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DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
ANNUAL ENVIRONMENTAL MONITORING REPORT JANUARY-DECEMBER 2005

Enclosed is the 2005 Annual Environmental Monitoring Report for the Kewaunee Power Plant Station (KPS). This report was prepared by Environmental Inc. and satisfies the requirements of KPS Technical Specification 6.9.b.1.

The results of the 2005 Land Use Census, submitted in accordance with the KPS Radiological Environmental Monitoring Manual, Section 2.2.2/2.3.2, are also included in this report.

If you have questions or require additional information, please feel free to contact Mr. Mike Hale at 920-388-8103.

Very truly yours,

Michael G. Gaffney
Site Vice President, Kewaunee Power Station

Enclosure

Commitments made by this letter: NONE

IE25

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2005 Annual Environmental Monitoring Report

Kewaunee Power Station

Dominion Energy Kewaunee, Inc.

2005 Annual Environmental Monitoring Report

Kewaunee Power Station

Part I, Programmatic Review of Sampling Results

Dominion Energy Kewaunee, Inc.

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REPORT TO

DOMINION NUCLEAR

RADIOLOGICAL MONITORING PROGRAM FOR THE KEWAUNEE POWER STATION KEWAUNEE, WISCONSIN

ANNUAL REPORT - PART I SUMMARY AND INTERPRETATION

January 1 to December 31, 2005

Prepared and submitted by:

ENVIRONMENTAL Inc.
Midwest Laboratory
Project No. 8002

Approved :

Bronia Grob
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Radiation Protection /
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PREFACE

The staff members of Environmental, Inc., Midwest Laboratory were responsible for the acquisition of data presented in this report. Samples were collected by the personnel of Environmental, Inc., Midwest Laboratory and the Kewaunee Power Station.

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1.0 INTRODUCTION

The Kewaunee Power Station is a 598 megawatt pressurized water reactor located on the Wisconsin shore of Lake Michigan in Kewaunee County. The Plant became critical on March 7, 1974. Initial power generation was achieved on April 8, 1974, and the Plant was declared commercial on June 16, 1974. This report summarizes the environmental operation data collected during the period January - December 2005.

Dominion Nuclear, an operating company for the Kewaunee Power Station, assumes the responsibility for the environmental program at the Plant and any questions relating to this subject should be directed to Mr. J. Michael Hale, Radiation Protection / Chemistry Manager, at (920) 388-8103.

2.0 SUMMARY

Results of sample analyses during the period January - December 2005 are summarized in Table 4.5. Radionuclide concentrations measured at indicator locations are compared with levels measured at control locations and in preoperational studies. The comparisons indicate background-level radioactivities in all samples collected.

3.0 RADIOLOGICAL SURVEILLANCE PROGRAM

Following is a description of the Radiological Surveillance Program and its execution.

3.1 Methodology

The sampling locations are shown in Figure 4-1. Table 4.1 describes the locations, lists for each direction and distance from the reactor, and indicates which are indicators and which are control locations.

The sampling program monitors the air, terrestrial, and aquatic environments. The types of samples collected at each location and the frequency of collections are presented in Table 4.2, using sample codes defined in Table 4.3. The collections and analyses that comprise the program are described below. Finally, the execution of the program in the current reporting year is discussed.

3.1.1 The Air Program

Airborne Particulates

The airborne particulate samples are collected on 47 mm diameter glass fiber filters at a volumetric rate of approximately one cubic foot per minute. The filters are collected weekly from six locations (K-1f, K-2, K-7, K-8, K-16 and K-31), and dispatched by mail to Environmental, Inc. for radiometric analysis. The material on the filter is counted for gross beta activity approximately 72 hours or later after collection to allow for decay of naturally-occurring short-lived radionuclides.

Quarterly composites from each sampling location are analyzed for gamma-emitting isotopes on a high-purity germanium (HPGe) detector.

Airborne Iodine

Charcoal filters are located at locations K-1f, K-2, K-7, K-8, K-16 and K-31. The filters are changed bi-weekly and analyzed for iodine-131 immediately after arrival at the laboratory.

Ambient Gamma Radiation - TLDs

The integrated gamma-ray background is measured at the six air sampling locations (K-1f, K-2, K-7, K-8, K-16 and K-31), at four milk sampling locations (K-3, K-5, K-25 and K-39), and four additional sites (K-15, located 9.25 miles northwest of the plant; K-17, located 4.25 miles west of the plant; K-27, located 1.5 miles northwest of the plant and K-30, located 1.0 miles north of the plant) by thermoluminescent dosimetry (TLDs). Two TLD cards, each having four main readout areas containing $CaSO_4$:Dy phosphor, are placed at each location (eight TLDs at each location). One card is exchanged quarterly, the other card is exchanged annually and read only on an emergency basis.

Precipitation

Monthly composites of precipitation samples collected at K-11 are analyzed for tritium activity and counted using a liquid scintillation method.

3.1.2 The Terrestrial Program

Milk

Milk is collected semimonthly from May through October, and monthly during the rest of the year from five herds that graze within four miles of the reactor site (K-5, K-25, K-34, K-38 and K-39), from one herd grazing between four and ten miles from the reactor site (K-3), and from a dairy in Green Bay (K-28). The samples are analyzed for iodine-131, strontium-89 and strontium-90, cesium-137, barium-lanthanum-140, potassium-40, calcium and stable potassium.

Well Water

One gallon of water is collected quarterly from four off-site wells located at K-10, K-11, K-13 and K-25 and from two on-site wells located at K-1g and K-1h.

Gamma spectroscopic analyses, tritium and gross beta on the total residue are performed for each water sample. The concentration of potassium-40 is calculated from the total potassium, determined by atomic absorption, on all samples.

Additionally, samples of water from two on-site wells (K-1g and K-1h) are analyzed for gross alpha. Water from the on-site well (K-1g) is analyzed for strontium-89 and strontium-90.

Domestic Meat

Domestic meat samples are obtained annually (in the third quarter) at locations K-24, K-29 and K-32 and if available at locations K-20, K-27 and K-34. The flesh is separated from the bones and analyzed for gross alpha, gross beta and gamma emitting isotopes.

Eggs

Eggs are collected quarterly from locations K-24, K-27 (if available) and K-32. Samples are analyzed for gross beta, strontium-89, strontium-90 and gamma-emitting isotopes.

Vegetables

Vegetable samples (6 varieties) are collected at locations K-17 and K-26, and two varieties of grain, if available, at location K-23. The samples are analyzed for gross beta, strontium-89, strontium-90 and gamma emitting isotopes.

Grass and Cattle Feed

Grass is collected during the second, third and fourth quarters from two on-site locations (K-1b and K-1f) and from the dairy farm locations. Cattle feed is collected during the first quarter from the same farms. The samples are analyzed for gross beta, strontium-89 and -90, and gamma emitting isotopes.

Soil

Soil samples are collected twice a year on-site at K-1f and from the dairy farm locations (K-3, K-5, K-25, K-34, K-38 and K-39). The samples are analyzed for gross alpha, gross beta, strontium-89, strontium-90 and gamma emitting isotopes.

3.1.3 The Aquatic Program

Surface Water

One-gallon water samples are taken monthly from three locations on Lake Michigan: 1) at the point where the condenser water is discharged into Lake Michigan (K-1d); 2) Two Creeks Park (K-14) located 2.5 miles south of the reactor site; and 3) at the main pumping station located approximately equidistant from Kewaunee and Green Bay, which pumps water from the Rostok water intake (K-9) located 11.5 miles north of the reactor site. Both raw and tap water are collected at K-9. One-gallon water samples are taken monthly from three creeks that pass through the site (K-1a, K-1b, and K-1e). Samples from North and Middle Creeks (K-1a, K-1b) are collected near the mouth of each creek. Samples from the South Creek (K-1e) are collected about ten feet downstream from the point where the outflow from the two drain pipes meet. Additionally, the drainage pond (K-1k), located approximately 0.6 miles southwest of the plant, is included in the sampling program. Water samples at K-14 are collected and analyzed in duplicate.

The water is analyzed for gamma emitting isotopes, gross beta activity in total residue, dissolved solids and suspended solids, and potassium-40. The concentration of potassium-40 is calculated from total potassium, which is determined by flame photometry. In addition, quarterly composites of the monthly grab samples are analyzed for tritium, strontium-89 and strontium-90.

Fish

Fish samples are collected during the second, third and fourth quarters at location K-1d. The flesh is separated from the bones, gamma scanned and analyzed for gross beta activity. Ashed bone samples are analyzed for gross beta, strontium-89 and strontium-90 activities.

Slime

Slime samples are collected during the second and third quarters from three Lake Michigan locations (K-1d, K-9 and K-14), from three creek locations (K-1a, K-1b and K-1e) and from the drainage pond (K-1k), if available. The samples are analyzed for gross beta activity. If the quantity is sufficient, they are also gamma scanned and analyzed for strontium-89 and strontium-90 activities.

Bottom Sediment

Bottom sediments are collected in May and November from five locations (K-1c, K-1d, K-1j, K-9 and K-14). The samples are analyzed for gross beta, strontium-89, strontium-90 and gamma emitting isotopes. It is known that the measured radioactivity per unit mass of sediment increases with decreasing particle size, and the sampling procedure is designed to assure collection of very fine particles.

3.1.4 Program Execution

Program execution is summarized in Table 4.4. The program was executed for the year 2005 as described in the preceding sections, with the following exceptions:

(1) Air particulates / Air iodine sampling was not available at location K-2 from October 26 through December 29, 2005. The sampler was disconnected during yard maintenance.

(2) Vegetables were not available at location K-17, Jansky's Farm. The garden was discontinued. Additional vegetable samples were collected at K-3, K-24 and K-38.

(3) No TLD was available at location K-27 for the first quarter of 2005. The TLD was lost in the field.

3.1.5 Program Modifications

There were no program modifications for 2005.

3.2 Results and Discussion

The results for the reporting period January to December 2005 are presented in summary form in Table 4.5. For each type of analysis, of each sampled medium, the table shows the annual mean and range for all indicator and control locations. The location with the highest annual mean and the results for this location are also given.

The discussion of the results has been divided into three broad categories: the air, terrestrial, and aquatic environments. Within each category, samples will be discussed in the order listed in Table 4.4. Any discussion of previous environmental data for the Kewaunee Power Station refers to data collected by Environmental Inc., Midwest Laboratory.

The tabulated results of all measurements made in 2005 are not included in this section, although references to these results will be made in the discussion. A complete tabulation of results is contained in Part II of the 2005 annual report on the Radiological Monitoring Program for the Kewaunee Power Station.

3.2.1 Atmospheric Nuclear Detonations and Nuclear Accidents

There were no atmospheric nuclear tests or accidents reported in 2005. The last reported test was conducted by the People's Republic of China on October 16, 1980.

3.2.2 The Air Environment

Airborne Particulates

The annual gross beta concentration in air particulates measured 0.023 pCi/m^3 at both the indicator and control locations. The averages were similar to the means observed from 1994 (and prior to) through 2004. Results are tabulated below.

Year	Average of Indicators	Average of Controls
Concentration (pCi/m^3)		
1994	0.016	0.018
1995	0.019	0.018
1996	0.020	0.019
1997	0.019	0.019
1998	0.019	0.019
1999	0.022	0.023
2000	0.022	0.021
2001	0.024	0.023
2002	0.023	0.023
2003	0.022	0.022
2004	0.019	0.020
2005	0.023	0.023

Average annual gross beta concentrations in airborne particulates.

Airborne Particulates (continued)

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7, which is produced continuously in the upper atmosphere by cosmic radiation (Arnold and Al-Salih, 1955), was detected in all samples. All other gamma-emitting isotopes were below their respective LLD limits.

Airborne Iodine

Bi-monthly levels of airborne iodine-131 were below the lower limit of detection (LLD) of 0.030 pCi/m^3 at all locations. There is no indication of an effect of the plant operation on the local air environment.

Ambient Gamma Radiation - TLDs

Ambient gamma radiation was monitored by TLDs at fourteen locations: eight indicator and six control.

Quarterly TLDs at indicator locations measured a mean dose equivalent of (15.7 mR/91 days), in agreement with the mean at the control locations of (14.3 mR/91 days), and were similar to the means obtained from 1994 (and prior to) through 2004. The results are tabulated below. No plant effect on ambient gamma radiation was indicated These values are slightly lower than the United States average value of 19.5 mR/91 days due to natural background radiation (National Council on Radiation Protection and Measurements, 1975). The highest annual mean was 17.6 mR/91 days, measured at the indicator location K-7.

Year	Average (Indicators)	Average (Controls)
	Dose rate (mR/91 days)	
1994	14.8	13.8
1995	16.7	15.6
1996	15.9	14.9
1997	16.0	15.1
1998	16.1	15.5
1999	17.4	16.9
2000	18.7	18.2
2001	18.6	18.3
2002	16.1	15.1
2003	14.1	13.7
2004	14.8	14.0
2005	15.7	14.3

Ambient gamma radiation as measured by thermoluminescent dosimetry.
Average quarterly dose rates.

Precipitation

Precipitation was monitored for tritium at one indicator location, K-11. The concentration was below the LLD level of 192 pCi/L in all samples.

3.2.3 The Terrestrial Environment

Milk

Of 126 analyses for iodine-131 in milk, all were below the LLD level of 0.5 pCi/L.

Strontium-89 concentrations measured below an LLD level of 1.4 pCi/L in all samples. Low levels of strontium-90 were found in seventy-four of the eighty four samples tested. Mean values were almost identical for indicator and control locations (1.1 and 1.0 pCi/L, respectively) and are similar to or less than averages seen from 1990 through 2004.

Barium-lanthanum-140 concentrations were below the LLD of 15 pCi/L and Cesium-137 concentrations were below the LLD of 10 pCi/L in all samples. Potassium-40 results are similar at both the indicator and control locations (1365 and 1353 pCi/L, respectively), and are essentially identical to the levels observed from 1990 through 2004. There was no indication of any effect due to the operation of the Kewaunee Power Station.

Due to the chemical similarities between strontium and calcium, and cesium and potassium, organisms tend to deposit cesium-137 in the soft tissue and muscle and strontium-89 and strontium-90 in the bone. Consequently, ratios of strontium-90 activity to the weight of calcium in milk and cesium-137 activity to the weight of potassium in milk were monitored in order to detect potential environmental accumulation of these radionuclides. The measured concentrations of stable potassium and calcium are in agreement with previously determined values of 1.50 ± 0.21 g/L and 1.16 ± 0.08 g/L, respectively (National Center for Radiological Health, 1968).

Well Water

Gross alpha concentrations, measured at the two on-site wells (K-1g and K-1h), averaged 3.1 pCi/L. Gross beta activity, above the LLD value of 1.9 pCi/L was detected in 10 of the 24 samples tested. Gross beta concentrations averaged 4.6 pCi/L at the indicator locations and less than LLD for the control location.

Levels of strontium-89 and strontium-90 were measured for the on-site well (K-1g). The concentrations measured below the LLD value of 0.7 and 0.7 pCi/L, respectively.

All samples were tested for tritium and gamma emitting isotopes. Tritium concentrations measured below the LLD of 171 pCi/L. Gamma-emitting isotopes measured below their respective LLDs.

Potassium-40 averages are generally in proportion to gross beta measurements and were in agreement with previously measured values. No plant effect was indicated.

Domestic Meat

In domestic meat samples, gross alpha concentration measured below the lower limit of detection for both indicator and control locations. Gross beta concentration averaged 3.64 pCi/g wet for indicator locations and 3.39 pCi/g wet for the control location. The differences are not significant. Gamma-spectroscopic analyses showed that almost all of the beta activity was due to naturally occurring potassium-40. All other gamma-emitting isotopes were below their respective LLD limits.

Eggs

In egg samples, gross beta concentrations averaged 1.69 pCi/g wet for the indicator location and 1.67 pCi/g wet for the control, similar to concentrations of naturally-occurring potassium-40 observed in the samples (1.16 and 1.24 pCi/g wet respectively). Other gamma-emitting isotopes were below their respective LLDs. Levels of strontium-89 measured below the LLD of 0.008 pCi/g wet in all samples, strontium-90 measured below the LLD level of 0.004 pCi/g wet.

Vegetables and Grain

In vegetables, gross beta concentrations averaged 2.33 pCi/g wet at the control location K-26, due primarily to potassium-40 activity. All other gamma emitting isotopes measured below respective LLDs. Strontium-89 measured below the LLD level of 0.018 pCi/g wet. Strontium-90 measured below the LLD level of 0.006 pCi/g wet.

In two grain samples (clover and oats) from location K-23, gross beta concentrations averaged 6.35 pCi/g wet, due primarily to potassium-40 and beryllium-7 activity (4.68 and 0.94 pCi/g wet, respectively). Strontium-89 measured below the LLD level of 0.015 pCi/g wet, strontium-90 measured below the LLD level of 0.009 pCi/g wet.

Grass and Cattle Feed

In grass, mean gross beta concentrations measured 8.53 and 14.15 pCi/g wet at indicator and control locations, respectively, and in all cases was predominantly due to naturally occurring potassium-40 and beryllium-7. All other gamma-emitting isotopes were below their respective LLDs. Strontium-89 measured below the LLD levels of 0.032. Strontium-90 activity was measured in one of 24 samples tested, at a concentration of 0.019 pCi/g wet.

In cattlefeed, the mean gross beta concentration was lower at the control locations (7.38 pCi/g wet) than at indicator locations (12.82 pCi/g wet). The highest average gross beta levels were in samples from the indicator location K-38 (15.78 pCi/g wet), and reflected the potassium-40 levels observed in the samples. This pattern is similar to that observed since 1978. Strontium-89 levels were below the LLD level of 0.054 pCi/g wet in all samples. Low levels of strontium-90 activity , above the LLD value of 0.027 pCi/g wet were detected in two of twelve samples, and averaged 0.040 pCi/g wet, similar or lower than levels observed in 1995 through 2004. The presence of radiostrontium in the environment can still be attributed to fallout from the nuclear testing in previous decades.

With the exception of naturally-occurring potassium, gamma-emitting isotopes were below their respective LLD levels.

Soil

Gross alpha concentrations in soil samples averaged 9.47 pCi/g dry at the indicator locations and 8.32 pCi/g dry at the control location. Mean gross beta levels measured at the indicator and control locations averaged 27.74 and 26.68 pCi/g dry, respectively, primarily due to the potassium-40 activity. Strontium-89 was below the LLD level of 0.083 pCi/g dry in all samples. Low levels of strontium-90 activity were detected in eight of the fourteen samples tested and averaged 0.057 pCi/g dry.

Low levels of Cesium-137 were detected in twelve of fourteen soil samples, similar at both indicator and control locations (0.12 and 0.18 pCi/g dry, respectively). Potassium-40 was detected in all samples and averaged 20.70 and 19.76 pCi/g dry at indicator and control locations, respectively. All other gamma-emitting isotopes were below their respective LLD's. These levels of detected activities are similar to those observed from 1989 through 2004.

3.2.4 The Aquatic Environment

Surface Water

In all surface water tested, gross beta activity in suspended solids measured below the LLD level of 1.3 pCi/L. Mean gross beta concentration in dissolved solids was higher at the indicator locations (5.2 pCi/L) as compared to the control locations (1.7 pCi/L). The pattern is similar to activity distribution observed from 1978 through 2004.

Year	Average (Indicators)	Average (Controls)
	Dose rate (mR/91 days)	
1994	5.0	2.3
1995	4.3	2.2
1996	4.3	2.2
1997	6.3	2.4
1998	5.9	2.1
1999	5.6	2.2
2000	7.0	2.4
2001	5.9	2.2
2002	5.7	2.2
2003	7.3	2.4
2004	6.2	2.3
2005	5.2	1.7

Average annual gross beta concentrations in surface water (DS).

The difference in levels are due in part to the indicator location (K-1k), a pond formed by drainage of surrounding fields to the southwest. The control sample is Lake Michigan water, which varies very little in gross beta concentration during the year, while indicator samples include two creek locations (K-1a and K-1e) which are much higher in gross beta concentration and exhibit large month-to-month variations. The K-1a creek draws its water from the surrounding fields which are heavily fertilized; and the K-1e creek draws its water mainly from the Sewage Treatment Plant. In general, gross beta concentrations were high when potassium-40 levels were high and low when potassium-40 levels were low, indicating that the fluctuations in beta concentration were due to variations in potassium-40 concentrations and not to plant operations. The fact that similar fluctuations at these locations were observed in the pre-operational studies conducted prior to 1974 supports this assessment.

Slight tritium activity was observed in three of eight samples collected at K-14 (Two Creeks Park). All other samples measured below an LLD value of 170 pCi/L.

Strontium-89 concentrations were below the LLD of 1.2 pCi/L. Strontium-90 measured 1.1 pCi/L in one of the twenty-seven indicator samples. All other samples measured below an LLD value of 0.8 pCi/L.

Gamma-emitting isotopes were below their respective LLDs in all samples.

Fish

In fish, gross beta concentrations averaged 3.96 pCi/g wet in muscle and 1.80 pCi/g wet in bone fractions. In muscle, the gross beta concentration was primarily due to potassium-40 activity.

Cesium-137 concentration in muscle was detected in two of six samples tested at a level of 0.045 pCi/g wet, lower than levels observed between 1979 and 1991 (average of 0.12 pCi/g wet), and similar to levels seen in 1992 (0.066 pCi/g wet), in 1993 (0.068 pCi/g wet), in 1994 (0.067 pCi/g wet), in 1995 (0.056 pCi/g wet), in 1996 (0.055 pCi/g wet), in 1997 (0.053 pCi/g wet), 1998 (0.075 pCi/g wet), in 1999 (0.062 pCi/g wet), in 2000 (0.063 pCi/g wet) and 0.040 pCi/g wet in 2001 and 2002, 0.048 pCi/g wet in 2003 and 0.042 pCi/g wet in 2004.

The strontium-89 concentration was below the LLD of 0.86 pCi/g wet in all samples. Strontium-90 was detected above the LLD value of 0.05 pCi/g wet and averaged 0.25 pCi/g wet.

Periphyton (Slime) or Aquatic Vegetation

In periphyton (slime) and aquatic vegetation samples, mean gross beta concentrations were slightly higher at the control location than at the indicators (4.53 and 3.86 pCi/g wet, respectively).

The strontium-89 concentration was below the LLD of 0.14 pCi/g wet in all samples. Strontium-90 was not detected above an LLD value of 0.079 pCi/g wet.

Cs-137 activity was detected above the LLD value of 0.035 pCi/g wet in one of fourteen samples tested at a concentration of 0.035 pCi/g wet, similar or less than measurements taken from 1989 through 2004. Other gamma-emitting isotopes, with the exception of naturally-occurring beryllium-7 and potassium-40, were below their respective LLDs.

Bottom Sediments

In bottom sediment samples, the mean gross beta concentrations measured 8.98 pCi/g dry at the indicator locations and 24.49 pCi/g dry at the control location.

Cs-134 measured below the LLD level of 0.027 pCi/g dry in all samples. A low level of cesium-137 was observed in one of eight samples from indicator locations at a concentration of 0.038 pCi/g dry. At the control location , cesium-137 measured 0.12 pCi/g dry in one of two samples tested. On average, cesium-137 measurements are lower than or similar to levels observed from 1979 through 2004.

Levels of strontium-89 and strontium-90 measured below respective detection limits of 0.052 pCi/g dry and 0.026 pCi/g in all samples.

3.3 Land Use Census

The Land Use Census satisfies the requirements of the KPS Radiological Environmental Monitoring Manual. Section 2.2.2 states:

> "A land use census shall be conducted and shall identify within a distance of 8 km (5 mi.) the location, in each of the 10 meteorological sectors, of the nearest milk animal, the nearest residence and the nearest garden of greater than $50m^2$ (500 ft^2) producing broad leaf vegetation."

The 2005 Land Use Census was completed to identify the presence of the nearest milk animals, gardens and farm crops of the Kewaunee Power Station.

The Land Use Census was completed on September 2, 2005. The census is conducted annually during the growing season per Health Physics Procedure HP 1.14.

In summary, the highest D/Q locations for nearest garden, nearest residence and nearest milk animal did not change from the 2004 census.

4.0 FIGURES AND TABLES

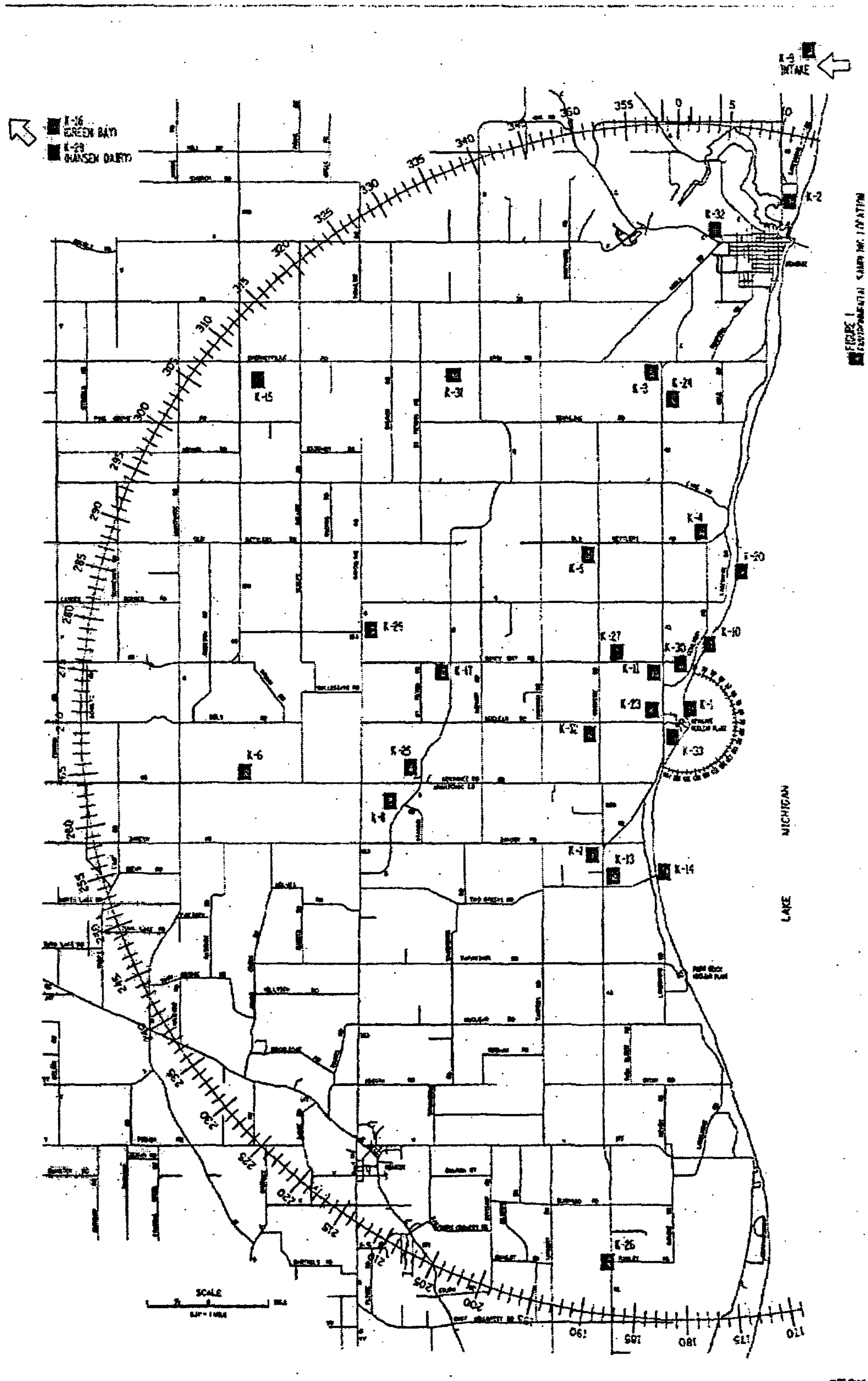

Figure 4-1. Sampling locations, Kewaunee Power Station

Table 4.1. Sampling locations, Kewaunee Power Station.

Code	Type[a]	Distance (miles)[b] and Sector	Location
K-1			Onsite
K-1a	I	0.62 N	North Creek
K-1b	I	0.12 N	Middle Creek
K-1c	I	0.10 N	500' north of condenser discharge
K-1d	I	0.10 E	Condenser discharge
K-1e	I	0.12 S	South Creek
K-1f	I	0.12 S	Meteorological Tower
K-1g	I	0.06 W	South Well
K-1h	I	0.12 NW	North Well
K-1j	I	0.10 S	500' south of condenser discharge
K-1k	I	0.60 SW	Drainage Pond, south of plant
K-2	C	9.5 NNE	WPS Operations Building in Kewaunee
K-3	C	6.0 N	Lyle and John Siegmund Farm, N2815 Hy 12, Kewaunee
K-5	I	3.5 NNW	Ed Paplham Farm, E4160 Old Settlers Rd, Kewaunee
K-7	I	2.75 SSW	Ron Zimmerman Farm, 17620 Nero Road, Two Rivers
K-8	C	5.0 WSW	Saint Isidore the Farmer Church, Tisch Mills
K-9	C	11.5 NNE	Rostok Water Intake for Green Bay, Wisconsin, two miles north of Kewaunee
K-10	I	1.5 NNE	Turner Farm, Kewaunee site
K-11	I	1.0 NW	Harlan Ihlenfeld Farm, N879 Hy 42, Kewaunee
K-13	C	3.0 SSW	Rand's General Store
K-14	I	2.5 S	Two Creeks Park, 2.5 miles south of site
K-15	C	9.25 NW	Gas Substation, 1.5 miles north of Stangelville
K-16	C	26 NW	WPS Division Office Building, Green Bay, Wisconsin
K-17	I	4.25 W	Jansky's Farm, N885 Tk B, Kewaunee
K-20	I	2.5 N	Carl Struck Farm, Lakeshore Dr, Kewaunee
K-23	I	0.5 W	0.5 miles west of plant, Kewaunee site
K-24	I	5.45 N	Fectum Farm, N2653 Hy 42, Kewaunee
K-25	I	2.0 WSW	Wotachek Farm, 4819 E. Cty Tk BB, Denmark
K-26	C	10.7 SSW	Bertler's Fruit Stand (8.0 miles south of "BB")
K-27	I	1.5 NW	Schlies Farm, E4298 Sandy Bay Rd, Kewaunee
K-28	C	26 NW	Hansen Dairy, Green Bay, Wisconsin
K-29	I	5.75 W	Kunesh Farm, Route 1, Kewaunee
K-30	I	1.00N	End of site boundary
K-31	C	6.25NNW	E. Krok Substation
K-32	C	11.50 N	Piggly Wiggly, 931 Marquette Dr., Kewaunee
K-34	I	2.5 N	Leon and Vicki Struck, N1549 Lakeshore Dr., Kewaunee
K-38	I	3.0 mi. WNW	Dave Sinkula Farm, N890 Town Hall Road, Kewaunee
K-39	I	3.8 mi. N	Francis and Sue Wojta, N1859 Lakeshore Dr., Kewaunee

[a] I = indicator; C = control.

[b] Distances are measured from reactor stack.

Table 4.2. Type and frequency of collection.

Location	Weekly	Biweekly	Monthly	Quarterly	Semiannually	Annually
K-1a			SW		SL	
K-1b			SW	GR[a]	SL	
K-1c					BS[b]	
K-1d			SW	FI[a]	BS[b], SL	
K-1e			SW		SL	
K-1f	AP	AI		GR[a], TLD	SO	
K-1g				WW		
K-1h				WW		
K-1j					BS[b]	
K-1k			SW		SL	
K-2	AP	AI		TLD		
K-3			MI[c]	GR[a], TLD, CF[d]	SO	
K-5			MI[c]	GR[a], TLD, CF[d]	SO	
K-7	AP	AI		TLD		
K-8	AP	AI		TLD		
K-9			SW		BS[b], SL	
K-10				WW		
K-11			PR	WW		
K-13				WW		
K-14			SW		BS[b], SL	
K-15				TLD		
K-16	AP	AI		TLD		
K-17				TLD		VE
K-20						DM
K-23						GRN
K-24				EG		DM
K-25			MI[c]	GR[a], TLD, CF[d], WW	SO	
K-26						VE
K-27				TLD, EG		DM
K-28			MI[c]			
K-29						DM
K-30				TLD		
K-31	AP	AI		TLD		
K-32				EG		DM
K-34			MI[c]	GR[a], CF[d]	SO	
K-38			MI[c]	GR[a], CF[d]	SO	
K-39			MI[c]	GR[a], TLD, CF[d]	SO	

[a] Three times a year, second, third and fourth quarters. [b] To be collected in May and November.
[c] Monthly from November through April; semimonthly May through October.
[d] First quarter (January, February, March) only.

Table 4.3. Sample Codes:

AP	Airborne particulates	MI	Milk
AI	Airborne Iodine	PR	Precipitation
BS	Bottom (river) sediments	SL	Slime
CF	Cattlefeed	SO	Soil
DM	Domestic Meat	SW	Surface water
EG	Eggs	TLD	Thermoluminescent Dosimeter
FI	Fish	VE	Vegetables
GRN	Grain	WW	Well water
GR	Grass		

Table 4.4. Sampling Summary, January - December 2005.

Sample Type	Collection Type and Frequency[a]	Number of Locations	Number of Samples Collected	Number of Samples Missed
Air Environment				
Airborne particulates	C/W	6	309	9
Airborne Iodine	C/BW	6	159	3
TLD's	C/Q	14	55	1
Precipitation	C/M	1	12	0
Terrestrial Environment				
Milk (May-Oct)	G/SM	7	84	0
(Nov-Apr)	G/M	7	42	0
Well water	G/Q	6	24	0
Domestic meat	G/A	3	3	0
Eggs	G/Q	2	8	0
Vegetables - 5 varieties	G/A	1	7	0
Grain - oats	G/A	1	1	0
- clover	G/A	1	1	0
Grass	G/TA	8	24	0
Cattle feed	G/A	6	12	0
Soil	G/SA	7	14	0
Aquatic Environment				
Surface water	G/M	7	105	3
Fish	G/TA	1	6	0
Slime	G/SA	7	14	0
Bottom sediments	G/SA	5	10	0

[a] Type of collection is coded as follows: C = continuous; G = grab.
Frequency is coded as follows: W = weekly; BW = bi-weekly; SM = semimonthly; M = monthly; Q = quarterly; SA = semiannually; TA = three times per year; A = annually.

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility Kewaunee Power Station — Docket No. 50-305

Location of Facility Kewaunee County, Wisconsin (County, State) — Reporting Period January-December, 2005

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean Location[d]	Location with Highest Annual Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
TLDs (Quarterly) (mR/91days)	Gamma	55	3.0	15.7 (31/31) (10.8-20.5)	K-7, Zimmerman Farm 2.75 mi. SSW	18.4 (4/4) (15.1-20.5)	14.3 (24/24) (10.1-19.1)	0
Airborne Particulates (pCi/m³)	GB	309	0.002	0.023 (106/106) (0.006-0.056)	K-7, Zimmerman 2.75 mi. SSW	0.023 (53/53) (0.006-0.056)	0.023 (203/203) (0.005-0.056)	0
	GS	18						
	Be-7		0.020	0.056 (6/6) (0.039-0.066)	K-31, E. Krok Substation, 6.25 mi. NNW	0.062 (3/3) (0.035-0.078)	0.060 (12/12) (0.035-0.078)	0
	Nb-95		0.0015	< LLD	-	-	< LLD	0
	Zr-Nb-95		0.0019	< LLD	-	-	< LLD	0
	Ru-103		0.0010	< LLD	-	-	< LLD	0
	Ru-106		0.0086	< LLD	-	-	< LLD	0
	Cs-134		0.0012	< LLD	-	-	< LLD	0
	Cs-137		0.0008	< LLD	-	-	< LLD	0
	Ce-141		0.0022	< LLD	-	-	< LLD	0
	Ce-144		0.0054	< LLD	-	-	< LLD	0
Airborne Iodine (pCi/m³)	I-131	156	0.03	< LLD	-	-	< LLD	0
Precipitation (pCi/L)	H-3	12	192	< LLD	-	-	None	0
Milk (pCi/L)	I-131	126	0.5	< LLD	-	-	< LLD	0
	Sr-89	84	1.4	< LLD	-	-	< LLD	0
	Sr-90	84	0.5	1.1 (53/60) (0.6-2.0)	Wojta Farm, 3.0 mi. N	1.3 (10/10) (0.8-2.0)	1.0 (21/24) (0.6-1.6)	0
	GS	126						
	K-40		50	1365 (90/90) (1127-1617)	K-34, Struck Farm 2.5 mi. N	1392 (18/18) (1127-1617)	1353 (36/36) (1072-1548)	0
	Cs-134		10	< LLD	-	-	< LLD	0
	Cs-137		10	< LLD	-	-	< LLD	0
	Ba-La-140		15	< LLD	-	-	< LLD	0
(g/L)	K-stable	84	1.0	1.60 (60/60) (1.39-1.75)	K-34, Struck Farm 2.5 mi. N	1.62 (12/12) (1.43-1.71)	1.60 (24/24) (1.41-1.79)	0
(g/L)	Ca	84	0.4	0.95 (60/60) (0.76-1.29)	K-3, Siegmund Farm 6.0 mi. N	0.99 (12/12) (0.77-1.33)	0.95 (24/24) (0.77-1.33)	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility	Kewaunee Power Station	Docket No.	50-305
Location of Facility	Kewaunee County, Wisconsin (County, State)	Reporting Period	January-December, 2005

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
					Location[d]	Mean (F)[c] Range[c]		
Well Water (pCi/L)	GA	8	2.1	3.1 (3/8) (2.9-3.4)	K-1g, South Well 0.06 mi. W	3.2 (2/4) (2.9-3.4)	None	0
	GB	24	1.9	4.6 (10/20) (2.0-7.7)	K-10, Turner Farm 1.5 mi. NNE	5.5 (2/4) (3.2-7.7)	< LLD	0
	H-3	24	171	< LLD	-	-	None	0
	K-40(fp)	24	0.87	2.00 (20/20) (0.81-3.95)	K-10, Turner Farm 1.5 mi. NNE	2.84 (4/4) (1.82-3.95)	1.01 (4/4) (0.87-1.08)	0
	Sr-89	4	0.7	< LLD	-	-	None	0
	Sr-90	4	0.7	< LLD	-	-	None	0
	GS	24						
	Mn-54		15	< LLD	-	-	< LLD	0
	Fe-59		30	< LLD	-	-	< LLD	0
	Co-58		15	< LLD	-	-	< LLD	0
	Co-60		15	< LLD	-	-	< LLD	0
	Zn-65		30	< LLD	-	-	< LLD	0
	Zr-Nb-95		15	< LLD	-	-	< LLD	0
	Cs-134		15	< LLD	-	-	< LLD	0
	Cs-137		18	< LLD	-	-	< LLD	0
	Ba-La-140		15	< LLD	-	-	< LLD	0
Domestic Meat (pCi/gwet)	GA	5	0.120	< LLD	-	-	< LLD	0
	GB	5	0.030	3.64 (2/2) (3.41-3.86)	K-29, Kunesh Farm 5.75 mi. W	3.40 (1/1) -	3.39 (1/1) -	0
	GS	5						
	Be-7		0.34	< LLD	-	-	< LLD	0
	K-40		0.50	3.18 (2/2) (3.16-3.2)	K-29, Kunesh Farm 5.75 mi. W	2.84 (1/1)	2.44 (1/1) -	0
	Nb-95		0.059	< LLD	-	-	< LLD	0
	Zr-95		0.15	< LLD	-	-	< LLD	0
	Ru-103		0.057	< LLD	-	-	< LLD	0
	Ru-106		0.19	< LLD	-	-	< LLD	0
	Cs-134		0.022	< LLD	-	-	< LLD	0
	Cs-137		0.028	< LLD	-	-	< LLD	0
	Ce-141		0.11	< LLD	-	-	< LLD	0
	Ce-144		0.15	< LLD	-	-	< LLD	0
Eggs (pCi/gwet)	GB	8	0.010	1.69 (4/4) (1.48-1.99)	K-24, Fectum Farm 5.45 mi. N	1.69 (4/4) (1.48-1.99)	1.67 (4/4) (1.41-1.80)	0
	Sr-89	8	0.008	< LLD	-	-	< LLD	0
	Sr-90	8	0.004	< LLD	-	-	< LLD	0
	GS	8						
	Be-7		0.093	< LLD	-	-	< LLD	0
	K-40		0.50	1.16 (4/4) (0.89-1.40)	K-32, Grocery 11.5 mi. N	1.24 (4/4) (1.12-1.39)	1.24 (4/4) (1.12-1.39)	0
	Nb-95		0.017	< LLD	-	-	< LLD	0
	Zr-95		0.029	< LLD	-	-	< LLD	0
	Ru-103		0.011	< LLD	-	-	< LLD	0
	Ru-106		0.071	< LLD	-	-	< LLD	0
	Cs-134		0.013	< LLD	-	-	< LLD	0
	Cs-137		0.010	< LLD	-	-	< LLD	0
	Ce-141		0.021	< LLD	-	-	< LLD	0
	Ce-144		0.054	< LLD	-	-	< LLD	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility: Kewaunee Power Station
Location of Facility: Kewaunee County, Wisconsin
(County, State)

Docket No.: 50-305
Reporting Period: January-December, 2005

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
					Location[d]	Mean (F)[c] Range[c]		
Vegetables (pCi/gwet)	GB	7	0.010	None	K-26, Bertler's 10.7 mi. SSW	2.33 (7/7) (1.26-3.09)	2.33 (7/7) (1.26-3.09)	0
	Sr-89	7	0.018	None	-	-	< LLD	0
	Sr-90	7	0.006	None	-	-	<LLD	0
								0
	GS	7						
	Be-7		0.19	None	-	-	< LLD	0
					-			
	K-40		0.50	None -	K-26, Bertler's 10.7 mi. SSW	1.69 (7/7) (1.04-2.40)	1.69 (7/7) (1.04-2.40)	0
	Nb-95		0.032	None	-	-	< LLD	0
	Zr-95		0.044	None	-	-	< LLD	0
	Ru-103		0.025	None	-	-	< LLD	0
	Ru-106		0.17	None	-	-	< LLD	0
	Cs-134		0.014	None	-	-	< LLD	0
	Cs-137		0.026	None	-	-	< LLD	0
	Ce-141		0.043	None	-	-	< LLD	0
	Ce-144		0.14	None	-	-	< LLD	0
Grain - Oats & Clover (pCi/gwet)	GB	2	0.010	6.35 (2/2) (5.73-6.96)	K-23, Kewaunee Site, 0.5 mi. W	6.35 (2/2) (5.73-6.96)	None	0
	Sr-89	2	0.015	< LLD	-	-	None	0
	Sr-90	2	0.009	< LLD	-	-	None	0
	GS	2						
	Be-7		0.50	0.94 (2/2) (0.70-1.18)	K-23, Kewaunee Site, 0.5 mi. W	0.94 (2/2) (0.70-1.18)	None	0
	K-40		0.50	4.68 (2/2) (4.28-5.08)	K-23, Kewaunee Site, 0.5 mi. W	4.68 (2/2) (4.28-5.08)	None	0
	Nb-95		0.039	< LLD	-	-	None	0
	Zr-95		0.059	< LLD	-	-	None	0
	Ru-103		0.037	< LLD	-	-	None	0
	Ru-106		0.22	< LLD	-	-	None	0
	Cs-134		0.026	< LLD	-	-	None	0
	Cs-137		0.020	< LLD	-	-	None	0
	Ce-141		0.054	< LLD	-	-	None	0
	Ce-144		0.17	< LLD	-	-	None	0
Cattlefeed (pCi/gwet)	GB	10	0.10	12.82 (10/10) (2.73-22.53)	K-38, Sinkula Farm 3.8 mi. WNW	15.78 (2/2) (9.02-22.53)	7.38 (2/2) (2.5-12.26)	0
	Sr-89	10	0.054	< LLD	-	-	< LLD	0
	Sr-90	10	0.027	0.0395 (2/10) (0.039-0.040)	K-25, Wotachek Farm 2.0 mi. WSW	0.040 (1/2)	<LLD	0
	GS	10						
	Be-7		0.58	< LLD	-	-	< LLD	0
	K-40		0.10	12.01 (10/10) (2.3-21.17)	K-5, Paplham Farm 3.5 mi. NNW	15.42 (2/2) (12.05-18.79)	6.50 (2/2) (2.64-10.36)	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility Kewaunee Power Station Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) Reporting Period January-December, 2005

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Cattlefeed (continued)	Nb-95	0.086	< LLD	-	-	< LLD	0
	Zr-95	0.12	< LLD	-	-	< LLD	0
	Ru-103	0.085	< LLD	-	-	< LLD	0
	Ru-106	0.40	< LLD	-	-	< LLD	0
	Cs-134	0.036	< LLD	-	-	< LLD	0
	Cs-137	0.050	< LLD	-	-	< LLD	0
	Ce-141	0.16	< LLD	-	-	< LLD	0
	Ce-144	0.38	< LLD	-	-	< LLD	0
Grass (pCi/gwet)	GB 24	0.10	8.53 (21/21) (5.45-13.90)	K-3, Siegmund Farm 6.0 mi. N	14.15 (3/3) (8.21-21.83)	14.15 (3/3) (8.21-21.83)	0
	Sr-89 24	0.032	< LLD	-	-	< LLD	0
	Sr-90 24	0.014	0.019 (1/21)	K-38, Sinkula Farm 3.8 mi. WNW	0.019 (1/3)	< LLD	0
	GS 24						
	Be-7	0.27	1.76 (20/21) (0.45-4.09)	K-38, Sinkula Farm 3.8 mi. WNW	2.45 (3/3) (0.59-4.09)	2.18 (3/3) (0.95-4.35)	0
	K-40	0.50	6.29 (21/21) (3.31-11.44)	K-3, Siegmund Farm 6.0 mi. N	9.14 (3/3) (6.98-13.28)	9.14 (3/3) (6.98-13.28)	0
	Nb-95	0.042	< LLD	-	-	< LLD	0
	Zr-95	0.064	< LLD	-	-	< LLD	0
	Ru-103	0.042	< LLD		-	< LLD	0
	Ru-106	0.29	< LLD	-	-	< LLD	0
	Cs-134	0.042	< LLD	-	-	< LLD	0
	Cs-137	0.030	< LLD	-	-	< LLD	0
	Ce-141	0.085	< LLD	-	-	< LLD	0
	Ce-144	0.23	< LLD	-	-	< LLD	0
Soil (pCi/gdry)	GA 14	1.0	9.47 (12/12) (6.54-12.89)	K-38, Sinkula Farm 3.8 mi. WNW	12.60 (2/2) (12.30-12.89)	8.32 (2/2) (8.08-8.55)	0
	GB 14	2.0	27.74 (12/12) (19.49-39.08)	K-38, Sinkula Farm 3.8 mi. WNW	36.39 (2/2) (33.69-39.08)	26.68 (2/2) (24.61-28.75)	0
	Sr-89 14	0.083	< LLD	-	-	< LLD	0
	Sr-90 14	0.031	0.062 (6/12) (0.031-0.14)	K-25, Wotachek Farm 2.0 mi. WSW	0.14 (1/2)	0.043 (2/2) (0.039-0.047)	0
	GS 14						
	Be-7	0.56	< LLD	-	-	< LLD	0
	K-40	1.4	20.70 (12/12) (12.81-25.60)	K-38, Sinkula Farm 3.8 mi. WNW	24.88 (2/2) (24.15-25.60)	19.76 (2/2) (19.27-20.24)	0
	Nb-95	0.096	< LLD	-	-	< LLD	0
	Zr-95	0.10	< LLD	-	-	< LLD	0
	Ru-103	0.066	< LLD		-	< LLD	0
	Ru-106	0.32	< LLD	-	-	< LLD	0
	Cs-134	0.050	< LLD	-	-	< LLD	0
	Cs-137	0.035	0.12 (10/12) (0.093-0.15)	K-3, Siegmund Farm 6.0 mi. N	0.18 (2/2) (0.16-0.19)	0.18 (2/2) (0.16-0.19)	0
	Ce-141	0.11	< LLD	-	-	< LLD	0
	Ce-144	0.20	< LLD	-	-	< LLD	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility	Kewaunee Power Station	Docket No.	50-305
Location of Facility	Kewaunee County, Wisconsin (County, State)	Reporting Period	January-December, 2005

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Surface Water	GB (SS)	105	1.3	1.1 (1/81)	K-14, Two Creeks Park 2.5 mi. S	1.1 (1/12)	< LLD	0
(pCi/L)	GB (DS)	105	1.2	5.2 (81/81) (1.2-22.0)	K-1k, Drainage Pond 0.60 mi. SW	9.4 (9/9) (1.6-22.0)	1.7 (24/24) (1.1-2.9)	0
	GB (TR)	105	1.2	5.2 (81/81) (1.2-22.0)	K-1k, Drainage Pond 0.60 mi. SW	9.5 (9/9) (2.5-22.0)	1.7 (24/24) (1.1-2.9)	0
	GS	105						
	Mn-54		15	< LLD	-	-	< LLD	0
	Fe-59		30	< LLD	-	-	< LLD	0
	Co-58		15	< LLD	-	-	< LLD	0
	Co-60		15	< LLD	-	-	< LLD	0
	Zn-65		30	< LLD	-	-	< LLD	0
	Zr-Nb-95		15	< LLD	-	-	< LLD	0
	Cs-134		10	< LLD	-	-	< LLD	0
	Cs-137		10	< LLD	-	-	< LLD	0
	Ba-La-140		15	< LLD	-	-	< LLD	0
	H-3	35	170	253 (3/27) (187-319)	K-1k, Drainage Pond 0.60 mi. SW	253 (3/8) (187-319)	< LLD	0
	Sr-89	35	1.2	< LLD	-	-	< LLD	0
	Sr-90	35	0.8	1.1 (1/27) (1.1-1.1)	K-1d, Discharge 0.10 mi. E	1.1 (1/4)	< LLD	0
	K-40	105	0.87	3.9 (81/81) (1.0-14.8)	K-1a, North Creek 0.62 mi. N	7.8 (12/12) (5.3-14.8)	1.1 (24/24) (0.9-1.3)	0
Fish (Muscle) (pCi/gwet)	GB	6	0.5	3.96 (6/6) (2.23-5.49)	K-1d, Cond. Discharge 0.10 mi. E	3.96 (6/6) (2.23-5.49)	None	0
	GS	6						
	K-40		0.5	2.76 (6/6) (2.09-3.58)	K-1d, Cond. Discharge 0.10 mi. E	2.76 (6/6) (2.09-3.58)	None	0
	Mn-54		0.026	< LLD	-	-	None	0
	Fe-59		0.140	< LLD	-	-	None	0
	Co-58		0.045	< LLD	-	-	None	0
	Co-60		0.020	< LLD	-	-	None	0
	Cs-134		0.021	< LLD	-	-	None	0
	Cs-137		0.033	0.045 (2/6)	K-1d, Cond. Discharge 0.10 mi. E	0.045 (2/6)	None	0
Fish (Bones) (pCi/gwet)	GB	6	1.99	1.80 (6/6) (0.68-2.44)	K-1d, Cond. Discharge 0.10 mi. E	1.80 (6/6) (0.68-2.44)	None	0
	Sr-89	6	0.86	< LLD	-	-	None	0
	Sr-90	6	0.05	0.25 (6/6) (0.073-0.45)	K-1d, Cond. Discharge 0.10 mi. E	0.25 (6/6) (0.073-0.45)	None	0
								0

Environmental Radiation Monitoring Program Summary.

Name of Facility	Kewaunee Power Station	Docket No.	50-305
Location of Facility	Kewaunee County, Wisconsin (County, State)	Reporting Period	January-December, 2005

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
					Location[d]	Mean (F)[c] Range[c]		
Periphyton (Slime)	GB	14	0.1	3.86 (12/12) (0.95-7.02)	K-1a, North Creek 0.62 mi. N	6.08 (2/2) (5.13-7.02)	4.53 (2/2) (3.98-5.08)	0
(pCi/gwet)	Sr-89	14	0.14	< LLD	-	-	< LLD	0
	Sr-90	14	0.079	0.17 (2/12) (0.077-0.26)	K-14, Two Creeks Park 2.5 mi. S	0.26 (1/2)	< LLD	0
	GS	14						
	Be-7		0.47	1.14 (7/12) (0.64-2.37)	K-1b, Middle Creek 0.12 mi. N	2.37 (1/2) (2.37-2.37)	< LLD	0
	K-40		0.5	2.47 (12/12) (0.96-4.79)	K-1a, North Creek 0.62 mi. N	4.26 (2/2) (3.72-4.79)	3.12 (2/2) (2.85-3.38)	0
	Mn-54		0.032	< LLD	-	-	< LLD	0
	Co-58		0.039	< LLD	-	-	< LLD	0
	Co-60		0.024	< LLD	-	-	< LLD	0
	Nb-95		0.062	< LLD	-	-	< LLD	0
	Zr-95		0.072	< LLD	-	-	< LLD	0
	Ru-103		0.043	< LLD	-	-	< LLD	0
	Ru-106		0.30	< LLD	-	-	< LLD	0
	Cs-134		0.027	< LLD	-	-	< LLD	0
	Cs-137		0.035	0.048 (2/12) (0.042-0.051)	K-1d, Cond. Discharge 0.10 mi. E	0.050 (1/2)	< LLD	0
	Ce-141		0.061	< LLD	-	-	< LLD	0
	Ce-144		0.200	< LLD	-	-	< LLD	0
Bottom Sediments	GB	10	1.0	8.98 (8/8) (4.62-11.90)	K-9, Rostok Intake 11.5 mi. NNE	24.49 (2/2) (20.58-28.40)	24.49 (2/2) (20.58-28.40)	0
(pCi/gdry)	Sr-89	10	0.040	< LLD	-	-	< LLD	0
	Sr-90	10	0.026	< LLD	-	-	< LLD	0
	GS	10						
	K-40		0.5	8.10 (8/8) (5.76-10.09)	K-9, Rostok Intake 11.5 mi. NNE	9.40 (2/2) (8.48-10.32)	9.40 (2/2) (8.48-10.32)	0
	Co-58		0.000	< LLD	-	-	< LLD	0
	Co-60		0.035	< LLD	-	-	< LLD	0
	Cs-134		0.027	< LLD	-	-	< LLD	0
	Cs-137		0.027	0.038 (1/8) (0.000-0.038)	#DIV/0! #DIV/0!	#DIV/0! #DIV/0!	0.120 (1/2) (0.120-0.120)	0

[a] GA = gross alpha, GB = gross beta, GS = gamma spectroscopy, SS = suspended solids, DS = dissolved solids, TR = total residue.

[b] LLD = nominal lower limit of detection based on a 4.66 sigma counting error for background sample.

[c] Mean and range are based on detectable measurements only (i.e., >LLD) Fraction of detectable measurements at specified locations is indicated in parentheses (F).

[d] Locations are specified by station code (Table 4.1) and distance (miles) and direction relative to reactor site.

[e] Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.

Table 4.6 Land Use Census

The following table lists an inventory of residence, gardens ≥ 500 ft^2 and milk animals found nearest to the plant in each of the 10 meteorological sectors within a five mile radius of the Kewaunee Power Station.

Sector	Township No.	Residence	Garden	Milk Animals	Distance From Plant (miles)	Location ID
A	1			X	4.78	
A	13		X		3.05	
A	24	X			1.81	
B	18			X	2.69	K-34
B	24	X			1.26	
B	24		X		1.47	K-19
R	23			X	2.21	
R	26	X	X		1.05	K-11
Q	23	X			1.37	
Q	23		X	X	1.47	K-27
P	20			X	4.20	
P	26	X			1.42	
P	26		X		1.52	
N	26		X		1.16	
N	34			X	2.53	
N	35	X			1.05	
M	34		X		1.58	
M	34			X	1.98	K-25
M	35	X			1.42	
L	35	X			1.05	
L	35		X	X	1.30	
K	10			X	3.24	
K	35	X	X		0.96	
J	11	X	X	(Note 1)	2.68	

Note 1. There were no milk animals located in Sector J within five miles of the Kewaunee Power Station.

Land Use Census (continued)

The following is a sector by sector listing of those changes between the 2004 and 2005 census.

Sector A	No changes
Sector B	No changes
Sector R	No changes
Sector Q	No changes
Sector P	No changes
Sector N	No changes
Sector M	No changes

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APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: Environmental Inc., Midwest Laboratory participates in intercomparison studies administered by Environmental Resources Associates, and serves as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. Results are reported in Appendix A. TLD Intercomparison results, in-house spikes, blanks, duplicates and mixed analyte performance evaluation program results are also reported. Appendix A is updated four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only.

January, 2005 through December, 2005

Appendix A

Interlaboratory Comparison Program Results

Environmental, Inc., Midwest Laboratory has participated in interlaboratory comparison (crosscheck) programs since the formulation of it's quality control program in December 1971. These programs are operated by agencies which supply environmental type samples containing concentrations of radionuclides known to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on a laboratory's analytical procedures and to alert it of any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

Results in Table A-1 were obtained through participation in the environmental sample crosscheck program administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

The results in Table A-2 list results for thermoluminescent dosimeters (TLDs), via International Intercomparison of Environmental Dosimeters, when available, and internal laboratory testing.

Table A-3 lists results of the analyses on in-house "spiked" samples for the past twelve months. All samples are prepared using NIST traceable sources. Data for previous years available upon request.

Table A-4 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years available upon request.

Table A-5 list results of the in-house "duplicate" program for the past twelve months. Acceptance is based on the difference of the results being less than the sum of the errors. Data for previous years available upon request.

The results in Table A-6 were obtained through participation in the Mixed Analyte Performance Evaluation Program.

Attachment A lists acceptance criteria for "spiked" samples.

Out-of-limit results are explained directly below the result.

Attachment A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES[a]

Analysis	Level	One standard deviation for single determination
Gamma Emitters	5 to 100 pCi/liter or kg > 100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg > 50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg > 30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium-40	≥ 0.1 g/liter or kg	5% of known value
Gross alpha	≤ 20 pCi/liter > 20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤ 100 pCi/liter > 100 pCi/liter	5.0 pCi/liter 5% of known value
Tritium	≤ 4,000 pCi/liter > 4,000 pCi/liter	$\pm 1\sigma$ = (pCi/liter) = $169.85 \times (\text{known})^{0.0933}$ 10% of known value
Radium-226,-228	≥ 0.1 pCi/liter	15% of known value
Plutonium	≥ 0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	≤ 55 pCi/liter > 55 pCi/liter	6.0 pCi/liter 10% of known value
Uranium-238, Nickel-63[b] Technetium-99[b]	≤ 35 pCi/liter > 35 pCi/liter	6.0 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter > 100 pCi/liter	10 pCi/liter 10% of known value
Others[b]	—	20% of known value

[a] From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program, Fiscal Year, 1981-1982, EPA-600/4-81-004.

[b] Laboratory limit.

TABLE A-1. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)[a].

Lab Code	Date	Concentration (pCi/L)				
		Analysis	Laboratory Result[b]	ERA Result[c]	Control Limits	Acceptance
STW-1051	02/15/05	Sr-89	28.0 ± 1.2	29.4	20.7 - 38.1	Pass
STW-1051	02/15/05	Sr-90	25.1 ± 0.7	24.4	15.7 - 33.1	Pass
STW-1052	02/15/05	Ba-133	52.9 ± 2.8	53.4	44.2 - 62.6	Pass
STW-1052	02/15/05	Co-60	54.4 ± 0.4	56.6	47.9 - 65.3	Pass
STW-1052	02/15/05	Cs-134	67.7 ± 1.8	64.9	56.2 - 73.6	Pass
STW-1052	02/15/05	Cs-137	39.6 ± 1.8	40.2	31.5 - 48.9	Pass
STW-1052	02/15/05	Zn-65	159.7 ± 3.0	161.0	133.0 - 189.0	Pass
STW-1053	02/15/05	Gr. Alpha	55.1 ± 1.8	67.9	38.5 - 97.3	Pass
STW-1053	02/15/05	Gr. Beta	46.8 ± 1.3	51.1	38.5 - 97.3	Pass
STW-1054	02/15/05	Ra-226	13.7 ± 1.5	14.1	10.4 - 17.8	Pass
STW-1054	02/15/05	Ra-228	13.3 ± 0.6	13.7	7.8 - 19.6	Pass
STW-1054	02/15/05	Uranium	5.1 ± 0.2	5.0	0.0 - 10.2	Pass
STW-1055	05/17/05	Sr-89	45.1 ± 4.1	41.3	32.6 - 50.0	Pass
STW-1055	05/17/05	Sr-90	7.5 ± 0.9	5.9	0.0 - 14.6	Pass
STW-1056	05/17/05	Ba-133	87.1 ± 2.0	88.4	73.1 - 104.0	Pass
STW-1056	05/17/05	Co-60	38.4 ± 0.8	37.0	28.3 - 45.7	Pass
STW-1056	05/17/05	Cs-134	75.3 ± 0.7	78.6	69.9 - 87.3	Pass
STW-1056	05/17/05	Cs-137	201.0 ± 8.4	194.0	184.0 - 218.0	Pass
STW-1056	05/17/05	Zn-65	130.0 ± 6.7	118.0	97.6 - 138.0	Pass
STW-1057	05/17/05	Gr. Alpha	42.7 ± 2.9	37.0	21.0 - 53.0	Pass
STW-1057	05/17/05	Gr. Beta	34.0 ± 0.4	34.2	25.5 - 42.9	Pass
STW-1058	05/17/05	I-131	14.7 ± 0.5	15.5	10.3 - 20.7	Pass
STW-1059	05/17/05	Ra-226	6.6 ± 0.1	7.6	5.6 - 9.5	Pass
STW-1059	05/17/05	Ra-228	19.3 ± 0.7	18.9	10.7 - 27.1	Pass
STW-1059	05/17/05	Uranium	9.6 ± 0.1	10.1	4.9 - 15.3	Pass
STW-1060	05/17/05	H-3	24100.0 ± 109.0	24400.0	20200.0 - 28600.0	Pass
STW-1067	08/16/05	Sr-89	29.1 ± 3.0	28.0	19.3 - 36.7	Pass
STW-1067	08/16/05	Sr-90	36.0 ± 0.6	33.8	25.1 - 42.5	Pass
STW-1068	08/16/05	Ba-133	107.0 ± 1.7	106.0	87.7 - 124.0	Pass
STW-1068	08/16/05	Co-60	15.2 ± 0.2	13.5	4.8 - 22.2	Pass
STW-1068	08/16/05	Cs-134	89.1 ± 0.3	92.1	83.4 - 101.0	Pass
STW-1068	08/16/05	Cs-137	72.1 ± 1.0	72.7	64.0 - 81.4	Pass
STW-1068	08/16/05	Zn-65	67.4 ± 1.4	65.7	54.3 - 77.1	Pass
STW-1069	08/16/05	Gr. Alpha	44.3 ± 1.5	55.7	31.6 - 79.8	Pass
STW-1069	08/16/05	Gr. Beta	58.4 ± 2.1	61.3	44.0 - 78.6	Pass
STW-1070	08/16/05	Ra-226	16.6 ± 1.5	16.6	12.3 - 20.9	Pass
STW-1070	08/16/05	Ra-228	6.2 ± 0.3	6.2	3.5 - 8.9	Pass
STW-1070	08/16/05	Uranium	4.5 ± 0.1	4.5	0.0 - 9.7	Pass

TABLE A-1. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)[a].

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result[b]	ERA Result[c]	Control Limits	Acceptance
STW-1072	11/15/05	Sr-89	20.6 ± 0.4	19.0	10.3 - 27.7	Pass
STW-1072	11/15/05	Sr-90	15.0 ± 0.3	16.0	7.3 - 24.7	Pass
STW-1073	11/15/05	Ba-133	31.8 ± 1.8	31.2	22.5 - 39.9	Pass
STW-1073	11/15/05	Co-60	85.0 ± 1.4	84.1	75.4 - 92.8	Pass
STW-1073	11/15/05	Cs-134	37.2 ± 2.1	33.9	25.2 - 42.6	Pass
STW-1073	11/15/05	Cs-137	27.8 ± 0.7	28.3	19.6 - 37.0	Pass
STW-1073	11/15/05	Zn-65	109.0 ± 1.0	105.0	86.8 - 123.0	Pass
STW-1074 [d]	11/15/05	Gr. Alpha	41.1 ± 1.2	23.3	13.2 - 33.4	Fail
STW-1074	11/15/05	Gr. Beta	42.7 ± 0.5	39.1	30.4 - 47.8	Pass
STW-1075	11/15/05	I-131	20.5 ± 0.6	17.4	12.2 - 22.6	Pass
STW-1076	11/15/05	Ra-226	7.8 ± 0.6	8.3	6.2 - 10.5	Pass
STW-1076 [e]	11/15/05	Ra-228	5.5 ± 0.6	3.5	2.0 - 5.0	Fail
STW-1076	11/15/05	Uranium	15.5 ± 0.3	16.1	10.9 - 21.3	Pass
STW-1077	11/15/05	H-3	12500.0 ± 238.0	12200.0	10100.0 - 14300.0	Pass

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by Environmental Resources Associates (ERA).

[b] Unless otherwise indicated, the laboratory result is given as the mean ± standard deviation for three determinations.

[c] Results are presented as the known values, expected laboratory precision (1 sigma, 1 determination) and control limits as provided by ERA.

[d] The original samples were calculated using an Am-241 efficiency. The samples were spiked with Th-232. Samples were recounted and calculated using the Th-232 efficiency. Results of the recount: 27.01 ± 2.35 pCi/L.

[e] Decay of short-lived radium daughters contributed to a higher counting rate. Delay of counting for 100 minutes provided better results. The reported result was the average of the first cycle of 100 minutes, the average of the second cycle counts was 4.01 pCi/L

TABLE A-2. Crosscheck program results; Thermoluminescent Dosimetry, (TLD, $CaSO_4$: Dy Cards).

Lab Code	Date	mR				
		Description	Known Value	Lab Result ± 2 sigma	Control Limits	Acceptance
Environmental, Inc.						
2005-1	4/4/2005	30 cm	55.01	64.02 ± 2.86	38.51 - 71.51	Pass
2005-1	4/4/2005	60 cm	13.75	15.43 ± 1.02	9.63 - 17.88	Pass
2005-1	4/4/2005	60 cm	13.75	14.98 ± 0.80	9.63 - 17.88	Pass
2005-1	4/4/2005	90 cm	6.11	6.24 ± 0.16	4.28 - 7.94	Pass
2005-1	4/4/2005	90 cm	6.11	5.45 ± 0.48	4.28 - 7.94	Pass
2005-1	4/4/2005	120 cm	3.44	3.50 ± 0.35	2.41 - 4.47	Pass
2005-1	4/4/2005	120 cm	3.44	3.15 ± 0.18	2.41 - 4.47	Pass
2005-1	4/4/2005	150 cm	2.2	2.31 ± 0.25	1.54 - 2.86	Pass
2005-1	4/4/2005	180 cm	1.53	1.65 ± 0.41	1.07 - 1.99	Pass
Environmental, Inc.						
2005-2	9/12/2005	30 cm	54.84	59.30 ± 2.66	38.39 - 71.29	Pass
2005-2	9/12/2005	60 cm	13.71	17.55 ± 1.30	9.60 - 17.82	Pass
2005-2	9/12/2005	75 cm	8.77	8.24 ± 0.38	6.14 - 11.40	Pass
2005-2	9/12/2005	90 cm	6.09	5.94 ± 0.49	4.26 - 7.92	Pass
2005-2	9/12/2005	90 cm	6.09	5.93 ± 0.37	4.26 - 7.92	Pass
2005-2	9/12/2005	120 cm	3.43	3.42 ± 0.18	2.40 - 4.46	Pass
2005-2	9/12/2005	150 cm	2.19	1.71 ± 0.14	1.53 - 2.85	Pass
2005-2	9/12/2005	150 cm	2.19	1.87 ± 0.27	1.53 - 2.85	Pass
2005-2	9/12/2005	180 cm	1.52	1.58 ± 0.99	1.06 - 1.98	Pass

TABLE A-3. In-House "Spike" Samples

Lab Code [b]	Date	Analysis	Concentration (pCi/L)[a] Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
W-11105	1/11/2005	Gr. Alpha	24.05 ± 1.01	20.08	10.04 - 30.12	Pass
W-11105	1/11/2005	Gr. Beta	61.59 ± 1.11	65.70	55.70 - 75.70	Pass
SPW-764	2/18/2005	H-3	77595.00 ± 764.00	80543.00	64434.40 - 96651.60	Pass
SPAP-766	2/18/2005	Gr. Beta	416.08 ± 5.52	463.00	370.40 - 509.30	Pass
STW-2887	2/28/2005	Tc-99	32.91 ± 1.23	32.98	20.98 - 44.98	Pass
W-30105	3/1/2005	Gr. Alpha	25.22 ± 0.45	20.08	10.04 - 30.12	Pass
W-30105	3/1/2005	Gr. Beta	62.27 ± 0.48	65.73	55.73 - 75.73	Pass
SPW-1836	4/15/2005	I-131	109.79 ± 0.94	106.30	85.04 - 127.56	Pass
SPW-1836	4/15/2005	I-131(G)	110.25 ± 9.68	106.30	95.67 - 116.93	Pass
SPMI-1838	4/15/2005	Cs-134	25.94 ± 1.28	26.60	16.60 - 36.60	Pass
SPMI-1838	4/15/2005	Cs-137	59.31 ± 3.66	60.90	50.90 - 70.90	Pass
SPMI-1838	4/15/2005	I-131	97.71 ± 0.81	106.30	85.04 - 127.56	Pass
SPMI-1838	4/15/2005	I-131(G)	109.45 ± 3.06	106.30	95.67 - 116.93	Pass
SPMI-1838	4/15/2005	Sr-89	104.44 ± 2.89	108.20	86.56 - 129.84	Pass
SPMI-1838	4/15/2005	Sr-90	8.97 ± 0.79	7.53	0.00 - 17.53	Pass
SPVE-1932	4/18/2005	I-131(G)	1.00 ± 0.04	0.73	0.44 - 1.02	Pass
SPCH-1935	4/18/2005	I-131	382.40 ± 14.95	328.64	262.91 - 394.37	Pass
SPAP-1966	4/18/2005	Cs-134	52.10 ± 7.27	53.35	43.35 - 63.35	Pass
SPAP-1966	4/18/2005	Cs-134	57.28 ± 13.47	53.35	43.35 - 63.35	Pass
SPAP-1966	4/18/2005	Cs-137	124.68 ± 18.41	121.77	109.59 - 133.95	Pass
SPAP-1968	4/18/2005	Cs-134	52.10 ± 7.27	53.35	43.35 - 63.35	Pass
SPAP-1968	4/18/2005	Cs-137	116.79 ± 14.00	121.77	109.59 - 133.95	Pass
SPW-2098	4/26/2005	Fe-55	2565.20 ± 63.66	3017.60	2414.08 - 3621.12	Pass
SPW-2922	5/31/2005	Cs-134	27.01 ± 1.09	25.54	15.54 - 35.54	Pass
SPW-2922	5/31/2005	Cs-134	65.38 ± 2.92	60.71	50.71 - 70.71	Pass
SPW-2922	5/31/2005	Sr-89	107.90 ± 3.60	113.90	91.12 - 136.68	Pass
SPW-2922	5/31/2005	Sr-90	11.11 ± 1.13	6.90	0.00 - 16.90	Pass
SPAP-2892	6/1/2005	Gr. Beta	420.32 ± 5.55	448.00	358.40 - 492.80	Pass
SPW-2895	6/1/2005	H-3	75271.00 ± 724.00	78676.00	62940.80 - 94411.20	Pass
w-60105	6/1/2005	Gr. Alpha	23.69 ± 0.52	20.08	10.04 - 30.12	Pass
w-60105	6/1/2005	Gr. Beta	60.08 ± 0.57	65.73	55.73 - 75.73	Pass
SPF-3089	6/7/2005	Cs-134	1.08 ± 0.05	1.02	0.61 - 1.43	Pass
SPF-3089	6/7/2005	Cs-137	2.54 ± 0.10	2.43	1.46 - 3.40	Pass
SPW-	7/1/2005	Ni-63	20.57 ± 1.10	16.75	10.05 - 23.45	Pass
SPW-47731	8/24/2005	C-14	2112.30 ± 9.13	2370.80	1422.48 - 3319.12	Pass
SPW-47732	8/24/2005	C-14	2294.10 ± 10.37	2370.80	1422.48 - 3319.12	Pass
SPW-4775	8/24/2005	Fe-55	2633.50 ± 62.40	2777.50	2222.00 - 3333.00	Pass
SPMI-4834	8/30/2005	Cs-134	49.27 ± 4.68	47.02	37.02 - 57.02	Pass
SPMI-4834	8/30/2005	Cs-137	58.17 ± 8.18	60.37	50.37 - 70.37	Pass
SPMI-4834	8/30/2005	Sr-89	66.39 ± 3.13	65.90	52.72 - 79.08	Pass
SPMI-4834	8/30/2005	Sr-90	11.15 ± 1.13	9.60	0.00 - 19.60	Pass

TABLE A-3. In-House "Spike" Samples

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory results 2s, n=1[b]	Known Activity	Control Limits[c]	Acceptance
SPW-4836	8/30/2005	Cs-134	47.35 ± 5.19	47.02	37.02 - 57.02	Pass
SPW-4836	8/30/2005	Cs-137	62.91 ± 9.08	60.37	50.37 - 70.37	Pass
SPW-4836	8/30/2005	Sr-89	11.04 ± 0.98	9.60	0.00 - 19.60	Pass
SPW-4836	8/30/2005	Sr-90	65.89 ± 2.79	65.90	52.72 - 79.08	Pass
SPW-5014	8/30/2005	H-3	77518.20 ± 753.80	77602.52	62082.02 - 93123.02	Pass
W-90705	9/7/2005	Gr. Alpha	24.61 ± 0.48	20.08	10.04 - 30.12	Pass
W-90705	9/7/2005	Gr. Beta	58.35 ± 0.49	65.73	55.73 - 75.73	Pass
SPW-5237	9/22/2005	C-14	2387.40 ± 11.00	2370.80	1422.48 - 3319.12	Pass
SPW-5508	9/26/2005	Ni-63	20.64 ± 1.23	16.70	10.02 - 23.38	Pass
SPW-6019	10/24/2005	Tc-99	547.99 ± 6.69	539.22	377.45 - 700.99	Pass
SPF-6293	11/4/2005	Cs-134	941.30 ± 44.10	886.00	797.40 - 974.60	Pass
SPF-6293	11/4/2005	Cs-137	2570.40 ± 105.30	2400.00	2160.00 - 2640.00	Pass
SPAP-6309	11/7/2005	Cs-134	41.24 ± 1.91	44.03	34.03 - 54.03	Pass
SPAP-6309	11/7/2005	Cs-137	114.03 ± 5.01	120.24	108.22 - 132.26	Pass
SPAP-6311	11/7/2005	Gr. Beta	1.58 ± 0.02	1.42	1.14 - 11.42	Pass
SPW-6451	11/10/2005	H-3	77126.00 ± 747.00	76749.00	61399.20 - 92098.80	Pass
W-120105	12/1/2005	Gr. Alpha	25.16 ± 0.45	20.08	10.04 - 30.12	Pass
W-120105	12/1/2005	Gr. Beta	74.58 ± 0.81	65.73	55.73 - 75.73	Pass
SPW-7440	12/30/2005	Cs-134	42.67 ± 4.22	42.03	32.03 - 52.03	Pass
SPW-7440	12/30/2005	Cs-137	61.19 ± 7.20	59.91	49.91 - 69.91	Pass
SPMI-7442	12/31/2005	Cs-134	40.41 ± 5.66	42.03	32.03 - 52.03	Pass
SPMI-7442	12/31/2005	Cs-137	60.05 ± 7.80	59.91	49.91 - 69.91	Pass

[a] Liquid sample results are reported in pCi/Liter, air filters(pCi/filter), charcoal (pCi/m^3), and solid samples (pCi/g).

[b] Laboratory codes as follows: W (water), MI (milk), AP (air filter), SO (soil), VE (vegetation), CH (charcoal canister), F (fish).

[c] Results are based on single determinations.

[d] Control limits are based on Attachment A, Page A2 of this report.

NOTE: For fish, Jello is used for the Spike matrix. For Vegetation, cabbage is used for the Spike matrix.

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis	Concentration (pCi/L)[a] Laboratory results (4.66σ) LLD	Activity[b]	Acceptance Criteria (4.66 σ)
W-11105	water	1/11/2005	Gr. Alpha	0.055	0.00 ± 0.038	1
W-11105	water	1/11/2005	Gr. Beta	0.15	-0.016 ± 0.10	3.2
SPW-765	water	2/18/2005	H-3	165.8	7.4 ± 82.5	200
SPAP-766	Air Filter	2/18/2005	Gr. Beta	0.72	0.29 ± 0.48	3.2
STW-2888	water	2/28/2005	Tc-99	1.32	0.45 ± 0.81	10
W-30105	water	3/1/2005	Gr. Alpha	0.067	-0.007 ± 0.043	1
W-30105	water	3/1/2005	Gr. Beta	0.18	-0.04 ± 0.11	3.2
SPW-1837	water	4/15/2005	Cs-134	4.66		10
SPW-1837	water	4/15/2005	Cs-137	5.38		10
SPW-1837	water	4/15/2005	I-131	0.30	-0.13 ± 0.16	0.5
SPW-1837	water	4/15/2005	I-131(G)	6.56		20
SPMI-1839	Milk	4/15/2005	I-131	0.26	-0.083 ± 0.14	0.5
SPMI-1839	Milk	4/15/2005	Sr-89	0.54	-0.069 ± 0.56	5
SPMI-1839	Milk	4/15/2005	Sr-90	0.53	0.88 ± 0.34	1
SPCH-1934	Charcoal	4/18/2005	I-131(G)	2.34		9.6
SPW-2097	water	4/26/2005	Fe-55	859.0	96.1 ± 528.4	1000
SPW-2923	water	5/31/2005	Cs-134	3.29		10
SPW-2923	water	5/31/2005	Cs-137	3.87		10
SPW-2896	water	6/1/2005	H-3	138.30	48.1 ± 85.9	200
w-60105	water	6/1/2005	Gr. Alpha	0.061	0.002 ± 0.043	1
w-60105	water	6/1/2005	Gr. Beta	0.16	0.056 ± 0.11	3.2
SPF-3090	Fish	6/7/2005	Cs-134	15.69		100
SPF-3090	Fish	6/7/2005	Cs-137	11.71		100
SPW-	water	7/1/2005	Ni-63	1.60	0.79 ± 0.99	20
SPW-4774	water	8/24/2005	C-14	12.18	2.84 ± 6.45	200
SPW-4776	water	8/24/2005	Fe-55	833	275 ± 525	1000
SPMI-4835	Milk	8/30/2005	Co-60	4.42		10
SPMI-4835	Milk	8/30/2005	Cs-134	4.18		10
SPMI-4835	Milk	8/30/2005	Cs-137	6.25		10
SPMI-4835	Milk	8/30/2005	I-131(G)	5.37		20
SPMI-4835	Milk	8/30/2005	Sr-89	0.66	-0.23 ± 0.65	5
SPMI-4835 [d]	Milk	8/30/2005	Sr-90	0.66	1.02 ± 0.41	1
SPW-4837	water	8/30/2005	Co-60	2.48		10
SPW-4837	water	8/30/2005	Cs-134	3.85		10
SPW-4837	water	8/30/2005	Cs-137	3.00		10
SPW-4837	water	8/30/2005	Sr-89	0.63	0.25 ± 0.53	5
SPW-4837	water	8/30/2005	Sr-90	0.63	-0.035 ± 0.29	1
SPW-5015	water	8/30/2005	H-3	142.8	168 ± 93	200
SPW-5238	water	9/22/2005	C-14	17.10	3.02 ± 9.04	200

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis	Concentration (pCi/L)[a] Laboratory results (4.66σ) LLD	Activity[b]	Acceptance Criteria (4.66 σ)
W-90705	water	9/7/2005	Gr. Alpha	0.056	0.034 ± 0.04	1
W-90705	water	9/7/2005	Gr. Beta	0.16	0.082 ± 0.11	3.2
SPW-5238	water	9/22/2005	C-14	17.10	3.02 ± 9.04	200
SPW-5509	water	9/26/2005	Ni-63	1.25	1.23 ± 0.79	20
SPW-6020	water	10/24/2005	Tc-99	4.81	-1.75 ± 2.90	10
SPF-6294	Fish	11/4/2005	Cs-134	18.60		100
SPF-6294	Fish	11/4/2005	Cs-137	12.99		100
SPAP-6310	Air Filter	11/7/2005	Cs-134	3.23		100
SPAP-6310	Air Filter	11/7/2005	Cs-137	3.86		100
SPAP-6312	Air Filter	11/7/2005	Gr. Beta	1.22	-0.64 ± 0.64	3.2
W-120105	water	12/1/2005	Gr. Alpha	0.05	0.033 ± 0.04	1
W-120105	water	12/1/2005	Gr. Beta	0.15	-0.043 ± 0.11	3.2
SPMI-7419	Milk	12/22/2005	Co-60	7.24		10
SPMI-7419	Milk	12/22/2005	Cs-137	5.61		10
SPMI-7419	Milk	12/22/2005	I-131(G)	10.96		20
SPW-7421	water	12/22/2005	Co-60	2.43		10
SPW-7421	water	12/22/2005	Cs-137	3.12		10
SPW-7441	water	12/30/2005	Cs-134	4.25		10
SPW-7441	water	12/30/2005	Cs-137	1.63		10
SPMI-7443	Milk	12/30/2005	Cs-134	4.74		10
SPMI-7443	Milk	12/30/2005	Cs-137	8.53		10

[a] Liquid sample results are reported in pCi/Liter, air filters(pCi/filter), charcoal (pCi/charcoal canister), and solid samples (pCi/g).

[b] Activity reported is a net activity result. For gamma spectroscopic analysis, activity detected below the LLD value is not reported

[c] I-131(G); iodine-131 as analyzed by gamma spectroscopy.

[d] Low levels of Sr-90 are still detected in the environment. A concentration of (1-5 pCi/L) in milk is not unusual.

TABLE A-5. In-House "Duplicate" Samples

			Concentration (pCi/L)[a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
SW-62, 63	1/3/2005	Gr. Beta	3.01 ± 0.57	2.39 ± 0.58	2.70 ± 0.41	Pass
SW-62, 63	1/3/2005	K-40	2.00 ± 0.20	2.10 ± 0.20	2.05 ± 0.14	Pass
CF-95, 96	1/3/2005	Gr. Beta	6.26 ± 0.23	6.28 ± 0.23	6.27 ± 0.16	Pass
CF-95, 96	1/3/2005	K-40	5.68 ± 0.59	5.37 ± 0.48	5.53 ± 0.38	Pass
AP-791, 792	1/14/2005	Be-7	0.057 ± 0.017	0.07 ± 0.04	0.06 ± 0.02	Pass
WW-353, 354	1/19/2005	Gr. Beta	8.37 ± 1.21	10.28 ± 1.34	9.32 ± 0.90	Pass
SO-383, 384	1/19/2005	H-3	453.50 ± 107.20	417.90 ± 106.00	435.70 ± 75.38	Pass
LW-431, 432	1/27/2005	Gr. Beta	2.45 ± 0.54	2.20 ± 0.54	2.33 ± 0.38	Pass
MI-486, 487	2/1/2005	K-40	1319.40 ± 163.60	1177.20 ± 179.70	1248.30 ± 121.51	Pass
SW-511, 512	2/1/2005	I-131	0.37 ± 0.22	0.44 ± 0.23	0.40 ± 0.16	Pass
TD-628, 629	2/1/2005	H-3	489663 ± 1918	491225 ± 1915	490444 ± 1355	Pass
DW-538, 539	2/3/2005	Gr. Beta	3.93 ± 1.18	3.62 ± 1.10	3.78 ± 0.81	Pass
MI-564, 565	2/8/2005	K-40	1316.20 ± 171.10	1292.60 ± 154.40	1304.40 ± 115.23	Pass
DW-50134, 5	2/11/2005	Gr. Beta	18.41 ± 0.98	16.76 ± 0.98	17.59 ± 0.69	Pass
SWU-893, 894	2/22/2005	Gr. Beta	4.00 ± 0.96	4.20 ± 0.72	4.10 ± 0.60	Pass
SW-925, 926	2/25/2005	Gr. Beta	5.97 ± 1.51	6.14 ± 1.55	6.06 ± 1.08	Pass
SW-950, 951	3/1/2005	Gr. Beta	0.92 ± 0.27	1.21 ± 0.27	1.07 ± 0.19	Pass
SW-950, 951	3/1/2005	Gr. Beta	2.06 ± 0.40	2.29 ± 0.44	2.18 ± 0.30	Pass
SW-973, 974	3/1/2005	I-131	1.08 ± 0.19	0.92 ± 0.18	1.00 ± 0.13	Pass
DW-50248, 9	3/16/2005	Gr. Alpha	5.27 ± 1.06	4.17 ± 0.90	4.72 ± 0.70	Pass
DW-1264, 1265	3/19/2005	I-131	0.54 ± 0.21	0.73 ± 0.20	0.63 ± 0.15	Pass
AP-1955, 1956	3/28/2005	Be-7	0.071 ± 0.009	0.071 ± 0.009	0.071 ± 0.006	Pass
AP-1890, 1891	3/29/2005	Be-7	0.060 ± 0.013	0.069 ± 0.013	0.065 ± 0.009	Pass
AP-2025, 2026	3/29/2005	Be-7	0.063 ± 0.012	0.071 ± 0.011	0.067 ± 0.008	Pass
MI-1346, 1347	3/30/2005	K-40	1252.80 ± 120.50	1334.10 ± 106.60	1293.45 ± 80.44	Pass
AP-2048, 2049	3/30/2005	Be-7	0.075 ± 0.018	0.071 ± 0.015	0.073 ± 0.012	Pass
AP-2081, 2082	3/30/2005	Be-7	0.073 ± 0.016	0.061 ± 0.018	0.067 ± 0.012	Pass
SWU-1521, 1522	3/31/2005	Gr. Beta	2.83 ± 1.16	3.46 ± 1.23	3.14 ± 0.85	Pass
WW-1738, 1739	4/5/2005	Gr. Beta	11.44 ± 1.17	11.14 ± 1.62	11.29 ± 1.00	Pass
SW-1857, 1858	4/13/2005	Gr. Beta	7.04 ± 1.71	9.96 ± 1.65	8.50 ± 1.19	Pass
LW-1911, 1912	4/14/2005	Gr. Beta	2.50 ± 0.63	3.23 ± 0.67	2.86 ± 0.46	Pass
F-1976, 1977	4/18/2005	K-40	3.09 ± 0.60	3.33 ± 0.40	3.21 ± 0.36	Pass
MI-2111, 2112	4/26/2005	K-40	1291.50 ± 177.90	1323.70 ± 108.80	1307.60 ± 104.27	Pass
SWU-2158, 2159	4/26/2005	Gr. Beta	3.69 ± 0.74	3.54 ± 0.66	3.62 ± 0.50	Pass
DW-2349, 2350	4/29/2005	I-131	0.58 ± 0.27	0.49 ± 0.27	0.53 ± 0.19	Pass
SO-2305, 2306	5/2/2005	Cs-137	0.11 ± 0.05	0.11 ± 0.04	0.11 ± 0.03	Pass
SO-2305, 2306	5/2/2005	Gr. Alpha	7.55 ± 2.88	12.41 ± 3.38	9.98 ± 2.22	Pass
SO-2305, 2306	5/2/2005	Gr. Beta	28.74 ± 2.57	28.17 ± 2.52	28.46 ± 1.80	Pass
SO-2305, 2306	5/2/2005	K-40	21.51 ± 1.22	21.42 ± 1.24	21.47 ± 0.87	Pass
SO-2305, 2306	5/2/2005	Sr-90	32.90 ± 9.90	29.60 ± 13.90	31.25 ± 8.53	Pass
MI-2260, 2261	5/3/2005	K-40	1028.10 ± 99.36	1206.70 ± 118.50	1117.40 ± 77.32	Pass
F-2630, 2631	5/5/2005	K-40	3.08 ± 0.46	3.04 ± 0.51	3.06 ± 0.34	Pass
VE-2502, 2503	5/10/2005	Gr. Alpha	0.06 ± 0.03	0.07 ± 0.04	0.07 ± 0.03	Pass

TABLE A-5. In-House "Duplicate" Samples

			Concentration (pCi/L)[a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
VE-2502, 2503	5/10/2005	Gr. Beta	3.81 ± 0.10	3.86 ± 0.10	3.83 ± 0.07	Pass
VE-2502, 2503	5/10/2005	K-40	3.79 ± 0.40	4.30 ± 0.59	4.04 ± 0.36	Pass
G-2546, 2547	5/11/2005	Be-7	0.81 ± 0.39	1.25 ± 0.38	1.03 ± 0.27	Pass
G-2546, 2547	5/11/2005	K-40	9.43 ± 1.00	7.96 ± 0.85	8.70 ± 0.66	Pass
SS-2787, 2788	5/18/2005	Cs-137	0.13 ± 0.04	0.14 ± 0.05	0.13 ± 0.03	Pass
SS-2787, 2788	5/18/2005	K-40	12.44 ± 0.76	13.33 ± 0.83	12.88 ± 0.56	Pass
SO-3056, 3057	5/19/2005	Cs-137	0.18 ± 0.04	0.17 ± 0.01	0.18 ± 0.02	Pass
SO-3056, 3057 [b]	5/19/2005	K-40	20.06 ± 1.10	21.73 ± 0.36	20.90 ± 0.58	Fail
SS-3175, 3176	5/23/2005	K-40	6.06 ± 0.44	5.96 ± 0.61	6.01 ± 0.38	Pass
SO-2865, 2866	5/25/2005	Cs-137	0.18 ± 0.04	0.18 ± 0.03	0.18 ± 0.02	Pass
SO-2865, 2866	5/25/2005	Gr. Beta	32.95 ± 2.48	33.88 ± 2.36	33.41 ± 1.71	Pass
SO-2865, 2866	5/25/2005	K-40	21.93 ± 0.97	22.32 ± 0.98	22.13 ± 0.69	Pass
DW-2935, 2936	5/27/2005	I-131	0.51 ± 0.34	0.56 ± 0.30	0.53 ± 0.23	Pass
SWU-3103, 3104	6/1/2005	Gr. Beta	3.29 ± 0.49	3.75 ± 0.66	3.52 ± 0.41	Pass
G-2958, 2959	6/1/2005	Be-7	1.06 ± 0.40	1.21 ± 0.28	1.14 ± 0.24	Pass
G-2958, 2959 [b]	6/1/2005	Gr. Beta	8.06 ± 0.07	7.79 ± 0.07	7.93 ± 0.05	Fail
G-2958, 2959	6/1/2005	K-40	5.93 ± 0.73	6.05 ± 0.28	5.99 ± 0.39	Pass
BS-4089, 4090	6/3/2005	Co-60	0.11 ± 0.02	0.10 ± 0.02	0.11 ± 0.02	Pass
BS-4089, 4090	6/3/2005	Cs-137	0.60 ± 0.05	0.62 ± 0.05	0.61 ± 0.04	Pass
DW-50527, 8	6/8/2005	Gr. Alpha	11.58 ± 1.31	13.52 ± 1.43	12.55 ± 0.97	Pass
VE-3278, 3279	6/13/2005	K-40	6.34 ± 0.59	7.29 ± 0.68	6.81 ± 0.45	Pass
MI-3299, 3300	6/15/2005	K-40	1215.40 ± 110.20	1250.70 ± 106.70	1233.05 ± 76.70	Pass
BS-3348, 3349	6/17/2005	Co-60	0.20 ± 0.04	0.22 ± 0.04	0.21 ± 0.03	Pass
BS-3348, 3349	6/17/2005	Cs-137	2.59 ± 0.10	2.51 ± 0.07	2.55 ± 0.06	Pass
BS-3348, 3349	6/17/2005	K-40	11.57 ± 0.81	11.82 ± 0.76	11.69 ± 0.56	Pass
DW-3486, 3487	6/28/2005	Gr. Beta	0.97 ± 0.54	1.67 ± 0.58	1.32 ± 0.40	Pass
SWT-3631, 3632	6/28/2005	Gr. Beta	2.12 ± 0.53	1.62 ± 0.56	1.87 ± 0.39	Pass
W-3507, 3508	6/29/2005	H-3	38717 ± 382	38017 ± 535	38367 ± 329	Pass
VE-3555, 3556	6/29/2005	Gr. Beta	7.53 ± 0.18	7.56 ± 0.18	7.55 ± 0.13	Pass
VE-3555, 3556	6/29/2005	K-40	5.70 ± 0.52	5.64 ± 0.53	5.67 ± 0.37	Pass
AP-3781, 3782	6/29/2005	Be-7	0.09 ± 0.02	0.08 ± 0.02	0.09 ± 0.01	Pass
LW-3610, 3611	6/30/2005	Gr. Beta	1.37 ± 0.35	1.40 ± 0.36	1.39 ± 0.25	Pass
SW-3760, 3761	6/30/2005	Gr. Beta	9.70 ± 1.63	9.77 ± 1.61	9.73 ± 1.15	Pass
E-3654, 3655	7/5/2005	Gr. Beta	1.76 ± 0.07	1.69 ± 0.07	1.72 ± 0.05	Pass
E-3654, 3655	7/5/2005	K-40	1.49 ± 0.25	1.05 ± 0.21	1.27 ± 0.16	Pass
MI-3676, 3677	7/5/2005	K-40	1383.90 ± 116.20	1428.20 ± 125.40	1406.05 ± 85.48	Pass
DW-3739, 3740	7/5/2005	I-131	1.93 ± 0.24	2.18 ± 0.23	2.05 ± 0.17	Pass
W-3808, 3809	7/6/2005	H-3	4189.61 ± 196.68	4438.33 ± 201.39	4313.97 ± 140.75	Pass
DW-3938, 3939	7/8/2005	I-131	1.11 ± 0.30	1.26 ± 0.31	1.18 ± 0.22	Pass
VE-3896, 3897	7/12/2005	K-40	3.44 ± 0.62	3.60 ± 0.36	3.52 ± 0.36	Pass
MI-3963, 3964	7/13/2005	K-40	1438.70 ± 102.80	1351.80 ± 100.80	1395.25 ± 71.99	Pass
DW-4068, 4069	7/15/2005	I-131	0.64 ± 0.27	0.91 ± 0.28	0.78 ± 0.20	Pass

TABLE A-5. In-House "Duplicate" Samples

			Concentration (pCi/L)[a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
VE-4290, 4291	7/26/2005	Gr. Alpha	0.11 ± 0.04	0.05 ± 0.03	0.08 ± 0.03	Pass
VE-4290, 4291	7/26/2005	Gr. Beta	4.55 ± 0.13	4.69 ± 0.14	4.62 ± 0.09	Pass
SWU-4311, 4312	7/26/2005	Gr. Beta	2.62 ± 0.64	1.67 ± 0.37	2.15 ± 0.37	Pass
SWU-4311, 4312	7/26/2005	H-3	192.30 ± 92.90	304.60 ± 97.40	248.45 ± 67.30	Pass
G-4383, 4384	8/1/2005	Be-7	2.06 ± 0.49	1.76 ± 0.29	1.91 ± 0.28	Pass
G-4383, 4384	8/1/2005	Gr. Beta	8.76 ± 0.22	8.40 ± 0.20	8.58 ± 0.15	Pass
G-4383, 4384	8/1/2005	K-40	6.74 ± 0.64	6.88 ± 0.92	6.81 ± 0.56	Pass
MI-4425, 4426	8/1/2005	K-40	1358.10 ± 169.20	1267.90 ± 164.40	1313.00 ± 117.96	Pass
TD-4446, 4447	8/1/2005	H-3	563.00 ± 252.00	529.00 ± 251.00	546.00 ± 177.84	Pass
SL-4473, 4474	8/4/2005	Gr. Beta	5.44 ± 0.48	4.57 ± 0.42	5.00 ± 0.32	Pass
SL-4473, 4474	8/4/2005	K-40	2.91 ± 0.83	2.74 ± 0.54	2.82 ± 0.49	Pass
VE-4532, 4533	8/5/2005	Gr. Beta	31.20 ± 1.20	31.70 ± 1.20	31.45 ± 0.85	Pass
VE-4618, 4619	8/9/2005	Gr. Alpha	0.09 ± 0.05	0.09 ± 0.04	0.09 ± 0.03	Pass
VE-4618, 4619	8/9/2005	Gr. Beta	4.60 ± 0.13	4.54 ± 0.12	4.57 ± 0.09	Pass
VE-4618, 4619	8/9/2005	K-40	4.19 ± 0.46	4.34 ± 0.47	4.27 ± 0.33	Pass
F-4639, 4640	8/11/2005	Cs-137	0.05 ± 0.02	0.05 ± 0.02	0.05 ± 0.02	Pass
F-4639, 4640	8/11/2005	Gr. Beta	3.33 ± 0.11	3.37 ± 0.10	3.35 ± 0.07	Pass
F-4639, 4640	8/11/2005	K-40	2.62 ± 0.57	2.58 ± 0.59	2.60 ± 0.41	Pass
DW-4730, 4731	8/12/2005	I-131	0.82 ± 0.23	0.83 ± 0.25	0.83 ± 0.17	Pass
MI-4855, 4856	8/28/2005	K-40	1341.50 ± 107.70	1340.00 ± 114.70	1340.75 ± 78.67	Pass
MI-4855, 4856	8/28/2005	Sr-90	0.77 ± 0.37	0.87 ± 0.37	0.82 ± 0.26	Pass
MI-4945, 4946	8/31/2005	K-40	1388.90 ± 158.90	1307.50 ± 165.20	1348.20 ± 114.61	Pass
MI-4945, 4946	8/31/2005	Sr-90	0.67 ± 0.34	0.82 ± 0.36	0.75 ± 0.25	Pass
TD-4921, 4922	9/1/2005	H-3	5737.00 ± 266.00	5860.00 ± 269.00	5798.50 ± 189.15	Pass
VE-4900, 4901	9/2/2005	Gr. Beta	3.40 ± 0.06	3.51 ± 0.06	3.45 ± 0.04	Pass
VE-4900, 4901	9/2/2005	K-40	2.15 ± 0.27	2.27 ± 0.24	2.21 ± 0.18	Pass
DW-50769, 50770	9/2/2005	Gr. Alpha	6.17 ± 1.42	6.08 ± 1.46	6.13 ± 1.02	Pass
VE-4990, 4991	9/6/2005	K-40	18.81 ± 1.12	19.52 ± 0.86	19.17 ± 0.71	Pass
MI-5011, 5012	9/8/2005	K-40	1584.00 ± 194.00	1707.60 ± 173.00	1645.80 ± 129.97	Pass
VE-5119, 5120	9/12/2005	Gr. Alpha	0.10 ± 0.06	0.09 ± 0.05	0.10 ± 0.04	Pass
VE-5119, 5120	9/12/2005	Gr. Beta	6.05 ± 0.18	5.92 ± 0.17	5.98 ± 0.12	Pass
VE-5119, 5120	9/12/2005	K-40	4.61 ± 0.46	4.74 ± 0.69	4.68 ± 0.41	Pass
LW-5361, 5362	9/12/2005	Gr. Beta	1.09 ± 0.33	1.18 ± 0.34	1.13 ± 0.24	Pass
SW-5098, 5099	9/13/2005	I-131	0.44 ± 0.22	0.31 ± 0.20	0.38 ± 0.15	Pass
LW-5178, 5179	9/14/2005	Gr. Beta	2.92 ± 0.56	2.95 ± 0.59	2.93 ± 0.41	Pass
DW-5239, 5240	9/16/2005	I-131	0.45 ± 0.27	0.55 ± 0.29	0.50 ± 0.20	Pass
CF-5432, 5433	9/19/2005	Be-7	0.91 ± 0.40	0.64 ± 0.30	0.78 ± 0.25	Pass
CF-5432, 5433	9/19/2005	K-40	1.43 ± 0.34	1.38 ± 0.43	1.41 ± 0.27	Pass
MI-5292, 5293	9/21/2005	K-40	1228.80 ± 78.13	1297.00 ± 81.03	1262.90 ± 56.28	Pass
BS-5340, 5341	9/23/2005	Be-7	1286.10 ± 550.80	1222.90 ± 394.40	1254.50 ± 338.72	Pass
BS-5340, 5341	9/23/2005	Cs-137	726.97 ± 76.24	677.49 ± 70.03	702.23 ± 51.76	Pass

TABLE A-5. In-House "Duplicate" Samples

			Concentration (pCi/L)[a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
BS-5340, 5341	9/23/2005	K-40	12404 ± 1154	13033 ± 983	12719 ± 758	Pass
DW-5382, 5383	9/23/2005	I-131	0.79 ± 0.31	0.53 ± 0.31	0.66 ± 0.22	Pass
MI-5405, 5406	9/27/2005	K-40	1324.80 ± 112.20	1366.80 ± 99.44	1345.80 ± 74.96	Pass
AP-5769, 5770	9/27/2005	Be-7	0.08 ± 0.01	0.09 ± 0.02	0.08 ± 0.01	Pass
AP-5983, 5984	9/27/2005	Be-7	0.08 ± 0.01	0.08 ± 0.01	0.08 ± 0.01	Pass
AP-5878, 5879	9/29/2005	Be-7	0.06 ± 0.01	0.07 ± 0.01	0.07 ± 0.01	Pass
G-5526, 5527	10/3/2005	Be-7	4.03 ± 0.62	4.07 ± 0.80	4.05 ± 0.51	Pass
G-5526, 5527	10/3/2005	Gr. Beta	8.10 ± 0.30	8.80 ± 0.40	8.41 ± 0.24	Pass
G-5526, 5527	10/3/2005	K-40	4.93 ± 0.67	6.00 ± 0.72	5.47 ± 0.49	Pass
VE-5721, 5722	10/10/2005	Gr. Alpha	0.07 ± 0.05	0.08 ± 0.06	0.08 ± 0.04	Pass
VE-5721, 5722	10/10/2005	Gr. Beta	5.09 ± 0.15	5.00 ± 0.16	5.05 ± 0.11	Pass
VE-5721, 5722	10/10/2005	K-40	4.27 ± 0.43	4.20 ± 0.34	4.23 ± 0.27	Pass
CF-5695, 5696	10/11/2005	Be-7	2.70 ± 0.37	2.80 ± 0.34	2.75 ± 0.25	Pass
CF-5695, 5696	10/11/2005	K-40	11.79 ± 0.86	13.11 ± 0.68	12.45 ± 0.55	Pass
LW-6129, 6130	10/11/2005	Gr. Beta	1.34 ± 0.25	1.85 ± 0.29	1.59 ± 0.19	Pass
LW-6129, 6130	10/11/2005	H-3	304.35 ± 95.31	369.23 ± 97.88	336.79 ± 68.31	Pass
DW-50844, 5	10/11/2005	Gr. Beta	5.30 ± 1.50	4.20 ± 1.40	4.75 ± 1.03	Pass
LW-5748, 5749 [c]	10/12/2005	Gr. Beta	1.09 ± 0.25	1.89 ± 0.28	1.49 ± 0.19	Fail
AP-6485, 6486	10/20/2005	Be-7	0.10 ± 0.03	0.09 ± 0.03	0.09 ± 0.02	Pass
SWU-6156, 6157	10/25/2005	Gr. Beta	4.69 ± 1.34	4.18 ± 1.34	4.44 ± 0.95	Pass
VE-6186, 6187	10/26/2005	K-40	2.90 ± 0.49	2.83 ± 0.51	2.87 ± 0.35	Pass
LW-6203, 6204	10/27/2005	Gr. Beta	2.92 ± 0.62	3.09 ± 0.66	3.01 ± 0.45	Pass
SO-6270, 6271	10/28/2005	Cs-137	0.33 ± 0.03	0.34 ± 0.04	0.33 ± 0.03	Pass
SO-6270, 6271	10/28/2005	Gr. Beta	26.85 ± 2.78	22.25 ± 2.41	24.55 ± 1.84	Pass
SO-6270, 6271	10/28/2005	K-40	13.67 ± 0.74	14.02 ± 0.76	13.85 ± 0.53	Pass
TD-6320, 6321	11/1/2005	H-3	444202 ± 1770	446633 ± 1775	445418 ± 1253	Pass
SO-6605, 6606	11/11/2005	Gr. Beta	18.22 ± 2.23	18.47 ± 2.22	18.35 ± 1.57	Pass
CF-6509, 6510	11/14/2005	K-40	0.85 ± 0.14	0.99 ± 0.22	0.92 ± 0.13	Pass
SW-6638, 6639	11/22/2005	I-131	0.95 ± 0.35	0.67 ± 0.31	0.81 ± 0.23	Pass
SO-6887, 6888	11/22/2005	Gr. Alpha	6.80 ± 2.92	10.27 ± 3.26	8.53 ± 2.19	Pass
SO-6887, 6888	11/22/2005	Gr. Beta	19.27 ± 2.16	18.43 ± 2.21	18.85 ± 1.54	Pass
SO-6887, 6888	11/22/2005	K-40	14.29 ± 1.11	13.78 ± 0.78	14.03 ± 0.68	Pass
SWT-6721, 6722	11/29/2005	Gr. Beta	0.98 ± 0.31	0.87 ± 0.31	0.93 ± 0.22	Pass
VE-6775, 6776	11/29/2005	Gr. Beta	12.75 ± 0.28	13.16 ± 0.21	12.96 ± 0.18	Pass
LW-6743, 6744	11/30/2005	Gr. Beta	3.19 ± 0.47	2.50 ± 0.44	2.85 ± 0.32	Pass
DW-51023, 4	12/2/2005	Gr. Alpha	0.55 ± 1.40	2.21 ± 1.31	1.38 ± 0.96	Pass
SWT-7282, 7283	12/27/2005	Gr. Beta	1.62 ± 0.37	1.85 ± 0.38	1.74 ± 0.27	Pass

Note: Duplicate analyses are performed on every twentieth sample received in-house. Results are not listed for those analyses with activities that measure below the LLD.

[a] Results are reported in units of pCi/L, except for air filters (pCi/Filter), food products, vegetation, soil, sediment (pCi/g).

[b] 600 minute count time or longer, resulting in lower error.

[c] Recount of W-5748, 2.38 ± 0.85 pCi/L Averaged result; 2.14 ± 0.45 pCi/L

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP)[a].

			Concentration [b]			
Lab Code[c]	Date	Analysis	Laboratory result	Known Activity	Control Limits [d]	Acceptance
STW-1045	01/01/05	Gr. Alpha	0.45 ± 0.10	0.53	0.00 - 1.05	Pass
STW-1045	01/01/05	Gr. Beta	1.90 ± 0.10	1.67	0.84 - 2.51	Pass
STW-1046	01/01/05	Am-241	1.62 ± 0.12	1.72	1.20 - 2.24	Pass
STW-1046	01/01/05	Co-57	239.40 ± 1.20	227.00	158.90 - 295.10	Pass
STW-1046	01/01/05	Co-60	248.70 ± 1.00	251.00	175.70 - 326.30	Pass
STW-1046	01/01/05	Cs-134	115.50 ± 1.80	127.00	88.90 - 165.10	Pass
STW-1046	01/01/05	Cs-137	328.50 ± 1.70	332.00	232.40 - 431.60	Pass
STW-1046	01/01/05	Fe-55	64.90 ± 7.00	75.90	53.13 - 98.67	Pass
STW-1046	01/01/05	H-3	304.00 ± 9.70	280.00	196.00 - 364.00	Pass
STW-1046	01/01/05	Mn-54	334.80 ± 1.90	331.00	231.70 - 430.30	Pass
STW-1046	01/01/05	Ni-63	7.10 ± 1.60	9.00	0.00 - 20.00	Pass
STW-1046	01/01/05	Pu-238	0.01 ± 0.02	0.02	0.00 - 1.00	Pass
STW-1046	01/01/05	Pu-239/40	2.50 ± 0.14	2.40	1.68 - 3.12	Pass
STW-1046	01/01/05	Sr-90	0.70 ± 0.80	0.00	0.00 - 5.00	Pass
STW-1046	01/01/05	Tc-99	43.20 ± 1.40	42.90	30.03 - 55.77	Pass
STW-1046	01/01/05	U-233/4	3.31 ± 0.20	3.24	2.27 - 4.21	Pass
STW-1046	01/01/05	U-238	3.38 ± 0.20	3.33	2.33 - 4.33	Pass
STW-1046	01/01/05	Zn-65	538.40 ± 3.80	496.00	347.20 - 644.80	Pass
STVE-1047	01/01/05	Co-57	10.60 ± 0.20	9.88	6.92 - 12.84	Pass
STVE-1047	01/01/05	Co-60	3.00 ± 0.20	3.15	2.21 - 4.10	Pass
STVE-1047	01/01/05	Cs-134	4.80 ± 0.40	5.00	3.50 - 6.50	Pass
STVE-1047	01/01/05	Cs-137	4.10 ± 0.30	4.11	2.88 - 5.34	Pass
STVE-1047	01/01/05	Mn-54	5.10 ± 0.30	5.18	3.63 - 6.73	Pass
STVE-1047	01/01/05	Zn-65	6.20 ± 0.50	6.29	4.40 - 8.18	Pass
STSO-1048	01/01/05	Am-241	96.60 ± 10.00	109.00	76.30 - 141.70	Pass
STSO-1048	01/01/05	Co-57	264.00 ± 2.00	242.00	169.40 - 314.60	Pass
STSO-1048	01/01/05	Co-60	226.50 ± 2.20	212.00	148.40 - 275.60	Pass
STSO-1048	01/01/05	Cs-134	760.60 ± 3.70	759.00	531.30 - 986.70	Pass
STSO-1048	01/01/05	Cs-137	336.20 ± 3.60	315.00	220.50 - 409.50	Pass
STSO-1048	01/01/05	K-40	663.70 ± 18.00	604.00	422.80 - 785.20	Pass
STSO-1048	01/01/05	Mn-54	541.30 ± 3.90	485.00	339.50 - 630.50	Pass
STSO-1048	01/01/05	Ni-63	924.30 ± 17.20	1220.00	854.00 - 1586.00	Pass
STSO-1048	01/01/05	Pu-238	0.60 ± 0.80	0.48	0.00 - 1.00	Pass
STSO-1048	01/01/05	Pu-239/40	78.00 ± 4.80	89.50	62.65 - 116.35	Pass
STSO-1048	01/01/05	Sr-90	514.60 ± 18.70	640.00	448.00 - 832.00	Pass
STSO-1048	01/01/05	U-233/4	47.90 ± 4.00	62.50	43.75 - 81.25	Pass
STSO-1048	01/01/05	U-238	226.30 ± 8.60	249.00	174.30 - 323.70	Pass
STSO-1048	01/01/05	Zn-65	851.30 ± 7.30	810.00	567.00 - 1053.00	Pass
STAP-1050	01/01/05	Gr. Alpha	0.11 ± 0.03	0.23	0.00 - 0.46	Pass
STAP-1050	01/01/05	Gr. Beta	0.38 ± 0.05	0.30	0.15 - 0.45	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP)[a].

			Concentration [b]			
Lab Code[c]	Date	Analysis	Laboratory result	Known Activity	Control Limits [d]	Acceptance
STAP-1049	01/01/05	Am-241	0.10 ± 0.04	0.10	0.07 - 0.13	Pass
STAP-1049	01/01/05	Co-57	4.76 ± 0.64	4.92	3.44 - 6.40	Pass
STAP-1049	01/01/05	Co-60	2.84 ± 0.22	3.03	2.12 - 3.94	Pass
STAP-1049	01/01/05	Cs-134	3.54 ± 0.37	3.51	2.46 - 4.56	Pass
STAP-1049	01/01/05	Cs-137	2.20 ± 0.27	2.26	1.58 - 2.94	Pass
STAP-1049	01/01/05	Mn-54	3.15 ± 0.21	3.33	2.33 - 4.33	Pass
STAP-1049	01/01/05	Pu-238	0.16 ± 0.04	0.20	0.14 - 0.25	Pass
STAP-1049	01/01/05	Pu-239/40	0.17 ± 0.02	0.17	0.14 - 0.25	Pass
STAP-1049 [e]	01/01/05	Sr-90	2.24 ± 0.34	1.35	0.95 - 1.76	Fail
STAP-1049	01/01/05	U-233/4	0.34 ± 0.02	0.34	0.24 - 0.44	Pass
STAP-1049	01/01/05	U-238	0.35 ± 0.02	0.35	0.25 - 0.46	Pass
STAP-1049	01/01/05	Zn-65	3.12 ± 0.15	3.14	2.20 - 4.08	Pass
STW-1061	07/01/05	Am-241	2.21 ± 0.13	2.23	1.56 - 2.90	Pass
STW-1061	07/01/05	Co-57	293.20 ± 7.30	272.00	190.40 - 353.60	Pass
STW-1061	07/01/05	Co-60	275.70 ± 1.30	261.00	182.70 - 339.30	Pass
STW-1061	07/01/05	Cs-134	171.80 ± 4.00	167.00	116.90 - 217.10	Pass
STW-1061	07/01/05	Cs-137	342.10 ± 2.20	333.00	233.10 - 432.90	Pass
STW-1061	07/01/05	Fe-55	167.80 ± 9.30	196.00	137.20 - 254.80	Pass
STW-1061	07/01/05	H-3	514.20 ± 12.60	527.00	368.90 - 685.10	Pass
STW-1061	07/01/05	Mn-54	437.00 ± 2.50	418.00	292.60 - 543.40	Pass
STW-1061	07/01/05	Ni-63	105.10 ± 3.60	100.00	70.00 - 130.00	Pass
STW-1061	07/01/05	Pu-238	1.64 ± 0.12	1.91	1.34 - 2.48	Pass
STW-1061	07/01/05	Pu-239/40	2.32 ± 0.13	2.75	1.93 - 3.58	Pass
STW-1061	07/01/05	Sr-90	9.20 ± 1.30	8.98	6.29 - 11.67	Pass
STW-1061	07/01/05	Tc-99	72.30 ± 2.30	66.50	46.55 - 86.45	Pass
STW-1061	07/01/05	U-233/4	4.11 ± 0.18	4.10	2.87 - 5.33	Pass
STW-1061	07/01/05	U-238	4.14 ± 0.18	4.26	2.98 - 5.54	Pass
STW-1061	07/01/05	Zn-65	364.60 ± 4.90	330.00	231.00 - 429.00	Pass
STW-1062	07/01/05	Gr. Alpha	0.57 ± 0.05	0.79	0.21 - 1.38	Pass
STW-1062	07/01/05	Gr. Beta	1.36 ± 0.05	1.35	0.85 - 1.92	Pass
STSO-1063 [f]	07/01/05	Am-241	48.40 ± 3.90	81.10	56.77 - 105.43	Fail
STSO-1063	07/01/05	Co-57	608.30 ± 2.80	524.00	366.80 - 681.20	Pass
STSO-1063	07/01/05	Co-60	322.70 ± 2.40	287.00	200.90 - 373.10	Pass
STSO-1063	07/01/05	Cs-134	632.10 ± 5.20	568.00	397.60 - 738.40	Pass
STSO-1063	07/01/05	Cs-137	512.40 ± 4.20	439.00	307.30 - 570.70	Pass
STSO-1063	07/01/05	K-40	720.50 ± 19.00	604.00	422.80 - 785.20	Pass
STSO-1063	07/01/05	Mn-54	516.80 ± 5.10	439.00	307.30 - 570.70	Pass
STSO-1063	07/01/05	Ni-63	366.50 ± 13.30	445.00	311.50 - 578.50	Pass
STSO-1063	07/01/05	Pu-238	68.80 ± 15.00	60.80	42.56 - 79.04	Pass
STSO-1063	07/01/05	Pu-239/40	0.00 ± 0.00	0.00	0.00 - 0.00	
STSO-1063	07/01/05	Sr-90	602.90 ± 17.20	757.00	529.90 - 984.10	Pass
STSO-1063	07/01/05	U-233/4	61.50 ± 1.00	52.50	36.75 - 68.25	Pass
STSO-1063	07/01/05	U-238	164.50 ± 16.70	168.00	117.60 - 218.40	Pass
STSO-1063	07/01/05	Zn-65	874.70 ± 8.40	823.00	576.10 - 1070.00	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP)[a].

			Concentration [b]			
Lab Code[c]	Date	Analysis	Laboratory result	Known Activity	Control Limits [d]	Acceptance
STVE-1064	07/01/05	Am-241	0.18 ± 0.03	0.23	0.16 - 0.30	Pass
STVE-1064	07/01/05	Co-57	15.90 ± 0.20	13.30	9.31 - 17.29	Pass
STVE-1064	07/01/05	Co-60	4.80 ± 0.10	4.43	3.10 - 5.76	Pass
STVE-1064	07/01/05	Cs-134	4.60 ± 0.20	4.09	2.86 - 5.32	Pass
STVE-1064	07/01/05	Cs-137	5.90 ± 0.30	5.43	3.80 - 7.06	Pass
STVE-1064	07/01/05	Mn-54	7.20 ± 0.20	6.57	4.60 - 8.54	Pass
STVE-1064	07/01/05	Pu-238	0.04 ± 0.02	0.00	0.00 - 1.00	Pass
STVE-1064	07/01/05	Pu-239/40	0.13 ± 0.02	0.16	0.11 - 0.21	Pass
STVE-1064	07/01/05	Sr-90	2.80 ± 0.30	2.42	1.69 - 3.15	Pass
STVE-1064	07/01/05	U-233/4	0.28 ± 0.03	0.33	0.23 - 0.43	Pass
STVE-1064	07/01/05	U-238	0.33 ± 0.04	0.35	0.24 - 0.45	Pass
STVE-1064	07/01/05	Zn-65	11.00 ± 0.50	10.20	7.14 - 13.26	Pass
STAP-1065	07/01/05	Gr. Alpha	0.30 ± 0.04	0.48	0.00 - 0.80	Pass
STAP-1065	07/01/05	Gr. Beta	0.97 ± 0.06	0.83	0.55 - 1.22	Pass
STAP-1066	07/01/05	Am-241	0.14 ± 0.03	0.16	0.11 - 0.21	Pass
STAP-1066	07/01/05	Co-57	5.81 ± 0.17	6.20	4.34 - 8.06	Pass
STAP-1066	07/01/05	Co-60	2.79 ± 0.14	2.85	2.00 - 3.71	Pass
STAP-1066	07/01/05	Cs-134	3.67 ± 0.12	3.85	2.70 - 5.01	Pass
STAP-1066	07/01/05	Cs-137	2.93 ± 0.23	3.23	2.26 - 4.20	Pass
STAP-1066	07/01/05	Mn-54	4.11 ± 0.26	4.37	3.06 - 5.68	Pass
STAP-1066	07/01/05	Pu-238	0.11 ± 0.02	0.10	0.07 - 0.13	Pass
STAP-1066	07/01/05	Pu-239/40	0.10 ± 0.01	0.09	0.06 - 0.12	Pass
STAP-1066	07/01/05	Sr-90	2.25 ± 0.29	2.25	1.58 - 2.93	Pass
STAP-1066	07/01/05	U-233/4	0.28 ± 0.02	0.27	0.19 - 0.35	Pass
STAP-1066	07/01/05	U-238	0.28 ± 0.02	0.28	0.20 - 0.37	Pass
STAP-1066	07/01/05	Zn-65	4.11 ± 0.26	4.33	3.06 - 5.68	Pass

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the Department of Energy's Mixed Analyte Performance Evaluation Program, Idaho Operations office, Idaho Falls, Idaho

[b] Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (filters, vegetation) as requested by the Department of Energy.

[c] Laboratory codes as follows: STW (water), STAP (air filter), STSO (soil), STVE (vegetation).

[d] MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP.

[e] The strontium carbonate precipitates were redissolved and processed. The average of the three analyses was 1.34 although the recovery was only 30%. The result of a new analysis was 1.56 pCi/L.

[f] Incorrect sample weight used in calculation. Result of recalculation: 97.0 ± 7.8 Bq/kg.

APPENDIX B

DATA REPORTING CONVENTIONS

Data Reporting Conventions

1.0. All activities, except gross alpha and gross beta, are decay corrected to collection time or the end of the collection period.

2.0. Single Measurements

Each single measurement is reported as follows: $x \pm s$

where: x = value of the measurement;

$s = 2\sigma$ counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is less than the lower limit of detection L, it is reported as: < L,

where L = the lower limit of detection based on 4.66σ uncertainty for a background sample.

3.0. Duplicate analyses

3.1 Individual results: For two analysis results; $x_1 \pm s_1$ and $x_2 \pm s_2$

Reported result: $x \pm s$; where $x = (1/2)(x_1 + x_2)$ and $s = (1/2)\sqrt{s_1^2 + s_2^2}$

3.2. Individual results: $< L_1$, $< L_2$ Reported result: < L, where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$, $< L$ Reported result: $x \pm s$ if $x \geq L$; <L otherwise.

4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average $\bar{x}$ and standard deviation s of a set of n numbers $x_1, x_2 \ldots x_n$ are defined as follows:

$$\bar{x} = \frac{1}{n}\sum x \qquad s = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$$

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all values in the averaging group are less than the highest LLD, the highest LLD is reported.

4.4 If all but one of the values are less than the highest LLD, the single value x and associated two sigma error is reported.

4.5 In rounding off, the following rules are followed:

4.5.1. If the number following those to be retained is less than 5, the number is dropped, and the retained number s are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2. If the number following those to be retained is equal to or greater than 5, the number is dropped and the last retained number is raised by 1. As an example, 11.445 is rounded off to 11.45.

APPENDIX C

Maximum Permissible Concentrations

of Radioactivity in Air and Water

Above Background in Unrestricted Areas

Table C-1. Maximum permissible concentrations of radioactivity in air and water above natural background in unrestricted areas[a].

	Air (pCi/m^3)		Water (pCi/L)
Gross alpha	1×10^{-3}	Strontium-89	8,000
Gross beta	1	Strontium-90	500
Iodine-131[b]	2.8×10^{-1}	Cesium-137	1,000
		Barium-140	8,000
		Iodine-131	1,000
		Potassium-40[c]	4,000
		Gross alpha	2
		Gross beta	10
		Tritium	1×10^{6}

[a] Taken from Table 2 of Appendix B to Code of Federal Regulations Title 10, Part 20, and appropriate footnotes. Concentrations may be averaged over a period not greater than one year.

[b] Value adjusted by a factor of 700 to reduce the dose resulting from the air-grass-cow-milk-child pathway.

[c] A natural radionuclide.

2005 Annual Environmental Monitoring Report

Kewaunee Power Station
Part II, Data Tabulations, Graphs and Analyses

Dominion Energy Kewaunee, Inc.

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REPORT TO

DOMINION NUCLEAR

RADIOLOGICAL MONITORING PROGRAM FOR
THE KEWAUNEE POWER STATION
KEWAUNEE, WISCONSIN

ANNUAL REPORT - PART II
DATA TABULATIONS AND ANALYSES

January 1 to December 31, 2005

Prepared and submitted by

ENVIRONMENTAL, Inc.
Midwest Laboratory
Project No. 8002

Approved:

Bronia Grob
Laboratory Manager

J. Michael Hale
Radiation Protection /
Chemistry Mgr., KPS

PREFACE

The staff members of Environmental, Inc., Midwest Laboratory were responsible for the acquisition of data presented in this report. Samples were collected by the personnel of Environmental, Inc., Midwest Laboratory and the Kewaunee Power Station.

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LIST OF TABLES

1.0 INTRODUCTION

The following constitutes Part II of the final report for the 2005 Radiological Monitoring Program conducted at the Kewaunee Power Station (KPS), Kewaunee, Wisconsin.

Included are tabulations of data for all samples collected in 2005, graphs of data trends and descriptions of radiochemical procedures. A summary and interpretation of the data presented here are published in Part I of the 2005 Annual Report on the Radiological Monitoring Program for the Kewaunee Power Station.

NOTE: Page 2 is intentionally left out.

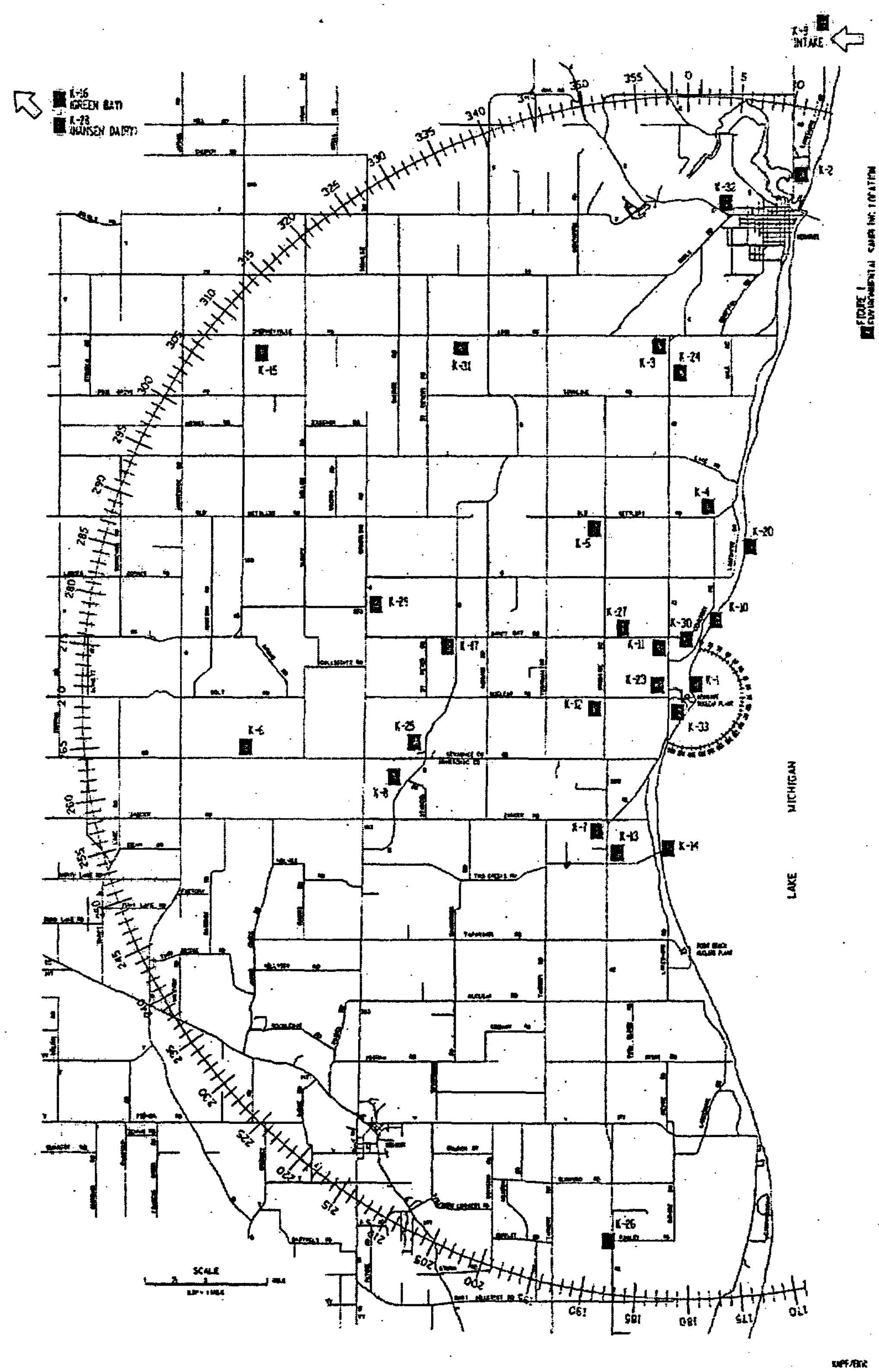

Figure 1. Sampling locations, Kewaunee Power Station

Table 1. Sampling locations, Kewaunee Power Station.

Code	Type[a]	Distance (miles)[b] and Sector	Location
K-1			Onsite
K-1a	I	0.62 N	North Creek
K-1b	I	0.12 N	Middle Creek
K-1c	I	0.10 N	500' north of condenser discharge
K-1d	I	0.10 E	Condenser discharge
K-1e	I	0.12 S	South Creek
K-1f	I	0.12 S	Meteorological Tower
K-1g	I	0.06 W	South Well
K-1h	I	0.12 NW	North Well
K-1j	I	0.10 S	500' south of condenser discharge
K-1k	I	0.60 SW	Drainage Pond, south of plant
K-2	C	9.5 NNE	WPS Operations Building in Kewaunee
K-3	C	6.0 N	Lyle and John Siegmund Farm, N2815 Hy 12, Kewaunee
K-5	I	3.5 NNW	Ed Paplham Farm, E4160 Old Settlers Rd, Kewaunee
K-7	I	2.75 SSW	Ron Zimmerman Farm, 17620 Nero Road, Two Rivers
K-8	C	5.0 WSW	Saint Isidore the Farmer Church, Tisch Mills
K-9	C	11.5 NNE	Rostok Water Intake for Green Bay, Wisconsin, two miles north of Kewaunee
K-10	I	1.5 NNE	Turner Farm, Kewaunee site
K-11	I	1.0 NW	Harlan Ihlenfeld Farm, N879 Hy 42, Kewaunee
K-13	C	3.0 SSW	Rand's General Store
K-14	I	2.5 S	Two Creeks Park, 2.5 miles south of site
K-15	C	9.25 NW	Gas Substation, 1.5 miles north of Stangelville
K-16	C	26 NW	WPS Division Office Building, Green Bay, Wisconsin
K-17	I	4.25 W	Jansky's Farm, N885 Tk B, Kewaunee
K-20	I	2.5 N	Carl Struck Farm, Lakeshore Dr, Kewaunee
K-23	I	0.5 W	0.5 miles west of plant, Kewaunee site
K-24	I	5.45 N	Fectum Farm, N2653 Hy 42, Kewaunee
K-25	I	2.0 WSW	Wotachek Farm, 4819 E. Cty Tk BB, Denmark
K-26	C	10.7 SSW	Bertler's Fruit Stand (8.0 miles south of "BB")
K-27	I	1.5 NW	Schlies Farm, E4298 Sandy Bay Rd, Kewaunee
K-28	C	26 NW	Hansen Dairy, Green Bay, Wisconsin
K-29	I	5.75 W	Kunesh Farm, Route 1, Kewaunee
K-30	I	1.00N	End of site boundary
K-31	C	6.25NNW	E. Krok Substation
K-32	C	11.50 N	Piggly Wiggly, 931 Marquette Dr., Kewaunee
K-34	I	2.5 N	Leon and Vicki Struck, N1549 Lakeshore Dr., Kewaunee
K-38	I	3.0 mi. WNW	Dave Sinkula Farm, N890 Town Hall Road, Kewaunee
K-39	I	3.8 mi. N	Francis and Sue Wojta, N1859 Lakeshore Dr., Kewaunee

[a] I = indicator; C = control.

[b] Distances are measured from reactor stack.

KEWAUNEE

Table 2. Type and frequency of collection.

Location	Weekly	Biweekly	Monthly	Quarterly	Semiannually	Annually
K-1a			SW		SL	
K-1b			SW	GR[a]	SL	
K-1c					BS[b]	
K-1d			SW	FI[a]	BS[b], SL	
K-1e			SW		SL	
K-1f	AP	AI		GR[a], TLD	SO	
K-1g				WW		
K-1h				WW		
K-1j					BS[b]	
K-1k			SW		SL	
K-2	AP	AI		TLD		
K-3			MI[c]	GR[a], TLD, CF[d]	SO	
K-5			MI[c]	GR[a], TLD, CF[d]	SO	
K-7	AP	AI		TLD		
K-8	AP	AI		TLD		
K-9			SW		BS[b], SL	
K-10				WW		
K-11			PR	WW		
K-13				WW		
K-14			SW		BS[b], SL	
K-15				TLD		
K-16	AP	AI		TLD		
K-17				TLD		VE
K-20						DM
K-23						GRN
K-24				EG		DM
K-25			MI[c]	GR[a], TLD, CF[d], WW	SO	
K-26						VE
K-27				TLD, EG		DM
K-28			MI[c]			
K-29						DM
K-30				TLD		
K-31	AP	AI		TLD		
K-32				EG		DM
K-34			MI[c]	GR[a], CF[d]	SO	
K-38			MI[c]	GR[a], CF[d]	SO	
K-39			MI[c]	GR[a], TLD, CF[d]	SO	

[a] Three times a year, second, third and fourth quarters.

[b] To be collected in May and November.

[c] Monthly from November through April; semimonthly May through October.

[d] First quarter (January, February, March) only.

Table 3. Sample Codes:

AP	Airborne particulates	MI	Milk
AI	Airborne Iodine	PR	Precipitation
BS	Bottom (river) sediments	SL	Slime
CF	Cattlefeed	SO	Soil
DM	Domestic Meat	SW	Surface water
EG	Eggs	TLD	Thermoluminescent Dosimeter
FI	Fish	VE	Vegetables
GRN	Grain	WW	Well water
GR	Grass		

Note: Page 6 is intentionally left out.

KEWAUNEE

GRAPHS OF DATA TRENDS

Note: Conventions used in trending data.

The following conventions should be used in the interpretation of the graphs of data trends:

1. Both solid and open data points may be used in the graphs. A solid point indicates an activity, an open point, a lower limit of detection (LLD) value.
2. Data points are connected by a solid line. A break in the plot indicates missing data.

Kewaunee

Air Particulates - Gross Beta

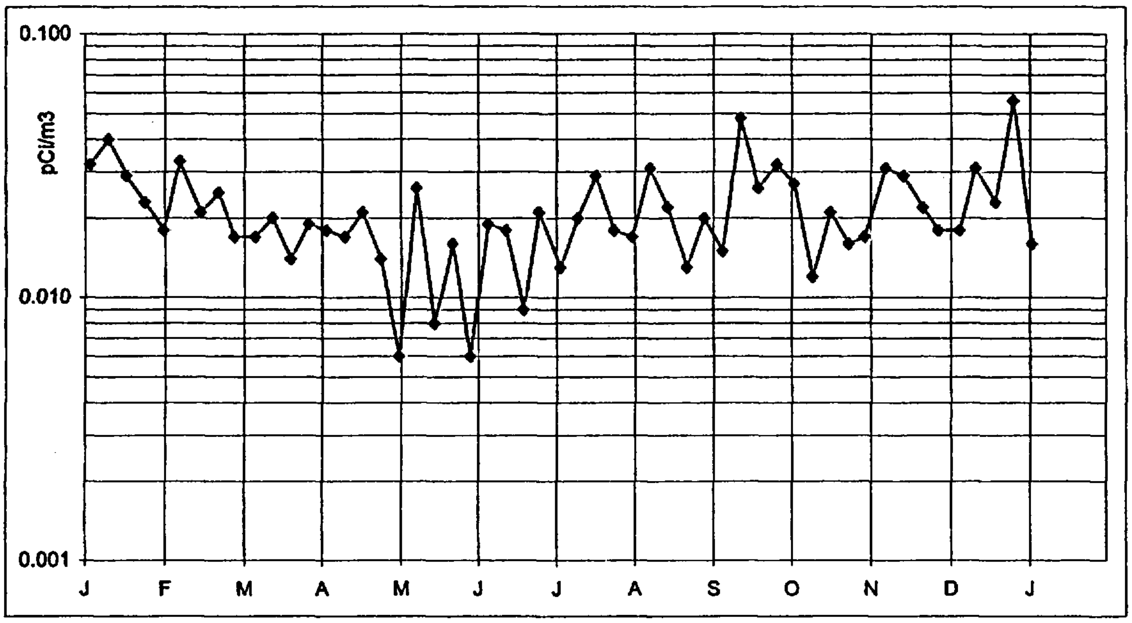

Figure 2. Location K-1f (weekly samples, 2005).

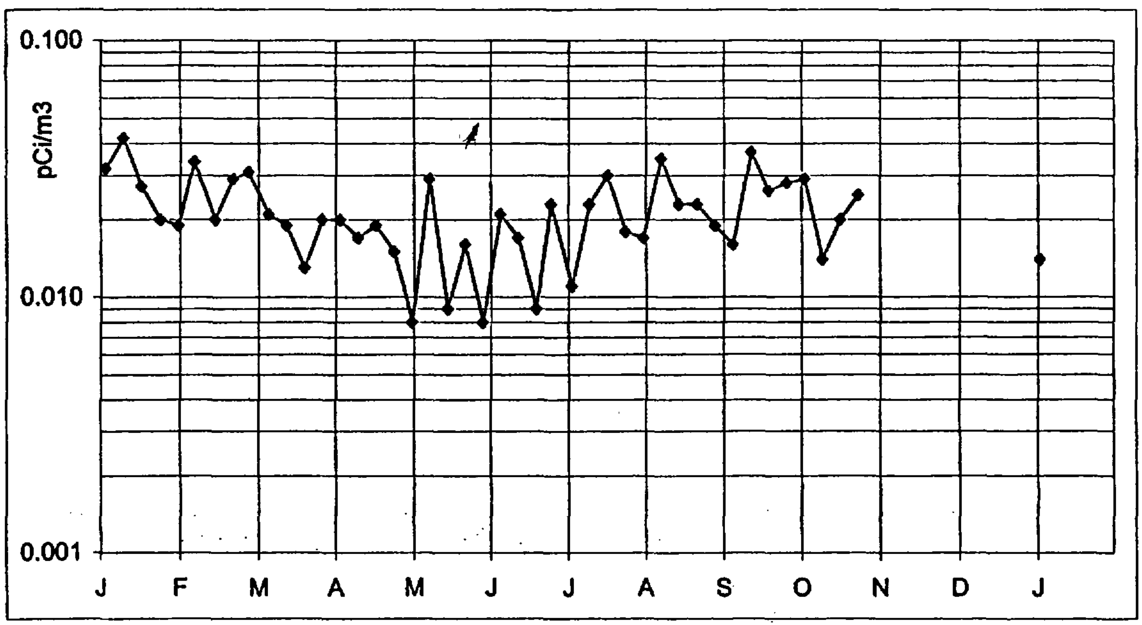

Figure 3. Location K-2 (weekly samples, 2005).

Kewaunee

Air Particulates - Gross Beta

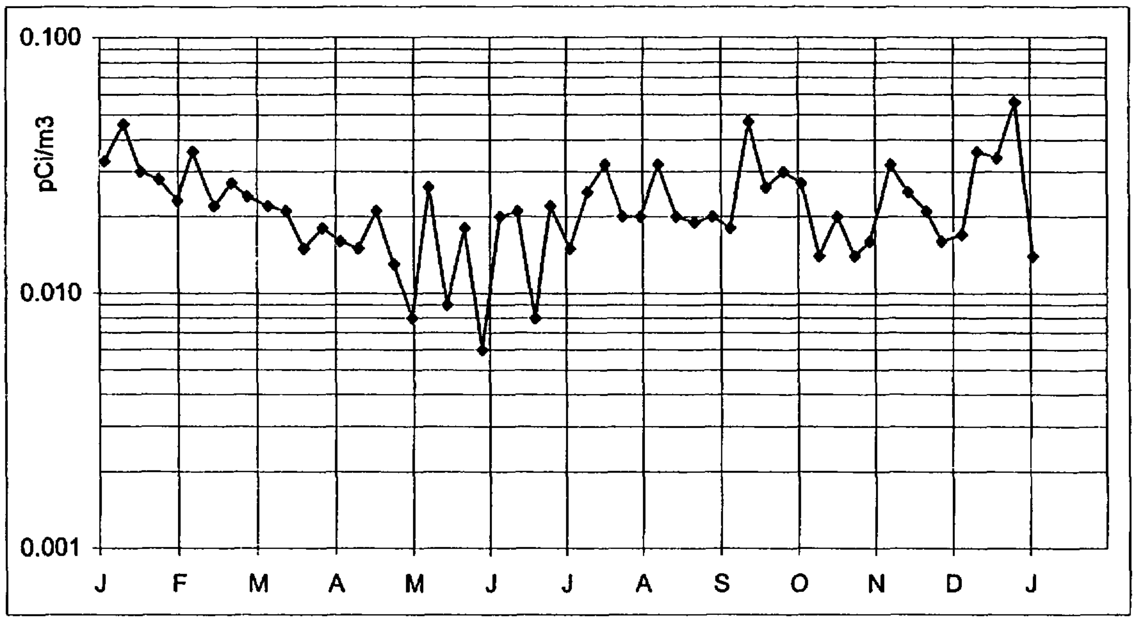

Figure 4. Location K-7 (weekly samples, 2005).

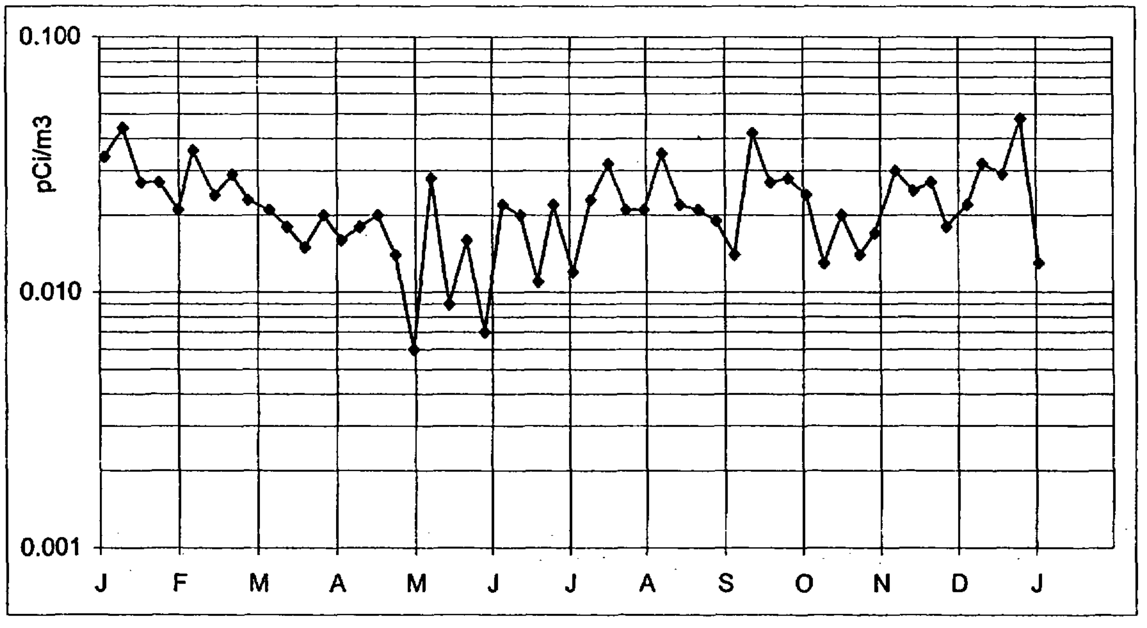

Figure 5. Location K-8 (weekly samples, 2005).

Kewaunee

Air Particulates - Gross Beta

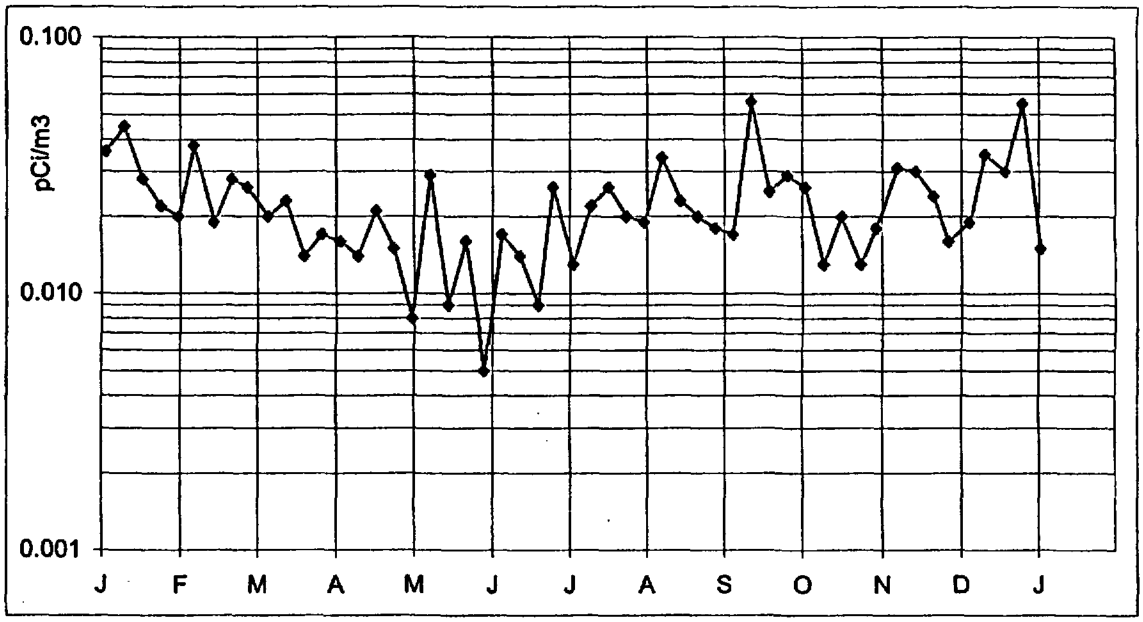

Figure 6. Location K-16 (weekly samples, 2005).

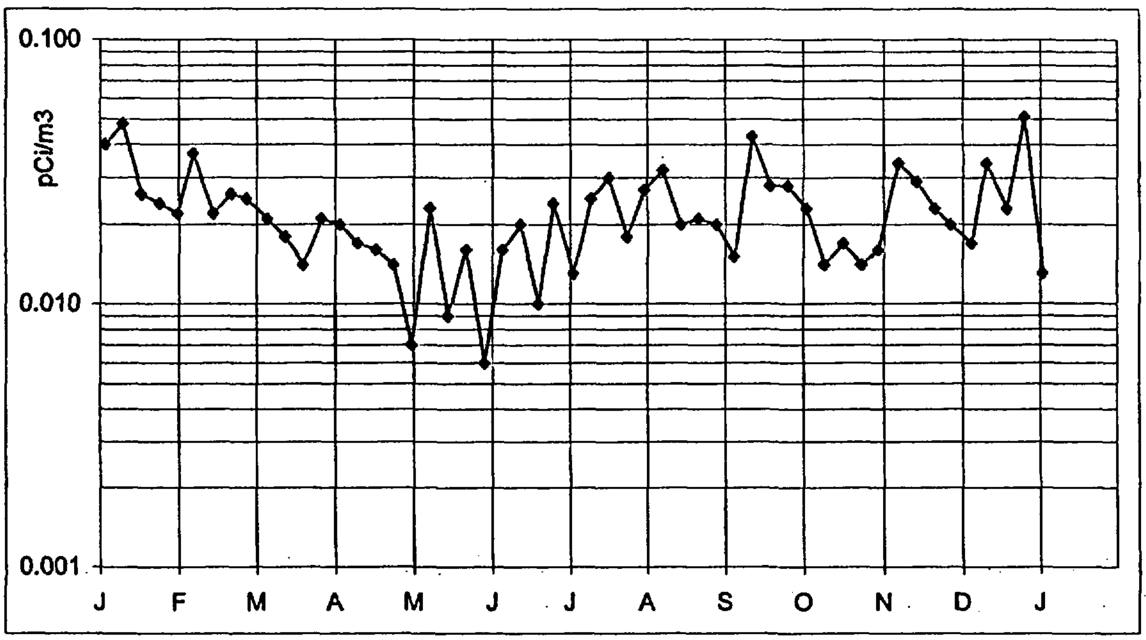

Figure 7. Location K-31 (weekly samples, 2005).

Kewaunee

Air Particulates - Gross Beta

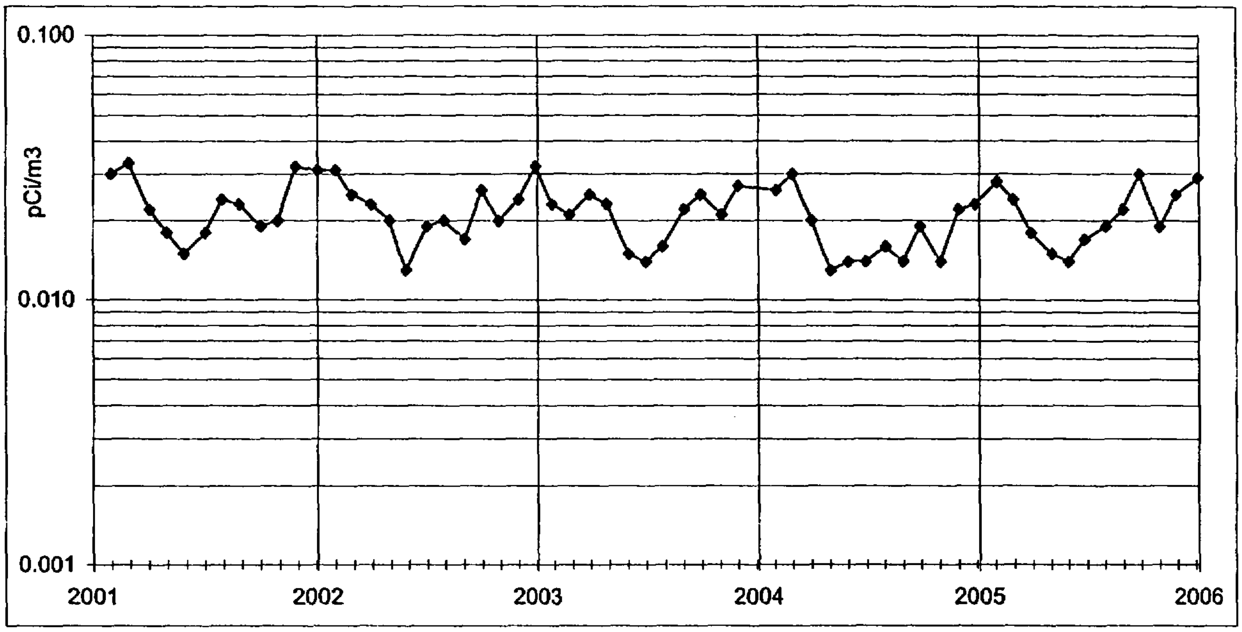

Figure 8. Location K-1f (monthly averages, 2001-2005).

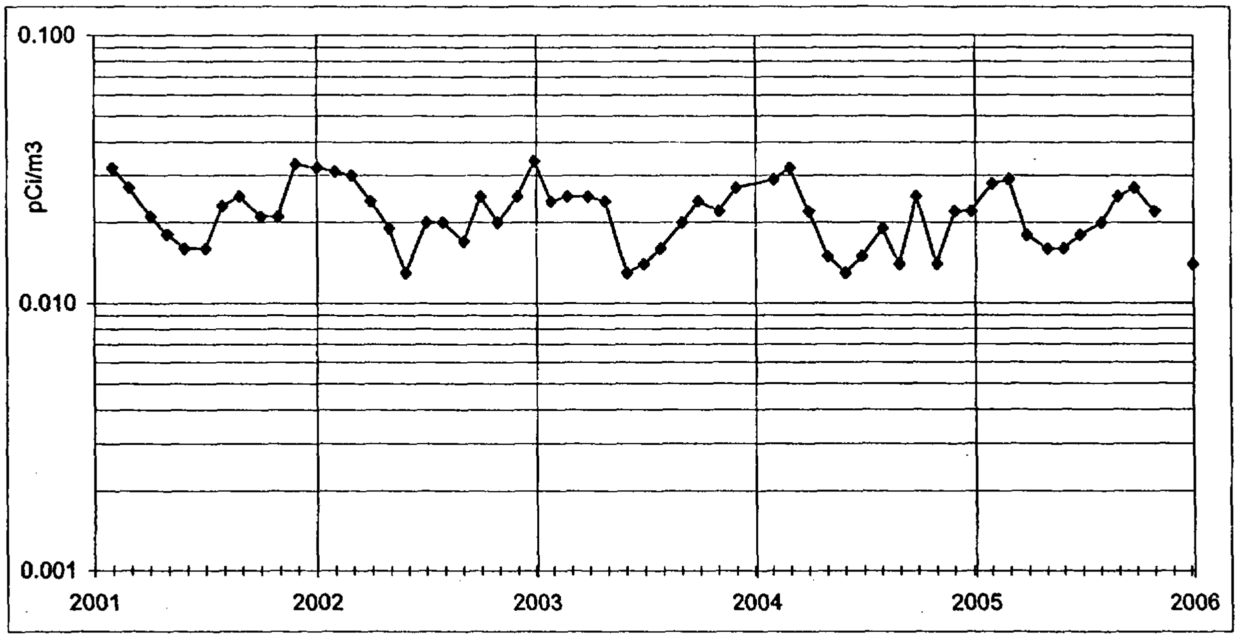

Figure 9. Location K-2 (monthly averages, 2001-2005).

Kewaunee

Air Particulates - Gross Beta

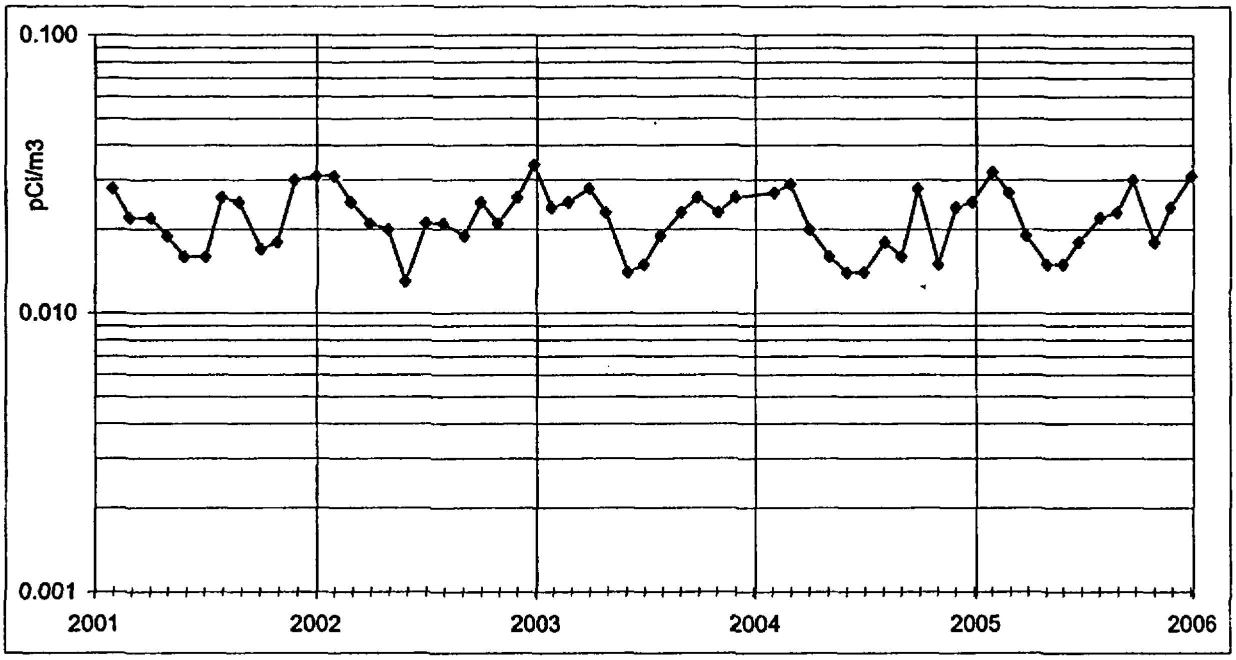

Figure 10. Location K-7 (monthly averages, 2001-2005).

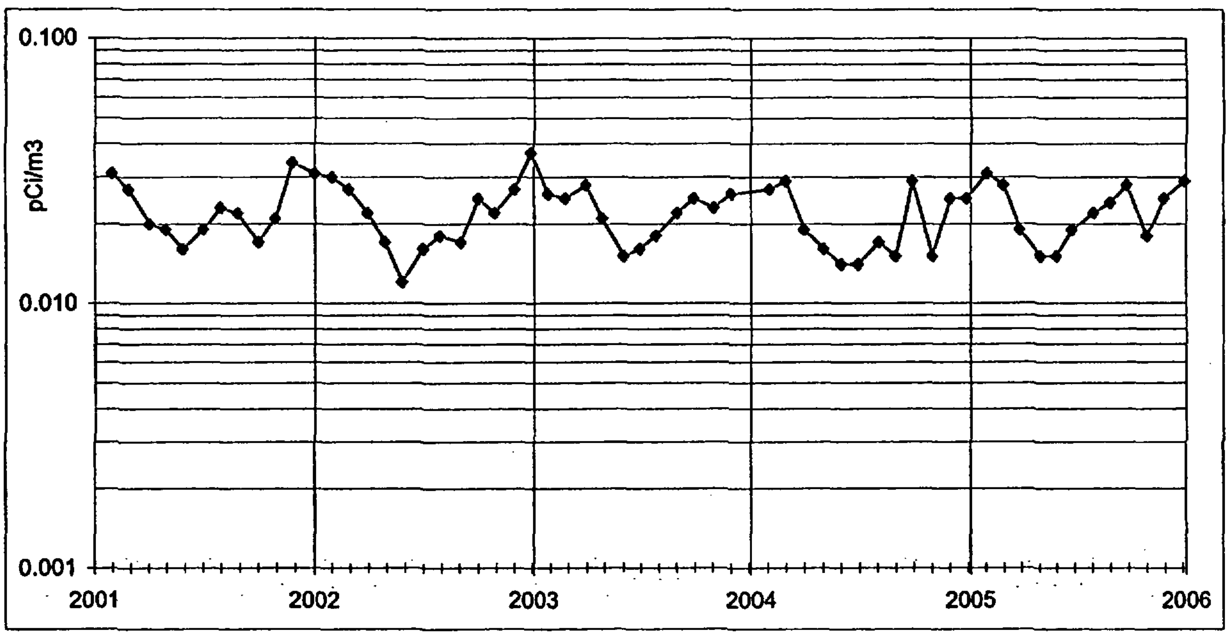

Figure 11. Location K-8 (monthly averages, 2001-2005).

Kewaunee

Air Particulates - Gross Beta

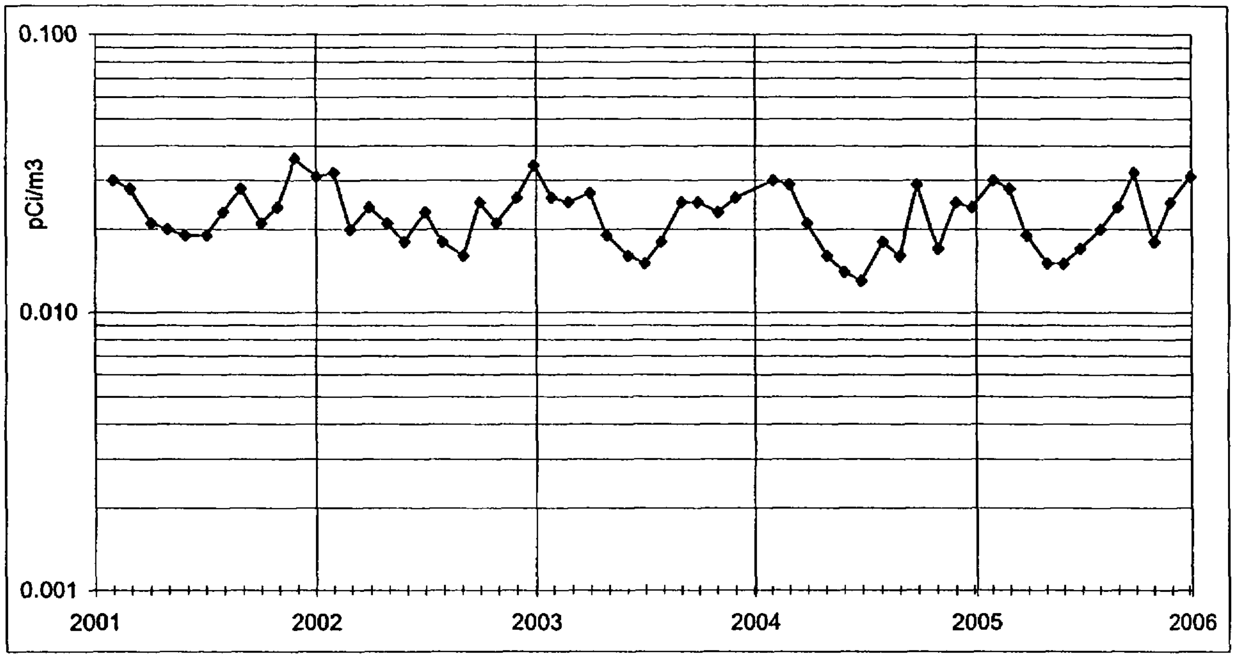

Figure 12. Location K-16 (monthly averages, 2001-2005).

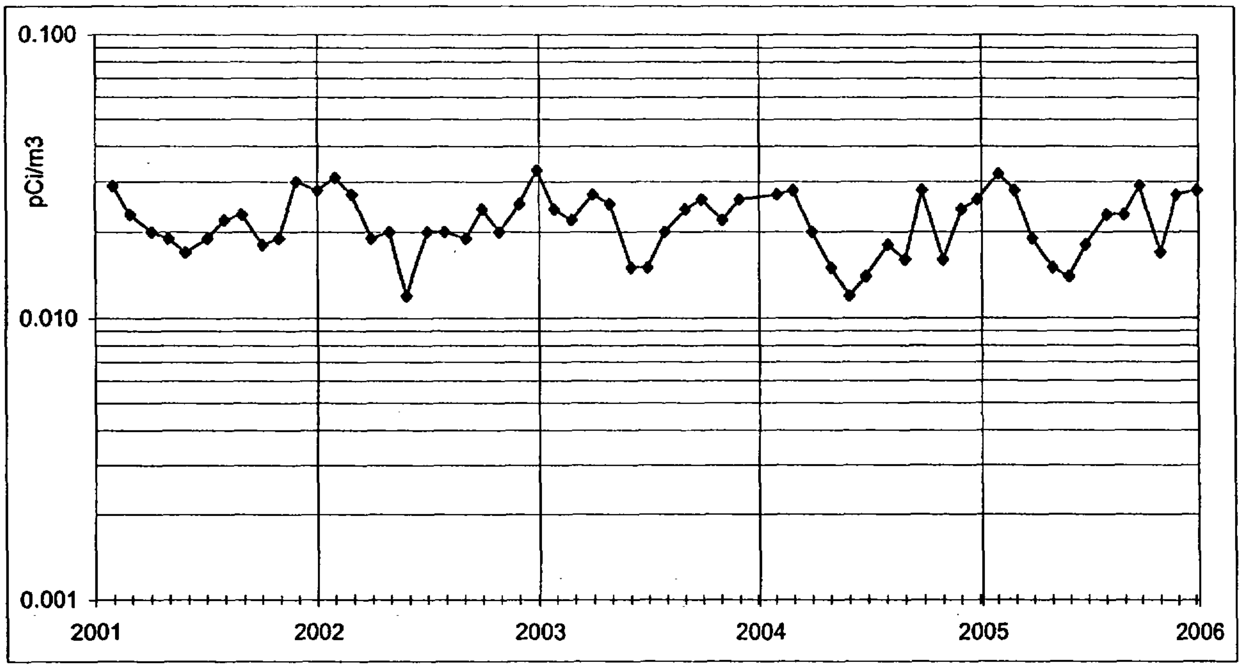

Figure 13. Location K-31 (monthly averages, 2001-2005).

Kewaunee

WELL WATER-GROSS ALPHA

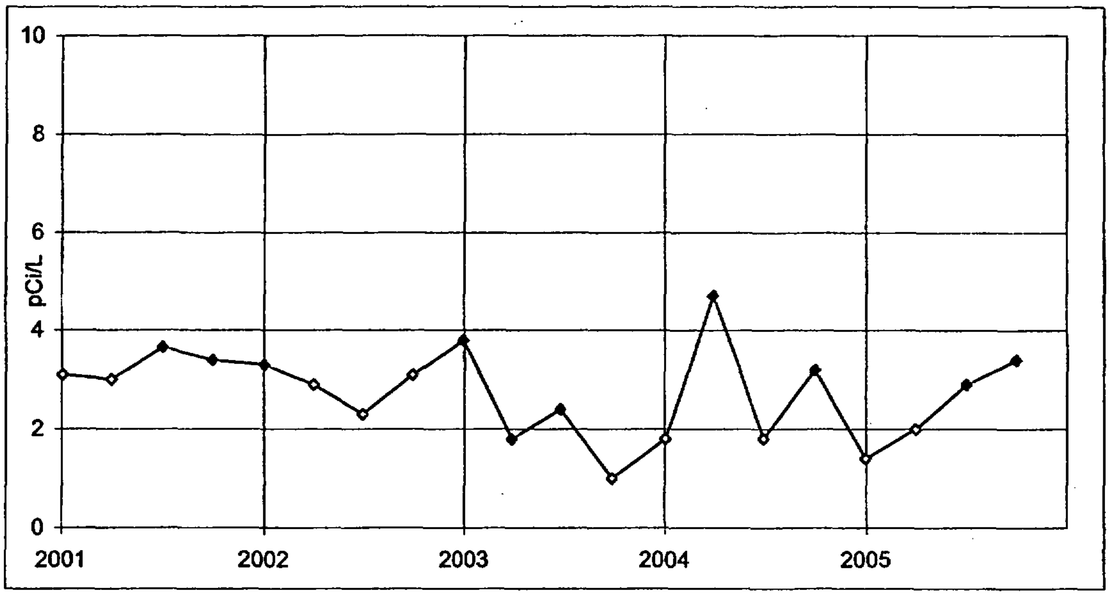

Figure 14. Location K-1g. Total Residue. Quarterly collection.

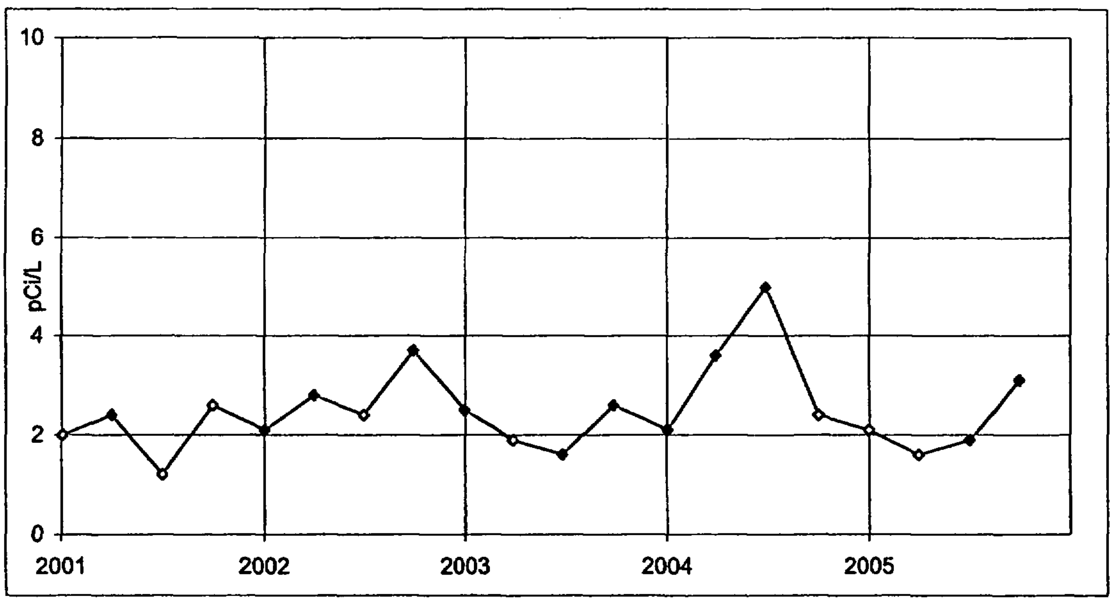

Figure 15. Location K-1h. Total Residue. Quarterly collection.

Kewaunee

WELL WATER-GROSS BETA

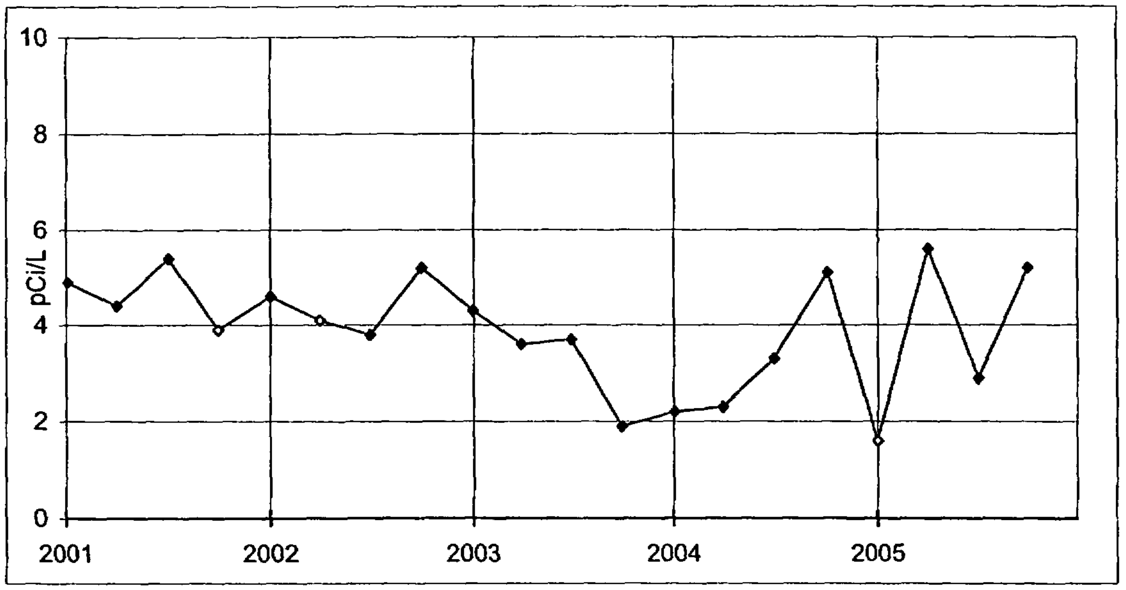

Figure 16. Location K-1g. Total Residue. Quarterly collection.

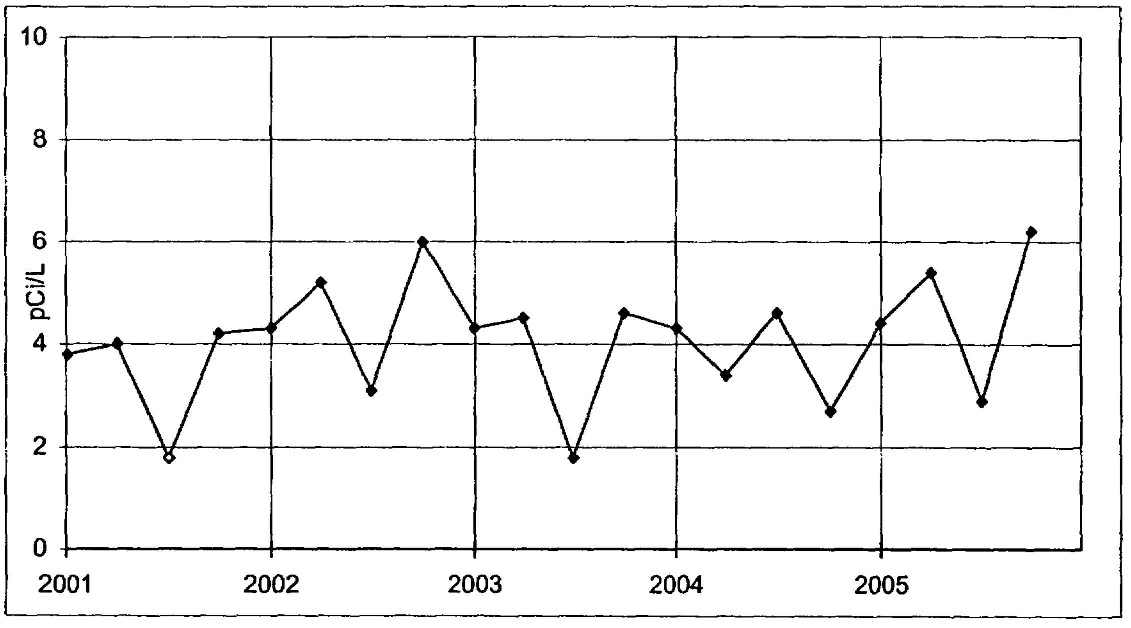

Figure 17. Location K-1h. Total Residue. Quarterly collection.

Kewaunee

WELL WATER-GROSS BETA

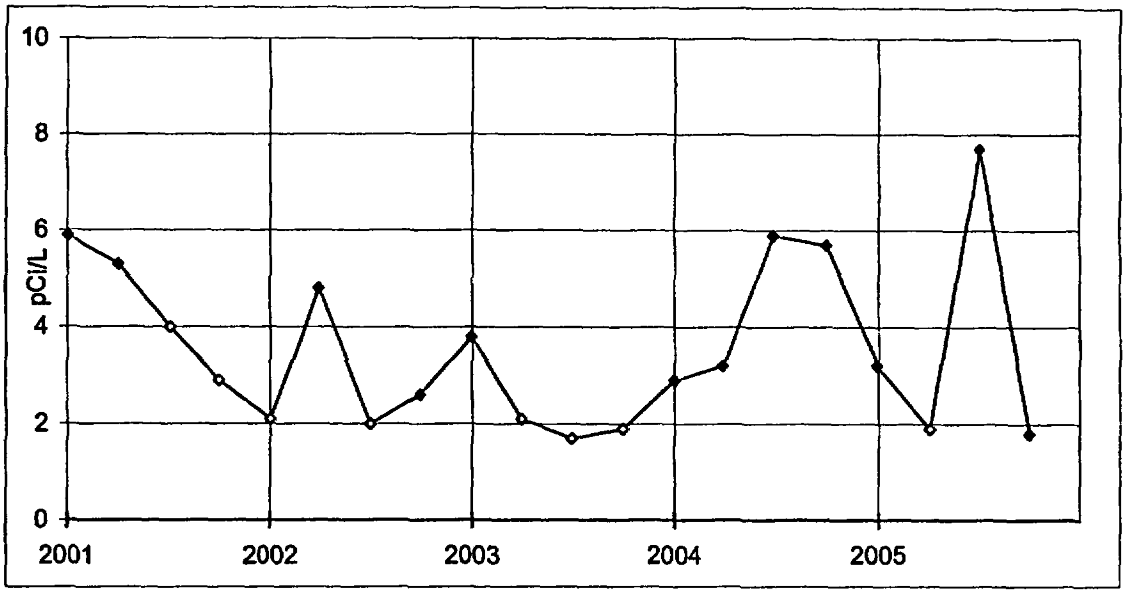

Figure 18. Location K-10. Total Residue. Quarterly collection.

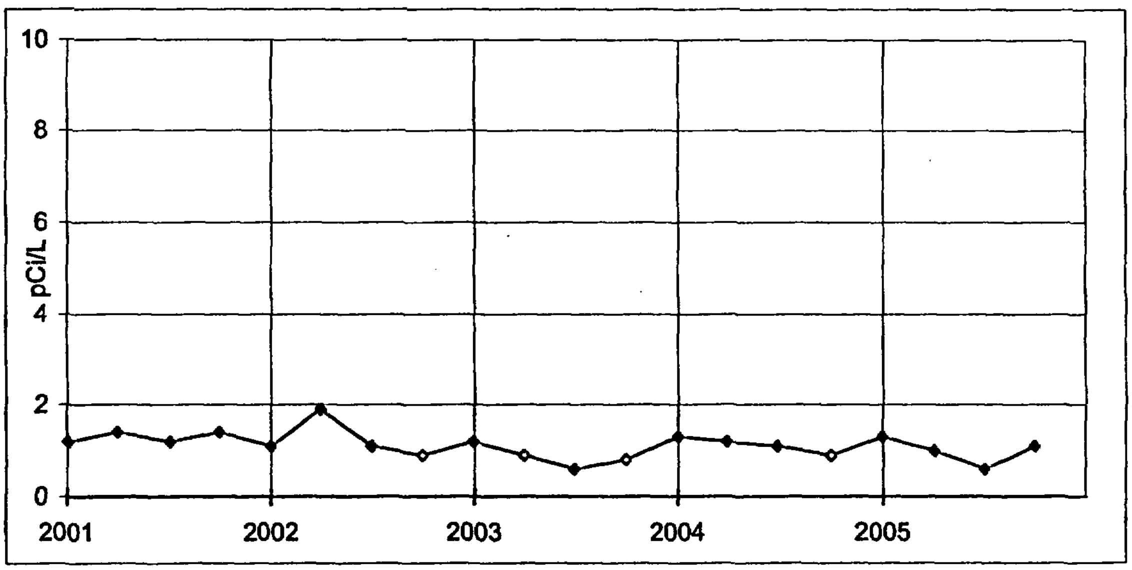

Figure 19. Location K-11. Total Residue. Quarterly collection.

Kewaunee

WELL WATER-GROSS BETA

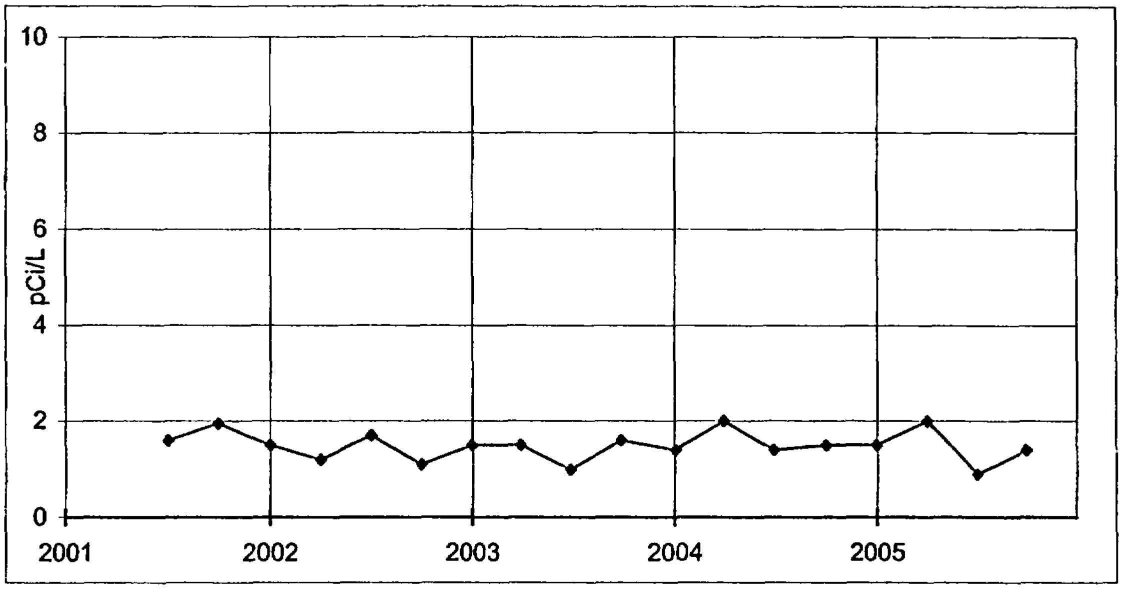

Figure 20. Location K-25. Total Residue. Quarterly collection.

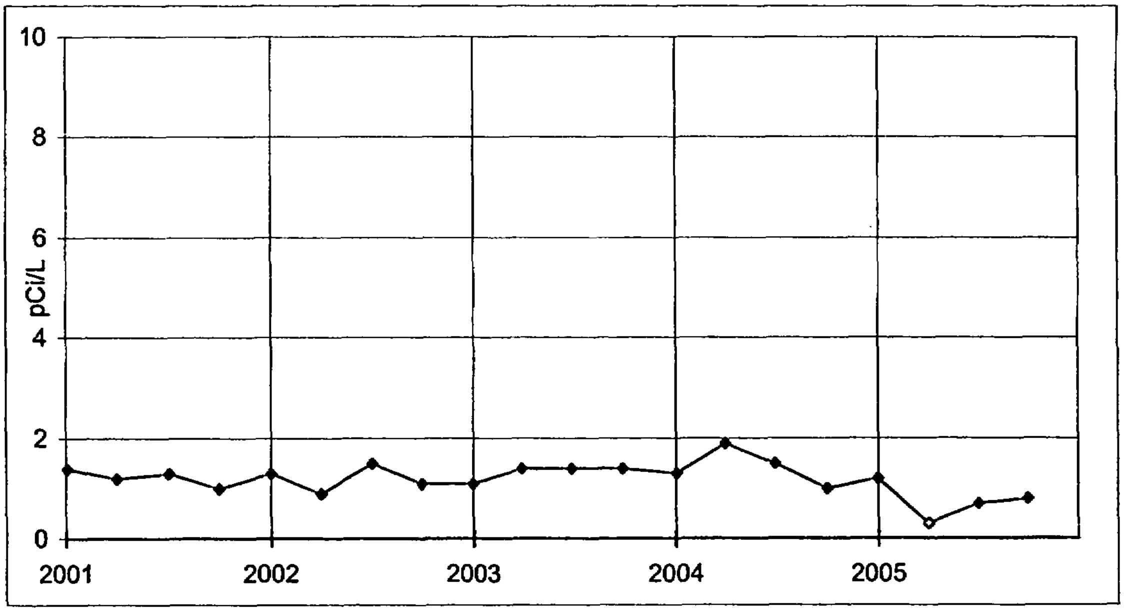

Figure 21. Location K-13. Total Residue. Quarterly collection.

Kewaunee
Milk - Strontium-90

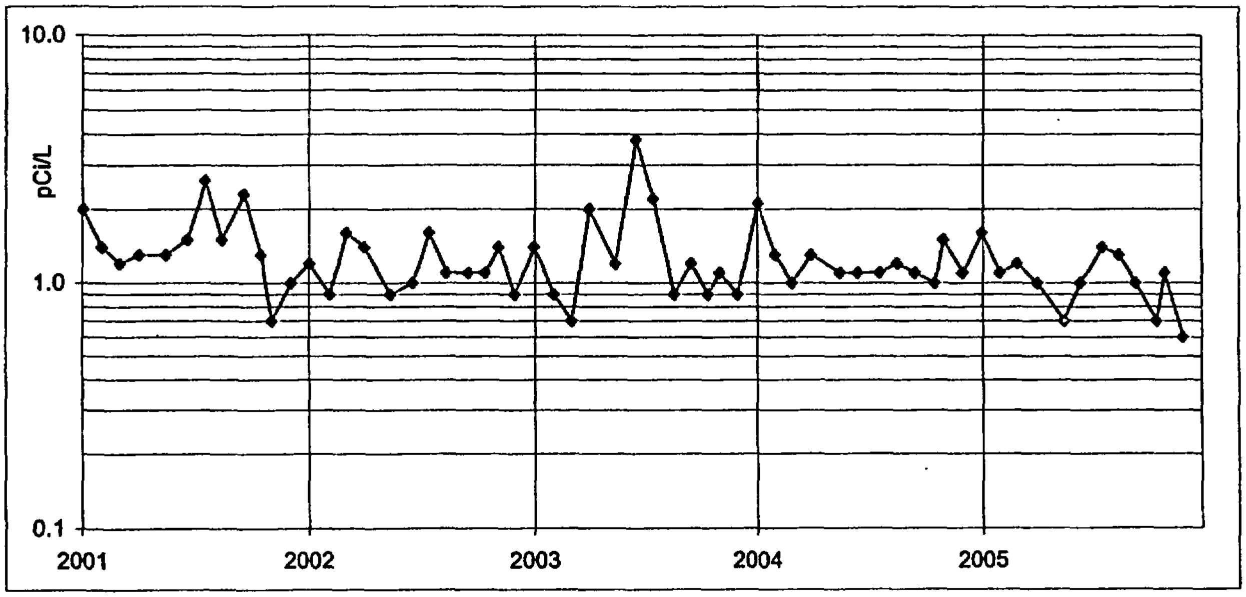

Figure 22. Milk samples. Location K-3.

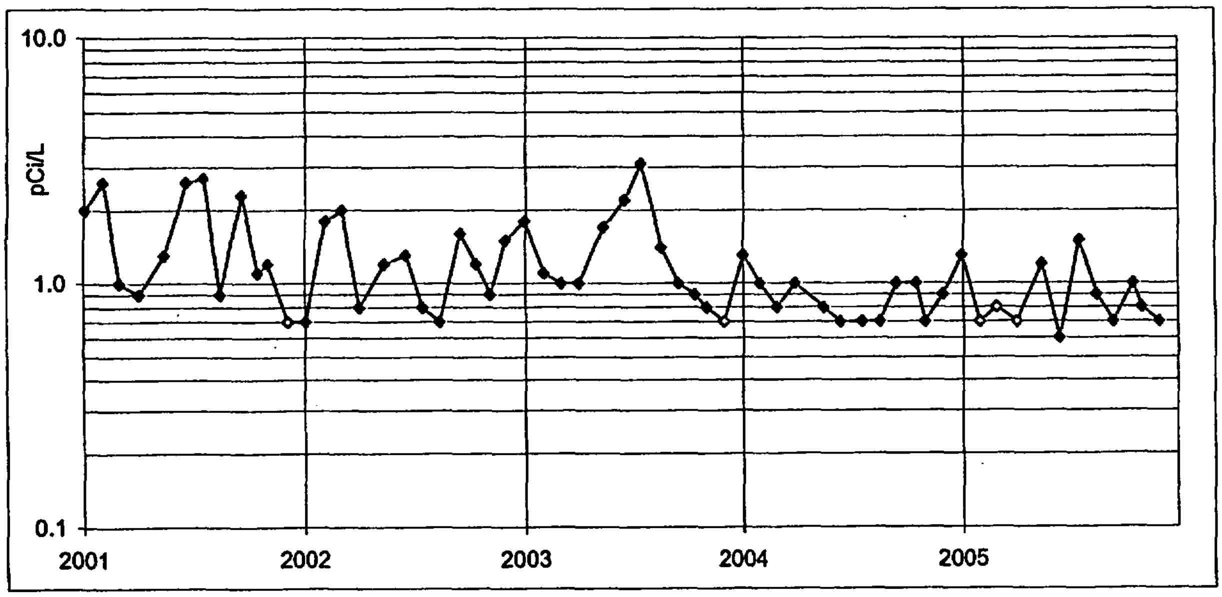

Figure 23. Milk samples. Location K-5.

Kewaunee
Milk - Strontium-90

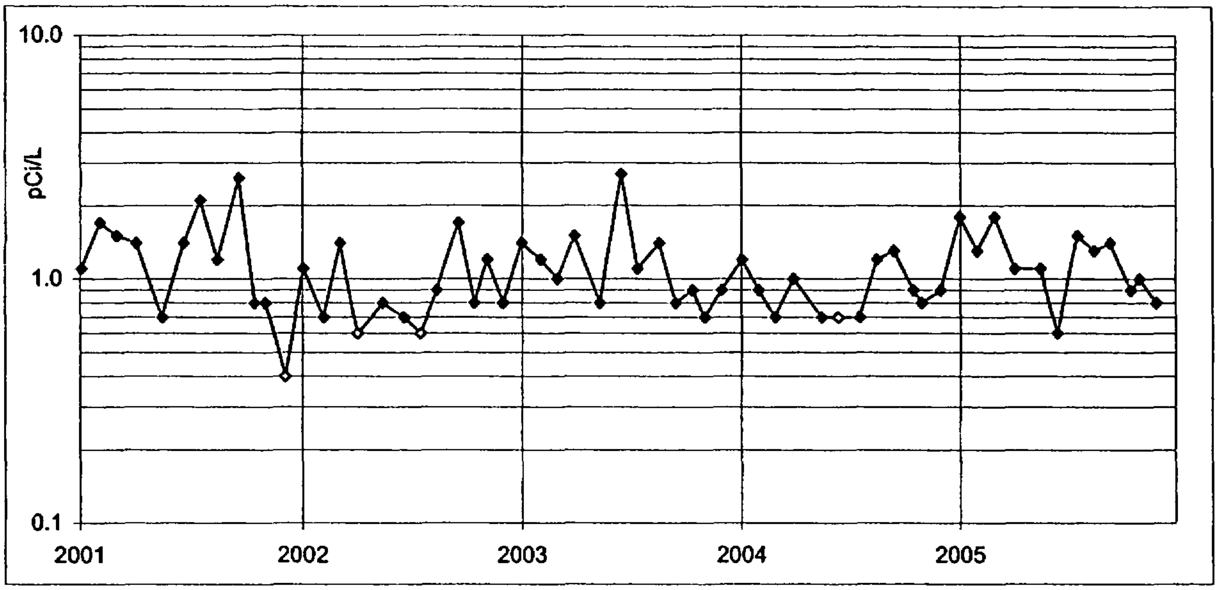

Figure 24. Milk samples. Location K-25.

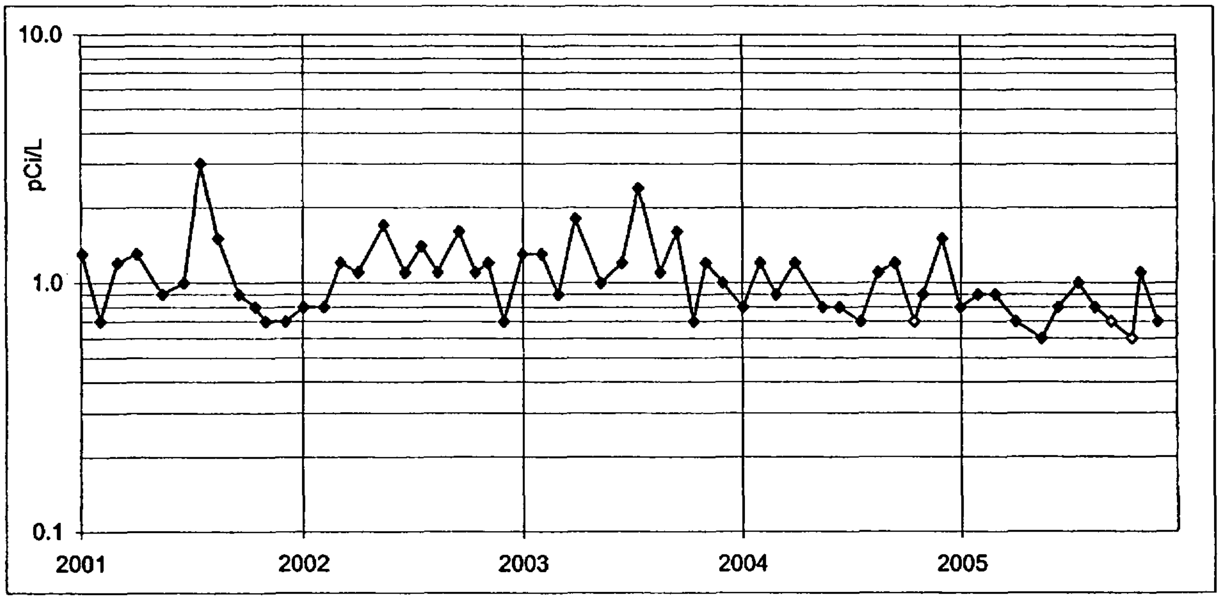

Figure 25. Milk samples. Location K-28.

Kewaunee
Milk - Strontium-90

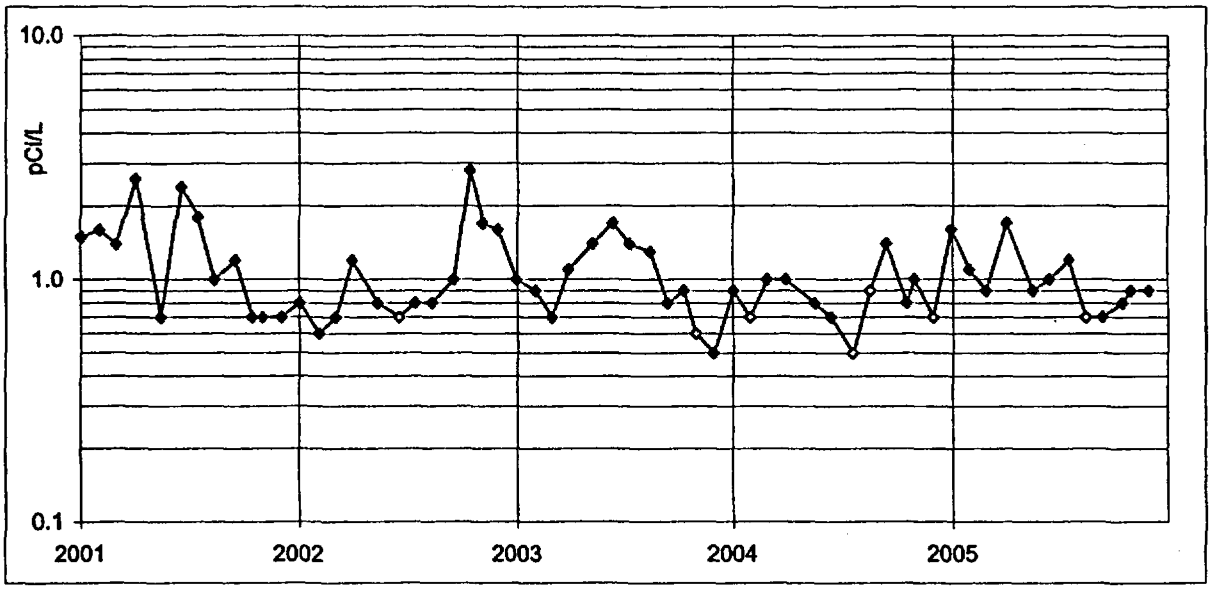

Figure 26. Milk samples. Location K-34.

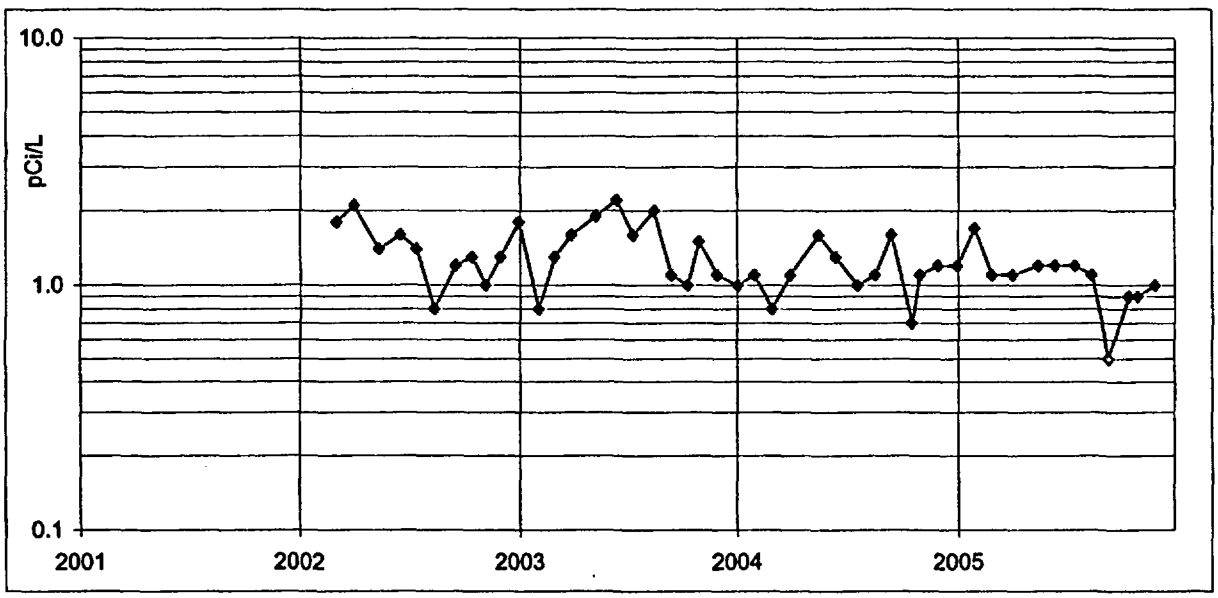

Figure 27. Milk samples. Location K-38.

Kewaunee
Milk - Strontium-90

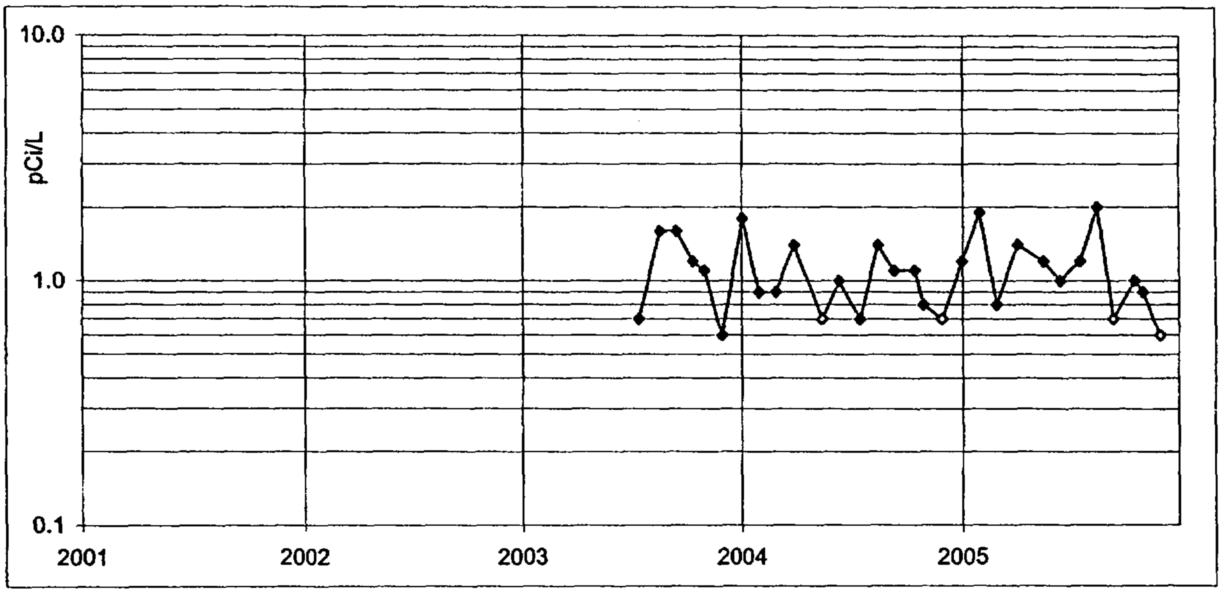

Figure 28. Milk samples. Location K-39.

Kewaunee

Surface Water - Gross Beta

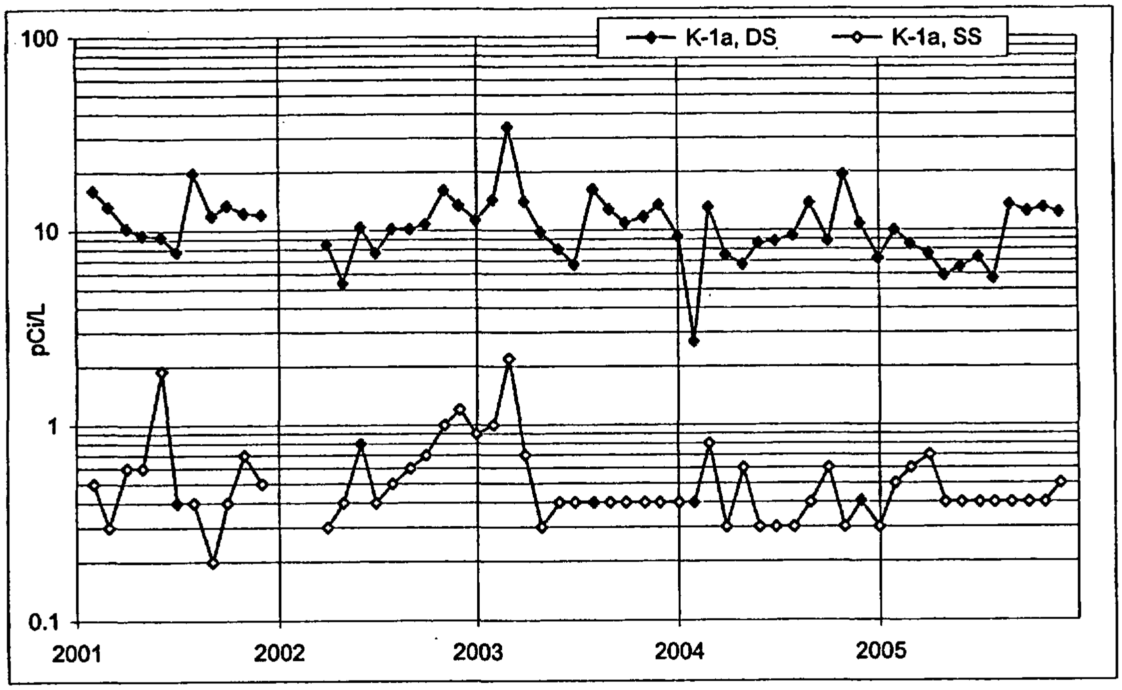

Figure 29. Surface water. North Creek, Onsite (K-1a).

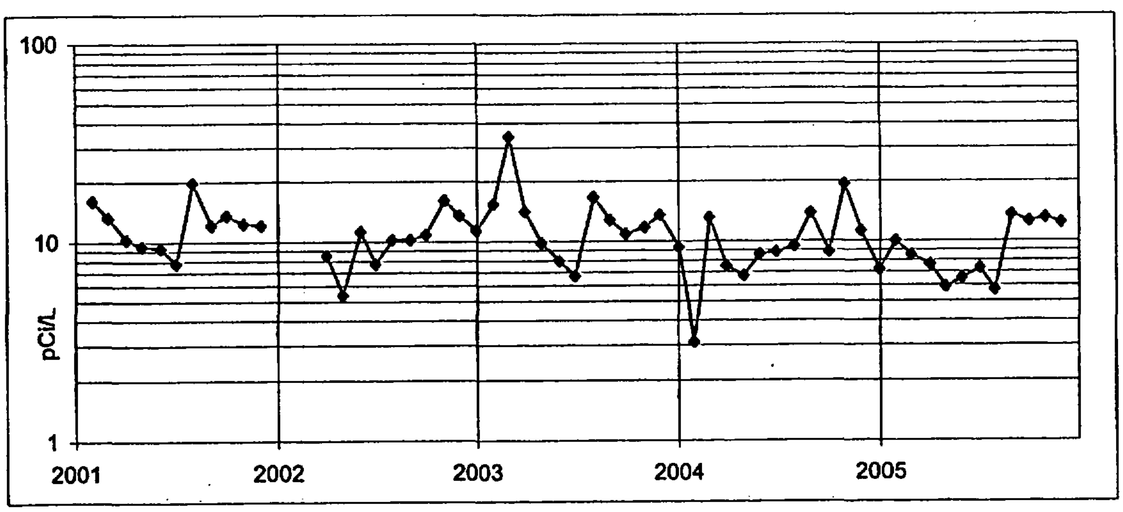

Figure 30. Surface water. North Creek, Onsite (K-1a).
Total Residue

Kewaunee

Surface Water - Gross Beta

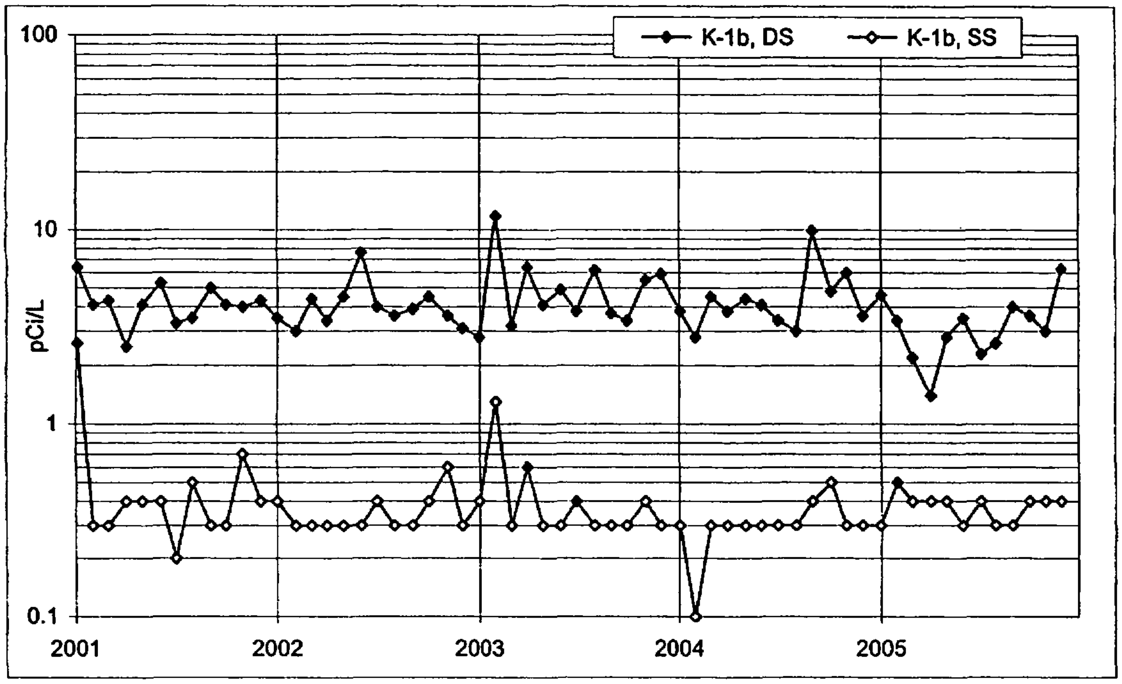

Figure 31. Surface water. Middle Creek, Onsite (K-1b).

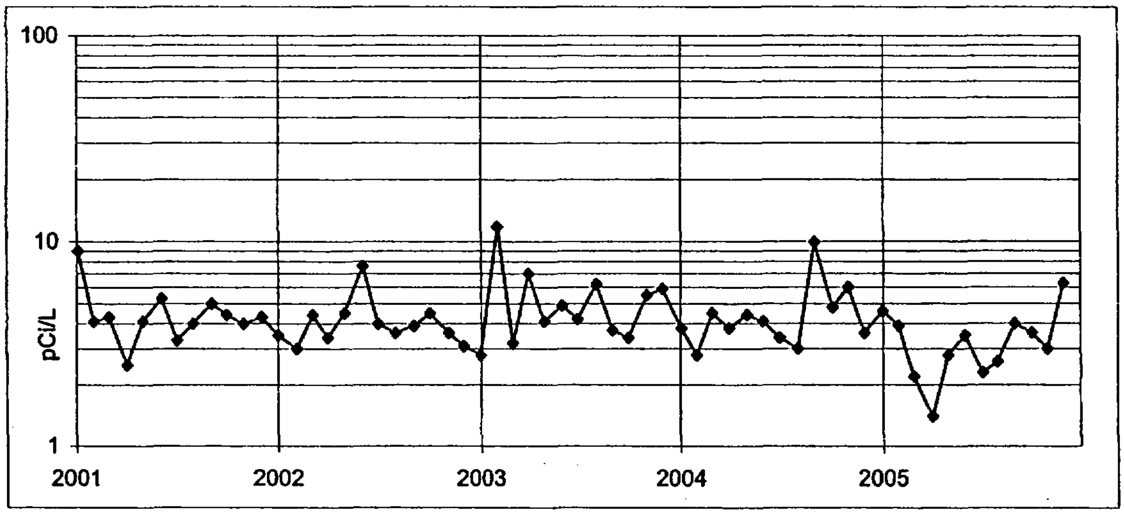

Figure 32. Surface water. Middle Creek, Onsite (K-1b).
Total Residue

Kewaunee

Surface Water - Gross Beta

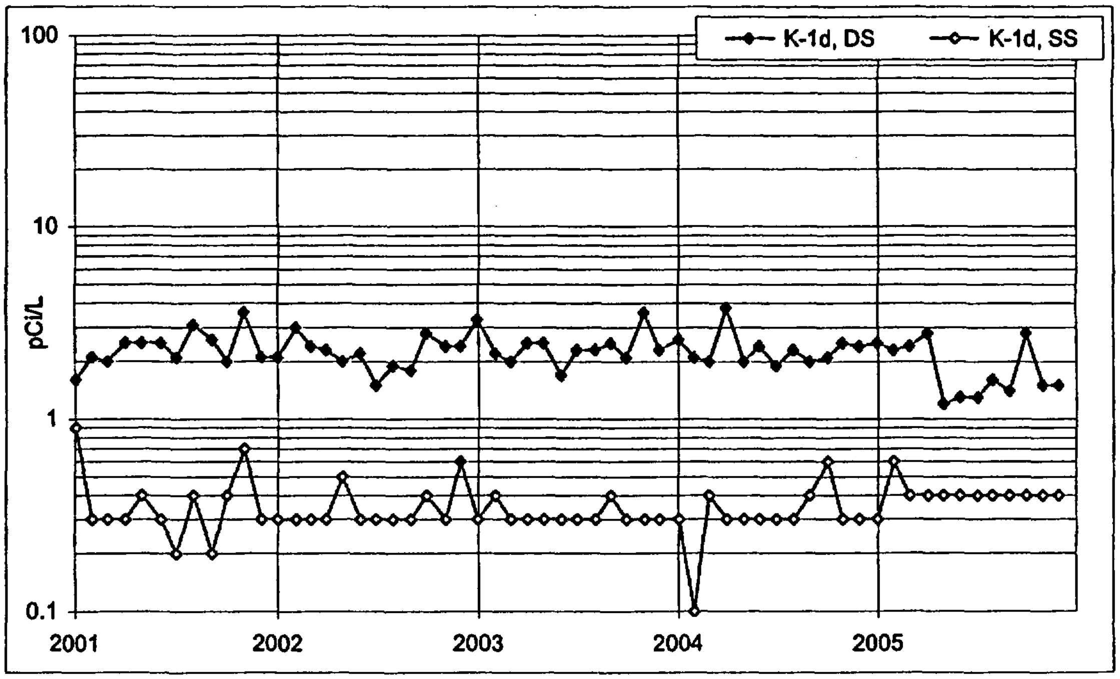

Figure 33. Surface water. Lake Michigan, condenser discharge, Onsite (K-1d).

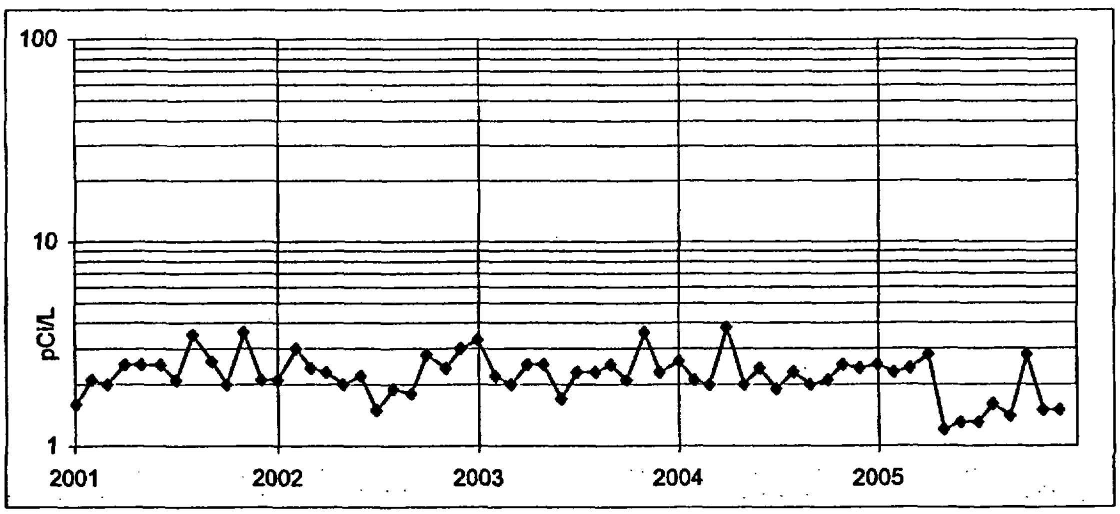

Figure 34. Surface water. Lake Michigan, condenser discharge, Onsite (K-1d).
Total Residue

Kewaunee

Surface Water - Gross Beta

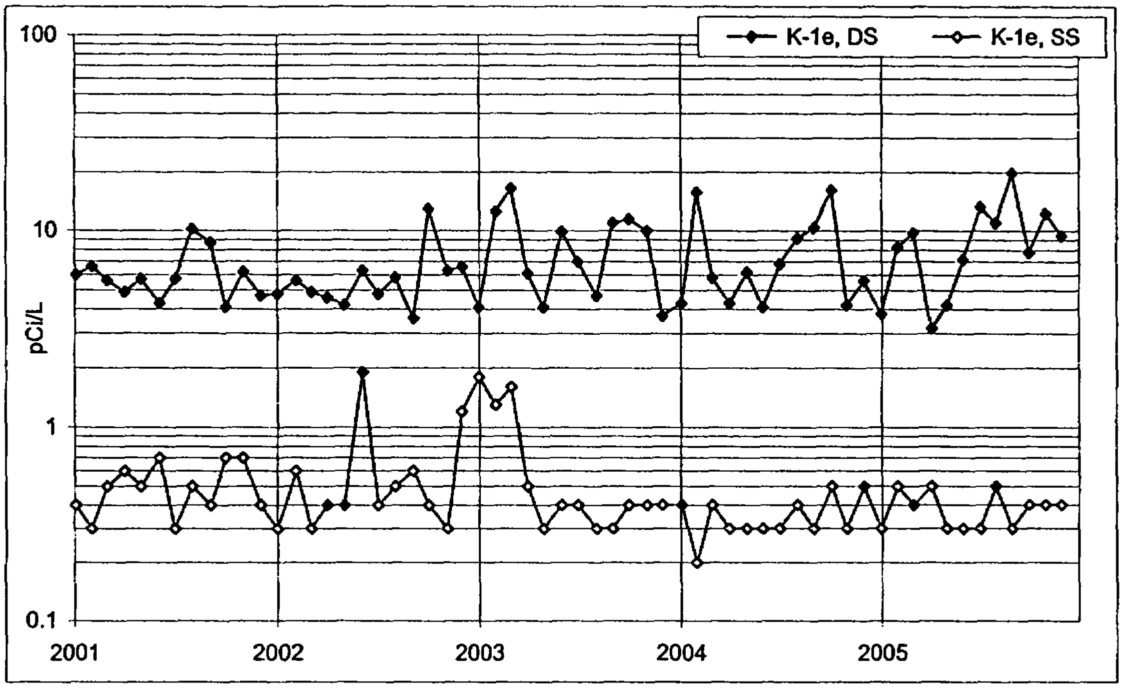

Figure 35. Surface water. South Creek, Onsite (K-1e).

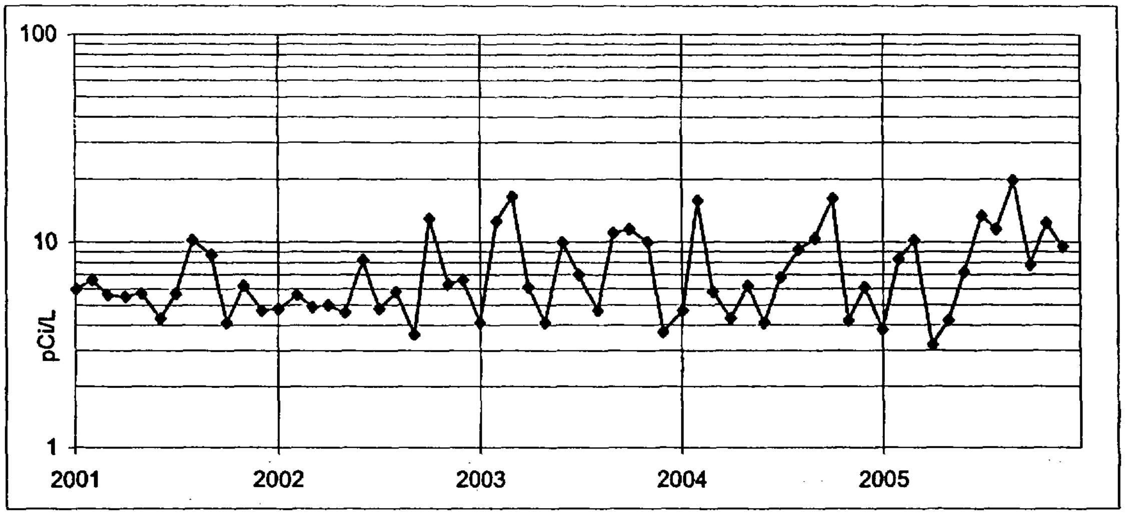

Figure 36. Surface water. South Creek, Onsite (K-1e).
Total Residue

Surface Water - Gross Beta

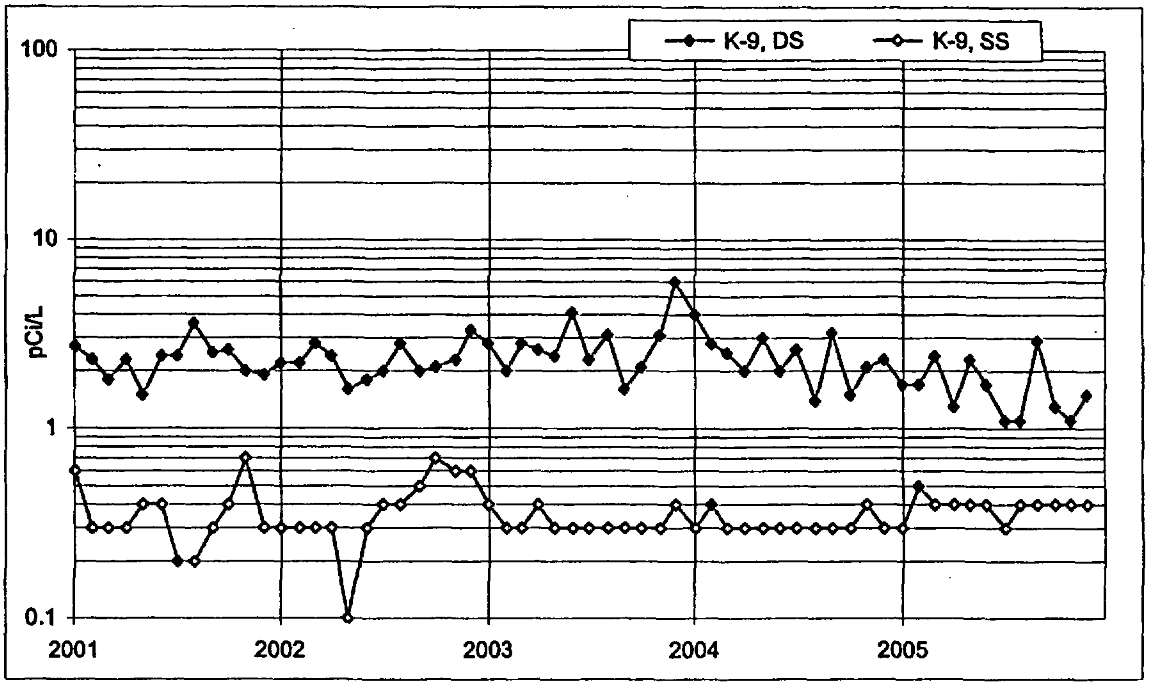

Figure 37. Surface water (raw). Lake Michigan, Rostok Intake (K-9)

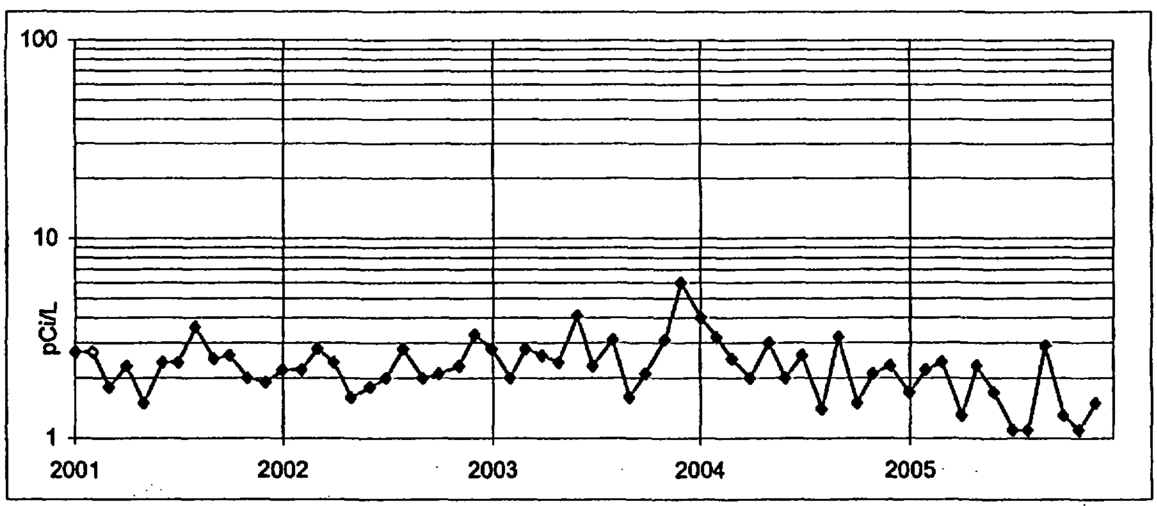

Figure 38. Surface water (raw). Lake Michigan, Rostok Intake (K-9)
Total Residue

Kewaunee

Surface Water - Gross Beta

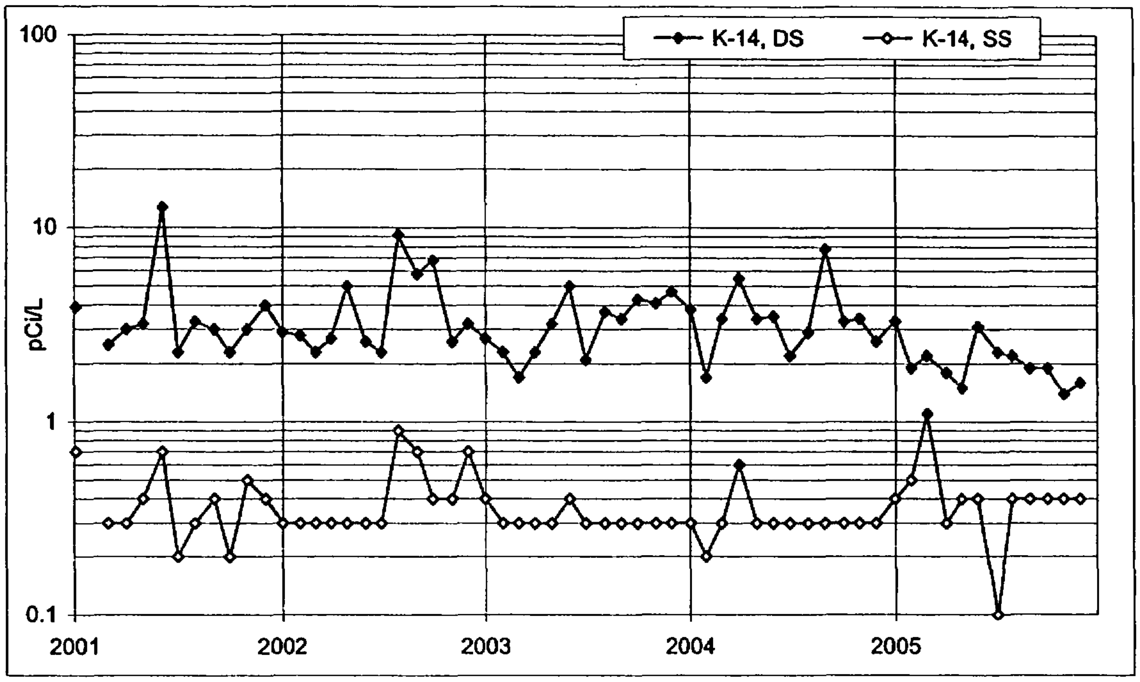

Figure 39. Surface water . Lake Michigan, Two Creeks Park (K-14a).

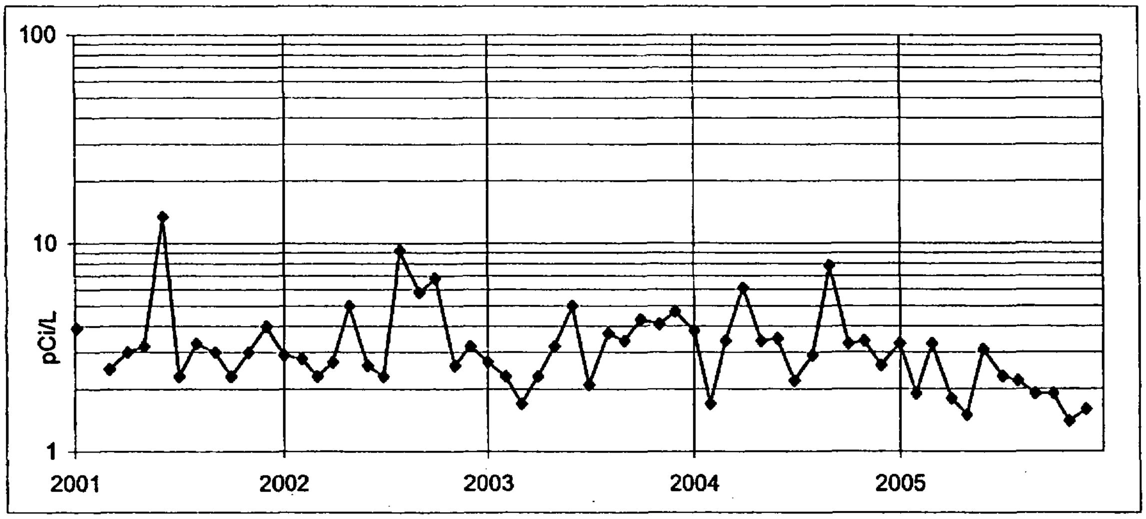

Figure 40. Surface water . Lake Michigan, Two Creeks Park (K-14a).
Total Residue

Kewaunee

Surface Water - Gross Beta

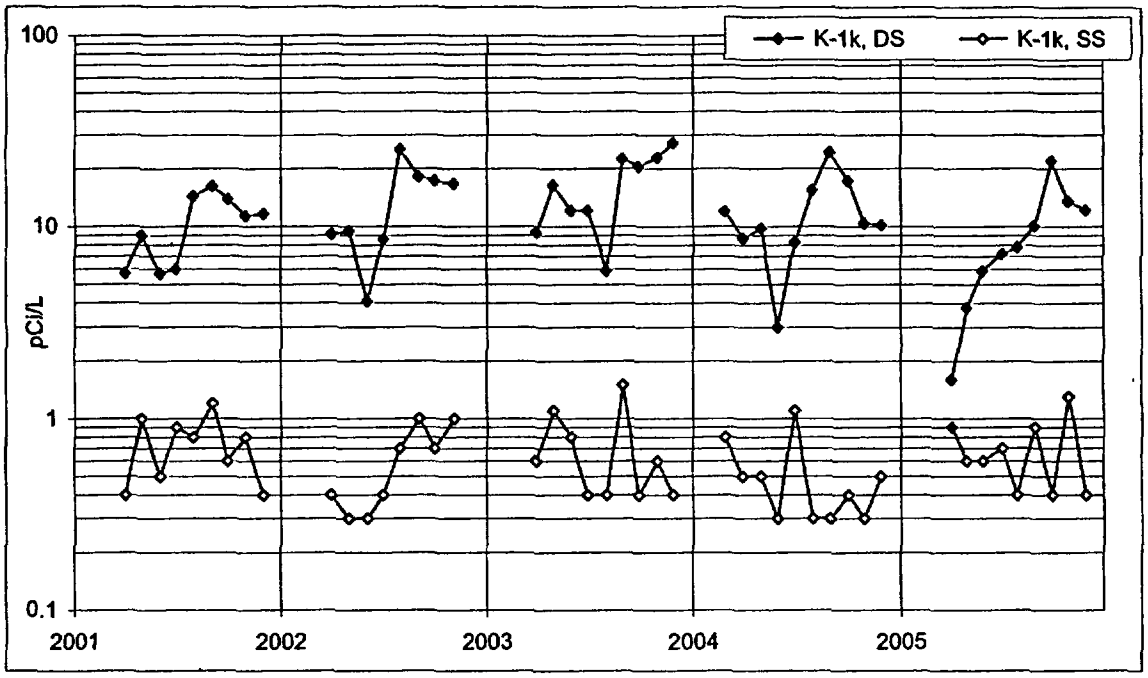

Figure 41. Surface water. School Forest Pond (K-1k).

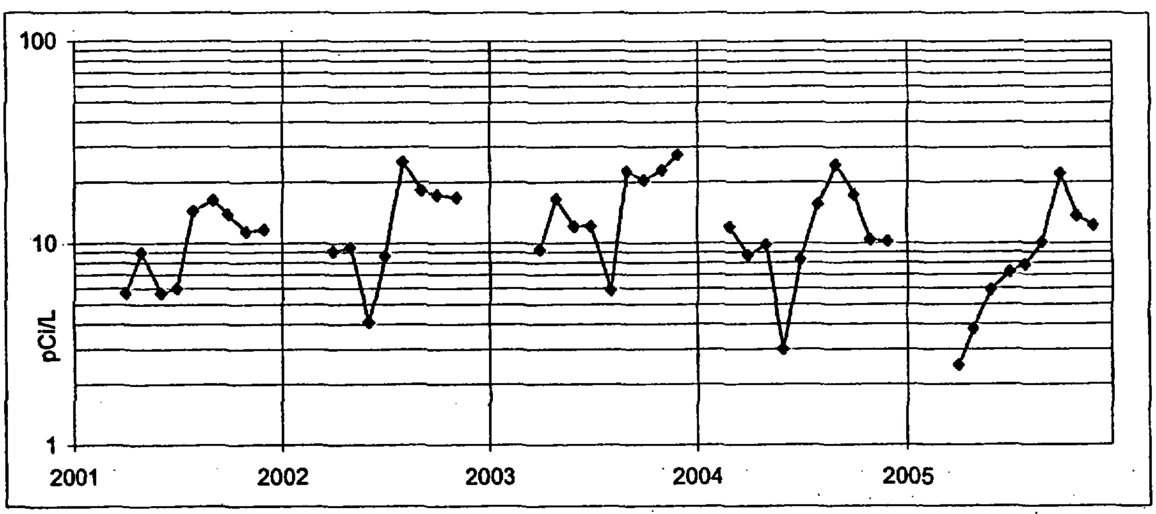

Figure 42. Surface water . School Forest Pond (K-1k).
Total Residue

Kewaunee

Surface Water - Tritium

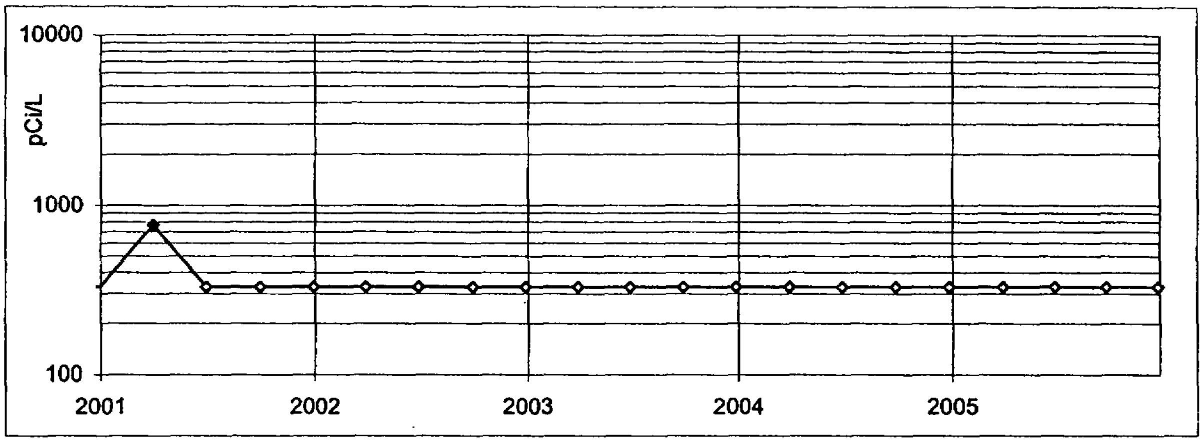

Figure 43. Surface water. Lake Michigan, condenser discharge, K-1d. Quarterly collection.

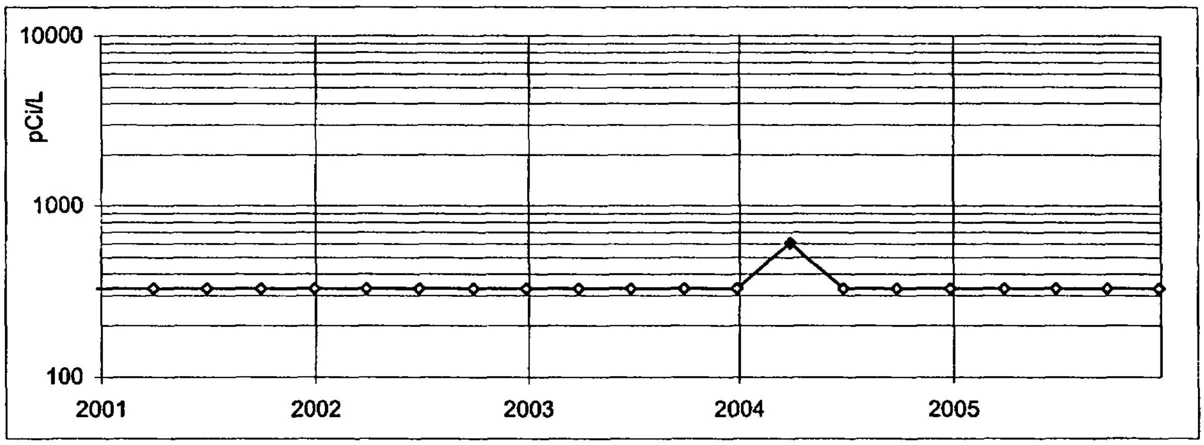

Figure 44. Surface water. Lake Michigan, Two Creeks Park, K-14a. Quarterly collection.

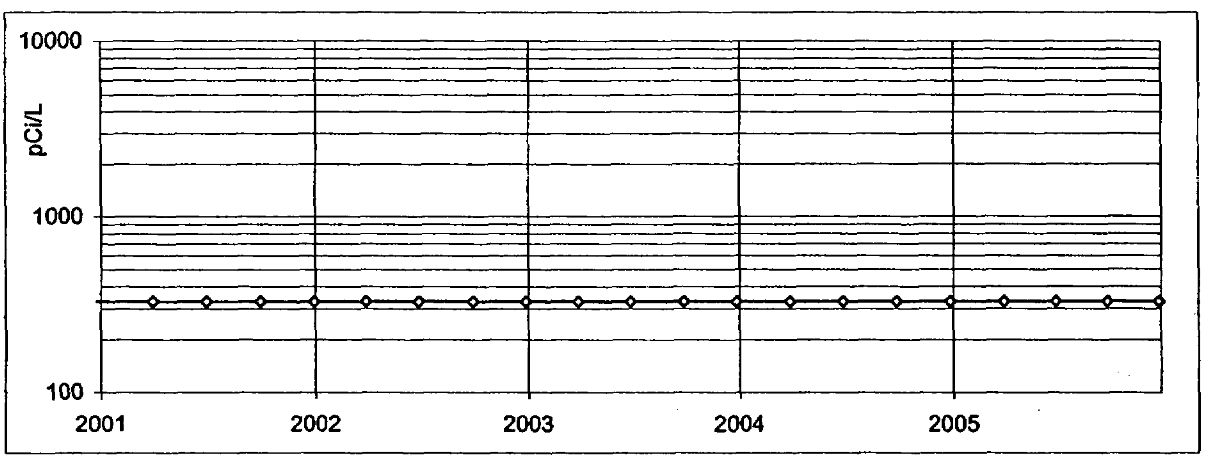

Figure 45. Surface water. Lake Michigan, Rostok Intake, K-9. Quarterly collection.

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6.0 DATA TABULATIONS

Table 4. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: K-1f
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-05	305	0.032 ± 0.004	07-05-05	460	0.013 ± 0.002
01-11-05	305	0.040 ± 0.004	07-12-05	405	0.020 ± 0.003
01-18-05	308	0.029 ± 0.004	07-19-05	412	0.029 ± 0.003
01-25-05	300	0.023 ± 0.003	07-26-05	402	0.018 ± 0.003
02-01-05	306	0.018 ± 0.003	08-02-05	402	0.017 ± 0.003
02-07-05	259	0.033 ± 0.004	08-09-05	406	0.031 ± 0.003
02-15-05	347	0.021 ± 0.003	08-16-05	412	0.022 ± 0.003
02-22-05	305	0.025 ± 0.004	08-23-05	399	0.013 ± 0.003
02-28-05	307	0.017 ± 0.003	08-30-05	380	0.020 ± 0.003
03-08-05	461	0.017 ± 0.002	09-06-05	354	0.015 ± 0.003
03-15-05	402	0.020 ± 0.003	09-13-05	334	0.048 ± 0.004
03-22-05	408	0.014 ± 0.002	09-20-05	302	0.026 ± 0.004
03-29-05	404	0.019 ± 0.003	09-27-05	307	0.032 ± 0.004
1st Quarter Mean ± s.d.		0.024 ± 0.008	3rd Quarter Mean ± s.d.		0.023 ± 0.010
04-05-05	389	0.018 ± 0.003	10-04-05	298	0.027 ± 0.004
04-12-05	390	0.017 ± 0.002	10-11-05	309	0.012 ± 0.003
04-19-05	404	0.021 ± 0.003	10-18-05	299	0.021 ± 0.004
04-26-05	406	0.014 ± 0.002	10-25-05	305	0.016 ± 0.003
05-03-05	410	0.006 ± 0.002	10-31-05	264	0.017 ± 0.004
05-10-05	402	0.026 ± 0.003	11-08-05	346	0.031 ± 0.004
05-17-05	387	0.008 ± 0.002	11-15-05	305	0.029 ± 0.004
05-24-05	348	0.016 ± 0.003	11-22-05	305	0.022 ± 0.003
05-31-05	369	0.006 ± 0.002	11-28-05	258	0.018 ± 0.004 [b]
06-07-05	394	0.019 ± 0.003	12-06-05	349	0.018 ± 0.004 [c]
06-14-05	385	0.018 ± 0.003	12-12-05	261	0.031 ± 0.004 [c]
06-21-05	406	0.009 ± 0.002	12-20-05	347	0.023 ± 0.003 [c]
06-27-05	351	0.021 ± 0.003	12-27-05	311	0.056 ± 0.005 [c]
			01-03-06	295	0.016 ± 0.003
2nd Quarter Mean ± s.d.		0.015 ± 0.006	4th Quarter Mean ± s.d.		0.024 ± 0.011
			Cumulative Average		0.022
			Previous Annual Average		0.018

[a] Iodine-131 is sampled biweekly. Concentrations are < 0.03 pCi/m^3 unless otherwise noted.
[b] Timer reading suspect (29.8 hrs.), filter appears normal, volume is estimate.
[c] Timer out of service, filter appears normal, volume is estimate.

Table 5. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: K-2
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-05	356	0.032 ± 0.004	07-05-05	403	0.011 ± 0.003
01-11-05	355	0.042 ± 0.004	07-12-05	356	0.023 ± 0.003
01-18-05	353	0.027 ± 0.003	07-19-05	351	0.030 ± 0.004
01-25-05	357	0.020 ± 0.003	07-26-05	363	0.018 ± 0.003
02-01-05	356	0.019 ± 0.003	08-02-05	350	0.017 ± 0.003
02-07-05	301	0.034 ± 0.004	08-09-05	354	0.035 ± 0.004
02-15-05	405	0.020 ± 0.003	08-16-05	353	0.023 ± 0.003
02-22-05	331	0.029 ± 0.004	08-23-05	356	0.023 ± 0.003
02-28-05	263	0.031 ± 0.004	08-30-05	355	0.019 ± 0.003
03-08-05	347	0.021 ± 0.003	09-06-05	354	0.016 ± 0.003
03-15-05	301	0.019 ± 0.003	09-13-05	329	0.037 ± 0.004
03-22-05	306	0.013 ± 0.003	09-20-05	307	0.026 ± 0.004
03-29-05	302	0.020 ± 0.003	09-27-05	301	0.028 ± 0.004
1st Quarter Mean ± s.d.		0.025 ± 0.008	3rd Quarter Mean ± s.d.		0.024 ± 0.008
04-05-05	329	0.020 ± 0.003	10-04-05	304	0.029 ± 0.004
04-12-05	354	0.017 ± 0.003	10-11-05	305	0.014 ± 0.003
04-19-05	354	0.019 ± 0.003	10-18-05	302	0.020 ± 0.003
04-26-05	359	0.015 ± 0.002	10-25-05	51	0.025 ± 0.015 [b]
05-03-05	356	0.008 ± 0.003	10-31-05	ND [c]	-
05-10-05	352	0.029 ± 0.003	11-08-05	ND [c]	-
05-17-05	352	0.009 ± 0.002	11-15-05	ND [c]	-
05-24-05	357	0.016 ± 0.003	11-22-05	ND [c]	-
05-31-05	354	0.008 ± 0.003	11-28-05	ND [c]	-
06-07-05	364	0.021 ± 0.003	12-06-05	ND [c]	-
06-14-05	345	0.017 ± 0.003	12-13-05	ND [c]	-
06-21-05	356	0.009 ± 0.002	12-20-05	ND [c]	-
06-27-05	307	0.023 ± 0.004	12-27-05	ND [c]	-
			01-03-06	218	0.014 ± 0.004
2nd Quarter Mean ± s.d.		0.016 ± 0.006	4th Quarter Mean ± s.d.		0.020 ± 0.007
			Cumulative Average		0.022
			Previous Annual Average		0.020

[a] Iodine-131 is sampled biweekly. Concentrations are < 0.03 pCi/m^3 unless otherwise noted.
[b] Low volume, The sampler pump power was disconnected during yard maintenance.
[c] No sample, The sampler pump power was disconnected during yard maintenance.

Table 6. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: K-7
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-05	303	0.033 ± 0.004	07-05-05	355	0.015 ± 0.003
01-11-05	306	0.046 ± 0.004	07-12-05	303	0.025 ± 0.004
01-18-05	305	0.030 ± 0.004	07-19-05	308	0.032 ± 0.004
01-25-05	301	0.028 ± 0.003	07-26-05	303	0.020 ± 0.004
02-01-05	307	0.023 ± 0.003	08-02-05	301	0.020 ± 0.004
02-07-05	260	0.036 ± 0.004	08-09-05	330	0.032 ± 0.004
02-15-05	347	0.022 ± 0.003	08-16-05	359	0.020 ± 0.003
02-22-05	301	0.027 ± 0.004	08-23-05	345	0.019 ± 0.003
02-28-05	263	0.024 ± 0.004	08-30-05	316	0.020 ± 0.003
03-08-05	344	0.022 ± 0.003	09-06-05	303	0.018 ± 0.004
03-15-05	301	0.021 ± 0.004	09-13-05	302	0.047 ± 0.005
03-22-05	306	0.015 ± 0.003	09-20-05	332	0.026 ± 0.004
03-29-05	317	0.018 ± 0.003	09-27-05	357	0.030 ± 0.003
1st Quarter Mean ± s.d.		0.027 ± 0.008	3rd Quarter Mean ± s.d.		0.025 ± 0.009
04-05-05	321	0.016 ± 0.003	10-04-05	351	0.027 ± 0.003
04-12-05	324	0.015 ± 0.003	10-11-05	353	0.014 ± 0.003
04-19-05	339	0.021 ± 0.003	10-18-05	360	0.020 ± 0.003
04-26-05	353	0.013 ± 0.002	10-25-05	355	0.014 ± 0.003
05-03-05	364	0.008 ± 0.002	10-31-05	303	0.016 ± 0.003
05-10-05	347	0.026 ± 0.003	11-08-05	406	0.032 ± 0.003
05-17-05	330	0.009 ± 0.002	11-15-05	354	0.025 ± 0.003
05-24-05	300	0.018 ± 0.003	11-22-05	355	0.021 ± 0.003
05-31-05	318	0.006 ± 0.003	11-28-05	301	0.016 ± 0.003
06-07-05	327	0.020 ± 0.003	12-06-05	408	0.017 ± 0.003
06-14-05	317	0.021 ± 0.003	12-12-05	283	0.036 ± 0.004
06-21-05	314	0.008 ± 0.002	12-20-05	359	0.034 ± 0.004
06-27-05	274	0.022 ± 0.004	12-27-05	313	0.056 ± 0.005
			01-03-06	294	0.014 ± 0.003
2nd Quarter Mean ± s.d.		0.016 ± 0.006	4th Quarter Mean ± s.d.		0.024 ± 0.012
			Cumulative Average		0.023
			Previous Annual Average		0.020

[a] Iodine-131 is sampled biweekly. Concentrations are < 0.03 pCi/m^3 unless otherwise noted.

Table 7. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: K-8
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-05	303	0.034 ± 0.004	07-05-05	355	0.012 ± 0.003
01-11-05	306	0.044 ± 0.004	07-12-05	303	0.023 ± 0.004
01-18-05	304	0.027 ± 0.004	07-19-05	307	0.032 ± 0.004
01-25-05	302	0.027 ± 0.003	07-26-05	303	0.021 ± 0.004
02-01-05	307	0.021 ± 0.003	08-02-05	301	0.021 ± 0.004
02-07-05	260	0.036 ± 0.004	08-09-05	305	0.035 ± 0.004
02-15-05	347	0.024 ± 0.003	08-16-05	307	0.022 ± 0.004
02-22-05	302	0.029 ± 0.004	08-23-05	303	0.021 ± 0.004
02-28-05	265	0.023 ± 0.004	08-30-05	302	0.019 ± 0.003
03-08-05	344	0.021 ± 0.003	09-06-05	303	0.014 ± 0.003
03-15-05	303	0.018 ± 0.003	09-13-05	301	0.042 ± 0.004
03-22-05	304	0.015 ± 0.003	09-20-05	333	0.027 ± 0.004
03-29-05	306	0.020 ± 0.003	09-27-05	356	0.028 ± 0.003
1st Quarter Mean ± s.d.		0.026 ± 0.008	3rd Quarter Mean ± s.d.		0.024 ± 0.008
04-05-05	301	0.016 ± 0.003	10-04-05	351	0.024 ± 0.003
04-12-05	313	0.018 ± 0.003	10-11-05	354	0.013 ± 0.003
04-19-05	338	0.020 ± 0.003	10-18-05	359	0.020 ± 0.003
04-26-05	353	0.014 ± 0.003	10-25-05	355	0.014 ± 0.003
05-03-05	363	0.006 ± 0.002	10-31-05	308	0.017 ± 0.004
05-10-05	323	0.028 ± 0.003	11-08-05	401	0.030 ± 0.003
05-17-05	304	0.009 ± 0.003	11-15-05	354	0.025 ± 0.003
05-24-05	301	0.016 ± 0.003	11-22-05	354	0.027 ± 0.003
05-31-05	307	0.007 ± 0.003	11-28-05	302	0.018 ± 0.003
06-07-05	307	0.022 ± 0.003	12-06-05	407	0.022 ± 0.003
06-14-05	297	0.020 ± 0.003	12-12-05	305	0.032 ± 0.004
06-21-05	304	0.011 ± 0.003	12-20-05	405	0.029 ± 0.003
06-27-05	274	0.022 ± 0.004	12-27-05	365	0.048 ± 0.004
			01-03-06	343	0.013 ± 0.003
2nd Quarter Mean ± s.d.		0.016 ± 0.007	4th Quarter Mean ± s.d.		0.024 ± 0.009
			Cumulative Average		0.023
			Previous Annual Average		0.021

[a] Iodine-131 is sampled biweekly. Concentrations are < 0.03 pCi/m^3 unless otherwise noted.

Table 8. Airborne particulates and charcoal canisters, analyses for gross beta and Iodine-131[a].
Location: K-16
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-05	304	0.036 ± 0.004	07-05-05	345	0.013 ± 0.003
01-11-05	305	0.045 ± 0.004	07-12-05	295	0.022 ± 0.004
01-18-05	301	0.028 ± 0.004	07-19-05	311	0.026 ± 0.004
01-25-05	306	0.022 ± 0.003	07-26-05	307	0.020 ± 0.003
02-01-05	307	0.020 ± 0.003	08-02-05	304	0.019 ± 0.003
02-07-05	257	0.038 ± 0.004	08-09-05	306	0.034 ± 0.004
02-15-05	347	0.019 ± 0.003	08-16-05	303	0.023 ± 0.004
02-22-05	305	0.028 ± 0.004	08-23-05	305	0.020 ± 0.004
02-28-05	264	0.026 ± 0.004	08-30-05	304	0.018 ± 0.003
03-08-05	345	0.020 ± 0.003	09-06-05	303	0.017 ± 0.003
03-15-05	302	0.023 ± 0.004	09-13-05	304	0.056 ± 0.005
03-22-05	306	0.014 ± 0.003	09-20-05	307	0.025 ± 0.004
03-29-05	302	0.017 ± 0.003	09-27-05	326	0.029 ± 0.004
1st Quarter Mean ± s.d.		0.026 ± 0.009	3rd Quarter Mean ± s.d.		0.025 ± 0.011
04-05-05	304	0.016 ± 0.003	10-04-05	356	0.026 ± 0.003
04-12-05	303	0.014 ± 0.003	10-11-05	354	0.013 ± 0.003
04-19-05	304	0.021 ± 0.003	10-18-05	365	0.020 ± 0.003
04-26-05	303	0.015 ± 0.003	10-25-05	354	0.013 ± 0.003
05-03-05	308	0.008 ± 0.003	10-31-05	290	0.018 ± 0.004
05-10-05	302	0.029 ± 0.003	11-08-05	404	0.031 ± 0.003
05-17-05	303	0.009 ± 0.003	11-15-05	354	0.030 ± 0.004
05-24-05	305	0.016 ± 0.003	11-22-05	330	0.024 ± 0.003
05-31-05	304	0.005 ± 0.003	11-28-05	260	0.016 ± 0.004
06-07-05	301	0.017 ± 0.003	12-06-05	348	0.019 ± 0.003
06-14-05	306	0.014 ± 0.003	12-12-05	270	0.035 ± 0.004
06-21-05	304	0.009 ± 0.002	12-20-05	359	0.030 ± 0.004
06-27-05	264	0.026 ± 0.004	12-27-05	310	0.055 ± 0.005
			01-03-06	297	0.015 ± 0.003
2nd Quarter Mean ± s.d.		0.015 ± 0.007	4th Quarter Mean ± s.d.		0.025 ± 0.011
			Cumulative Average		0.023
			Previous Annual Average		0.021

[a] Iodine-131 is sampled biweekly. Concentrations are < 0.03 pCi/m ^{3} unless otherwise noted.

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Table 9. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: K-31
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-05	305	0.040 ± 0.004	07-05-05	361	0.013 ± 0.003
01-11-05	304	0.048 ± 0.004	07-12-05	302	0.025 ± 0.004
01-18-05	303	0.026 ± 0.004	07-19-05	300	0.030 ± 0.004
01-25-05	306	0.024 ± 0.003	07-26-05	309	0.018 ± 0.003
02-01-05	305	0.022 ± 0.003	08-02-05	301	0.027 ± 0.004
02-07-05	259	0.037 ± 0.004	08-09-05	327	0.032 ± 0.004
02-15-05	347	0.022 ± 0.003	08-16-05	350	0.020 ± 0.003
02-22-05	306	0.026 ± 0.004	08-23-05	357	0.021 ± 0.003
02-28-05	263	0.025 ± 0.004	08-30-05	355	0.020 ± 0.003
03-08-05	345	0.021 ± 0.003	09-06-05	353	0.015 ± 0.003
03-15-05	301	0.018 ± 0.003	09-13-05	355	0.043 ± 0.004
03-22-05	305	0.014 ± 0.003	09-20-05	358	0.028 ± 0.003
03-29-05	302	0.021 ± 0.003	09-27-05	351	0.028 ± 0.003
1st Quarter Mean ± s.d.		0.026 ± 0.010	3rd Quarter Mean ± s.d.		0.025 ± 0.008
04-05-05	313	0.020 ± 0.004	10-04-05	356	0.023 ± 0.003
04-12-05	340	0.017 ± 0.003	10-11-05	355	0.014 ± 0.003
04-19-05	354	0.016 ± 0.003	10-18-05	344	0.017 ± 0.003
04-26-05	354	0.014 ± 0.002	10-25-05	319	0.014 ± 0.003
05-03-05	358	0.007 ± 0.002	10-31-05	265	0.016 ± 0.004
05-10-05	327	0.023 ± 0.003	11-08-05	357	0.034 ± 0.004
05-17-05	302	0.009 ± 0.003	11-15-05	314	0.029 ± 0.004
05-24-05	332	0.016 ± 0.003	11-22-05	308	0.023 ± 0.004
05-31-05	354	0.006 ± 0.003	11-28-05	256	0.020 ± 0.004
06-07-05	364	0.016 ± 0.003	12-06-05	348	0.017 ± 0.003
06-14-05	331	0.020 ± 0.003	12-12-05	283	0.034 ± 0.004
06-21-05	315	0.010 ± 0.002	12-20-05	406	0.023 ± 0.003
06-27-05	272	0.024 ± 0.004	12-27-05	362	0.051 ± 0.004
			01-03-06	331	0.013 ± 0.003
2nd Quarter Mean ± s.d.		0.015 ± 0.006	4th Quarter Mean ± s.d.		0.023 ± 0.011
			Cumulative Average		0.022
			Previous Annual Average		0.020

[a] Iodine-131 is sampled biweekly. Concentrations are < 0.03 pCi/m^3 unless otherwise noted.

Table 10. Airborne particulate data, gross beta analyses, monthly averages, minima and maxima.

January

Location	Average	Minima	Maxima
Indicators	0.030	0.018	0.046
K-1f	0.028	0.018	0.040
K-7	0.032	0.023	0.046
Controls	0.030	0.019	0.048
K-2	0.028	0.019	0.042
K-8	0.031	0.021	0.044
K-16	0.030	0.020	0.045
K-31	0.032	0.022	0.048

February

Location	Average	Minima	Maxima
Indicators	0.026	0.017	0.036
K-1f	0.024	0.017	0.033
K-7	0.027	0.022	0.036
Controls	0.028	0.019	0.038
K-2	0.029	0.020	0.034
K-8	0.028	0.023	0.036
K-16	0.028	0.019	0.038
K-31	0.028	0.022	0.037

March

Location	Average	Minima	Maxima
Indicators	0.018	0.014	0.022
K-1f	0.018	0.014	0.020
K-7	0.019	0.015	0.022
Controls	0.018	0.013	0.023
K-2	0.018	0.013	0.021
K-8	0.019	0.015	0.021
K-16	0.019	0.014	0.023
K-31	0.019	0.014	0.021

April

Location	Average	Minima	Maxima
Indicators	0.015	0.006	0.021
K-1f	0.015	0.006	0.021
K-7	0.015	0.008	0.021
Controls	0.015	0.006	0.021
K-2	0.016	0.008	0.020
K-8	0.015	0.006	0.020
K-16	0.015	0.008	0.021
K-31	0.015	0.007	0.020

May

Location	Average	Minima	Maxima
Indicators	0.014	0.006	0.026
K-1f	0.014	0.006	0.026
K-7	0.015	0.006	0.026
Controls	0.015	0.005	0.029
K-2	0.016	0.008	0.029
K-8	0.015	0.007	0.028
K-16	0.015	0.005	0.029
K-31	0.014	0.006	0.023

June

Location	Average	Minima	Maxima
Indicators			
K-1f	0.017	0.009	0.021
K-7	0.018	0.008	0.022
Controls	0.018	0.009	0.026
K-2	0.018	0.009	0.023
K-8	0.019	0.011	0.022
K-16	0.017	0.009	0.026
K-31	0.018	0.010	0.024

Note: Samples collected on the first, second or third day of the month are grouped with data of the previous month.

Table 10. Airborne particulate data, gross beta analyses, monthly averages, minima and maxima.

July

Location	Average	Minima	Maxima
Indicators	0.021	0.013	0.032
K-1f	0.019	0.013	0.029
K-7	0.022	0.015	0.032
Controls	0.021	0.011	0.032
K-2	0.020	0.011	0.030
K-8	0.022	0.012	0.032
K-16	0.020	0.013	0.026
K-31	0.023	0.013	0.030

October

Location	Average	Minima	Maxima
Indicators	0.018	0.012	0.027
K-1f	0.019	0.012	0.027
K-7	0.018	0.014	0.027
Controls	0.019	0.013	0.029
K-2	0.022	0.014	0.029
K-8	0.018	0.013	0.024
K-16	0.018	0.013	0.026
K-31	0.017	0.014	0.023

August

Location	Average	Minima	Maxima
Indicators	0.022	0.013	0.032
K-1f	0.022	0.013	0.031
K-7	0.023	0.019	0.032
Controls	0.024	0.018	0.035
K-2	0.025	0.019	0.035
K-8	0.024	0.019	0.035
K-16	0.024	0.018	0.034
K-31	0.023	0.018	0.034

November

Location	Average	Minima	Maxima
Indicators	0.024	0.016	0.032
K-1f	0.025	0.018	0.031
K-7	0.024	0.016	0.032
Controls	0.026	0.016	0.034
K-2	-	-	-
K-8	0.025	0.018	0.030
K-16	0.025	0.016	0.031
K-31	0.027	0.020	0.034

September

Location	Average	Minima	Maxima
Indicators	0.030	0.015	0.048
K-1f	0.030	0.015	0.048
K-7	0.030	0.018	0.047
Controls	0.029	0.014	0.056
K-2	0.027	0.016	0.037
K-8	0.028	0.014	0.042
K-16	0.032	0.017	0.056
K-31	0.029	0.015	0.043

December

Location	Average	Minima	Maxima
Indicators	0.030	0.014	0.056
K-1f	0.029	0.016	0.056
K-7	0.031	0.014	0.056
Controls	0.025	0.013	0.055
K-2	0.014	0.014	0.014
K-8	0.029	0.013	0.048
K-16	0.031	0.015	0.055
K-31	0.028	0.013	0.051

Note: Samples collected on the first, second or third day of the month are grouped with data of the previous month.

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Table 11. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes.

	Sample Description and Concentration (pCi/m^3)			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Indicator				
K-1f				
Lab Code	KAP-2010	KAP-4075	KAP-5899, 5900	KAP-7509
Volume (m^3)	4417	5041	4975	4252
Be-7	0.053 ± 0.013	0.064 ± 0.014	0.065 ± 0.008	0.041 ± 0.010
Nb-95	< 0.0006	< 0.0006	< 0.0003	< 0.0006
Zr-95	< 0.0018	< 0.0005	< 0.0008	< 0.0010
Ru-103	< 0.0008	< 0.0007	< 0.0004	< 0.0008
Ru-106	< 0.0045	< 0.0049	< 0.0047	< 0.0047
Cs-134	< 0.0007	< 0.0004	< 0.0005	< 0.0007
Cs-137	< 0.0004	< 0.0004	< 0.0005	< 0.0004
Ce-141	< 0.0021	< 0.0007	< 0.0008	< 0.0006
Ce-144	< 0.0037	< 0.0041	< 0.0024	< 0.0040
K-7				
Lab Code	KAP-2012	KAP-4077	KAP-5902	KAP-7511
Volume (m^3)	3961	4228	4214	4795
Be-7	0.061 ± 0.014	0.056 ± 0.012	0.066 ± 0.014	0.039 ± 0.009
Nb-95	< 0.0015	< 0.0007	< 0.0006	< 0.0006
Zr-95	< 0.0019	< 0.0017	< 0.0012	< 0.0009
Ru-103	< 0.0009	< 0.0008	< 0.0006	< 0.0005
Ru-106	< 0.0086	< 0.0065	< 0.0047	< 0.0053
Cs-134	< 0.0011	< 0.0005	< 0.0006	< 0.0008
Cs-137	< 0.0005	< 0.0005	< 0.0003	< 0.0003
Ce-141	< 0.0020	< 0.0013	< 0.0016	< 0.0012
Ce-144	< 0.0023	< 0.0037	< 0.0032	< 0.0020

Table 11. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, (continued).

	Sample Description and Concentration (pCi/m^3)			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Control				
K-2				
Lab Code	KAP-2011	KAP-4076	KAP-5901	KAP-7510
Volume (m^3)	4333	4539	4532	1180
Be-7	0.063 ± 0.012	0.056 ± 0.012	0.065 ± 0.014	0.042 ± 0.030
Nb-95	< 0.0007	< 0.0003	< 0.0009	< 0.0028
Zr-95	< 0.0011	< 0.0005	< 0.0008	< 0.0043
Ru-103	< 0.0008	< 0.0007	< 0.0009	< 0.0026
Ru-106	< 0.0051	< 0.0038	< 0.0053	< 0.012
Cs-134	< 0.0007	< 0.0007	< 0.0005	< 0.0020
Cs-137	< 0.0005	< 0.0006	< 0.0006	< 0.0020
Ce-141	< 0.0017	< 0.0010	< 0.0018	< 0.0021
Ce-144	< 0.0026	< 0.0021	< 0.0025	< 0.012
K-8				
Lab Code	KAP-2013	KAP-4078	KAP-5903	KAP-7512
Volume (m^3)	3953	4085	4079	4963
Be-7	0.062 ± 0.013	0.074 ± 0.014	0.070 ± 0.012	0.036 ± 0.010
Nb-95	< 0.0007	< 0.0005	< 0.0009	< 0.0009
Zr-95	< 0.0011	< 0.0009	< 0.0009	< 0.0017
Ru-103	< 0.0006	< 0.0010	< 0.0007	< 0.0004
Ru-106	< 0.0049	< 0.0044	< 0.0042	< 0.0061
Cs-134	< 0.0010	< 0.0005	< 0.0011	< 0.0005
Cs-137	< 0.0006	< 0.0003	< 0.0006	< 0.0005
Ce-141	< 0.0009	< 0.0013	< 0.0018	< 0.0008
Ce-144	< 0.0034	< 0.0041	< 0.0023	< 0.0028

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Table 11. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, (continued).

	Sample Description and Concentration (pCi/m^3)			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Control				
K-16				
Lab Code	KAP-2014	KAP-4079	KAP-5904	KAP-7513, 4
Volume (m^3)	3951	3911	4020	4651
Be-7	0.078 ± 0.013	0.063 ± 0.013	0.072 ± 0.016	0.035 ± 0.006
Nb-95	< 0.0009	< 0.0005	< 0.0006	< 0.0004
Zr-95	< 0.0016	< 0.0017	< 0.0017	< 0.0006
Ru-103	< 0.0010	< 0.0005	< 0.0006	< 0.0007
Ru-106	< 0.0045	< 0.0067	< 0.0043	< 0.0041
Cs-134	< 0.0009	< 0.0006	< 0.0008	< 0.0004
Cs-137	< 0.0006	< 0.0008	< 0.0006	< 0.0005
Ce-141	< 0.0010	< 0.0014	< 0.0022	< 0.0005
Ce-144	< 0.0038	< 0.0050	< 0.0054	< 0.0028
K-31				
Lab Code	KAP-2010	KAP-4080	KAP-5905	KAP-7515
Volume (m^3)	3951	4316	4379	4604
Be-7	0.066 ± 0.015	0.058 ± 0.016	0.072 ± 0.014	0.043 ± 0.011
Nb-95	< 0.0009	< 0.0004	< 0.0010	< 0.0004
Zr-95	< 0.0016	< 0.0012	< 0.0006	< 0.0016
Ru-103	< 0.0009	< 0.0005	< 0.0004	< 0.0008
Ru-106	< 0.0045	< 0.0049	< 0.0055	< 0.0049
Cs-134	< 0.0012	< 0.0004	< 0.0006	< 0.0007
Cs-137	< 0.0005	< 0.0004	< 0.0004	< 0.0006
Ce-141	< 0.0012	< 0.0017	< 0.0015	< 0.0008
Ce-144	< 0.0044	< 0.0044	< 0.0038	< 0.0022

Table 12. Ambient gamma radiation (TLD), quarterly exposure.

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	
Date Placed	01-03-05	04-04-05	07-05-05	10-03-05	
Date Removed	04-04-05	07-05-05	10-03-05	01-03-06	
	mR/91 days[a]				
Indicator					Mean±s.d.
K-1f	10.8 ± 0.4	13.6 ± 0.7[c]	12.3 ± 0.4	12.1 ± 0.8	12.2 ± 1.1
K-5	13.8 ± 0.5	20.2 ± 0.7	19.0 ± 0.6	18.5 ± 0.5	17.9 ± 2.8
K-7	15.1 ± 0.6	20.5 ± 0.8	18.9 ± 0.7	19.2 ± 0.6	18.4 ± 2.3
K-17	11.3 ± 0.4	14.5 ± 0.4	16.7 ± 0.5	13.1 ± 0.3	13.9 ± 2.3
K-25	13.9 ± 0.6	18.7 ± 0.6	17.2 ± 0.8	16.8 ± 0.5	16.7 ± 2.0
K-27	ND[b]	19.2 ± 1.2	16.0 ± 0.6	17.2 ± 1.0	17.5 ± 1.6
K-30	12.5 ± 0.4	14.6 ± 0.7	15.3 ± 0.6	13.2 ± 0.7	13.9 ± 1.3
K-39	12.7 ± 0.6	18.2 ± 0.6	16.1 ± 0.7	16.1 ± 0.8	15.8 ± 2.3
Mean ± s.d.	12.9 ± 1.5	17.4 ± 2.8	16.4 ± 2.1	15.8 ± 2.7	15.6 ± 2.0
Control					
K-2	11.7 ± 0.4	16.6 ± 0.6	16.1 ± 0.6	15.3 ± 0.6	14.9 ± 2.2
K-3	14.2 ± 0.8	19.1 ± 0.9	17.9 ± 1.0	17.2 ± 1.0	17.1 ± 2.1
K-8	12.9 ± 0.5	16.3 ± 0.7	16.4 ± 0.8	15.0 ± 0.7	15.1 ± 1.6
K-15	11.3 ± 0.4	15.8 ± 0.5	15.0 ± 0.5	14.3 ± 0.3	14.1 ± 2.0
K-16	12.1 ± 0.7	13.2 ± 0.5	13.1 ± 0.7	12.4 ± 0.4	12.7 ± 0.6
K-31	10.1 ± 0.3	13.6 ± 0.8	12.3 ± 0.4	12.3 ± 0.7	12.1 ± 1.5
Mean ± s.d.	12.1 ± 1.4	15.8 ± 2.2	15.1 ± 2.1	14.4 ± 1.9	14.3 ± 1.6

[a] The uncertainty for each location corresponds to the two-standard deviation error of the average dose of eight dosimeters placed at this location.
[b] TLD lost in the field.
[c] TLD missing on date removed. Found later by KPS personnel.

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Table 13. Precipitation samples collected at Location K-11; analysis for tritium.

Date Collected	Lab Code	H-3 pCi/L	H-3 T.U. (100 T.U. = 320 pCi/L)
01/04/05	KP -73	< 192	< 60
02/01/05	-555	< 163	< 51
03/01/05	-999, 1000	< 163	< 51
04/05/05	-1646	< 139	< 43
05/03/05	-2422	< 140	< 44
05/31/05	-2999	< 167	< 52
07/05/05	-3820	< 165	< 52
08/02/05	-4478	< 168	< 53
08/30/05	-4939	< 166	< 52
10/04/05	-5572	< 169	< 53
10/31/05	-6291	< 180	< 56
11/28/05	-6727	< 184	< 58

Table 14. Milk, analyses for Iodine-131 and gamma-emitting isotopes.
Collection: Semimonthly during grazing season, monthly at other times.

Collection Date	Lab Code	Concentration (pCi/L)				
		I-131	Cs-134	Cs-137	Ba-La-140	K-40
Indicators						
K-5						
01-03-05	KMI - 3	< 0.5	< 10	< 10	< 15	1320 ± 152
02-01-05	- 490	< 0.5	< 10	< 10	< 15	1332 ± 117
03-01-05	- 954	< 0.5	< 10	< 10	< 15	1327 ± 115
04-04-05	- 1573	< 0.5	< 10	< 10	< 15	1365 ± 179
05-02-05	- 2254	< 0.5	< 10	< 10	< 15	1472 ± 111
05-17-05	- 2613	< 0.5	< 10	< 10	< 15	1396 ± 184
06-01-05	- 2964	< 0.5	< 10	< 10	< 15	1349 ± 190
06-14-05	- 3284	< 0.5	< 10	< 10	< 15	1479 ± 119
07-05-05	- 3667	< 0.5	< 10	< 10	< 15	1368 ± 165
07-19-05	- 4027	< 0.5	< 10	< 10	< 15	1200 ± 155
08-01-05	- 4411	< 0.5	< 10	< 10	< 15	1397 ± 119
08-16-05	- 4700	< 0.5	< 10	< 10	< 15	1302 ± 116
09-01-05	- 4885	< 0.5	< 10	< 10	< 15	1524 ± 167
09-13-05	- 5107	< 0.5	< 10	< 10	< 15	1369 ± 184
10-03-05	- 5490	< 0.5	< 10	< 10	< 15	1303 ± 160
10-18-05	- 5915	< 0.5	< 10	< 10	< 15	1418 ± 162
11-01-05	- 6240	< 0.5	< 10	< 10	< 15	1441 ± 118
12-01-05	- 6761	< 0.5	< 10	< 10	< 15	1388 ± 177
K-25						
01-04-05	KMI - 4	< 0.5	< 10	< 10	< 15	1368 ± 117
02-01-05	- 491	< 0.5	< 10	< 10	< 15	1288 ± 184
03-02-05	- 955	< 0.5	< 10	< 10	< 15	1404 ± 161
04-05-05	- 1574	< 0.5	< 10	< 10	< 15	1315 ± 125
05-03-05	- 2255	< 0.5	< 10	< 10	< 15	1322 ± 116
05-17-05	- 2614	< 0.5	< 10	< 10	< 15	1411 ± 173
06-02-05	- 2965	< 0.5	< 10	< 10	< 15	1407 ± 168
06-14-05	- 3285	< 0.5	< 10	< 10	< 15	1238 ± 178
07-06-05	- 3668	< 0.5	< 10	< 10	< 15	1354 ± 106
07-19-05	- 4028	< 0.5	< 10	< 10	< 15	1353 ± 163
08-02-05	- 4412	< 0.5	< 10	< 10	< 15	1443 ± 172
08-16-05	- 4701	< 0.5	< 10	< 10	< 15	1284 ± 176
09-02-05	- 4886	< 0.5	< 10	< 10	< 15	1385 ± 119
09-13-05	- 5108	< 0.5	< 10	< 10	< 15	1491 ± 123
10-04-05	- 5491	< 0.5	< 10	< 10	< 15	1328 ± 118
10-18-05	- 5916	< 0.5	< 10	< 10	< 15	1485 ± 179
11-02-05	- 6241	< 0.5	< 10	< 10	< 15	1224 ± 162
12-02-05	- 6762	< 0.5	< 10	< 10	< 15	1472 ± 184

Table 14. Milk, analyses for iodine-131 and gamma-emitting isotopes (continued).

Collection Date	Lab Code	Concentration (pCi/L)				
		I-131	Cs-134	Cs-137	Ba-La-140	K-40
Indicators						
K-34						
01-03-05	KMI - 6	< 0.5	< 10	< 10	< 15	1465 ± 121
02-01-05	- 493	< 0.5	< 10	< 10	< 15	1460 ± 178
03-01-05	- 957	< 0.5	< 10	< 10	< 15	1409 ± 174
04-04-05	- 1576	< 0.5	< 10	< 10	< 15	1399 ± 185
05-02-05	- 2257	< 0.5	< 10	< 10	< 15	1320 ± 111
05-17-05	- 2616	< 0.5	< 10	< 10	< 15	1353 ± 184
06-01-05	- 2967	< 0.5	< 10	< 10	< 15	1522 ± 188
06-14-05	- 3287	< 0.5	< 10	< 10	< 15	1374 ± 127
07-05-05	- 3670	< 0.5	< 10	< 10	< 15	1282 ± 229
07-19-05	- 4030	< 0.5	< 10	< 10	< 15	1422 ± 179
08-01-05	- 4414	< 0.5	< 10	< 10	< 15	1318 ± 187
08-16-05	- 4703	< 0.5	< 10	< 10	< 15	1490 ± 191
09-01-05	- 4888	< 0.5	< 10	< 10	< 15	1341 ± 110
09-13-05	- 5110	< 0.5	< 10	< 10	< 15	1617 ± 177
10-03-05	- 5493	< 0.5	< 10	< 10	< 15	1127 ± 184
10-18-05	- 5918	< 0.5	< 10	< 10	< 15	1350 ± 127
11-01-05	- 6243	< 0.5	< 10	< 10	< 15	1418 ± 180
12-01-05	- 6764	< 0.5	< 10	< 10	< 15	1385 ± 131

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Table 14. Milk, analyses for iodine-131 and gamma-emitting isotopes (continued).

Collection Date	Lab Code	Concentration (pCi/L)				
		I-131	Cs-134	Cs-137	Ba-La-140	K-40
Indicators						
K-38						
01-03-05	KMI - 7	< 0.5	< 10	< 10	< 15	1438 ± 171
02-02-05	- 494	< 0.5	< 10	< 10	< 15	1291 ± 155
03-02-05	- 958	< 0.5	< 10	< 10	< 15	1370 ± 114
04-05-05	- 1577	< 0.5	< 10	< 10	< 15	1517 ± 171
05-03-05	- 2258	< 0.5	< 10	< 10	< 15	1222 ± 166
05-17-05	- 2617	< 0.5	< 10	< 10	< 15	1177 ± 175
06-02-05	- 2968	< 0.5	< 10	< 10	< 15	1253 ± 181
06-14-05	- 3288	< 0.5	< 10	< 10	< 15	1442 ± 182
07-06-05	- 3671	< 0.5	< 10	< 10	< 15	1300 ± 129
07-19-05	- 4031	< 0.5	< 10	< 10	< 15	1338 ± 179
08-01-05	- 4415	< 0.5	< 10	< 10	< 15	1444 ± 174
08-16-05	- 4704	< 0.5	< 10	< 10	< 15	1251 ± 126
09-02-05	- 4889	< 0.5	< 10	< 10	< 15	1236 ± 152
09-13-05	- 5111	< 0.5	< 10	< 10	< 15	1282 ± 182
10-04-05	- 5494	< 0.5	< 10	< 10	< 15	1301 ± 173
10-18-05	- 5919	< 0.5	< 10	< 10	< 15	1249 ± 216
11-01-05	- 6244	< 0.5	< 10	< 10	< 15	1370 ± 163
12-01-05	- 6765	< 0.5	< 10	< 10	< 15	1297 ± 122
K-39						
01-03-05	KMI - 8	< 0.5	< 10	< 10	< 15	1377 ± 117
02-02-05	- 495	< 0.5	< 10	< 10	< 15	1391 ± 166
03-02-05	- 959	< 0.5	< 10	< 10	< 15	1307 ± 159
04-05-05	- 1578	< 0.5	< 10	< 10	< 15	1324 ± 170
05-03-05	- 2259	< 0.5	< 10	< 10	< 15	1341 ± 180
05-17-05	- 2618	< 0.5	< 10	< 10	< 15	1268 ± 130
06-02-05	- 2969	< 0.5	< 10	< 10	< 15	1214 ± 171
06-14-05	- 3289	< 0.5	< 10	< 10	< 15	1350 ± 187
07-06-05	- 3672	< 0.5	< 10	< 10	< 15	1458 ± 120
07-19-05	- 4032	< 0.5	< 10	< 10	< 15	1418 ± 158
08-01-05	- 4416	< 0.5	< 10	< 10	< 15	1364 ± 115
08-16-05	- 4705	< 0.5	< 10	< 10	< 15	1330 ± 178
09-02-05	- 4890	< 0.5	< 10	< 10	< 15	1425 ± 110
09-13-05	- 5112	< 0.5	< 10	< 10	< 15	1502 ± 172
10-04-05	- 5495	< 0.5	< 10	< 10	< 15	1391 ± 153
10-18-05	- 5920	< 0.5	< 10	< 10	< 15	1370 ± 175
11-01-05	- 6245	< 0.5	< 10	< 10	< 15	1414 ± 170
12-01-05	- 6766	< 0.5	< 10	< 10	< 15	1442 ± 192

Table 14. Milk, analyses for iodine-131 and gamma-emitting isotopes (continued).

Collection Date	Lab Code	Concentration (pCi/L)				
		I-131	Cs-134	Cs-137	Ba-La-140	K-40
Control						
K-3						
01-04-05	KMI - 2	< 0.5	< 10	< 10	< 15	1291 ± 164
02-02-05	- 489	< 0.5	< 10	< 10	< 15	1475 ± 186
03-02-05	- 953	< 0.5	< 10	< 10	< 15	1361 ± 183
04-05-05	- 1572	< 0.5	< 10	< 10	< 15	1346 ± 195
05-03-05	- 2253	< 0.5	< 10	< 10	< 15	1366 ± 170
05-17-05	- 2612	< 0.5	< 10	< 10	< 15	1072 ± 187
06-02-05	- 2963	< 0.5	< 10	< 10	< 15	1316 ± 109
06-14-05	- 3283	< 0.5	< 10	< 10	< 15	1337 ± 119
07-06-05	- 3666	< 0.5	< 10	< 10	< 15	1446 ± 155
07-19-05	- 4026	< 0.5	< 10	< 10	< 15	1355 ± 158
08-02-05	- 4410	< 0.5	< 10	< 10	< 15	1346 ± 199
08-16-05	- 4699	< 0.5	< 10	< 10	< 15	1329 ± 127
09-02-05	- 4884	< 0.5	< 10	< 10	< 15	1403 ± 119
09-13-05	- 5106	< 0.5	< 10	< 10	< 15	1360 ± 110
10-04-05	- 5489	< 0.5	< 10	< 10	< 15	1416 ± 174
10-18-05	- 5914	< 0.5	< 10	< 10	< 15	1453 ± 176
11-02-05	- 6239	< 0.5	< 10	< 10	< 15	1360 ± 174
12-02-05	- 6760	< 0.5	< 10	< 10	< 15	1548 ± 183
K-28						
01-04-05	KMI - 5	< 0.5	< 10	< 10	< 15	1370 ± 116
02-02-05	- 492	< 0.5	< 10	< 10	< 15	1278 ± 157
03-02-05	- 956	< 0.5	< 10	< 10	< 15	1301 ± 160
04-05-05	- 1575	< 0.5	< 10	< 10	< 15	1405 ± 180
05-03-05	- 2256	< 0.5	< 10	< 10	< 15	1181 ± 166
05-17-05	- 2615	< 0.5	< 10	< 10	< 15	1289 ± 169
06-02-05	- 2966	< 0.5	< 10	< 10	< 15	1409 ± 189
06-14-05	- 3286	< 0.5	< 10	< 10	< 15	1487 ± 205
07-06-05	- 3669	< 0.5	< 10	< 10	< 15	1329 ± 92
07-19-05	- 4029	< 0.5	< 10	< 10	< 15	1381 ± 110
08-02-05	- 4413	< 0.5	< 10	< 10	< 15	1293 ± 159
08-16-05	- 4702	< 0.5	< 10	< 10	< 15	1467 ± 167
09-02-05	- 4887	< 0.5	< 10	< 10	< 15	1272 ± 155
09-13-05	- 5109	< 0.5	< 10	< 10	< 15	1277 ± 173
10-04-05	- 5492	< 0.5	< 10	< 10	< 15	1345 ± 115
10-18-05	- 5917	< 0.5	< 10	< 10	< 15	1282 ± 171
11-02-05	- 6242	< 0.5	< 10	< 10	< 15	1330 ± 117
12-02-05	- 6763	< 0.5	< 10	< 10	< 15	1418 ± 113

Table 15. Milk, analyses for strontium-89, strontium-90, stable potassium, stable calcium, and ratios of strontium-90 per gram of calcium and cesium-137 per gram of potassium. Collection: Monthly composites.

		Concentration				Ratios	
Collection Period	Lab Code	Sr-89 (pCi/L)	Sr-90 (pCi/L)	K (g/L)	Ca (g/L)	Sr-90 per gram Ca	Cs-137 per gram K
Indicators							
			K-5				
January	KMI - 3	< 1.0	1.3 ± 0.4	1.53 ± 0.18	0.97	1.34	< 6.55
February	- 490	< 1.0	< 0.7	1.54 ± 0.14	1.01	< 0.69	< 6.49
March	- 954	< 1.0	< 0.8	1.53 ± 0.13	0.84	< 0.95	< 6.52
April	- 1573	< 0.6	< 0.7	1.58 ± 0.21	0.92	< 0.76	< 6.34
May	- 2667	< 0.7	1.2 ± 0.4	1.66 ± 0.17	0.82	1.46	< 6.03
June	- 3364	< 0.7	0.6 ± 0.3	1.63 ± 0.18	0.84	0.71	< 6.12
July	- 4098	< 0.8	1.5 ± 0.5	1.48 ± 0.18	0.92	1.63	< 6.74
August	- 4721	< 0.5	0.9 ± 0.4	1.56 ± 0.14	0.99	0.91	< 6.41
September	- 5169	< 0.8	0.7 ± 0.4	1.67 ± 0.20	0.81	0.86	< 5.98
October	- 6013	< 0.7	1.0 ± 0.4	1.57 ± 0.19	0.89	1.12	< 6.36
November	- 6240	< 0.6	0.8 ± 0.4	1.67 ± 0.14	1.15	0.70	< 6.00
December	- 6761	< 0.8	0.7 ± 0.3	1.60 ± 0.20	1.14	0.61	< 6.23
			K-25				
January	KMI - 4	< 0.7	1.8 ± 0.5	1.58 ± 0.14	1.00	1.80	< 6.32
February	- 491	< 0.7	1.3 ± 0.4	1.49 ± 0.21	1.01	1.29	< 6.72
March	- 955	< 0.6	1.8 ± 0.5	1.62 ± 0.19	0.94	1.91	< 6.16
April	- 1574	< 0.5	1.1 ± 0.4	1.52 ± 0.14	1.01	1.09	< 6.58
May	- 2668	< 0.5	1.1 ± 0.4	1.58 ± 0.17	0.88	1.25	< 6.33
June	- 3365	< 0.6	0.6 ± 0.3	1.53 ± 0.20	0.83	0.72	< 6.54
July	- 4099	< 0.6	1.5 ± 0.5	1.56 ± 0.16	1.03	1.46	< 6.39
August	- 4722	< 0.5	1.3 ± 0.4	1.58 ± 0.20	0.96	1.35	< 6.34
September	- 5170	< 0.7	1.4 ± 0.4	1.66 ± 0.14	0.89	1.57	< 6.02
October	- 6014	< 0.9	0.9 ± 0.4	1.63 ± 0.17	0.82	1.10	< 6.15
November	- 6241	< 0.7	1.0 ± 0.4	1.42 ± 0.19	1.00	1.00	< 7.07
December	- 6762	< 0.7	0.8 ± 0.3	1.70 ± 0.21	1.29	0.62	< 5.88

Table 15. Milk, analyses for strontium-89, strontium-90, stable potassium, stable calcium, and ratios of strontium-90 per gram of calcium and cesium-137 per gram of potassium (continued).

		Concentration				Ratios	
Collection Period	Lab Code	Sr-89 (pCi/L)	Sr-90 (pCi/L)	K (g/L)	Ca (g/L)	Sr-90 per gram Ca	Cs-137 per gram K
Indicators							
				K-34			
January	KMI - 6	< 1.4	1.6 ± 0.4	1.69 ± 0.14	0.99	1.62	< 5.90
February	- 493	< 0.5	1.1 ± 0.4	1.69 ± 0.21	1.05	1.05	< 5.92
March	- 957	< 0.6	0.9 ± 0.4	1.63 ± 0.20	0.90	1.00	< 6.14
April	- 1576	< 0.6	1.7 ± 0.5	1.62 ± 0.21	0.97	1.75	< 6.18
May	- 2670	< 0.6	0.9 ± 0.4	1.55 ± 0.17	0.83	1.08	< 6.47
June	- 3367	< 0.6	1.0 ± 0.3	1.67 ± 0.18	0.78	1.28	< 5.97
July	- 4101	< 0.6	1.2 ± 0.4	1.56 ± 0.24	1.02	1.18	< 6.40
August	- 4724	< 0.7	< 0.7	1.62 ± 0.22	0.87	< 0.80	< 6.16
September	- 5172	< 0.6	0.7 ± 0.3	1.71 ± 0.17	0.92	0.76	< 5.85
October	- 6016	< 0.6	0.8 ± 0.4	1.43 ± 0.18	0.89	0.90	< 6.98
November	- 6243	< 0.6	0.9 ± 0.3	1.64 ± 0.21	0.93	0.97	< 6.10
December	- 6764	< 0.7	0.9 ± 0.3	1.60 ± 0.15	0.98	0.92	< 6.25

Table 15. Milk, analyses for strontium-89, strontium-90, stable potassium, stable calcium, and ratios of strontium-90 per gram of calcium and cesium-137 per gram of potassium (continued).

Collection Period	Lab Code	Concentration: Sr-89 (pCi/L)	Concentration: Sr-90 (pCi/L)	Concentration: K (g/L)	Concentration: Ca (g/L)	Ratios: Sr-90 per gram Ca	Ratios: Cs-137 per gram K
Indicators							
K-38							
January	KMI - 7	< 1.2	1.2 ± 0.3	1.66 ± 0.20	0.99	1.21	< 6.02
February	- 494	< 0.5	1.7 ± 0.5	1.49 ± 0.18	1.04	1.63	< 6.70
March	- 958	< 0.6	1.1 ± 0.5	1.58 ± 0.13	0.95	1.16	< 6.31
April	- 1577	< 0.6	1.1 ± 0.5	1.75 ± 0.20	0.90	1.22	< 5.70
May	- 2671	< 0.6	1.2 ± 0.4	1.39 ± 0.20	0.84	1.43	< 7.21
June	- 3368	< 0.8	1.2 ± 0.4	1.56 ± 0.21	0.84	1.43	< 6.42
July	- 4102	< 0.6	1.2 ± 0.4	1.52 ± 0.18	1.00	1.20	< 6.56
August	- 4725	< 0.5	1.1 ± 0.4	1.56 ± 0.17	0.97	1.13	< 6.42
September	- 5173	< 0.8	< 0.5	1.46 ± 0.19	0.76	< 0.66	< 6.87
October	- 6017	< 0.6	0.9 ± 0.4	1.47 ± 0.22	1.05	0.86	< 6.78
November	- 6244	< 0.7	0.9 ± 0.4	1.58 ± 0.19	0.97	0.93	< 6.31
December	- 6765	< 0.8	1.0 ± 0.4	1.50 ± 0.14	1.22	0.82	< 6.67
K-39							
January	KMI - 8	< 0.9	1.2 ± 0.4	1.59 ± 0.14	1.00	1.20	< 6.28
February	- 495	< 0.7	1.9 ± 0.5	1.61 ± 0.19	0.99	1.92	< 6.22
March	- 959	< 0.7	0.8 ± 0.4	1.51 ± 0.18	0.99	0.81	< 6.62
April	- 1578	< 0.7	1.4 ± 0.5	1.53 ± 0.20	1.00	1.40	< 6.53
May	- 2672	< 0.7	1.2 ± 0.4	1.51 ± 0.18	0.83	1.45	< 6.63
June	- 3369	< 0.7	1.0 ± 0.4	1.48 ± 0.21	0.76	1.32	< 6.75
July	- 4103	< 0.7	1.2 ± 0.5	1.66 ± 0.16	0.99	1.21	< 6.02
August	- 4726	< 0.5	2.0 ± 0.5	1.56 ± 0.17	0.99	2.02	< 6.42
September	- 5174	< 0.8	< 0.7	1.69 ± 0.16	0.80	< 0.88	< 5.91
October	- 6018	< 1.3	1.0 ± 0.4	1.60 ± 0.19	1.00	1.00	< 6.27
November	- 6245	< 0.8	0.9 ± 0.4	1.63 ± 0.20	0.88	1.02	< 6.12
December	- 6766	< 0.8	< 0.6	1.67 ± 0.22	0.98	< 0.61	< 6.00

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Table 15. Milk, analyses for strontium-89, strontium-90, stable potassium, stable calcium, and ratios of strontium-90 per gram of calcium and cesium-137 per gram of potassium (continued).

Collection Period	Lab Code	Concentration Sr-89 (pCi/L)	Sr-90 (pCi/L)	K (g/L)	Ca (g/L)	Ratios Sr-90 per gram Ca	Cs-137 per gram K
Control							
			K-3				
January	KMI - 2	< 0.8	1.6 ± 0.5	1.49 ± 0.19	0.97	1.65	< 6.70
February	- 489	< 0.9	1.1 ± 0.4	1.71 ± 0.22	1.01	1.09	< 5.86
March	- 953	< 0.6	1.2 ± 0.4	1.57 ± 0.21	0.88	1.36	< 6.36
April	- 1572	< 0.6	1.0 ± 0.4	1.56 ± 0.23	0.93	1.08	< 6.43
May	- 2666	< 0.9	< 0.7	1.41 ± 0.21	0.85	< 0.82	< 7.10
June	- 3363	< 0.7	1.0 ± 0.4	1.53 ± 0.13	0.85	1.18	< 6.52
July	- 4097	< 0.6	1.4 ± 0.5	1.62 ± 0.18	1.03	1.36	< 6.18
August	- 4720	< 0.5	1.3 ± 0.4	1.55 ± 0.19	1.05	1.24	< 6.47
September	- 5168	< 0.8	1.0 ± 0.4	1.60 ± 0.13	0.77	1.30	< 6.26
October	- 6012	< 0.5	0.7 ± 0.4	1.66 ± 0.20	1.02	0.69	< 6.03
November	- 6239	< 0.7	1.1 ± 0.4	1.57 ± 0.20	1.33	0.83	< 6.36
December	- 6760	< 1.0	0.6 ± 0.4	1.79 ± 0.21	1.13	0.53	< 5.59
			K-28				
January	KMI - 5	< 0.6	0.8 ± 0.4	1.58 ± 0.13	1.01	0.79	< 6.31
February	- 492	< 0.5	0.9 ± 0.3	1.48 ± 0.18	0.95	0.95	< 6.77
March	- 956	< 0.5	0.9 ± 0.4	1.50 ± 0.18	0.94	0.96	< 6.65
April	- 1575	< 0.5	0.7 ± 0.4	1.62 ± 0.21	0.92	0.76	< 6.16
May	- 2669	< 0.6	0.6 ± 0.3	1.43 ± 0.19	0.77	0.78	< 7.00
June	- 3366	< 0.7	0.8 ± 0.4	1.67 ± 0.23	0.81	0.99	< 5.97
July	- 4100	< 0.6	1.0 ± 0.4	1.57 ± 0.12	0.82	1.22	< 6.38
August	- 4723	< 0.5	0.8 ± 0.4	1.60 ± 0.19	0.96	0.83	< 6.27
September	- 5171	< 0.8	< 0.7	1.47 ± 0.19	0.81	< 0.86	< 6.79
October	- 6015	< 0.6	< 0.6	1.52 ± 0.17	0.94	< 0.64	< 6.59
November	- 6242	< 0.7	1.1 ± 0.4	1.54 ± 0.14	1.05	1.05	< 6.50
December	- 6763	< 0.7	0.7 ± 0.3	1.64 ± 0.13	0.97	0.72	< 6.10

Table 16. Well water, analyses for gross alpha, gross beta, tritium, strontium-89[a], strontium-90[a], potassium-40 and gamma-emitting isotopes.
Collection: Quarterly.

Sample Description and Concentration (pCi/L)

Indicator

K-1g

Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KWW-64	KWW-1579	KWW-3687	KWW-5605
Gross alpha	< 1.4	< 2.0	2.9 ± 1.3	3.4 ± 2.6
Gross beta	< 1.6	5.6 ± 1.6	2.9 ± 0.9	5.2 ± 3.0
H-3	< 162	< 139	< 169	< 147
Sr-89	< 0.7	< 0.6	< 0.6	< 0.6
Sr-90	< 0.7	< 0.5	< 0.5	< 0.5
K-40 (ICP)	2.68	2.60	2.25	2.71
Mn-54	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15	< 15

K-1h

Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KWW-65	KWW-1580	KWW-3688	KWW-5606
Gross alpha	< 2.1	< 1.6	1.9 ± 1.4	3.1 ± 1.8
Gross beta	4.4 ± 1.4	5.4 ± 1.6	2.9 ± 0.9	6.2 ± 1.7
H-3	< 162	< 171	< 169	< 147
K-40 (ICP)	2.77	2.60	2.18	2.66
Mn-54	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15	< 15

[a] Strontium analyses required on samples from K-1g only.

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Table 17. Well water, analyses for gross beta, tritium, potassium-40, and gamma-emitting isotopes.

Collection: Quarterly.

Sample Description and Concentration (pCi/L)

Indicator

K-10

Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KWW-66	KWW-1581	KWW-3689	KWW-5607
Gross beta	3.2 ± 1.7	< 1.9	7.7 ± 3.5	1.8 ± 1.1
H-3	< 162	< 171	< 169	< 171
K-40 (ICP)	2.25	1.82	3.95	3.33
Mn-54	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15	< 15

K-11

Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KWW-67	KWW-1582	KWW-3690	KWW-5608
Gross beta	1.3 ± 0.3	1.0 ± 0.4	0.6 ± 0.2	1.1 ± 0.6
H-3	< 162	< 171	< 169	< 147
K-40 (ICP)	0.95	0.95	0.81	1.03
Mn-54	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15	< 15

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Table 17. Well water, analyses for gross beta, tritium, potassium-40, and gamma-emitting isotopes.

Sample Description and Concentration (pCi/L)

Indicator

K-25

Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KWW-69	KWW-1584	KWW-3692	KWW-5610
Gross beta	1.5 ± 0.3	2.0 ± 0.6	0.9 ± 0.2	1.4 ± 0.7
H-3	< 162	< 171	< 169	< 147
K-40 (ICP)	1.12	1.12	0.99	1.19
Mn-54	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15	< 15

Control

K-13

Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KWW-68	KWW-1583	KWW-3691	KWW-5609
Gross beta	1.2 ± 1.0	< 0.3	0.7 ± 0.2	0.8 ± 0.2
H-3	< 162	< 171	< 169	< 147
K-40 (ICP)	1.04	1.04	0.87	1.08
Mn-54	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15	< 15

Note: Page 55 is intentionally left out.

Table 18. Domestic meat samples (chickens), analyses of flesh for gross alpha, gross beta, and gamma-emitting isotopes. Annual collection.

Sample Description and Concentration (pCi/g wet)

	Indicator			Control
Location	K-24	K-29	K-20	K-32
Date Collected	09-01-05	09-01-05		09-01-05
Lab Code	KME-4891	KME-4892		KME-4893
Gross Alpha	< 0.07	< 0.12		0.08 ± 0.05
Gross Beta	3.41 ± 0.14	3.86 ± 0.19		3.39 ± 0.13
Be-7	< 0.34	< 0.16		< 0.31
K-40	3.16 ± 0.85	3.20 ± 0.44		2.44 ± 0.47
Nb-95	< 0.059	< 0.053		< 0.044
Zr-95	< 0.15	< 0.027		< 0.040
Ru-103	< 0.057	< 0.027		< 0.031
Ru-106	< 0.19	< 0.13		< 0.14
Cs-134	< 0.022	< 0.014		< 0.012
Cs-137	< 0.028	< 0.012		< 0.023
Ce-141	< 0.11	< 0.045		< 0.060
Ce-144	< 0.15	< 0.12		< 0.10

Table 19. Eggs, analyses for gross beta, strontium-89, strontium-90 and gamma emitting isotopes.
Collection: Quarterly

Sample Description and Concentration (pCi/g wet)

Location	K-24			
Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KE-9	KE-1570	KE-3653	KE-5500
Gross beta	1.48 ± 0.05	1.62 ± 0.06	1.99 ± 0.09	1.68 ± 0.07
Sr-89	< 0.008	< 0.007	< 0.006	< 0.006
Sr-90	< 0.003	< 0.004	< 0.004	< 0.003
Be-7	< 0.073	< 0.081	< 0.093	< 0.079
K-40	1.40 ± 0.23	0.89 ± 0.19	1.08 ± 0.23	1.25 ± 0.21
Nb-95	< 0.011	< 0.011	< 0.009	< 0.016
Zr-95	< 0.016	< 0.013	< 0.010	< 0.014
Ru-103	< 0.011	< 0.008	< 0.008	< 0.010
Ru-106	< 0.045	< 0.054	< 0.060	< 0.031
Cs-134	< 0.007	< 0.008	< 0.009	< 0.008
Cs-137	< 0.009	< 0.008	< 0.005	< 0.006
Ce-141	< 0.009	< 0.016	< 0.013	< 0.015
Ce-144	< 0.043	< 0.035	< 0.039	< 0.049

Location	K-32			
Date Collected	01-03-05	04-04-05	07-05-05	10-03-05
Lab Code	KE-10	KE-1571	KE-3654, 5	KE-5501
Gross beta	1.41 ± 0.05	1.80 ± 0.06	1.72 ± 0.05	1.76 ± 0.06
Sr-89	< 0.008	< 0.006	< 0.005	< 0.008
Sr-90	< 0.004	< 0.004	< 0.003	< 0.003
Be-7	< 0.054	< 0.056	< 0.074	< 0.060
K-40	1.12 ± 0.23	1.39 ± 0.22	1.27 ± 0.16	1.16 ± 0.26
Nb-95	< 0.013	< 0.009	< 0.010	< 0.017
Zr-95	< 0.015	< 0.015	< 0.017	< 0.029
Ru-103	< 0.006	< 0.006	< 0.010	< 0.010
Ru-106	< 0.054	< 0.052	< 0.071	< 0.049
Cs-134	< 0.013	< 0.006	< 0.010	< 0.009
Cs-137	< 0.008	< 0.008	< 0.010	< 0.006
Ce-141	< 0.010	< 0.017	< 0.010	< 0.021
Ce-144	< 0.046	< 0.043	< 0.043	< 0.054

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Table 20. Vegetable and grain samples, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes. Annual collection.

Sample Description and Concentration (pCi/g wet)

Location	K-3[a]		K-23	
Date Collected	09-02-05	09-02-05	08-01-05	08-01-05
Lab Code	KVE-4897	KVE-4898	KVE-4380	KVE-4381
Type	Corn, Corn Leaves	Broccoli	Clover	Oats
Gross beta	3.46 ± 0.08	2.69 ± 0.09	6.96 ± 0.19	5.73 ± 0.16
Sr-89	< 0.006	< 0.008	< 0.008	< 0.015
Sr-90	< 0.002	< 0.004	< 0.004	< 0.009
Be-7	1.01 ± 0.21	0.58 ± 0.22	1.18 ± 0.32	0.70 ± 0.26
K-40	2.90 ± 0.34	2.45 ± 0.45	4.28 ± 0.54	5.08 ± 0.76
Nb-95	< 0.011	< 0.016	< 0.039	< 0.024
Zr-95	< 0.017	< 0.043	< 0.023	< 0.059
Ru-103	< 0.011	< 0.007	< 0.023	< 0.037
Ru-106	< 0.11	< 0.14	< 0.13	< 0.22
Cs-134	< 0.011	< 0.014	< 0.021	< 0.026
Cs-137	< 0.016	< 0.017	< 0.017	< 0.020
Ce-141	< 0.031	< 0.022	< 0.047	< 0.054
Ce-144	< 0.085	< 0.085	< 0.15	< 0.17

Location	K-24[a]		K-38[a]	
Date Collected	09-02-05	09-02-05	09-02-05	09-02-05
Lab Code	KVE-4899	KVE-4900,1	KVE-4908	KVE-4909
Type	Cabbage	Zucchini	Beet Greens	Cabbage
Gross beta	5.49 ± 0.17	3.46 ± 0.04	8.76 ± 0.19	4.88 ± 0.16
Sr-89	< 0.015	< 0.004	< 0.018	< 0.010
Sr-90	< 0.006	< 0.002	< 0.006	0.006 ± 0.002
Be-7	0.45 ± 0.26	< 0.10	0.54 ± 0.20	0.58 ± 0.21
K-40	3.66 ± 0.37	2.21 ± 0.18	6.90 ± 0.62	3.52 ± 0.45
Nb-95	< 0.011	< 0.006	< 0.017	< 0.029
Zr-95	< 0.036	< 0.015	< 0.047	< 0.032
Ru-103	< 0.021	< 0.010	< 0.016	< 0.021
Ru-106	< 0.11	< 0.047	< 0.10	< 0.13
Cs-134	< 0.011	< 0.007	< 0.012	< 0.011
Cs-137	< 0.014	< 0.009	< 0.020	< 0.016
Ce-141	< 0.025	< 0.018	< 0.030	< 0.027
Ce-144	< 0.12	< 0.071	< 0.085	< 0.092

[a] Not required by Technical Specifications.

Table 20. Vegetable and grain samples, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/g wet)

Location	K-26 (control)			
Date Collected	09-02-05	09-02-05	09-02-05	09-02-05
Lab Code	KVE-4902	KVE-4903	KVE-4904	KVE-4905
Type	Cauliflower	Broccoli	Corn	Cabbage
Gross beta	2.59 ± 0.05	2.84 ± 0.06	3.02 ± 0.06	1.26 ± 0.03
Sr-89	< 0.003	< 0.004	< 0.005	< 0.002
Sr-90	< 0.001	< 0.001	< 0.002	< 0.001
Be-7	< 0.087	< 0.19	< 0.16	< 0.074
K-40	1.48 ± 0.25	2.13 ± 0.34	2.33 ± 0.39	1.04 ± 0.26
Nb-95	< 0.017	< 0.032	< 0.023	< 0.014
Zr-95	< 0.027	< 0.044	< 0.028	< 0.016
Ru-103	< 0.012	< 0.025	< 0.024	< 0.008
Ru-106	< 0.070	< 0.17	< 0.13	< 0.067
Cs-134	< 0.008	< 0.014	< 0.009	< 0.010
Cs-137	< 0.014	< 0.026	< 0.007	< 0.014
Ce-141	< 0.012	< 0.043	< 0.032	< 0.022
Ce-144	< 0.067	< 0.14	< 0.059	< 0.062

Date Collected	09-02-05	09-02-05	10-04-05
Lab Code	KVE-4906	KVE-4907	KVE-5535
Type	Carrots	Cucumbers	Pumpkin
Gross beta	3.09 ± 0.07	1.30 ± 0.02	2.24 ± 0.04
Sr-89	< 0.005	< 0.001	< 0.002
Sr-90	< 0.002	< 0.001	0.001 ± 0.001
Be-7	< 0.095	< 0.051	< 0.078
K-40	2.40 ± 0.29	1.09 ± 0.17	1.39 ± 0.24
Nb-95	< 0.014	< 0.003	< 0.012
Zr-95	< 0.032	< 0.012	< 0.020
Ru-103	< 0.017	< 0.009	< 0.013
Ru-106	< 0.12	< 0.054	< 0.086
Cs-134	< 0.009	< 0.005	< 0.006
Cs-137	< 0.009	< 0.007	< 0.010
Ce-141	< 0.022	< 0.015	< 0.018
Ce-144	< 0.088	< 0.056	< 0.074

Table 21. Cattlefeed, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes.
Collection: First Quarter.

Sample Description and Concentration (pCi/g wet)

	Control	
Location	K-3	K-3
Date Collected	01-03-05	01-03-05
Lab Code	KCF-84	KCF-90
Type	Hay	Silage
Gross beta	12.26 ± 0.41	2.50 ± 0.06
Sr-89	< 0.018	< 0.003
Sr-90	0.016 ± 0.006	0.002 ± 0.001
Be-7	< 0.21	< 0.17
K-40	10.36 ± 0.60	2.64 ± 0.34
Nb-95	< 0.029	< 0.018
Zr-95	< 0.044	< 0.031
Ru-103	< 0.022	< 0.016
Ru-106	< 0.10	< 0.10
Cs-134	< 0.018	< 0.006
Cs-137	< 0.018	< 0.013
Ce-141	< 0.031	< 0.029
Ce-144	< 0.073	< 0.073

	Indicator			
Location	K-5	K-5	K-25	K-25
Date Collected	01-03-05	01-03-05	01-03-05	01-03-05
Lab Code	KCF-85	KCF-91	KCF-86	KCF-92
Type	Hay	Silage	Hay	Silage
Gross beta	15.68 ± 0.51	13.80 ± 0.45	14.68 ± 0.49	2.73 ± 0.10
Sr-89	< 0.021	< 0.019	< 0.019	< 0.016
Sr-90	0.022 ± 0.007	< 0.010	0.040 ± 0.008	< 0.006
Be-7	< 0.53	< 0.20	< 0.48	< 0.14
K-40	18.79 ± 1.39	12.05 ± 0.60	13.62 ± 1.11	2.30 ± 0.29
Nb-95	< 0.082	< 0.015	< 0.086	< 0.026
Zr-95	< 0.099	< 0.026	< 0.10	< 0.031
Ru-103	< 0.085	< 0.023	< 0.062	< 0.020
Ru-106	< 0.37	< 0.14	< 0.40	< 0.12
Cs-134	< 0.030	< 0.018	< 0.029	< 0.007
Cs-137	< 0.050	< 0.014	< 0.027	< 0.012
Ce-141	< 0.15	< 0.040	< 0.11	< 0.047
Ce-144	< 0.38	< 0.077	< 0.25	< 0.096

Table 21. Cattlefeed, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/g wet)				
	Indicator			
Location	K-34	K-34	K-38	K-38
Date Collected	01-03-05	01-03-05	01-03-05	01-03-05
Lab Code	KCF-87	KCF-93	KCF-88	KCF-94
Type	Hay	Silage	Hay	Silage
Gross beta	21.49 ± 0.69	8.87 ± 0.30	22.53 ± 0.68	9.02 ± 0.29
Sr-89	< 0.047	< 0.013	< 0.054	< 0.013
Sr-90	< 0.027	< 0.006	0.025 ± 0.013	0.009 ± 0.005
Be-7	< 0.58	< 0.17	< 0.36[a]	< 0.19
K-40	17.74 ± 1.14	8.01 ± 0.63	21.17 ± 1.26	7.16 ± 0.65
Nb-95	< 0.062	< 0.024	< 0.069	< 0.027
Zr-95	< 0.12	< 0.051	< 0.089	< 0.049
Ru-103	< 0.043	< 0.025	< 0.044	< 0.017
Ru-106	< 0.25	< 0.18	< 0.25	< 0.12
Cs-134	< 0.029	< 0.020	< 0.027	< 0.022
Cs-137	< 0.029	< 0.017	< 0.036	< 0.018
Ce-141	< 0.16	< 0.061	< 0.060	< 0.035
Ce-144	< 0.22	< 0.11	< 0.21	< 0.12
Location	K-39	K-39		
Date Collected	01-03-05	01-03-05		
Lab Code	KCF-89	KCF-95, 6		
Type	Hay	Silage		
Gross beta	13.14 ± 0.47	6.27 ± 0.16		
Sr-89	< 0.036	< 0.010		
Sr-90	0.039 ± 0.012	0.007 ± 0.003		
Be-7	< 0.37	< 0.23		
K-40	13.76 ± 1.11	5.53 ± 0.38		
Nb-95	< 0.051	< 0.022		
Zr-95	< 0.079	< 0.035		
Ru-103	< 0.043	< 0.016		
Ru-106	< 0.19	< 0.10		
Cs-134	< 0.036	< 0.008		
Cs-137	< 0.036	< 0.014		
Ce-141	< 0.11	< 0.050		
Ce-144	< 0.19	< 0.11		

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Table 22. Grass, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes.
Collection: Quarterly, April through December
Units: pCi/g wet

Sample Description and Concentration

	Indicator			
Location	K-1b	K-1f	K-5	K-25
Date Collected	05-02-05	06-01-05	05-02-05	05-02-05
Lab Code	KG-2298	KG-2958, 9	KG-2300	KG-2301
Gross beta	5.95 ± 0.12	7.93 ± 0.05	8.38 ± 0.15	8.23 ± 0.15
Sr-89	< 0.005	< 0.005	< 0.011	< 0.007
Sr-90	< 0.004	< 0.005	< 0.004	< 0.005
Be-7	0.47 ± 0.22	1.14 ± 0.24	0.91 ± 0.38	0.45 ± 0.19
K-40	5.43 ± 0.58	5.99 ± 0.39	6.76 ± 0.79	6.80 ± 0.59
Mn-54	< 0.022	< 0.018	< 0.024	< 0.012
Co-58	< 0.012	< 0.009	< 0.019	< 0.011
Co-60	< 0.019	< 0.012	< 0.022	< 0.013
Nb-95	< 0.027	< 0.015	< 0.025	< 0.022
Zr-95	< 0.049	< 0.041	< 0.046	< 0.036
Ru-103	< 0.032	< 0.014	< 0.029	< 0.016
Ru-106	< 0.24	< 0.13	< 0.16	< 0.15
Cs-134	< 0.032	< 0.018	< 0.019	< 0.018
Cs-137	< 0.016	< 0.017	< 0.026	< 0.013
Ce-141	< 0.059	< 0.038	< 0.062	< 0.024
Ce-144	< 0.23	< 0.14	< 0.13	< 0.14

	Indicator			Control
Location	K-34	K-38	K-39	K-3
Date Collected	06-01-05	06-01-05	05-02-05	05-02-05
Lab Code	KG-2960	KG-2961	KG-2302	KG-2299
Gross beta	7.61 ± 0.06	7.17 ± 0.06	9.28 ± 0.19	8.21 ± 0.16
Sr-89	< 0.005	< 0.006	< 0.009	< 0.009
Sr-90	< 0.004	< 0.004	< 0.006	< 0.006
Be-7	< 0.27	0.59 ± 0.24	0.65 ± 0.29	0.95 ± 0.34
K-40	6.15 ± 0.60	5.76 ± 0.64	6.91 ± 1.00	6.98 ± 0.61
Mn-54	< 0.020	< 0.024	< 0.020	< 0.022
Co-58	< 0.017	< 0.012	< 0.028	< 0.022
Co-60	< 0.021	< 0.008	< 0.032	< 0.017
Nb-95	< 0.014	< 0.015	< 0.029	< 0.026
Zr-95	< 0.050	< 0.036	< 0.063	< 0.032
Ru-103	< 0.028	< 0.024	< 0.021	< 0.021
Ru-106	< 0.23	< 0.14	< 0.29	< 0.26
Cs-134	< 0.018	< 0.012	< 0.042	< 0.028
Cs-137	< 0.017	< 0.007	< 0.030	< 0.025
Ce-141	< 0.029	< 0.028	< 0.034	< 0.054
Ce-144	< 0.18	< 0.086	< 0.14	< 0.20

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Table 22. Grass samples, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes (continued).

Sample Description and Concentration

	Indicator			
Location	K-1b	K-1f	K-5	K-25
Date Collected	07-05-05	08-01-05	07-05-05	07-05-05
Lab Code	KG-3712	KG-4382	KG-3714	KG-3715
Gross beta	8.09 ± 0.20	8.88 ± 0.21	10.87 ± 0.26	5.80 ± 0.14
Sr-89	< 0.013	< 0.021	< 0.010	< 0.009
Sr-90	< 0.008	< 0.014	0.011 ± 0.004	< 0.005
Be-7	1.10 ± 0.17	1.14 ± 0.28	1.10 ± 0.081	0.57 ± 0.11
K-40	6.47 ± 0.46	7.79 ± 0.73	6.24 ± 0.23	3.31 ± 0.18
Mn-54	< 0.017	< 0.025	< 0.011	< 0.007
Co-58	< 0.020	< 0.022	< 0.006	< 0.007
Co-60	< 0.019	< 0.023	< 0.007	< 0.007
Nb-95	< 0.023	< 0.016	< 0.011	< 0.009
Zr-95	< 0.043	< 0.030	< 0.012	< 0.015
Ru-103	< 0.018	< 0.028	< 0.009	< 0.009
Ru-106	< 0.18	< 0.20	< 0.063	< 0.056
Cs-134	< 0.016	< 0.026	< 0.011	< 0.008
Cs-137	< 0.009	< 0.025	< 0.005	< 0.006
Ce-141	< 0.029	< 0.053	< 0.020	< 0.012
Ce-144	< 0.12	< 0.13	< 0.052	< 0.049
	Indicator			Control
Location	K-34	K-38	K-39	K-3
Date Collected	08-01-05	08-01-05	07-05-05	07-05-05
Lab Code	KG-4383, 4	KG-4385	KG-3716	KG-3713
Gross beta	8.58 ± 0.15	7.75 ± 0.21	9.22 ± 0.20	12.42 ± 0.25
Sr-89	< 0.009	< 0.012	< 0.018	< 0.020
Sr-90	< 0.005	< 0.007	0.011 ± 0.006	< 0.010
Be-7	1.91 ± 0.28	2.68 ± 0.49	1.09 ± 0.31	1.23 ± 0.11
K-40	6.81 ± 0.56	5.30 ± 0.57	6.37 ± 0.65	7.17 ± 0.25
Mn-54	< 0.019	< 0.028	< 0.015	< 0.009
Co-58	< 0.017	< 0.028	< 0.025	< 0.010
Co-60	< 0.010	< 0.015	< 0.015	< 0.009
Nb-95	< 0.020	< 0.033	< 0.030	< 0.013
Zr-95	< 0.044	< 0.062	< 0.042	< 0.013
Ru-103	< 0.031	< 0.032	< 0.024	< 0.011
Ru-106	< 0.21	< 0.19	< 0.17	< 0.081
Cs-134	< 0.023	< 0.020	< 0.021	< 0.007
Cs-137	< 0.022	< 0.022	< 0.019	< 0.010
Ce-141	< 0.052	< 0.043	< 0.034	< 0.022
Ce-144	< 0.16	< 0.15	< 0.14	< 0.047

Table 22. Grass samples, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/g wet)

	Indicator			
Location	K-1b	K-1b	K-5	K-25
Date Collected	10-03-05	10-03-05	10-03-05	10-03-05
Lab Code	KG-5526, 7	KG-5528	KG-5530	KG-5531
Gross beta	8.41 ± 0.24	8.07 ± 0.29	9.38 ± 0.21	13.90 ± 0.36
Sr-89	< 0.019	< 0.014	< 0.014	< 0.029
Sr-90	< 0.007	< 0.006	0.005 ± 0.003	< 0.012
Be-7	4.05 ± 0.51	1.76 ± 0.35	2.84 ± 0.30	4.02 ± 0.50
K-40	5.47 ± 0.49	5.54 ± 0.70	6.05 ± 0.57	11.44 ± 0.79
Mn-54	< 0.026	< 0.034	< 0.014	< 0.017
Co-58	< 0.020	< 0.029	< 0.020	< 0.031
Co-60	< 0.017	< 0.013	< 0.014	< 0.022
Nb-95	< 0.034	< 0.037	< 0.030	< 0.042
Zr-95	< 0.033	< 0.064	< 0.044	< 0.057
Ru-103	< 0.036	< 0.024	< 0.033	< 0.042
Ru-106	< 0.19	< 0.24	< 0.13	< 0.25
Cs-134	< 0.027	< 0.025	< 0.031	< 0.022
Cs-137	< 0.023	< 0.017	< 0.018	< 0.020
Ce-141	< 0.079	< 0.046	< 0.059	< 0.085
Ce-144	< 0.22	< 0.12	< 0.11	< 0.14

	Indicator			Control
Location	K-34	K-38	K-39	K-3
Date Collected	10-03-05	10-03-05	10-03-05	10-03-05
Lab Code	KG-5532	KG-5533	KG-5534	KG-5529
Gross beta	11.26 ± 0.25	5.45 ± 0.16	8.93 ± 0.18	21.83 ± 0.78
Sr-89	< 0.018	< 0.015	< 0.011	< 0.032
Sr-90	< 0.007	0.019 ± 0.004	< 0.004	< 0.011
Be-7	2.89 ± 0.56	4.09 ± 0.31	1.73 ± 0.35	4.35 ± 0.50
K-40	7.68 ± 0.92	3.38 ± 0.40	6.38 ± 0.71	13.28 ± 0.70
Mn-54	< 0.028	< 0.018	< 0.022	< 0.016
Co-58	< 0.041	< 0.009	< 0.024	< 0.018
Co-60	< 0.040	< 0.012	< 0.026	< 0.017
Nb-95	< 0.027	< 0.022	< 0.037	< 0.028
Zr-95	< 0.047	< 0.032	< 0.033	< 0.025
Ru-103	< 0.038	< 0.027	< 0.022	< 0.012
Ru-106	< 0.25	< 0.15	< 0.19	< 0.13
Cs-134	< 0.021	< 0.026	< 0.018	< 0.016
Cs-137	< 0.024	< 0.017	< 0.024	< 0.018
Ce-141	< 0.056	< 0.045	< 0.043	< 0.062
Ce-144	< 0.20	< 0.12	< 0.13	< 0.15

Table 23. Soil samples, analyses for gross alpha, gross beta, strontium-89, strontium-90, and gamma-emitting isotopes.

Collection: Semiannually

Sample Description and Concentration (pCi/g dry)

	Indicator		
Location	K-1f	K-5	K-25
Date Collected	05-02-05	05-02-05	05-02-05
Lab Code	KSO-2303	KSO-2305, 6	KSO-2307
Gross alpha	10.53 ± 3.09	9.98 ± 2.22	11.25 ± 3.27
Gross beta	20.56 ± 2.16	28.46 ± 1.80	30.49 ± 2.64
Sr-89	< 0.043	< 0.035	< 0.055
Sr-90	< 0.015	0.031 ± 0.009	0.14 ± 0.022
Be-7	< 0.15	< 0.25	< 0.36
K-40	18.48 ± 0.80	21.47 ± 0.87	16.42 ± 1.01
Nb-95	< 0.044	< 0.043	< 0.023
Zr-95	< 0.026	< 0.041	< 0.050
Ru-103	< 0.029	< 0.046	< 0.027
Ru-106	< 0.10	< 0.15	< 0.28
Cs-134	< 0.034	< 0.047	< 0.044
Cs-137	< 0.024	0.11 ± 0.031	0.10 ± 0.039
Ce-141	< 0.040	< 0.058	< 0.045
Ce-144	< 0.10	< 0.20	< 0.14
Location	K-1f	K-5	K-25
Date Collected	10-03-05	10-03-05	10-03-05
Lab Code	KSO-5636	KSO-5638	KSO-5639
Gross alpha	7.10 ± 3.12	9.64 ± 3.41	7.23 ± 3.16
Gross beta	21.91 ± 3.02	29.32 ± 3.27	32.61 ± 3.32
Sr-89	< 0.046	< 0.056	< 0.042
Sr-90	< 0.018	0.032 ± 0.014	0.015 ± 0.008
Be-7	< 0.18	< 0.44	< 0.50
K-40	17.85 ± 1.10	22.69 ± 1.28	21.37 ± 1.25
Nb-95	< 0.038	< 0.086	< 0.096
Zr-95	< 0.075	< 0.086	< 0.10
Ru-103	< 0.054	< 0.032	< 0.066
Ru-106	< 0.26	< 0.27	< 0.32
Cs-134	< 0.043	< 0.046	< 0.047
Cs-137	< 0.035	0.15 ± 0.052	0.14 ± 0.039
Ce-141	< 0.076	< 0.089	< 0.11
Ce-144	< 0.17	< 0.19	< 0.18

Table 23. Soil samples, analyses for gross alpha, gross beta, strontium-89, strontium-90, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/g dry)

	Indicator		
Location	K-34	K-38	K-39
Date Collected	05-02-05	05-02-05	05-02-05
Lab Code	KSO-2308	KSO-2309	KSO-2310
Gross alpha	9.36 ± 3.00	12.89 ± 3.49	6.54 ± 2.71
Gross beta	24.42 ± 2.36	33.69 ± 2.75	19.49 ± 2.23
Sr-89	< 0.041	< 0.047	< 0.083
Sr-90	0.028 ± 0.010	0.050 ± 0.014	< 0.031
Be-7	< 0.24	< 0.22	< 0.36
K-40	19.67 ± 0.82	24.15 ± 1.05	14.73 ± 1.07
Nb-95	< 0.030	< 0.050	< 0.057
Zr-95	< 0.039	< 0.039	< 0.059
Ru-103	< 0.026	< 0.027	< 0.023
Ru-106	< 0.12	< 0.18	< 0.19
Cs-134	< 0.032	< 0.034	< 0.041
Cs-137	0.093 ± 0.031	0.11 ± 0.048	0.099 ± 0.035
Ce-141	< 0.041	< 0.056	< 0.049
Ce-144	< 0.12	< 0.14	< 0.16
Location	K-34	K-38	K-39
Date Collected	10-03-05	10-03-05	10-03-05
Lab Code	KSO-5640	KSO-5641	KSO-5642
Gross alpha	7.87 ± 3.31	12.30 ± 3.63	8.90 ± 3.42
Gross beta	28.48 ± 3.34	39.08 ± 3.37	24.37 ± 3.17
Sr-89	< 0.065	< 0.072	< 0.049
Sr-90	0.081 ± 0.018	0.038 ± 0.016	< 0.018
Be-7	< 0.35	< 0.40	< 0.56
K-40	18.82 ± 0.90	25.60 ± 1.28	12.81 ± 0.97
Nb-95	< 0.080	< 0.086	< 0.083
Zr-95	< 0.085	< 0.050	< 0.083
Ru-103	< 0.055	< 0.050	< 0.051
Ru-106	< 0.24	< 0.25	< 0.29
Cs-134	< 0.038	< 0.040	< 0.050
Cs-137	0.099 ± 0.031	0.15 ± 0.053	0.11 ± 0.045
Ce-141	< 0.088	< 0.081	< 0.11
Ce-144	< 0.13	< 0.17	< 0.12

Table 23. Soil samples, analyses for gross alpha, gross beta, strontium-89, strontium-90, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/g dry)

	Control	
Location	K-3	
Date Collected	05-02-05	10-03-05
Lab Code	KSO-2304	KSO-5637
Gross alpha	8.55 ± 2.97	8.08 ± 3.19
Gross beta	24.61 ± 2.40	28.75 ± 3.08
Sr-89	< 0.048	< 0.060
Sr-90	0.047 ± 0.014	0.039 ± 0.013
Be-7	< 0.22	< 0.41
K-40	20.24 ± 0.81	19.27 ± 1.24
Nb-95	< 0.034	< 0.042
Zr-95	< 0.036	< 0.045
Ru-103	< 0.029	< 0.045
Ru-106	< 0.22	< 0.27
Cs-134	< 0.028	< 0.044
Cs-137	0.19 ± 0.036	0.16 ± 0.044
Ce-141	< 0.048	< 0.071
Ce-144	< 0.098	< 0.20

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Table 24. Surface water samples, analyses for gross beta, potassium-40 and gamma-emitting isotopes.
Collection: Monthly

Sample Description and Concentration (pCi/L)

Indicator

K-1a

Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-55	KSW-500	KSW-944
Gross beta			
Suspended Solids	< 0.3	< 0.5	< 0.6
Dissolved Solids	7.2 ± 1.0	10.0 ± 1.2	8.5 ± 0.9
Total Residue	7.2 ± 1.0	10.0 ± 1.2	8.5 ± 0.9
K-40 (ICP)	7.35	6.31	5.97
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

K-1b

Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-56	KSW-501	KSW-945
Gross beta			
Suspended Solids	< 0.3	0.5 ± 0.3	< 0.4
Dissolved Solids	4.6 ± 0.7	3.4 ± 0.7	2.2 ± 0.5
Total Residue	4.6 ± 0.7	3.9 ± 0.8	2.2 ± 0.5
K-40 (ICP)	3.20	1.90	1.82
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

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Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-1a			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1551	KSW-2244	KSW-2944
Gross beta			
Suspended Solids	< 0.7	< 0.4	< 0.4
Dissolved Solids	7.6 ± 1.0	5.9 ± 0.7	6.5 ± 0.8
Total Residue	7.6 ± 1.0	5.9 ± 0.7	6.5 ± 0.8
K-40 (ICP)	5.54	6.66	5.29
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-1b			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1552	KSW-2245	KSW-2945
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.3
Dissolved Solids	1.4 ± 0.4	2.8 ± 0.5	3.5 ± 0.6
Total Residue	1.4 ± 0.4	2.8 ± 0.5	3.5 ± 0.6
K-40 (ICP)	1.21	1.82	2.13
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)

Indicator

K-1a

Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3678	KSW-4386	KSW-4910
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	7.3 ± 0.8	5.7 ± 0.7	13.5 ± 1.4
Total Residue	7.3 ± 0.8	5.7 ± 0.7	13.5 ± 1.4
K-40 (ICP)	6.38	6.61	9.77
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

K-1b

Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3679	KSW-4387	KSW-4911
Gross beta			
Suspended Solids	< 0.4	< 0.3	< 0.3
Dissolved Solids	2.3 ± 0.5	2.6 ± 0.5	4.0 ± 0.8
Total Residue	2.3 ± 0.5	2.6 ± 0.5	4.0 ± 0.8
K-40 (ICP)	2.35	2.64	2.18
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-1a			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5478	KSW-6230	KSW-6748
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.5
Dissolved Solids	12.5 ± 1.3	13.0 ± 0.8	12.3 ± 1.1
Total Residue	12.5 ± 1.3	13.0 ± 0.8	12.3 ± 1.1
K-40 (ICP)	14.79	9.52	9.00
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-1b			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5479	KSW-6231	KSW-6749
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	3.6 ± 0.7	3.0 ± 0.4	6.3 ± 0.8
Total Residue	3.6 ± 0.7	3.0 ± 0.4	6.3 ± 0.8
K-40 (ICP)	2.39	2.27	3.08
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40 and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-1d			
Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-57	KSW-502	KSW-946
Gross beta			
Suspended Solids	< 0.3	< 0.6	< 0.4
Dissolved Solids	2.5 ± 0.4	2.3 ± 0.4	2.4 ± 0.3
Total Residue	2.5 ± 0.4	2.3 ± 0.4	2.4 ± 0.3
K-40 (ICP)	1.38	1.21	1.21
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-1e			
Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-58	KSW-503	KSW-947
Gross beta			
Suspended Solids	< 0.3	< 0.5	0.4 ± 0.2
Dissolved Solids	3.8 ± 1.0	8.3 ± 1.6	9.8 ± 1.8
Total Residue	3.8 ± 1.0	8.3 ± 1.6	10.2 ± 1.8
K-40 (ICP)	2.34	7.79	5.71
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

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Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-1d			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1553	KSW-2246	KSW-2946
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	2.8 ± 0.5	1.2 ± 0.3	1.3 ± 0.3
Total Residue	2.8 ± 0.5	1.2 ± 0.3	1.3 ± 0.3
K-40 (ICP)	1.38	1.12	1.06
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-1e			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1554	KSW-2247	KSW-2947
Gross beta			
Suspended Solids	< 0.5	< 0.3	< 0.3
Dissolved Solids	3.2 ± 0.7	4.2 ± 0.9	7.2 ± 1.2
Total Residue	3.2 ± 0.7	4.2 ± 0.9	7.2 ± 1.2
K-40 (ICP)	2.94	4.07	5.56
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

	Sample Description and Concentration (pCi/L)		
Indicator			
K-1d			
Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3680	KSW-4388	KSW-4912
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	1.3 ± 0.3	1.6 ± 0.3	1.4 ± 0.4
Total Residue	1.3 ± 0.3	1.6 ± 0.3	1.4 ± 0.4
K-40 (ICP)	1.07	1.18	1.12
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-1e			
Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3681	KSW-4389	KSW-4913
Gross beta			
Suspended Solids	< 0.3	0.5 ± 0.2	< 0.3
Dissolved Solids	13.3 ± 1.5	11.0 ± 1.5	19.8 ± 2.3
Total Residue	13.3 ± 1.5	11.5 ± 1.5	19.8 ± 2.3
K-40 (ICP)	7.08	9.26	11.68
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-1d			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5480	KSW-6232	KSW-6750
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	2.8 ± 0.5	1.5 ± 0.2	1.5 ± 0.3
Total Residue	2.8 ± 0.5	1.5 ± 0.2	1.5 ± 0.3
K-40 (ICP)	1.06	1.05	1.21
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-1e			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5481	KSW-6233	KSW-6751
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	7.8 ± 1.2	12.3 ± 1.1	9.5 ± 3.1
Total Residue	7.8 ± 1.2	12.3 ± 1.1	9.5 ± 3.1
K-40 (ICP)	8.55	10.47	8.28
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40 and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)

Indicator

K-1k

Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	NS[a]	NS[a]	NS[a]
Gross beta			
Suspended Solids	-	-	-
Dissolved Solids	-	-	-
Total Residue	-	-	-
K-40 (ICP)			
Mn-54	-	-	-
Fe-59	-	-	-
Co-58	-	-	-
Co-60	-	-	-
Zn-65	-	-	-
Zr-Nb-95	-	-	-
Cs-134	-	-	-
Cs-137	-	-	-
Ba-La-140	-	-	-

Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1555	KSW-2248	KSW-2948
Gross beta			
Suspended Solids	0.9 ± 0.4	< 0.6	< 0.6
Dissolved Solids	1.6 ± 0.6	3.8 ± 0.8	5.9 ± 1.3
Total Residue	2.5 ± 0.7	3.8 ± 0.8	5.9 ± 1.3
K-40 (ICP)	2.60	4.41	2.27
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

[a] NS= No sample; water frozen.

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Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)

Indicator

K-1k

Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3682	KSW-4390	KSW-4914
Gross beta			
Suspended Solids	< 0.7	< 0.4	< 0.9
Dissolved Solids	7.2 ± 0.9	7.8 ± 1.0	10.1 ± 1.5
Total Residue	7.2 ± 0.9	7.8 ± 1.0	10.1 ± 1.5
K-40 (f.p.)	6.56	7.26	7.13
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5482	KSW-6234	KSW-6752
Gross beta			
Suspended Solids	< 0.4	< 1.3	< 0.4
Dissolved Solids	22.0 ± 1.6	13.6 ± 1.0	12.2 ± 1.2
Total Residue	22.0 ± 1.6	13.6 ± 1.0	12.2 ± 1.2
K-40 (f.p.)	11.68	10.47	8.28
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

[a] NS= No sample; water frozen.

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Table 24. Surface water samples, analyses for gross beta, potassium-40 and gamma-emitting isotopes.
Collection: Monthly

Sample Description and Concentration (pCi/L)

Indicator

K-9 (Raw)			
Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-59	KSW-504	KSW-948
Gross beta			
Suspended Solids	< 0.3	0.5 ± 0.3	< 0.4
Dissolved Solids	1.7 ± 0.7	1.7 ± 0.7	2.4 ± 0.5
Total Residue	1.7 ± 0.7	2.2 ± 0.8	2.4 ± 0.5
K-40 (ICP)	1.21	1.12	1.12
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-9 (Tap)			
Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-60	KSW-505	KSW-949
Gross beta			
Suspended Solids	< 0.3	< 0.6	< 0.4
Dissolved Solids	2.2 ± 0.4	2.0 ± 0.4	1.3 ± 0.3
Total Residue	2.2 ± 0.4	2.0 ± 0.4	1.3 ± 0.3
K-40 (ICP)	1.21	1.21	1.12
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-9 (Raw)			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1556	KSW-2249	KSW-2949
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	1.3 ± 0.4	2.3 ± 0.5	1.7 ± 0.4
Total Residue	1.3 ± 0.4	2.3 ± 0.5	1.7 ± 0.4
K-40 (ICP)	1.12	1.04	1.31
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-9 (Tap)			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1557	KSW-2250	KSW-2950
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.3
Dissolved Solids	2.4 ± 0.5	1.3 ± 0.3	1.7 ± 0.4
Total Residue	2.4 ± 0.5	1.3 ± 0.3	1.7 ± 0.4
K-40 (ICP)	1.21	1.04	1.30
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-9 (Raw)			
Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3683	KSW-4391	KSW-4915
Gross beta			
Suspended Solids	< 0.3	< 0.4	< 0.4
Dissolved Solids	1.1 ± 0.4	1.1 ± 0.4	2.9 ± 0.9
Total Residue	1.1 ± 0.4	1.1 ± 0.4	2.9 ± 0.9
K-40 (ICP)	1.03	1.29	1.04
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-9 (Tap)			
Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3684	KSW-4392	KSW-4916
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	1.9 ± 0.5	1.6 ± 0.3	2.5 ± 0.5
Total Residue	1.9 ± 0.5	1.6 ± 0.3	2.5 ± 0.5
K-40 (ICP)	1.03	1.09	1.05
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-9 (Raw)			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5483	KSW-6235	KSW-6753
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	1.3 ± 0.4	1.1 ± 0.3	1.5 ± 0.4
Total Residue	1.3 ± 0.4	1.1 ± 0.3	1.5 ± 0.4
K-40 (ICP)	0.89	1.03	1.22
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-9 (Tap)			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5484	KSW-6236	KSW-6754
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	1.6 ± 0.3	1.2 ± 0.3	1.2 ± 0.3
Total Residue	1.6 ± 0.3	1.2 ± 0.3	1.2 ± 0.3
K-40 (ICP)	1.03	1.07	1.26
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water, analyses for gross beta, potassium-40 and gamma-emitting isotopes (continued).

Sample Description and Concentration (pCi/L)			
Indicator			
K-14a			
Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-61	KSW-506	KSW-950, 1
Gross beta			
Suspended Solids	< 0.4	< 0.5	1.1 ± 0.2
Dissolved Solids	3.3 ± 0.6	1.9 ± 0.6	2.2 ± 0.2
Total Residue	3.3 ± 0.6	1.9 ± 0.6	3.3 ± 0.3
K-40 (ICP)	1.82	1.21	1.30
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-14b			
Date Collected	01-03-05	02-01-05	03-01-05
Lab Code	KSW-62, 3	KSW-507	KSW-952
Gross beta			
Suspended Solids	< 0.4	< 0.5	< 0.4
Dissolved Solids	2.7 ± 0.5	2.0 ± 0.6	2.6 ± 0.5
Total Residue	2.7 ± 0.5	2.0 ± 0.6	2.6 ± 0.5
K-40 (ICP)	1.73	1.21	1.30
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 24. Surface water, analyses for gross beta, potassium-40 and gamma-emitting isotopes (continued).

	Sample Description and Concentration (pCi/L)		
Indicator			
K-14a			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1558	KSW-2251	KSW-2951
Gross beta			
Suspended Solids	< 0.3	< 0.4	< 0.4
Dissolved Solids	1.8 ± 0.4	1.5 ± 0.4	3.1 ± 0.6
Total Residue	1.8 ± 0.4	1.5 ± 0.4	3.1 ± 0.6
K-40 (ICP)	1.90	1.38	1.43
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-14b			
Date Collected	04-04-05	05-02-05	06-01-05
Lab Code	KSW-1559	KSW-2252	KSW-2952
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.3
Dissolved Solids	1.7 ± 0.4	2.2 ± 0.6	2.5 ± 0.6
Total Residue	1.7 ± 0.4	2.2 ± 0.6	2.5 ± 0.6
K-40 (ICP)	2.08	1.38	1.44
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

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Table 24. Surface water, analyses for gross beta, potassium-40 and gamma-emitting isotopes (continued).

	Sample Description and Concentration (pCi/L)		
Indicator			
K-14a			
Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3685	KSW-4393	KSW-4917
Gross beta			
Suspended Solids	< 0.1	< 0.4	< 0.4
Dissolved Solids	2.3 ± 0.4	2.2 ± 0.4	1.9 ± 0.6
Total Residue	2.3 ± 0.4	2.2 ± 0.4	1.9 ± 0.6
K-40 (ICP)	1.12	1.45	1.06
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-14b			
Date Collected	07-05-05	08-01-05	09-01-05
Lab Code	KSW-3686	KSW-4394	KSW-4918
Gross beta			
Suspended Solids	< 0.1	< 0.4	< 0.4
Dissolved Solids	2.5 ± 0.5	3.2 ± 0.5	2.9 ± 0.7
Total Residue	2.5 ± 0.5	3.2 ± 0.5	2.9 ± 0.7
K-40 (ICP)	1.04	1.67	1.04
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

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Table 24. Surface water, analyses for gross beta, potassium-40 and gamma-emitting isotopes (continued).

	Sample Description and Concentration (pCi/L)		
Indicator			
K-14a			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5485	KSW-6237	KSW-6755
Gross beta			
Suspended Solids	< 0.4	< 0.4	< 0.4
Dissolved Solids	1.9 ± 0.4	1.4 ± 0.3	1.6 ± 0.4
Total Residue	1.9 ± 0.4	1.4 ± 0.3	1.6 ± 0.4
K-40 (ICP)	0.98	1.35	1.51
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15
K-14b			
Date Collected	10-03-05	11-01-05	12-01-05
Lab Code	KSW-5486	KSW-6238	KSW-6756
Gross beta			
Suspended Solids	< 0.4	0.4 ± 0.2	< 0.4
Dissolved Solids	1.8 ± 0.4	1.7 ± 0.4	1.7 ± 0.4
Total Residue	1.8 ± 0.4	2.1 ± 0.4	1.7 ± 0.4
K-40 (ICP)	1.13	1.32	1.51
Mn-54	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30
Co-58	< 15	< 15	< 15
Co-60	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30
Zr-Nb-95	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10
Ba-La-140	< 15	< 15	< 15

Table 25. Surface water, analyses for tritium, strontium-89 and strontium-90.
Collection: Quarterly composites of monthly samples.

Location and Collection Period	Lab Code	Concentration pCi/L H-3	Sr-89	Sr-90
Indicator				
K-1a				
1st Quarter	KSW -1135	< 167	< 0.6	< 0.6
2nd Quarter	-3616	< 161	< 0.8	< 0.6
3rd Quarter	-5349	< 147	< 0.6	< 0.6
4th Quarter	-7350	< 145	< 0.8	< 0.5
K-1b				
1st Quarter	KSW -1136	< 167	< 0.7	< 0.6
2nd Quarter	-3617	< 161	< 1.0	< 0.6
3rd Quarter	-5350	< 170	< 0.7	< 0.6
4th Quarter	-7351	< 145	< 0.9	< 0.5
K-1d				
1st Quarter	KSW -1137	< 167	< 0.6	< 0.7
2nd Quarter	-3618	< 161	< 0.8	1.1 ± 0.4
3rd Quarter	-5351	< 170	< 0.9	< 0.6
4th Quarter	-7352	< 145	< 0.7	< 0.5
K-1e				
1st Quarter	KSW -1138	< 167	< 0.7	< 0.6
2nd Quarter	-3619	< 161	< 0.7	< 0.5
3rd Quarter	-5352	< 147	< 0.8	< 0.5
4th Quarter	-7353, 4	< 145	< 0.7	< 0.4

Table 25. Surface water, analyses for tritium, strontium-89 and strontium-90 (continued).

Location and Collection Period		Concentration pCi/L H-3	Sr-89	Sr-90
Indicator				
K-14a				
1st Quarter	KSW -1141	187 ± 96	< 0.6	< 0.6
2nd Quarter	-3623	< 161	< 1.0	< 0.7
3rd Quarter	-5356	< 170	< 0.9	< 0.5
4th Quarter	-7358	< 145	< 0.7	< 0.4
K-14b				
1st Quarter	KSW -1142	< 167	< 0.5	< 0.5
2nd Quarter	-3624	253 ± 95	< 0.8	< 0.7
3rd Quarter	-5357	319 ± 115[b]	< 1.1	0.6 ± 0.3
4th Quarter	-7359	< 145	< 0.8	0.6 ± 0.3
K-1k				
1st Quarter	ND[a]			
2nd Quarter	KSW -3620	< 161	< 0.8	< 0.5
3rd Quarter	-5353	< 147	< 1.0	< 0.7
4th Quarter	-7355	< 145	< 0.9	< 0.6
Control				
K-9				
1st Quarter	KSW -1139 (Raw)	< 167	< 0.6	< 0.5
	-1140 (Tap)	< 167	< 0.5	< 0.6
2nd Quarter	KSW -3621 (Raw)	< 161	< 0.9	0.7 ± 0.4
	-3622 (Tap)	< 161	< 0.9	< 0.7
3rd Quarter	KSW -5354 (Raw)	< 170	< 1.1	< 0.6
	-5355 (Tap)	< 147	< 0.9	< 0.6
4th Quarter	KSW -7356 (Raw)	< 145	< 1.2	< 0.8
	-7357 (Tap)	< 145	< 0.9	< 0.6

[a] No data; water frozen.

[b] Result of recalculation.

Table 26. Fish, collected at K-1d, analyses for gross beta, strontium-89, strontium-90, strontium-90, and gamma-emitting isotopes.
Collection: Three times a year

Sample Description and Concentration (pCi/g wet)

Date Collected	05-31-05		06-03-05	
Lab Code	KF-2962		KF-3652	
Type	Whitefish		Sucker	
Portion	Flesh	Bones	Flesh	Bones
Gross beta	5.49 ± 0.16	1.95 ± 0.42	3.02 ± 0.16	1.62 ± 0.60
Sr-89	NA[a]	< 0.11	NA[a]	< 0.27
Sr-90	NA	0.40 ± 0.067	NA	0.16 ± 0.051
K-40	3.58 ± 0.63	NA[a]	2.09 ± 0.48	NA[a]
Mn-54	< 0.022	NA	< 0.009	NA
Fe-59	< 0.075	NA	< 0.12	NA
Co-58	< 0.031	NA	< 0.039	NA
Co-60	< 0.017	NA	< 0.017	NA
Cs-134	< 0.018	NA	< 0.021	NA
Cs-137	0.040 ± 0.022	NA	< 0.028	NA

Date Collected	07-06-05		07-08-05	
Lab Code	KF-5524		KF-5525	
Type	Sucker		Sucker	
Portion	Flesh	Bones	Flesh	Bones
Gross beta	5.47 ± 0.16	1.90 ± 0.54	4.61 ± 0.13	2.44 ± 0.55
Sr-89	NA[a]	< 0.66	NA[a]	< 0.86
Sr-90	NA	0.17 ± 0.071	NA	0.22 ± 0.088
K-40	3.20 ± 0.60	NA[a]	2.96 ± 0.55	NA[a]
Mn-54	< 0.026	NA	< 0.026	NA
Fe-59	< 0.14	NA	< 0.11	NA
Co-58	< 0.038	NA	< 0.045	NA
Co-60	< 0.012	NA	< 0.020	NA
Cs-134	< 0.021	NA	< 0.019	NA
Cs-137	< 0.033	NA	< 0.022	NA

[a] NA = Not analyzed; analyses not required.

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Table 26. Fish, collected at K-1d, analyses for gross beta, strontium-89, strontium-90, strontium-90, and gamma-emitting isotopes.
Collection: Three times a year

Sample Description and Concentration (pCi/g wet)				
Date Collected	12-12-05		12-13-05	
Lab Code	KF-7316		KF-7317	
Type	Carp		Chubs	
Portion	Flesh	Bones	Flesh	Bones
Gross beta	2.93 ± 0.08	2.20 ± 0.55	2.23 ± 0.06	0.68 ± 0.15
Sr-89	NA[a]	< 0.12	NA[a]	< 0.11
Sr-90	NA	0.45 ± 0.074	NA	0.073 ± 0.039
K-40	2.44 ± 0.39	NA[a]	2.31 ± 0.33	NA[a]
Mn-54	< 0.015	NA	< 0.008	NA
Fe-59	< 0.057	NA	< 0.024	NA
Co-58	< 0.020	NA	< 0.014	NA
Co-60	< 0.009	NA	< 0.012	NA
Cs-134	< 0.010	NA	< 0.010	NA
Cs-137	< 0.015	NA	0.049 ± 0.024	NA

[a] NA = Not analyzed; analyses not required.

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Table 27. Slime or aquatic vegetation, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes.
Collection: Semiannually

Sample Description and Concentration

	Indicators			Control
Location	K-1a	K-1b	K-1d	K-9
Date Collected	06-01-05	06-01-05	05-02-05	06-01-05
Lab Code	KSL-2983	KSL-2984	KSL-2296	KSL-2986
Gross beta	5.13 ± 0.16	5.84 ± 0.12	4.78 ± 0.55	5.08 ± 0.09
Sr-89	< 0.006	< 0.005	< 0.14	< 0.004
Sr-90	< 0.005	< 0.004	< 0.079	< 0.003
Be-7	< 0.15	< 0.17	0.39 ± 0.19	< 0.18
K-40	3.72 ± 0.41	3.28 ± 0.40	3.66 ± 0.37	3.38 ± 0.54
Mn-54	< 0.020	< 0.013	< 0.009	< 0.016
Co-58	< 0.014	< 0.009	< 0.013	< 0.022
Co-60	< 0.012	< 0.012	< 0.012	< 0.024
Nb-95	< 0.025	< 0.012	< 0.012	< 0.017
Zr-95	< 0.027	< 0.024	< 0.034	< 0.054
Ru-103	< 0.021	< 0.016	< 0.009	< 0.022
Ru-106	< 0.15	< 0.14	< 0.082	< 0.28
Cs-134	< 0.020	< 0.015	< 0.014	< 0.027
Cs-137	< 0.021	< 0.020	0.035 ± 0.016	< 0.020
Ce-141	< 0.036	< 0.031	< 0.027	< 0.051
Ce-144	< 0.096	< 0.072	< 0.090	< 0.15

Location	K-1e	K-1k	K-14
Date Collected	05-02-05	06-01-05	06-01-05
Lab Code	KSL-2297	KSL-2985	KSL-2987
Gross beta	3.49 ± 0.22	5.24 ± 0.11	4.05 ± 0.10
Sr-89	< 0.033	< 0.003	< 0.019
Sr-90	< 0.026	< 0.003	< 0.014
Be-7	0.64 ± 0.19	< 0.22	1.07 ± 0.27
K-40	1.86 ± 0.34	3.68 ± 0.59	1.77 ± 0.49
Mn-54	< 0.011	< 0.021	< 0.014
Co-58	< 0.010	< 0.021	< 0.014
Co-60	< 0.008	< 0.022	< 0.022
Nb-95	< 0.011	< 0.027	< 0.023
Zr-95	< 0.016	< 0.029	< 0.022
Ru-103	< 0.016	< 0.018	< 0.015
Ru-106	< 0.12	< 0.16	< 0.21
Cs-134	< 0.011	< 0.022	< 0.018
Cs-137	< 0.021	< 0.012	< 0.025
Ce-141	< 0.021	< 0.049	< 0.020
Ce-144	< 0.060	< 0.13	< 0.062

Table 27. Slime or aquatic vegetation, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes.
Collection: Semiannually

Sample Description and Concentration

	Indicators			Control
Location	K-1a	K-1b	K-1d	K-9
Date Collected	08-01-05	09-01-05	08-01-05	09-01-05
Lab Code	KSL-4377	KSL-4894	KSL-4378	KSL-4896
Gross beta	7.02 ± 0.17	4.96 ± 0.40	0.95 ± 0.25	3.98 ± 0.10
Sr-89	< 0.007	< 0.095	< 0.040	< 0.008
Sr-90	< 0.004	0.060 ± 0.022	< 0.022	< 0.003
Be-7	< 0.47	2.37 ± 0.42	0.77 ± 0.25	< 0.17
K-40	4.79 ± 0.96	2.31 ± 0.50	0.96 ± 0.29	2.85 ± 0.27
Mn-54	< 0.032	< 0.026	< 0.017	< 0.014
Co-58	< 0.027	< 0.017	< 0.019	< 0.019
Co-60	< 0.022	< 0.021	< 0.021	< 0.011
Nb-95	< 0.015	< 0.043	< 0.024	< 0.022
Zr-95	< 0.059	< 0.035	< 0.028	< 0.033
Ru-103	< 0.031	< 0.029	< 0.013	< 0.024
Ru-106	< 0.30	< 0.11	< 0.064	< 0.12
Cs-134	< 0.021	< 0.018	< 0.014	< 0.012
Cs-137	< 0.035	< 0.024	< 0.014	< 0.008
Ce-141	< 0.061	< 0.043	< 0.032	< 0.046
Ce-144	< 0.20	< 0.11	< 0.078	< 0.078

Location	K-1e	K-1k	K-14
Date Collected	07-05-05	09-01-05	08-01-05
Lab Code	KSL-3717	KSL-4895	KSL-4379
Gross beta	3.65 ± 0.24	6.08 ± 0.33	1.55 ± 0.21
Sr-89	< 0.030	< 0.057	< 0.025
Sr-90	< 0.016	0.019 ± 0.010	< 0.015
Be-7	1.39 ± 0.34	0.88 ± 0.37	0.83 ± 0.22
K-40	1.69 ± 0.42	3.49 ± 0.66	2.02 ± 0.30
Mn-54	< 0.011	< 0.018	< 0.014
Co-58	< 0.022	< 0.039	< 0.017
Co-60	< 0.019	< 0.023	< 0.014
Nb-95	< 0.016	< 0.062	< 0.018
Zr-95	< 0.041	< 0.072	< 0.045
Ru-103	< 0.025	< 0.043	< 0.024
Ru-106	< 0.15	< 0.13	< 0.16
Cs-134	< 0.021	< 0.022	< 0.012
Cs-137	< 0.017	< 0.029	< 0.015
Ce-141	< 0.046	< 0.056	< 0.042
Ce-144	< 0.083	< 0.14	< 0.10

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Table 28. Bottom sediment samples, analyses for gross beta, strontium-89, strontium-90, and gamma-emitting isotopes.
Collection: May and November

Sample Description and Concentration (pCi/g dry)

	Indicator				Control
Location	K-1c	K-1d	K-1j	K-14	K-9
Collection Date	05-02-05	05-02-05	05-02-05	05-02-05	05-02-05
Lab Code	KBS-2311	KBS-2312	KBS-2313	KBS-2315	KBS-2314
Gross beta	9.79 ± 1.23	8.84 ± 1.17	7.13 ± 1.08	4.62 ± 0.90	28.40 ± 1.92
Sr-89	< 0.037	< 0.039	< 0.030	< 0.035	< 0.052
Sr-90	< 0.026	0.061 ± 0.023	< 0.021	< 0.021	0.051 ± 0.021
K-40	8.69 ± 0.63	7.22 ± 0.62	6.70 ± 0.59	5.76 ± 0.48	10.32 ± 0.68
Co-58	< 0.019	< 0.015	< 0.023	< 0.019	< 0.020
Co-60	< 0.027	< 0.020	< 0.017	< 0.013	< 0.020
Cs-134	< 0.025	< 0.027	< 0.026	< 0.020	< 0.033
Cs-137	< 0.020	< 0.023	< 0.022	< 0.019	0.12 ± 0.033
Location	K-1c	K-1d	K-1j	K-14	K-9
Collection Date	11-01-05	11-01-05	11-01-05	11-01-05	11-01-05
Lab Code	KBS-6303	KBS-6304	KBS-6305	KBS-6307	KBS-6306
Gross beta	11.37 ± 1.78	11.90 ± 1.80	9.00 ± 1.67	9.22 ± 1.65	20.58 ± 2.34
Sr-89	< 0.036	< 0.040	< 0.038	< 0.038	< 0.049
Sr-90	0.019 ± 0.009	< 0.015	< 0.020	< 0.019	0.050 ± 0.014
K-40	8.77 ± 0.70	10.09 ± 0.67	9.40 ± 0.73	8.14 ± 0.65	8.48 ± 0.45
Co-58	< 0.029	< 0.024	< 0.027	< 0.035	< 0.028
Co-60	< 0.026	< 0.016	< 0.026	< 0.016	< 0.016
Cs-134	< 0.021	< 0.025	< 0.027	< 0.027	< 0.019
Cs-137	< 0.025	0.038 ± 0.021	< 0.021	< 0.022	< 0.030

APPENDIX A

RADIOCHEMICAL ANALYTICAL PROCEDURES

Environmental, Inc.
Midwest Laboratory
an Allegheny Technologies Co.

ANALYTICAL PROCEDURES MANUAL

ENVIRONMENTAL, Inc.
MIDWEST LABORATORY

prepared for

DOMINION NUCLEAR

KEWAUNEE POWER STATION

Revised 12-17-04

KPS

List of Procedures

Procedure Number		Revision Number	Revision Date
AB-01	Determination of Gross Alpha and/or Gross Beta in Solid Samples	3	07-07-04
AP-02	Determination of Gross Alpha and/or Gross Beta in Air Particulate Filters	1	07-15-91
AP-03	Procedure for Compositing Air Particulate Filters for Gamma Spectroscopic Analysis	2	07-21-98
CA-01	Determination of Stable Calcium in Milk	0	07-08-88
COMP-01	Procedure for Compositing Water and Milk Samples	0	07-09-04
GS-01	Determination of Gamma Emitters by Gamma Spectroscopy	3	02-03-04
I-131-01	Determination of I-131 in Milk by Anion Exchange (Batch Method)	4	03-16-04
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SP-01	Sample Preparation	6	01-26-04
SR-02	Determination of Sr-89 and Sr-90 in Water (Clear or Drinking Water	Reissue	12-15-04
SR-05	Determination of Sr-89 and Sr-90 in Ashed Samples	Reissue	12-15-04
SR-06	Determination of Sr-89 and Sr-90 in Soil and Bottom Sediments	Reissue	08-05-04
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T-02	Determination of Tritium in Water	5	01-29-02
TLD-01	Preparation and Readout of Teledyne Isotopes TLD Cards	7	06-07-01
W(DS)-01	Determination of Gross Alpha and/or Gross Beta in Water (Dissolved Solids or Total Residue)	4	07-21-98
W(SS)-02	Determination of Gross Alpha and/or Gross Beta in Water (Suspended Solids)	3	12-17-04

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DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN SOLID SAMPLES

PROCEDURE NO. AB-01

Prepared by

Environmental, Inc.
Midwest Laboratory

Copy No. ______________

Revision #	Date	Pages	Prepared by	Approved by
3	07-07-04	3	B Grob	SA Coorlim

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN SOLID SAMPLES

Principle of Method

100 mg to 200 mg of sample is distributed evenly on a 2" ringed planchet, counted in a proportional counter, and concentrations of gross alpha and /or gross beta are calculated.

A. Vegetation, Meat, Fish, and Wildlife

Procedure

1. Weigh out accurately in a planchet no more than 100 mg of ashed or dried and ground sample for gross alpha assay and no more than 200 mg for gross beta assay.

   NOTE: If both gross alpha and gross beta analyses are required, do not use more than 100mg.

2. Add a few drops of water and spread uniformly over area of the planchet. Dry under a heat lamp.

NOTE: If necessary, a few drops (6-7) of a lucite solution (0.5 mg/ml in acetone) may be added to keep residue in place. Dry under an infrared lamp for 10-20 minutes.

4. Store the planchets in a dessicator until counting.

5. Count the gross alpha and gross beta activity in a low background proportional counter.

Calculations

Gross alpha / gross beta activity:

$$(\text{pCi/g wet}) = \frac{A}{B \times C \times D \times F \times 2.22} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times F \times 2.22}$$

Where:

A = Net alpha / beta counts (cpm)
B = Efficiency for counting alpha / beta activity (cpm/dpm)
C = Weight of sample (grams), ash or dry
D = Correction factor for self absorption (See Proc. AB-02)
E_{sb} = Counting error of sample plus background
E_b = Counting error of background
F = Ratio of wet weight to ashed or dry weight

REFERENCES: Radioassay Procedures for Environmental Samples, U.S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.

B. Gross Alpha and/or Gross beta in Soil and Bottom Sediments

Procedure

1. Weigh out accurately in a planchet no more than 100 mg of a pulverized sample for a gross alpha assay and no more than 200 mg for a gross beta assay.

   NOTE: If both gross alpha and gross beta analyses are required, do not use more than 100mg.

2. Add a few drops of water and spread uniformly over area of the planchet. Dry under a heat lamp.

NOTE: If necessary, a few drops (6-7) of a lucite solution (0.5 mg/ml in acetone) may be added to keep residue in place. Dry under an infrared lamp for 10-20 minutes.

3. Store the planchets in a dessicator until counting.

4. Count the gross alpha and gross beta activity in a low background proportional counter.

Calculations

Gross alpha / gross beta activity:

$$(pCi/g\ dry) = \frac{A}{B \times C \times D \times 2.22} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times 2.22}$$

Where: 3

A = Net alpha / beta counts (cpm)
B = Efficiency for counting alpha / beta activity (cpm/dpm)
C = Weight of sample (grams)
D = Correction factor for self absorption (See Proc. AB-02)
E_{sb} = Counting error of sample plus background
E_b = Counting error of background

REFERENCES: Radioassay Procedures for Environmental Samples, U.S. Department of Health, Education and Welfare. Environmental Health Series, January 1967,

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DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN AIR PARTICULATE FILTERS

PROCEDURE NO. AP-02

Prepared by

Environmental, Inc.
Midwest Laboratory

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Revised Pages	Revision #	Date	Pages	Prepared by	Approved by
	0	07-11-86	3	B. Grob	LG Huebner
2	1	07-15-91	3	B. Grob	LG Huebner
	Reissue	08-18-04	2	[signature]	[signature]

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN AIR PARTICULATE FILTERS

Principle of Method

Air particulate filters are stored for at least 72 hours to allow for the decay of short-lived radon and thoron daughters and then counted in a proportional counter.

Apparatus

Forceps
Loading Sheet
Proportional Counter
Stainless Steel Planchets (standard 2" x 1/8")

Procedure

1. Store the filters for at least 72 hours from the day of collection.
2. Place filters on a stainless steel planchet.
3. Fill out a sample loading sheet. Fill in the date, counter number, counting time, sample identification number, sample collection date, and initials.

NOTE: Blanks are loaded with each batch of samples. Load the counter blank planchet as a last sample.

4. Count in a proportional counter long enough to obtain the required LLDs.
5. After counting is completed, return the filters to the original envelopes.
6. Submit counter printout, field collection sheet, and the loading sheet to the dark clerk for calculation.

Calculations

Gross alpha (beta) concentration:

$$(\text{pCi/L}) = \frac{A}{B \times C \times 2.22} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{B \times C \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Volume of sample
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background

REFERENCES: Radioassay Procedures for Environmental Samples, U.S. Department of Health, Education and Welfare. Environmental Health Series, January 1967,

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PROCEDURE for COMPOSITING AIR PARTICULATE FILTERS for GAMMA SPECTROSCOPIC ANALYSIS

PROCEDURE NO. AP-03

Prepared by

Environmental Inc.
Midwest Laboratory

Copy No. __________

Revised Pages	Revision #	Date	Pages	Prepared by	Approved by
	0	12-15-89	3	B. Grob	L.G. Huebner
	1	03-21-95	3	B. Grob	L.G. Huebner
	2	07-21-98	3	A. Fayman	B. Grob

PROCEDURE FOR COMPOSITING AIR PARTICULATE FILTERS FOR GAMMA SPECTROSCOPIC ANALYSIS

Principle of Method

AP filters are placed in a Petri dish in chronological order, labeled and submitted to the counting room for analysis by gamma spectroscopy.

Materials

Tweezers (long)
Blank filter paper
Small Petri Dish (50 x 9 mm)
Scotch Tape

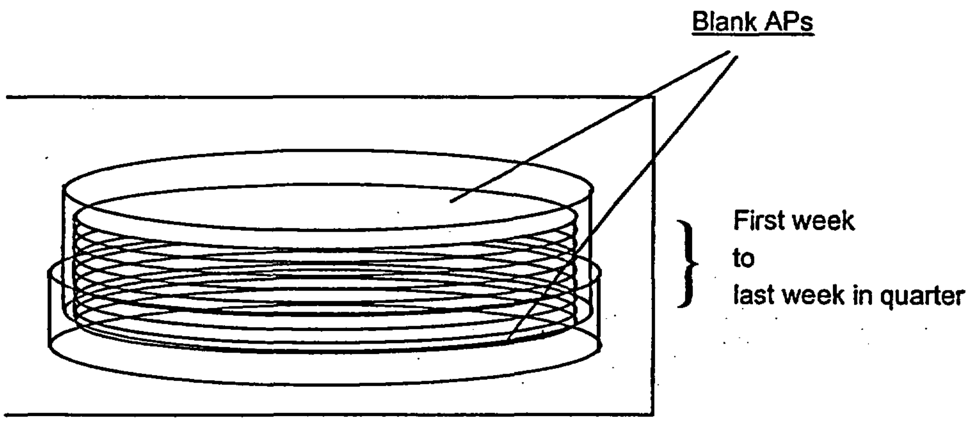
Procedure

1. In the Recording Book enter:
   - Sample ID (project)
   - Sample No.
   - Location
   - Collection Period
   - Date Composited
2. Obtain sample numbers from Receiving Clerk.
3. Stack the envelopes with APs from each location in chronological order, starting with the earliest date on the bottom. After you are done, flip the stack over.
4. Place blank filter paper, "fluffy" side down, in deep half of Petri dish.
5. Beginning from the top of the stack, remove each AP from its envelope and place in the Petri Dish with the deposit facing down.
6. Continue transferring AP's from envelopes into the Petri Dish.
7. Place blank filter, "fluffy" side down, on top of APs.
8. Cap the Petri Dish using the shallow half (you may use Scotch tape to hold cap in place, (if needed). Turn the Petri dish over.
9. On the Petri dish and each stack of glassine envelopes (each location kept together by either paperclips or rubber bands) using a black marker write:
   - Sample ID
   - Sample No.
   - Last date of collection
   - Collection Period
10. Submit the samples to the counting room.
11. After counting, samples are stored in the warehouse, according to client's requirements.

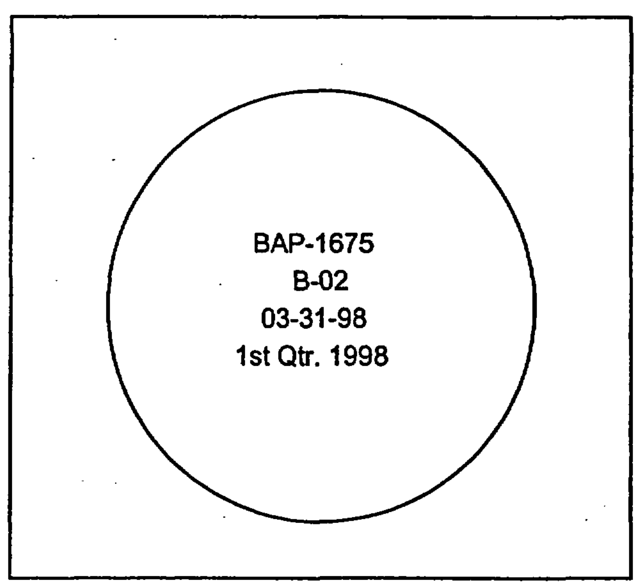
PROCEDURE for COMPOSITING AIR PARTICULATE FILTERS
FOR GAMMA SPECTROSCOPIC ANALYSIS

<u>Example</u>

- Sample ID (project) BAP
- Sample No. 2
- Location 1675
- Last Collection Date 03-31-98
- Collection Period 1st Qtr. 1998



Side View



Top View

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DETERMINATION OF STABLE CALCIUM IN MILK

PROCEDURE NO. TIML-CA-01

Prepared by

Teledyne Isotopes Midwest Laboratory

Copy No. ________

Revision No.	Date	Pages	Prepared by	Approved by
0	07-08-88	4	B. Grob	L. G. Huebner

Determination of Stable Calcium in Milk

Principle of Method

Strontium, barium, and calcium are absorbed on the cation-exchange resin, then eluted with sodium chloride solution. An aliquot of the eluate is diluted to reduce the high sodium ion concentration. From this diluted aliquot, calcium oxalate is precipitated, dissolved in dilute hydrochloric acid, and the oxalate is titrated with standardized potassium permaganate.

Reagents

Ammonium hydroxide, NH_4OH: 6N
Ammonium oxalate, $(NH_4)_2C_2O_4 \cdot H_2O$: 0.03N
Carrier solutions:
- Ba^{+2} as barium nitrate, $Ba(NO_3)2$: 20 mgBa^{+2} per ml
- Sr^{+2} as strontium nitrate, $Sr(NO_3)_2$: 20 mg Sr^{+2} per ml

Cation-exchange resin: Dowex 50W-X8 (Na^+ form, 50-100 mesh)
Citrate solution: 3N (pH 6.5)
Hydrochloric acid, HCl: 6N
Oxalic acid, $H_2C_2O_4 \cdot 2H_2$: 1N
Potassium permanganate, $KMnO_4$: 0.05N standardized
Sodium chloride, NaCl: 4N
Sodium oxalate, $Na_2C_2O_4$:

Apparatus

Burette

Procedure

1. Follow the TIML-SR-01 or SR-07 procedures, Steps 1-10.

2. Into a 40 ml glass centrifuge tube, pipette 10 ml aliquot of the initial eluate collected in Step 10.

3. Dilute the 10 ml aliquot to approximately 20 ml with D.I. water.

4. Heat in a hot water bath. Add 5 ml of 1N oxalic acid, and stir. While hot, adjust to pH 3 with 6N NH_4OH (use a pH meter) to precipitate calcium oxalate. Cool slowly to room temperature, centrifuge, and discard the supernate.

Procedure (continued)

5. Thoroughly wash the precipitate and the wall of the centrifuge tube, using not more than 5 ml of 0.03N ammonium oxalate. Centrifuge, and discard the supernatant.

6. Wash the precipitate with 10 ml of hot D.I. water. Cool to room temperature, centrifuge, and discard the supernate. (A stirring rod may be used to agitate the precipitate while it is being washed. It is important to remove all excess oxalic acid from the precipitate.)

7. Dissolve the precipitate in approximately 2.5 ml of 6N HCl. Heat in hot water bath for 5 minutes.

8. Dilute the acid solution to approximately 10 ml with D.I. water. Quantitatively transfer it to a 125 ml Erlenmeyer flask, rinsing the centrifuge tube with D.I. water.

9. Add an additional 1 ml of 6N HCl, and adjust the volume of solution to approximately 25 ml with D.I. water. Heat to near boiling.

10. While hot, titrate with standardized 0.05N $KMnO_4$ to the first faint pink endpoint which persists for at least 30 seconds.

Calculations

$$\text{Calcium (g/liter)} = \frac{A \times B \times C}{D}$$

Where:

A = Volume of $KMnO_4$ solution used for titration (ml)
B = Normality of standardized KMn_4 solution (mg/ml)
C = Milli-equivalent weight of calcium (mg/meg)
D = Sample volume (ml)

Since the sample size is 10 ml and the milli-equivalent weight of calcium is 20 mg, the equation reduces to:

$$\text{Calcium (g/liter)} - A \times B \times 2$$

Evaluation of Data

The standard deviation of replicate analyses has been determined to be ±0.02 g/liter.

Reference: Radioassay Procedures for Environmental Samples, U.S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.

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PROCEDURE FOR COMPOSITING WATER AND MILK SAMPLES

PROCEDURE NO. COMP-01

Prepared by

Environmental, Inc.
Midwest Laboratory

Copy No. __________

Revision #	Date	Pages	Prepared by	Approved by
0	11-07-88	2	B Grob	LG Huebner
Reissue	07-09-04	2	B Grob	SA Coorlim

PROCEDURE FOR COMPOSITING WATER AND MILK SAMPLES

Procedure

1. At the beginning of each composite period, (month, quarter, semi-annual), prepare a one-gallon cubitainer for a specific location and time-period.
2. Remove equal aliquots of the original samples (for example, one liter) and transfer to the prepared cubitainer.
3. When the composite is completed, submit the sample to the receiving clerk to assign a laboratory code number.
4. Analyze according to the client requirements.

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DETERMINATION OF GAMMA EMITTERS BY GAMMA SPECTROSCOPY

(GERMANIUM DETECTORS)

GS-01

Prepared by

Environmental Inc.
Midwest Laboratory

Copy No. ____________

Revised Pages	Revision #	Date	Pages	Prepared by	Approved by
Reprint	2	07-01-98	3	F. G. Shaw	S. A. Coorlim
	3	02-03-04	4	S. A. Coorlim	[signature]

DETERMINATION OF GAMMA EMITTERS BY GAMMA SPECTROSCOPY

(GERMANIUM DETECTORS)

Principle of Method

Samples are weighed or measured into calibrated containers and set directly on an HPGe (high-purity germanium) detector. The sample is counted for a sufficient length of time necessary to reach the required MDA (Minimum Detectable Activity). Results are decay corrected to the date of collection, where appropriate, using a dedicated computer and software.

Apparatus

Counting Containers
Counting Equipment
Cylinders
Marking Pens
Recording Books

A. Milk, Water, and other Liquid Samples

1. Measure with a graduated cylinder, 500 mL, 1.0 L, 2.0 L or 3.5 L of sample into a calibrated sample container (Marinelli beaker). Use the largest volume possible, based on available sample quantity.

2. Affix a label to the container cover with the sample number, volume, date and time of collection. Mark "I-131" if analysis for I-131 by gamma spectroscopy is required.

3. Count for estimated time required to meet the client's specifications. Record file number, sample identification number, date and time counting started, detector number, geometry, sample size, and date and time of collection.

4. Stop the counting; transfer the spectrum to the disk, and print out the results.

5. Check the results for required MDAs. If the client's specifications are not met, continue the counting.

6. Once the required MDAs have been met, record the counting time.

7. Return the sample to the original container and mark with a red marker.

NOTE: Refer to procedure OP-10, Operating Procedure for the EG&G ORTEC OMNIGAM Gamma Spectroscopy System.

B. Airborne Particulates

1. Place the air filters in a small Petrie dish following Procedure AP-03.

2. Place Petrie dish (with marked side up) on the detector and count long enough to meet the client specifications. Record the file number, sample identification number, date and time counting started, detector number, geometry, sample size, and date and time collected.

NOTE: When counting individual filters, place in a labeled Petrie dish with active (deposit) side up.

3. Stop counting and transfer spectrum to the disk. Print out and check the results before removing the sample. If client specifications are not met, continue counting.

4. When the required MDAs have been met, record the counting time.

5. Replace air filters in the original envelopes for storage or further analyses.

NOTE: Refer to procedure OP-10, Operating Procedure for the EG&G ORTEC OMNIGAM Gamma Spectroscopy System.

C. Other Samples

NOTE: Samples, e.g. soil, vegetation, fish, powdered samples, etc., are prepared in the prep lab and delivered to the counting room

1. Place the sample on the detector and count long enough to meet client's technical requirements. Record the file number, sample identification number, date and time counting started, detector number, geometry, sample size, and date (and time, if applicable) of collection.

2. Stop the counting and transfer the spectrum to the disk. Print out and check the results before removing the sample. If client specifications are not met, continue counting.

3. When the required MDAs have been met, record the counting time. Mark the container with red marker and return to the prep lab for transfer to storage or further analyses.

NOTE: Refer to procedure OP-10, Operating Procedure for the EG&G ORTEC OMNIGAM Gamma Spectroscopy System.

D. Charcoal Cartridges

For counting charcoal cartridges, follow Procedure I-131-02, I-131-04 or I-131-05.

CALCULATIONS:

Activity (pCi/L) ± the two sigma error for a select gamma peak, region of interest (ROI) =

$$\frac{A}{2.22 \times C \times D \times G \times Y} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{2.22 \times C \times D \times G \times Y}$$

where:

A = Net cpm, (ROI)

C = Volume of sample (liter)

G = Efficiency (cpm/dpm)

Y = Abundance (% of gamma disintegrations)

E_{sb} = Counting error of sample plus background

E_b = Counting error for background.

D = Correction for decay to the time of collection $= e^{-\lambda t}$ or $e^{\frac{-0.693 \times t}{t_{1/2}}}$

where:

t = elapsed time from the time of collection to the counting time (in days)

$t_{1/2}$ = half-life

MDA (Minimum Detectable Activity) is calculated using the RISO method.

$$MDA = 4.65 \times \frac{\sqrt{B}/LT}{2.22 \times C \times D \times G \times Y}$$

where:

B = Background (cpm)

LT = Live time (min)

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DETERMINATION OF I-131 IN MILK AND WATER BY ANION EXCHANGE

(BATCH METHOD)

PROCEDURE NO. I-131-01

Prepared by

Environmental Inc.
Midwest Laboratory

Copy No. ____________

Revised Pages	Revision #	Date	Pages	Prepared by	Approved by
Reissue	4	03-16-04	5	S.A. [signature]	[signature]

Revision History

Pages	Revision #	Date	Pages	Prepared by	Approved by
	0	06-12-85	6	B. Grob	L.G. Huebner
2, 3, 4, 5	1	04-10-91	6	B. Grob	L.G. Huebner
2	2	08-14-92	6	B. Grob	L.G. Huebner
4	3	09-24-92	6	B. Grob	L.G. Huebner

DETERMINATION OF I-131 IN MILK AND WATER BY ANION EXCHANGE (BATCH METHOD)

Principle of Method

After samples have been treated to convert all iodine in the sample to a common oxidation state, the iodine is isolated by solvent extraction or a combination of ion exchange and solvent extraction steps.

Iodine, as the iodide, is concentrated by adsorption on an anion resin. Following a NaCl wash, the iodine is eluted with sodium hypochlorite. Iodine in the iodate form is reduced to I_2 and the elemental iodine extracted into $CHCl_3$, back-extracted into water then finally precipitated as palladium iodide.

Chemical recovery of the added carrier is determined gravimetrically from the PdI_2 precipitate. I-131 is determined by beta counting the PdI_2.

Reagents

Anion Exchange Resin, Dowex 1x8 (50-100 mesh), chloride form
Chloroform, $CHCl_3$, reagent grade
Hydrochloric Acid: HCL: 1N
Hydrochloric Acid: HCL: 3N
Wash Solution: H_20 - $HN0_3$ - NH_2OH HCL, 50 mL H_2O; 10 mL 1M - NH_2OH-HCl;
10 mL concentrated HNO_3
Hydroxylamine Hydrochloride, NH_2OH HCl - 1M
Nitric Acid, HNO_3 - concentrated, 6N
Palladium Chloride, $PdCl_2$, 7.2 mg Pd^{++}/mL (1.2 g $PdCl_2$/100 mL of 6N HCl)
Sodium Bisulfite, $NaHSO_3$ - 1M
Sodium Chloride, NaCl - 2M
Sodium Hypochlorite, NaOCl - 5% (Clorox)
Sodium Hydroxide, 12N NaOH
Potassium Iodide, KI, ca. 29 mg KI/mL (See Proc. CAR-01 for preparation)

Special Apparatus

Chromatographic Column, 20mm x 150mm (Reliance Glass Cat. #R2725T)
Heat Lamp
Filter Paper, Whatman #42, 21mm
Mylar
pH Meter
Polyester Gummed Tape, 1 1/2", Scotch #853

Vacuum Filter Holder, 2.5 cm^2 filter area

Part A

Water Samples:

NOTE: Samples containing suspended matter should be filtered before proceeding to Step 1.

1. Transfer 2 liters (if available) of clear sample to the beaker. Add 1.00 mL of standardized iodide carrier and 5 mL of 5% sodium hypochlorite to each sample.

2. Add a clean magnetic stirring bar to each sample beaker. Stir each sample for 20 minutes.

3. Add 25 mL of 1M hydroxylamine hydrochloride and stir for 2 minutes

4. Add 10 mL of 1M sodium bisulfite.

5. Adjust pH to 6.5 using 12N NaOH or 6N HNO_3.

6. Continue to Step. 10

Milk Samples:

7. Transfer 2 liters (if available) of clear sample to the beaker. Add 1.00 mL of standardized iodide carrier to each sample.

8. Add a clean magnetic stirring bar to each sample beaker. Stir each sample for 5 minutes or longer on a magnetic stirrer. Allow sample to equilibrate at least 1/2 hour. If a milk sample is curdled or lumpy, vacuum filter the sample through a Buchner funnel using a cheesecloth filter. Wash the curd thoroughly with deionized water, collecting the washings with the filtrate. Pour the filtrate back into the original washed and labeled 4 liter beaker and discard the curd.

9. Continue to Step. 10

10. Add approximately 45 grams of Dowex 1x8 (20-50 mesh) anion resin to each sample beaker and stir for at least 1 hour. Allow the resin to settle for 10 minutes.

11. Gently decant and discard the milk or water sample. Take care to retain as much resin as possible in the beaker. Add approx. 1 liter of deionized water to rinse the resin, allow to settle 2 minutes, and pour off the rinse.

12. Using a deionized water wash bottle, transfer the resin to the column marked with the sample number. Allow resin to settle 2 minutes and drain the standing water. Wash resin with 100 mL of 2M NaCl.

13. Measure 50 mL 5% sodium hypochlorite in a graduated cylinder. Add sodium hypochlorite to column in 10-20 mL increments, stirring resin as needed to eliminate gas bubbles and maintain flow rate of 2 mL/min. Collect eluate in 250 mL beaker and discard the resin.

Part B

Iodine Extraction Procedure

CAUTION: Perform following steps in the fume hood.

1. Acidify the eluate from Step 6 by adding ca. 15 mL of concentrated HNO_3 to make the sample 2-3 N in HNO_3 and transfer to 250 mL separatory funnel. (Add the acid slowly with stirring until the vigorous reaction subsides).

2. Add 50 mL of $CHCl_3$ and 10 mL of 1M hydroxylamine hydrochloride (freshly prepared). Extract iodine into organic phase (about 2 minutes equilibration). Draw off the organic phase (lower phase) into another separatory funnel.

3. Add 25 mL of $CHCl_3$ and 5 mL of 1M hydroxylamine hydrochloride to the first separatory funnel and again equilibrate for 2 minutes. Combine the organic phases. Discard the aqueous phase (Upper phase) if no other analyses are required. If Pu, U or Sr is required on the same sample aliquot, submit the aqueous phase and data sheet to the appropriate laboratory section.

4. Add 20 mL H_2O-HNO_3-NH_2OH HCl wash solution to the separatory funnel containing the $CHCl_3$. Equilibrate 2 minutes. Allow phases to separate and transfer $CHCl_3$ (lower phase) to a clean separatory funnel. Discard the wash solution.

5. Add 25 mL H_2O and 10 drops of 1M sodium bisulfite (freshly prepared) to the separatory funnel containing the $CHCl_3$. Drain aqueous phase (upper phase) into a 100 mL beaker. Proceed to the precipitation of PdI_2.

Part C

Precipitation of Palladium Iodide

CAUTION: AMMONIUM HYDROXIDE INTERFERES WITH THIS PROCEDURE

1. Add 10 mL of 3N HCl to the aqueous phase from the iodine extraction procedure in Step 5.

2. Place the beaker on a stirrer-hot plate. Using the magnetic stirrer, boil and stir the sample until it evaporates to 30 mL or begins to turn yellow.

3. Turn the heat off. Remove the magnetic stirrer, rinse with deionized water.

4. Add, dropwise, to the solution, 2.0 mL of palladium chloride.

5. Cool the sample to room temperature. Place the beaker with sample on the stainless steel tray and put in the refrigerator overnight.

6. Weigh a clean 21mm Whatman No. 42 filter which has been dried under the heat lamp.

7. Place the weighed filter in the filter holder. Filter the sample and wash the residue with water and then with absolute alcohol.

8. Remove filter from filter holder and place it in a labeled Petri dish.

9. Dry under the lamp for 20 minutes.

Precipitation of Palladium Iodide (continued)

10. Weigh the filter with the precipitate and calculate carrier recovery.
11. Cut a $1^1/_2$" strip of polyester tape and lay it on a clean surface, Gummed side up. Place the filter, precipitate side up, in the center of the tape.
12. Cut a $1^1/_2$" wide piece of mylar. Using a spatula to press it in place, put it directly over the precipitate and seal the edges to the polyester tape. Trim to about 5mm from the edge of the filter with scissors.
13. Mount the sample on the plastic disc and write the sample number on the back side of the disc.
14. Count the sample on a proportional beta counter.

Calculations

Calculate the sample activity using computer program I-131.

I-131 concentration (pCi/L):

$$(= \frac{A}{2.22 \times B \times C \times D \times R} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{2.22 \times B \times C \times D \times R}$$

where:

A = Net cpm, sample

B = Efficiency for counting beta I-131 (cpm/dpm)

C = Volume of sample (liters)

D = Correction for decay to the time of collection = $e^{-\lambda t}$ =

where

t = elapsed time from the time of collection to the counting time (in days)

E_{sb} = Counting error of sample plus background

E_b = Counting error of background

R = Carrier recovery

2.22 = dpm/pCi

REFERENCE: "Determination of I-131 by Beta-Gamma Coincidence Counting of PdI_2". Radiological Science Laboratory. Division of Laboratories and Research, New York State Department of Health, March 1975, Revised February 1977.

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DETERMINATION OF AIRBORNE I-131 IN CHARCOAL CARTRIDGES BY GAMMA SPECTROSCOPY

PROCEDURE NO. I-131-02

Prepared by
Environmental Incorporated
Midwest Laboratory

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Revised Pages	Revision #	Date	Pages	Prepared by	Approved by
1-4	Reissue	05-07-04	4	S.A. [signature]	[signature]

DETERMINATION OF AIRBORNE I-131 IN CHARCOAL CARTRIDGES BY GAMMA SPECTROSCOPY

Principle of Method

A charcoal cartridge is placed on the detector (face loaded) and counted for I-131 by gamma spectroscopy.

Alternatively a "batch" method may be used. Five or six cartridges are mounted (face loaded) in a modified Marinelli holder and placed on the gamma detector. The batch is typically counted overnight.

The 0.36 MeV peak is used to calculate the concentration at counting time.

Procedure

NOTE: Cartridges should be counted for I-131 within 8 days (one half-life) of the collection date. Count as soon as possible upon receipt.

Individual Cartridge Counting

1. Place the charcoal cartridge on the detector with the rim facing the detector and the air flow indicator (arrow) pointing away from the detector, (Fig. 1). Count long enough to meet the required Lower Limit of Detection (LLD).

2. Calculate the concentration of I-131 (pCi/m^3). Input lab code, volume and date and time of collection (use the midpoint of collection period). Notify the supervisor immediately of any positive result.

Batch Method

4. Load the charcoal cartridges in the modified Marinelli holder with the rim facing the detector and the air flow indicator (arrow) pointing away from the detector (Fig. 2). Use a rubber band to hold the side mounted cartridges in place.

5. Place the holder on the detector and count long enough for the lowest volume cartridge to meet the required Lower Limit of Detection (LLD). Batch charcoals are typically counted overnight.

6. Calculate the concentration of I-131 at the time of counting and a volume of 1.0 m^3. Submit printout to data clerk for final calculations without delay.

Note: A batch method is used for screening only. If I-131 activity is detected, each cartridge from the batch must be analyzed individually.

Calculations:

A_1 = I-131 concentration

$$(\text{pCi/sample}) = \frac{A}{2.22 \times B_1 \times B_2} \text{ (at counting time)}$$

where:

A = Net count rate of I-131 in the 0.36 MeV peak (cpm)

B_1 = Efficiency for the I-131 in 0.36 MeV peak (cpm/dpm)

B_2 = retention efficiency for the I-131 cartridge.

2.22 = dpm/pCi

I-131 concentration at the time of collection:

$$(\text{pCi/m}^3) = \frac{A_1}{C \times D} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{C \times D}$$

where:

C = Volume of sample (m^3)
D = Correction for decay to the time of collection = e^{-lt}

$$\text{Exp}\left(-\frac{0.693 \times t}{8.04}\right) = e^{-0.0862t}$$

where:

t = the elapsed time from the time of collection to the counting time (in days)

E_{sb} = Counting error of sample plus background

E_b = Counting error of background

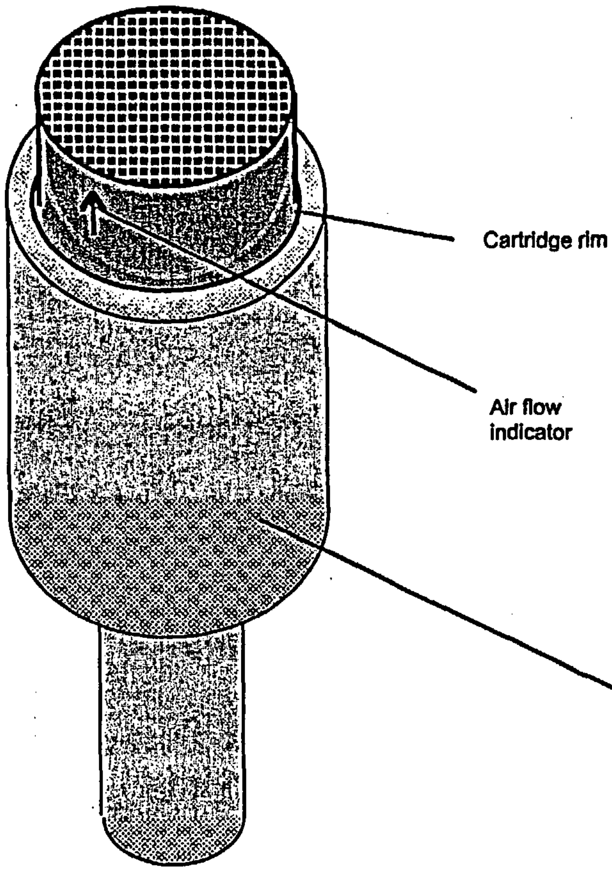

Figure 1. Face loading of the charcoal cartridge.

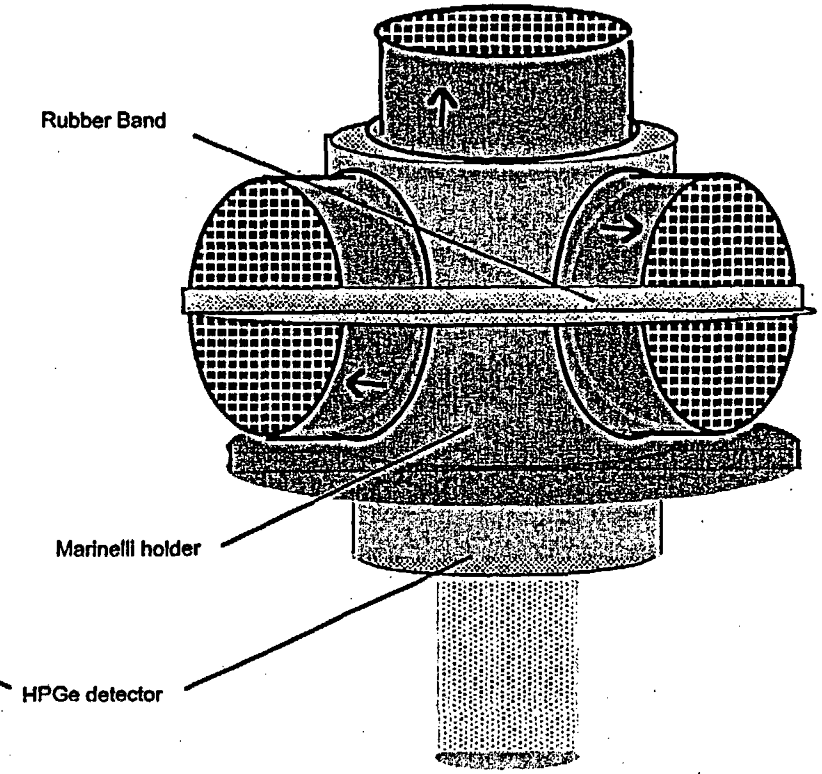

Figure 2. Face loading of cartridges in a batch.

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SAMPLE PREPARATION

EIML-SP-01

Prepared by

Environmental, Inc.
Midwest Laboratory

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Revision #	Date	Pages	Prepared by	Approved by
5	05-07-02	14	S. A. Coorlim	B. Grob
6	01-26-04	9	S. A. Coorlim	B. Grob

TABLE OF CONTENTS

SAMPLE PREPARATION

Principle of Method

Different classes of samples require different preparations. In general, food products are prepared as for home use, while others are dried and ashed as received.

Reagents

Formaldehyde

Apparatus

Balance
Ceramic Dishes
Counting Containers
Cutting Board
Drying Oven
Drying Pans
Grinder
High Temperature Marking Pen
Knives
Labels
Muffle Furnace
Plastic Bags
Pulverizer
Scissors
Spatulas

PROCEDURE FOR PACKING STANDARD CALIBRATED COUNTING CONTAINERS

A. 1.0, 2.0, 3.5 L: Pour 1.0, 2.0, or 3.5 liters of water into corresponding container. Mark the level and empty the container. Fill with the sample to the mark, except for grass. Pack as much as will fit into the container.

B. 250 mL, and 500 mL: Fill to the rim on the inside wall, which is 1/4" from the top.

C. 4 oz: Fill to the 100 mL mark.

Notes to Procedures:

1. Pack sample containers tightly. For soil, sediments or other dried samples, make sure samples are leveled.
2. A few mL. of formaldehyde may be added to wet samples to prevent spoilage.
3. For tritium analysis, transfer approximately 100 g of wet sample to a 4 oz. container. Label with the sample number and seal.
4. If a gamma scan is the only required analysis, the drying and ashing steps are skipped. Transfer the samples to a plastic bag, seal, label, and store in a cooler or freezer until disposal.
5. If there is sufficient quantity, use surplus sample for drying and ashing instead of waiting for gamma scanning to be completed.
6. US Ecology Inc. samples: record total weight received.
7. US Ecology Inc. and Maxey Flats samples are **DRIED** before gamma spectroscopic analysis.
8. If I-131 analysis is required, the sample must be prepared and submitted to the counting room immediately. Mark "I-131" on the tape.

A. Vegetables, Fruits, Grass, Green Leafy Vegetation and Cattle Feed

Note: Do not wash the samples.

1. Cut vegetables and hard fruits into small pieces (about 1/4" cubes). Mash soft fruits. Cut grass and green leafy vegetation into approximately 1-2" long stems. Pack cattle feed and silage as is. Use larger containers if sufficient amount of sample is available.
2. Transfer sample to a standard calibrated container. Use the largest size possible for the amount of sample available. Pack tightly but **DO NOT FILL ABOVE THE MARK.** Record the wet weight.
3. Seal with cover. Attach label to the cover recording the sample number, weight, and collection date.
4. Submit to the counting room for gamma spectroscopic analysis without delay or store in a cooler, (for short period), until counting.
5. Proceed to Drying and Ashing, Vegetation Samples

B. Slime and Aquatic Vegetation

1. Remove any foreign material. Place the sample in a sieve pan and wash until all sand and dirt is removed (turn the sample over several times). Squeeze out the water by hand.
2. Place the sample in a standard calibrated container. Use the largest size possible for the amount of sample available. Weigh and record wet weight. **DO NOT FILL ABOVE THE RIM.**

6\. Seal with cover. Attach label to the cover recording the sample number, weight, and collection date.

4\. Submit to the counting room without delay. Slime decomposes quickly, even with formaldehyde. If gamma scanning must be delayed, freeze.

5\. Proceed to Drying and Ashing, Vegetation Samples

C. Drying and Ashing, Vegetation Samples

1. After gamma scan is complete, transfer the sample to a drying pan and dry at 110°C.
2. Cool, weigh, and record dry weight.
3. Transfer to a tared ceramic dish, and record dry weight for ashing. Ash in a muffle furnace by gradually increasing the temperature to 600°C.

NOTE: If ashing is incomplete (black carbon remains), cool the dish, crush the ash with spatula, and continue ashing overnight at 600°C. It is not necessary to increase the temperature gradually.

4\. Cool and weigh the ashed sample and record ash weight. Grind and sieve through a 30 mesh screen. Transfer to a 4 oz. container, seal, and label with sample number, weight, analyses required, and date of collection. The sample is now ready for analysis.

D. Fish

1. Wash the fish.

2. Fillet and pack the fish immediately (to prevent moisture loss) in a 250 mL, 500 mL, or 4 oz. standard calibrated container. Use 500 mL size if enough sample is available. **DO NOT FILL ABOVE THE RIM.** Record the wet weight.

3. Proceed to Step 2, Waterfowl, Meat and Wildlife Samples below.

E. Waterfowl, Meat, and Wildlife

1. Skin and clean the animal. Remove a sufficient amount of flesh to fill an appropriate standard calibrated container (500 mL, 250 mL, or 4 oz). Weigh without delay (to prevent moisture loss). **DO NOT FILL ABOVE THE RIM.** Record the wet weight.

2. If bones are to be analyzed, boil remaining flesh and bones in water for about 1 hour. Clean the bones. Air dry, weigh, and record as wet weight. Dry at 110°C. Record dry weight. Ash at 800°C, cool, weigh, and record the ash weight. Grind to a homogeneous sample. The sample is ready for analysis.

3. Seal with cover. Attach label to the cover recording the sample number, weight, and collection date.

4. Submit to the counting room for gamma spectroscopic analysis without delay or store in a refrigerator, (for short period), until counting.

5. Proceed to Drying and Ashing, Fish and Game Samples

F. Drying and Ashing, Fish and Meat Samples

1. After gamma scan is complete, transfer the sample to a drying pan and dry at 110°C.

2. Cool, weigh, and record dry weight.

3. Transfer to a tared ceramic dish. Record dry weight for ashing.

4. Ash in a muffle furnace by gradually increasing the temperature to 450°C. If considerable amount of carbon remains after overnight ashing, the ash should be crushed with a spatula and placed back in the muffle furnace until ashing is completed.

5. Cool and weigh the ashed sample and record the ash weight. Grind and sieve through a 30 mesh screen. Transfer to a 4 oz. container, seal, and record sample number, weight, analyses required, and date of collection. The sample is now ready for analysis.

G. Eggs

1. Remove the egg shells and mix the eggs with a spatula.

2. Transfer the mixed eggs to a standard calibrated 500 mL container. Record the wet weight. **DO NOT FILL ABOVE THE RIM.**

3. Seal with cover. Attach label to the cover recording the sample number, weight, and collection date.

4. Submit to the counting room for gamma spectroscopic analysis without delay or store in a refrigerator, (for short period), until counting.

5. After the gamma scan is complete, transfer the sample to a drying pan and dry at 110°C.

6. Cool, weigh, and record dry weight.

7. Transfer to tared ceramic dish. Record dry weight for ashing.

8. Cool and weigh the ashed sample and record the weight. Grind and sieve through a 30 mesh screen. Transfer to a 4 oz. container, seal, and record sample number, weight, analyses required, and date of collection. The sample is now ready for analysis.

9. Store the remaining dry sample in a plastic bag.

H. Bottom Sediments and Soil

1. Remove rocks, roots, and any other foreign materials.

2. Place approximately 1 kg of sample on the drying pan and dry at 110°C.

3. Seal, label, and save remaining sample.

4. Grind or pulverize the dried sample and sieve through a No. 20 mesh screen.

5. For gamma spectroscopic analysis, transfer sieved sample to a standard calibrated 500 mL, 250 mL, or 4 oz. container. **DO NOT FILL ABOVE THE RIM.** Record dry weight.

6. Seal with cover. Attach label to the top of the cover and record the sample number, weight, and date of collection.

7. Submit to the counting room for gamma spectroscopic analysis without delay.

8. For gross alpha and beta analysis transfer 1-2 g of sample to a 4 oz. container, seal and label with the sample number. For other analysis (i.e., radiostrontium, transuranics etc.,) transfer to a ceramic dish and ash in a muffler furnance at 600°C. Cool and transfer to a 4 oz. container, seal and label with the sample number.

9. Store the remaining sieved sample in a plastic bag.

10. After the gamma scan is complete, transfer the sample to a plastic bag, seal, label, and store until disposal.

I. Milk

1. Transfer 25 mL of milk for gross alpha and beta analysis or 100-1000 mL for other analysis into a glass beaker.
2. Dry at 110°C.
3. Ash in the muffler furnance by gradually increasing the temperature to 600°C. If a considerable amount of carbon remains (black), cool the beaker, crush the ash with a spatula and continue ashing until completed (white or light gray in color).
4. Cool and weigh the ashed sample and record the ash weight. Grind and transfer to a 4oz. container, seal and record the sample number. The sample is now ready for analysis.

J. Dry Foods (Powdered Milk, Infant Formula, Animal Feed)

For gamma isotopic analysis of powdered samples, no preparation is necessary. The samples are transferred to a Marinelli beaker as received.

1. Tare a 250 or 500 ml. Marinelli beaker (with lid), depending on sample size available. Record the tare weight.
2. Transfer sample to the beaker. (Refer to pg. 4, "PROCEDURE FOR PACKING STANDARD CALIBRATED COUNTING CONTAINERS")
3. Attach a label to the top of the cover and record the sample number, weight and collection date.
4. Submit to the counting room without delay.
5. Submit to the counting room for gamma spectroscopic analysis without delay.
6. For gross alpha and beta analysis transfer 1-2 g of sample to a 4 oz. container, seal and label with the sample number. For other analysis (i.e., radiostrontium, transuranics etc.) transfer to a ceramic dish and ash in a muffle furnance at 600°C. Cool and transfer to a 4 oz. container, seal and label with the sample number.

K. Feces

NOTE: Perform Transfer operation in the hood. Wear new plastic gloves and face mask.

1. Take a 600 mL beaker, clean acid etched area and write sample # using HI-Temp marker.
2. Cover the beaker with parafilm and weigh. Record the weight.
3. Transfer the whole sample to the beaker using a new plastic spoon.
4. Cover the beaker with the same parafilm and weigh. Record total weight.
5. Transfer the beaker to the drying oven, remove parafilm and dry the sample overnight at 110° C.
6. In the morning, turn oven off. Let the exhaust fan run until sample cools to room temperature.
7. Transfer beaker to the muffle furnace. Set temperature to 175° C. Gradually increase the temperature to 450° C and ash the sample overnight.

NOTE: In the morning, carefully open the door and visually inspect the sample. Do not touch or remove the beaker from the furnace. If ashing is incomplete, (black carbon remains), continue ashing for another 24 hours or until the ash is grey-white.

8. Once ashing is complete, turn the temperature off. Let the exhaust fan run until beaker is cool.
9. Remove the beaker from the furnace and cover with parafilm. The sample is ready for analysis.

NOTE: Digest the whole ash sample in the same beaker before taking aliquot for analysis. Do not weigh the beaker.

L. Bottom Sediments and Soil, Analysis for Ra-226 by Gamma Spectroscopy

1. Remove rocks, roots and any other foreign materials.
2. Place approximately 1 kg of sample in a drying pan and dry at 110°C. Save any remaining sample.
3. Grind or pulverize the dried sample and sieve through a No. 20 mesh screen.
4. Transfer sieved sample to a standard calibrated 500 mL or 250 mL container.
   DO NOT FILL ABOVE THE RIM. Record dry weight.
5. Seal with cover and electrical tape. Attach label to the top of the cover and record the sample number, weight, and date of collection and date and time the container was sealed.
6. Deliver to counting room for gamma spectroscopic analysis. (The sample is stored for a minimum of 20 days to allow Pb-214 to come to equilibrium with Ra-226. The Pb-214 peak is then used to calculate the Ra-226 concentration.)
7. Store the remaining sieved sample in a plastic bag for possible future reanalysis.
8. After the gamma scan is completed, transfer sample to a plastic bag, label and store until disposal.

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DETERMINATION OF SR-89 AND SR-90 IN WATER

(CLEAR OR DRINKING WATER)

PROCEDURE NO. SR-02

Prepared by

Environmental Inc.
Midwest Laboratory

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	Reissue	12-15-04	6	SA Coorlim	[signature]

Determination of Sr-89 and Sr-90 in Water

Principle of Method

The acidified sample of clear water with stable strontium, barium, and calcium carriers is treated with oxalic acid at a pH of 3.0 to precipitate insoluble oxalates. The oxalates are dissolved in nitric acid, and strontium nitrate is separated from calcium as a precipitate in 70% nitric acid. The residue is purified by adding iron and rare earth carriers and precipitating them as hydroxides. After a second strontium nitrate precipitation from 70% nitric acid, the nitrates are dissolved in acid with added yttrium carrier and are stored for ingrowth of yttrium-90. The yttrium is again precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and collected on No. 42 (2.4 cm) Whatman filter for counting.

Reagents

Ammonium acetate buffer: pH 5.0
Ammonium hydroxide, NH_4OH: concentrated (15N), 6N
Ammonium oxalate, $(NH_4)_2C_2O_4 \cdot H_2O$: 0.5%w/v
Carrier solutions:

- Ba^{+2} as barium nitrate, $Ba(NO_3)_2$: 20mg Ba^{+2} per mL
- Ca^{+2} as calcium nitrate, $Ca(NO_3)_2 \cdot H_2O$: 40 mg Ca^{+2} per mL
- Sr^{+2} as strontium nitrate, $Sr(NO_3)_2$: 20 mg Sr^{+2} per mL
- Y^{+3} as yttrium nitrate, $Y(NO_3)_3$: 10 mg Y^{+3} per mL

Hydrochloric acid, HCl: concentrated (3N)
Nitric acid, HNO_3: Fuming (90%), concentrated (16N), 6N
Oxalic acid, $H_2C_2O_2 \cdot 2H_2O$: Saturated at room temperature
Scavenger solutions: 20 mg Fe^{+3} per mL, 10 mg each Ce^{+3} and Zr^{+4} per mL

- Fe^{+3} as ferric chloride, $FeCl_3 \cdot H_20$
- Ce^{+3} as cerous nitrate, $Ce(NO_3)_3 \cdot 6H_2O$
- Zr^{+4} as zirconyl chloride, $ZrOCl_2 \cdot 8H_2O$

Sodium carbonate, Na_2CO_3: 3N, 0.1N
Sodium chromate, Na_2CrO_4: 3N

Apparatus

Analytical balance
Low background beta counter
pH meter

Determination of Sr-89 and Sr-90 in Water

Procedure

1. Measure 1 liter of acidified water in a 2 liter beaker.

   NOTE: If the sample contains foreign matter, such as sand, dirt, etc., filter through a 47mm glass fiber filter using suction flask.

2. To acidified clear water in a 2 liter beaker, add 1 mL of strontium carrier solution, 1 mL barium carrier solution, and if necessary, 1 mL of calcium carrier solution. (Improved precipitation may be obtained by adding calcium to soft waters.) Stir thoroughly, and while stirring add 125 mL of saturated oxalic acid solution.

3. Using a pH meter, adjust the pH to 3.0 with 15N NH_4OH and allow the precipitate to settle for 5-6 hours or overnight.

4. Decant to waste most of the supernate (liquid) and transfer the precipitate to a 250mL centrifuge bottle using deionized water. Discard the supernate to waste.

5. Dissolve the precipitate with 10mL of 6N HNO_3 and transfer to a 250mL beaker. Then use 20mL of 16N HNO_3 to rinse the centrifuge tube and combine it to the solution in the 250mL beaker.

6. Evaporate the solution to dryness. Cool; then add 50mL 16N HNO_3 and repeat the acid addition and evaporation until the residue is colorless.

7. Transfer the residue to a 40mL centrifuge tube, rinsing with a minimum volume of 16N HNO_3. Cover with parafilm and cool in an ice bath. Centrifuge at 1500-1800 rpm for 10 minutes, and discard the supernate to waste.

8. Dissolve the precipitate in 5mL of 6N HNO_3 and then add 30mL of fuming nitric acid. Cover with parafilm , cool in the ice bath, centrifuge, and discard the supernate to waste,

9. Dissolve the nitrate precipitate in about 10mL of deionized water (perform under the hood). Add 1mL of scavenger solution. Adjust the pH of the mixture to 7 with 6N NH_4OH. Heat in hot water bath for 10 minutes, stir, and filter through a Whatman No. 541 filter into another 40mL centrifuge tube. Discard the mixed hydroxide precipitate (filter paper).

10. To the filtrate, add 5 mL of ammonium acetate buffer. Adjust pH with 3N HNO_3 or NH_4OH to pH 5.5.

    NOTE: The pH of the solution at this point is critical.

    Add dropwise, while stirring, 1mL of 3N Na_2CrO_4 solution, stir, and heat in a water bath.

11. Cool and centrifuge. Decant the supernate into another 40mL centrifuge tube. (Save the precipitate for Ba analysis if needed.)

12. Heat the supernate in a water bath. Adjust the pH to 8-8.5 with NH_4OH. With continuous stirring, cautiously add 5 mL of 3N Na_2CO_3 solution. Heat gently for 10 minutes. Cool, centrifuge, and decant the supernate to waste. Wash the precipitate with 0.1N Na_2CO_3. Centrifuge again and decant the supernate to waste.

13. Dissolve the precipitate in no more than 4mL of 3N HNO_3. Then add 20-30mL of fuming HNO_3, cover with parafilm, cool in a water bath, and centrifuge. Decant and discard the supernate.

Determination of Sr-89 and Sr-90 in Water

Procedure (continued)

14. Repeat Step 13. **RECORD THE TIME AND DATE AS THE BEGINNING OF YTTRIUM-90 INGROWTH.**

15. Dissolve precipitate in a 4mL of 6N HNO_3 and add 1mL of yttrium carrier solution.

16. Cover with parafilm and store for 7-14 days.

    NOTE: At this point, the sample can be transferred to a glass scintillation vial for ingrowth storage. Use several portions of 6N HNO_3 (a total of not more than 4mL); then add 1mL yttrium carrier to the vial.)

Separation

NOTE: If the sample was stored in the scintillation vial, transfer back into 40mL centrifuge tube using a few drops of 6N HNO_3 as a rinse.

1. After storage (ingrowth period), heat the 40mL centrifuge tube containing the sample in the hot water bath (approximately 90°C) for 10 minutes.
2. Adjust pH to 8 with NH_4OH, stirring continuously.
3. Cool in a cold water bath and centrifuge for 5 minutes.
4. Decant the supernate into a 40mL centrifuge tube marked with the sample number and "SR-89." **RECORD THE DATE AND TIME OF DECANTATION** as the end of Y-90 ingrowth in Sr fraction and the beginning of its decay in Y-90 fraction..
5. Redissolve the precipitate by adding 3-4 drops of 6N HCl and add 5-10mL of DI water while stirring.
6. Repeat Steps 1, 2, and 3.
7. Combine supernate with the one in Step 4.

Determination of Sr-89 and Sr-90 in Water

Determination

A. Strontium-90 (Yttrium-90)

1. Add 3 drops of 6N HCl to dissolve the precipitate; then add 5-10mL of water. Heat in a water bath at approximately 90°C. Add 1mL of saturated oxalic acid solution dropwise with vigorous stirring. Adjust to a pH of 2-3 with NH_4OH. Allow the precipitate to digest for about an hour.

   NOTE: Do Part "B" while precipitate is digesting.

2. Cool to room temperature in a cold water bath. Centrifuge for 10 minutes and decant most of the supernate. Filter by suction on a weighed 2.5cm filter paper. Wash the precipitate with water and alcohol.
3. Dry the precipitate under the lamp for 30 minutes. Cool and weigh. Mount and count without delay in a proportional counter. (See Part C for mounting.)

B. Strontium-89 (Total Strontium)

1. Heat the solution from Step 7 in water bath.
2. Adjust the pH to 8-8.5 using NH_4OH.
3. With continuous stirring, add 5mL of 3N Na_2CO_3 solution. Stir until precipitate appears. Heat gently for 10 minutes.
4. Cool and filter on a weighed No. 42 (2.4cm) Whatman filter paper.
5. Wash thoroughly with water and alcohol.
6. Mount and count without delay its beta activity as "total radiostrontium" in a proportional counter.

C. Filtering and Mounting

1. Place filters under heat lamps for 30 minutes before weighing.
2. Use an analytical balance for weighing (accuracy 0.01 mg).
3. Label a clean petri dish with the weight of the filter paper. (After samples are filtered, the filter paper will again be dried and weighed to determine weight of precipitate before mounting.)
4. Mount weighed filter paper and precipitate on nylon disc using 1" transparent tape to hold filter paper and 2" mylar foil placed over precipitate and held in place with slip-ring. Trim off excess mylar foil and place the mounted sample in a labeled petri dish.
5. Fill out corresponding loading sheets and place samples in counting room.

Determination of Sr-89 and Sr-90 in Water

Calculations

Part A

Strontium-90 Concentration (pCi/liter) $= \frac{A}{BCDEF}$

Where:

A = Net beta rate of yttrium-90 (cpm)
B = Recovery of yttrium carrier
C = Counter efficiency for counting yttrium-90 or yttrium oxalate mounted on a 2.4cm diameter filter paper (cpm/pCi)
D = Sample volume (liters)
E = Correction factor $e^{-\lambda t}$ for yttrium-90 decay, where t is the time from the time of decantation (Step 4, Separation) to the time of counting
F = Correction factor $1-e^{-\lambda t}$ for the degree of equilibrium attained during the yttrium-90 ingrowth period, where t is the time from collection of the water sample to the time of decantation (Step 4, Separation)

Part B

Strontium-89 Concentration (pCi/liter) $= \frac{1}{BC}\left[\frac{A}{DE} - F(GH + IJ)\right]$

Where:

A = Net beta count rate of "total radiostrontium" (cpm)
B = Counter efficiency for counting strontium-89 as strontium carbonate mounted on a 2.4cm diameter filter paper (cpm/pCi)
C = Correction factor $e^{-\lambda t}$ for strontium-89 decay, where t is the time from sample collection to the time of counting.
D = Recovery of strontium carrier
E = Volume of water sample (liters)
F = Strontium-90 concentration (pCi/L) from Part A
G = Self-absorption factor for strontium-90 as strontium carbonate mounted on a 2.4cm diameter filter, obtained from a self-absorption curve prepared by plotting the fraction of a standard activity absorbed against density thickness of the sample (mg/cm^2)
H = Counter efficiency for counting strontium-90 as strontium carbonate mounted on a 2.4cm diameter filter paper (cpm/pCi)
I = Counter efficiency for counting yttrium-90 as yttrium oxalate mounted on a 2.4cm diameter filter paper (cpm/pCi)
J = Correction factor $1-e^{-\lambda t}$ for yttrium ingrowth, where it is the time from the last decantation of the nitric acid (Step 4, Separation)

REFERENCE: Radioassay Procedures for Environmental Samples, U. S. Department of Health, Education, and Welfare. Environmental Health Series, January 1967.

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DETERMINATION OF SR-89 AND SR-90 IN ASHED SAMPLES (VEGETATION, FISH, ETC.)

PROCEDURE NO. SR-05

Prepared by

Environmental Inc.
Midwest Laboratory

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DETERMINATION OF SR-89 AND SR-90 IN ASHED SAMPLES (VEGETATION, FISH, ETC.

Principle of Method

The sample with stable strontium and barium carriers added is leached in nitric acid and filtered. After filtration, filtrate is reduced in volume by evaporation. The residue is purified by adding iron and rare earth carriers and precipitating them as hydroxides. After a second strontium nitrate precipitation from 70% nitric acid, the nitrates are dissolved in acid again with added yttrium carrier and are stored for ingrowth of yttrium-90. The yttrium is precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and collected on No. 42 (2.4cm) Whatman filter for counting.

Reagents

Ammonium acetate buffer: pH 5.0
Ammonium hydroxide, NH_4OH: concentrated (15N), 6N
Carrier solutions: Ba^{+2} as barium nitrate, Ba(NO3)2: 20mg Ba^{+2} per mL
  Sr^{+2} as strontium nitrate, $Sr(NO_3)_2$: 20mg Sr^{+2} per mL
  Y^{+3} as yttrium nitrate, $Y(NO_3)_3$: 10 mg Y^{+3} per mL
Hydrochloric acid, HCl: 6N
Nitric acid, HNO_3: Fuming (90%), concentrated (16N), 6N
Oxalic acid, $H_2C_2O_2 \cdot 2H_2O$: Saturated at room temperature
Scavenger solutions: 20mg Fe^{+3} per mL, 10mg each Ce^{+3} and Zr^{+4} per mL
  Fe^{+3} as ferric chloride, $FeCl_3 \cdot 6H_20$
  Ce^{+3} as cerous nitrate, $Ce(NO_3)_3 \cdot 6H_2O$
  Zr^{+4} as zirconyl chloride, $ZrOCl_2 \cdot 8H_2O$
Sodium carbonate, Na_2CO_3: 3N, 0.1N
Sodium chromate, Na_2CrO_4: 3N

Apparatus

Analytical balance
Low background beta counter
pH meter

DETERMINATION OF SR-89 AND SR-90 IN ASHED SAMPLES (VEGETATION, FISH, ETC.

Procedure

1. Weigh 3g of ash and transfer to the 250mL beaker.
2. Add 50mL concentrated nitric acid.
3. Add 1mL strontium and 1mL barium carrier solutions.
4. Place the sample on the moderate hot plate under the hood and cover with the watch glass.
5. Allow to leach for 2 hours or longer.
6. Remove sample beaker from the hot plate and allow to cool to room temperature.
7. Add deionized water, filling to 100mL; mark on the beaker.
8. Filter the sample through Whatman No. 541 filter paper.
9. Place the filtrate on the moderate hot plate under the hood and gently evaporate to 5ml.
10. Transfer the sample into 40mL centrifuge tube. Rinse the beaker with 16N HNO_3. Add rinsing to the tube.
11. Centrifuge for 10 minutes and discard the supernate to waste.
12. Carefully add 30mL of concentrated HNO_3 to the precipitate. Heat in a hot water bath for about 30 minutes, stirring occasionally. Cool the sample in an ice water bath for about 5 minutes. Centrifuge and discard the supernate.
13. Repeat Step 12.
14. Dissolve the nitrate precipitate in about 10 mL of deionized water (perform under the hood). Add 1mL of scavenger solution. Adjust the pH of the mixture to 7 with 6N NH_4OH. Heat in hot water bath for 10 minutes, stir, and filter through a Whatman No. 541 filter into another 40mL centrifuge tube. Discard the mixed hydroxide precipitate (filter paper).
15. Add 5mL of ammonium acetate buffer to the filtrate. Adjust pH with 6N HNO_3 or NH_4OH to pH 5.5.

    NOTE: The pH of the solution at this point is critical.

    Add dropwise with stirring 1mL of 3N Na_2CrO_4 solution, stir, and heat in a water bath.
16. Cool and centrifuge. Decant the supernate into another 40mL centrifuge tube. (Save the precipitate for Ba analysis if needed.)
17. Heat the supernate in a water bath. Adjust the pH to 8-8.5 with NH_4OH. With continuous stirring, add 5mL of 3N Na_2CO_3 solution. Heat gently for 10 minutes. Cool, centrifuge, and decant the supernate to waste. Wash the precipitate with 0.1N Na_2CO_3. Centrifuge again and decant the supernate to waste.

DETERMINATION OF SR-89 AND SR-90 IN ASHED SAMPLES (VEGETATION, FISH, ETC.

Procedure (continued)

18. Dissolve the precipitate in no more than 4mL of 3N HNO_3. Then add 20-30mL of fuming HNO_3, cover with parafilm, cool in a water bath, and centrifuge. Decant and discard the supernate.
19. Repeat Step 13. **RECORD THE TIME AND DATE AS THE BEGINNING OF YTTRIUM-90 INGROWTH.**
20. Dissolve precipitate in 4mL of 6N HNO_3 and add 1mL of yttrium carrier solution.
21. Cover with parafilm and store for 7-14 days.

NOTE: At this point, the sample can be transferred to a glass scintillation vial for ingrowth storage. Use several portions of 6N HNO_3 (a total of not more than 4mL); then add 1mL of yttrium carrier to the vial.

Separation

NOTE: If the sample was stored in the scintillation vial, transfer back into 40mL centrifuge tube using a few drops of 6N HNO_3 as a rinse.

1. After storage (ingrowth period), heat the 40 mL centrifuge tube containing the sample in the hot water bath (approximately 90°C) for 10 minutes.
2. Adjust pH to 8 with NH_4OH, stirring continuously.
3. Cool in a cold water bath and centrifuge for 5 minutes.
4. Decant the supernate into a 40 mL centrifuge tube marked with the sample number and "SR-89". **RECORD THE TIME AND DATE AS THE END OF YTTRIUM-90 INGROWTH** in the Sr fraction and the beginning of its decay in Y-90 fraction.
5. Redissolve precipitate by adding 3-4 drops of 6N HCl and add 5-10mL of DI water with stirring.
6. Repeat Steps 1, 2, and 3.
7. Combine supernate with the one in Step 4.

DETERMINATION OF SR-89 AND SR-90 IN ASHED SAMPLES (VEGETATION, FISH, ETC.

Determination

A. Strontium-90 (Yttrium-90)

1. Add 3 drops of 6N HCl to dissolve the precipitate; then add 5-10mL of water. Heat in a water bath to approximately 90°C. Add 1mL of saturated oxalic acid solution drop-wise with vigorous stirring. Adjust to a pH of 2-3 with NH_4OH. Allow the precipitate to digest for about one hour.

   NOTE: Do Part "B" while precipitate is digesting.

2. Cool to room temperature in a cold water bath. Centrifuge for 10 min. and decant most of the supernate. Filter by suction on a weighed 2.5cm filter paper. Wash the precipitate with water and alcohol.
3. Dry the precipitate under the lamp for 30 minutes. Cool and weigh. Mount and count without delay in a proportional counter. (See Part C for mounting.)

B. Strontium-89 (Total Strontium)

1. Heat the solution from Step 7 in water bath.
2. Adjust the pH to 8-8.5 using NH_4OH.
3. With continuous stirring, add 5mL of 3N Na_2CO_3 solution. Stir until precipitate appears. Heat gently for 10 minutes.
4. Cool and filter on a weighed No- 42 (2.4cm) Whatman filter paper.
5. Wash thoroughly with water and alcohol.
6. Mount and count without delay its beta activity as "total radiostrontium" in a proportion counter.

C. Filtering and Mounting

1. Place filters under heat lamps for 30 minutes before weighing.
2. Use an analytical balance for weighing (accuracy 0.01 mg).
3. Label a clean petri dish with the weight of the filter paper. (After samples are filtered, the filter paper will again be dried and weighed to determine weight of precipitate before mounting.)
4. Mount weighed filter paper and precipitate on a nylon disc using 1" transparent tape to hold filter paper and 2" mylar foil placed over precipitate and held in place with slip-ring. Trim off excess mylar foil and place the mounted sample in a labeled petri dish.
5. Fill out corresponding loading sheets and place samples in counting room.

DETERMINATION OF SR-89 AND SR-90 IN ASHED SAMPLES (VEGETATION, FISH, ETC.

Calculations

Part A

Strontium-90 Concentration (pCi/g wet) = $\frac{A}{2.22BCDEFG} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{2.22BCDEFG}$

Where:

A = Net beta count rate of yttrium-90 (cpm)
B = Recovery of yttrium carrier
C = Counter efficiency for counting yttrium-90 or yttrium oxalate (cpm/pCi).
D = Sample volume
E = Correction factor $e^{-\lambda t}$ for yttrium-90 decay, where t is the time from the time of decantation (Step 4, Separation) to the time of counting
F = Correction factor $1 - e^{-\lambda t}$ for the degree of equilibrium attained during the yttrium-90 ingrowth period, where t is the time from the collection of the water sample to the time of decantation (Step 4, Separation)
G = Ratio of wet weight to ashed weight
E_{sb} = Counting error of sample plus background
E_b = Counting error of background

Part B

Strontium-89 Concentration (pCi/g wet) = $\frac{1}{2.22BC}\left[\frac{A}{DEK} - F(GHIJ)\right] \pm \frac{2\sqrt{E_{sb}^2 + E_{sb}^2}}{2.22BCDEFK}$

Where:

A = Net beta count rate of "total radiostrontium" (cpm)
B = Counter efficiency for counting strontium-89 as strontium carbonate (cpm/pCi).
C = Correction factor $e^{-\lambda t}$ for strontium-89 decay, where t is the time from sample collection to the time of counting
D = Recovery of strontium carrier
E = Sample size (grams), ash
F = Strontium-90 concentration (pCi/g wet) from Part A
G = Self-absorption factor for Sr-90 as strontium carbonate, obtained from a self-absorption curve prepared by plotting the fraction of a standard activity absorbed against density thickness of the sample (mg/cm^2)
H = Counter efficiency for counting strontium-90 as strontium carbonate (cpm/pCi).
I = Counter efficiency for counting yttrium-90 as yttrium oxalate (cpm/pCi).
J = Correction factor $1-e^{-\lambda t}$ for yttrium-90 ingrowth, where t is the time from the last decantation of the nitric acid (Step 4, Separation)
K = Ratio of wet weight to ashed weight

REFERENCE: Radioassay Procedures for Environmental Samples, U. S. Department of Health, Education, and Welfare. Environmental Health Series, January 1967.

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DETERMINATION OF SR-89 AND SR-90 IN SOIL AND BOTTOM SEDIMENTS

PROCEDURE NO. SR-06

Prepared by

Environmental Inc.
Midwest Laboratory

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DETERMINATION OF SR-89 AND SR-90 IN SOIL AND BOTTOM SEDIMENTS

Principle of Method

The sample with stable strontium and barium carriers added is leached in hydrochloric acid. After separation from calcium, the residue is purified by adding iron and rare earth carriers and precipitating them as hydroxides. After a second strontium nitrate precipitation from 70% nitric acid, the nitrates are dissolved in acid again with added yttrium carrier and are stored for ingrowth of yttrium-90. The yttrium is precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and is collected on No. 42 (2.4cm) What man filter for counting.

Reagents

Ammonium acetate buffer: pH 5.0
Ammonium hydroxide, NH_4OH: concentrated (15N), 6N
Carrier solutions: Ba^{+2} as barium nitrate, $Ba(NO_3)_2$: 20mg Ba^{+2} per mL
  Sr^{+2} as strontium nitrate, $Sr(NO_3)_2$: 20mg Sr^{+2} per mL
  Y^{+3} as yttrium nitrate, $Y(NO_3)_3$: 10 mg Y^{+3} per mL
Hydrochloric acid, HCl: 6N
Nitric acid, HNO_3: Fuming (90%), concentrated (16N), 6N
Oxalic acid, $H_2C_2O_2 \cdot 2H_2O$: Saturated at room temperature
Scavenger solutions: 20mg Fe^{+3} per mL, 10mg each Ce^{+3} and Zr^{+4} per mL
  Fe^{+3} as ferric chloride, $FeCl_3 \cdot 6H_2O$
  Ce^{+3} as cerous nitrate, $Ce(NO_3)_3 \cdot 6H_2O$
  Zr^{+4} as zirconyl chloride, $ZrOCl_2 \cdot 8H_2O$
Sodium carbonate, Na_2CO_3: 3N, 0.1N
Sodium chromate, Na_2CrO_4: 3N

Apparatus

Analytical balance
Centrifuge
Hot plate
Low background beta counter
pH meter
Plastic disc and ring
Stirrer

DETERMINATION OF SR-89 AND SR-90 IN SOIL AND BOTTOM SEDIMENTS

Procedure

1. Weigh out 5 – 50 g sample into a 1 liter beaker depending on the required LLD. Add 1mL of strontium carrier and 1mL of Ba carrier.

2. Stir mechanically while slowly adding 200mL of 6N HCl. (It may be necessary to add a few drops of 1
octyl alcohol to prevent excessive frothing.) Continue stirring for about 3 hours. Allow a minimum of two hours for the insoluble material to settle.

3. Stir the mixture and filter with suction through a 24cm Whatman No. 42 filter paper using a Buchner funnel. Wash the residue with hot water. Wash with 6N HCl and again with hot water until the yellow color of ferric chloride is removed. Discard the residue.

4. Transfer the filtrate to a 1 liter beaker and evaporate to approximately 200mL. Cool and slowly add 200mL of concentrated HNO_3. (If there is excessive frothing, add a few drops of octyl alcohol.) Evaporate to 100-200mL.

5. Add 500mL of water and stir.

6. Add 25 grams of oxalic acid with magnetic stirring until it is completely dissolved.

7. Adjust the pH to 5.5-6.0 with concentrated NH_4OH. (If the brown color of ferric hydroxide persists, add more oxalic acid and readjust the pH.) The optimum condition is an excess of oxalic acid in solution without causing crystallization of ammonium oxalate upon cooling.

8. Allow precipitate to settle for 5-6 hours or overnight.

9. Decant most of the supernate (liquid) and transfer the precipitate to a 250mL centrifuge tube using deionized water for rinsing. Add rinsing to the tube. Centrifuge and decant supernate.

10. Wash the precipitate with 50-100mL portion of water and centrifuge again.

11. Repeat washing as needed until all the yellow color of the solution has been removed.

12. Cool the precipitate and dissolve it with 6N HNO_3 and transfer it into a 250mL beaker. Rinse the tube with 6N HNO_3, making the total volume to 50-100 mL. Add about 6 drops of H_2O_2 (30%) to facilitate dissolution.

13. Cool to room temperature. If insoluble material is present at this point, filter by suction through a glass fiber filter. Discard the filter and residue.

14. Transfer the solution to an appropriate size beaker and evaporate to dryness. The evaporation must be done slowly to avoid spattering.

15. Dissolve the salt in water and perform successive fuming nitric acid separations (the first two separations at concentration slightly greater than 75%) until the strontium has been separated from the bulk of the calcium. Samples with a high calcium content will require five or more separations.

16. The volumes of 75% HNO_3 vary (fuming solutions may be changed as required by the mass of calcium present, keeping in mind that minimum volumes are always best.)

Procedure (continued)

17. If calcium content is still thick, evaporate the solution to dryness and bake.
18. Dissolve the residue with 50mL boiling water and filter. Discard residue.
19. Evaporate the solution to dryness again.
20. Cool and dissolve the residue in a minimum amount of water and add 50 mL of fuming HNO_3.
21. Continue the fuming nitric acid separations until the strontium has been separated from the bulk of calcium.
22. Transfer the solution to a 40mL conical, heavy-duty centrifuge tube, using a minimum of concentrated HNO_3 to effect the transfer. Cool the centrifuge tube in an ice bath for about. Centrifuge and discard the supernatant.

NOTE: *The precipitate consists of calcium, strontium, and barium-radium nitrate.*

The supernatant contains part of the sample's calcium and phosphate content.

23. Add 30mL of concentrated HNO_3 to the precipitate. Heat in a hot water bath with stirring for about 10 minutes. Cool the solution in an ice bath, stirring for about 5 minutes. Centrifuge and discard the supernatant.

NOTE: *Additional calcium is removed from the sample. Nitrate precipitation with 70% HNO_3 will afford a partial decontamination from soluble calcium, while strontium, barium, and radium are completely precipitated.*

Separation of calcium is best at 60% HNO_3; however, at 60% the precipitation of strontium is not complete. Therefore, it is common practice to precipitate $(Sr(NO_3)_2$ with 70% HNO_3, which is the concentration of commercially available 16N HNO_3.

Most other fission products, induced activities, and actinides are soluble in concentrated HNO_3, affording a good "gross" decontamination step from a wide spectrum of radionuclides. The precipitation is usually repeated several times.

24. Repeat Step 23 two (2) more times.
25. Dissolve the nitrate precipitate in about 20mL distilled water. Add 1mL of scavenger solution. Adjust the pH of the mixture to 7 with 6N NH_4OH. Heat, stir, and filter through a Whatman No. 541 filter. Discard the mixed hydroxide precipitate.
26. To the filtrate, add 5mL of ammonium acetate buffer. Adjust pH with 6N HNO_3 or NH_4OH to pH 5.5.

NOTE: *The pH of the solution at this point is critical.*
Add dropwise with stirring 1mL of 3N Na_2CrO_4 solution, stir and heat in a water bath.

27. Cool and centrifuge. Decant the supernate into another 40mL centrifuge tube. (Save the precipitate for barium analysis if needed.)

Procedure (continued)

28. Heat the supernate in a water bath. Adjust the pH to 8-8.5 with NH_4OH. With continuous stirring, add 5mL 3N Na_2CO_3 solution. Heat gently for 10 minutes. Cool, centrifuge, and decant the supernate to waste. Wash the precipitate with 0.1N Na_2CO_3. Centrifuge again and decant the supernate to waste.

29. Dissolve the precipitate in no more than 4mL of 6N HNO_3. Add 20-30mL of fuming HNO_3, cover with parafilm, cool in a water bath, and centrifuge. Decant and discard the supernate. 1

30. Repeat Step 13. **RECORD THE TIME AND DATE AS THE BEGINNING OF YTTRIUM-90 INGROWTH.**

31. Dissolve precipitate in 4mL of 6N HNO_3 and add 1mL of yttrium carrier solution.

32. Cover with parafilm and store for 7-14 days.

NOTE: *At this point, the sample can be transferred to a glass scintillation vial for the ingrowth storage. Use several portions of 6N HNO_3 (a total of not more than 4mL); then add 1mL of yttrium carrier to the vial.*

Separation

NOTE: *If the sample was stored in the scintillation vial, transfer back into 40mL centrifuge tube using a few drops of 6N HNO_3 as a rinse.*

1. After storage (ingrowth period), heat the 40mL centrifuge tube containing the sample in the hot water bath (approximately 90°C) for 10 minutes.

2. Adjust pH to 8 with NH_4OH, stirring continuously.

3. Cool in a cold water bath and centrifuge for 5 minutes.

4. Decant the supernate into a 40 mL centrifuge tube marked with the sample number and "SR-89." **RECORD THE DATE AND TIME OF DECANTATION AS THE END OF Y-90 INGROWTH** in Sr fraction and the beginning of its decay in Y-90 fraction.

5. Redissolve the precipitate by adding 3-4 drops of 6N HCl. Add 5-10mL of deionized water with stirring.

6. Repeat Steps 1, 2, and 3.

7. Combine supernate with the one in Step 4.

Determination

A. Strontium-90 (Yttrium-90)

1. Add 3 drops of 6N HCl to dissolve the precipitate; then add 5-10mL of water. Heat in a water bath at approximately 90°C. Add 1mL of saturated oxalic acid solution dropwise with vigorous stirring. Adjust to a pH of 2-3 with NH_4OH. Allow the precipitate to digest for about an hour.

NOTE: *Do Part "B" while precipitate is digesting.*

2. Cool to room temperature in a cold water bath. Filter by suction on a weighed 2.5cm filter paper. Wash precipitate with water and alcohol. 1

3. Dry the precipitate under the lamp for 30 minutes. Cool and weigh. Mount and count without delay in a proportional counter. (See Part C for mounting.)

B. Strontium-89 (Total Strontium)

1. Heat the solution from Step 7 in water bath.

2. Adjust the pH to 8-8.5 using NH_4OH.

3. With continuous stirring, add 5mL of 3N Na_2CO_3 solution. Stir until precipitate appears. Heat gently for 10 minutes.

4. Cool and filter on a weighed No. 42 (2.4cm) Whatman filter paper.

5. Wash thoroughly with water and alcohol.

6. Mount and count without delay its beta activity as "total radiostrontium" in a proportional counter.

C. Filtering and Mounting

1. Place filters under heat lamps for 30 minutes before weighing.

2. Use an analytical balance for weighing (accuracy 0.01 mg).

3. Label a clean petri dish with the weight of the filter paper. (After samples are filtered, the filter paper will again be dried and weighed to determine weight of precipitate before mounting.)

4. Mount weighed filter paper and precipitate on nylon disc using 1" transparent tape to hold filter paper and 2" mylar foil placed over precipitate and held in place with slip-ring. Trim off excess mylar foil and place the mounted sample in a labeled petri dish.

5. Fill out corresponding loading sheets and place samples in counting room.

Calculations

Part A

Strontium-90 Concentration (pCi/g dry) = $\frac{A}{2.22BCDEF} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{2.22BCDEF}$

Where:

A = Net beta count rate of yttrium-90 (cpm)
B = Recovery of yttrium carrier
C = Counter efficiency for counting yttrium-90 or yttrium oxalate mounted on a 2.4cm diameter filter paper (cpm/pCi)
D = Sample weight (grams), dry
E = Correction factor $e^{-\lambda t}$ for yttrium-90 decay, where t is the time from the time of decantation (Step 4, Separation) to the time of counting
F = Correction factor $1- e^{-\lambda t}$ for the degree of equilibrium attained during the yttrium-90 ingrowth period, where t is the time from the collection of the water sample to the time of decantation (Step 4, Separation)
E_{sb} = Counting error of sample plus background
E_b = Counting error of background

Part B

Strontium-89 Concentration (pCi/g dry) $= \frac{1}{BxC}\left[\frac{A}{2.22xDxE} - F(H + IxJ)\right] \pm 2\sigma$

Where:

A = Net beta count rate of "total radiostrontium" (cpm)
B = Counter efficiency for counting strontium-89 as strontium carbonate mounted on a 2.4cm diameter filter paper (cpm/pCi)
C = Correction factor $e^{-\lambda t}$ for strontium-89 decay, where t is the time from sample collection to the time of counting
D = Recovery of strontium carrier
E = Sample weight (grams, dry)
F = Strontium-90 concentration (pCi/g) from Part A
H = Counter efficiency for counting strontium-90 as strontium carbonate mounted on a 2.4cm diameter filter paper (cpm/pCi)
I = Counter efficiency for counting yttrium-90 as yttrium oxalate mounted on a 2.4cm diameter filter paper (cpm/pCi)
J = Correction factor $1- e^{-\lambda t}$ for yttrium-90 ingrowth, where t is the time from the last decantation of the nitric acid (Step 4, Separation)

REFERENCE: Radioassay Procedures for Environmental Samples, U. S. Department of Health, Education, and Welfare. Environmental Health Series, January 1967.

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DETERMINATION OF SR-89 AND SR-90 IN MILK
(ION EXCHANGE BATCH METHOD)

PROCEDURE NO. SR-07

Prepared by

Environmental Inc.
Midwest Laboratory

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Reissue		08-05-04	7	[signature]	[signature]

DETERMINATION OF SR-89 AND SR-90 IN MILK (ION EXCHANGE BATCH METHOD)

Principle of Method

A citrate complex of strontium carrier at the pH of milk is added to the milk sample. Strontium, barium, and calcium are absorbed on the cation-exchange resin.

Strontium, barium, and calcium are eluted from the cation-exchange resin with sodium chloride solution. Following dilution of the eluate, the alkaline earths are precipitated as carbonates. The carbonates are then converted to nitrates. Strontium is purified by Argonne method using three grams of extraction material in a chromatographic column. Yttrium carrier is added and a sample is stored for ingrowth of yttrium-90. The yttrium is again precipitated as hydroxide and separated from strontium with the strontium being in the supernate. Each fraction is precipitated separately as an oxalate (yttrium) and carbonate (strontium) and collected on No. 42 (2.4 cm) Whatman filter for counting.

The concentration of Sr-89 is calculated as the difference between the activity for "total radiostrontium" and the activity due to Sr-90.

Reagents

Ammonium hydroxide, NH_4OH: concentrated (15N)
Carrier solutions:
- Sr^{+2} as strontium nitrate, $Sr(NO_3)_2$: 20mg Sr^{+2} per mL
- Y^{+3} as yttrium nitrate, $Y(NO_3)_3$: 10 mg Y^{+3} per mL

Cation-exchange resin: Dowex 50W-X8 (Na^+ form, 50-100 mesh)
Citrate solution: pH 6.5
DI water
Ethyl alcohol, C_2H_5OH: 95%
Hydrochloric acid, HCl: 6N
Nitric acid, HNO_3: 3N
Oxalic acid, $H_2C_2O_2 \cdot 2H_2O$: 2N
Sodium carbonate, Na_2CO_3: 3N
Sodium chloride, NaCl: 4N
Silver nitrate, $AgNO_3$: 1N
Strontium Spec Resin

Apparatus

Ion-exchange system:

The apparatus for this system is illustrated in Figure Sr-07-1. At the top is a 1-liter glass separatory funnel which serves as the reservoir. Below it is connected a 250 mL glass column, 5 cm in diameter and 25 cm long, which services as the cation column. The column has an extra coarse, fritted glass disc at the bottom.

Millipore filtering apparatus
Chromatographic Column

Preparation and regeneration of cation resin:

1. Wash 170 mL of Dowex 50W resin to fill the cation column.
2. Pass 500 mL of 1N NaOH through the column at a flow rate of 10 mL/minute.
3. Rinse with 500-1000 mL of H_2O.
4. Test effluent with $AgNO_3$. If effluent is clear, the resin is ready for milk.

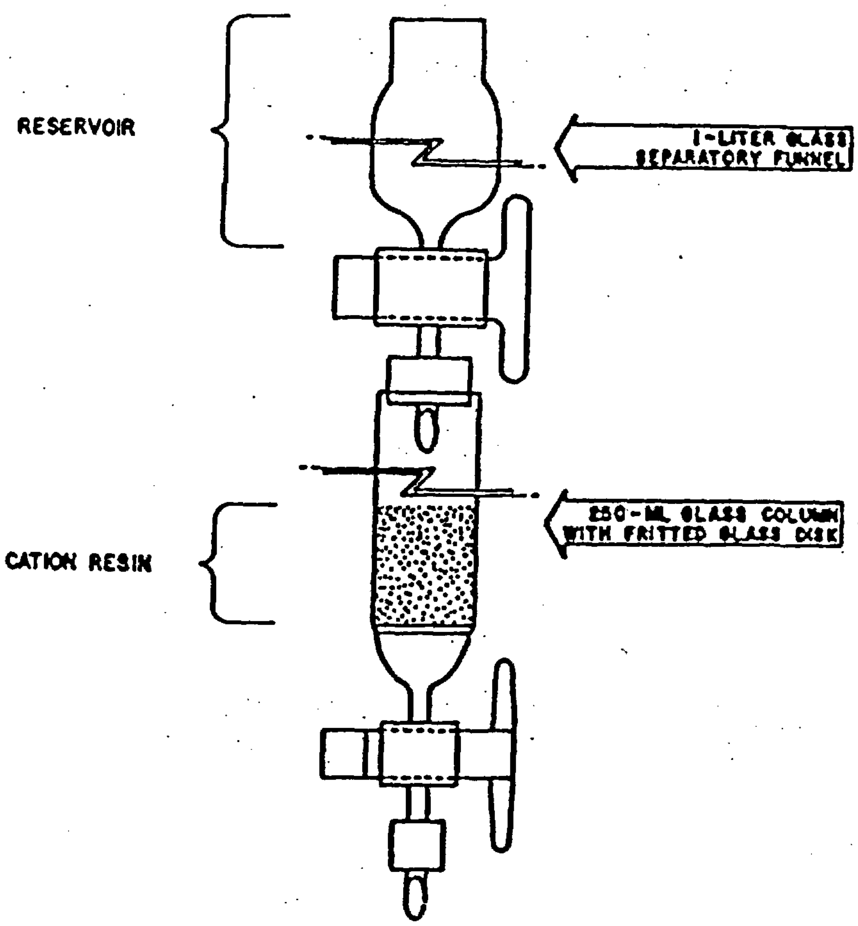

Figure SR-07-01

DETERMINATION OF SR-89 AND SR-90 IN MILK (ION EXCHANGE BATCH METHOD)

Procedure

1. Place 1 liter of milk in 4 liter beaker.
2. Pipette 1.0 mL of strontium carrier solution into 10 mL of citrate solution. Swirl to mix.
3. Transfer the mixture quantitatively to the milk with 5 mL of DI water.
4. Add a clean magnetic stirring bar to each sample beaker. Stir each sample for 5 minutes or longer on a magnetic stirrer. Allow sample to equilibrate at least 1/2 hour. If a milk sample is curdled or lumpy, vacuum filter the sample through a Buchner funnel using a cheesecloth filter. Wash the curd thoroughly with deionized water, collecting the washings with the filtrate. Pour the filtrate back into the original washed and labeled 4-liter beaker and discard the curd.
5. Add approximately 170 mL of Dowex 50Wx8 (50-100 mesh) cation resin to each sample beaker. Stir on a magnetic stirrer for 2 hours. Turn off the stirrer and allow the resin to settle for 10 minutes.
6. Gently decant and discard the milk sample, taking care to retain as much resin as possible in the beaker. Add approximately 1 liter of deionized water to rinse the resin, allow to settle 2 minutes, and pour off the rinse. Repeat rinsing until all traces of milk are removed from the resin.
7. Using a DI water wash bottle, transfer the resin to the column marked with the sample number. Allow resin to settle 2 minutes and drain the standing water.
8. Connect 1-liter separatory funnel containing 1 liter of 4N NaCl to the cation column. Allow solution to flow at 10 mL/minute to elute the alkali metal and alkaline earth ions and to recharge the column. Collect 1 liter of eluate into a 2-liter beaker, but leave the resin covered with 2-3 mL of solution.
9. Wash the column with 500 mL of H_2O or more to remove excess NaCl. Discard the wash.
10. Remove 20 mL of the NaCl eluate into a small bottle for the determination of stable calcium, if required (see procedure on calcium determination).
11. Dilute the eluate to 1500 mL with DI water.
12. Heat the solution to 85-90°C (near boiling on a hot plate) and add, with constant stirring, 100 mL of 3N Na_2CO_3. Cover with watch glass. Let stand overnight.
13. Decant most of supernate to waste. Transfer precipitate to a 250 mL centrifuge bottle with DI water.
14. Centrifuge. Pour off the supernate to waste. Dry the precipitate in an oven at 100°C for 1-2 hours.
15. Dissolve the precipitate in 30 mL 3M HNO_3.
16. Place each sample centrifuge tube in front of a corresponding Sr extraction column.
17. Condition columns by passing 30 mL 3M HNO_3 through them with the stopcocks fully open. Catch effluent in a waste beaker.
18. Add sample from the centrifuge tube into the correspondingly numbered column.

    NOTE: Use *no water to make this transfer. Use only 3M HNO_3 to rinse out the beaker. Allow the sample to pass through the column. Catch effluent in a waste beaker.*

Procedure (continued)

19. When the column reservoir is drained, measure 70 mL 3M HNO_3 in a graduated cylinder and pass through the column to rinse. Catch effluent in a waste beaker. When the column is drained, RECORD THE DATE AND TIME ON THE WORK SHEET AS THE BEGINNING OF Y-90 INGROWTH.

20. Write the sample number on a clean 150 mL beaker. Place it under the column after the rinse solution has drained. Discard the contents of the waste beaker.

21. Elute strontium by adding 70 mL DI water to the column. Catch effluent in the 150 mL beaker.

22. When the elution is complete, add 1.00 mL standardized yttrium carrier to the numbered sample beaker using an Eppendorf pipet.

23. Place sample beaker on a moderate hotplate and evaporate gently to approximately 10 mL volume. Remove beaker from hotplate and allow to cool.

    NOTE: *If the sample accidentally evaporates to dryness, allow it to cool, then add a few drops 3M HNO_3 and approximately 10 mL DI water. Warm gently and swirl to dissolve residue.*

24. Mark the sample number on a 40 mL centrifuge tube. Transfer the sample using the minimum amount of DI water.

25. Seal the sample tube with parafilm and place in a rack to stand for a minimum 5-day period for Y-90 ingrowth.

26. Rinse the Sr extraction columns with an additional 70 mL DI water. Catch effluent in a waste beaker. Leave the columns wet with DI water, with the stopcocks closed.

27. Enter column number, date and sample number in the Sr Column Log.

Separation

1. After storage (ingrowth period), heat the 40mL centrifuge tube containing the sample in the hot water bath (approximately 90°C) for 10 minutes.

2. Adjust pH to 8.0-8.5 with NH_4OH, stirring continuously.

3. Cool in a cold water bath and centrifuge for 5 minutes.

4. Decant the supernate into a 40mL centrifuge tube marked with the sample number and "Sr-89." RECORD THE DATE AND TIME OF DECANTATION AS THE END OF Y-90 INGROWTH IN SR FRACTION AND THE BEGINNING OF ITS DECAY IN Y-90 FRACTION.

5. Redissolve the precipitate by adding 3-4 drops of 6N HCl and add 5-10 mL of DI water with stirring.

6. Repeat Steps 1, 2, and 3.

7. Combine supernate with the one in Step 4.

8. Wash precipitate twice with 20 mL portions of DI Water. Centrifuge each time and discard supernate.

9. Proceed with Determination.

DETERMINATION OF SR-89 AND SR-90 IN MILK (ION EXCHANGE BATCH METHOD)

Determination

A. Strontium-90 (Yttrium-90)

1. Add 3 drops of 6N HCl to dissolve the precipitate from Step 4, Separation; then add 5-10 mL of DI water. Heat in a water bath at approximately 90°C for about 10 minutes. Add 1 ml of saturated oxalic acid solution dropwise with vigorous stirring. Adjust to a pH of 2-3 with NH_4OH. Allow the precipitate to digest for approximately one hour.

   NOTE: *Do Part "B" while precipitate is digesting.*

2. Cool to room temperature in a cold water bath. Centrifuge for 10 minutes and decant most of the supernate to waste. Filter by suction on a weighed 2.5 cm filter paper. Wash the precipitate with DI water and ethyl alcohol.

3. Dry the precipitate under the lamp for 30 minutes. Cool and weigh. Mount and count in a proportional counter. (See Part C for mounting.)

B. Strontium-89 (Total Strontium)

1. Heat the solution from Step 7, Separation, in water bath.

2. Adjust the pH to 8-8.5 using NH_4OH.

3. With continuous stirring, add 5 mL of 3N Na_2CO_3 solution. Stir until precipitate appears. Heat gently for 10 minutes.

4. Cool and filter on a weighed No. 42 (2.4 cm) Whatman filter paper.

5. Wash precipitate with water and ethyl alcohol.

6. Dry the precipitate under the lamp for 30 minutes. Cool and weigh. Mount and count in a proportional counter. (See Part C for mounting.)

C. Filtering and Mounting

1. Place filters under heat lamps for 30 minutes before weighing.

2. Weigh the filter papers on an analytical balance (accuracy 0.01 mg).

3. Label a clean petri dish with the weight of the filter paper. (After samples are filtered, the filter paper will again be dried and weighed to determine weight of precipitate <u>before</u> mounting.)

4. Mount weighed filter paper and precipitate on nylon disc using 1" transparent tape to hold filter paper and 2" mylar foil placed over precipitate and held in place with slip-ring. Trim off excess mylar foil and place the mounted sample in a labeled petri dish.

5. Fill out corresponding loading sheets and place samples in counting room.

DETERMINATION OF SR-89 AND SR-90 IN MILK (ION EXCHANGE BATCH METHOD)

Calculations

Strontium-90 Concentration (pCi/L) = $\frac{A}{2.22 \times B \times C \times D \times E \times F \times G}$

Where:

2.22 = dpm/pCi

A = Net beta count rate of yttrium-90 (cpm)
B = Recovery of yttrium carrier
C = Recovery of strontium carrier
D = Counter efficiency for counting yttrium-90 as yttrium oxalate mounted on a 2.4 cm diameter filter paper (cpm/dpm)
E = Sample volume (liters)
F = Correction factor $e^{-\lambda t}$ for yttrium-90 decay, where t is the time from the time of decantation (Step 4, Separation) to the time of counting
G = Correction factor $1-e^{-\lambda t}$ for the degree of equilibrium attained during the yttrium-90 ingrowth period, where t is the time from the beginning of ingrowth (Step 19, Total Radiostrontium Separation) to the time of decantation (Step 4, Separation)

Lower Limit of Detection (LLD), at 4.66 sigma

LLD for Sr-90: 1 pCi/L. LLD is based on the following typical parameters:

Sample Size: 1 L
Recovery (Sr and Y): 0.6
Decay Factor (Y-90): 0.8
Ingrowth Factor (Y-90): 0.6
Counter Efficiency: 0.4
Counter Background: 0.3cpm
Counting Time: 100 minutes

(Changes in any of the above parameters will change LLD correspondingly.)

DETERMINATION OF SR-89 AND SR-90 IN MILK (ION EXCHANGE BATCH METHOD)

Calculations

$$\text{Strontium-89 Concentration (pCi/L)} = \frac{1}{2.22 \times B \times C}\left[\frac{A}{D \times E} - 2.22 \times F(G + H \times I)\right]$$

Where:

2.22 = dpm/pCi

A = Net beta count rate of "total radiostrontium" (cpm)
B = Counter efficiency for counting strontium-89 as strontium carbonate mounted on a 2.4 cm diameter filter paper (cpm/dpm)
C = Correction factor $e^{-\lambda t}$ for strontium-89 decay, where t is the time from sample collection to the time of counting
D = Recovery of strontium carrier
E = Sample volume (liters)
F = Strontium-90 concentration (pCi/liter) from Part A
G = Counter efficiency for counting strontium-90 as strontium carbonate mounted on a 2.4 cm diameter filter paper (cpm/dpm)
H = Counter efficiency for counting yttrium-90 as yttrium oxalate mounted on a 2.4 cm diameter filter paper (cpm/dpm)
I = Correction factor $1-e^{-\lambda t}$ for yttrium-90 ingrowth, where t is the time from the last decantation of the nitric acid (Step 4, Separation) to the time of counting

Lower Limit of Detection (LLD), at 4.66 sigma

LLD for Sr-89: 2..0 pCi/L. LLD is based on the following typical parameters:

Sample Size: 1 L
Recovery: 0.7
Decay Factor: 0.5
Counter Efficiency: 0.3
Counter Background: 0.3 cpm
Counting Time: 100 minutes
LLD for Sr-90: 1 pCi/L

(Changes in any of the above parameters will change LLD correspondingly.)

REFERENCES: Radioassay Procedures for Environmental Samples, U. S. Department of Health, Education, and Welfare. Environmental Health Series, January 1967.

Horwitz, Dietz, Fisher, Analytical Chemistry, 63 (5), March 1991.

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DETERMINATION OF TRITIUM IN WATER

(DIRECT METHOD)

PROCEDURE NO. EIML-T-02

Prepared by

Environmental Inc., Midwest Laboratory

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Revision #	Date	Pages	Prepared by	Approved by
0	11-22-85	5	B Grob	L. G. Huebner
1	09-27-91	4	B Grob	L. G. Huebner
2	04-24-95	4	B Grob	L. G. Huebner
3	07-07-98	4	D. Rieter	B Grob
4	06-06-00	4	R. Amrofmin	B Grob
5	01-29-02	4	[signature]	[signature]

DETERMINATION OF TRITIUM IN WATER (DIRECT METHOD)

Principle of Method

The water sample is purified by distillation, a portion of the distillate is transferred to a counting vial and the scintillation fluid added. The contents of the vial are thoroughly mixed and counted in aliquot scintillation counter.

Reagents

Scintillation medium, Ultima-Gold LLT, Packard Instruments Co.
Tritium standard solution
Dead water
Ethyl alcohol
Sodium Hydroxide (pellets)
Potassium permanganate (crystals)

Apparatus

Condenser
Distillation flask, 250-mL capacity
Liquid scintillation counter
Pipette and disposable tips (0.1ml., 5-10 ml.)
Kimwipes

Procedure

NOTE: All glassware must be dry. Set drying oven for 100-125°C.

1. Place 60-70 mL of the sample in a 250-mL distillation flask. Add a boiling chip to the flask. Add one NaOH pellet and about 0.02g KMnO4. Connect a side arm adapter and a condenser to the outlet of the flask. Place a receptacle at the outlet of the condenser. Set variac at 70 mark. Heat to boiling to distill. Discard the first 5-10mL of distillate. Collect next 20-25mL of distillate for analysis. Do not distill to dryness.

2. Mark the vial caps with the sample number and date.

   NOTE: Use the same type of vial for the whole batch (samples, background and standard.)

3. Mark three vial caps "BKG-1", " BKG-2", " BKG-3", and date.

4. Mark three vial caps "ST-1", " ST-2", " ST-3"; standard number, and date.

5. Dispense 13 mL of sample into marked vials and "dead" water into vials marked BKG-1, BKG-2, BKG-3.

NOTE 1: The Pipette is set (and calibrated) to deliver 6.5 mL, so pipette twice into each vial. Use new tip for each sample and new tip (one) for three background samples.

NOTE 2: Make sure the pipette has not been reset. If it has been reset, or if you are not sure, do not use it; check with your supervisor.

NOTE 3: Make sure the plastic tip is pushed all the way on the pipette and is tight. If it is not, the air will be draw in and the volume withdrawn will not be correct (it will be smaller).

6. Dispense 13 mL (see Notes 1, 2, and 3, above) of "dead" water into each vial marked "ST-1", "ST-2" and "ST-3."

7. Using a 0.1 mL pipette, withdraw water from each of the three standard vials. Discard this 0.1 mL of water.

8. Take a new 0.1 mL tip. Dispense 0.1 mL of standard into each of the three vials marked "ST-1," "ST-2," and "ST-3."

9. Take all vials containing samples, background, and standard to the counting room.

   NOTE: To avoid spurious counts, scintillation fluid should not be added under fluorescent light.

10. Dispense 10 mL of scintillation fluid into each vial (one at a time), cap tightly, and shake VIGOROUSLY for at least 30 seconds. Recheck the cap for tightness.

11. Wet a Kimwipe with alcohol and wipe off each vial in the following order:
    Background
    Samples
    Standard

12. Load the vials in the following order:
    BKG-1
    ST-1
    Samples
    BKG -2*
    ST -2*
    Samples
    BKG-3
    ST -3

    *BKG-2 and ST-2 should be approximately in the middle of the batch

13. Let the vials dark- and temperature-adapt for about one hour.

NOTE 1: To check if vials have reached counter temperature, inspect one vial (Bkg). The liquid should be transparent. If the temperature is too high (or too low), the liquid will be white and very viscous.

NOTE 2: The temperature inside the counter should be between 10° and 14°C (check thermometer). In this temperature range, the liquid is transparent.

14. Set the counter for 100-minute counting time and infinite cycles. (Follow manufacturer's procedure for setting the counter.)

15. Fill out the loading sheet, being sure to indicate the date and time counting started, and your initials.

NOTE 1: Do not count prepared background and standard sets with another batch of samples if plastic vials are used. Prepare new backgrounds and standards for each batch.

NOTE 2: If glass vials are used, the prepared background and standard sets can be counted with other batches up to one month after preparation, provided they are not taken out of the counter (not warmed up) and the same vial type from the same manufacturing batch (the same carton) is used. After one month prepare new sets of backgrounds and standards.

Calculations

$$pCi/L = \frac{\frac{A}{t_1} - \frac{B}{t_2}}{2.22EVe^{-\lambda t_3}} + \frac{2\sqrt{\frac{A}{t_1^2} + \frac{B}{t_2^2}}}{2.22EVe^{\lambda t_3}}$$

Where:

A	=	Total counts, sample
B	=	Total counts, background
E	=	Efficiency, (cpm/dpm)
V	=	Volume (liter)
e	=	Base of the natural logarithm = 2.71828
λ	=	$\frac{0.693}{12.26} = 0.5652$
t_1	=	Counting time, sample
t_2	=	Counting time, background
t_3	=	Elapsed time from the time of collection to the time of counting (in years)

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MEASUREMENT of AMBIENT GAMMA RADIATION by THERMOLUMINESCENT DOSIMETRY ($CaSO_4$:Dy)

PROCEDURE NO. EIML-TLD-01

Prepared by

Environmental, Inc.
Midwest Laboratory

Copy No. ____________

Revision #	Date	Pages	Prepared by	Approved by
5	01-08-90	6	B Grob	LG Huebner
6	04-24-95	6	B Grob	LG Huebner
7,Reissue	06-07-01	3	SA Coorlim	BGrob

MEASUREMENT of AMBIENT GAMMA RADIATION by THERMOLUMINESCENT DOSIMETRY ($CaSO_4$:Dy)

Principle of Method

The cards are spread out in a single layer on a perforated metal tray and annealed for two hours at 250-260 °C. After annealing, the cards are packaged and sent to the field.

Once the cards are returned from the field they are read as soon as possible. After reading, several cards are chosen, annealed and irradiated with a known dose using a Ra-226 source encapsulated in an iridium needle to calculate efficiency. The net exposure is calculated after in-transit exposure is subtracted.

I. Equipment & Materials:

TLD Reader: (Teledyne Isotopes Model 8300)
TLD Cards ($CaSO_4$:Dy phosphor)
TLD Card Holder with copper shielding
Transparent plastic bags (6oz and 8oz puncture proof Whirl-Pak)
Heat sealer
Labels
Ra-226 Needle: ("American Radium" No. 37852)
Annealing oven
Forceps
Black Plastic bags (pouches)
Scotch tape
Recording sheet
Turntable

II. Preparation

1. Enter location I.D, dosimeter (card) number, and date annealed on the readout recording sheet. As per project requirements, include cards for in-transits and spares.
2. Spread the cards in a single layer on the perforated tray.
3. Preheat the annealing oven to 250-260 °C
4. Set the alarm and anneal for two hours. Remove tray from the oven and let cool.
5. Place each card in a black plastic bag (pouch), seal the flap with scotch tape, and place in the card holder.
6. Attach a label identifying the station, location, and exposure period, on each holder. Place the holders into a transparent plastic bag and heat seal.
7. Ship without delay. Place a "Do Not X-Ray" sticker on the mailing container.

III. Reader Calibration

1. Adjust the nitrogen flow control to 6 SCF per hour.
2. Open the card drawer.
3. Turn "FUNCTION" switch to "CALIBRATE". The "WAIT" sign will be illuminated and the reading will change every three seconds. The reading should be 1000 ±10. If not, adjust using the "CALIBRATE" dial.

III. Reader Calibration (continued)

4. Turn "FUNCTION" switch to "OPERATE". Press "START". When the "READ" signal appears, the reading should be as posted. If not, adjust with "Sensitivity" dial. (Turn clockwise if reading is low, counterclockwise if reading is high).
5. Wait for "START" button to light before continuing. Press "START". Continue adjusting "SENSITIVITY" until the reading is as posted. Make and record 5 readings.
6. When the "START" button lights, push in the card drawer to position No. 3. Press "START". Wait for the "READ" signal and record the reading. (dark current / background)
7. Repeat this step four more times (total of five readings) and record the results.

NOTE: The reading should be as posted on the reader. If not, notify the Lab supervisor.

IV. Readout of TLD Cards

1. After the "START" button lights, pull out card drawer. Take the card out of the holder and insert in the drawer with printed card number facing down and to the back (away from you).
2. Push drawer into position No. 1. Push "START" button.
3. When "READ" sign appears, record the reading.
4. When "START" button lights up, push the drawer to position No. 2. Push "START" button. Repeat steps 2.3 and 2.4 until all positions are read out.
5. Read out and record the reading for the rest of the cards in the same manner.

V. Efficiency Determination

NOTE: Perform an efficiency calibration after each field cycle. (i.e. random TLDs from each project are calibrated after every readout of that project.).

1. After readout of a project is completed, select two to three cards at random.
2. Anneal and package as described in Part II, Steps 2 thru 8.
3. Clip the holders (with the freshly annealed cards) on the irradiation turntable. Start rotation.
4. Attach the Ra-226 needle to center of the turntable. Record the time. Irradiate overnight.
5. Remove the needle, record the time, and read out the cards as in Part III.
6. Average all the readings, and subtract average dark current reading (Part III, Step 6-7).
7. Calculate efficiency (light response) as follows:

$$\text{Efficiency} = \frac{\text{Net Average Reading (from step 6.)}}{\text{Hours of exposure x 2.097}}$$

8. Submit the field data and efficiency data sheets to data clerk for calculations.

NOTE:
The calculation program will automatically subtract the in-transit exposure and prorate exposure to a selected number of days (usually 30 or 91). Occasionally, some TLDs are placed and/or removed at different times resulting in a different number of exposure days in the field. Exposure will be prorated for the selected number of days.

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DETERMINATION of GROSS ALPHA and/or GROSS BETA in WATER

(DISSOLVED SOLIDS or TOTAL RESIDUE)

PROCEDURE NO. W(DS)-01

Prepared by
Environmental, Inc.
Midwest Laboratory

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Revision #	Date	Pages	Prepared by	Approved by
4	07-21-98	4	D Rieter	B Grob
Reissue	07-23-04	4	SA Coorlim	B Grob

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN WATER

(Dissolved Solids or Total Residue)[a]

Principle of Method

Water samples containing suspended matter are filtered through a membrane filter and the filtrate is analyzed. The filtered water sample is evaporated and the residue is transferred to a tared planchet for counting gross alpha and gross beta activity.

Reagents

All chemicals should be of "reagent-grade" or equivalent whenever they are commercially available.

Lucite: 0.5 mg/ml in acetone
Nitric acid, HNO_3: 16 N (concentrated), 1 N (62 ml of N HNO_3 diluted to 1 liter)

Apparatus

Filter, membrane Type AA, 0.08
Filtration equipment
Planchets (Standard 2"x1/8" stainless steel , ringed planchet)
Electric hotplate
Heat lamp
Drying oven
Muffle furnace
Analytical Balance
Dessicator
Proportional counter

Procedure

1. Filter a volume of sample containing not more than 100 mg of dissolved solids for alpha assay, or not more than 200 mg of dissolved solids for beta assay.[a]

NOTE: For gross alpha and gross beta assay in the same sample, limit the amount of solids to 100 mg.

2. Filter sample through a membrane filter. Wash the sides of the funnel with deionized (D. I.) water. Discard the filter, unless determining suspended solids also. See procedure W(SS-)02.

3. Evaporate the filtrate to <u>NEAR</u> dryness on a hot plate.

4. Add 20 ml of concentrated HNO_3 and evaporate to <u>NEAR</u> dryness again.

NOTE: If a water samples is known or suspected to contain chloride salts, these salts should be converted to nitrates before the sample residue is transferred to a stainless steel planchet. (Chlorides will attack stainless steel and increase the sample solids. No correction can be made for these added solids.) Chloride salts can be converted to nitrate salts by adding concentrated HNO_3 and evaporating to near dryness.

5. Transfer quantitatively the residue to a TARED PLANCHET, using an unused plastic disposable pipette for each sample, (not more than 1 or 2 ml at a time) evaporating each portion to dryness under the lamp. Spread residue uniformly on the planchet.

NOTE: Non-uniformity of the sample residue in the counting planchet interferes with the accuracy and precision of the method.

6. Wash the beaker with DI water several times and combine the washings and the residue in the planchet, using the rubber policeman to wash the walls. Evaporate to dryness.

NOTE: Rinse the rubber policeman with DI water between samples.

7. Bake in muffle furnace at 400° C for 45 minutes, cool and weigh.

NOTE: If the sample is very powdery, add a few drops (6-7) of the Lucite solution and dry under the infrared lamp for 10-20 minutes.

8. Store the sample in a dessicator until ready to count since vapors from the moist residue can damage the detector and the window and can cause erratic measurements.

9. Count the gross alpha and/or the gross beta activity in a low background proportional counter.

NOTE: If the gas-flow internal proportional counter does not discriminate for the higher energy alpha pulses at the beta plateau, the activity must be subtracted from the beta plus alpha activity. This is particularly important for samples with high alpha activity.

Samples may be counted for beta activity immediately after baking; alpha counting should be delayed at least 72 hours (until equilibrium has occurred).

[a] For analysis of total residue (for clear water), proceed as described above but do not filter the water. Measure out the appropriate amount and proceed to Step 3.

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN WATER

(Dissolved Solids or Total Residue)

Calculations

Gross alpha (beta) activity:

$$pCi/L = \frac{A}{B \times C \times D \times 2.22} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Volume of sample (liters)
- D = Correction factor for self-absorption (See Proc. AB-02)
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background

References:

Radio assay Procedures for Environmental Samples, US. Department of Health, Education and Welfare. Environmental Health Series, Jan. 1967.

EPA Prescribed Procedures for Measurement of Radioactivity in Drinking Water. August 1980.

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DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN WATER

(SUSPENDED SOLIDS)

PROCEDURE NO. W(SS)-02

Prepared by

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Midwest Laboratory

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Revised Pages	Revision #	Date	Pages	Prepared by	Approved by
	0	11-22-85	3	B. Grob	LG Huebner
	1	08-14-92	3	B. Grob	LG Huebner
	2	07-21-98	3	SA Coorlim	B. Grob
	3	12-17-04	3	SA Coorlim	[signature]

DETERMINATION of GROSS ALPHA and/or GROSS BETA in WATER (SUSPENDED SOLIDS)

Principle of Method

The sample is filtered through a tared membrane filter. The filter containing the solids is placed on a ringless, stainless steel planchet and air dried, then placed in a dessicator until ready for 'weighing. The gross alpha and gross beta activities are measured in a low background proportional counter.

Reagents

Apparatus

Filter, membrane, 47mm (0.8μm) 3
Filtration equipment
Planchets (Standard 2"x1/8" stainless steel, ringless planchet)
Analytical Balance
Dessicator
Proportional counter

Procedure

1. Filter sample through a TARED membrane Filter. Wash the sides of the funnel with deionized water.

   NOTE: If the sample contains sand, place it in a separatory funnel, allow the sand to settle for 30 minutes, then drain off the sand at the bottom. Shake funnel and repeat as above two times.

2. Place the filter on a ringless planchet and air dry for 24 hours..
3. Desiccate to constant weight and weigh. 3
4. Count for gross alpha and gross beta activity using a proportional counter.
5. Submit counts to data clerk for calculation.

Calculations

Gross alpha (beta) activity:

$$(pCi/L) = \frac{A}{B \times C \times D \times 2.22} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times 2.22}$$

Where:

2.22	= dpm/pCi
A	= Net alpha (beta) count (cpm)
B	= Efficiency for counting alpha (beta) activity (cpm/dpm)
C	= Volume of sample (liters)
D	= Correction factor for self-absorption (See Proc. AB-02)
E_{sb}	= Counting error of sample plus background
E_b	= Counting error of background

References: Radio assay Procedures for Environmental Samples, U.S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.