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Idaho National Laboratory Site Offsite Environmental Surveillance Program Report: First Quarter 2006

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Contributors:
Russ Mitchell, Marilyn Case

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By the S.M. Stoller Corporation,
Environmental Surveillance, Education and Research Program
Douglas K. Halford, Program Manager
1780 First Street, Idaho Falls, Idaho 83401
www.stoller-eser.com

EXECUTIVE SUMMARY

None of the radionuclides detected in any of the samples collected during the first quarter of 2006 could be directly linked with INL Site 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 INL Site. 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.

This report for the first quarter of 2006 contains results from the Environmental Surveillance, Education and Research (ESER) Program's monitoring of the Department of Energy's Idaho National Laboratory (INL) Site's offsite environment, January 1 through March 31, 2006. All sample types (media) and the sampling schedule followed during 2006 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})
- Precipitation sampling
- Milk sampling
- Large game animal sampling

Gross alpha and gross beta measurements are used as general indicators of the presence of radionuclides. Gross alpha and gross beta results were found to have no discernable statistical distribution during the first quarter of 2006. 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 first quarter were monthly or quarterly gross alpha or gross beta concentrations in air collected at Boundary locations statistically greater than corresponding data for Distant locations, as one would expect if the INL Site 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 concentrations at Distant and Boundary locations showed statistical differences during the weeks of February 15, March 8 and March 15. In all three cases, the Distant locations were statistically greater than the Boundary locations. Gross beta results were statistically greater at Boundary locations than at Distant locations during the weeks of January 4 and January 18, and statistically greater at the Distant locations than at Boundary locations during the week of March 8. These differences appear to be due to random variability in the data.

Iodine-131 (^{131}I) was not detected in any batch of charcoal cartridges during the first quarter.

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). No manmade gamma-emitting radionuclides were detected. Strontium-90 was found at two locations within the range of historical measurements.

A total of six detections of transuranic radionuclides (one of ^{241}Am, three of ^{238}Pu and two of $^{239/240}Pu$) were reported for the first quarter. Detections were reported at Distant, Boundary and INL Site locations. The highest reported value was at the upper portion of the range seen during the past several years. No specific source could be identified for the detected values.

Eleven atmospheric moisture samples were obtained during the first quarter of 2006 and analyzed for tritium. Two samples each from Atomic City and Rexburg, and one sample each from Blackfoot and Idaho Falls exceeded their respective 3s levels. The maximum value was well below the DOE DCG for tritium in air.

The ESER Program operates three PM_{10} samplers for particulate sampling, one each at Rexburg, Blackfoot, and Atomic City. Sampling of PM_{10} is primarily 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 particulate concentration was 31.52 $\mu g/m^3$ on February 9, 2006, at Rexburg. This is well below the EPA Air Quality Standard of 150 $\mu g/m^3$.

Sufficient precipitation occurred to allow collection of 16 samples—four from Idaho Falls, three from the Central Facilities Area (CFA) and nine from the Experimental Field Station (EFS) on the INL Site. One of the samples contained a detectable concentration of tritium, within the range reported by the EPA across the western United States.

Milk samples were collected weekly in Ucon and monthly at nine other locations around the INL Site. All samples were analyzed for gamma-emitting. No manmade gamma-emitting radionuclides were found in any sample.

Cesium-137 was detected in the muscle tissue taken from one of four game animals killed on INL Site roads. The detected concentration was similar to those found in both onsite and offsite tissues during recent years.

Table E-1 Summary of results for the first quarter of 2006.

Media	Sample Type	Analysis	Results
Air	Filters	Gross alpha, gross beta	There were no statistical differences noted for monthly or quarterly gross alpha or gross beta concentrations measured at INL Site, Boundary and Distant locations. Some weekly statistical differences were found; however, these appear to be due to normal variability in the data. No result exceeded the DCG for gross alpha or gross beta activity in air.
		Gamma-emitting radionuclides, select actinides, ^{90}Sr	No manmade gamma-emitting radionuclides or actinides were detected. Detectable ^{90}Sr was found at two locations, well below DOE limits. Six detections of the three actinides were reported, scattered among four locations. The highest reported detection was near the upper end of the range normally found for these radionuclides.
	Charcoal Cartridge	Iodine-131	No detections of ^{131}I were made during the first quarter.
	PM_{10}	Particulate matter	Forty-three valid samples were collected from three locations. No regulatory limits were exceeded.
Atmospheric Moisture	Liquid	Tritium	Eleven atmospheric moisture samples were collected. Six of the results were greater than the 3s uncertainty. No sample result exceeded the DCG for tritium in air.
Precipitation	Liquid	Tritium	A total of seven monthly and nine weekly samples were collected. Only one of these samples had a tritium result greater than the 3s uncertainty. Concentrations were consistent with those reported across the region and with previous results.
Milk	Liquid	Iodine-131, gamma emitting radionuclides	No manmade gamma-emitting radionuclides were found in any sample.
Game Animals	Tissue	Iodine-131, gamma emitting radionuclides	Cesium-137 was found in the muscle sample from one of the four game animals available for sampling during the first quarter. The detected value was well within the range of historical values.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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
ICP	Idaho Cleanup Project
INL	Idaho National Laboratory
INEEL	Idaho National Engineering and Environmental Laboratory
ISU	Idaho State University
LCS	Laboratory Control Standard
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	minimum detectable concentration
NIST	National Institute of Standard and Technology
NRTS	National Reactor Testing Station
PM_{10}	particulate matter less than 10 micrometers in diameter
QA	Quality Assurance
QAPP	Quality Assurance Project Plan

LIST OF UNITS

Bq	becquerel
Ci	curie
g	gram
L	liter
µCi	microcurie
mL	milliliter
mR	milliroentgens
mrem	millirem (rem = unit of dose equivalent [roentgen-equivalent-man])
mSv	millisieverts
pCi	picocurie
R	Roentgen
µSv	microsieverts

1. ESER PROGRAM DESCRIPTION

Operations at the Idaho National Laboratory (INL) Site 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 Safe Drinking 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 2003). During calendar year 2006, environmental monitoring within the INL Site boundaries was primarily the responsibility of the INL and Idaho Cleanup Project (ICP) contractors, while monitoring outside the INL Site 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, Idaho State University (ISU), the Wildlife Conservation Society and Teledyne Brown Engineering. This report contains monitoring results from the ESER Program for samples collected during the first quarter of 2006 (January 1–March 31, 2006).

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 INL Site
- Assess the potential radiation dose to members of the public from INL Site effluents
- 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 INL Site
- moisture in air at four locations around the INL Site
- precipitation from three locations on and around the INL Site
- surface water at five locations on the Snake River
- drinking water at 14 locations around the INL Site
- agricultural products, including milk at 10 dairies around the INL Site, potatoes from at least five local producers, wheat from approximately 10 local producers, lettuce from approximately nine home-owned and portable gardens on and around the INL, and four sheep from two operators which graze their sheep on the INL Site
- soil from 12 locations around the INL Site biennially
- environmental dosimeters from 15 locations semi-annually
- various numbers of wildlife including big game (pronghorn, mule deer, and elk), waterfowl and doves sampled on and near the INL Site.

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 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 Teledyne Brown Engineering, Inc. of Knoxville, Tennessee.

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 INL Site 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 RadNet [previously known as the Environmental Radiation Ambient Monitoring System (ERAMS) network] (EPA 2006). 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 was renamed RadNet in 2005 to reflect a new mission. RadNet is comprised of a nationwide network of sampling stations that provide air, precipitation, 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 RadNet data collected at Idaho Falls are not reported by the ESER Program but are available through the EPA RadNet website (http://www.epa.gov/narel/radnet/).

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 INL Site Environmental Report for each calendar year. These annual reports also include data collected by other INL Site 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 INL Site releases, meteorological data, and worldwide events that might conceivably have an effect on the INL Site 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.

Results are presented in this report with an analytical uncertainty term, *s*, where "*s*" is the estimated sample standard deviation (σ), assuming a Gaussian or normal distribution. All results are reported in this document, even those that do not necessarily represent detections. The term "detected", 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 measured at a concentration sufficient for the analytical instrument to record a value that is statistically different from background. The ESER has adopted guidelines developed by the United States Geological Survey (Bartholomay, et al. 2003), based on an extension of a method

proposed by Currie (1984), to interpret analytical results and make decisions concerning detection. Most of the following discussion is taken from Bartholomay et al (2003).

Laboratory measurements involve the analysis of a target sample and the analysis of a prepared laboratory blank (i.e., a sample which is identical to the sample collected in the environment, except that the radionuclide of interest is absent). Instrument signals for the target and blank vary randomly about the true signals and may overlap making it difficult to distinguish between radionuclide activities in blank and in environmental samples (Figure 1). That is, the variability around the sample result may substantially overlap the variability around a net activity of zero for samples with no radioactivity. In order to conclude that a radionuclide has been detected, it is essential to consider two fundamental aspects of the problem of detection: (1) the instrument signal for the sample must be greater than that observed for the blank before the decision can be made that the radionuclide has been detected; and (2) an estimate must be made of the minimum radionuclide concentration that will yield a sufficiently large observed signal before the correct decision can be made for detection or non-detection.

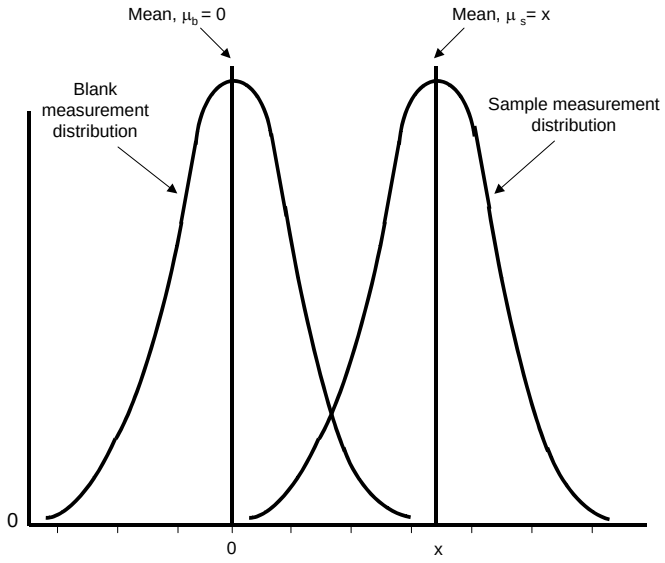

Figure 1. Example of overlap of blank and sample measurement distributions.

In the laboratory, instrument signals must exceed a critical level of 1.6s before the qualitative decision can be made as to whether the radionuclide was detected in a sample. At 1.6s there is about a 95-percent probability that the correct conclusion—not detected—will be made. Given a large number of samples, approximately 5 percent of the samples with measured concentrations greater than or equal to 1.6s, which were concluded as being detected, might not contain the radionuclide. These are referred to as false positives. For purposes of simplicity and consistency with past reporting, the ESER has rounded the 1.6s critical level estimate to 2s.

Once the critical level has been defined, the minimum detectable concentration may be determined. Concentrations that equal 3s represent a measurement at the detection level or minimum detectable concentration. For true concentrations of 3s or greater, there is a 95-percent probability that the radionuclide was detected in the target sample. In a large number of samples, the conclusion—not detected—will be made in 5 percent of the samples with true concentrations at the minimum detectable concentration of 3s. These measurements are known as false negatives. The ESER reports measured radionuclide concentrations greater than or equal to their respective 3s uncertainties as being “detected with confidence.”

Concentrations between 2s and 3s are reported as “questionably detected”. That is, the radionuclide may be present in the sample; however, the detection may not be reliable. Measurements made between 2s and 3s are examined further to determine if they are a part of a pattern (temporal or spatial) that might warrant further investigation or recounting. For example, if a particular radionuclide is typically detected at > 3s at a specific location, a sample result between 2s and 3s might be considered detected.

If a result is less than or equal to 2s there is little confidence that the radionuclide is present in the sample. Analytical results in this report are presented as the result value ± one standard deviation (1s) for reporting consistency with the annual report. To obtain the 2s or 3s values simply multiply the uncertainty term by 2 or 3.

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 INL SITE

The INL Site is a nuclear energy and homeland security 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 INL Site 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 has operated 52 various types of reactors, associated research centers, and waste handling areas. The NRTS was renamed the Idaho National Engineering Laboratory (INEL) in 1974, and the Idaho National Engineering and Environmental Laboratory (INEEL) in January 1997. With renewed interest in nuclear power the DOE announced in 2003 that Argonne National Laboratory and the INEEL would be the lead laboratories for development of the next generation of power reactors. On February 1, 2005 the INEEL and Argonne National Laboratory-West became the INL Site. The INL Site is committed to providing international nuclear leadership for the 21st Century, developing and demonstrating compelling national security technologies, and delivering excellence in science and technology as one of the Department of Energy's multiprogram national laboratories.

The cleanup operation, the ICP, is now a separately managed effort. The ICP is charged with safely and cost-effectively completing the majority of cleanup work from past laboratory missions by 2012.

3. AIR SAMPLING

The primary pathway by which radionuclides can move off the INL Site is through the air and for this reason the air pathway is the primary focus of monitoring on and around the INL Site. 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 INL Site 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 first quarter of 2006 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 first quarter of 2006 (Figure 2). Four of these samplers are located on the INL Site, eight are situated off the INL Site near the boundary and six have been placed at locations distant to the INL Site. Samplers are divided into INL Site, Boundary and Distant groups to determine if there is a gradient of radionuclide concentrations, increasing towards the INL Site. Each replicate sampler is relocated every year to a new location. One replicate sampler was placed at Mud Lake (a Boundary location) and one at the Experimental Field Station (an INL Site location) during 2006. An average of 16,148 ft^3 (457 m^3) of air was sampled at each location, each week, at an average flow rate of 1.60 ft^3/min (0.05 m^3/min). Particulates in air were collected on membrane particulate filters (1.2-µm pore size). Gases passing through the filter were collected with an activated charcoal cartridge.

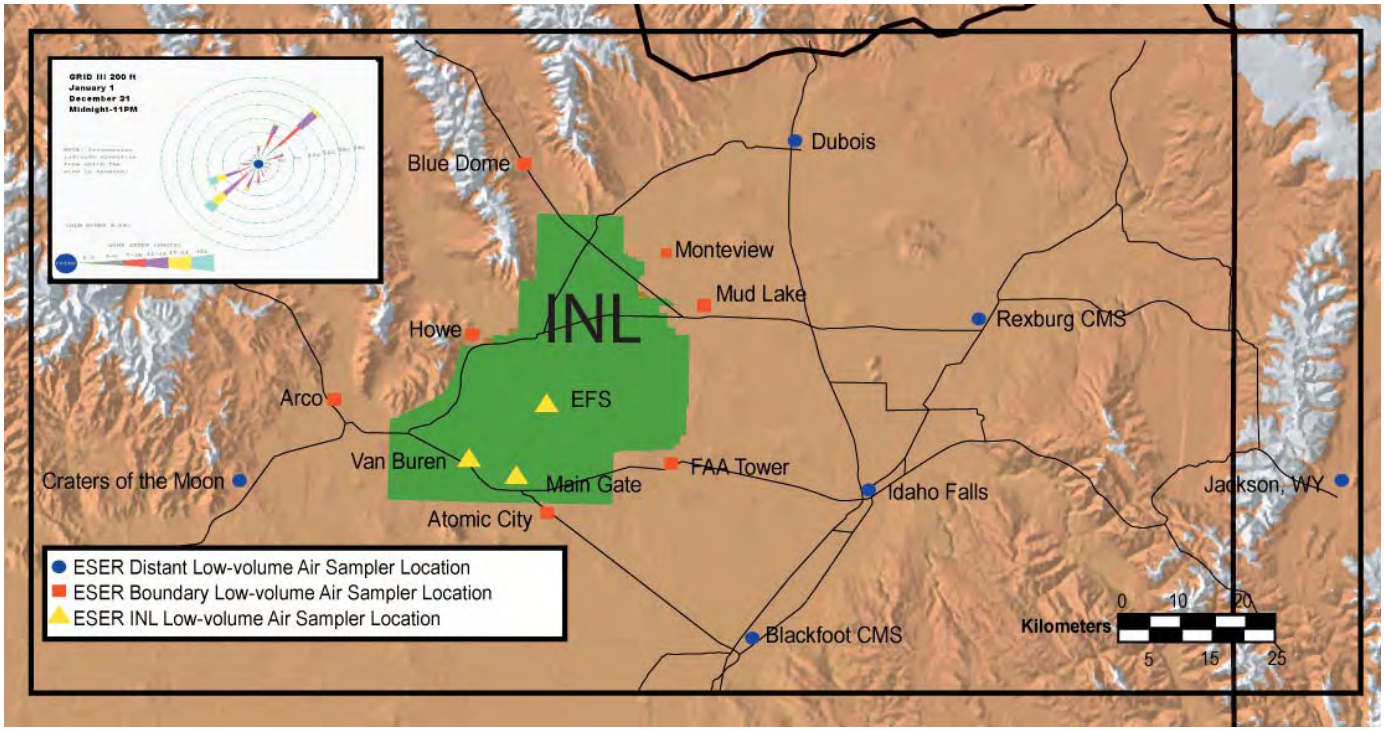

Figure 2. Low-volume air sampler locations.

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.

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, ^{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 iodine-131 (^{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 INL Site, Boundary, and Distant locations for the first quarter of 2006 are shown in Figure 3. Gross alpha data are tested for normality prior to statistical analyses, and generally show no consistent discernable distribution. Box and whisker plots are commonly used when there is no assumed distribution. Each data group in Figure 3 is presented as a box and whisker plot, with a median (small red square), a box enclosing values between the 25th and 75th percentiles, and whiskers representing the non-outlier range. 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 first quarter indicates that the outlier values were not due to mistakes in collection, analysis, or reporting procedures, but rather reflect natural variability in the measurements. The outlier values lie within the range of measurements made within the past several years. Thus, rather than dismissing the outliers, they were included in the subsequent statistical analyses.

Figure 3 graphically shows that the gross alpha measurements made at INL Site, Boundary and Distant locations are similar for the first quarter. If the INL Site were a significant source of offsite contamination, concentrations of contaminants could 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 INL Site, Boundary and Distant locations. The use of nonparametric tests, such as Kruskal-Wallis, gives less weight to outlier 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 location groups during the first quarter of 2006.

Comparisons of gross alpha concentrations were made for each month of the quarter (Figures 4 – 6). Again the Kruskal-Wallis test of multiple independent groups was used to determine if statistical differences exist between INL Site, Boundary and Distant data groups.

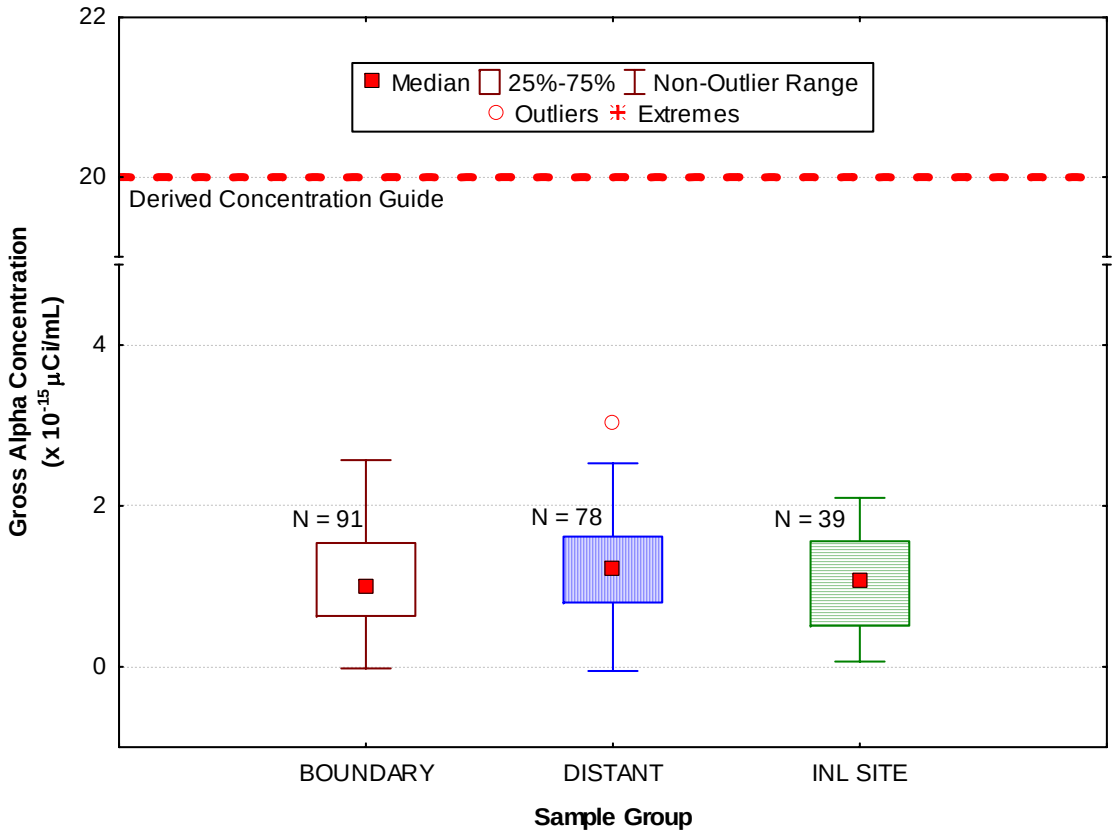

Figure 3. **Gross alpha concentrations in air at ESER INL Site, Boundary and Distant locations for the first quarter of 2006.**

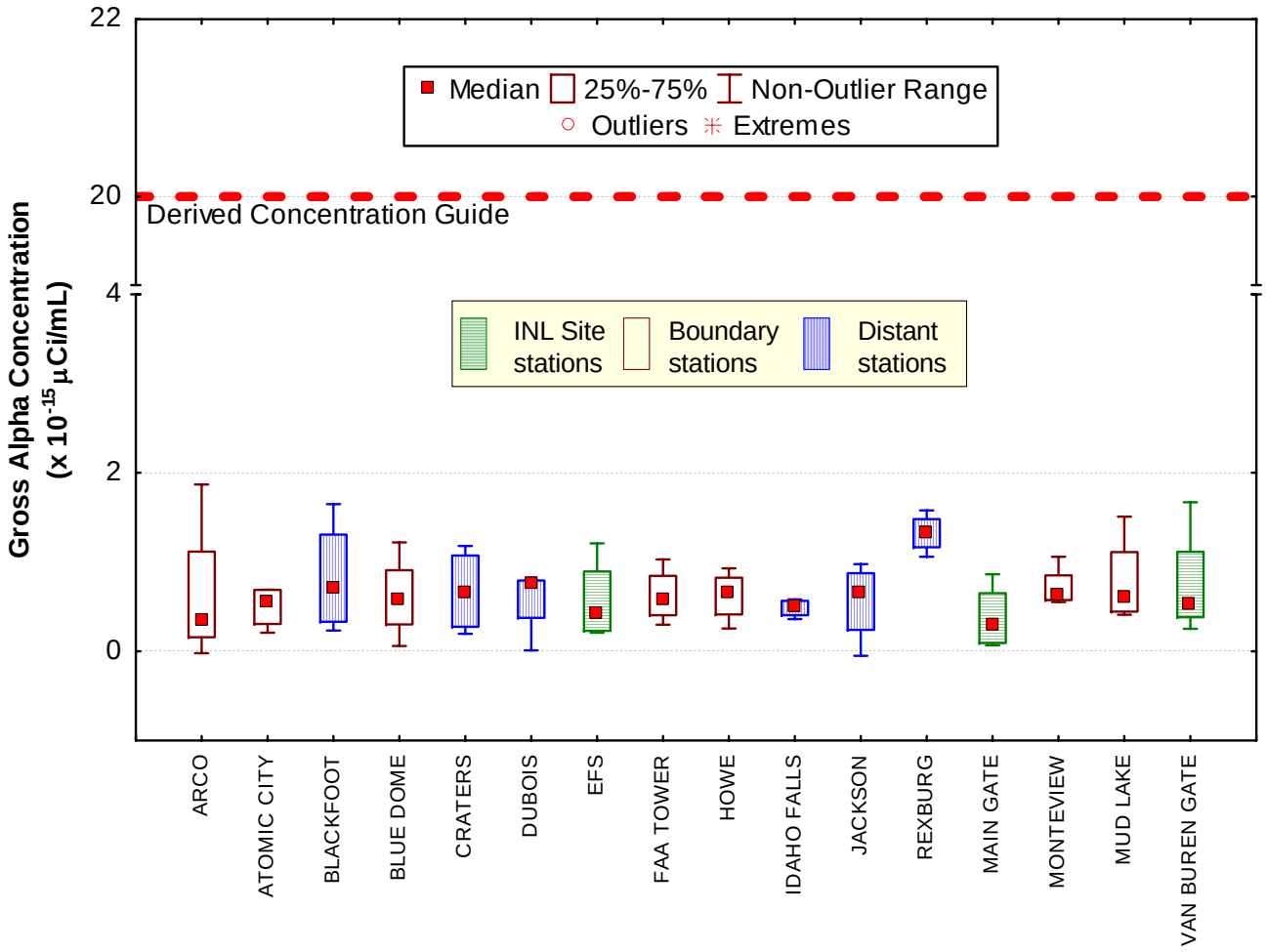

Figure 4. **January gross alpha concentrations in air at ESER INL Site, Boundary and Distant locations. Number of samples (N) = 4 at each location.**

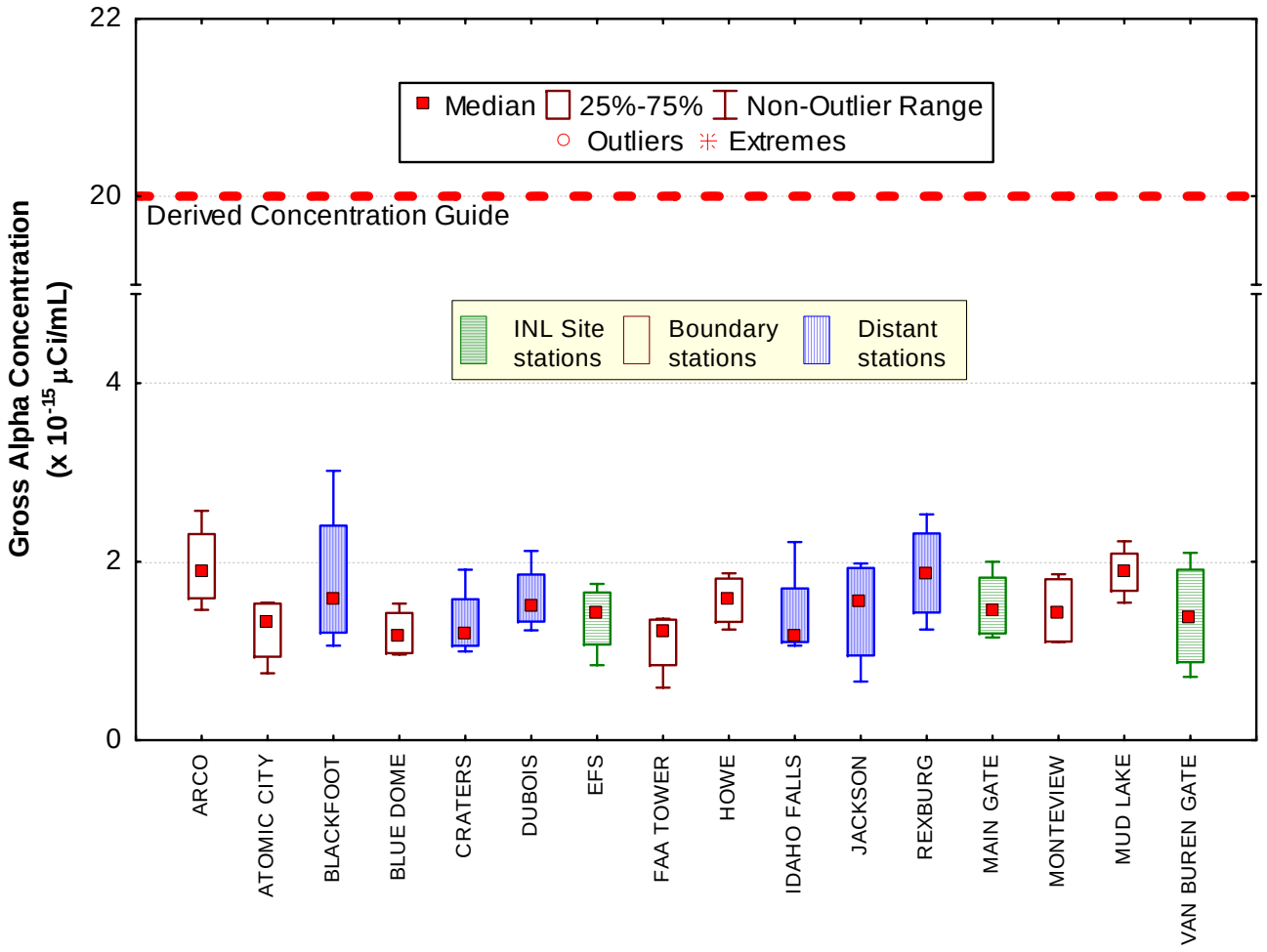

Figure 5. **February gross alpha concentrations in air at ESER INL Site, Boundary and Distant locations. Number of samples (N) = 4 at each location.**

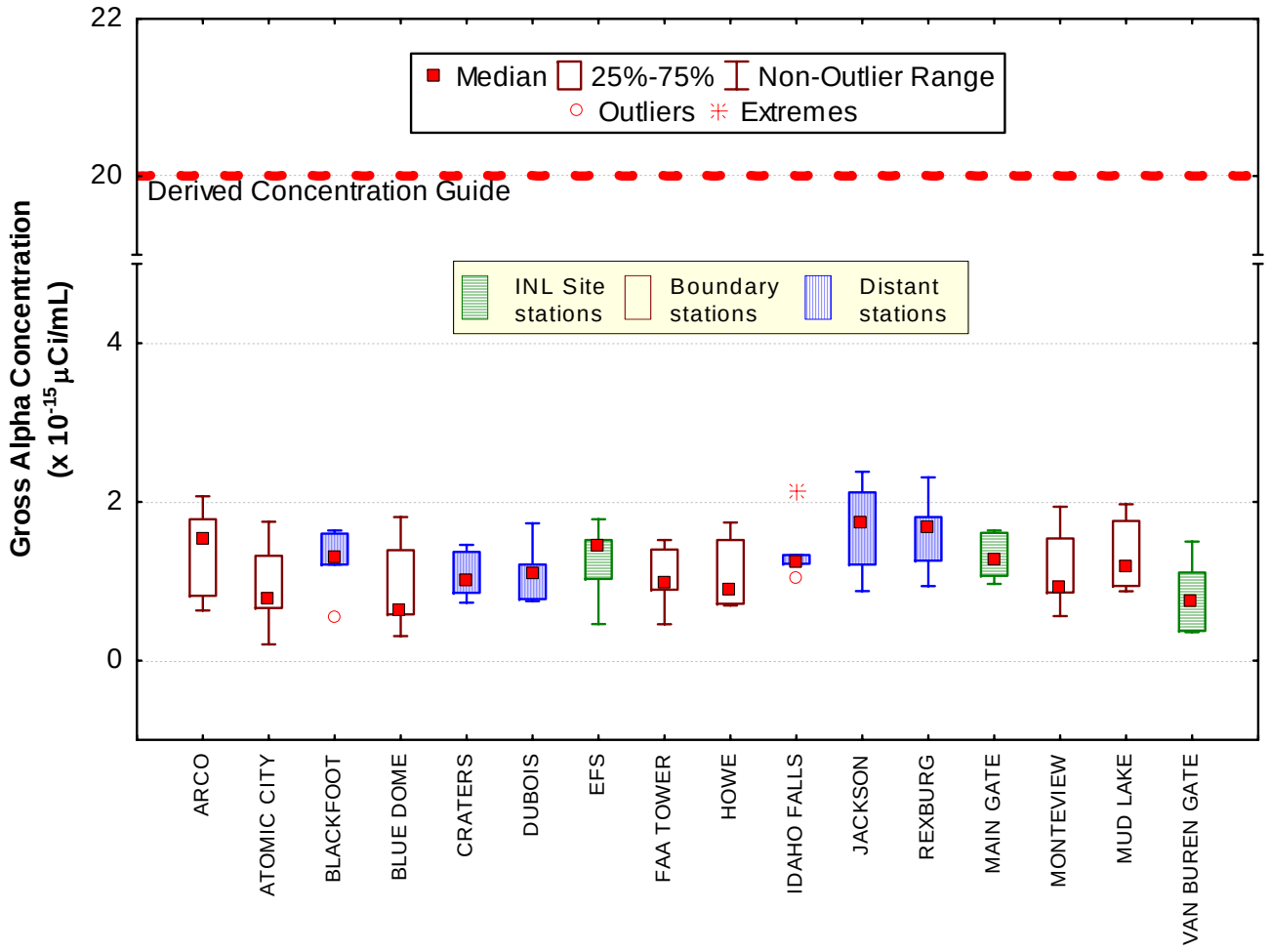

Figure 6. **March gross alpha concentrations in air at ESER INL Site, Boundary and Distant locations. Number of samples (N) = 5 at each location.**

There were no statistical differences in gross alpha results between groups for any month during the first quarter (Table D-1).

As an additional check, comparisons between gross alpha concentrations measured at Boundary and Distant locations were made on a weekly basis. The Mann-Whitney U test was used to compare the Boundary and Distant data because it is the most powerful nonparametric alternative to the t-test for independent samples. INL Site sample results were not included in this analysis because the onsite data, collected at only three locations, are not representative of the entire INL Site and would not aid in determining offsite impacts. In the first quarter, there were three weeks (February 15, March 8 and March 15) where a statistical difference existed between the two sample groups (Table D-2). In all three weeks, the gross alpha concentrations measured at Distant locations were statistically greater than those measured at Boundary locations, not indicative of an impact from the INL Site.

Gross beta results are presented in Table C-1. Gross beta concentrations in air for INL Site, Boundary and Distant locations for the first quarter of 2006 are shown in Figure 7. 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 8 – 10. 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, showed a statistical difference between Boundary and Distant measurements during the weeks of January 4, January 18 and March 8 (Table D-2). During the week of March 8, the Distant locations were statistically greater than the Boundary locations. During the other two weeks, the Boundary locations were statistically higher than the Distant locations. Examination of the data indicates that gross beta concentrations were much lower than average at all locations for these two weeks. No particular distribution was seen in the data to indicate an INL Site-related cause, and it is more likely due to random variability in the data.

No ^{131}I was detected in any of the charcoal cartridge batches collected during the first quarter of 2006. Weekly ^{131}I results for each location are listed in Table C-2 of Appendix C. Gamma spectrographic analysis is also done with the ^{131}I analysis. Cesium-137 was detected near the detection limit in 5 of the 26 measured batches of cartridges. The analytical laboratory considers these detections are a result of the materials used in the charcoal filters.

Weekly filters for the first quarter of 2006 were composited by location. All samples were analyzed for gamma-emitting radionuclides, including ^{137}Cs. Composites were also analyzed for ^{90}Sr, ^{238}Pu, $^{239/240}$Pu and ^{241}Am. No manmade gamma-emitting radionuclides were detected. Two composites, from Howe and Monteview, had detectable ^{90}Sr. The respective measured concentrations of $(41.6 \pm 11.1) \times 10^{-18}$ μCi/mL and $(41.5 \pm 10.9) \times 10^{-18}$ μCi/mL are within historical measurements and substantially below the Derived Concentration Guide of $9{,}000{,}000 \times 10^{-18}$ μCi/mL.

Americium-241 was detected at one location (a Boundary station), ^{238}Pu was detected at three locations (one INL Site and two Distant locations, and $^{239/240}$Pu was detected at one location (a Distant location). The highest reported value for ^{238}Pu of $(84.1 \pm 7.0) \times 10^{-18}$ μCi/mL was at the upper end of the range seen during the past few years. Any specific source for the detected radionuclides is difficult to identify due to the scattered nature of the detections (both in

wind direction and isotopes present). The statistical nature of the detections can also be seen by the presence of ^{241}Am at the Mud Lake duplicate sample but not the regular Mud Lake sample. Laboratory contamination is not indicated as no detections were noted on the blanks.

All results for composite filter samples are shown in Table C-3, Appendix C.

ATMOSPHERIC MOISTURE SAMPLING

Eleven atmospheric moisture samples were obtained during the first quarter of 2006 from Atomic City, Blackfoot CMS, Idaho Falls and Rexburg CMS. Atmospheric moisture is collected by pulling air through a column of absorbent material (molecular sieve material) 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.

Six samples exceeded the 3s uncertainty level for tritium—two each from Atomic City and Rexburg, and one each from Blackfoot and Idaho Falls. All samples with detectable tritium were significantly below the DOE DCG for tritium in air of 1×10^{-7} μCi/mL, ranging from $(2.6 \pm 0.8) \times 10^{-13}$ $\mu Ci/mL_{air}$ at Atomic City in February to $(8.0 \pm 1.4) \times 10^{-13}$ $\mu Ci/mL_{air}$, at Rexburg in March. All results are shown in Table C-4, Appendix C.

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 [CFR 2006]). 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 $\mu g/m^3$, with a maximum 24-hour concentration of 150 $\mu g/m^3$.

The ESER Program operates three PM_{10} particulate 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. The maximum 24-hour particulate concentration was 31.52 $\mu g/m^3$ on February 9, 2006, at Rexburg. The average, maximum, and minimum results of the 24-hour samples are shown are shown in Table 1. 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	0.00	10.08	4.23
Blackfoot, CMS	0.26	22.56	7.13
Rexburg, CMS	0.00	31.52	13.85

a. All concentrations are in ($\mu g/m^3$).

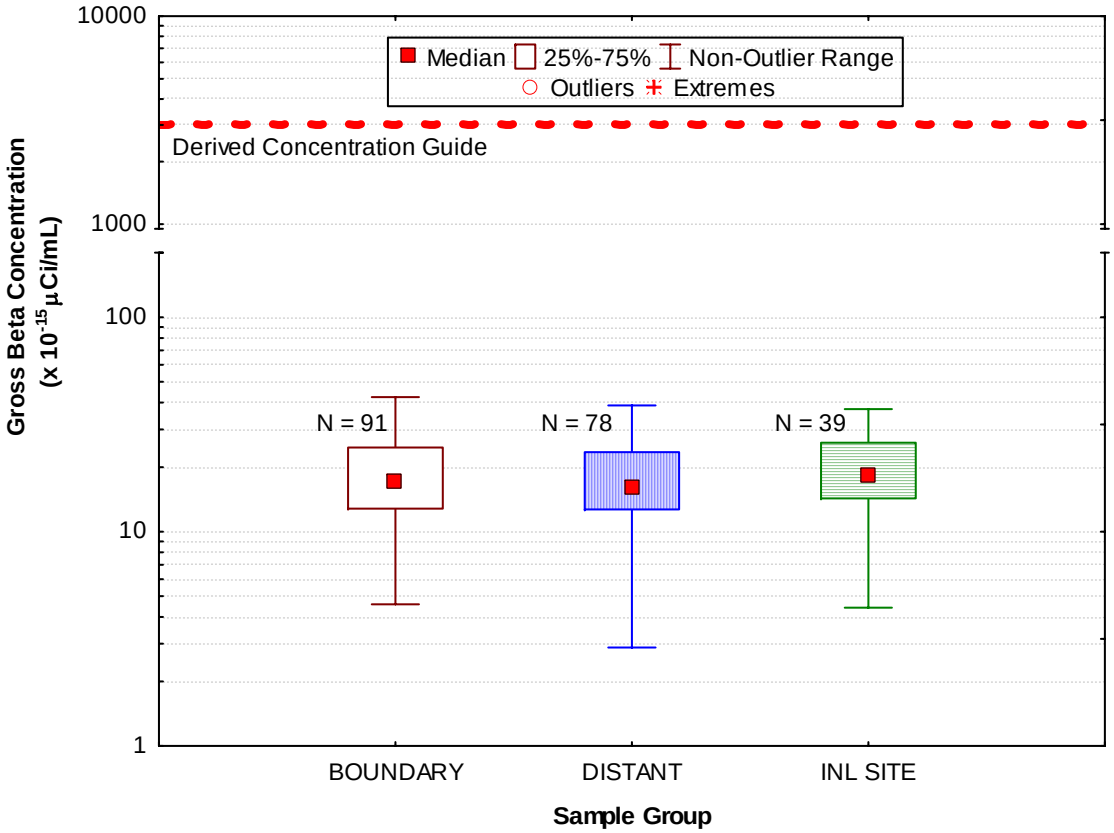

Figure 7. **Gross beta concentrations in air at ESER INL Site, Boundary and Distant locations for the first quarter 2006.**

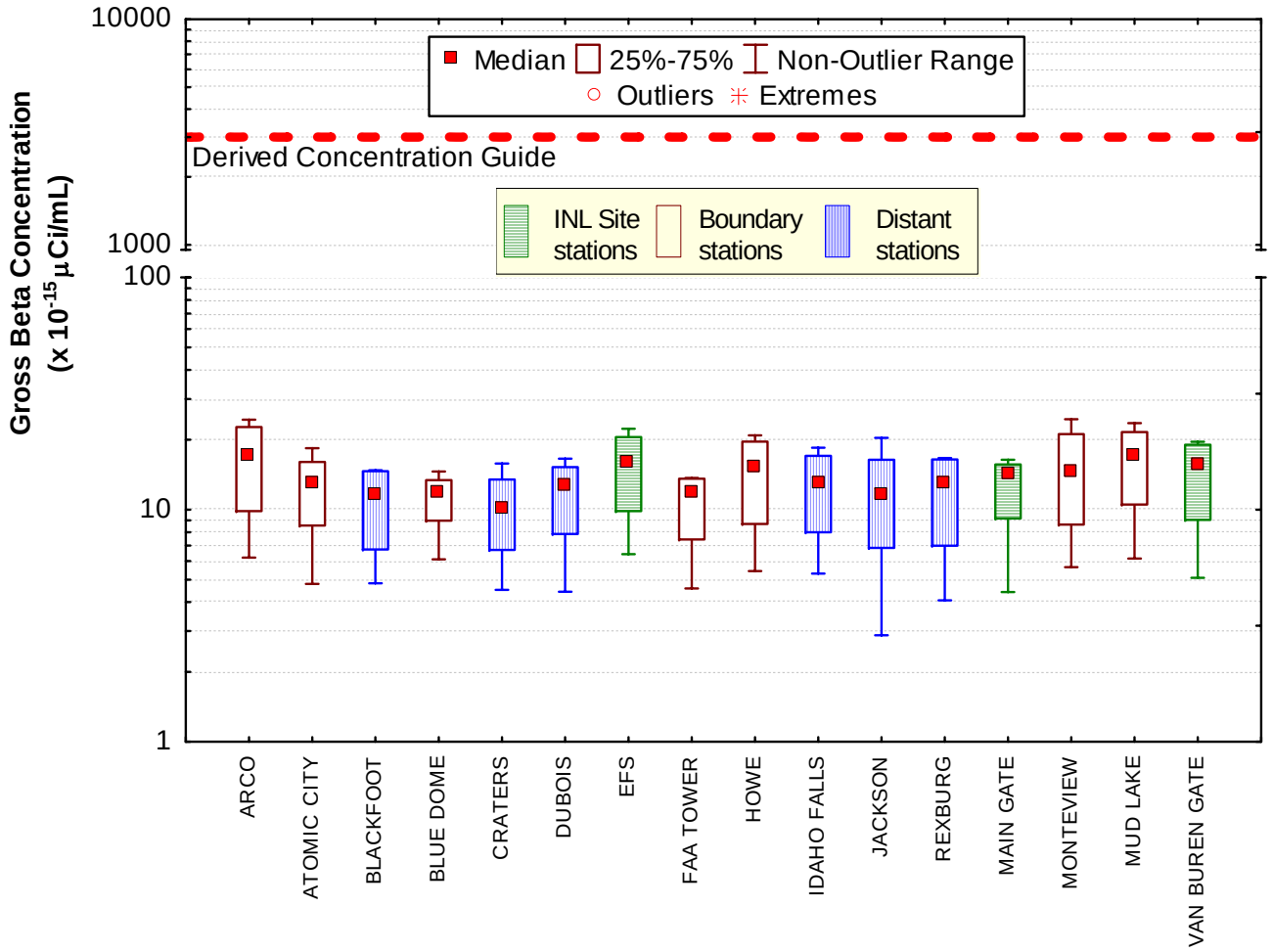

Figure 8. **January gross beta concentrations in air at ESER INL Site, Boundary and Distant locations. Number of samples (N) = 4 at each location.**

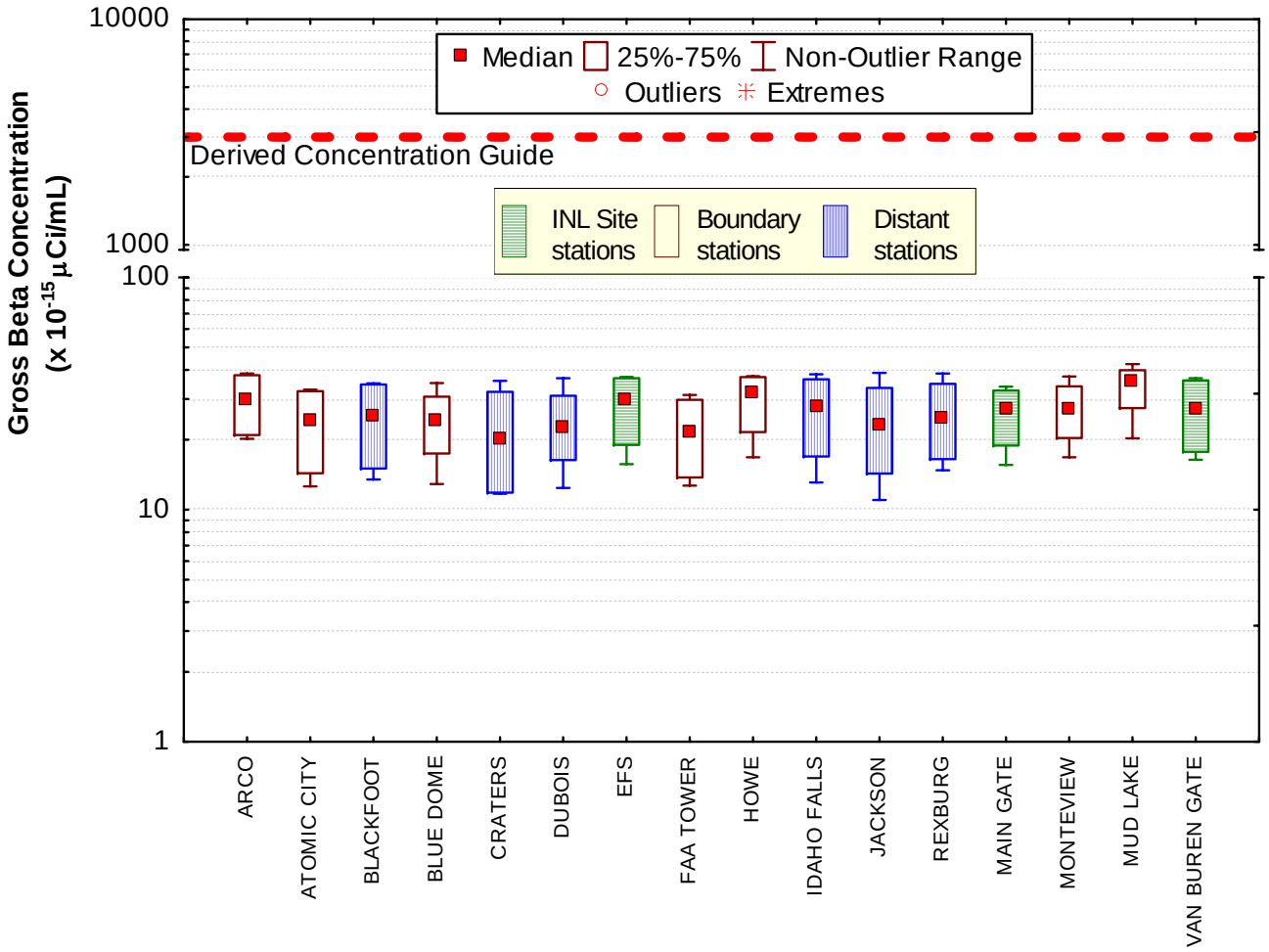

Figure 9. **February gross beta concentrations in air at ESER INL Site, Boundary and Distant locations. Number of samples (N) = 4 at each location.**

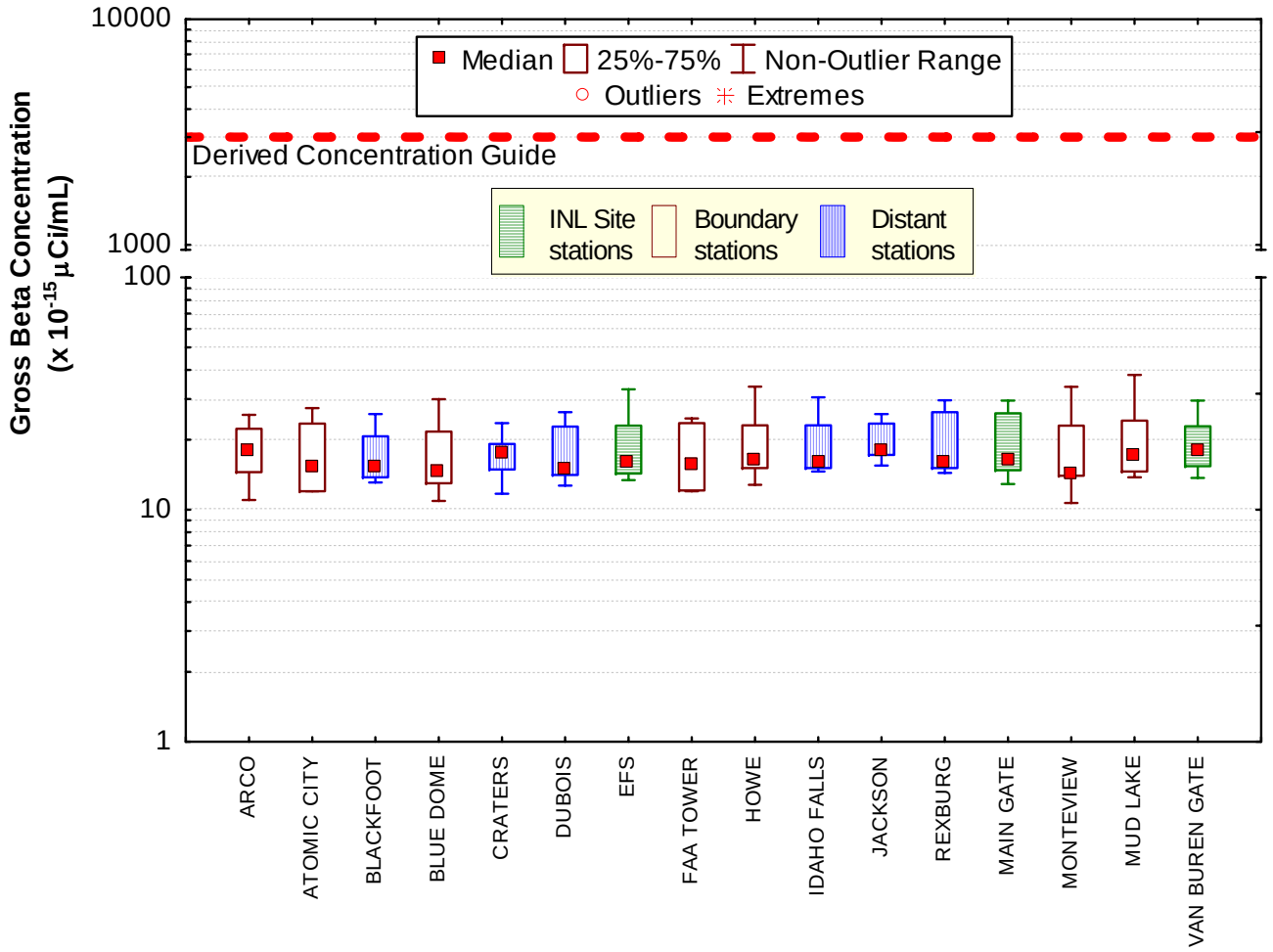

Figure 10. March gross beta concentrations in air at ESER INL Site, Boundary and Distant locations. Number of samples (N) = 5 at each location.

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 INL Site. Weekly precipitation samples are collected from the Experimental Field Station (EFS) on the INL Site. Surface and/or drinking water are sampled twice each year at 19 locations around the INL Site. This occurs during the second and fourth quarters.

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 monthly composites from Idaho Falls and CFA, and weekly from the EFS. Precipitation samples are analyzed for tritium. Storm events in the first quarter of 2006 produced sufficient precipitation to yield 16 samples – four from Idaho Falls, three from CFA, and nine weekly samples from the EFS.

Tritium was measured above the 3s value in only one of the 16 samples collected during the first quarter of 2006. 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. The EPA's RadNet program collects precipitation samples from across the United States. From 1980 to 2005, tritium measured in samples from Region 10 (which includes Idaho) ranged from -200 to 7500 pCi/L (EPA 2006). Tritium measured in all first quarter ESER samples were within this range, with a maximum of 217 ± 28 pCi/L at CFA. Data for all first quarter 2006 precipitation samples collected by the ESER Program are listed in Table C-6 (Appendix C).

5. AGRICULTURAL PRODUCT 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 INL Site and Southeast Idaho. Specifically, milk, wheat, potatoes, garden lettuce, sheep, big game, doves and waterfowl are sampled. Milk is sampled throughout the year and large game animals are sampled whenever available. Sheep are sampled during the second quarter. Lettuce, wheat and waterfowl are sampled during the third quarter, while potatoes 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 and large game animals sampled during the first quarter of 2006.

MILK SAMPLING

Milk samples were collected weekly in Ucon and monthly at nine other locations around the INL Site (Figure 11) during the first quarter of 2006. All samples were analyzed for gamma emitting radionuclides. Samples are analyzed for ^{90}Sr and tritium during the second and fourth quarters.

No manmade gamma-emitting radionuclides were detected in any of the samples for the first quarter. Data for ^{131}I and ^{137}Cs in milk samples are listed in Appendix C, Table C-7.

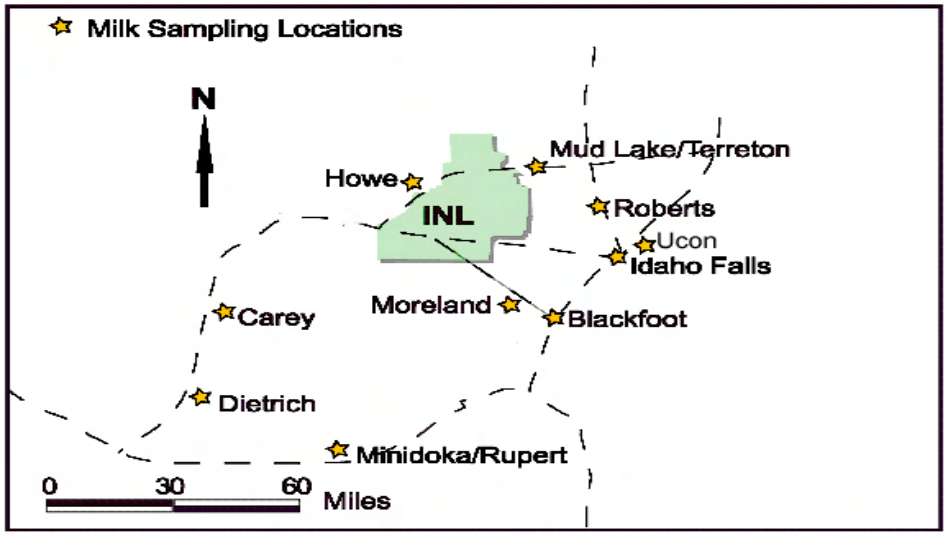

Figure 11. ESER milk sampling locations.

LARGE GAME ANIMAL SAMPLING

Four large game animals (three mule deer and one pronghorn) were sampled during the first quarter of 2006. Cesium-137 was detected in the muscle tissue of the pronghorn at a concentration similar to those found in both onsite and offsite game and sheep samples in recent years. Data for ^{137}Cs and ^{131}I in first quarter large game samples are listed in Appendix C, Table C-8.

6. QUALITY ASSURANCE

The ESER Quality Assurance Program consists of five ongoing tasks which measure:

1. method uncertainty
2. data completeness
3. data accuracy, using spike, performance evaluation and laboratory control samples
4. data precision, using split samples, duplicate samples and recounts
5. presence of contamination in samples, using blanks.

The following discussion briefly summarizes the results of the quality assurance program for the period from January 1 to March 31, 2006.

METHOD UNCERTAINTY

The Quality Assurance Project Plan (QAPP) establishes data quality and method quality objectives for the ESER surveillance program (Stoller 2002). Since the primary concern is with detection, the lower bound for the method uncertainty is set at zero. The upper bound is defined by the ESER program as the maximum concentration for the range of data over the past ten years, excepting those values determined to be extremes using box plots generated by a statistical data program. Each individual result is checked for acceptance on the basis of the result, whether it is below the lower limit (i.e., a negative value), greater than the upper limit, or between the lower and upper limit (the most common occurrence). The calculated method uncertainty is then compared to the 1s measured uncertainty. A sample is deemed acceptable when the measured 1s uncertainty is less than the calculated uncertainty. The upper bound values were recently re-evaluated and revised. Preliminary results indicate that more calculated method uncertainties for detected results were acceptable. In the first quarter of 2006, approximately 96.5 percent of method uncertainties were in the acceptable categories.

DATA COMPLETENESS

The QAPP specifies a 98 percent completeness goal for all regularly scheduled sample types (Stoller 2002). Data completeness for sample collection and delivery was 100 percent during the first quarter for all sample types with these exceptions:

- A number of precipitation samples were not collected due to lack of precipitation.
- Two (4 percent) of the 45 scheduled PM_{10} samples were invalid. One at Atomic City was due to a tripped breaker. The second invalid sample resulted from a power outage at Blackfoot. In addition, two samples during the quarter had post-sampling weights that were less than the pre-sampling weights.
- Of the four game animals sampled in the first quarter, the thyroid was not obtained from two animals and the liver was not obtained for two animals.

No samples were lost in analysis during the first quarter.

DATA ACCURACY

Accuracy is a measure of the degree to which a measured value agrees with the "true" value for a given parameter; accuracy includes elements of both bias and precision.

Spike Samples Submitted with Field Samples

The ESER obtains spike samples from the Department of Energy's Radiological and Environmental Sciences Laboratory, which prepares the spikes and issues data reports with the results. During the first quarter of 2006, no spikes were scheduled. A schedule was prepared for spike samples for the remainder of the year.

Performance Evaluation Samples

The QAP program was discontinued following the March 2004 distribution. Performance evaluation samples are now prepared through the Mixed Analyte Performance Evaluation Program (MAPEP), administered by the Department of Energy's Radiological and Environmental Sciences Laboratory. DOE has mandated that all laboratories performing analyses in support of the Office of Environmental Management shall participate in MAPEP. The program distributes samples of air, water, vegetation and soil for analysis in approximately January and June. Both radiological and nonradiological constituents are included in the program.

Internal Laboratory Spikes

The Idaho State University EAL uses National Institute of Standards and Technology (NIST) standards to prepare spiked water samples and uses commercially prepared calibration standards as NIST-traceable spiked samples. ISU considers a performance to be acceptable if results pass either the ±20 percent test specified by the ESER program or the three-sigma test described in the data precision section. A variety of checks are made each quarter on different geometries.

During the first quarter of 2006, only two analyses were conducted on NIST-traceable standards for gamma-emitting radionuclides. The geometries tested were single and ten charcoal cartridge screening. All of the results were within the ±20 percent range. Due to an oversight by the EAL the additional analyses normally performed were not conducted during the quarter. According to the EAL Quality Control Procedure, spike samples are only required for water samples; however, the usual practice is to perform at least one spike analysis for each geometry used during the quarter. Additional efforts will be made by the laboratory to ensure that this practice is maintained in future quarters.

Water samples spiked with tritium received 11 analyses during the quarterly reporting period. All were well within the ±20 percent criterion, generally -4 percent to -9 percent.

Teledyne Brown analyzed a laboratory control sample (LCS) with each batch of samples submitted by the ESER. During the first quarter this consisted of strontium-90 and actinides in air.

Media	Analyte	QAPP Accuracy	LCS Result	Within Criterion?
Air	Strontium-90	±10 percent	TBD	TBD
Air	Americium-241	±10 percent	TBD	TBD
Air	Plutonium-239/240	±10 percent	TBD	TBD

DATA PRECISION

Data precision is a measure of the variability associated with a measurement system. Precision is measured using duplicate samples, split samples and recounts. Data precision is measured using duplicate samples, split samples, and recounts. The Quality Assurance Project

Plan specifies that sample results should agree within ±20 percent or 3σ, whichever is greater. For environmental samples at levels that are within the normal range found by the ESER, the 3 standard deviation criterion is the one that applies in nearly all cases. The standard deviation criterion is considered to be met if the values of the duplicate samples differ by less than the root mean square of three standard deviations of each sample result. Mathematically, this is expressed as:

$|X-Y| < 3\ (\text{sqrt}(\sigma_x^2 + \sigma_y^2))$, where:

X is the result of the regular sample

Y is the result of the duplicate sample

σ_x is the uncertainty of the regular sample

σ_y is the uncertainty of the duplicate sample

Another measure of duplicate sample results is the relative percent difference. This value is the difference in the two results divided by the mean of the two results.

Field Duplicate Samples

Duplicate milk samples were collected from Blackfoot and Terreton on March 7 and analyzed for gamma-emitting radionuclides. All results were within the 3σ criteria.

Duplicate air samplers are operated at two locations adjacent to regular air samplers. In the first quarter of 2006 these samplers, designated as QA-1 and QA-2, were in operation at the EFS and Mud Lake, respectively. Particulate filters receive the standard analysis for gross alpha and gross beta; charcoal cartridges are analyzed specifically for iodine-131. All gross alpha and 25 of 26 gross beta results for the co-located samplers met the acceptability criteria. One result was outside of 3σ but had a relative percent difference of 13 percent, within the 20 percent range. Charcoal cartridge results are difficult to present because cartridges are counted in batches of ten.

Composite air samples from the two QA samplers were submitted for analysis at the end of the fourth quarter for gamma spectrometry at the EAL and for ^{90}Sr and transuranics at Teledyne Brown. The result for ^{241}Am failed to meet the acceptability criteria in the first quarter; other parameters were within specifications.

A comparison of duplicate results can also show bias in the sampling system. For example, if one set of results is consistently lower or higher than the other one might suspect that this bias was due to a leak in the system or variations in the calibration of the flow meter. Figures 12 and 13 show the difference in results (Main sampler - QA duplicate sampler) over time. The figures show that the bias is generally small and is not consistent in one direction.

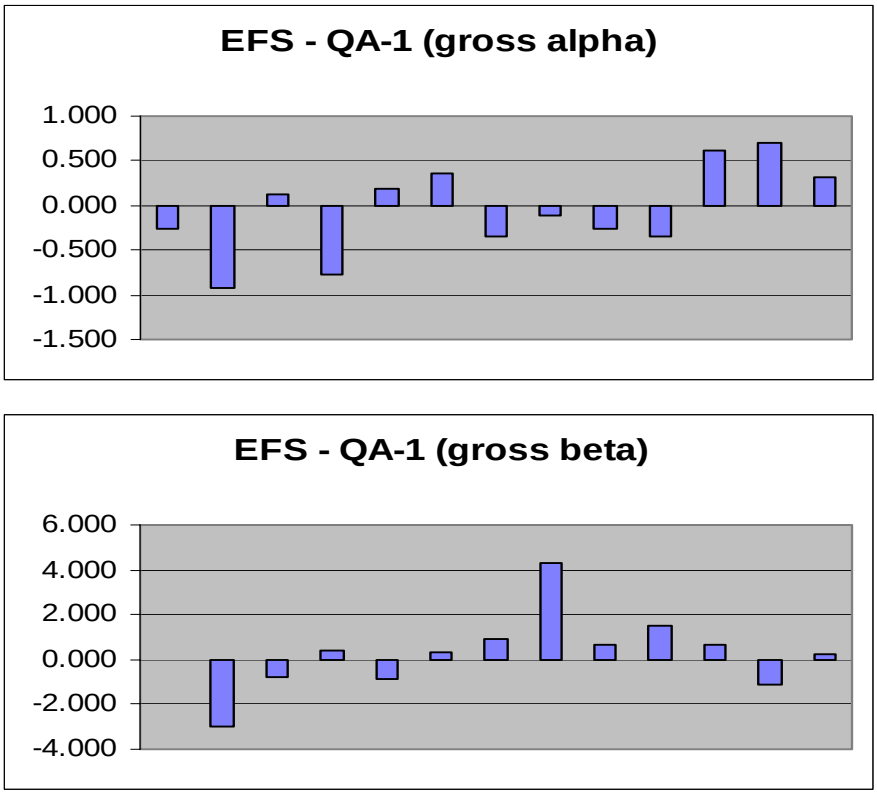

Figure 12. Difference in EFS/QA-1 gross alpha and gross beta activities.

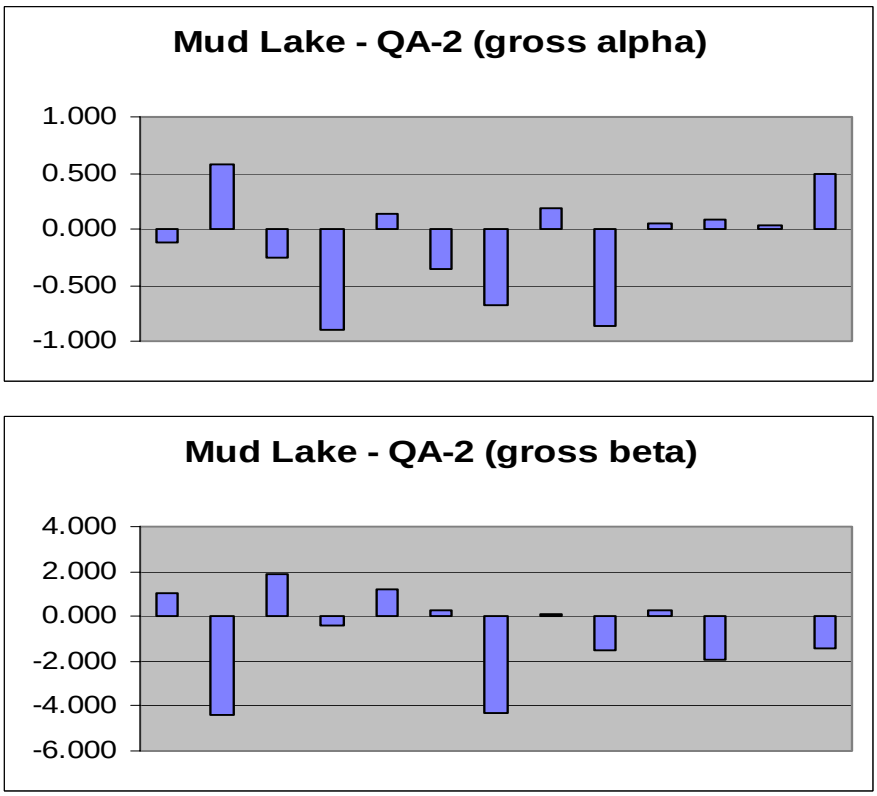

Figure 13. Difference in Mud Lake/QA-2 gross alpha and gross beta activities.

Lab Split Samples

The EAL splits and analyzes a number of milk, precipitation, and atmospheric moisture samples each quarter. The laboratory tests each result using both the ±20 percent criterion and the 3s criterion, although it considers the former test meaningless for analyses producing fewer than 15 total counts and questionable even where counts are on the order of 100. The latter criterion is applied in nearly all cases at the levels seen in environmental samples analyzed for the ESER program. Results of the EAL split sample analyses met the criteria for acceptance during the first quarter of 2006.

Sample Recounts

The ISU EAL recounts a number of samples of each media type. The lab tests each recount using both the 20 percent criterion and the 3σ criterion, subject to the limitations described in the previous section. For the first quarter reporting period, all 108 recounts met the criteria for acceptance.

BLANKS

Field blanks

The ESER program submits field blanks along with the regular samples to test for the introduction of contamination during the process of field collection, laboratory preparation, and laboratory analysis. The current program includes the use of two field blanks, designated as Blank A and Blank B, that each accompanies one of the air filter routes. Quarterly composites of the blanks are also submitted. After gamma spectrometry analysis, one of the blanks is analyzed for Sr-90 and the other for transuranics. Blanks are also submitted for milk and some other sample types.

Ideally blank results should be within ±2σ of zero and preferably within ±1σ of zero on most analyses. It would be expected, based on counting statistics for a sample that was truly a blank (i.e., the true value of the analyte was zero), that 68.3 percent of analyses would fall within one standard deviation, 95.5 percent would fall within two standard deviations, and 99.7 percent would fall within three standard deviations. In the fourth quarter, all results were within the 3σ significance level except for two gross alpha blanks.

Reagent Blanks

The Environmental Assessment Laboratory prepares and analyzes reagent blanks to help determine if the analysis will yield a zero result when no activity is present. ISU considers the result within specification if the concentration is less than the minimum detectable concentration (MDC) for the analysis. One such blank was analyzed for gross alpha and gross beta in the first quarter for water. The blank was well below the MDC for the analysis and also less than one standard deviation.

Teledyne Brown analyzes a blank with each set of results. All blanks for first quarter samples met Teledyne Brown's acceptance limits.

OTHER QA PROBLEMS NOTED

There were no additional QA problems noted in the first quarter.

7. REFERENCES

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APPENDIX A

SUMMARY OF SAMPLING SCHEDULE

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

Sample Type Analysis	Collection Frequency	LOCATIONS		
		Distant	Boundary	INL Site
AIR SAMPLING				
LOW-VOLUME AIR				
Gross Alpha, Gross Beta, ^{131}I	weekly	Blackfoot, Craters of the Moon, Dubois, Idaho Falls, Jackson WY, 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, Dubois, Idaho Falls, Jackson WY, 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, Fort Hall, Idaho Falls, Minidoka, Moreland, Roberts, Shoshone, Taber	Arco, Atomic City, Howe, Monteview, Mud Lake	None
ENVIRONMENTAL RADIATION SAMPLING				
TLDs				
Gamma Radiation	semiannual	Aberdeen, Blackfoot (2), Craters of the Moon, Dubois, Idaho Falls, Jackson WY, Minidoka, Rexburg, Roberts	Arco, Atomic City, Blue Dome, Howe, Monteview, Mud Lake	None
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

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

Sample Type Analysis	Collection Frequency	LOCATIONS		
		Distant	Boundary	INL Site
FOODSTUFF SAMPLING				
MILK				
Gamma Spec (^{131}I)	weekly	Ucon	None	None
Gamma Spec (^{131}I)	monthly	Blackfoot, Carey, Dietrich, Idaho Falls, Minidoka, Moreland, Roberts	Howe, Terreton	None
Tritium, ^{90}Sr	Semi-annually	Blackfoot, Carey, Dietrich, Idaho Falls, Minidoka, Moreland, Roberts	Howe, Terreton	None
POTATOES				
Gamma Spec, ^{90}Sr	annually	Aberdeen, Blackfoot, Fort Hall, Idaho Falls, Rupert, Taber, occasional samples across the U.S.	Arco, Monteview, Mud Lake, Terreton	None
WHEAT				
Gamma Spec, ^{90}Sr	annually	American Falls, Blackfoot, Dietrich, Idaho Falls, Minidoka, Carey	Arco, Monteview, Mud Lake, Taber, Terreton	None
LETTUCE				
Gamma Spec, ^{90}Sr	annually	Blackfoot, Carey, Idaho Falls, Pocatello	Arco, Atomic City, Howe, Mud Lake	EFS
BIG GAME				
Gamma Spec	varies	Occasional samples across the U.S.	Public Highways	INL Site roads
SHEEP				
Gamma Spec	annually	Blackfoot or Dubois	None	N. INL Site (Circular Butte), S. INL Site (Tractor Flats)
WATERFOWL				
Gamma Spec, ^{90}Sr, Transuranics	annually	Varies among: Heise, Firth, Fort Hall, Mud Lake and Market Lake	None	Wastewater disposal ponds
MARMOTS				
Gamma Spec	varies	Pocatello Zoo, Tie Canyon	None	RWMC

APPENDIX B

SUMMARY OF MDCs AND DCGs

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Table B-1. Summary of Approximate Minimum Detectable Concentrations for Radiological Analyses Performed During First Quarter 2006

Sample Type	Analysis	Approximate Minimum Detectable Concentration[a] (MDC)	Derived Concentration Guide[b] (DCG)
Air (particulate filter)[e]	Gross alpha[c]	5.15×10^{-16} µCi/mL	2×10^{-14} µCi/mL
	Gross beta[d]	1.19×10^{-15} µCi/mL	3×10^{-12} µCi/mL
	Specific gamma (^{137}Cs)	9.60×10^{-17} µCi/mL	4×10^{-10} µCi/mL
	^{238}Pu	1.33×10^{-17} µCi/mL	3×10^{-14} µCi/mL
	$^{239/240}$Pu	5.20×10^{-18} µCi/mL	2×10^{-14} µCi/mL
	^{241}Am	4.96×10^{-18} µCi/mL	2×10^{-14} µCi/mL
	^{90}Sr	4.24×10^{-17} µCi/mL	9×10^{-12} µCi/mL
Air (charcoal cartridge)[e]	^{131}I	1.17×10^{-15} µCi/mL	4×10^{-10} µCi/mL
Air (atmospheric moisture)[f]	^{3}H	1.05×10^{-7} µCi/mL$_{water}$	1×10^{-7} µCi/mL$_{air}$
Air (precipitation)	^{3}H	9.34×10^{-8} µCi/mL	2×10^{-3} µCi/mL
Milk	^{131}I	0.61 pCi/L	--
	^{137}Cs	2.64 pCi/L	--
Game Animal Tissue[g]	^{137}Cs	0.88 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 percent level of confidence and precision of plus or minus 100 percent 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 445 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 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. Results of the Kruskal-Wallace statistical test between INL Site, Boundary and Distant sample groups by month.

Parameter	P[a]
Gross Alpha	
Quarter	0.21
January	0.36
February	0.83
March	0.25
Gross Beta	
Quarter	0.40
January	0.26
February	0.57
March	0.67

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

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

		Mann-Whitney U test
Parameter	**Week**	**P[a]**
Gross Alpha		
	January 4	0.57
	January 10	0.57
	January 18	0.25
	January 25	0.78
	February 1	0.83
	February 8	0.89
	February 15	0.05
	February 22	0.14
	March 1	0.72
	March 8	0.01
	March 15	0.05
	March 22	0.78
	March 29	0.57
Gross Beta		
	January 4	0.02
	January 10	0.22
	January 18	0.01
	January 25	0.25
	February 1	0.13
	February 8	0.15
	February 15	0.39
	February 22	0.94
	March 1	0.15
	March 8	0.03
	March 15	0.10
	March 22	0.78
	March 29	0.21

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