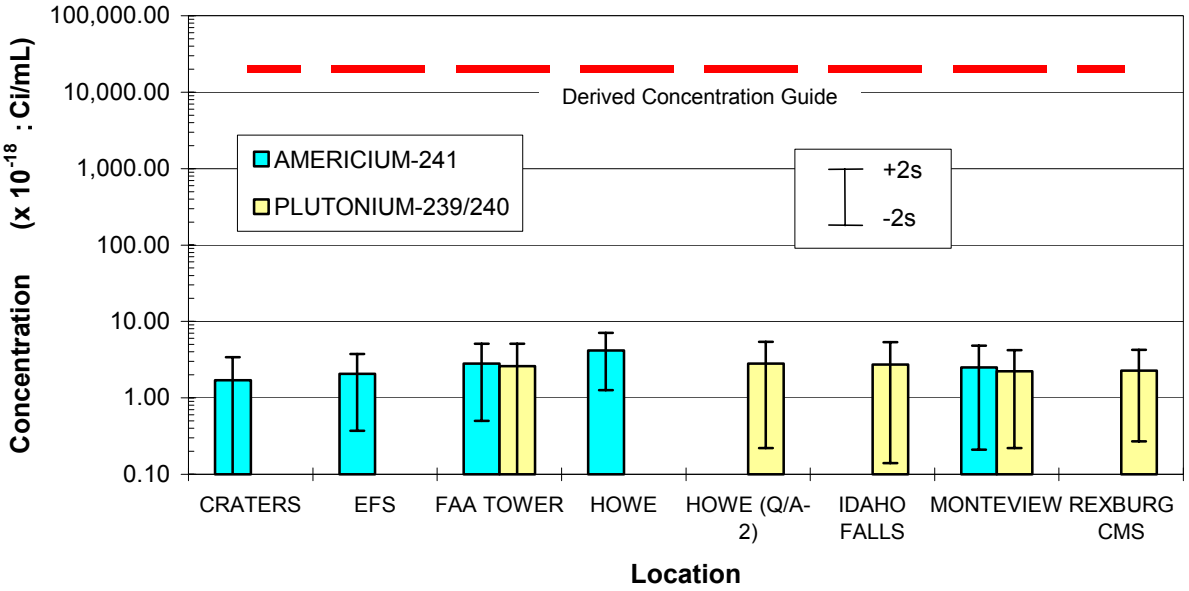


Figure 10. Specific radionuclides detected in quarterly composite air filters (by locations).

ATMOSPHERIC MOISTURE SAMPLING

Twenty-one atmospheric moisture samples collected using silica gel were obtained during the third quarter of 2002. Samples were divided as follows: two samples from Rexburg, four samples from Blackfoot, six samples from Atomic City, and nine samples from Idaho Falls. Atmospheric moisture is collected by pulling air through a column of absorbent material (i.e., silica gel) to absorb water vapor. The water is then extracted from the absorbent material by heat distillation. The resulting water samples are then analyzed for tritium using liquid scintillation.

Eleven samples exceeded their respective 2s values, one from Rexburg, two from Blackfoot, three from Atomic City, and five from Idaho Falls. Five sample results (one from Atomic City, four from Idaho Falls) are questionable due to small sample size (less than 9 mL). All sample results were well below the DOE DCG for tritium in air of 1×10^{-7} μCi/mL (3.7×10^{-3} Bq/mL). The maximum value was 6.6×10^{-12} μCi/mL of air (2.6×10^{-7} Bq/mL of air).

PM_{10} AIR SAMPLING

The EPA began using a standard for concentrations of airborne particulate matter (PM) less than 10 micrometers in diameter (PM_{10}) in 1987 (40 CFR 50.6, 1996). Particles of this size can be inhaled deep into the lungs and are considered to be responsible for most of the adverse health effects associated with airborne particulate pollution. The air quality standards for these particulates are an annual average of 50 μg/m^3, with a maximum 24-hour concentration of 150 μg/m^3.

The ESER Program operates three PM_{10} samplers, one each at the Rexburg CMS and Blackfoot CMS, and one in Atomic City. Sampling of PM_{10} is informational only as no chemical analyses are conducted for contaminants. A twenty-four hour sampling period is scheduled to run once every six days. Equipment problems nullified two samples from each location. The maximum 24-hour concentration was 79.0 µg/m^3 on July 12, 2002, in Blackfoot. The average, maximum, and minimum results of the 24-hour samples are summarized in Table 1. None of the results exceeds the maximum 24-hour air quality standard established by EPA. Results for all PM_{10} samples are listed in Table C-5, Appendix C.

Table 1. Summary of 24-hour PM_{10} values.

	Concentration[a]		
Location	**Minimum**	**Maximum**	**Average**
Atomic City	11.0	48.1	25.6
Blackfoot, CMS	21.3	79.0	36.6
Rexburg, CMS	20.1	58.4	35.0

a. All concentrations are in (: g/m^3).

4. WATER SAMPLING

The ESER program samples precipitation, surface water, and drinking water. Monthly composite precipitation samples are collected from Idaho Falls and the Central Facilities Area (CFA) on the INEEL. Weekly precipitation samples are collected from the Experimental Field Station (EFS) on the INEEL. Surface and/or drinking water are sampled twice each year at 19 locations around the INEEL. This occurs during the second and fourth quarters and is therefore not reported here. A summary of approximate minimum detectable concentrations (MDCs) for radiological analyses and DOE Derived Concentration Guide (DCG) (DOE 1993) values is provided in Appendix B.

PRECIPITATION SAMPLING

Precipitation samples are gathered when sufficient precipitation occurs to allow for the collection of the minimum sample volume of approximately 20 mL. Samples are taken of a monthly composite from Idaho Falls and CFA, and weekly from the EFS. Precipitation samples are analyzed for tritium. Storm events in the third quarter of 2002 produced enough precipitation for a total of 14 samples (11 samples and three splits) – three from CFA, three and two splits from Idaho Falls, and five and a split from the EFS.

Tritium was measured above the samples' 2s value in ten samples and two split samples: all the CFA and EFS samples, and three samples from Idaho Falls. While there is no regulatory limit for tritium in precipitation, the DOE DCG and maximum contaminant level set by EPA for tritium in drinking water can be used as screening values. The highest tritium detected concentration, 290 ± 58.3 pCi/L (10.7 ± 2.2 Bq/L), was from the sample collected from CFA on July 30, 2002. This value is many times lower than the DCG value (2×10^6 pCi/L) and the Safe Drinking Water Act limit (20,000 pCi/L) for tritium in drinking water.

Low levels of tritium exist in the environment at all times as a result of cosmic ray reactions with water molecules in the upper atmosphere. Tritium measured in third quarter ESER samples were within the range of values measured elsewhere. The EPA's ERAMS program collects precipitation samples from across the United States. From 1978 to 2001 tritium measured in those samples ranged from -2.00 to 7.38×10^6 pCi/L (-7.4 to 2.7×10^4 Bq/L) (EPA 2002). Data for all third quarter 2002 precipitation samples collected by the ESER Program are listed in Table C-6 (Appendix C).

5. AGRICULTURAL PRODUCTS AND WILDLIFE SAMPLING

Another potential pathway for contaminants to reach humans is through the food chain. The ESER Program samples multiple agricultural products and game animals from around the INEEL and Southeast Idaho. Specifically, milk, wheat, potatoes, garden lettuce, sheep, big game, waterfowl, doves, and marmots 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. See Table A-1, Appendix A, for more details on agricultural product and wildlife sampling. This section discusses results from milk, lettuce, wheat, and large game sampled during the third quarter of 2002. A summary of approximate minimum detectable concentrations (MDCs) for radiological analyses is provided in Appendix B. There are no regulatory standards for radionuclide concentrations in agricultural products or wildlife tissues.

MILK SAMPLING

Milk samples were collected weekly in Idaho Falls and monthly at nine other locations around the INEEL (Figure 11) during the third quarter of 2002. All samples were analyzed for gamma emitting radionuclides. Samples are analyzed for ^{90}Sr during the second and fourth quarters.

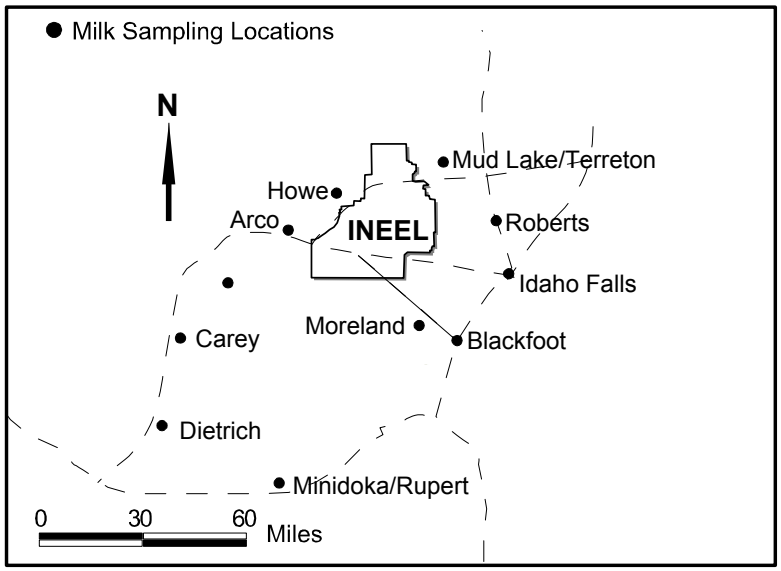


Figure 11. ESER Program milk sampling locations.

Data for ^{131}I and ^{137}Cs in milk samples are listed in Table C-7. Iodine-131 or ^{137}Cs were not measured above the 2s value in any milk sample during this quarter.

LETTUCE SAMPLING

Seven lettuce samples were collected from private gardens and analyzed for gamma emitting radionuclides and ^{90}Sr. No man-made gamma emitting radionuclides were detected in any of the samples. Strontium-90 was measured in five samples, those from Arco, Carey, Howe, Monteview, and Mud Lake above their 2s values. The highest concentration of ^{90}Sr was measured in the sample from Carey at 283.0 ± 160.0 pCi/kg (dry) (10.5 ± 5.93 Bq/kg [dry]).

Data for ^{137}Cs in all lettuce samples taken during the third quarter are listed in Table C-8 and ^{90}Sr data for all lettuce samples are listed in Table C-9 (Appendix C).

WHEAT SAMPLING

A total of 15 wheat samples were collected from local grain elevators. All samples were analyzed for gamma-emitting radionuclides and ^{90}Sr. Cesium-137 was measured above the 2s value in the sample from Aberdeen. Strontium-90 was measured above the 2s value in the sample from Monteview. Data for ^{137}Cs and ^{90}Sr in all wheat samples taken during the third quarter are listed in Appendix C, Table C-8 and Table C-9.

LARGE GAME ANIMAL SAMPLING

Four game animals were sampled during the third quarter of 2002. All were killed as a result of vehicular collisions. These accidents involved three mule deer (*Odocoileus hemionus*) and one pronghorn antelope (*Antilocapra americana*). Efforts were made to collect samples of thyroid, liver, and muscle tissue from each animal, but due to their condition at the time of sampling not all animals provided all samples. Cesium-137 and ^{131}I data for all big game samples are listed in Appendix C, Table C-10.

Each sample collected was analyzed for gamma emitting radionuclides. Liver and muscle tissue of all animals had detectable concentrations of naturally occurring potassium-40. Cesium-137 was detected in the liver tissue and measured in the muscle tissue and thyroid from a single mule deer sampled on August 8, 2002.

The concentrations measured in the above samples are within the range of values for samples collected in the past. Likewise, the presence of ^{137}Cs is commonly associated with fallout from past weapons testing and nuclear accidents (i.e., Chernobyl).

MARMOT SAMPLING

Marmots, otherwise known as rockchucks, are a large member of the squirrel family and are hunted and consumed by the Native American people in the area. A population of yellow-bellied marmots exists around and within the boundaries of the Radioactive Waste Management Complex (RWMC). During the third quarter of 2002, three marmots were collected from the Subsurface Disposal Area (SDA) of the RWMC. Two marmots were also collected, as controls, from the Pocatello Zoo. Each marmot was dissected into three samples, the edible portion (muscle tissue), viscera, and the remainder (skin, fur, bones). All samples were analyzed for gamma-emitting radionuclides, ^{90}Sr, ^{238}Pu, $^{239/240}Pu$, and ^{241}Am. Four samples of the edible portion of the marmot had results greater than their associated 2s for at least one radionuclide. Two samples from the SDA had ^{137}Cs above the 2s, one of these samples also had detecable ^{90}Sr. Two control samples exceeded their 2s values, one for ruthenium-103 and one for ^{90}Sr. These four samples, plus one additional sample also exceeded their 2s values for certain radionuclides in their viscera and remainder samples (Table 2). Results for all marmot samples are listed in Table C-11, Appendix C.

The potential dose from eating the most contaminated edible portions of the marmots collected in 2002 is .0073 mrem. Well below the EPA limit of 10 mrem.

Table 2. Radionuclides detected in 2002 marmot samples.

Location (Sample ID)		Analyte	Portion	Result[a]
SDA	(RWMC26)	Cesium-137	Edible	274 ± 17
SDA	(RWMC83)	Cesium-137	Edible	3.9 ± 1.6
Pocatello	(20061)	Ruthenium-106	Edible	38.1 ± 18.0
SDA	(RWMC83)	Strontium-90	Edible	17.9 ± 5.4
Pocatello	(2009)	Strontium-90	Edible	8.4 ± 4.2
SDA	(RWMC110)	Amercium-241	Viscera	4.3 ± 1.5
SDA	(RWMC83)	Amercium-241	Viscera	2.5 ± 1.0
SDA	(RWMC26)	Amercium-241	Viscera	1.6 ± 0.8
SDA	(RWMC26)	Cerium-141	Viscera	64.9 ± 29.0
Pocatello	(2009)	Cerium-141	Viscera	59.2 ± 22.0
SDA	(RWMC26)	Cesium-137	Viscera	130.0 ± 8.8
SDA	(RWMC83)	Cesium-137	Viscera	3.8 ± 1.8
Pocatello	(2009)	Manganese-54	Viscera	5.7 ± 2.2
Pocatello	(20061)	Niobium-95	Viscera	39.4 ± 20.0
SDA	(RWMC26)	Strontium-90	Viscera	39.6 ± 7.0
SDA	(RWMC83)	Strontium-90	Viscera	18.0 ± 6.0
SDA	(RWM8C26)	Americium-241	Remainder	3.68 ± 1.3
Pocatello	(2009)	Cerium-141	Remainder	54.3 ± 22.0
SDA	(RWMC26)	Cesium-137	Remainder	177.0 ± 11.0
SDA	(RWMC83)	Cesium-137	Remainder	4.2 ± 1.9
Pocatello	(20061)	Cobalt-60	Remainder	5.6 ± 1.9
SDA	(RWMC26)	Niobium-95	Remainder	47.4 ± 22.0
Pocatello	(20061)	Niobium-95	Remainder	35.3 ± 16.0
SDA	(RWMC83)	Strontium-90	Remainder	2,640 ± 270
SDA	(RWMC26)	Strontium-90	Remainder	625 ± 66
SDA	(RWMC110)	Strontium-90	Remainder	74.4 ± 13.0

a. All result are in picocuries per kilogram (pCI/kg) ± two standard deviations.

6. SOIL SAMPLING

Soil samples are collected every two years from 12 offsite locations (four Distant and eight Boundary) (Figure 12). Five points were sampled at each location within a 10-m by 10-m grid. At each point two discrete depth intervals: 0 to 5 centimeters (cm) (0 to 2 inches [in.]) and 5 to 10 cm (2 to 4 in.) were sampled. Samples from each depth at all five points were combined to make two composite samples: one for the 0 to 5 cm (0 to 2 in.) depth interval and one for the 5 to 10 cm (2 to 4 in.) depth interval, for each location. Samples were analyzed for gamma-emitting radionuclides, ^{90}Sr, and certain actinides.

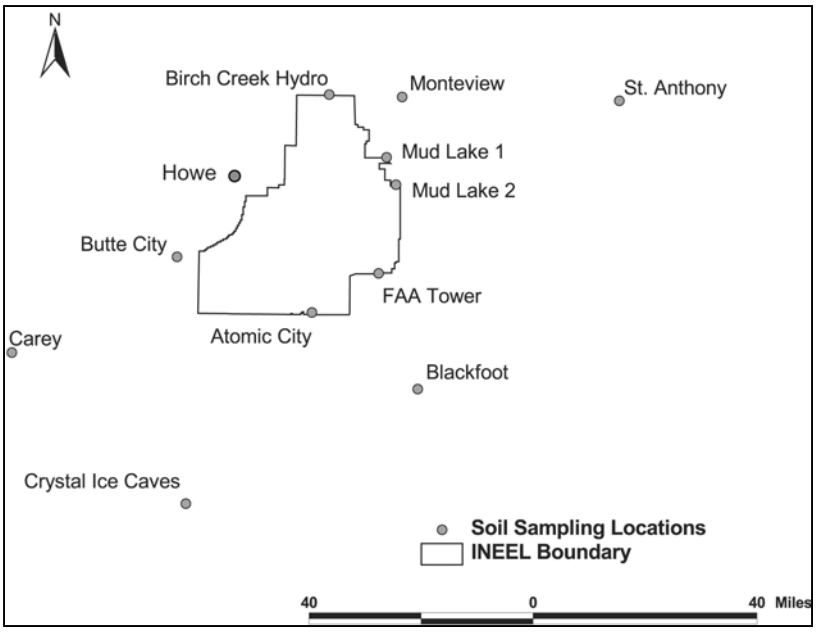
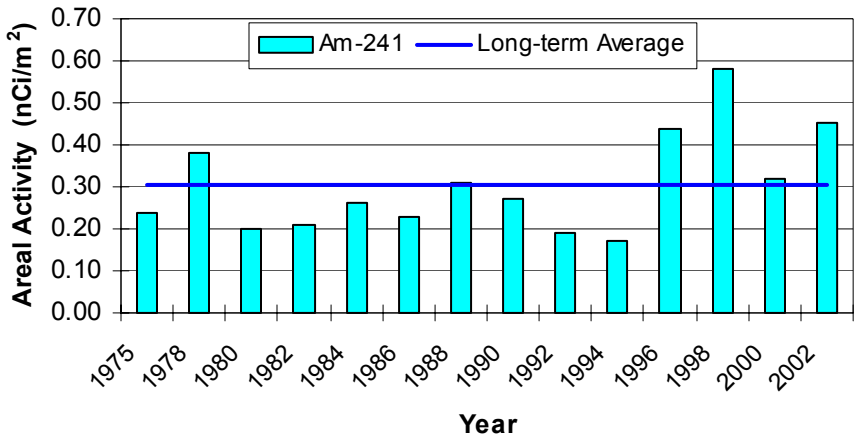
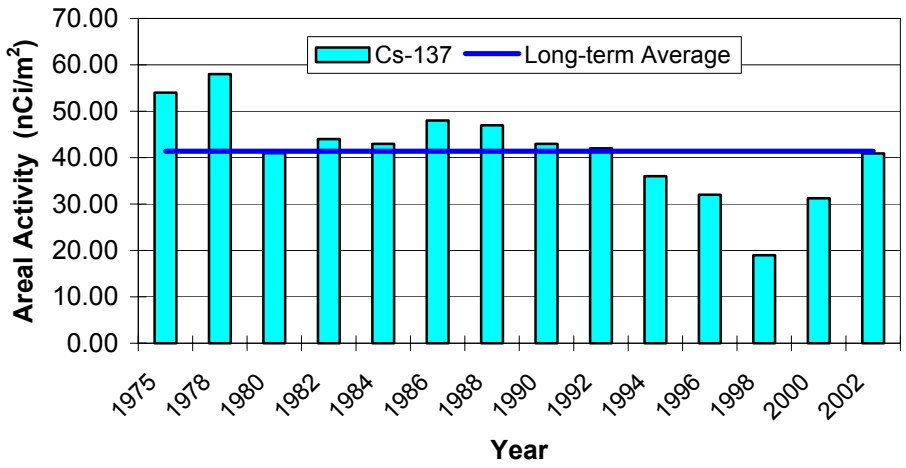


Figure 12. Offsite soil sampling locations.

Americium-241, $^{239/240}Pu$, and ^{137}Cs were measured in all samples but two samples (Howe split and Mud Lake) above their respective 2s concentrations. Plutonium-238 was detected in all samples above the 2s value, while ^{90}Sr was detected in three samples (Blackfoot, Carey and FAA Tower). Cobalt-60 was also measured above the 2s value in two samples (Atomic City and Mud Lake #1). The sample and duplicate from Howe also had ^{238}Pu above the 2s concentration.

Review of the geometric mean areal activity for radionuclide results showed that ^{241}Am and $^{239/240}Pu$ were above the long-term average concentrations for this area (Figure 13). All results were within the range of historical concentrations. Results for gamma emitting radionuclides (^{137}Cs and ^{60}Co) are included in Appendix C, Table C-12, while the transuranics are presented in Table C-13.





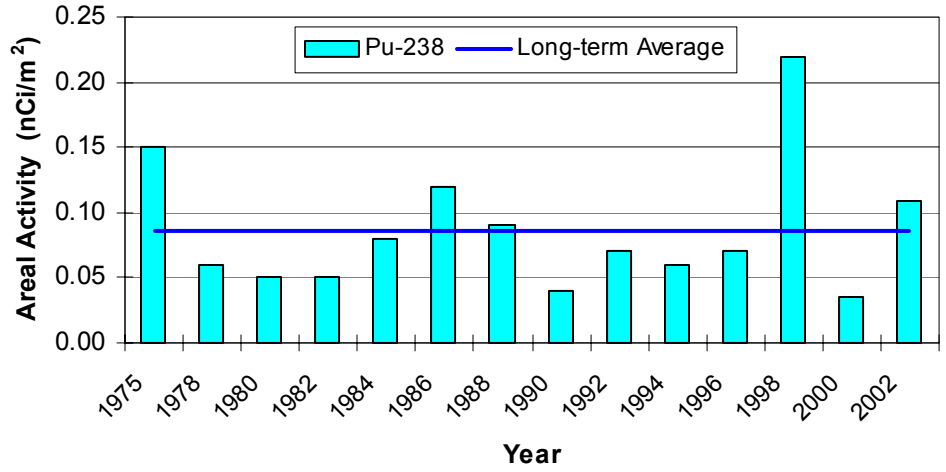
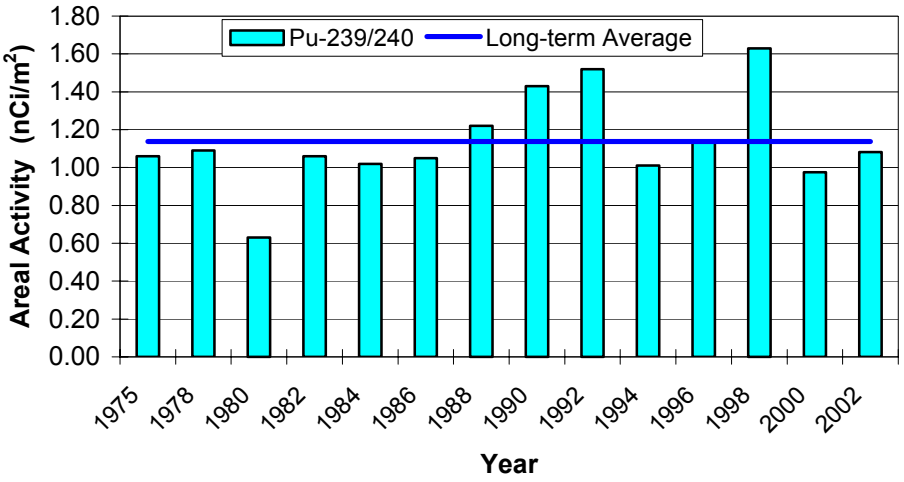


Figure 13. Geometric mean areal activity of surface soils (0 – 5 cm [0 – 2 in.]).



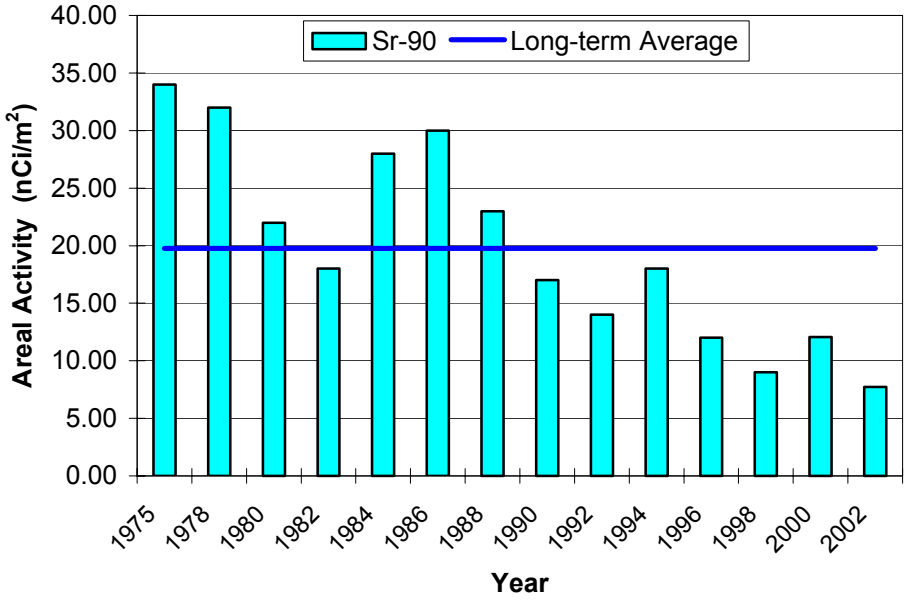


Figure 13. Geometric mean areal activity of surface soils (0 – 5 cm [0 – 2 in.]). (continued)

7. SUMMARY AND CONCLUSIONS

There were no observed gradients of gross alpha or gross beta concentrations in air increasing outwards from the INEEL toward Distant locations for any month of the quarter. Weekly statistical comparisons of Boundary locations with Distant locations showed differences in gross alpha concentrations for the weeks of September 4 and September 18, 2002 and in gross beta concentrations for July 10 and August 28, 2002. In all cases the Distant locations were higher than the Boundary locations. Levels of specific radionuclides measured in composited air filters (^{241}Am, ^{137}Cs, and ^{239,240}Pu) and detected in atmospheric moisture samples (tritium) were well below regulatory guidelines set by both the DOE and the EPA for protection of the public, and were not different from values measured historically at other locations across the United States.

Tritium was measured in 16 precipitation samples collected during the third quarter. The concentrations were consistent with measurements made by EPA at other locations across the United States and reported by the ERAMS program.

Milk samples collected during the third quarter had no measurable ^{131}I or ^{137}Cs in any samples above their 2s or 3s values. Strontium-90 was detected in two milk samples, one collected from Idaho Falls in May and one from Carey also in May. Another two samples had ^{90}Sr measured above only the 2s value.

Lettuce samples collected from local area gardens had no measurable gamma-emitting radionuclides. Strontium-90 was detected in four samples at levels consistent with historical concentrations. One additional sample had ^{90}Sr above only the 2s value.

Of 15 wheat samples collected during the third quarter of 2002 only two samples had measurable radionuclides present. The sample from Aberdeen contained ^{137}Cs, while the sample from Monteview contained ^{90}Sr, both above the 2s concentration. The ^{137}Cs result also exceeded the 3s concentration. Both concentrations were within the range of past values.

Results of analyses of tissues from four game animals indicated detectable levels of ^{137}Cs in the liver tissue and measurable amounts of ^{137}Cs in the muscle tissue and thyroid from a single animal.

In conclusion, no radionuclides, measured or detected, in any of the samples taken during the third quarter of 2002 could be directly linked with INEEL activities. Concentrations in all of the samples collected and analyzed during the third quarter, 2002 were similar to levels recorded in the past in the INEEL environment or in other locations in the United States and were well below regulatory standards for public health.

8. REFERENCES

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APPENDIX A

SUMMARY OF SAMPLING MEDIA & SCHEDULE

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Table A-1. Summary of the ESER Program's Sampling Schedule

Sample Type Analysis	Collection Frequency	LOCATIONS		
		Distant	Boundary	INEEL
AIR SAMPLING				
LOW-VOLUME AIR				
Gross Alpha, Gross Beta, ^{131}I	weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	Arco, Atomic City, FAA Tower, Howe, Monteview, Mud Lake, Blue Dome	Main Gate, EFS, Van Buren
Gamma Spec	quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	Arco, Atomic City, FAA Tower, Howe, Monteview, Mud Lake, Blue Dome	Main Gate, EFS, Van Buren
^{90}Sr, Transuranics	quarterly	Rotating schedule	Rotating schedule	Rotating schedule
ATMOSPHERIC MOISTURE				
Tritium	4 to 13 weeks	Blackfoot, Idaho Falls, Rexburg	Atomic City	None
PRECIPITATION				
Tritium	monthly	Idaho Falls	None	CFA
Tritium	weekly	None	None	EFS
PM-10				
Particulate Mass	every 6th day	Rexburg, Blackfoot	Atomic City	None
WATER SAMPLING				
SURFACE WATER				
Gross Alpha, Gross Beta, ^{3}H	semi-annually	Twin Falls, Buhl, Hagerman, Idaho Falls, Bliss	None	None
DRINKING WATER				
Gross Alpha, Gross Beta, ^{3}H	semi-annually	Aberdeen, Carey, Idaho Falls, Fort Hall, Minidoka, Moreland, Roberts, Shoshone, Tabor	Arco, Atomic City, Howe, Monteview, Mud Lake	None
ENVIRONMENTAL RADIATION SAMPLING				
TLDs				
Gamma Radiation	semiannual	Aberdeen, Blackfoot, Craters of the Moon, Idaho Falls, Minidoka, Jackson WY, Rexburg, Roberts	Arco, Atomic City, Howe, Monteview, Mud Lake, Reno Ranch	None

Table A-1. Summary of the ESER Program's Sampling Schedule (continued)

Sample Type / Analysis	Collection Frequency	LOCATIONS		
		Distant	Boundary	INEEL
SOIL SAMPLING				
SOIL				
Gamma Spec, ^{90}Sr, Transuranics	biennially	Carey, Crystal Ice Caves (Aberdeen), Blackfoot, St. Anthony	Butte City, Monteview, Atomic City, FAA Tower, Howe, Mud Lake (2), Birch Creek	None
FOODSTUFF SAMPLING				
MILK				
Gamma Spec (^{131}I)	weekly	Idaho Falls	None	None
Gamma Spec (^{131}I)	monthly	Blackfoot, Carey, Dietrich, Minidoka, Roberts, Moreland	Howe, Terreton, Arco	None
Tritium, ^{90}Sr	Semi-annually	Blackfoot, Carey, Dietrich, Idaho Falls, Minidoka, Roberts, Moreland	Howe, Terreton, Arco	None
POTATOES				
Gamma Spec, ^{90}Sr	annually	Blackfoot, Idaho Falls, Rupert, occasional samples across the U.S.	Arco, Mud Lake	None
WHEAT				
Gamma Spec, ^{90}Sr	annually	Am. Falls, Blackfoot, Dietrich, Idaho Falls, Minidoka, Carey	Arco, Monteview, Mud Lake, Tabor, Terreton	None
LETTUCE				
Gamma Spec, ^{90}Sr	annually	Blackfoot, Carey, Idaho Falls, Pocatello	Arco, Atomic City, Howe, Mud Lake	None
BIG GAME				
Gamma Spec	varies	Occasional samples across the U.S.	Public Highways	INEEL roads
SHEEP				
Gamma Spec	annually	Blackfoot or Dubois	None	No. INEEL (Circular Butte), So. INEEL (Tractor Flats)
WATERFOWL				
Gamma Spec, ^{90}Sr, Transuranics	annually	Varies among: Fort Hall, Hiese, Market Lake, Mud Lake	None	INEEL Waste disposal ponds
FISH				
Gamma Spec	annually or as available	None	None	Big Lost River

APPENDIX B

SUMMARY OF MDC's, DCG's, AND SDWA LIMITS

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Table B-1. Summary of Approximate Minimum Detectable Concentrations for Radiological Analyses Performed During Third quarter 2002

Sample Type	Analysis	Approximate Minimum Detectable Concentration[a] (MDC)	Derived Concentration Guide[b] (DCG)
Air (particulate filter)[e]	Gross alpha[c]	1.64×10^{-15} µCi/mL	2×10^{-14} µCi/mL
	Gross beta[d]	3.06×10^{-15} µCi/mL	3×10^{-12} µCi/mL
	Specific gamma (^{137}Cs)	2.85×10^{-16} µCi/mL	4×10^{-10} µCi/mL
	^{238}Pu	1.95×10^{-18} µCi/mL	3×10^{-14} µCi/mL
	$^{239/240}$Pu	2.61×10^{-18} µCi/mL	2×10^{-14} µCi/mL
	^{241}Am	1.15×10^{-18} µCi/mL	2×10^{-14} µCi/mL
	^{90}Sr	7.6×10^{-17} µCi/mL	9×10^{-12} µCi/mL
Air (charcoal cartridge)[e]	^{131}I	1.66×10^{-15} µCi/mL	4×10^{-10} µCi/mL
Air (atmospheric moisture)[f]	^{3}H	1.09×10^{-13} µCi/mL$_{water}$	1×10^{-7} µCi/mL$_{air}$
Air (precipitation)	^{3}H	1.07×10^{-7} µCi/mL	2×10^{-3} µCi/mL
Milk	^{131}I	0.55 pCi/L	--[g]
	^{137}Cs	3.09 pCi/L	--
Game Animal Tissue[h]	^{137}Cs	4.23 pCi/kg	--
Soil	^{241}Am	0.30 pCi/kg	--
	^{238}Pu	0.70 pCi/kg	--
	$^{239/240}$Pu	0.67 pCi/kg	--
	^{90}Sr	79.28 pCi/kg	--

a The MDC is an estimate of the concentration of radioactivity in a given sample type that can be identified with a 95% level of confidence and precision of plus or minus 100% under a specified set of typical laboratory measurement conditions.

b DCGs, set by the DOE, represent reference values for radiation exposure. They are based on a radiation dose of 100 mrem/yr for exposure through a particular exposure mode such as direct exposure, inhalation, or ingestion of water.

c The DCG for gross alpha is equivalent to the DCGs for ^{239,240}Pu and ^{241}Am.

d The DCG for gross beta is equivalent to the DCGs for ^{228}Ra

e The approximate MDC is based on an average filtered air volume (pressure corrected) of 570 m^3/week.

f The approximate MDC is expressed for tritium (as tritiated water) in air, and is based on an average filtered air volume of 39 m^3, assuming an average sampling period of eight weeks.

g -- means there is no established DCG for this media.

h. The approximate MDC assumes a sample size of 500 g.

APPENDIX C

SAMPLE ANALYSIS RESULTS

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APPENDIX D

STATISTICAL ANALYSIS RESULTS

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Table D-1. Kruskal-Wallace[a] statistical results between INEEL, Boundary, and Distant location groups by quarter and by month.

Parameter	p[b]
Gross Alpha	
Quarter	0.14
July	0.07
August	0.53
September	0.13
Gross Beta	
Quarter	0.90
July	0.99
August	0.99
September	0.55

a. See the Determining Statistical Differences of the Helpful Information section for details on the Kruskal-Wallace test.

b. A 'p' value greater than 0.05 signifies no statistical difference between data groups.

Table D-2. Statistical difference in weekly gross alpha concentrations measured at Boundary and Distant locations.

Mann-Whitney U Test[a]		
Parameter	**Week**	**p[b]**
Gross Alpha		
	July 3rd	0.67
	July 10th	0.09
	July 17th	0.48
	July 24th	0.86
	July 31st	0.48
	August 7th	0.81
	August 14th	0.87
	August 21st	0.15
	August 28th	0.08
	September 4th	0.03
	September 11th	0.73
	September 18th	0.05
	September 25th	0.48
Gross Beta		
	July 3rd	0.09
	July 10th	0.01
	July 17th	0.67
	July 24th	0.20
	July 31st	0.48
	August 7th	0.94
	August 14th	0.14
	August 21st	0.71
	August 28th	0.03
	September 4th	0.09
	September 11th	0.91
	September 18th	0.89
	September 25th	0.89

See the Determining Statistical Differences of the Helpful Information section for details on the Mann Whitney U test.

a. A 'p' value greater than 0.05 signifies no statistical difference between data groups.