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U S Nuclear Regulatory Commission
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Prairie Island Nuclear Generating Plant
Units 1 and 2
Dockets 50-282 and 50-306
Renewed License Nos. DPR-42 and DPR-60

Prairie Island Independent Spent
Fuel Storage Installation
Docket 72-10
Materials License No. SNM-2506

2011 Annual Radiological Environmental Monitoring Program (REMP) Report

Pursuant to Prairie Island Nuclear Generating Plant (PINGP) Technical Specification (TS) 5.6.2, Appendix A to Renewed Operating Licenses DPR-42 and DPR-60, and Prairie Island Independent Spent Fuel Storage Installation Technical Specification (ISFSI TS) 5.2, Appendix A to Materials License SNM-2506, Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM"), submits one copy of the Annual Radiological Environmental Monitoring Program report for the period January 1, 2011 through December 31, 2011 as Enclosure 1.

Summary of Commitments

This letter contains no new commitments and no revisions to existing commitments.

Mark A. Schimmel
Site Vice President, Prairie Island Nuclear Generating Plant
Northern States Power Company - Minnesota

Enclosure

cc: Regional Administrator, USNRC, Region III
Project Manager, Prairie Island Nuclear Generating Plant, USNRC, NRR
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**ENCLOSURE 1**

Annual Report to the United States Nuclear Regulatory Commission

Radiological Environmental Monitoring Program

January 1, 2011 through December 31, 2011

75 pages follow

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XCEL ENERGY CORPORATION

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

# ANNUAL REPORT
to the
UNITED STATES NUCLEAR REGULATORY COMMISSION

Radiological Environmental Monitoring Program

January 1 to December 31, 2011

| | | | |
|---|---|---|---|
| Docket No. | 50-282<br>50-306 | License No. | DPR-42<br>DPR-60 |
| ISFSI<br>Docket No.72-10 | | | SNM-2506 |

Prepared under Contract by

ENVIRONMENTAL, Inc.
MIDWEST LABORATORY

Project No. 8010

Approved: _____

Bronia Grob, M.S.
Laboratory Manager

# PREFACE

The staff of Environmental, Inc., Midwest Laboratory was responsible for the acquisition of data presented in this report. Samples were collected by members of the staff of the Prairie Island Nuclear Generating Plant, operated by Northern States Power Co. –Minnesota, for XCEL Energy Corporation. The report was prepared by Environmental, Inc., Midwest Laboratory.

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# 1.0 INTRODUCTION

This report summarizes and interprets results of the Radiological Environmental Monitoring Program (REMP) conducted by Environmental, Inc., Midwest Laboratory at the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, during the period January - December, 2011. This program monitors the levels of radioactivity in the air, terrestrial, and aquatic environments in order to assess the impact of the plant on its surroundings.

Tabulations of the individual analyses made during the year are not included in this report. These data are included in a reference document (Environmental, Inc., Midwest Laboratory, 2012b) available at Prairie Island Nuclear Generating Plant.

Prairie Island Nuclear Generating Plant is located on the Mississippi River in Goodhue County, Minnesota, owned by Xcel Energy Corporation and operated by Northern States Power Co.-Minnesota. The plant has two 575 MWe pressurized water reactors. Unit 1 achieved initial criticality on 1 December 1973. Commercial operation at full power began on 16 December 1973. Unit 2 achieved initial criticality on 17 December 1974. Commercial operation at full power began on 21 December 1974.

## 2.0 SUMMARY

The Radiological Environmental Monitoring Program (REMP) required by the U.S. Nuclear Regulatory Commission (NRC) Offsite Dose Calculation Manual for the Prairie Island Nuclear Generating Plant and the Independent Spent Fuel Storage Installation (ISFSI) is described. Results for 2011 are summarized and discussed.

Program findings show background levels of radioactivity in the environmental samples collected in the vicinity of the Prairie Island Nuclear Generating Plant, with the exception of the period from March 15 through April 19, 2011. The detection of iodine-131 in charcoal cartridges and milk and slight elevations of Cs-137 in air particulate composites are consistent with and attributable to radioactive elements released from the Fukushima Daiichi reactors or fuel pools in the aftermath of the March 11, 2011 Japanese earthquake and tsunami.

## 3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

### 3.1 Program Design and Data Interpretation

The purpose of the Radiological Environmental Monitoring Program (REMP) at the Prairie Island Nuclear Generating Plant is to assess the impact of the plant on its environment. For this purpose, samples are collected from the air, terrestrial, and aquatic environments and analyzed for radioactive content. In addition, ambient gamma radiation levels are monitored by thermoluminescent dosimeters (TLDs).

Sources of environmental radiation include the following:

(1) Natural background radiation arising from cosmic rays and primordial radionuclides;

(2) Fallout from atmospheric nuclear detonations;

(3) Releases from nuclear power plants;

(4) Industrial and medical radioactive waste; and

(5) Fallout from nuclear accidents.

In interpreting the data, effects due to the plant must be distinguished from those due to other sources.

A major interpretive aid in assessment of these effects is the design of the monitoring program at the Prairie Island Plant which is based on the indicator-control concept. Most types of samples are collected both at indicator locations (nearby, downwind, or downstream) and at control locations (distant, upwind, or upstream). A plant effect would be indicated if the radiation level at an indicator location was significantly larger than that at the control location. The difference would have to be greater than could be accounted for by typical fluctuations in radiation levels arising from other sources.

An additional interpretive technique involves analyses for specific radionuclides present in the environmental samples collected from the plant site. The plant's monitoring program includes analyses for tritium and iodine-131. Most samples are analyzed for gamma-emitting isotopes with results for the following groups quantified: zirconium-95, cesium-137, cerium-144, beryllium-7, and potassium-40. The first three gamma-emitting isotopes were selected as radiological impact indicators because of the different characteristic proportions in which they appear in the fission product mix produced by a nuclear reactor and that produced by a nuclear detonation. Each of the three isotopes is produced in roughly equivalent amounts by a reactor: each constitutes about 10% of the total activity of fission products 10 days after reactor shutdown. On the other hand, 10 days after a nuclear explosion, the contributions of zirconium-95, cerium-144, and cesium-137 to the activity of the resulting debris are in the approximate ratio 4:1:0.03 (Eisenbud, 1963). Beryllium-7 is of cosmogenic origin and potassium-40 is a naturally-occurring isotope. They were chosen as calibration monitors and should not be considered radiological impact indicators.

The other group quantified consists of niobium-95, ruthenium-103 and -106, cesium-134, barium-lanthanum-140, and cerium-141. These isotopes are released in small quantities by nuclear power plants, but to date their major source of injection into the general environment has been atmospheric nuclear testing. Nuclides of the final group, manganese-54, iron-59, cobalt-58 and -60, and zinc-65, are activation products and arise from activation of corrosion products. They are typical components of a nuclear power plant's effluents, but are not produced in significant quantities by nuclear detonations.

3.1 Program Design and Data Interpretation (continued)

Other means of distinguishing sources of environmental radiation are employed in interpreting the data. Current radiation levels are compared with previous levels, including those measured before the Plant became operational. Results of the plant's monitoring program can be related to those obtained in other parts of the world. Finally, results can be related to events known to cause elevated levels of radiation in the environment, e.g., atmospheric nuclear detonations.

3.2 Program Description

The sampling and analysis schedule for the radiological environmental monitoring program at Prairie Island is summarized in Table 5.1 and briefly reviewed below. Table 5.2 defines the sampling location codes used in Table 5.1 and specifies for each location its type (indicator or control) and its distance, direction, and sector relative to the reactor site or ISFSI facility, as appropriate. To assure that sampling is carried out in a reproducible manner, detailed sampling procedures have been prescribed (Prairie Island Nuclear Generating Plant, 2010). Maps of fixed sampling locations are included in Appendix D.

To monitor the airborne environment, air is sampled by continuous pumping at five stations, three site boundary indicators (P-2, P-3, and P-4), located in the highest calculated D/Q sectors, one community indicator (P-6), and one control (P-1). The particulates are collected on membrane filters, airborne iodine is trapped by activated charcoal. Particulate filters are analyzed for gross beta activity and charcoal filters for iodine-131. Quarterly composites of particulate filters from each location are analyzed for gamma emitting isotopes.

Offsite ambient gamma radiation is monitored at thirty-four locations, using $CaSO_4$:Dy dosimeters with four sensitive areas at each location: ten in an inner ring in the general area of the site boundary, fifteen in the outer ring within a 4-5 mile radius, eight at special interest locations, and one control location, 11.1 miles distant from the plant. They are replaced and measured quarterly.

Ambient gamma radiation is monitored at the Independent Spent Fuel Storage Installation (ISFSI) Facility by twenty $CaSO_4$:Dy dosimeters. Twelve dosimeters are located inside of the earthen berm in direct line of sight from the storage casks and eight dosimeters are located outside of the earthen berm. They are replaced and measured quarterly.

Milk samples are collected monthly from four farms (three indicators and one control) and analyzed for iodine-131 and gamma-emitting isotopes. The milk is collected biweekly during the growing season (May - October), because the milk animals may be on pasture.

For additional monitoring of the terrestrial environment, green leafy vegetables (cabbage) are collected annually from the highest D/Q garden and a control location (P-38), and analyzed for gamma-emitting isotopes, including iodine-131. Corn is collected annually only if fields are irrigated with river water and analyzed for gamma-emitting isotopes. Well water and ground water are collected quarterly from four locations near the plant and analyzed for tritium and gamma-emitting isotopes.

River water is collected weekly at two locations, one upstream of the plant (P-5) and one downstream (P-6, Lock and Dam No.3). Monthly composites are analyzed for gamma-emitting isotopes. Quarterly composites are analyzed for tritium.

3.2 Program Description (continued)

Drinking water is collected weekly from the City of Red Wing well. Monthly composites are analyzed for gross beta, iodine-131, and gamma-emitting isotopes. Quarterly composites are analyzed for tritium.

The aquatic environment is also monitored by semi-annual upstream and downstream collections of fish, periphyton or invertebrates, and bottom sediments. Shoreline sediment is collected semi-annually from one location. All samples are analyzed for gamma-emitting isotopes.

3.3 Program Execution

The Program was executed as described in the preceding section with the following exceptions:

(1) Airborne Particulates / Airborne Iodine:

A partial sample was collected from location P-4 for the week ending 3/8/11. Power was down approximately 19 hours due to switching operations at the plant.

A partial sample was collected from location P-3 for the week ending 7/5/11 due to a sample pump failure.

Air samples were not collected from the site boundary location of the highest calculated annual average ground level D/Q during 2011. The annual average ground level D/Q values were updated during 2011 for the station and the west sector became the new highest D/Q location. The second and third highest sectors were sampled with the current REMP air sample stations.

(2) Milk:

One location, P-42, Rother Farm, was dropped from the program in September, 2011. The farm stopped milk production.

(3) Drinking Water:

A partial sample was collected from location P-11 for the month of December, 2011. The weekly water sample taken on 12/21/11 was damaged in transit to the laboratory and was not included in the monthly or quarterly composite results.

Deviations from the program are summarized in Table 5.3.

## 3.4 Laboratory Procedures

The iodine-131 analyses in milk and drinking water were made using a sensitive radiochemical procedure which involves separation of the iodine using an ion-exchange method, solvent extraction and subsequent beta counting.

Gamma-spectroscopic analyses are performed using high-purity germanium (HPGe) detectors. Levels of iodine-131 in cabbage and natural vegetation and concentrations of airborne iodine-131 in charcoal samples were determined by gamma spectroscopy.

Tritium concentrations are determined by liquid scintillation.

Analytical Procedures used by Environmental, Inc. are on file and are available for inspection. Procedures are based on those prescribed by the Health and Safety Laboratory of the U.S. Dep't of Energy, Edition 28, 1997, U.S. Environmental Protection Agency for Measurement of Radioactivity in Drinking Water, 1980, and the U.S. Environmental Protection Agency, EERF, Radiochemical Procedures Manual, 1984.

Environmental, Inc., Midwest Laboratory has a comprehensive quality control/quality assurance program designed to assure the reliability of data obtained. Details of the QA Program are presented elsewhere (Environmental, Inc., Midwest Laboratory, 2009). The QA Program includes participation in Interlaboratory Comparison (crosscheck) Programs. Results obtained in the crosscheck programs are presented in Appendix A.

## 3.5 Program Modifications

P-42, Rother Farm, was dropped from the program in September of 2011. The farm stopped milk production.

## 3.6 Land Use Census

In accordance with the Prairie Island Nuclear Generating Plant Offsite Dose Calculation Manual, H4, (ODCM) a land use census is conducted in order to identify the location of the nearest milk animal, the nearest residence, and the nearest garden of greater than 500 $ft^2$ producing fresh leafy vegetables in each of the 16 meteorological sectors within a distance of 5 miles. This census is conducted at least once per 12 months between the dates of May 1 and October 31. If new locations yield a calculated dose or dose equivalent (via the same exposure pathway) twenty percent greater than the required locations per the ODCM, then the new locations are added to the radiological environmental monitoring program within 30 days, and sampling locations having lower calculated doses or a lower dose commitment may be deleted from this monitoring program after October 31 of the year in which the land use census was conducted.

This land use census insures the updating of the radiological environmental monitoring program should sampling locations change within the 5 mile radius from the plant.

The Land Use Census was completed in October, 2011. There were no changes to any of the highest D/Q locations for nearest milk animal or garden sites. The nearest residence changed from the WNW to the W sector after an update of the annual average meteorological data.

No downstream irrigation of corn was discovered within 5 miles of the Prairie Island Plant. Therefore, no corn samples were collected for analysis.

## 4.0 RESULTS AND DISCUSSION

All scheduled collections and analyses were made except those listed in Table 5.3.

The results are summarized in Table 5.4 in a format recommended by the Nuclear Regulatory Commission in Regulatory Guide 4.8. For each type of analysis of each sampled medium, this table lists the mean and range for all indicator locations and for all control locations. The locations with the highest mean and range are also shown.

### 4.1 Atmospheric Nuclear Detonations and Nuclear Accidents

The Fukushima Daiichi nuclear accident occurred on March 11, 2011, releasing large amounts of radioactive isotopes into the atmosphere and Pacific Ocean. Positive iodine-131, cesium-134 and cesium-137 activities were detected in environmental background samples from March through May. The accident, rated seven on the International Nuclear Event Scale (INES) compares with Chernobyl, rated level seven, and Three Mile Island rated level five.

### 4.2 Summary of Preoperational Data

The following constitutes a summary of preoperational studies conducted at the Prairie Island Nuclear Power Plant during the years 1970 to 1973, to determine background levels expected in the environment, and provided, where applicable, as a means for comparison with present day levels. Strict comparisons, however, are difficult, since background levels of radiation were much higher in these years due to radioactive fallout from the atmosphere. Gross beta measurements in fallout declined yearly from a level of 12,167 pCi/ $m^3$ to 1,020 pCi/ $m^3$, and these declining values are reflected throughout the various media tested.

In the air environment, ambient gamma radiation (TLDs) averaged 9.4 mR/4 weeks during pre-operational studies. Gross beta in air particulates declined from levels of 0.38 to 0.037 pCi/$m^3$. Average present day levels have stabilized at around 0.025 pCi/$m^3$. Airborne radioiodine remained below detection levels.

In the terrestrial environment of 1970 to 1973, milk, agricultural crops, and soil were monitored. In milk samples, low levels of Cs-137, I-131, and Sr-90 were detected. Cs-137 levels declined from 16.5 to 8.6 pCi/L. Present day measurements for both Cs-137 and I-131 are below detection levels. Agricultural crop measurements averaged 57.7 pCi/g for gross beta and 0.47 pCi/g for Cs-137. Gross beta measured in soil averaged 52 pCi/g.

The aqueous environment was monitored by testing of river, well and lake waters, bottom sediments, fish, aquatic vegetation and periphyton. Specific location comparison of drinking, river and well water concentrations for tritium and gross beta are not possible. However, tritium background levels, measured at eight separate locations, declined steadily from an average concentration of 1020 pCi/L to 490 pCi/L. Present day environmental levels of tritium measure below a detection limit of approximately 160 pCi/L. Values for gross beta, measured from 1970 to 1973, averaged 9.9 pCi/L in downstream Mississippi River water, 8.2 pCi/L for well water, and 11.0 pCi/L for lake water. Gamma emitters were below the lower limit of detection (LLD). In bottom sediments, gross beta background levels were determined at 51.0 pCi/g. Cs-137 activity during preoperational studies in 1973 measured 0.25 pCi/g upstream and 0.21 pCi/g downstream. The lower levels occasionally observed today can still be attributed to residual activity from atmospheric fallout. Gross beta in fish, measured in both flesh and skeletal samples, averaged 7.3 and 11.7 pCi/g, respectively. Gross beta background levels in aquatic vegetation, algae and periphyton samples measured 76.0 pCi/g , 46.0 pCi/g, and 13.6 pCi/g, respectively.

## 4.3 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected in the vicinity of the Prairie Island Nuclear Generating Plant.

### Ambient Radiation (TLDs)

Ambient radiation was measured in the general area of the site boundary, at the outer ring 4 - 5 mi. distant from the Plant, at special interest areas and at one control location. The means ranged from 15.4 mR/91 days at inner ring locations to 15.9 mR/91 days at outer ring locations. The mean at special interest locations was 15.1 mR/91 days and 15.70 mR/91 days at the control location. Dose rates measured at the inner and outer ring and the control locations were similar to those observed from 1996 through 2010. The results are tabulated below. No plant effect on ambient gamma radiation measurements was indicated (Figure 5-1).

| Year | Average (Inner and Outer Rings) | Control | Year | Average (Inner and Outer Rings) | Control |
|---|---|---|---|---|---|
| 1996 | 14.8 | 16.4 | 2004 | 17.6 | 17.6 |
| 1997 | 15.1 | 16.0 | 2005 | 16.8 | 16.3 |
| 1998 | 16.7 | 17.3 | 2006 | 16.6 | 16.6 |
| 1999 | 16.6 | 17.5 | 2007 | 17.5 | 17.7 |
| 2000 | 17.0 | 17.1 | 2008 | 16.9 | 17.1 |
| 2001 | 16.8 | 17.2 | 2009 | 15.9 | 16.3 |
| 2002 | 17.4 | 16.9 | 2010 | 16.0 | 16.0 |
| 2003 | 16.2 | 16.0 | 2011 | 15.7 | 15.7 |
| | | | | | |

Ambient gamma radiation as measured by thermoluminescent dosimetry.
Average quarterly dose rates (mR/91 days).

### ISFSI Facility Operations Monitoring

Ambient radiation was measured inside the ISFSI earth berm, outside the ISFSI earth berm and at two special locations between the plant ISFSI and the Prairie Island Indian Community. The mean dose rates averaged 103.1 mR/91 days inside the ISFSI earth berm and 19.7 mR/91 days outside the ISFSI earth berm. No additional casks were placed on the ISFSI pad in 2011, a total of twenty-nine loaded casks remain. The higher levels inside the earth berm are expected, due to the loaded spent fuel casks being in direct line-of-sight of the TLDs.

Ambient radiation levels measured outside the earth berm show a slight increase as compared to other offsite dose rates around the plant. If the dose rates outside the earth berm are an indication of gamma skyshine from the casks, they are consistent with predictions given in the ISFSI Safety Analysis Report, Table 7A-7, "Total Skyshine Dose Rate". The cumulative average of the two special Prairie Island Indian Community TLDs measured 14.8 and 13.9 mR/91 days. Although the skyshine neutron dose rates are not directly measured, the neutron levels measured next to the casks are below the levels predicted in the ISFSI SAR Report, Table 7A-4, "TN-40 Dose Rates at Short Distances". Therefore, the skyshine dose rates at farther distances from the casks should be at or below the calculated dose rates. No spent fuel storage effect on offsite ambient gamma radiation was indicated (Fig. 5-1).

Airborne Particulates

Typically, the highest averages for gross beta occur during the months of January and December, and the first and fourth quarters, as in 1996 through 2006, and also in 2008 through 2010. The elevated activity observed in 2007 was attributed to construction activity in the area, an increase in dust and consequent heavier particulate filter loading.

Average annual gross beta concentrations in airborne particulates were 0.026 pCi/$m^3$ at the indicators and 0.027 pCi/ $m^3$ at the control location and similar to levels observed from 1996 through 2006 and 2008 to 2010. The results are tabulated below.

| Year | Average of Indicators | Control |
|---|---|---|
| | Concentration (pCi/ $m^3$) | |
| 1996 | 0.023 | 0.020 |
| 1997 | 0.021 | 0.021 |
| 1998 | 0.022 | 0.018 |
| 1999 | 0.024 | 0.022 |
| 2000 | 0.025 | 0.025 |
| 2001 | 0.023 | 0.023 |
| 2002 | 0.028 | 0.023 |
| 2003 | 0.027 | 0.025 |
| 2004 | 0.025 | 0.026 |
| 2005 | 0.027 | 0.025 |
| 2006 | 0.026 | 0.025 |
| 2007 | 0.037 | 0.031 |
| 2008 | 0.028 | 0.027 |
| 2009 | 0.029 | 0.029 |
| 2010 | 0.025 | 0.025 |
| 2011 | 0.026 | 0.027 |
| | | |

Average annual gross beta concentrations in airborne particulates.

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, with an average activity of 0.070 pCi/$m^3$ for all locations. Cesium-137 was detected at P-04 (0.0007 pCi/$m^3$) and P-01(C) (0.0011 pCi/$m^3$), also in the second quarter. This is consistent with releases from the Fukushima event. All other isotopes were below the lower limit of detection.

Airborne Iodine

Airborne iodine-131 was detected in weekly samples from March 22 through April 12. The activity averaged 0.056 pCi/$m^3$ at indicator locations and 0.065 pCi/$m^3$ at the control, consistent with the Fukushima event. Iodine-131 remained below the lower limit of detection (LLD) of 0.030 pCi/$m^3$ in all samples for the rest of the year. There was no indication of a plant effect.

Milk

Iodine-131 activity (1.0±0.2 pCi/L) was detected at location P-18 the week of 04-19-11. This is consistent with releases from Fukushima. All other results were below a detection limit of 0.5 pCi/L in all samples. Cs-137 results were below the LLD level of 5 pCi/L in all samples. No other gamma-emitting isotopes, except naturally-occurring potassium-40, were detected in any milk samples. This is consistent with the findings of the National Center for Radiological Health that most radiocontaminants in feed do not find their way into milk due to the selective metabolism of the cow. The common exceptions are radioisotopes of potassium, cesium, strontium, barium, and iodine (National Center for Radiological Health, 1968).

In summary, the milk data for 2011 show no radiological effects of the plant operation.

Drinking Water

In drinking water from the City of Red Wing well, tritium activity measured below the LLD level of 152 pCi/L in all samples.

Gross beta concentrations averaged 12.4 pCi/L throughout the year, ranging from 8.7–19.5 pCi/L. These concentrations are consistent with levels observed from 1996 through 2010. The most likely contribution is the relatively high levels of naturally-occurring radium. Gamma spectroscopy indicates the presence of lead and bismuth isotopes, which are daughters of the radium decay chain. There is no indication from the 2011 data of any effect of plant operation.

| Year | | Gross Beta (pCi/L) |
|---|---|---|
| 1996 | | 6.3 |
| 1997 | | 5.1 |
| 1998 | | 5.4 |
| 1999 | | 5.3 |
| 2000 | | 10.1 |
| 2001 | | 8.3 |
| 2002 | | 8.7 |
| 2003 | | 9.9 |
| 2004 | | 9.8 |
| 2005 | | 11.5 |
| 2006 | | 13.4 |
| 2007 | | 11.6 |
| 2008 | | 11.6 |
| 2009 | | 11.4 |
| 2010 | | 11.7 |
| 2011 | | 12.4 |
| | | |

Average annual concentrations; Gross beta in drinking water.

River Water

Tritium in river water samples measured below the LLD level of 152 pCi/L in all samples. Gamma-emitting isotopes were below detection limits in all samples.

Well Water

At control well, P-43 (Peterson Farm) and the four indicator wells (P-8, Community Center, P-6, Lock and Dam No. 3, P-9, Plant Well No. 2 and P-24, Suter Farm ) no tritium was detected above a concentration level of 150 pCi/L.

Gamma-emitting isotopes were below detection limits in all samples.

In summary, well water data for 2011 show no radiological effects of the plant operation.

Crops

Two samples of broadleaf vegetation, cabbage leaves, were collected in September, 2011 and analyzed for gamma-emitting isotopes, including iodine-131. The I-131 level was below 0.019 pCi/g wet weight in all samples. With the exception of naturally-occurring beryllium-7 and potassium-40, all other gamma-emitting isotopes were below their respective detection limits. There was no indication of a plant effect.

Field sampling personnel conducted an annual land use survey and found no river water taken for irrigation into fields within 5 miles downstream from the Prairie Island Plant. The collection and analysis of corn samples was not required.

Fish

Fish were collected in May and September, 2011 and analyzed for gamma emitting isotopes. Only naturally-occurring potassium-40 was detected, and there was no significant difference between upstream and downstream results. There was no indication of a plant effect.

Aquatic Insects or Periphyton

Aquatic insects (invertebrates) or periphyton were collected in July and September, 2011 and analyzed for gamma-emitting isotopes. All gamma-emitting isotopes, with the exception of naturally-occurring potassium-40, were below detection limits. There was no indication of any plant effect.

Bottom and Shoreline Sediments

Upstream, downstream and downstream recreational area shoreline sediments were sampled in July and September, 2011 and analyzed for gamma-emitting isotopes. The only gamma-emitting isotopes detected were naturally-occurring beryllium-7 and potassium-40. There was no indication of a plant effect.

# 5.0 FIGURES AND TABLES

Figure 5-1. Offsite Ambient Radiation (TLDs); average of inner and outer ring indicator locations versus control location.

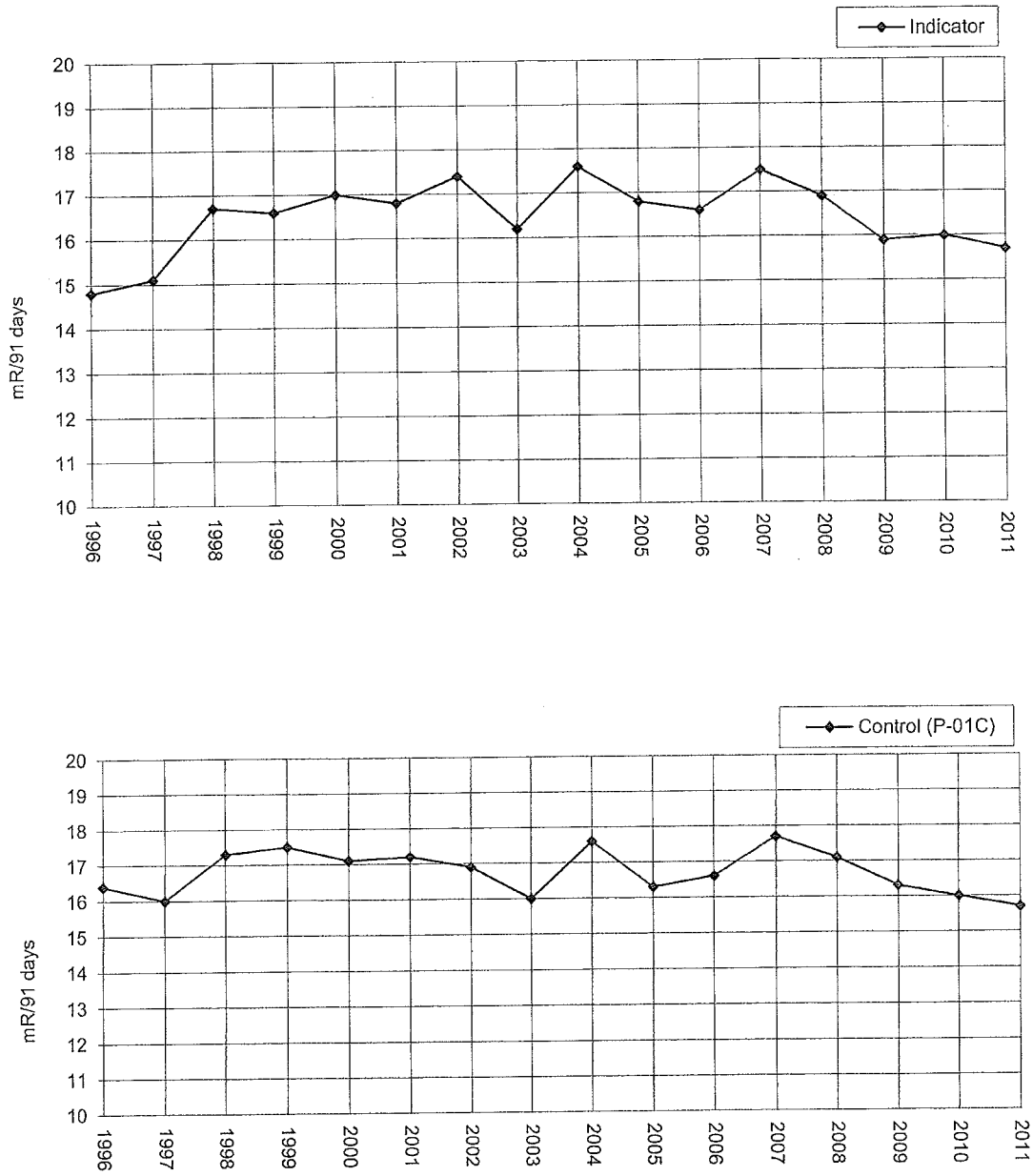
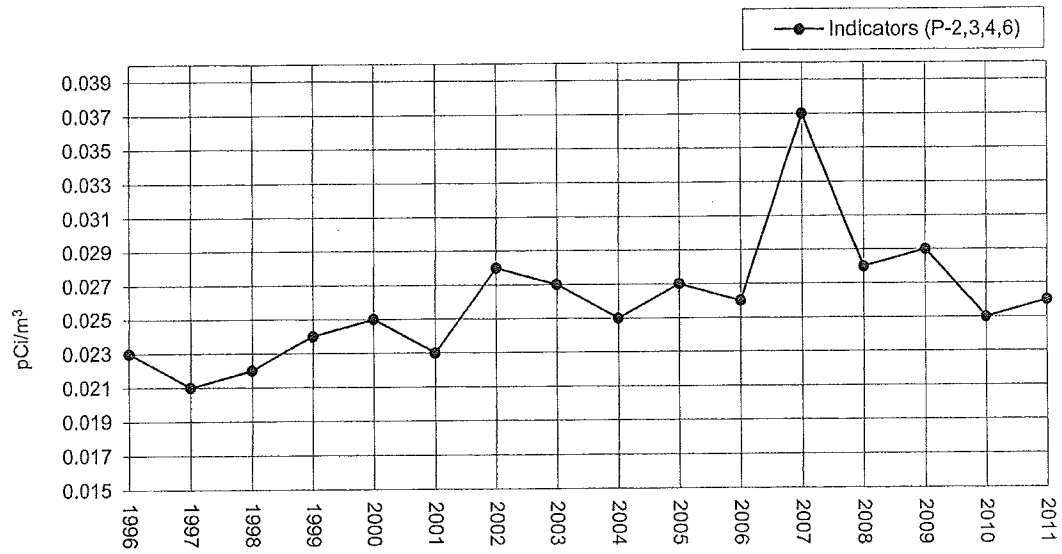
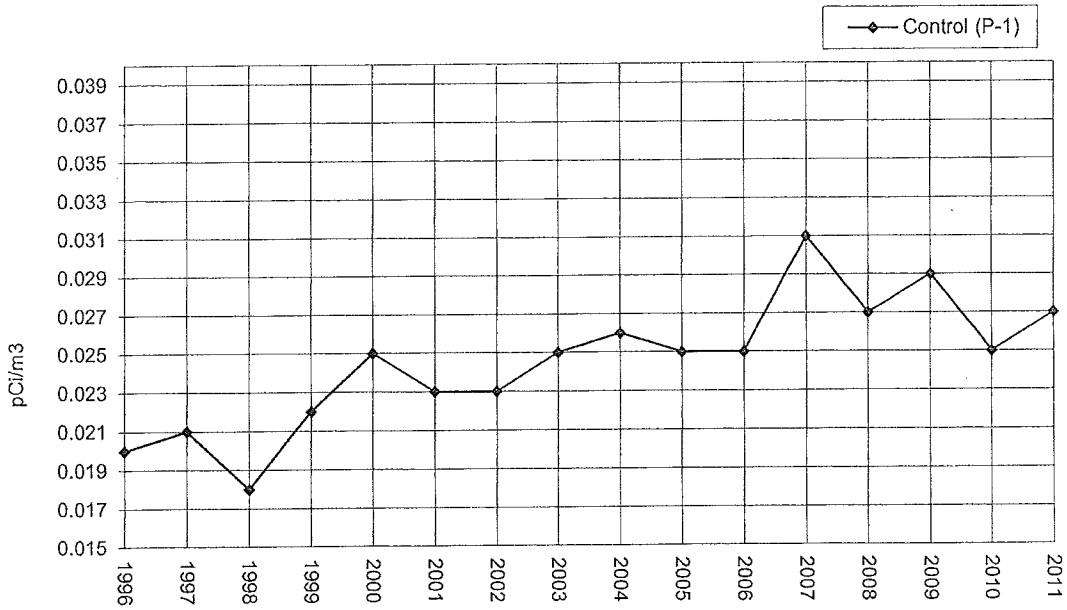


Figure 5-2. Airborne Particulates; analysis for gross beta, average mean of all indicator locations versus control location.



## PRAIRIE ISLAND

Table 5.1. Sample collection and analysis program, Prairie Island Nuclear Generating Plant.

| Medium | Location No. | Location Codes (and Type)[a] | Collection Type and Frequency[b] | Analysis Type and Frequency[c] |
|---|---|---|---|---|
| Ambient radiation (TLD's) | 54 | P-01A - P-10A<br>P-01B - P-15B<br>P-01S - P-08S<br>P-01IA - P-08IA<br>P-01IB - P-08IB<br>P-01IX- P-04IX, P-01C | C/Q | Ambient gamma |
| Airborne Particulates | 5 | P-1(C), P-2,<br>P-3, P-4, P-6 | C/W | GB, GS (QC of each location) |
| Airborne Iodine | 5 | P-1(C), P-2, P-3, P-4, P-6 | C/W | I-131 |
| Milk | 4 | P-18, P-37, P-42,<br>P-43 (C) | G/M[d] | I-131, GS |
| River water | 2 | P-5(C), P-6 | G/W | GS(MC), H-3(QC) |
| Drinking water | 1 | P-11 | G/W | GB(MC), I-131(MC)<br>GS (MC), H-3 (QC) |
| Well water | 5 | P-6, P-8, P-9, P-24,<br>P-43 (C) | G/Q | H-3, GS |
| Edible cultivated crops - leafy green vegetables | 3 | P-28, P-38(C), P-45 | G/A | GS (I-131) |
| Fish (one species, edible portion) | 2 | P-19(C), P-13 | G/SA | GS |
| Periphyton or invertebrates | 2 | P-40(C), P-6 | G/SA | GS |
| Bottom sediment | 2 | P-20(C), P-6 | G/SA | GS |
| Shoreline sediment | 1 | P-12 | G/SA | GS |

[a] Location codes are defined in Table D-2. Control stations are indicated by (C). All other stations are indicators.

[b] Collection type is coded as follows: C/ = continuous, G/ = grab. Collection frequency is coded as follows: W= weekly, M = monthly, Q = quarterly, SA = semiannually, A = annually.

[c] Analysis type is coded as follows: GB = gross beta, GS = gamma spectroscopy, H-3 = tritium, I-131 = iodine-131. Analysis frequency is coded as follows: MC = monthly composite, QC = quarterly composite.

[d] Milk is collected biweekly during the grazing season (May - October).

## PRAIRIE ISLAND

Table 5.2. Sampling locations, Prairie Island Nuclear Generating Plant.

| Code | Type[a] | Collection Site | Sample Type[b] | Distance and Direction from Reactor |
|---|---|---|---|---|
| P-1 | C | Air Station P-1 | AP, AI | 11.8 mi @ 316°/NNW |
| P-2 | | Air Station P-2 | AP, AI | 0.5 mi @ 294°/WNW |
| P-3 | | Air Station P-3 | AP, AI | 0.8 mi @ 313°/NW |
| P-4 | | Air Station P-4 | AP, AI | 0.4 mi @ 359°/N |
| P-5 | C | Upstream of Plant | RW | 1.8 mi @ 11°/N |
| P-6 | | Lock and Dam #3 & Air Station P-6 | AP, AI, RW WW, BS, BO[c] | 1.6 mi @ 129°/SE |
| P-8 | | Community Center | WW | 1.0 mi @ 321°/WNW |
| P-9 | | Plant Well #2 | WW | 0.3 mi @ 306°/NW |
| P-11 | | Red Wing Service Center | DW | 3.3 mi @ 158°/SSE |
| P-12 | | Downstream of Plant | SS | 3.0 mi @ 116°/ESE |
| P-13 | | Downstream of Plant | F[c] | 3.5 mi @ 113°/ESE |
| P-18 | | Christiansen Farm | M | 3.8 mi @ 88°/E |
| P-19 | C | Upstream of Plant | F[c] | 1.3 mi @ 0°/N |
| P-20 | C | Upstream of Plant | BS | 0.9 mi @ 45°/NE |
| P-24 | | Suter Residence | WW | 0.6 mi @ 158°/SSE |
| P-28 | | Allyn Residence | VE | 1.0 mi @ 152°/SSE |
| P-37 | | Welsch Farm | M | 4.1 mi @ 87°/E |
| P-38 | C | Cain Residence | VE | 14.2 mi @ 359°/N |
| P-40 | C | Upstream of Plant | BO[c] | 0.4 mi @ 0°/N |
| P-42 | | Rother Farm | M | 4.3 mi. @ 264°/W |
| P-43 | C | Peterson Farm | M, WW | 13.9 mi. @ 355°/N |
| P-45 | | Glazier Residence | VE | 0.6 mi. @ 341°/NNW |
| General Area of the Site Boundary | | | | |
| P-01A | | Property Line | TLD | 0.4 mi @ 359°/N |
| P-02A | | Property Line | TLD | 0.3 mi @ 10°/N |
| P-03A | | Property Line | TLD | 0.5 mi @ 183°/S |
| P-04A | | Property Line | TLD | 0.4 mi @ 204°/SWW |
| P-05A | | Property Line | TLD | 0.4 mi @ 225°/SW |
| P-06A | | Property Line | TLD | 0.4 mi @ 249°/WSW |
| P-07A | | Property Line | TLD | 0.4 mi @ 268°/W |
| P-08A | | Property Line | TLD | 0.4 mi @ 291°/WNW |
| P-09A | | Property Line | TLD | 0.7 mi @ 317°/NW |
| P-10A | | Property Line | TLD | 0.5 mi @ 333°/NNW |

## PRAIRIE ISLAND

Table 5.2. Sampling locations, Prairie Island Nuclear Generating Plant (continued).

| Code | Type[a] | Collection Site | Sample Type[b] | Distance and Direction from Reactor |
|---|---|---|---|---|
| Approximately 4 to 5 miles Distant from the Plant | | | | |
| P-01B | | Thomas Killian Residence | TLD | 4.7 mi @ 355°/N |
| P-02B | | Roy Kinneman Residence | TLD | 4.8 mi @ 17°/NNE |
| P-03B | | Wayne Anderson Farm | TLD | 4.9 mi @ 46°/NE |
| P-04B | | Nelson Drive (Road) | TLD | 4.2 mi @ 61°/ENE |
| P-05B | | County Road E and Coulee | TLD | 4.2 mi @ 102°/ESE |
| P-06B | | William Hauschibit Residence | TLD | 4.4 mi @ 112°/ESE |
| P-07B | | Red Wing Public Works | TLD | 4.7 mi @ 140°/SE |
| P-08B | | David Wnuk Residence | TLD | 4.1 mi @ 165°/SSE |
| P-09B | | Highway 19 South | TLD | 4.2 mi @ 187°/S |
| P-10B | | Cannondale Farm | TLD | 4.9 mi @ 200°/SSW |
| P-11B | | Wallace Weberg Farm | TLD | 4.5 mi @ 221°/SW |
| P-12B | | Ray Gergen Farm | TLD | 4.6 mi @ 251°/WSW |
| P-13B | | Thomas O'Rourke Farm | TLD | 4.4 mi @ 270°/W |
| P-14B | | David J. Anderson Farm | TLD | 4.9 mi @ 306°/NW |
| P-15B | | Holst Farms | TLD | 3.8 mi @ 345°/NNW |
| Special Interest Locations | | | | |
| P-01S | | Federal Lock & Dam #3 | TLD | 1.6 mi @ 129°/SE |
| P-02S | | Charles Suter Residence | TLD | 0.5 mi @ 155°/SSE |
| P-03S | | Carl Gustafson Farm | TLD | 2.2 mi @ 173°/S |
| P-04S | | Richard Burt Residence | TLD | 2.0 mi @ 202°/SSW |
| P-05S | | Kinney Store | TLD | 2.0 mi @ 270°/W |
| P-06S | | Earl Flynn Farm | TLD | 2.5 mi @ 299°/WNW |
| P-07S | | Indian Community | TLD | 0.7 mi @ 271°/W |
| P-08S | | Indian Community | TLD | 0.7 mi @ 287°/NWW |
| P-01C | C | Robert Kinneman Farm | TLD | 11.1 mi @ 331°/NNW |

## PRAIRIE ISLAND

Table 5.2. Sampling locations, Prairie Island Nuclear Generating Plant (continued).

| Code | Type[a] | Collection Site | Sample Type[b] | Distance and Direction from ISFSI Center. |
|---|---|---|---|---|
| ISFSI Area Inside Earth Berm | | | | |
| P-01IA | | ISFSI Nuisance Fence | TLD | 190' @ 45°/NE |
| P-02IA | | ISFSI Nuisance Fence | TLD | 360' @ 82°/E |
| P-03IA | | ISFSI Nuisance Fence | TLD | 370' @ 100°/E |
| P-04IA | | ISFSI Nuisance Fence | TLD | 200' @ 134°/SE |
| P-05IA | | ISFSI Nuisance Fence | TLD | 180' @ 219°/SW |
| P-06IA | | ISFSI Nuisance Fence | TLD | 320' @ 258°/WSW |
| P-07IA | | ISFSI Nuisance Fence | TLD | 320' @ 281°/WNW |
| P-08IA | | ISFSI Nuisance Fence | TLD | 190' @ 318°/NW |
| P-01IX | | ISFSI Nuisance Fence | TLD | 140' @ 180°/S |
| P-02IX | | ISFSI Nuisance Fence | TLD | 310' @ 270°/W |
| P-03IX | | ISFSI Nuisance Fence | TLD | 140' @ 0°/N |
| P-04IX | | ISFSI Nuisance Fence | TLD | 360' @ 90°/E |
| ISFSI Area Outside Earth Berm | | | | |
| P-01IB | | ISFSI Berm Area | TLD | 340' @ 3°/N |
| P-02IB | | ISFSI Berm Area | TLD | 380' @ 28°/NNE |
| P-03IB | | ISFSI Berm Area | TLD | 560' @ 85°/E |
| P-04IB | | ISFSI Berm Area | TLD | 590' @ 165°/SSE |
| P-05IB | | ISFSI Berm Area | TLD | 690' @ 186°/S |
| P-06IB | | ISFSI Berm Area | TLD | 720' @ 201°/SSW |
| P-07IB | | ISFSI Berm Area | TLD | 610' @ 271°/W |
| P-08IB | | ISFSI Berm Area | TLD | 360' @ 332°/NNW |

[a] "C" denotes control location. All other locations are indicators.

[b] Sample Codes:

| | | | |
|---|---|---|---|
| AP | Airborne particulates | F | Fish |
| AI | Airborne Iodine | M | Milk |
| BS | Bottom (river) sediments | SS | Shoreline Sediments |
| BO | Bottom organisms (periphyton or macroinvertebrates) | SW | Surface Water |
| | | VE | Vegetation/vegetables |
| DW | Drinking water | WW | Well water |

[c] Distance and direction data for fish and bottom organisms are approximate since availability of sample specimen may vary at any one location.

Table 5.3. Missed collections and analyses at the Prairie Island Nuclear Generating Plant.

All required samples were collected and analyzed as scheduled with the following exceptions:

| Sample Type | Analysis | Location | Collection Date or Period | Reason for not conducting REMP as required | Plans for Preventing Recurrence |
|---|---|---|---|---|---|
| AP/AI | Beta, I-131 | P-4 | 3/8/2011 | Partial sample, ~ 19 hrs. lost due to switching operations at Plant. | None Required |
| AP/AI | Beta, I-131 | P-3 | 7/5/2011 | Partial sample, due to sampler pump failure. | Replaced pump. |
| AP/I | Beta, I-131 | Highest D/Q sector | 2011 | March, 2011 meteorological data showed that the highest D/Q site was located in the W sector. | Sampler to be installed in the W sector for 2012. |
| DW | Gamma, Beta | P-11 | Dec., 2011 | Partial composite, the weekly collection for 12/21/11 was damaged in transit. | None |
| MI | Gamma, I-131 | P-42 | Sep., 2011 | Location dropped, dairy ceased milk production. | None |

Table 5.4 Radiological Environmental Monitoring Program Summary

Name of Facility: Prairie Island Nuclear Power Station
Location of Facility: Goodhue, Minnesota ( County, State )
Docket No.: 50-282, 50-306
Reporting Period: January-December, 2011

| 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] |
|---|---|---|---|---|---|---|---|
| **Direct Radiation** | | | | | | | |
| TLD (Inner Ring, Area at Site Boundary) mR/91 days) | Gamma 40 | 3.0 | 15.4 (40/40) ( 9.3-18.4) | P-06A 0.4 mi @ 249° /WSW | 17.1 (4/4) (14.9-18.4) | (See Control below.) | 0 |
| TLD (Outer Ring, 4-5 mi. distant) mR/91 days) | Gamma 60 | 3.0 | 15.9 (60/60) ( 12.2-20.1) | P-12B, R. Gergen Farm 4.6 mi @ 251° /WSW | 17.4 (4/4) (13.0-20.1) | (See Control below.) | 0 |
| TLD (Special Interest Areas) mR/91 days) | Gamma 32 | 3.0 | 15.1 (32/32) ( 11.1-19.8) | P-03S, Gustafson Farm, 2.2 mi @ 173° /S | 17.3 (4/4) (14.0-19.6) | (See Control below.) | 0 |
| TLD (Control) mR/91 days) | Gamma 4 | 3.0 | None | P-01C, Robert Kinneman 11.1 mi @ 331° /NNW | 15.7 (4/4) (13.6-17.4) | 15.7 (4/4) (13.6-17.4) | 0 |
| **Airborne Pathway** | | | | | | | |
| Airborne Particulates ($pCi/m^3$) | GB 265 | 0.005 | 0.026 (212/212) (0.007-0.056) | P-04, Air Station 0.4 mi @ 359° /N | 0.027 (53 /53) (0.010-0.053) | 0.027 (53/53) (0.010-0.053) | 0 |
| | GS 20 | | | | | | |
| | Be-7 | 0.015 | 0.066 (16/16) (0.050-0.077) | P-03, Air Station 0.8 mi @ 313° /NW | 0.070 (4/4) (0.060-0.076) | 0.066 (4/4) (0.055-0.082) | 0 |
| | Mn-54 | 0.0007 | < LLD | - | - | < LLD | 0 |
| | Co-58 | 0.0008 | < LLD | - | - | < LLD | 0 |
| | Co-60 | 0.0006 | < LLD | - | - | < LLD | 0 |
| | Zn-65 | 0.0011 | < LLD | - | - | < LLD | 0 |
| | Zr-Nb-95 | 0.0010 | < LLD | - | - | < LLD | 0 |
| | Ru-103 | 0.0009 | < LLD | - | - | < LLD | 0 |
| | Ru-106 | 0.0062 | < LLD | - | - | < LLD | 0 |
| | Cs-134 | 0.0007 | < LLD | - | - | < LLD | 0 |
| | Cs-137 | 0.0008 | < LLD | P-01, Air Station 11.8 mi @316°/NNW | 0.0011 (1/4) | 0.0011 (1/4) | 0 |
| | Ba-La-140 | 0.0022 | < LLD | - | - | < LLD | 0 |
| | Ce-141 | 0.0018 | < LLD | - | - | < LLD | 0 |
| | Ce-144 | 0.0042 | < LLD | - | - | < LLD | 0 |
| Airborne Iodine ($pCi/m^3$) | I-131 265 | 0.030 | 0.056 (14/212) (0.030-0.084) | P-01, Air Station 11.8 mi @316°/NNW | 0.065 (3/53) (0.042-0.080) | 0.065 (3/53) (0.042-0.080) | 0 |

Table 5.4 Radiological Environmental Monitoring Program Summary

Name of Facility: Prairie Island Nuclear Power Station
Location of Facility: Goodhue, Minnesota ( County, State )
Docket No.: 50-282, 50-306
Reporting Period: January-December, 2011

| 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] |
|---|---|---|---|---|---|---|---|
| **Terrestrial Pathway** | | | | | | | |
| Milk (pCi/L) | I-131 66 | 0.5 | 1.0 (1/48) | P-18, Christiansen Farm 3.8 mi @ 88° /E | 1.0 (1/18) | < LLD | 0 |
| | GS 66 | | | | | | |
| | K-40 | 200 | 1380 (48/48) (1281-1511) | P-43 (C)Peterson Farm 4.1 mi @ 87° /E | 1413 (18 /18) (1329-1482) | 1413 (18/18) (1329-1482) | 0 |
| | Cs-134 | 5 | < LLD | - | - | < LLD | 0 |
| | Cs-137 | 5 | < LLD | - | - | < LLD | 0 |
| | Ba-La-140 | 5 | < LLD | - | - | < LLD | 0 |
| Crops - Cabbage (pCi/gwet) | I-131 2 | 0.019 | < LLD | - | - | < LLD | 0 |
| Well Water (pCi/L) | H-3 20 | 150 | < LLD | - | - | < LLD | 0 |
| | GS 20 | | | | | | |
| | Mn-54 | 10 | < LLD | - | - | < LLD | 0 |
| | Fe-59 | 30 | < LLD | - | - | < LLD | 0 |
| | Co-58 | 10 | < LLD | - | - | < LLD | 0 |
| | Co-60 | 10 | < 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 |
| | Ce-144 | 53 | < LLD | - | - | < LLD | 0 |

Table 5.4 Radiological Environmental Monitoring Program Summary

Name of Facility: Prairie Island Nuclear Power Station
Location of Facility: Goodhue, Minnesota
( County, State )
Docket No. 50-282, 50-306
Reporting Period January-December, 2011

| 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] |
|---|---|---|---|---|---|---|---|
| **Waterborne Pathway** | | | | | | | |
| Drinking Water (pCi/L) | GB 12 | 1.0 | 12.4 (12/12) (8.7-19.5) | P-11, Red Wing S.C. 3.3 mi @ 158° /SSE | 12.4 (12/12) (8.7-19.5) | None | 0 |
| | I-131 12 | 1.0 | < LLD | - | - | None | 0 |
| | H-3 4 | 152 | < LLD | - | - | None | 0 |
| | GS 12 | | | | | | |
| | Mn-54 | 10 | < LLD | - | - | None | 0 |
| | Fe-59 | 30 | < LLD | - | - | None | 0 |
| | Co-58 | 10 | < LLD | - | - | None | 0 |
| | Co-60 | 10 | < LLD | - | - | None | 0 |
| | Zn-65 | 30 | < LLD | - | - | None | 0 |
| | Zr-Nb-95 | 15 | < LLD | - | - | None | 0 |
| | Cs-134 | 10 | < LLD | - | - | None | 0 |
| | Cs-137 | 10 | < LLD | - | - | None | 0 |
| | Ba-La-140 | 15 | < LLD | - | - | None | 0 |
| | Ce-144 | 49 | < LLD | - | - | None | 0 |
| River Water (pCi/L) | H-3 8 | 152 | < LLD | - | - | < LLD | 0 |
| | GS 24 | | | | | | |
| | Mn-54 | 10 | < LLD | - | - | < LLD | 0 |
| | Fe-59 | 30 | < LLD | - | - | < LLD | 0 |
| | Co-58 | 10 | < LLD | - | - | < LLD | 0 |
| | Co-60 | 10 | < 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 |
| | Ce-144 | 30 | < LLD | - | - | < LLD | 0 |
| Fish (pCi/g wet) | GS 4 | | | | | | |
| | K-40 | 0.10 | 2.72 (2/2) (2.57-2.88) | P-19, Upstream 1.3 mi @ 0°/N | 2.73 (2/2) (2.49-2.96) | 2.73 (2/2) (2.49-2.96) | 0 |
| | Mn-54 | 0.017 | < LLD | - | - | < LLD | 0 |
| | Fe-59 | 0.050 | < LLD | - | - | < LLD | 0 |
| | Co-58 | 0.015 | < LLD | - | - | < LLD | 0 |
| | Co-60 | 0.013 | < LLD | - | - | < LLD | 0 |
| | Zn-65 | 0.034 | < LLD | - | - | < LLD | 0 |
| | Zr-Nb-95 | 0.027 | < LLD | - | - | < LLD | 0 |
| | Cs-134 | 0.013 | < LLD | - | - | < LLD | 0 |
| | Cs-137 | 0.014 | < LLD | - | - | < LLD | 0 |
| | Ba-La-140 | 0.083 | < LLD | - | - | < LLD | 0 |

Table 5.4 Radiological Environmental Monitoring Program Summary

Name of Facility: Prairie Island Nuclear Power Station — Docket No.: 50-282, 50-306
Location of Facility: Goodhue, Minnesota ( County, State ) — Reporting Period: January-December, 2011

| 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] |
|---|---|---|---|---|---|---|---|
| **Waterborne Pathway** | | | | | | | |
| Invertebrates (pCi/g wet) | GS 4 | | | | | | |
| | Be-7 | 0.38 | < LLD | - | - | < LLD | 0 |
| | K-40 | 0.51 | < LLD | P-40, Upstream 0.4 mi. @ 0° /N | 0.77 (1/2) | 0.77 (1/2) - | 0 |
| | Mn-54 | 0.033 | < LLD | - | - | < LLD | 0 |
| | Co-58 | 0.032 | < LLD | - | - | < LLD | 0 |
| | Co-60 | 0.025 | < LLD | - | - | < LLD | 0 |
| | Zn-65 | 0.059 | < LLD | - | - | < LLD | 0 |
| | Zr-Nb-95 | 0.062 | < LLD | - | - | < LLD | 0 |
| | Ru-103 | 0.041 | < LLD | - | - | < LLD | 0 |
| | Ru-106 | 0.266 | < LLD | - | - | < LLD | 0 |
| | Cs-134 | 0.021 | < LLD | - | - | < LLD | 0 |
| | Cs-137 | 0.028 | < LLD | - | - | < LLD | 0 |
| | Ba-La-140 | 0.12 | < LLD | - | - | < LLD | 0 |
| | Ce-141 | 0.074 | < LLD | - | - | < LLD | 0 |
| | Ce-144 | 0.18 | < LLD | - | - | < LLD | 0 |
| Bottom and Shoreline Sediments (pCi/g dry) | GS 6 | | | | | | |
| | Be-7 | 0.21 | < LLD | P-20, Upstream 0.9 mi. @ 45° /NE | 0.82 (2/2) (0.77-0.87) | 0.82 (2/2) (0.77-0.87) | 0 |
| | K-40 | 0.10 | 9.07 (4/4) (7.88-10.36) | P-20, Upstream 0.9 mi. @ 45° /NE | 11.03 (2/2) (10.66-11.39) | 11.03 (2/2) (10.66-11.39) | 0 |
| | Mn-54 | 0.024 | < LLD | - | - | < LLD | 0 |
| | Co-58 | 0.020 | < LLD | - | - | < LLD | 0 |
| | Co-60 | 0.018 | < LLD | - | - | < LLD | 0 |
| | Zn-65 | 0.042 | < LLD | - | - | < LLD | 0 |
| | Zr-Nb-95 | 0.041 | < LLD | - | - | < LLD | 0 |
| | Ru-103 | 0.026 | < LLD | - | - | < LLD | 0 |
| | Ru-106 | 0.12 | < LLD | - | - | < LLD | 0 |
| | Cs-134 | 0.017 | < LLD | - | - | < LLD | 0 |
| | Cs-137 | 0.020 | < LLD | - - | - - | < LLD | 0 |
| | Ba-La-140 | 0.066 | < LLD | - | - | < LLD | 0 |
| | Ce-141 | 0.054 | < LLD | - | - | < LLD | 0 |
| | Ce-144 | 0.12 | < LLD | - | - | < LLD | 0 |

[a] GB = gross beta, GS = gamma scan.

[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. Fraction of detectable measurements at specified locations is indicated in parentheses (F).

[d] Locations are specified: (1) by name, and/or station code and (2) by 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 typical preoperational value for the medium or location.

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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 through December, 2011

## 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.

Table A-2 lists 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 lists REMP specific analytical results from 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. Complete analytical data for duplicate analyses is available upon request.

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

Results in Table A-7 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 Environmental Measurement Laboratory Quality Assessment Program (EML).

Attachment A lists the laboratory precision at the 1 sigma level for various analyses. The acceptance criteria in Table A-3 is set at ± 2 sigma.

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<br>> 100 pCi/liter or kg | 5.0 pCi/liter<br>5% of known value |
| Strontium-89[b] | 5 to 50 pCi/liter or kg<br>> 50 pCi/liter or kg | 5.0 pCi/liter<br>10% of known value |
| Strontium-90[b] | 2 to 30 pCi/liter or kg<br>> 30 pCi/liter or kg | 5.0 pCi/liter<br>10% of known value |
| Potassium-40 | ≥ 0.1 g/liter or kg | 5% of known value |
| Gross alpha | ≤ 20 pCi/liter<br>> 20 pCi/liter | 5.0 pCi/liter<br>25% of known value |
| Gross beta | ≤ 100 pCi/liter<br>> 100 pCi/liter | 5.0 pCi/liter<br>5% of known value |
| Tritium | ≤ 4,000 pCi/liter<br><br>> 4,000 pCi/liter | $\pm 1\sigma$ =<br>$169.85 \times (\text{known})^{0.0933}$<br>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,<br>Iodine-129[b] | ≤ 55 pCi/liter<br>> 55 pCi/liter | 6 pCi/liter<br>10% of known value |
| Uranium-238,<br>Nickel-63[b]<br>Technetium-99[b] | ≤ 35 pCi/liter<br>> 35 pCi/liter | 6 pCi/liter<br>15% of known value |
| Iron-55[b] | 50 to 100 pCi/liter<br>> 100 pCi/liter | 10 pCi/liter<br>10% of known value |
| Other Analyses [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 | Analysis | Concentration (pCi/L) Laboratory Result [b] | ERA Result [c] | Control Limits | Acceptance |
|---|---|---|---|---|---|---|
| STW-1243 | 04/04/11 | Sr-89 | 68.2 ± 5.8 | 63.2 | 51.1 - 71.2 | Pass |
| STW-1243 | 04/04/11 | Sr-90 | 44.3 ± 2.4 | 42.5 | 31.3 - 48.8 | Pass |
| STW-1244 | 04/04/11 | Ba-133 | 69.8 ± 3.9 | 75.3 | 63.0 - 82.8 | Pass |
| STW-1244 | 04/04/11 | Co-60 | 87.9 ± 3.8 | 88.8 | 79.9 - 100.0 | Pass |
| STW-1244 | 04/04/11 | Cs-134 | 69.5 ± 3.7 | 72.9 | 59.5 - 80.2 | Pass |
| STW-1244 | 04/04/11 | Cs-137 | 77.9 ± 5.3 | 77.0 | 69.3 - 87.4 | Pass |
| STW-1244 | 04/04/11 | Zn-65 | 105.2 ± 8.4 | 98.9 | 89.0 - 118.0 | Pass |
| STW-1245 | 04/04/11 | Gr. Alpha | 41.5 ± 2.3 | 50.1 | 26.1 - 62.9 | Pass |
| STW-1245 | 04/04/11 | Gr. Beta | 48.9 ± 1.8 | 49.8 | 33.8 - 56.9 | Pass |
| STW-1246 | 04/04/11 | I-131 | 26.6 ± 1.7 | 27.5 | 22.9 - 32.3 | Pass |
| STW-1247 | 04/04/11 | Ra-226 | 13.2 ± 0.6 | 12.1 | 9.0 - 14.0 | Pass |
| STW-1247 | 04/04/11 | Ra-228 | 11.2 ± 0.6 | 11.6 | 7.6 - 14.3 | Pass |
| STW-1247 | 04/04/11 | Uranium | 36.4 ± 0.6 | 39.8 | 32.2 - 44.4 | Pass |
| STW-1248 | 04/04/11 | H-3 | 10322 ± 285 | 10200.0 | 8870 - 11200 | Pass |
| STW-1256 | 10/07/11 | Sr-89 | 68.7 ± 6.0 | 69.7 | 56.9 - 77.9 | Pass |
| STW-1256 | 10/07/11 | Sr-90 | 36.9 ± 2.4 | 41.1 | 30.2 - 47.2 | Pass |
| STW-1257 | 10/07/11 | Ba-133 | 88.2 ± 7.8 | 96.9 | 81.8 - 106.0 | Pass |
| STW-1257 | 10/07/11 | Co-60 | 116.5 ± 7.1 | 119.0 | 107.0 - 133.0 | Pass |
| STW-1257 [d] | 10/07/11 | Cs-134 | 38.8 ± 8.0 | 33.4 | 26.3 - 36.7 | Fail |
| STW-1257 | 10/07/11 | Cs-137 | 45.6 ± 7.3 | 44.3 | 39.4 - 51.7 | Pass |
| STW-1257 | 10/07/11 | Zn-65 | 84.9 ± 15.4 | 76.8 | 68.9 - 92.5 | Pass |
| STW-1258 | 10/07/11 | Gr. Alpha | 35.7 ± 3.8 | 53.2 | 27.8 - 66.6 | Pass |
| STW-1258 | 10/07/11 | Gr. Beta | 36.1 ± 3.3 | 45.9 | 30.9 - 53.1 | Pass |
| STW-1259 | 10/07/11 | I-131 | 25.0 ± 1.1 | 27.5 | 22.9 - 32.3 | Pass |
| STW-1260 | 10/07/11 | Ra-226 | 12.2 ± 0.6 | 11.6 | 8.7 - 13.4 | Pass |
| STW-1260 | 10/07/11 | Ra-228 | 11.5 ± 1.7 | 10.3 | 6.7 - 12.8 | Pass |
| STW-1260 | 10/07/11 | Uranium | 46.6 ± 0.5 | 48.6 | 39.4 - 54.0 | Pass |
| STW-1261 | 10/07/11 | H-3 | 17435 ± 382 | 17400 | 15200 - 19100 | 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 sample was reanalyzed. Result of reanalysis was acceptable, 32.9 ± 7.4 pCi/L.

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

| Lab Code | Date | Description | Known Value (mR) | Lab Result ± 2 sigma (mR) | Control Limits (mR) | Acceptance |
|---|---|---|---|---|---|---|
| Environmental, Inc. | | | | | | |
| 2010-2 | 12/13/2010 | 100 cm. | 4.94 | 4.65 ± 0.57 | 3.46 - 6.42 | Pass |
| 2010-2 | 12/13/2010 | 110 cm. | 4.09 | 3.50 ± 0.74 | 2.86 - 5.32 | Pass |
| 2010-2 | 12/13/2010 | 120 cm. | 3.43 | 2.68 ± 0.36 | 2.40 - 4.46 | Pass |
| 2010-2 | 12/13/2010 | 150 cm. | 2.2 | 1.75 ± 0.42 | 1.54 - 2.86 | Pass |
| 2010-2 | 12/13/2010 | 180 cm. | 1.53 | 1.32 ± 0.52 | 1.07 - 1.99 | Pass |
| 2010-2 | 12/13/2010 | 40 cm. | 30.89 | 38.56 ± 2.11 | 21.62 - 40.16 | Pass |
| 2010-2 | 12/13/2010 | 50 cm. | 19.77 | 23.35 ± 1.82 | 13.84 - 25.70 | Pass |
| 2010-2 | 12/13/2010 | 60 cm. | 13.73 | 14.53 ± 1.24 | 9.61 - 17.85 | Pass |
| 2010-2 | 12/13/2010 | 60 cm. | 13.73 | 15.84 ± 1.53 | 9.61 - 17.85 | Pass |
| 2010-2 | 12/13/2010 | 80 cm. | 7.72 | 8.33 ± 0.74 | 5.40 - 10.04 | Pass |
| 2010-2 | 12/13/2010 | 90 cm. | 6.1 | 5.93 ± 0.73 | 4.27 - 7.93 | Pass |
| Environmental, Inc. | | | | | | |
| 2011-1 | 7/6/2011 | 100 cm. | 6.71 | 5.64 ± 0.30 | 4.70 - 8.72 | Pass |
| 2011-1 | 7/6/2011 | 110 cm. | 5.54 | 4.60 ± 0.46 | 3.88 - 7.20 | Pass |
| 2011-1 | 7/6/2011 | 120 cm. | 4.66 | 4.68 ± 0.29 | 3.26 - 6.06 | Pass |
| 2011-1 | 7/6/2011 | 150 cm. | 2.98 | 2.93 ± 0.66 | 2.09 - 3.87 | Pass |
| 2011-1 | 7/6/2011 | 180 cm. | 2.07 | 2.05 ± 0.18 | 1.45 - 2.69 | Pass |
| 2011-1 | 7/6/2011 | 40 cm. | 41.92 | 52.36 ± 3.08 | 29.34 - 54.50 | Pass |
| 2011-1 | 7/6/2011 | 45 cm. | 33.12 | 41.83 ± 3.46 | 23.18 - 43.06 | Pass |
| 2011-1 | 7/6/2011 | 50 cm. | 26.83 | 28.61 ± 2.63 | 18.78 - 34.88 | Pass |
| 2011-1 | 7/6/2011 | 60 cm. | 18.63 | 21.00 ± 1.15 | 13.04 - 24.22 | Pass |
| 2011-1 | 7/6/2011 | 70 cm. | 13.69 | 13.24 ± 1.76 | 9.58 - 17.80 | Pass |
| 2011-1 | 7/6/2011 | 80 cm. | 10.48 | 12.18 ± 0.65 | 7.34 - 13.62 | Pass |
| 2011-1 | 7/6/2011 | 90 cm. | 8.28 | 7.95 ± 0.82 | 5.80 - 10.76 | Pass |

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

| Lab Code [b] | Date | Concentration (pCi/L) [a] Analysis | Laboratory results 2s, n=1 [c] | Known Activity | Control Limits [d] | Acceptance |
|---|---|---|---|---|---|---|
| SPW-202 | 1/17/2011 | U-238 | 4.19 ± 0.19 | 4.17 | 0.00 - 16.17 | Pass |
| W-20111 | 2/1/2011 | Ra-226 | 16.32 ± 0.47 | 16.77 | 11.74 - 21.80 | Pass |
| W-20711 | 2/7/2011 | Gr. Alpha | 23.02 ± 0.45 | 20.00 | 10.00 - 30.00 | Pass |
| W-20711 | 2/7/2011 | Gr. Beta | 46.59 ± 0.41 | 45.20 | 35.20 - 55.20 | Pass |
| XWW-331 | 2/11/2011 | Ba-133 | 144.30 ± 8.50 | 144.40 | 129.96 - 158.84 | Pass |
| XWW-331 | 2/11/2011 | Cs-134 | 22.20 ± 3.70 | 21.50 | 11.50 - 31.50 | Pass |
| XWW-331 | 2/11/2011 | Cs-137 | 64.70 ± 7.40 | 61.00 | 51.00 - 71.00 | Pass |
| XWW-331 | 2/11/2011 | H-3 | 13399 ± 334 | 12538 | 10030 - 15046 | Pass |
| SPAP-567 | 2/14/2011 | Gr. Beta | 46.90 ± 0.11 | 48.10 | 28.86 - 67.34 | Pass |
| SPAP-569 | 2/14/2011 | Cs-134 | 7.70 ± 1.70 | 7.49 | 0.00 - 17.49 | Pass |
| SPAP-569 | 2/14/2011 | Cs-137 | 102.47 ± 3.20 | 106.79 | 96.11 - 117.47 | Pass |
| SPAP-571 | 2/14/2011 | H-3 | 75815 ± 542 | 73230 | 58584 - 87876 | Pass |
| SPW-581 | 2/15/2011 | Cs-134 | 39.91 ± 1.38 | 37.45 | 27.45 - 47.45 | Pass |
| SPW-581 | 2/15/2011 | Cs-137 | 56.28 ± 2.28 | 53.39 | 43.39 - 63.39 | Pass |
| SPW-581 | 2/15/2011 | Sr-89 | 112.92 ± 5.61 | 121.42 | 97.14 - 145.70 | Pass |
| SPW-581 | 2/15/2011 | Sr-90 | 47.80 ± 2.02 | 42.07 | 33.66 - 50.48 | Pass |
| SPMI-583 | 2/15/2011 | Cs-137 | 57.04 ± 2.76 | 53.39 | 43.39 - 63.39 | Pass |
| SPMI-583 | 2/15/2011 | Sr-90 | 36.27 ± 1.47 | 42.07 | 33.66 - 50.48 | Pass |
| SPW-602 | 2/17/2011 | U-238 | 3.98 ± 0.19 | 4.17 | 0.00 - 16.17 | Pass |
| SPW-686 | 2/25/2011 | Ni-63 | 167.41 ± 3.05 | 208.11 | 145.68 - 270.54 | Pass |
| SPF-1113 | 3/17/2011 | Cs-137 | 2369 ± 22 | 2170 | 1953 - 2387 | Pass |
| XWW-1602 | 3/21/2011 | Ba-133 | 26.83 ± 6.35 | 28.58 | 18.58 - 38.58 | Pass |
| XWW-1602 | 3/21/2011 | Cs-134 | 18.90 ± 4.06 | 16.30 | 6.30 - 26.30 | Pass |
| XWW-1602 | 3/21/2011 | Cs-137 | 33.98 ± 5.88 | 30.50 | 20.50 - 40.50 | Pass |
| XWW-1602 | 3/21/2011 | H-3 | 7348 ± 248 | 7617 | 6094 - 9140 | Pass |
| XWW-2537 | 4/4/2011 | Ba-133 | 43.40 ± 4.26 | 42.70 | 32.70 - 52.70 | Pass |
| XWW-2537 | 4/4/2011 | Cs-134 | 13.50 ± 2.40 | 11.90 | 1.90 - 21.90 | Pass |
| XWW-2537 | 4/4/2011 | Cs-137 | 68.30 ± 5.90 | 60.70 | 50.70 - 70.70 | Pass |
| XWW-2537 | 4/4/2011 | H-3 | 7134 ± 257 | 7234 | 5787 - 8681 | Pass |
| SPW-2877 | 5/3/2011 | Ra-228 | 25.23 ± 2.48 | 31.62 | 22.13 - 41.11 | Pass |
| SPMI-3167 | 5/24/2011 | Cs-134 | 33.04 ± 8.25 | 34.19 | 24.19 - 44.19 | Pass |
| SPMI-3167 | 5/24/2011 | Cs-137 | 51.53 ± 8.63 | 53.06 | 43.06 - 63.06 | Pass |
| SPMI-3167 | 5/24/2011 | Sr-89 | 90.89 ± 4.30 | 93.47 | 74.78 - 112.16 | Pass |
| SPMI-3167 | 5/24/2011 | Sr-90 | 41.17 ± 1.53 | 41.80 | 33.44 - 50.16 | Pass |
| W-52411 | 5/24/2011 | Ra-226 | 17.90 ± 0.42 | 16.80 | 11.76 - 21.84 | Pass |
| W-60711 | 6/7/2011 | Gr. Alpha | 23.00 ± 0.49 | 20.00 | 10.00 - 30.00 | Pass |
| W-60711 | 6/7/2011 | Gr. Beta | 43.27 ± 0.42 | 45.20 | 35.20 - 55.20 | Pass |
| SPAP-4167 | 7/7/2011 | Cs-134 | 6.92 ± 1.45 | 6.57 | 0.00 - 16.57 | Pass |
| SPAP-4167 | 7/7/2011 | Cs-137 | 108.02 ± 2.84 | 105.80 | 95.22 - 116.38 | Pass |
| SPW-4169 | 7/7/2011 | Cs-134 | 34.52 ± 4.79 | 32.84 | 22.84 - 42.84 | Pass |
| SPW-4169 | 7/7/2011 | Cs-137 | 58.29 ± 6.19 | 52.92 | 42.92 - 62.92 | Pass |

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

| Lab Code [b] | Date | Concentration (pCi/L)[a] Analysis | Laboratory results 2s, n=1 [c] | Known Activity | Control Limits [d] | Acceptance |
|---|---|---|---|---|---|---|
| SPW-4169 | 7/7/2011 | Sr-89 | 66.12 ± 4.18 | 69.64 | 55.71 - 83.57 | Pass |
| SPW-4169 | 7/7/2011 | Sr-90 | 41.72 ± 1.79 | 41.68 | 33.34 - 50.02 | Pass |
| SPW-4171 | 7/7/2011 | H-3 | 70582 ± 767 | 71646 | 57317 - 85975 | Pass |
| SPW-4180 | 7/7/2011 | Tc-99 | 95.69 ± 1.65 | 97.02 | 67.91 - 126.13 | Pass |
| SPW-41821 | 7/7/2011 | Ra-228 | 32.57 ± 2.63 | 30.63 | 21.44 - 39.82 | Pass |
| SPW-4241 | 7/7/2011 | Ni-63 | 403.01 ± 4.66 | 415.20 | 290.64 - 539.76 | Pass |
| SPW-4180 | 7/8/2011 | Tc-99 | 100.30 ± 1.75 | 97.02 | 67.91 - 126.13 | Pass |
| SPW-5029 | 7/29/2011 | C-14 | 3991 ± 17 | 4739 | 2843 - 6634 | Pass |
| SPW-5031 | 7/29/2011 | Fe-55 | 13801 ± 331 | 14895 | 11916 - 17874 | Pass |
| W-91411 | 9/14/2011 | Gr. Alpha | 21.58 ± 0.44 | 20.00 | 10.00 - 30.00 | Pass |
| W-91411 | 9/14/2011 | Gr. Beta | 43.02 ± 0.40 | 45.20 | 35.20 - 55.20 | Pass |
| SPW-91511 | 9/15/2011 | Tc-99 | 29.92 ± 1.07 | 32.34 | 20.34 - 44.34 | Pass |
| W-91911 | 9/19/2011 | Ra-226 | 17.06 ± 0.42 | 16.80 | 11.76 - 21.84 | Pass |
| W-100711 | 10/7/2011 | Gr. Alpha | 22.05 ± 0.45 | 20.00 | 10.00 - 30.00 | Pass |
| W-100711 | 10/7/2011 | Gr. Beta | 45.51 ± 0.41 | 45.20 | 35.20 - 55.20 | Pass |
| W-101111 | 10/11/2011 | Ra-226 | 16.02 ± 0.40 | 16.80 | 11.76 - 21.84 | Pass |
| XWW-7220 | 11/17/2011 | Ba-133 | 25.11 ± 4.36 | 27.47 | 17.47 - 37.47 | Pass |
| XWW-7220 | 11/17/2011 | Cs-134 | 14.09 ± 3.11 | 16.60 | 6.60 - 26.60 | Pass |
| XWW-7220 | 11/17/2011 | Cs-137 | 35.59 ± 4.28 | 29.98 | 19.98 - 39.98 | Pass |
| W-113011 | 11/30/2011 | Ra-226 | 16.12 ± 0.39 | 16.80 | 11.76 - 21.84 | Pass |
| W-120111 | 12/1/2011 | Gr. Alpha | 21.34 ± 0.43 | 20.00 | 10.00 - 30.00 | Pass |
| W-120111 | 12/1/2011 | Gr. Beta | 45.55 ± 0.41 | 45.20 | 35.20 - 55.20 | Pass |
| SPW-41823 | 12/9/2011 | Ra-228 | 26.98 ± 2.38 | 29.40 | 20.58 - 38.22 | Pass |
| SPMI-8906 | 12/22/2011 | Cs-134 | 29.11 ± 3.52 | 28.14 | 18.14 - 38.14 | Pass |
| SPMI-8906 | 12/22/2011 | Cs-137 | 58.27 ± 7.62 | 52.36 | 42.36 - 62.36 | Pass |
| SPW-8916 | 12/22/2011 | Cs-134 | 31.74 ± 3.63 | 28.14 | 18.14 - 38.14 | Pass |
| SPW-8916 | 12/22/2011 | Cs-137 | 56.48 ± 6.12 | 52.36 | 42.36 - 62.36 | Pass |
| SPAP-8902 | 12/23/2011 | Gr. Beta | 45.72 ± 0.11 | 47.11 | 28.27 - 65.95 | Pass |
| SPAP-8904 | 12/23/2011 | Cs-134 | 5.19 ± 0.63 | 5.63 | 0.00 - 15.63 | Pass |
| SPAP-8904 | 12/23/2011 | Cs-137 | 101.21 ± 2.55 | 104.71 | 94.24 - 115.18 | Pass |
| SPW-8918 | 12/23/2011 | H-3 | 136759 ± 1056 | 137638 | 110110 - 165166 | Pass |
| SPW-8922 | 12/23/2011 | Ni-63 | 202.21 ± 3.75 | 206.88 | 144.82 - 268.94 | Pass |
| SPW-8924 | 12/23/2011 | Tc-99 | 126.10 ± 1.86 | 129.36 | 90.55 - 168.17 | Pass |
| SPF-8926 | 12/23/2011 | Cs-134 | 0.34 ± 0.01 | 0.33 | 0.20 - 0.47 | Pass |
| SPF-8926 | 12/23/2011 | Cs-137 | 2.34 ± 0.02 | 2.09 | 1.25 - 2.93 | 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), U (urine).

[c] Results are based on single determinations.

[d] Control limits are established from the precision values listed in Attachment A of this report, adjusted to ± 2 $\sigma$.

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[b] | Concentration (pCi/L)[a] | | |
|---|---|---|---|---|---|---|
| | | | | Laboratory results (4.66σ) | | Acceptance |
| | | | | LLD | Activity[c] | Criteria (4.66 σ) |
| SPW-202 | Water | 1/17/2011 | U-238 | 0.10 | 0.12 ± 0.12 | 1 |
| W-20111 | Water | 2/1/2011 | Ra-226 | 0.04 | 0.05 ± 0.03 | 1 |
| W-20711 | Water | 2/7/2011 | Gr. Alpha | 0.44 | -0.02 ± 0.29 | 1 |
| W-20711 | Water | 2/7/2011 | Gr. Beta | 0.75 | -0.03 ± 0.53 | 3.2 |
| SPAP-566 | Air Filter | 2/14/2011 | Gr. Beta | 0.64 | 2.24 ± 0.61 | 3.2 |
| SPAP-568 | Air Filter | 2/14/2011 | Cs-134 | 2.34 | - | 100 |
| SPAP-568 | Air Filter | 2/14/2011 | Cs-137 | 1.56 | - | 100 |
| SPAP-570 | Air Filter | 2/14/2011 | H-3 | 103.20 | -49.40 ± 52.50 | 200 |
| SPW-580 | Water | 2/15/2011 | Cs-134 | 2.68 | - | 10 |
| SPW-580 | Water | 2/15/2011 | Cs-137 | 2.84 | - | 10 |
| SPW-580 | Water | 2/15/2011 | Sr-89 | 0.73 | 0.24 ± 0.57 | 5 |
| SPW-580 | Water | 2/15/2011 | Sr-90 | 0.57 | 0.02 ± 0.27 | 1 |
| SPMI-582 | Milk | 2/15/2011 | Cs-134 | 3.49 | - | 10 |
| SPMI-582 | Milk | 2/15/2011 | Cs-137 | 3.54 | - | 10 |
| SPMI-582 | Milk | 2/15/2011 | I-131(G) | 4.14 | - | 20 |
| SPMI-582 | Milk | 2/15/2011 | Sr-89 | 0.71 | 0.16 ± 0.67 | 5 |
| SPMI-582 | Milk | 2/15/2011 | Sr-90 | 0.55 | 0.59 ± 0.32 | 1 |
| SPW-601 | Water | 2/17/2011 | U-238 | 0.20 | 0.09 ± 0.17 | 1 |
| SPW-685 | Water | 2/25/2011 | Ni-63 | 1.61 | 0.05 ± 0.98 | 20 |
| SPF-1112 | Fish | 3/17/2011 | Cs-134 | 6.74 | - | 100 |
| SPF-1112 | Fish | 3/17/2011 | Cs-137 | 5.45 | - | 100 |
| BKW-40111 | Water | 4/1/2011 | I-131 | 4.16 | - | 10 |
| BKW-40111 | Water | 4/1/2011 | Co-60 | 3.11 | - | 10 |
| BKW-40111 | Water | 4/1/2011 | Cs-134 | 4.73 | - | 10 |
| BKW-40111 | Water | 4/1/2011 | Cs-137 | 5.04 | - | 10 |
| SPW-2887 | Water | 5/3/2011 | Ra-228 | 0.72 | 0.46 ± 0.39 | 2 |
| W-52411 | Water | 5/24/2011 | Ra-226 | 0.04 | 0.05 ± 0.03 | 1 |
| W-60711 | Water | 6/7/2011 | Gr. Alpha | 0.51 | 0.00 ± 0.36 | 1 |
| W-60711 | Water | 6/7/2011 | Gr. Beta | 1.58 | 0.38 ± 1.12 | 3.2 |
| SPAP-4164 | Air Filter | 7/7/2011 | Gr. Beta | 0.72 | 1.04 ± 0.48 | 3.2 |
| SPW-4168 | Water | 7/7/2011 | Cs-134 | 3.41 | - | 10 |
| SPW-4168 | Water | 7/7/2011 | Cs-137 | 2.45 | - | 10 |
| SPW-4168 | Water | 7/7/2011 | Sr-89 | 0.72 | 0.40 ± 0.50 | 5 |
| SPW-4168 | Water | 7/7/2011 | Sr-90 | 0.51 | -0.19 ± 0.21 | 1 |
| SPW-4171 | Water | 7/7/2011 | H-3 | 152.00 | 37.10 ± 81.80 | 200 |
| SPW-41811 | Water | 7/7/2011 | Ra-228 | 0.77 | 0.51 ± 0.42 | 2 |

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

| Lab Code | Sample Type | Date | Analysis[b] | Concentration (pCi/L)[a] | | |
|---|---|---|---|---|---|---|
| | | | | Laboratory results (4.66σ) | | Acceptance |
| | | | | LLD | Activity[c] | Criteria (4.66 σ) |
| SPW-4241 | Water | 7/7/2011 | Ni-63 | 1.70 | 0.09 ± 1.03 | 20 |
| SPW-4179 | Water | 7/8/2011 | Tc-99 | 1.20 | -0.96 ± 0.71 | 10 |
| SPW-5028 | Water | 7/29/2011 | C-14 | 109.80 | 61.90 ± 59.20 | 200 |
| SPW-5031 | Water | 7/29/2011 | Fe-55 | 140.60 | 0.00 ± 85.30 | 1000 |
| W-91411 | Water | 9/14/2011 | Gr. Alpha | 0.48 | -0.06 ± 0.33 | 1 |
| W-91411 | Water | 9/14/2011 | Gr. Beta | 0.78 | -0.43 ± 0.53 | 3.2 |
| SPW-91511 | Water | 9/15/2011 | Tc-99 | 1.11 | -0.62 ± 0.66 | 10 |
| W-91911 | Water | 9/19/2011 | Ra-226 | 0.03 | 0.04 ± 0.02 | 1 |
| W-100711 | Water | 10/7/2011 | Gr. Alpha | 0.44 | -0.26 ± 0.28 | 1 |
| W-100711 | Water | 10/7/2011 | Gr. Beta | 0.76 | -0.43 ± 0.52 | 3.2 |
| W-101111 | Water | 10/11/2011 | Ra-226 | 0.04 | 0.05 ± 0.03 | 1 |
| W-113011 | Water | 11/30/2011 | Ra-226 | 0.03 | 0.04 ± 0.02 | 1 |
| W-120111 | Water | 12/1/2011 | Gr. Alpha | 0.41 | -0.20 ± 0.27 | 1 |
| W-120111 | Water | 12/1/2011 | Gr. Beta | 0.75 | -0.10 ± 0.53 | 3.2 |
| SPW-41813 | Water | 12/9/2011 | Ra-228 | 0.71 | 0.17 ± 0.35 | 2 |
| SPMI-8905 | Milk | 12/22/2011 | Cs-134 | 3.27 | - | 10 |
| SPMI-8905 | Milk | 12/22/2011 | Cs-137 | 3.38 | - | 10 |
| SPMI-8905 | Milk | 12/22/2011 | I-131(G) | 2.17 | - | 20 |
| SPW-8915 | Water | 12/22/2011 | Cs-134 | 3.37 | - | 10 |
| SPW-8915 | Water | 12/22/2011 | Cs-137 | 3.45 | - | 10 |
| SPW-8915 | Water | 12/22/2011 | I-131(G) | 3.38 | - | 20 |
| SPAP-8901 | Air Filter | 12/23/2011 | Gr. Beta | 0.78 | 0.50 ± 0.46 | 3.2 |
| SPAP-8903 | Air Filter | 12/23/2011 | Cs-134 | 1.65 | - | 100 |
| SPAP-8903 | Air Filter | 12/23/2011 | Cs-137 | 2.41 | - | 100 |
| SPW-8917 | Water | 12/23/2011 | H-3 | 150.20 | -3.04 ± 78.80 | 200 |
| SPW-8921 | Water | 12/23/2011 | Ni-63 | 16.92 | -4.60 ± 10.16 | 20 |
| SPW-8923 | Water | 12/23/2011 | Tc-99 | 5.66 | -5.45 ± 3.34 | 10 |
| SPF-8925 | Fish | 12/23/2011 | Cs-134 | 7.15 | - | 100 |
| SPF-8925 | Fish | 12/23/2011 | Cs-137 | 9.73 | - | 100 |

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

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

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

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

| Lab Code | Date | Analysis | Concentration (pCi/L)[a] First Result | Second Result | Averaged Result | Acceptance |
|---|---|---|---|---|---|---|
| CF-20, 21 | 1/3/2011 | Be-7 | 0.24 ± 0.14 | 0.34 ± 0.17 | 0.29 ± 0.11 | Pass |
| CF-20, 21 | 1/3/2011 | K-40 | 10.37 ± 0.43 | 9.76 ± 0.68 | 10.07 ± 0.40 | Pass |
| CF-20, 21 | 1/3/2011 | Sr-90 | 0.01 ± 0.01 | 0.01 ± 0.01 | 0.01 ± 0.00 | Pass |
| WW-65, 66 | 1/6/2011 | H-3 | 321.91 ± 97.19 | 345.76 ± 98.16 | 333.83 ± 69.06 | Pass |
| BS-165, 166 | 1/11/2011 | Cs-137 | 0.13 ± 0.02 | 0.15 ± 0.02 | 0.14 ± 0.01 | Pass |
| BS-165, 166 | 1/11/2011 | H-3 | 286.00 ± 80.00 | 284.00 ± 80.00 | 285.00 ± 56.57 | Pass |
| BS-165, 166 | 1/11/2011 | K-40 | 14.11 ± 0.52 | 13.79 ± 0.60 | 13.95 ± 0.40 | Pass |
| BS-176, 177 | 1/11/2011 | H-3 | 391.00 ± 92.00 | 332.00 ± 89.00 | 361.50 ± 64.00 | Pass |
| BS-176, 177 | 1/11/2011 | K-40 | 9.06 ± 0.44 | 8.28 ± 0.81 | 8.67 ± 0.46 | Pass |
| BS-197, 198 | 1/11/2011 | Cs-137 | 0.14 ± 0.03 | 0.15 ± 0.04 | 0.15 ± 0.03 | Pass |
| BS-197, 198 | 1/11/2011 | H-3 | 459.00 ± 103.00 | 283.00 ± 95.00 | 371.00 ± 70.06 | Pass |
| BS-197, 198 | 1/11/2011 | K-40 | 14.40 ± 0.77 | 14.16 ± 1.23 | 14.28 ± 0.73 | Pass |
| WW-358, 359 | 1/17/2011 | H-3 | 331.44 ± 93.05 | 407.65 ± 95.91 | 369.55 ± 66.81 | Pass |
| DW-20009, 20010 | 1/19/2011 | Ra-226 | 3.66 ± 0.57 | 2.74 ± 0.43 | 3.20 ± 0.36 | Pass |
| DW-20009, 20010 | 1/19/2011 | Ra-228 | 1.51 ± 0.64 | 1.36 ± 0.60 | 1.44 ± 0.44 | Pass |
| WW-337, 338 | 1/25/2011 | H-3 | 21986 ± 402 | 21896 ± 401 | 21941 ± 284 | Pass |
| W-491, 492 | 1/27/2011 | Ra-226 | 6.70 ± 0.50 | 6.10 ± 0.50 | 6.40 ± 0.35 | Pass |
| W-491, 492 | 1/27/2011 | Ra-228 | 6.60 ± 1.30 | 8.40 ± 1.40 | 7.50 ± 0.96 | Pass |
| DW-20014, 20015 | 1/28/2011 | Gr. Alpha | 1.91 ± 0.71 | 2.34 ± 0.80 | 2.13 ± 0.53 | Pass |
| SWU-447, 448 | 1/31/2011 | Gr. Beta | 7.42 ± 1.17 | 6.85 ± 1.11 | 7.14 ± 0.81 | Pass |
| W-694, 695 | 2/7/2011 | H-3 | 628.26 ± 104.30 | 692.37 ± 106.89 | 660.32 ± 74.67 | Pass |
| DW-20022, 20023 | 2/9/2011 | Ra-228 | 0.71 ± 0.47 | 1.13 ± 0.54 | 0.92 ± 0.36 | Pass |
| SW-626, 627 | 2/16/2011 | H-3 | 1268.17 ± 129.52 | 1144.65 ± 125.39 | 1206.41 ± 90.14 | Pass |
| LW-825, 826 | 2/24/2011 | Gr. Beta | 2.65 ± 0.82 | 2.45 ± 0.74 | 2.55 ± 0.55 | Pass |
| SWT-845, 846 | 3/1/2011 | Gr. Beta | 1.11 ± 0.39 | 0.80 ± 0.37 | 0.96 ± 0.27 | Pass |
| MI-998, 999 | 3/7/2011 | K-40 | 1760.10 ± 127.50 | 1708.50 ± 131.60 | 1734.30 ± 91.62 | Pass |
| W-1024, 1025 | 3/7/2011 | H-3 | 489.83 ± 101.09 | 581.39 ± 105.06 | 535.61 ± 72.90 | Pass |
| WW-1156, 1157 | 3/16/2011 | Gr. Beta | 1.79 ± 0.78 | 0.47 ± 0.66 | 1.13 ± 0.51 | Pass |
| P-1198, 1199 | 3/17/2011 | H-3 | 504.00 ± 133.00 | 597.00 ± 136.00 | 550.50 ± 95.11 | Pass |
| SW-1434, 1435 | 3/28/2011 | H-3 | 15523 ± 359 | 15968 ± 364 | 15746 ± 256 | Pass |
| WW-1588, 1589 | 3/28/2011 | Gr. Beta | 1.81 ± 1.23 | 2.81 ± 1.38 | 2.31 ± 0.92 | Pass |
| SG-1714, 1715 | 3/28/2011 | Gr. Alpha | 8.82 ± 0.81 | 8.58 ± 0.74 | 8.70 ± 0.55 | Pass |
| SG-1714, 1715 | 3/28/2011 | Gr. Beta | 13.78 ± 0.65 | 12.76 ± 0.58 | 13.27 ± 0.44 | Pass |
| AP-1862, 1863 | 3/28/2011 | Be-7 | 0.09 ± 0.02 | 0.08 ± 0.02 | 0.08 ± 0.01 | Pass |
| W-2143, 2144 | 3/28/2011 | H-3 | 536.40 ± 99.37 | 466.79 ± 96.46 | 501.59 ± 69.25 | Pass |
| AP-2269, 2270 | 3/28/2011 | Be-7 | 0.07 ± 0.01 | 0.08 ± 0.01 | 0.07 ± 0.01 | Pass |
| DW-20061, 20062 | 3/28/2011 | Gr. Alpha | 2.82 ± 1.33 | 3.89 ± 1.26 | 3.36 ± 0.92 | Pass |
| SWU-1455, 1456 | 3/29/2011 | Gr. Beta | 2.50 ± 0.75 | 2.75 ± 0.83 | 2.62 ± 0.56 | Pass |
| SWU-1522, 1523 | 3/29/2011 | Gr. Beta | 1.36 ± 0.87 | 2.14 ± 0.96 | 1.75 ± 0.65 | Pass |
| PM-1543, 1544 | 3/29/2011 | Gr. Beta | 13.81 ± 0.26 | 13.67 ± 0.27 | 13.74 ± 0.19 | Pass |
| PM-1543, 1544 | 3/29/2011 | Sr-90 | 8.12 ± 3.20 | 7.71 ± 3.25 | 7.91 ± 2.28 | Pass |

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

| Lab Code | Date | Analysis | Concentration (pCi/L)[a] First Result | Second Result | Averaged Result | Acceptance |
|---|---|---|---|---|---|---|
| SWT-5885, 5886 | 3/29/2011 | Gr. Beta | 1.21 ± 0.54 | 0.77 ± 0.54 | 0.99 ± 0.38 | Pass |
| AP-1883, 1884 | 3/30/2011 | Be-7 | 0.07 ± 0.01 | 0.09 ± 0.02 | 0.08 ± 0.01 | Pass |
| AP-2248, 2249 | 3/30/2011 | Be-7 | 0.06 ± 0.01 | 0.06 ± 0.01 | 0.06 ± 0.01 | Pass |
| DW-20066, 20067 | 3/30/2011 | Ra-226 | 2.14 ± 0.16 | 2.10 ± 0.16 | 2.12 ± 0.11 | Pass |
| DW-20066, 20067 | 3/30/2011 | Ra-228 | 2.55 ± 0.65 | 1.78 ± 0.62 | 2.17 ± 0.45 | Pass |
| P-1567, 1568 | 4/1/2011 | H-3 | 289.00 ± 103.00 | 296.00 ± 103.00 | 292.50 ± 72.83 | Pass |
| MI-1609, 1610 | 4/4/2011 | I-131 | 0.85 ± 0.17 | 0.91 ± 0.18 | 0.88 ± 0.13 | Pass |
| MI-1609, 1610 | 4/4/2011 | K-40 | 1323.80 ± 112.00 | 1323.20 ± 96.22 | 1323.50 ± 73.83 | Pass |
| MI-1609, 1610 | 4/4/2011 | Sr-90 | 0.85 ± 0.33 | 0.97 ± 0.34 | 0.91 ± 0.24 | Pass |
| S-1651, 1652 | 4/4/2011 | Ac-228 | 0.88 ± 0.08 | 1.03 ± 0.22 | 0.96 ± 0.12 | Pass |
| S-1651, 1652 | 4/4/2011 | Pb-214 | 1.09 ± 0.12 | 0.84 ± 0.16 | 0.97 ± 0.10 | Pass |
| AP-1841, 1842 | 4/7/2011 | Be-7 | 0.12 ± 0.02 | 0.12 ± 0.01 | 0.12 ± 0.01 | Pass |
| AP-1841, 1842 | 4/7/2011 | Cs-137 | 0.00 ± 0.00 | 0.00 ± 0.00 | 0.00 ± 0.00 | Pass |
| AP-1841, 1842 | 4/7/2011 | I-131(G) | 0.02 ± 0.00 | 0.03 ± 0.00 | 0.03 ± 0.00 | Pass |
| S-1990, 1991 | 4/7/2011 | Ac-228 | 15.83 ± 0.39 | 16.12 ± 0.64 | 15.98 ± 0.37 | Pass |
| S-1990, 1991 | 4/7/2011 | Pb-214 | 11.21 ± 0.23 | 11.81 ± 1.22 | 11.51 ± 0.62 | Pass |
| WW-2552, 2553 | 4/7/2011 | H-3 | 761.09 ± 116.48 | 759.04 ± 116.41 | 760.07 ± 82.34 | Pass |
| PM-1904, 1905 | 4/11/2011 | K-40 | 13585 ± 611 | 14278 ± 648 | 13932 ± 445 | Pass |
| PM-1904, 1905 | 4/11/2011 | Sr-90 | 9.94 ± 3.05 | 5.62 ± 2.52 | 7.78 ± 1.98 | Pass |
| P-2011, 2012 | 4/11/2011 | H-3 | 670.00 ± 108.00 | 619.00 ± 106.00 | 644.50 ± 75.66 | Pass |
| WW-2053, 2054 | 4/13/2011 | H-3 | 220.20 ± 86.50 | 246.80 ± 87.80 | 233.50 ± 61.63 | Pass |
| BS-2095, 2096 | 4/13/2011 | K-40 | 12.88 ± 0.72 | 13.56 ± 1.08 | 13.22 ± 0.65 | Pass |
| DW-20099, 20100 | 4/13/2011 | U-233/4 | 1.64 ± 0.40 | 1.31 ± 0.34 | 1.48 ± 0.26 | Pass |
| DW-20099, 20100 | 4/13/2011 | U-238 | 1.49 ± 0.39 | 1.28 ± 0.33 | 1.39 ± 0.26 | Pass |
| WW-2416, 2417 | 4/19/2011 | H-3 | 217.10 ± 97.00 | 184.90 ± 95.60 | 201.00 ± 68.10 | Pass |
| P-2185, 2186 | 4/20/2011 | H-3 | 405.00 ± 93.00 | 504.00 ± 98.00 | 454.50 ± 67.55 | Pass |
| WW-2353, 2354 | 4/20/2011 | H-3 | 525.54 ± 119.74 | 399.41 ± 115.99 | 462.48 ± 83.35 | Pass |
| DW-20115, 20116 | 4/26/2011 | U-233/4 | 11.94 ± 2.34 | 10.71 ± 1.19 | 11.33 ± 1.31 | Pass |
| DW-20115, 20116 | 4/26/2011 | U-238 | 2.70 ± 1.15 | 3.89 ± 0.72 | 3.30 ± 0.68 | Pass |
| SO-2960, 2961 | 4/27/2011 | K-40 | 22.63 ± 1.36 | 22.90 ± 0.03 | 22.77 ± 0.68 | Pass |
| MI-2657, 2658 | 5/2/2011 | K-40 | 1319.30 ± 101.30 | 1403.20 ± 131.60 | 1361.25 ± 83.04 | Pass |
| DW-20130, 20131 | 5/2/2011 | U-233/4 | 7.59 ± 0.90 | 7.62 ± 0.83 | 7.61 ± 0.61 | Pass |
| DW-20130, 20131 | 5/2/2011 | U-238 | 4.67 ± 0.72 | 4.84 ± 0.66 | 4.76 ± 0.49 | Pass |
| DW-20148, 20149 | 5/3/2011 | U-233/4 | 6.64 ± 0.83 | 6.35 ± 0.81 | 6.50 ± 0.58 | Pass |
| DW-20148, 20149 | 5/3/2011 | U-238 | 6.11 ± 0.83 | 5.18 ± 0.73 | 5.65 ± 0.55 | Pass |
| PM-2810, 2811 | 5/4/2011 | Cs-134 | 18.64 ± 12.16 | 33.33 ± 11.86 | 25.99 ± 8.49 | Pass |
| PM-2810, 2811 | 5/4/2011 | Cs-137 | 28.99 ± 14.92 | 21.17 ± 12.16 | 25.08 ± 9.62 | Pass |
| PM-2810, 2811 | 5/4/2011 | K-40 | 14368 ± 720 | 14309 ± 638 | 14339 ± 481 | Pass |
| WW-3065, 3066 | 5/16/2011 | H-3 | 280.51 ± 86.98 | 179.46 ± 82.83 | 229.98 ± 60.05 | Pass |
| WW-3086, 3087 | 5/16/2011 | H-3 | 341.14 ± 85.94 | 377.97 ± 87.43 | 359.56 ± 61.30 | Pass |

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

| Lab Code | Date | Analysis | Concentration (pCi/L)[a] First Result | Second Result | Averaged Result | Acceptance |
|---|---|---|---|---|---|---|
| SG-3134, 3135 | 5/16/2011 | Ac-228 | 11.19 ± 0.82 | 12.50 ± 0.84 | 11.85 ± 0.59 | Pass |
| SG-3134, 3135 | 5/16/2011 | Pb-214 | 9.12 ± 0.17 | 9.37 ± 0.42 | 9.25 ± 0.23 | Pass |
| F-3221, 3222 | 5/23/2011 | K-40 | 2.73 ± 0.39 | 2.81 ± 0.42 | 2.77 ± 0.29 | Pass |
| SS-3434, 3435 | 5/25/2011 | K-40 | 11533.00 ± 563.70 | 11236.00 ± 566.10 | 11384.50 ± 399.45 | Pass |
| AP-3329, 3330 | 5/26/2011 | Be-7 | 0.24 ± 0.11 | 0.23 ± 0.13 | 0.24 ± 0.08 | Pass |
| WW-3350, 3351 | 6/1/2011 | H-3 | 235.37 ± 83.98 | 173.12 ± 81.05 | 204.25 ± 58.36 | Pass |
| G-3413, 3414 | 6/1/2011 | Be-7 | 0.28 ± 0.10 | 0.25 ± 0.09 | 0.27 ± 0.07 | Pass |
| G-3413, 3414 | 6/1/2011 | Gr. Beta | 11.04 ± 0.31 | 10.85 ± 0.31 | 10.95 ± 0.22 | Pass |
| G-3413, 3414 | 6/1/2011 | K-40 | 6.80 ± 0.33 | 6.71 ± 0.38 | 6.76 ± 0.25 | Pass |
| AP-3602, 3603 | 6/3/2011 | Be-7 | 0.20 ± 0.08 | 0.25 ± 0.10 | 0.22 ± 0.07 | Pass |
| SO-3797, 3798 | 6/8/2011 | Ac-228 | 0.99 ± 0.05 | 1.00 ± 0.06 | 1.00 ± 0.04 | Pass |
| SO-3797, 3798 | 6/8/2011 | Bi-212 | 1.10 ± 0.12 | 1.08 ± 0.17 | 1.09 ± 0.10 | Pass |
| SO-3797, 3798 | 6/8/2011 | Bi-214 | 0.87 ± 0.02 | 0.86 ± 0.02 | 0.87 ± 0.01 | Pass |
| SO-3797, 3798 | 6/8/2011 | Cs-137 | 0.41 ± 0.01 | 0.39 ± 0.01 | 0.40 ± 0.01 | Pass |
| SO-3797, 3798 | 6/8/2011 | K-40 | 16.08 ± 0.26 | 16.27 ± 0.29 | 16.18 ± 0.19 | Pass |
| SO-3797, 3798 | 6/8/2011 | Pb-212 | 0.98 ± 0.10 | 0.93 ± 0.02 | 0.96 ± 0.05 | Pass |
| SO-3797, 3798 | 6/8/2011 | Pb-214 | 0.95 ± 0.02 | 0.91 ± 0.02 | 0.93 ± 0.01 | Pass |
| SO-3797, 3798 | 6/8/2011 | Th-232 | 0.47 ± 0.05 | 0.49 ± 0.04 | 0.48 ± 0.03 | Pass |
| SO-3797, 3798 | 6/8/2011 | U-233/4 | 0.16 ± 0.02 | 0.15 ± 0.02 | 0.16 ± 0.01 | Pass |
| SO-3797, 3798 | 6/8/2011 | U-238 | 0.16 ± 0.02 | 0.13 ± 0.02 | 0.15 ± 0.01 | Pass |
| MI-3935, 3936 | 6/20/2011 | K-40 | 1764.60 ± 119.40 | 1843.10 ± 136.50 | 1803.85 ± 90.68 | Pass |
| BS-4172, 4173 | 6/21/2011 | Cs-137 | 51.50 ± 23.78 | 48.57 ± 17.06 | 50.04 ± 14.63 | Pass |
| BS-4172, 4173 | 6/21/2011 | K-40 | 11730.00 ± 679.60 | 11120.00 ± 512.30 | 11425.00 ± 425.53 | Pass |
| DW-20183, 20184 | 6/21/2011 | U-233/4 | 10.00 ± 1.00 | 8.40 ± 0.90 | 9.20 ± 0.67 | Pass |
| DW-20183, 20184 | 6/21/2011 | U-238 | 6.70 ± 0.80 | 6.10 ± 0.80 | 6.40 ± 0.57 | Pass |
| WW-4019, 4020 | 6/24/2011 | Gr. Beta | 3.56 ± 1.20 | 3.16 ± 1.21 | 3.36 ± 0.85 | Pass |
| PM-4193, 4194 | 6/30/2011 | K-40 | 14795.00 ± 759.00 | 14660.00 ± 750.00 | 14727.50 ± 533.52 | Pass |
| LW-4235, 4236 | 6/30/2011 | Gr. Beta | 2.70 ± 0.72 | 2.11 ± 0.78 | 2.41 ± 0.53 | Pass |
| AP-4367, 4368 | 7/7/2011 | Be-7 | 0.17 ± 0.10 | 0.19 ± 0.11 | 0.18 ± 0.07 | Pass |
| MI-4416, 4417 | 7/11/2011 | K-40 | 1342.40 ± 91.49 | 1447.00 ± 114.80 | 1394.70 ± 73.40 | Pass |
| W-4914, 4915 | 7/11/2011 | H-3 | 576.36 ± 110.35 | 584.67 ± 110.67 | 580.52 ± 78.14 | Pass |
| MI-4438, 4439 | 7/12/2011 | K-40 | 1280.60 ± 107.50 | 1381.20 ± 112.70 | 1330.90 ± 77.87 | Pass |
| VE-4481, 4482 | 7/13/2011 | K-40 | 4452.60 ± 332.40 | 4767.90 ± 349.70 | 4610.25 ± 241.24 | Pass |
| AP-4677, 4678 | 7/15/2011 | Be-7 | 0.18 ± 0.08 | 0.23 ± 0.09 | 0.20 ± 0.06 | Pass |
| W-5537, 5538 | 7/18/2011 | H-3 | 650.13 ± 105.19 | 695.39 ± 106.94 | 672.76 ± 75.00 | Pass |
| P-4764, 4765 | 7/19/2011 | H-3 | 179.82 ± 84.81 | 138.72 ± 82.79 | 159.27 ± 59.26 | Pass |
| WW-5211, 5212 | 7/24/2011 | H-3 | 191.94 ± 85.50 | 136.22 ± 82.76 | 164.08 ± 59.50 | Pass |

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

| Lab Code | Date | Analysis | Concentration (pCi/L)[a] First Result | Second Result | Averaged Result | Acceptance |
|---|---|---|---|---|---|---|
| VE-4998, 4999 | 7/25/2011 | Be-7 | 543.90 ± 158.20 | 488.30 ± 163.80 | 516.10 ± 113.86 | Pass |
| VE-4998, 4999 | 7/25/2011 | K-40 | 2562.20 ± 319.80 | 2414.00 ± 350.00 | 2488.10 ± 237.05 | Pass |
| DW-20258, 20259 | 7/25/2011 | U-233/4 | 21.34 ± 1.52 | 24.93 ± 2.93 | 23.14 ± 1.65 | Pass |
| DW-20258, 20259 | 7/25/2011 | U-235 | 0.57 ± 0.26 | 0.69 ± 0.26 | 0.63 ± 0.18 | Pass |
| DW-20258, 20259 | 7/25/2011 | U-238 | 14.11 ± 1.24 | 15.81 ± 1.23 | 14.96 ± 0.87 | Pass |
| DW-20269, 20270 | 7/25/2011 | U-233/4 | 4.93 ± 0.73 | 4.65 ± 0.68 | 4.79 ± 0.50 | Pass |
| DW-20269, 20270 | 7/25/2011 | U-238 | 3.26 ± 0.60 | 2.53 ± 0.50 | 2.90 ± 0.39 | Pass |
| DW-20280, 20281 | 7/25/2011 | U-233/4 | 3.58 ± 0.58 | 3.33 ± 0.56 | 3.46 ± 0.40 | Pass |
| DW-20280, 20281 | 7/25/2011 | U-238 | 1.64 ± 0.40 | 2.11 ± 0.45 | 1.88 ± 0.30 | Pass |
| MI-5019, 5020 | 7/26/2011 | K-40 | 1348.50 ± 101.00 | 1347.40 ± 109.70 | 1347.95 ± 74.56 | Pass |
| W-5447, 5448 | 7/26/2011 | H-3 | 246.31 ± 99.19 | 241.99 ± 99.02 | 244.15 ± 70.08 | Pass |
| G-5124, 5125 | 7/28/2011 | Gr. Beta | 7.48 ± 0.20 | 7.17 ± 0.19 | 7.33 ± 0.14 | Pass |
| AP-5232, 5233 | 7/28/2011 | Be-7 | 0.15 ± 0.08 | 0.22 ± 0.13 | 0.19 ± 0.08 | Pass |
| SL-5169, 5170 | 8/1/2011 | Be-7 | 2.37 ± 0.16 | 2.17 ± 0.17 | 2.27 ± 0.12 | Pass |
| SL-5169, 5170 | 8/1/2011 | Gr. Beta | 4.74 ± 0.45 | 3.94 ± 0.39 | 4.34 ± 0.30 | Pass |
| SL-5169, 5170 | 8/1/2011 | K-40 | 3.12 ± 0.16 | 2.96 ± 0.21 | 3.04 ± 0.13 | Pass |
| G-5190, 5191 | 8/1/2011 | Be-7 | 3.14 ± 0.30 | 3.44 ± 0.27 | 3.29 ± 0.20 | Pass |
| G-5190, 5191 | 8/1/2011 | Gr. Beta | 8.07 ± 0.28 | 7.86 ± 0.27 | 7.97 ± 0.19 | Pass |
| G-5190, 5191 | 8/1/2011 | K-40 | 5.51 ± 0.46 | 5.57 ± 0.44 | 5.54 ± 0.32 | Pass |
| DW-20291, 20292 | 8/2/2011 | U-233/4 | 3.24 ± 0.54 | 2.60 ± 0.50 | 2.92 ± 0.37 | Pass |
| DW-20291, 20292 | 8/2/2011 | U-238 | 1.59 ± 0.38 | 2.00 ± 0.43 | 1.80 ± 0.29 | Pass |
| SG-5342, 5343 | 8/5/2011 | Ac-228 | 14.41 ± 0.36 | 14.13 ± 0.48 | 14.27 ± 0.30 | Pass |
| SG-5342, 5343 | 8/5/2011 | Bi-212 | 4.14 ± 0.65 | 4.73 ± 1.21 | 4.44 ± 0.69 | Pass |
| SG-5342, 5343 | 8/5/2011 | K-40 | 7.67 ± 0.92 | 7.95 ± 1.21 | 7.81 ± 0.76 | Pass |
| SG-5342, 5343 | 8/5/2011 | Pb-214 | 10.72 ± 0.21 | 10.67 ± 0.28 | 10.70 ± 0.18 | Pass |
| SG-5342, 5343 | 8/5/2011 | Tl-208 | 0.96 ± 0.06 | 1.00 ± 0.06 | 0.98 ± 0.04 | Pass |
| MI-5405, 5406 | 8/8/2011 | K-40 | 1545.30 ± 116.00 | 1388.00 ± 98.20 | 1466.65 ± 75.99 | Pass |
| DW-20301, 20302 | 8/9/2011 | Gr. Alpha | 6.36 ± 1.09 | 5.30 ± 1.08 | 5.83 ± 0.77 | Pass |
| DW-20301, 20302 | 8/9/2011 | Gr. Beta | 14.36 ± 0.92 | 13.51 ± 0.89 | 13.94 ± 0.64 | Pass |
| DW-5603, 5604 | 8/16/2011 | Ra-228 | 1.68 ± 0.88 | 2.26 ± 0.91 | 1.97 ± 0.63 | Pass |
| VE-5753, 5754 | 8/22/2011 | Be-7 | 0.78 ± 0.20 | 0.75 ± 0.23 | 0.77 ± 0.15 | Pass |
| VE-5753, 5754 | 8/22/2011 | K-40 | 6.16 ± 0.51 | 6.63 ± 0.57 | 6.40 ± 0.38 | Pass |
| S-5801, 5802 | 8/29/2011 | Ac-228 | 0.43 ± 0.09 | 0.38 ± 0.07 | 0.41 ± 0.06 | Pass |
| S-5801, 5802 | 8/29/2011 | K-40 | 6.54 ± 0.51 | 5.96 ± 0.49 | 6.25 ± 0.35 | Pass |
| S-5801, 5802 | 8/29/2011 | Pb-212 | 0.31 ± 0.03 | 0.36 ± 0.03 | 0.34 ± 0.02 | Pass |
| S-5801, 5802 | 8/29/2011 | Pb-214 | 0.28 ± 0.04 | 0.25 ± 0.04 | 0.27 ± 0.03 | Pass |
| S-5801, 5802 | 8/29/2011 | Tl-208 | 0.14 ± 0.02 | 0.12 ± 0.02 | 0.13 ± 0.01 | Pass |
| S-5801, 5802 | 8/29/2011 | U-235 | 0.05 ± 0.02 | 0.04 ± 0.01 | 0.05 ± 0.01 | Pass |
| ME-5996, 5997 | 9/1/2011 | Gr. Alpha | 0.03 ± 0.02 | 0.03 ± 0.02 | 0.03 ± 0.01 | Pass |
| ME-5996, 5997 | 9/1/2011 | Gr. Beta | 2.55 ± 0.07 | 2.62 ± 0.07 | 2.58 ± 0.05 | Pass |
| ME-5996, 5997 | 9/1/2011 | K-40 | 2.66 ± 0.35 | 2.24 ± 0.58 | 2.45 ± 0.34 | Pass |

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

| Lab Code | Date | Analysis | Concentration (pCi/L)[a] First Result | Second Result | Averaged Result | Acceptance |
|---|---|---|---|---|---|---|
| SL-6017, 6018 | 9/6/2011 | Be-7 | 0.47 ± 0.17 | 0.51 ± 0.19 | 0.49 ± 0.13 | Pass |
| SL-6017, 6018 | 9/6/2011 | Gr. Beta | 4.23 ± 0.16 | 3.94 ± 0.15 | 4.09 ± 0.11 | Pass |
| SL-6017, 6018 | 9/6/2011 | K-40 | 4.43 ± 0.55 | 4.24 ± 0.53 | 4.34 ± 0.38 | Pass |
| VE-6038, 6039 | 9/7/2011 | Sr-90 | 1.86 ± 0.98 | 2.30 ± 0.92 | 2.08 ± 0.67 | Pass |
| SW-6059, 6060 | 9/8/2011 | H-3 | 219.75 ± 97.52 | 177.41 ± 95.76 | 198.58 ± 68.34 | Pass |
| VE-6302, 6303 | 9/13/2011 | Be-7 | 0.76 ± 0.24 | 0.85 ± 0.20 | 0.81 ± 0.16 | Pass |
| VE-6302, 6303 | 9/13/2011 | Gr. Beta | 27.00 ± 1.02 | 25.50 ± 0.95 | 26.25 ± 0.70 | Pass |
| VE-6302, 6303 | 9/13/2011 | H-3 | 6966.00 ± 249.00 | 6947.00 ± 249.00 | 6956.50 ± 176.07 | Pass |
| VE-6302, 6303 | 9/13/2011 | K-40 | 20.62 ± 0.68 | 20.63 ± 0.64 | 20.63 ± 0.47 | Pass |
| W-7098, 7099 | 9/19/2011 | H-3 | 586.61 ± 103.06 | 525.71 ± 100.63 | 556.16 ± 72.02 | Pass |
| W-6407, 6408 | 9/20/2011 | Ra-228 | 1.61 ± 0.94 | 0.79 ± 0.81 | 1.20 ± 0.62 | Pass |
| MI-6479, 6480 | 9/27/2011 | K-40 | 1384.10 ± 111.10 | 1411.40 ± 105.00 | 1397.75 ± 76.43 | Pass |
| W-6579, 6580 | 9/27/2011 | H-3 | 287.97 ± 99.68 | 285.95 ± 99.60 | 286.96 ± 70.45 | Pass |
| AP-7015, 7016 | 9/27/2011 | Be-7 | 0.08 ± 0.02 | 0.09 ± 0.02 | 0.08 ± 0.01 | Pass |
| AP-6105, 6106 | 9/28/2011 | Be-7 | 0.11 ± 0.02 | 0.09 ± 0.02 | 0.10 ± 0.01 | Pass |
| LW-6603, 6604 | 9/28/2011 | Gr. Beta | 2.15 ± 1.04 | 1.65 ± 0.90 | 1.90 ± 0.69 | Pass |
| AP-7056, 7057 | 9/29/2011 | Be-7 | 0.08 ± 0.02 | 0.06 ± 0.01 | 0.07 ± 0.01 | Pass |
| G-6730, 6731 | 10/3/2011 | Be-7 | 4.24 ± 0.36 | 4.47 ± 0.37 | 4.36 ± 0.26 | Pass |
| G-6730, 6731 | 10/3/2011 | Gr. Beta | 8.27 ± 0.33 | 7.93 ± 0.31 | 8.10 ± 0.23 | Pass |
| G-6730, 6731 | 10/3/2011 | K-40 | 6.46 ± 0.56 | 5.41 ± 0.50 | 5.94 ± 0.38 | Pass |
| AP-7077, 7078 | 10/3/2011 | Be-7 | 0.08 ± 0.01 | 0.07 ± 0.01 | 0.07 ± 0.01 | Pass |
| AP-7077, 7078 | 10/3/2011 | Be-7 | 0.08 ± 0.01 | 0.07 ± 0.01 | 0.07 ± 0.01 | Pass |
| VE-6798, 6799 | 10/4/2011 | K-40 | 11.76 ± 0.65 | 11.91 ± 0.62 | 11.84 ± 0.45 | Pass |
| AP-6820, 6821 | 10/6/2011 | Be-7 | 0.22 ± 0.08 | 0.18 ± 0.10 | 0.20 ± 0.06 | Pass |
| W-7755, 7756 | 10/9/2011 | H-3 | 261.92 ± 96.52 | 221.92 ± 94.80 | 241.92 ± 67.65 | Pass |
| BS-7944, 7945 | 10/10/2011 | Cs-137 | 291.17 ± 34.00 | 330.68 ± 36.40 | 310.93 ± 24.90 | Pass |
| BS-7944, 7945 | 10/10/2011 | K-40 | 14237.00 ± 686.40 | 15359.00 ± 703.80 | 14798.00 ± 491.55 | Pass |
| BS-7140, 7141 | 10/13/2011 | K-40 | 2.59 ± 0.35 | 2.58 ± 0.52 | 2.59 ± 0.31 | Pass |
| AP-7168, 7169 | 10/13/2011 | Be-7 | 0.25 ± 0.09 | 0.25 ± 0.11 | 0.25 ± 0.07 | Pass |
| DW-20349, 20350 | 10/13/2011 | U-233/4 | 1.77 ± 0.41 | 2.25 ± 0.77 | 2.01 ± 0.44 | Pass |
| DW-20349, 20350 | 10/13/2011 | U-238 | 0.28 ± 0.19 | 0.31 ± 0.33 | 0.30 ± 0.19 | Pass |
| WW-7667, 7668 | 10/19/2011 | H-3 | 1049.11 ± 116.32 | 1071.39 ± 117.10 | 1060.25 ± 82.53 | Pass |
| WW-7381, 7382 | 10/21/2011 | H-3 | 1904.40 ± 145.45 | 1813.62 ± 142.91 | 1859.01 ± 101.95 | Pass |
| SS-7495, 7496 | 10/26/2011 | K-40 | 10.16 ± 0.55 | 9.56 ± 0.49 | 9.86 ± 0.37 | Pass |
| W-7516, 7517 | 10/27/2011 | H-3 | 191.46 ± 84.47 | 224.05 ± 86.03 | 207.76 ± 60.28 | Pass |
| VE-7537, 7538 | 10/28/2011 | K-40 | 2.08 ± 0.23 | 2.41 ± 0.21 | 2.24 ± 0.16 | Pass |
| MI-7622, 7623 | 10/31/2011 | K-40 | 1386.20 ± 116.80 | 1407.90 ± 116.50 | 1397.05 ± 82.48 | Pass |
| DW-20399, 20400 | 10/31/2011 | U-233/4 | 5.70 ± 0.70 | 5.70 ± 0.70 | 5.70 ± 0.49 | Pass |
| DW-20399, 20400 | 10/31/2011 | U-238 | 3.10 ± 0.50 | 3.70 ± 0.70 | 3.40 ± 0.43 | Pass |
| BS-7600, 7601 | 11/1/2011 | Gr. Beta | 6.83 ± 1.44 | 5.31 ± 1.35 | 6.07 ± 0.98 | Pass |

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

| Lab Code | Date | Analysis | Concentration (pCi/L)[a] First Result | Second Result | Averaged Result | Acceptance |
|---|---|---|---|---|---|---|
| SG-8471, 8472 | 11/1/2011 | Gr. Alpha | 13.63 ± 2.32 | 11.13 ± 2.00 | 12.38 ± 1.53 | Pass |
| SG-8471, 8472 | 11/1/2011 | Gr. Beta | 20.30 ± 1.43 | 17.65 ± 1.42 | 18.98 ± 1.01 | Pass |
| DW-20424, 20425 | 11/7/2011 | U-233/4 | 5.90 ± 0.80 | 6.10 ± 0.80 | 6.00 ± 0.57 | Pass |
| DW-20424, 20425 | 11/7/2011 | U-235 | 0.10 ± 0.10 | 0.30 ± 0.20 | 0.20 ± 0.11 | Pass |
| DW-20424, 20425 | 11/7/2011 | U-238 | 4.30 ± 0.70 | 3.70 ± 0.60 | 4.00 ± 0.46 | Pass |
| DW-20424, 20425 | 11/7/2011 | U-238 | 10.30 ± 1.00 | 10.10 ± 1.00 | 10.20 ± 0.71 | Pass |
| DW-20435, 20436 | 11/8/2011 | U-233/4 | 11.00 ± 1.10 | 10.60 ± 0.80 | 10.80 ± 0.68 | Pass |
| DW-20435, 20436 | 11/8/2011 | U-238 | 5.90 ± 0.80 | 4.90 ± 0.60 | 5.40 ± 0.50 | Pass |
| SG-7902, 7903 | 11/10/2011 | Ac-228 | 21.38 ± 0.47 | 20.48 ± 0.52 | 20.93 ± 0.35 | Pass |
| SG-7902, 7903 | 11/10/2011 | K-40 | 9.72 ± 1.04 | 9.53 ± 0.92 | 9.63 ± 0.69 | Pass |
| SG-7902, 7903 | 11/10/2011 | Pb-212 | 3.99 ± 0.10 | 3.99 ± 0.10 | 3.99 ± 0.07 | Pass |
| SG-7902, 7903 | 11/10/2011 | Pb-214 | 9.15 ± 0.23 | 9.14 ± 0.21 | 9.15 ± 0.16 | Pass |
| BS-8033, 8034 | 11/11/2011 | Cs-137 | 0.03 ± 0.02 | 0.03 ± 0.02 | 0.03 ± 0.01 | Pass |
| LW-8075, 8076 | 11/16/2011 | Gr. Beta | 1.93 ± 0.62 | 2.55 ± 0.64 | 2.24 ± 0.44 | Pass |
| AP-8193, 8194 | 11/17/2011 | Be-7 | 0.21 ± 0.11 | 0.26 ± 0.13 | 0.24 ± 0.08 | Pass |
| F-8663, 8664 | 11/19/2011 | Cs-137 | 0.03 ± 0.02 | 0.03 ± 0.02 | 0.03 ± 0.01 | Pass |
| F-8663, 8664 | 11/19/2011 | Gr. Beta | 3.55 ± 0.10 | 3.71 ± 0.10 | 3.63 ± 0.07 | Pass |
| F-8663, 8664 | 11/19/2011 | K-40 | 3.04 ± 0.42 | 3.05 ± 0.35 | 3.05 ± 0.27 | Pass |
| DW-20449, 20450 | 11/28/2011 | U-233/4 | 0.70 ± 0.20 | 0.80 ± 0.20 | 0.75 ± 0.14 | Pass |
| DW-20449, 20450 | 11/28/2011 | U-238 | 0.60 ± 0.20 | 0.60 ± 0.20 | 0.60 ± 0.14 | Pass |
| SWU-8388, 8389 | 11/29/2011 | Gr. Beta | 1.66 ± 0.57 | 1.65 ± 0.59 | 1.66 ± 0.41 | Pass |
| AP-8841, 8842 | 12/15/2011 | Be-7 | 0.23 ± 0.12 | 0.19 ± 0.09 | 0.21 ± 0.07 | Pass |
| W-8886, 8887 | 12/15/2011 | Gr. Alpha | 0.83 ± 0.81 | 1.58 ± 0.99 | 1.21 ± 0.64 | Pass |
| W-8886, 8887 | 12/15/2011 | Gr. Beta | 6.80 ± 1.25 | 5.94 ± 1.22 | 6.37 ± 0.87 | Pass |
| W-8886, 8887 | 12/15/2011 | Ra-226 | 0.23 ± 0.15 | 0.41 ± 0.16 | 0.32 ± 0.11 | Pass |
| SO-8958, 8959 | 12/21/2011 | K-40 | 14.58 ± 0.86 | 15.07 ± 0.87 | 14.83 ± 0.61 | Pass |
| AP-8907, 8908 | 12/22/2011 | Be-7 | 0.15 ± 0.06 | 0.11 ± 0.07 | 0.13 ± 0.05 | Pass |
| AP-9196, 9197 | 12/28/2011 | Be-7 | 0.06 ± 0.01 | 0.07 ± 0.01 | 0.06 ± 0.01 | Pass |
| LW-9091, 9092 | 12/29/2011 | Gr. Beta | 1.97 ± 0.63 | 1.74 ± 0.60 | 1.86 ± 0.44 | 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).

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-1237 [e] | 02/01/11 | Am-241 | 0.35 ± 0.10 | 0.53 | 0.37 - 0.69 | Fail |
| STW-1237 | 02/01/11 | Co-57 | < 0.2 | 0.00 | - | Pass |
| STW-1237 | 02/01/11 | Co-60 | 24.10 ± 0.40 | 24.60 | 17.20 - 32.00 | Pass |
| STW-1237 | 02/01/11 | Cs-134 | 19.80 ± 0.40 | 21.50 | 15.10 - 28.00 | Pass |
| STW-1237 | 02/01/11 | Cs-137 | 29.40 ± 0.50 | 29.40 | 20.60 - 38.20 | Pass |
| STW-1237 | 02/01/11 | H-3 | 238.90 ± 8.80 | 243.00 | 170.00 - 316.00 | Pass |
| STW-1237 | 02/01/11 | K-40 | 95.40 ± 3.10 | 91.00 | 64.00 - 118.00 | Pass |
| STW-1237 | 02/01/11 | Mn-54 | 32.50 ± 0.60 | 31.60 | 22.10 - 41.10 | Pass |
| STW-1237 | 02/01/11 | Ni-63 | 16.30 ± 0.60 | 18.60 | 13.00 - 24.20 | Pass |
| STW-1237 | 02/01/11 | Pu-238 | 1.11 ± 0.12 | 1.06 | 0.75 - 1.38 | Pass |
| STW-1237 | 02/01/11 | Pu-239/40 | 0.88 ± 0.12 | 0.81 | 0.57 - 1.05 | Pass |
| STW-1237 | 02/01/11 | Sr-90 | 8.70 ± 0.70 | 8.72 | 6.10 - 11.34 | Pass |
| STW-1237 | 02/01/11 | Tc-99 | 7.60 ± 0.60 | 8.99 | 6.29 - 11.69 | Pass |
| STW-1237 | 02/01/11 | Zn-65 | < 0.5 | 0.00 | - | Pass |
| STW-1238 | 02/01/11 | Gr. Alpha | 0.82 ± 0.07 | 1.14 | 0.34 - 1.93 | Pass |
| STW-1238 | 02/01/11 | Gr. Beta | 2.82 ± 0.07 | 2.96 | 1.48 - 4.44 | Pass |
| STVE-1239 | 02/01/11 | Co-57 | 11.27 ± 0.21 | 9.94 | 6.96 - 12.92 | Pass |
| STVE-1239 | 02/01/11 | Co-60 | 4.95 ± 0.16 | 4.91 | 3.44 - 6.38 | Pass |
| STVE-1239 | 02/01/11 | Cs-134 | 5.18 ± 0.19 | 5.50 | 3.85 - 7.15 | Pass |
| STVE-1239 | 02/01/11 | Cs-137 | < 0.09 | 0.00 | - | Pass |
| STVE-1239 | 02/01/11 | Mn-54 | 6.91 ± 0.25 | 6.40 | 4.48 - 8.32 | Pass |
| STVE-1239 | 02/01/11 | Zn-65 | 3.10 ± 0.32 | 2.99 | 2.09 - 3.89 | Pass |
| STSO-1240 | 02/01/11 | Co-57 | 984.10 ± 4.10 | 927.00 | 649.00 - 1205.00 | Pass |
| STSO-1240 | 02/01/11 | Co-60 | 540.70 ± 3.00 | 482.00 | 337.00 - 627.00 | Pass |
| STSO-1240 | 02/01/11 | Cs-134 | 726.70 ± 5.92 | 680.00 | 476.00 - 884.00 | Pass |
| STSO-1240 | 02/01/11 | Cs-137 | 883.10 ± 4.70 | 758.00 | 531.00 - 985.00 | Pass |
| STSO-1240 | 02/01/11 | K-40 | 622.70 ± 16.70 | 540.00 | 378.00 - 702.00 | Pass |
| STSO-1240 | 02/01/11 | Mn-54 | -0.30 ± 1.00 | 0.00 | - | Pass |
| STSO-1240 [f] | 02/01/11 | Ni-63 | 384.00 ± 16.90 | 582.00 | 407.00 - 757.00 | Fail |
| STSO-1240 | 02/01/11 | U-233/4 | 166.60 ± 7.30 | 176.00 | 123.00 - 229.00 | Pass |
| STSO-1240 | 02/01/11 | U-238 | 172.00 ± 7.40 | 184.00 | 129.00 - 239.00 | Pass |
| STSO-1240 | 02/01/11 | Zn-65 | 1671.00 ± 13.10 | 1359.00 | 951.00 - 1767.00 | Pass |
| STAP-1241 | 02/01/11 | Am-241 | 0.00 ± 0.01 | 0.00 | -0.10 - 0.10 | Pass |
| STAP-1241 | 02/01/11 | Co-57 | 3.48 ± 0.06 | 3.33 | 2.33 - 4.33 | Pass |
| STAP-1241 | 02/01/11 | Co-60 | 0.00 ± 0.02 | 0.00 | -0.10 - 0.10 | Pass |
| STAP-1241 | 02/01/11 | Cs-134 | 3.44 ± 0.27 | 3.49 | 2.44 - 4.54 | Pass |
| STAP-1241 | 02/01/11 | Cs-137 | 2.46 ± 0.27 | 2.28 | 1.60 - 2.96 | 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-1241 | 02/01/11 | Gr. Alpha | 0.39 ± 0.05 | 0.66 | 0.20 - 1.12 | Pass |
| STAP-1241 | 02/01/11 | Gr. Beta | 1.54 ± 0.07 | 1.32 | 0.66 - 1.99 | Pass |
| STAP-1241 | 02/01/11 | Mn-54 | 2.90 ± 0.10 | 2.64 | 1.85 - 3.43 | Pass |
| STAP-1241 | 02/01/11 | Pu-238 | 0.07 ± 0.02 | 0.10 | 0.07 - 0.13 | Pass |
| STAP-1241 | 02/01/11 | Pu-239/40 | 0.06 ± 0.02 | 0.08 | 0.05 - 0.10 | Pass |
| STAP-1241 [g] | 02/01/11 | Sr-90 | 1.89 ± 0.15 | 1.36 | 0.95 - 1.77 | Fail |
| STAP-1241 | 02/01/11 | U-233/4 | 0.13 ± 0.02 | 0.18 | 0.13 - 0.23 | Pass |
| STAP-1241 | 02/01/11 | U-238 | 0.14 ± 0.02 | 0.19 | 0.13 - 0.24 | Pass |
| STAP-1241 | 02/01/11 | Zn-65 | 3.80 ± 0.18 | 3.18 | 2.23 - 4.13 | Pass |
| STW-1249 | 08/01/11 | I-129 | 7.32 ± 0.30 | 9.50 | 6.70 - 12.40 | Pass |
| STVE-1250 | 08/01/11 | Co-57 | 0.01 ± 0.02 | 0.00 | - | Pass |
| STVE-1250 | 08/01/11 | Co-60 | 3.57 ± 0.13 | 3.38 | 2.37 - 4.39 | Pass |
| STVE-1250 | 08/01/11 | Cs-134 | -0.02 ± 0.04 | 0.00 | -0.10 - 0.10 | Pass |
| STVE-1250 | 08/01/11 | Cs-137 | 5.28 ± 0.20 | 4.71 | 3.30 - 6.12 | Pass |
| STVE-1250 | 08/01/11 | Mn-54 | 6.48 ± 0.22 | 5.71 | 4.00 - 7.42 | Pass |
| STVE-1250 | 08/01/11 | Zn-65 | 7.35 ± 0.34 | 6.39 | 4.47 - 8.31 | Pass |
| STSO-1251 | 08/01/11 | Co-57 | 1333.90 ± 4.20 | 1180.00 | 826.00 - 1534.00 | Pass |
| STSO-1251 | 08/01/11 | Co-60 | 701.30 ± 3.40 | 644.00 | 451.00 - 837.00 | Pass |
| STSO-1251 | 08/01/11 | Cs-134 | 0.71 ± 1.05 | 0.00 | - | Pass |
| STSO-1251 | 08/01/11 | Cs-137 | 1106.00 ± 5.60 | 979.00 | 685.00 - 1273.00 | Pass |
| STSO-1251 | 08/01/11 | K-40 | 749.20 ± 19.00 | 625.00 | 438.00 - 813.00 | Pass |
| STSO-1251 | 08/01/11 | Mn-54 | 984.30 ± 5.40 | 848.00 | 594.00 - 1102.00 | Pass |
| STSO-1251 | 08/01/11 | Ni-63 | 0.11 ± 1.21 | 0.00 | - | Pass |
| STSO-1251 | 08/01/11 | Pu-238 | 97.90 ± 7.40 | 93.60 | 65.50 - 121.70 | Pass |
| STSO-1251 | 08/01/11 | Pu-239/40 | 78.80 ± 6.40 | 77.40 | 54.20 - 100.60 | Pass |
| STSO-1251 [h] | 08/01/11 | Sr-90 | 219.40 ± 16.70 | 320.00 | 224.00 - 416.00 | Fail |
| STSO-1251 [i] | 08/01/11 | Tc-99 | 110.00 ± 8.00 | 182.00 | 127.00 - 237.00 | Fail |
| STSO-1251 | 08/01/11 | U-233/4 | 267.00 ± 10.20 | 263.00 | 184.00 - 342.00 | Pass |
| STSO-1251 | 08/01/11 | U-238 | 280.30 ± 10.40 | 274.00 | 192.00 - 356.00 | Pass |
| STSO-1251 | 08/01/11 | Zn-65 | 1639.90 ± 11.40 | 1560.00 | 1092.00 - 2028.00 | Pass |
| STAP-1252 | 08/01/11 | Co-57 | 5.06 ± 0.08 | 5.09 | 3.56 - 6.62 | Pass |
| STAP-1252 | 08/01/11 | Co-60 | 3.13 ± 0.09 | 3.20 | 2.24 - 4.16 | Pass |
| STAP-1252 | 08/01/11 | Cs-134 | 0.01 ± 0.03 | 0.00 | -0.10 - 0.10 | Pass |
| STAP-1252 | 08/01/11 | Cs-137 | 2.61 ± 0.09 | 2.60 | 1.82 - 3.38 | Pass |
| STAP-1252 | 08/01/11 | Mn-54 | 0.01 ± 0.03 | 0.00 | -0.10 - 0.10 | Pass |
| STAP-1252 | 08/01/11 | Pu-238 | 0.13 ± 0.02 | 0.12 | 0.08 - 0.15 | Pass |
| STAP-1252 | 08/01/11 | Pu-239/40 | 0.15 ± 0.02 | 0.14 | 0.10 - 0.18 | Pass |
| STAP-1252 | 08/01/11 | Sr-90 | 1.65 ± 0.16 | 1.67 | 1.17 - 2.17 | 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-1252 | 08/01/11 | U-233/4 | 0.17 ± 0.02 | 0.16 | 0.11 - 0.21 | Pass |
| STAP-1252 | 08/01/11 | U-238 | 0.17 ± 0.02 | 0.17 | 0.12 - 0.22 | Pass |
| STAP-1252 | 08/01/11 | Zn-65 | 4.46 ± 0.23 | 4.11 | 2.88 - 5.34 | Pass |
| STW-1254 | 08/01/11 | Co-57 | 37.20 ± 0.50 | 36.60 | 25.60 - 47.60 | Pass |
| STW-1254 | 08/01/11 | Co-60 | 28.80 ± 0.40 | 29.30 | 20.50 - 38.10 | Pass |
| STW-1254 | 08/01/11 | Cs-134 | 18.00 ± 0.60 | 19.10 | 13.40 - 24.80 | Pass |
| STW-1254 | 08/01/11 | Cs-137 | 0.06 ± 0.13 | 0.00 | - | Pass |
| STW-1254 | 08/01/11 | H-3 | 1039.90 ± 17.90 | 1014.00 | 710.00 - 1318.00 | Pass |
| STW-1254 | 08/01/11 | K-40 | 161.40 ± 4.10 | 156.00 | 109.00 - 203.00 | Pass |
| STW-1254 | 08/01/11 | Mn-54 | 25.70 ± 0.50 | 25.00 | 17.50 - 32.50 | Pass |
| STW-1254 | 08/01/11 | Ni-63 | 0.60 ± 2.00 | 0.00 | - | Pass |
| STW-1254 | 08/01/11 | Pu-238 | 0.04 ± 0.02 | 0.02 | 0.00 - 1.00 | Pass |
| STW-1254 | 08/01/11 | Pu-239/40 | 2.27 ± 0.14 | 2.40 | 1.68 - 3.12 | Pass |
| STW-1254 | 08/01/11 | Sr-90 | 15.60 ± 1.80 | 14.20 | 9.90 - 18.50 | Pass |
| STW-1254 | 08/01/11 | Tc-99 | -0.30 ± 0.50 | 0.00 | - | Pass |
| STW-1254 | 08/01/11 | U-233/4 | 2.78 ± 0.20 | 2.78 | 1.95 - 3.61 | Pass |
| STW-1254 | 08/01/11 | U-238 | 2.86 ± 0.21 | 2.89 | 2.02 - 3.76 | Pass |
| STW-1254 | 08/01/11 | Zn-65 | 30.20 ± 0.90 | 28.50 | 20.00 - 37.10 | Pass |
| STW-1255 | 08/01/11 | Gr. Alpha | 0.72 ± 0.12 | 0.87 | 0.26 - 1.47 | Pass |
| STW-1255 | 08/01/11 | Gr. Beta | 4.71 ± 0.15 | 4.81 | 2.41 - 7.22 | 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).

[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. A known value of "zero" indicates an analysis was included in the testing series as a "false positive". MAPEP does not provide control limits.

[e] Result of a repeat analysis was still unacceptable. ERA crosschecks for Am-241 were acceptable, but biased low. Matrix spikes were prepared, ( 5.17 and 51.7 pCi/L), to verify method; results were acceptable, 4.4 and 47.5 pCi/L. Am-241 has been added to the internal spike and blank program for 2012.

[f] An error in percent recovery was found, result of recalculation, 427.3 ± 18.8 Bq/kg dry.

[g] No errors found in calculation or procedure, results of reanalysis; 1.73 Bq/filter.

[h] The analyses were repeated through a strontium column; mean result of triplicate analyses, 304.2 Bq/kg.

[i] The lab does not currently analyze soil for Tc-99, but is evaluating the procedure. After consultation with Eichrom, the analysis was repeated using a matrix spike correction. Mean result of triplicate reanalyses; 183.3 Bq/kg.

TABLE A-7. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)[a].

| Lab Code [b] | Date | Analysis | Concentration (pCi/L) [b] Laboratory Result [c] | ERA Result [d] | Control Limits | Acceptance |
|---|---|---|---|---|---|---|
| STAP-1230 | 03/21/11 | Am-241 | 46.0 ± 1.8 | 62.5 | 36.6 - 85.7 | Pass |
| STAP-1230 | 03/21/11 | Co-60 | 401.2 ± 12.1 | 390.0 | 302.0 - 487.0 | Pass |
| STAP-1230 | 03/21/11 | Cs-134 | 268.2 ± 24.8 | 279.0 | 182.0 - 345.0 | Pass |
| STAP-1230 | 03/21/11 | Cs-137 | 345.3 ± 24.9 | 312.0 | 234.0 - 410.0 | Pass |
| STAP-1230 | 03/21/11 | Mn-54 | < 1.9 | 0.0 | - | Pass |
| STAP-1230 | 03/21/11 | Pu-238 | 76.1 ± 3.2 | 69.0 | 47.4 - 90.7 | Pass |
| STAP-1230 | 03/21/11 | Pu-239/40 | 70.50 ± 3.10 | 65.5 | 47.5 - 85 | Pass |
| STAP-1230 | 03/21/11 | Sr-90 | 208.40 ± 18.70 | 185.0 | 81.4 - 288 | Pass |
| STAP-1230 | 03/21/11 | U-233/4 | 56.10 ± 2.10 | 61.5 | 38.7 - 91 | Pass |
| STAP-1230 | 03/21/11 | U-238 | 58.90 ± 2.60 | 61.0 | 39.0 - 87 | Pass |
| STAP-1230 | 03/21/11 | Uranium | 118.50 ± 5.52 | 125.0 | 63.9 - 199 | Pass |
| STAP-1230 | 03/21/11 | Zn-65 | 312.60 ± 23.40 | 279.0 | 193.0 - 386 | Pass |
| STAP-1231 | 03/21/11 | Gr. Alpha | 88.40 ± 3.70 | 74.3 | 38.5 - 112 | Pass |
| STAP-1231 | 03/21/11 | Gr. Beta | 85.10 ± 2.80 | 69.5 | 42.8 - 102 | Pass |
| STSO-1232 | 03/21/11 | Ac-228 | 1327.8 ± 97.5 | 1490.0 | 958.0 - 2100.0 | Pass |
| STSO-1232 | 03/21/11 | Am-241 | 662.8 ± 88.1 | 914.0 | 546.0 - 1170.0 | Pass |
| STSO-1232 | 03/21/11 | Bi-212 | 1396.2 ± 185.3 | 1400.0 | 368.0 - 2090.0 | Pass |
| STSO-1232 | 03/21/11 | Bi-214 | 841.1 ± 33.2 | 725.0 | 445.0 - 1040.0 | Pass |
| STSO-1232 | 03/21/11 | Co-60 | 2423.7 ± 27.1 | 2220.0 | 1620.0 - 2980.0 | Pass |
| STSO-1232 | 03/21/11 | Cs-134 | 2481.3 ± 42.2 | 2450.0 | 1580.0 - 2950.0 | Pass |
| STSO-1232 | 03/21/11 | Cs-137 | 2108.2 ± 30.2 | 1920.0 | 1470.0 - 2490.0 | Pass |
| STSO-1232 | 03/21/11 | K-40 | 11497.3 ± 276.6 | 11500.0 | 8320.0 - 15600.0 | Pass |
| STSO-1232 | 03/21/11 | Mn-54 | < 17.4 | 0.0 | - | Pass |
| STSO-1232 | 03/21/11 | Pb-212 | 994.7 ± 30.0 | 1440.0 | 931.0 - 2030.0 | Pass |
| STSO-1232 | 03/21/11 | Pb-214 | 918.3 ± 42.6 | 805.0 | 482.0 - 1200.0 | Pass |
| STSO-1232 | 03/21/11 | Pu-238 | 1593.6 ± 156.7 | 1420.0 | 813.0 - 2000.0 | Pass |
| STSO-1232 | 03/21/11 | Pu-239/40 | 1428.9 ± 143.4 | 1400.0 | 956.0 - 1860.0 | Pass |
| STSO-1232 | 03/21/11 | Sr-90 | 8638.0 ± 442.8 | 7590.0 | 2740.0 - 12400.0 | Pass |
| STSO-1232 | 03/21/11 | Th-234 | 1350.1 ± 180.0 | 962.0 | 305.0 - 1830.0 | Pass |
| STSO-1232 | 03/21/11 | U-233/4 | 748.0 ± 94.4 | 972.0 | 616.0 - 1210.0 | Pass |
| STSO-1232 | 03/21/11 | U-238 | 909.0 ± 104.9 | 962.0 | 588.0 - 1220.0 | Pass |
| STSO-1232 | 03/21/11 | Uranium | 1690.8 ± 104.9 | 1980.0 | 1130.0 - 2670.0 | Pass |
| STSO-1232 | 03/21/11 | Zn-65 | 2356.2 ± 57.1 | 1990.0 | 1580.0 - 2670.0 | Pass |

TABLE A-7. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)[a].

| Lab Code [b] | Date | Analysis | Concentration (pCi/L) [b] Laboratory Result [c] | ERA Result [d] | Control Limits | Acceptance |
|---|---|---|---|---|---|---|
| STVE-1233 | 03/21/11 | Am-241 | 2377.5 ± 83.2 | 3200.0 | 1820.0 - 4400.0 | Pass |
| STVE-1233 | 03/21/11 | Cm-244 | 602.9 ± 38.4 | 812.0 | 400.0 - 1260.0 | Pass |
| STVE-1233 | 03/21/11 | Co-60 | 810.2 ± 32.4 | 733.0 | 496.0 - 1050.0 | Pass |
| STVE-1233 | 03/21/11 | Cs-134 | 849.4 ± 54.5 | 770.0 | 441.0 - 1070.0 | Pass |
| STVE-1233 | 03/21/11 | Cs-137 | 889.9 ± 36.3 | 829.0 | 608.0 - 1150.0 | Pass |
| STVE-1233 | 03/21/11 | K-40 | 28146.70 ± 698.80 | 25800.0 | 18500.0 - 36500 | Pass |
| STVE-1233 | 03/21/11 | Mn-54 | < 19.3 | 0.0 | - | Pass |
| STVE-1233 | 03/21/11 | Pu-238 | 3068.10 ± 170.70 | 2990.0 | 1610.0 - 4380 | Pass |
| STVE-1233 | 03/21/11 | Pu-239/40 | 3180.00 ± 88.90 | 3100.0 | 1920.0 - 4230 | Pass |
| STVE-1233 | 03/21/11 | Sr-90 | 8549.20 ± 675.00 | 7890.0 | 4410.0 - 10500 | Pass |
| STVE-1233 | 03/21/11 | U-233/4 | 2418.60 ± 142.50 | 2610.0 | 1790.0 - 3460 | Pass |
| STVE-1233 | 03/21/11 | U-238 | 2417.00 ± 142.50 | 2590.0 | 1820.0 - 3270 | Pass |
| STVE-1233 | 03/21/11 | Uranium | 4929.80 ± 142.50 | 5320.0 | 3660.0 - 6860 | Pass |
| STVE-1233 | 03/21/11 | Zn-65 | 962.40 ± 62.50 | 799.0 | 577.0 - 1090 | Pass |
| STW-1234 | 03/21/11 | Am-241 | 100.0 ± 6.4 | 135.0 | 92.5 - 182.0 | Pass |
| STW-1234 | 03/21/11 | Co-60 | 401.6 ± 7.2 | 411.0 | 358.0 - 486.0 | Pass |
| STW-1234 | 03/21/11 | Cs-134 | 222.7 ± 12.3 | 231.0 | 171.0 - 265.0 | Pass |
| STW-1234 | 03/21/11 | Cs-137 | 410.3 ± 9.5 | 417.0 | 354.0 - 500.0 | Pass |
| STW-1234 | 03/21/11 | Mn-54 | < 3.0 | 0.0 | - | Pass |
| STW-1234 | 03/21/11 | Pu-238 | 130.9 ± 5.5 | 131.0 | 99.1 - 162.0 | Pass |
| STW-1234 | 03/21/11 | Pu-239/40 | 113.0 ± 5.0 | 119.0 | 92.1 - 147.0 | Pass |
| STW-1234 | 03/21/11 | Sr-90 | 739.6 ± 13.0 | 773.0 | 491.0 - 1030.0 | Pass |
| STW-1234 | 03/21/11 | U-233/4 | 83.4 ± 3.8 | 94.3 | 71.1 - 122.0 | Pass |
| STW-1234 | 03/21/11 | U-238 | 85.5 ± 3.9 | 93.5 | 71.4 - 116.0 | Pass |
| STW-1234 | 03/21/11 | Uranium | 172.0 ± 8.5 | 192.0 | 138.0 - 256.0 | Pass |
| STW-1234 | 03/21/11 | Zn-65 | 114.5 ± 10.8 | 111.0 | 94.1 - 138.0 | Pass |
| STW-1235 | 03/21/11 | Gr. Alpha | 97.6 ± 2.9 | 112.0 | 49.7 - 166.0 | Pass |
| STW-1235 | 03/21/11 | Gr. Beta | 99.6 ± 2.0 | 99.8 | 58.4 - 146.0 | Pass |
| STW-1236 | 03/21/11 | H-3 | 16307.0 ± 377.0 | 15200.0 | 9900.0 - 22500.0 | Pass |

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the Environmental Measurements Laboratory Quality Assessment Program (EML).

[b] Laboratory codes as follows: STW (water), STAP (air filter), STSO (soil), STVE (vegetation). Results are reported in units of pCi/L, except for air filters (pCi/Filter), vegetation and soil (pCi/kg).

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

[d] Results are presented as the known values, expected laboratory precision (1 sigma, 1 determination) and control limits as provided by ERA. A known value of "zero" indicates an analysis was included in the testing series as a "false positive". Control limits are not provided.

# 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 $4.66\sigma$ uncertainty for a background sample.

3.0. Duplicate analyses

If duplicate analyses are reported, the convention is as follows. :

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 numbers 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 | $1 \times 10^{-3}$ | Strontium-89 | 8,000 |
| Gross beta | 1 | Strontium-90 | 500 |
| Iodine-131[b] | $2.8 \times 10^{-1}$ | Cesium-137 | 1,000 |
| | | Barium-140 | 8,000 |
| | | Iodine-131 | 1,000 |
| | | Potassium-40[c] | 4,000 |
| | | Gross alpha | 2 |
| | | Gross beta | 10 |
| | | Tritium | $1 \times 10^6$ |

[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.

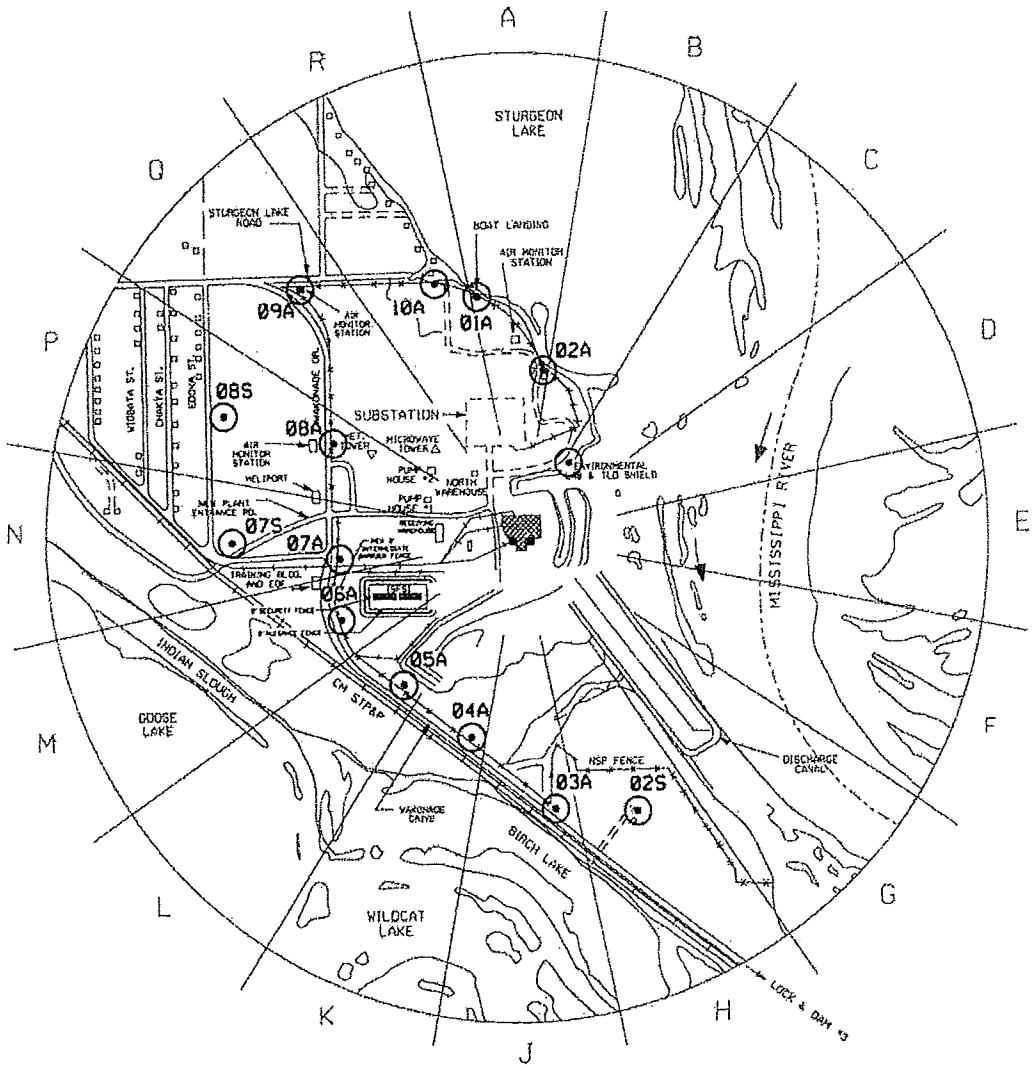
[b] Value adjusted by a factor of 700 to reduce the dose resulting from the air-grass-cow-milk-child pathway.

[c] A natural radionuclide.

# APPENDIX D

Sampling Location Maps

TLD LOCATIONS
ONE MILE RADIUS



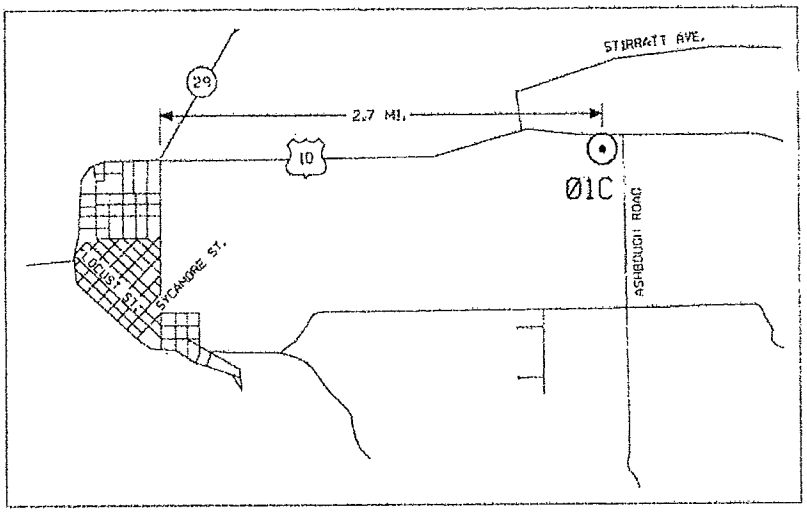

PLANT AREA ENLARGED PLAN [1.00 MILE RADIUS]
[NO SCALE]

MONITORING LEGEND:

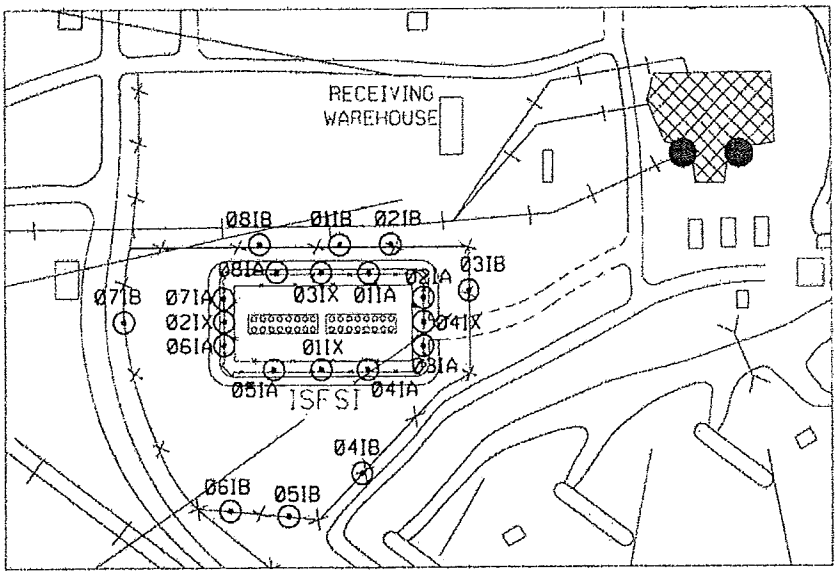
⊙ PRAIRIE ISLAND TLD POINTS

TLD01.DGN

# TLD LOCATIONS




CONTROL POINTS
PRESCOTT, WISCONSIN



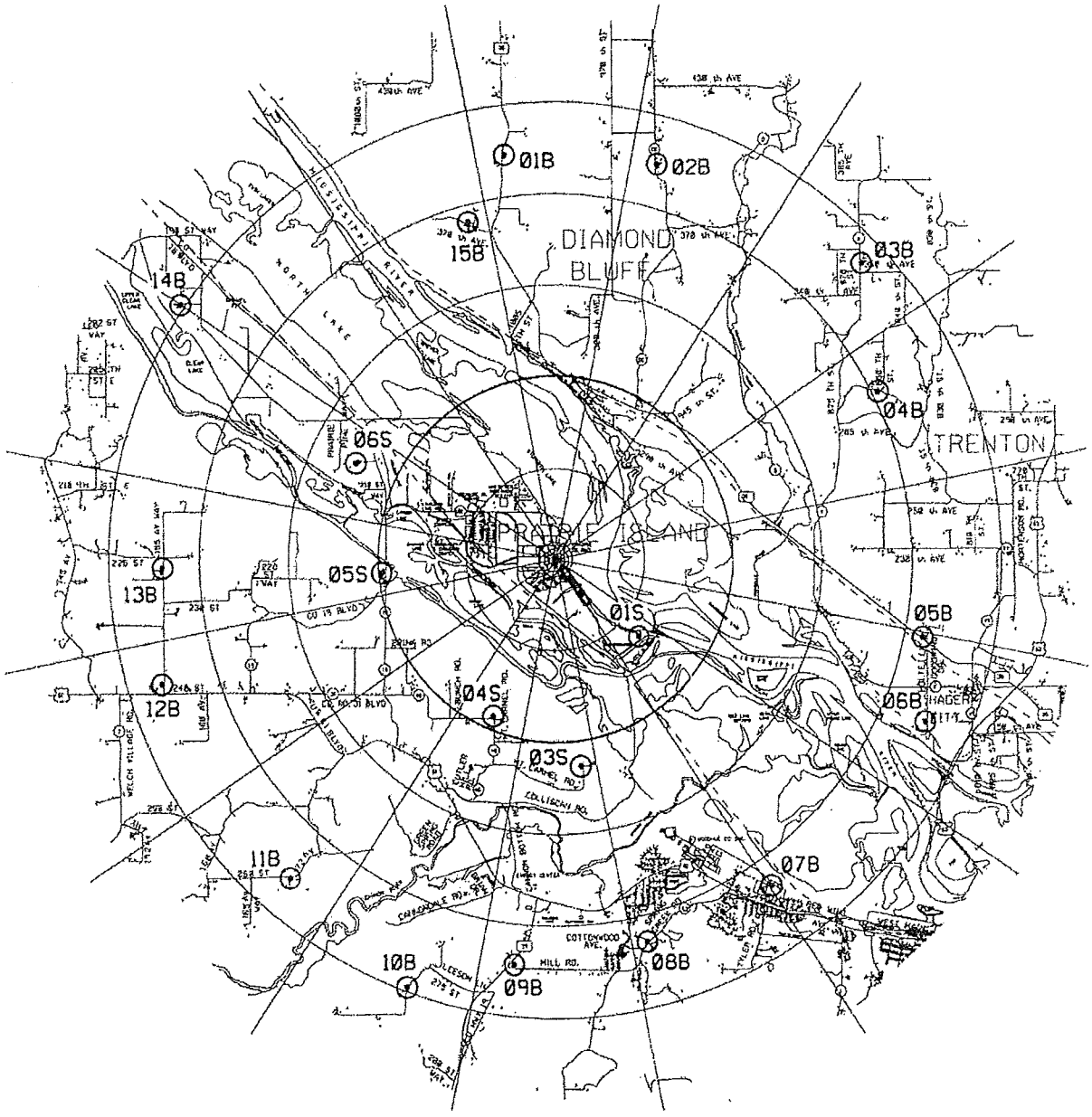

ISFSI AREA TLD LOCATIONS

MONITORING LEGEND:

⊙ PRAIRIE ISLAND TLD POINTS

TLD LOCATIONS

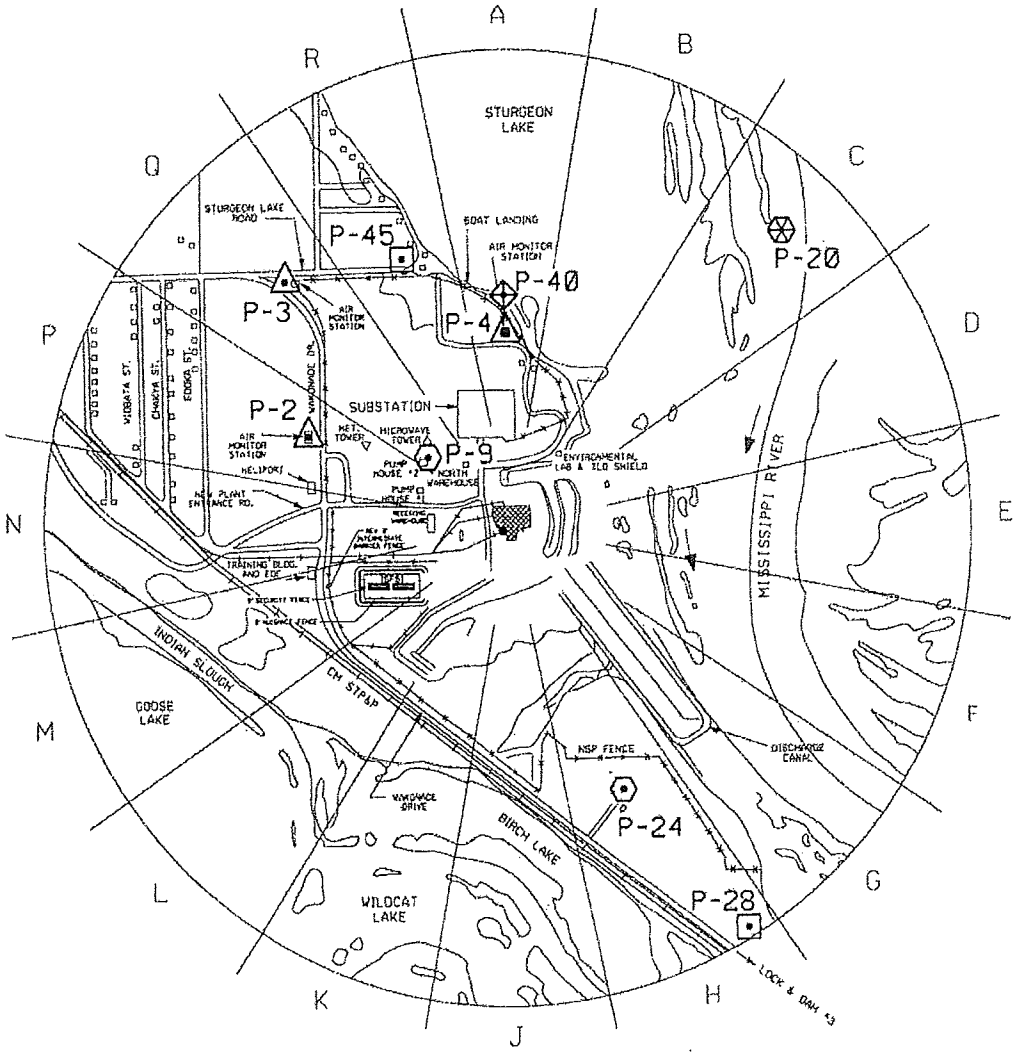
FIVE MILE RADIUS




MONITORING LEGEND:

⊙ PRAIRIE ISLAND TLD POINTS

# ENVIRONMENTAL SAMPLING POINTS
## ONE MILE RADIUS




PLANT AREA ENLARGED PLAN [1.00 MILE RADIUS]

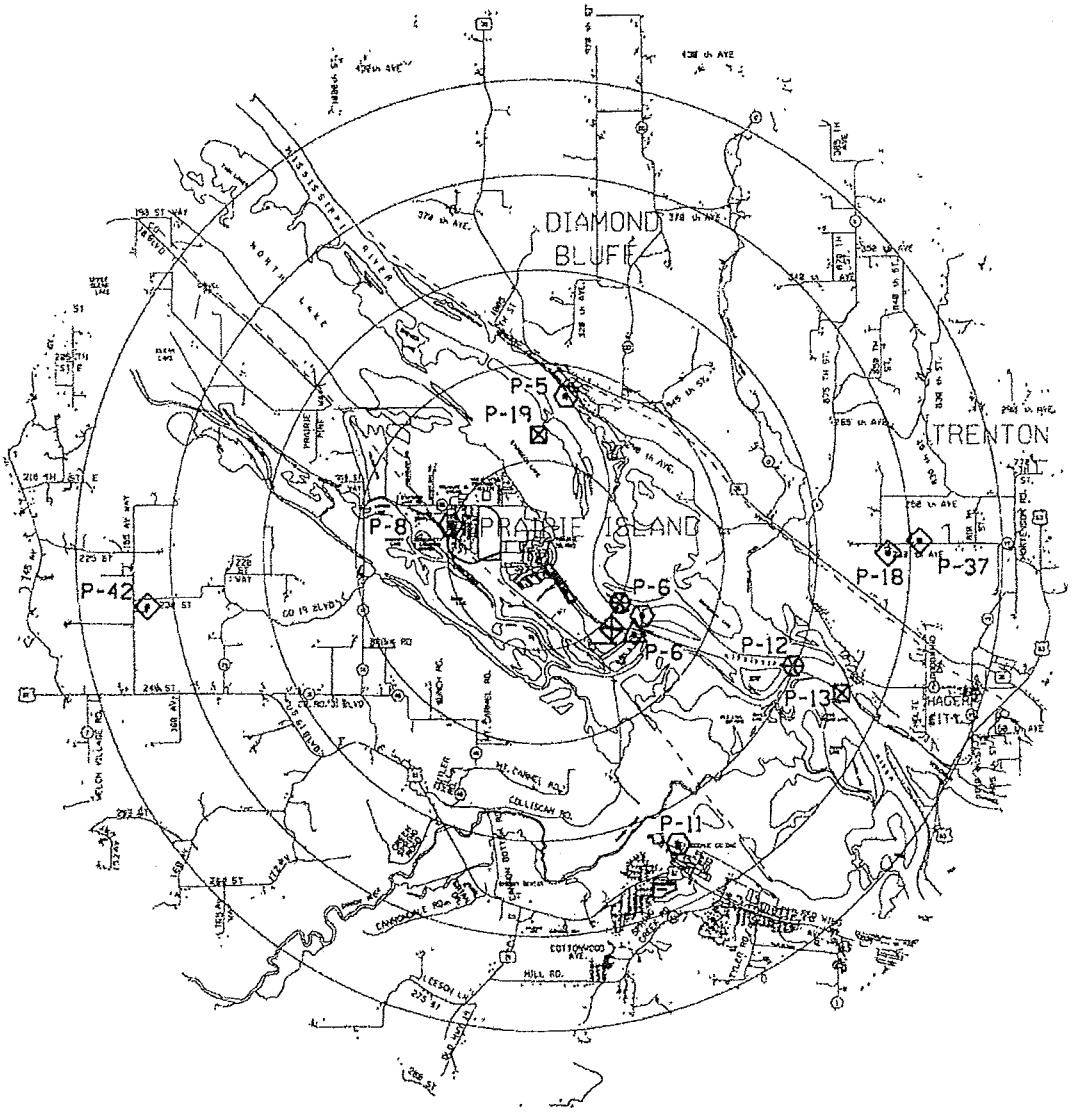
[NO SCALE]

### MONITORING LEGEND

- MILK SAMPLING POINT ID NUMBERS
  P-18, P-37, P-42, P-43
- AIR SAMPLING POINT ID NUMBERS
  P-1, P-2, P-3, P-4, P-6
- WATER SAMPLING POINT ID NUMBERS
  P-5, P-6, P-8, P-9, P-11, P-24, P-43
- VEGETATION / VEGETABLES ID NUMBERS
  P-28, P-38, P-45
- FISH SAMPLING POINT ID NUMBERS
  P-13, P-19
- INVERTEBRATES POINT ID NUMBERS
  P-6, P-40
- SEDIMENT SAMPLING POINT ID NUMBERS
  P-6, P-12, P-20

# ENVIRONMENTAL SAMPLING POINTS

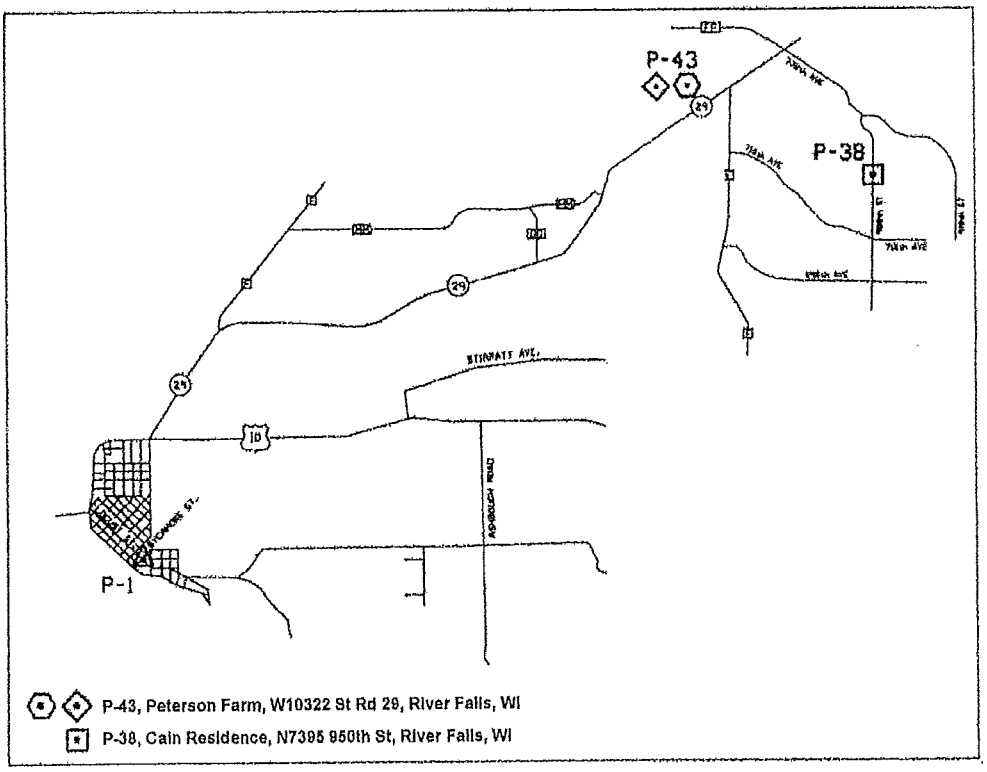
## FIVE MILE RADIUS




MONITORING LEGEND

- MILK SAMPLING POINT ID NUMBERS P-18, P-37, P-42, P-43
- AIR SAMPLING POINT ID NUMBERS P-1, P-2, P-3, P-4, P-6
- WATER SAMPLING POINT ID NUMBERS P-5, P-6, P-8, P-9, P-11, P-24, P-43
- VEGETATION / VEGETABLES ID NUMBERS P-28, P-38, P-45
- FISH SAMPLING POINT ID NUMBERS P-13, P-19
- INVERTEBRATES POINT ID NUMBERS P-6, P-40
- SEDIMENT SAMPLING POINT ID NUMBERS P-6, P-12, P-20

## ENVIRONMENTAL SAMPLING POINTS




**CONTROL POINTS**
PRESCOTT, WISCONSIN

**MONITORING LEGEND**

- MILK SAMPLING POINT ID NUMBERS
  P-18, P-37, P-41, P-42, P-43
- AIR SAMPLING POINT ID NUMBERS
  P-1, P-2, P-3, P-4, P-6
- WATER SAMPLING POINT ID NUMBERS
  P-5, P-6, P-8, P-9, P11, P-43
- VEGETATION / VEGETABLES ID NUMBERS
  P-28, P-38, P-45

# APPENDIX E

Special Well and

Surface Water Samples

## 1.0 INTRODUCTION

This appendix to the Radiological Environmental Monitoring Program Annual Report to the United States Nuclear Regulatory Commission summarizes and interprets results of the special well and surface water samples taken at the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, during the period January - December, 2011. This supplemental special sampling program was established in December of 1989 when higher than expected levels of tritium were detected in a nearby residence well sample.

Tabulations of the special sampling program individual analyses made during the year are included in this appendix. A summary table of tritium analyses is also included in this appendix.

## 2.0 SUMMARY

This special sampling program was established following the detection of tritium in a residence well water sample south of the PINGP during 1989. This program is described and the results for 2011 are summarized and discussed.

Program findings for 2011 detected low levels of tritium in nearby residence wells and ground water surface samples at or near expected natural background levels with the exception of sample wells P-10 and MW-8 and the D5 Fuel Oil Storage Tank Vault. The 2011 sample results (except for P-10, MW-8, and D5 Fuel Oil Storage Tank Vault) ranged from <19 pCi/L to 302 pCi/L. Sample well P-10 ranged from 49 pCi/L to 522 pCi/L. Sample well MW-8 ranged from 216 pCi/L to 382 pCi/L. The D5 Fuel Oil Storage Tank Vault had 1 sample at 897 pCi/L. All tritium results are far below the Environmental Protection Agency's drinking water standard of 20,000 pCi/L and present no harm to any members of the public.

None of the water samples monitored for gamma-emitting isotopes showed any activity above LLD.

## 3.0 Special Tritium Sampling Program

### 3.1 Program Design and Data Interpretation

The purpose of this sampling program is to assess the impact of any tritium leaching into the environment (ground water system) from the PINGP. For this purpose, special water samples are collected and analyzed for tritium content.

### 3.2 Program Description

The sampling and analysis schedule for the special water sampling program is summarized in Table E-4.1 and briefly reviewed below. Table E-4.2 defines the additional sample locations and codes for the special water sampling program.

Special well, tank, and surface water samples were collected quarterly (spring, summer, fall) at seven locations, quarterly at one location, monthly at six locations, semi-annually at seven locations, and annually at thirty-eight locations. The Peterson (P-43) and Hanson (SW-1) farm wells are used as control locations for these special samples.

To detect low levels of tritium at or below natural background levels, analyses of the samples have been contracted to a laboratory (University of Waterloo Laboratories) capable of detecting tritium concentrations down to 19 pCi/L. Waterloo Laboratories report tritium analyses results in Tritium Units (1 TU = 3.2 pCi/L). The tritium results in this report are indicated in pCi/L.

### 3.3 Program Execution

The special water sampling was executed as described in the preceding section.

### 3.4 Program Modifications

Changes to the program in 2011 include:

- In accordance with a recommendation by American Nuclear Insurers, samples from monitoring wells P-10 and MW-8, and stormwater runoff samples from sites S-6 and S-7 were sent to Environmental Incorporated for analysis of hard-to-detect nuclides. Results of the analyses are included in Table E-4.5.
- Samples were taken from the warehouse septic tank
- A sample was taken from water found in the D5 Fuel Oil Storage Tank Vault

## 3.5 Results and Discussion

Results show tritium in well water and ground water samples at or near expected natural background levels except the P-10 and MW-8 sample wells and the D5 Fuel Oil Storage Tank Vault. Table E-4.4 provides the complete data table of results for each period and sampling location.

The tritium level annual averages have shown a downward trend since the special sampling began in 1989.

Except for sample wells P-10 and MW-8, and D5 Fuel Oil Storage Tank Vault, the 2011 sample results are within the range of expected background tritium levels in shallow ground water and surface water due to tritium concentrations measured in precipitation. Sampling points in North America have shown tritium concentrations in precipitation ranging from 5 pCi/L to 157 pCi/L (Environmental Isotope Data No. 10; World Survey of Isotope Concentration in Precipitation (1988-1991)).

The higher level results at the Suter residence and Birch Lake in 1989 were possibly due to seepage from the PINGP discharge canal water into the ground water. This is thought to occur due to the elevation difference between the Vermillion River and the discharge canal. The Suter residence is located between the discharge canal and Birch Lake, which connects to the Vermillion River. The PINGP discharge canal piping was lengthened during 1991, so that liquid discharges from the plant are released near the end of the discharge canal, diffused and discharged to the Mississippi River. In 1992, the underground liquid discharge pipe from the plant to the discharge canal piping was replaced with a double walled leak detectable piping system. This year's sample results continue to indicate that these modifications have eliminated the suspected radioactive effluent flow into the local ground water.

The elevated tritium levels in sample wells P-10 and MW-8 in 2011 may be due to prior leakage from the PINGP liquid radwaste discharge pipe, discharge of turbine building sump water into the landlocked area, or discharge of heating steam condensate from the main warehouse in 1978/1979. The liquid radwaste discharge pipe was replaced in 1992 and the discharge to the landlocked area has been terminated, the last discharge took place on 11/14/09. The main warehouse heating system was repaired in 1979. An additional discharge of 3,900 gallons of heating steam condensate was released in 2011 from the main warehouse. Corrective actions were taken to repair the main warehouse condensate return pumps. Additional corrective actions to prevent recurrence are being developed.

None of the water samples monitored for gamma-emitting isotopes showed any activity greater than the LLD.

Table E-4.1. Sample collection and analysis program for special well, storage tank, and surface water samples, Prairie Island Nuclear Generating Plant, 2011.

| Medium | No. | Location codes and type [a] | Collection type and frequency [b] | Analysis type [c] |
|---|---|---|---|---|
| Well water | 25 | P-8, REMP P-6, PIIC-02, PIIC-03, PIIC-19, PIIC-20, PIIC-22, PIIC-23, PIIC-24, PIIC-26, PIIC-28, P-7, P-11, PZ-1, PZ-2, PZ-4, PZ-5, PZ-7, MW-6, P-26, P-30, SW-3, SW-4, SW-5, P-9 | G/A | H-3 |
| Well water | 1 | P-24D | G/Q | H-3 |
| Well water | 7 | P-2, P-3, P-5, P-6, PZ-8, MW-4, MW-5 | G/Q' | H-3 |
| Well water | 5 | P-43(C), SW-1(C), MW-7, MW-8, P-10 | G/M | H-3 |
| Surface water | 8 | S-1, S-2, S-3, S-4, S-5, S-6, S-7, P-31 | G/A[d] | H-3 |
| Storage Tank | 7 | 11 CST, 21 CST, 22 CST, U1/2 Demin Hdr, Warehouse Septic, D5 Vault | G/S[e] | H-3 |
| Storage Tank | 1 | Septic Tank | G/M | H-3 |
| Snow | 5 | S-6, S-7, S-8, S-9, P-43(C) | G/A | H-3 |

[a] Location codes are defined in table D-4.2. Control Stations are indicated by (C). All other stations are indicators.

[b] Collection type is codes as follows: G/ = grab. Collection frequency is coded as follows: M = monthly; Q = quarterly; Q' = quarterly (spring, summer, and fall), S= semiannually: A = annually.

[c] Analysis type is coded as follows: H-3 = tritium.

[d] Location S-6 and S-7 are sampled semi-annually.

[e] Location D5 Vault was sampled annually.

Table E-4.2. Sampling locations for special well, storage tank, and surface water samples, Prairie Island Nuclear Generating Plant, 2011.

| Code | Collection site | Type of sample [a] | Distance and direction from reactor |
|---|---|---|---|
| P-8 | PI Community well | WW | 1.0 mi. @ 321°/WNW |
| REMP P-6 | Lock & Dam #3 well | WW | 1.6 mi. @ 129°/SE |
| PIIC-02 | 2077 Other Day Road | WW | 1.4 mi. @ 315°/NW |
| PIIC-03 | 6096 Whipple Way | WW | 1.4 mi. @ 310°/NW |
| PIIC-19 | 6372 Sturgeon Lake Rd | WW | 1.7 mi. @ 293°/WNW |
| PIIC-20 | 2158 Holmquist Road | WW | 1.6 mi @ 300°/WNW |
| PIIC-22 | 1773 Buffalo Slough Rd | WW | 1 mi. @ 315°/NW |
| PIIC-23 | 2.7 miles NW | WW | 2.7 mi @315°/NW |
| PIIC-24 | 6424 Sturgeon Lake Rd | WW | 1.7 mi. @ 293°/WNW |
| PIIC-26 | 1771 Buffalo Slough Rd | WW | 1 mi. @ 315°/NW |
| PIIC-28 | 1960 Larson Lane | WW | 1.5 mi @ 288°/WNW |
| P-24D | Suter residence | WW | 0.6 mi. @ 158°/SSE |
| P-43 | Peterson Farm (Control) | WW | 13.9 mi. @ 355°/N |
| SW-1 | Hanson Farm (Control) | WW | 2.2 mi. @ 315°/NW |
| P-2 | Sample well | WW | See map |
| P-3 | Sample well | WW | See map |
| P-5 | Sample well | WW | See map |
| P-6 | Sample well | WW | See map |
| P-7 | Sample well | WW | See map |
| P-10 | Sample well | WW | See map |
| P-11 | Sample well | WW | See map |
| PZ-1 | Sample well | WW | See map |
| PZ-2 | Sample well | WW | See map |
| PZ-4 | Sample well | WW | See map |
| PZ-5 | Sample well | WW | See map |
| PZ-7 | Sample well | WW | See map |
| PZ-8 | Sample well | WW | See map |
| MW-4 | Sample well | WW | See map |
| MW-5 | Sample well | WW | See map |
| MW-6 | Sample well | WW | See map |
| MW-7 | Sample well | WW | See map |
| MW-8 | Sample well | WW | See map |
| P-26 | PITC well | WW | 0.4 mi. @ 258°/WSW |
| P-30 | Environ lab well | WW | 0.2 mi. @ 32°/NNE |

Table E-4.2. Sampling locations for special well, storage tank, and surface water samples, Prairie Island Nuclear Generating Plant, 2011 (continued).

| Code | Collection site | Type of sample [a] | Distance and direction from reactor |
|---|---|---|---|
| SW-3 | Cooling Tower pump | WW | See map |
| SW-4 | New Admin Bldg | WW | 0.05 mi. @ 315°/NW |
| SW-5 | Plant Screenhouse well | WW | 0.05 mi. @ 0°/N |
| P-9 | Plant well # 2 | WW | 0.3 mi. @ 306°/NW |
| S-1 | Upstream Miss. River | SW | See map |
| S-2 | Recirc/Intake canal | SW | See map |
| S-3 | Cooling water canal | SW | See map |
| S-4 | Discharge Canal (end) | SW | See map |
| S-5 | Mid Discharge Canal | SW | See map |
| S-6 | Roof Stormwater Runoff (also snow) | SW | 0.05 mi. @ 0°/N |
| S-7 | Parking Lot Stormwater (also snow) | SW | 0.3 mi @ 306°/NW |
| S-8 | P-10 are snow | SW | See map |
| S-9 | MW-7/8 area snow | SW | See map |
| P-31 | Birch Lake Seepage | SW | |
| 11 CST | Storage Tank | ST | Turbine Building |
| 21 CST | Storage Tank | ST | Turbine Building |
| 22 CST | Storage Tank | ST | Turbine Building |
| Unit 1/2 demin hdr | Storage Tank | ST | Turbine Building |
| Septic System | Storage Tank | ST | Outside #1 Warehouse |
| Warehouse Septic | Storage Tank | ST | Outside #1 Warehouse |
| D5 Vault | Concrete Vault | ST | Outside Turbine Bldg |

[a] Sample codes: WW = Well water; SW = Surface Water: ST = Storage Tank.

Table E-4.3 Radiological Environmental Monitoring Program Summary: Special well, storage tank, and surface water samples.

Name of Facility Prairie Island Nuclear Power Station Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January – December, 2011

| 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] |
|---|---|---|---|---|---|---|---|
| Offsite Well Water (pCi/L) | H-3 18 | 19 | 38 (1/18) | P-24D, Suter | 38 (1/7) | (See Control Below) | 0 |
| Onsite Well Water (pCi/L) | H-3 71 | 19 | 109 (62/71) (20-522) | MW-8, well | 262 (12/12) (216-382) | (See Control Below) | 11 |
| Onsite Surface Water (pCi/L) | H-3 14 | 19 | 120 (11/14) (26-302) | S-9, MW-7/8 Area snow | 302 (1/1) | (See Control Below) | 0 |
| Onsite Storage Tank (pCi/L) | H-3 25 | 19 | 120 (19/25) (24-897) | D-5, Fuel Oil Storage Tank Vault | 897 (1/1) | (See Control Below) | 2 |
| Control (offsite well water) | H-3 24 | 19 | none | P-43, Peterson | 23 (2/12) (22-23) | 23 (2/24) (22-23) | 0 |
| Control (offsite snow/ runoff) | H-3 2 | 19 | none | P-43 | 34 (2/2) (25-43) | 34 (2/2) (25-43) | 0 |

[a] H-3 = tritium

[b] LLD = Nominal lower limit of detection based on 4.66 sigma error for background sample. Value shown is lowest for the period.

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

[d] Locations are specified by code.

[e] Non-routine results are those which exceed ten times the control station value.

Table E-4.4 Radiological Environmental Monitoring Program , Complete Data Table, 2011.

| | SAMPLE DATES | JAN 2011 | FEB 2011 | MAR 2011 | APR 2011 | MAY 2011 | JUN 2011 | JUL 2011 | AUG 2011 | SEP 2011 | OCT 2011 | NOV 2011 | DEC 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CODE | SAMPLE LOCATIONS | | | | | | | | | | | | |
| | OFFSITE WELLS | Tritium Concentration (pCi/L) | | | | | | | | | | | |
| P-8 | PI Comm. Well | | | | | | | | < 19 | | | | |
| REMP P-6 | Lock & Dam #3 well | | | | | | | | | | | < 19 | |
| PIIC-02 | 2077 Other Day Road | | | | | | | | < 19 | | | | |
| PIIC-03 | 6096 Whipple Way | | | | | | | | < 19 | | | | |
| PIIC-19 | 6372 Sturgeon Lake Rd | | | | | | | | < 19 | | | | |
| PIIC-20 | 2158 Holmquist Rd | | | | | | | | < 19 | | | | |
| PIIC-22 | 1773 Buffalo Slough Rd | | | | | | | | < 19 | | | | |
| PIIC-23 | 2.7 miles NW of plant | | | | | | | | < 19 | | | | |
| PIIC-24 | 6424 Sturgeon Lake Rd | | | | | | | | < 19 | | | | |
| PIIC-26 | 1771 Buffalo Slough Rd | | | | | | | | < 19 | | | | |
| PIIC-28 | 1960 Larson Lane | | | | | | | | < 19 | | | | |
| P-24D | Suter residence | 38 | < 19 | | < 19 | < 19 | | < 19 | | < 19 | | < 19 | |
| P-43 | Peterson Farm(Control | < 19 | 22 | 23 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 |
| SW-1 | Hanson Farm (Control) | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 | < 19 |
| P-43 | Snow/Runoff | 43 | | | 25 | | | | | | | | |

Table E-4.4 Radiological Environmental Monitoring Program , Complete Data Table, 2011 (continued).

| | SAMPLE DATES | JAN 2011 | FEB 2011 | MAR 2011 | APR 2011 | MAY 2011 | JUN 2011 | JUL 2011 | AUG 2011 | SEP 2011 | OCT 2011 | NOV 2011 | DEC 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CODE | SAMPLE LOCATIONS | | | | | | | | | | | | |
| | ONSITE WELLS | Tritium Concentration (pCi/L) | | | | | | | | | | | |
| P-2 | Sample well | | | | 51 | | | 85 | | | 35 | | |
| P-3 | Sample well | | | | 41 | | | 20 | | | < 19 | | |
| P-5 | Sample well | | | | 59 | | | 46 | | | 81 | | |
| P-6 | Sample well | | | | 44 | | | < 19 | | | 24 | | |
| P-7 | Sample well | | | | | | | 39 | | | | | |
| P-10 | Sample well | 148 | 82 | 66 | 522 | 365 | 214 | 186 | 132 | 53 | 49 | 103 | 234 |
| P-11 | Sample well | | | | | | | 33 | | | | | |
| PZ-1 | Sample well | | | | | | | < 19 | | | | | |
| PZ-2 | Sample well | | | | | | | < 19 | | | | | |
| PZ-4 | Sample well | | | | | | | 48 | | | | | |
| PZ-5 | Sample well | | | | | | | 22 | | | | | |
| PZ-7 | Sample well | | | | | | | 37 | | | | | |
| PZ-8 | Sample well | | | | 35 | | | 20 | | | 31 | | |
| MW-4 | Sample well | | | | | 36 | | 21 | | | 23 | | |
| MW-5 | Sample well | | | | 28 | | | 27 | | | 20 | | |
| MW-6 | Sample well | | | | | | | 80 | | | | | |
| MW-7 | Sample well | 43 | 54 | 40 | 39 | < 19 | < 19 | 31 | < 19 | 57 | 51 | 29 | < 19 |
| MW-8 | Sample well | 250 | 269 | 283 | 382 | 295 | 225 | 227 | 241 | 264 | 216 | 266 | 227 |
| P-26 | PITC well | | | | | | | | | | | 46 | |
| P-30 | Env. lab well | | | | | | | | | | | 28 | |
| SW-3 | CT pump | | | | | | | | | | | < 19 | |
| P-9 | Plant well # 2 | | | | | | | | | | | 23 | |
| SW-4 | New Admin | | | | | | | | | | | 24 | |
| SW-5 | Pln Scrnhs | | | | | | | | | | | 37 | |

Table E-4.4 Radiological Environmental Monitoring Program , Complete Data Table, 2011 (continued).

| | SAMPLE DATES | JAN 2011 | FEB 2011 | MAR 2011 | APR 2011 | MAY 2011 | JUN 2011 | JUL 2011 | AUG 2011 | SEP 2011 | OCT 2011 | NOV 2011 | DEC 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CODE | SAMPLE LOCATIONS | | | | | | | | | | | | |
| | ONSITE SURFACE WATER | Tritium Concentration (pCi/L) | | | | | | | | | | | |
| S-1 | Mississippi River upstream | | | | | | | | | | | 43 | |
| S-2 | Recirculation/Intake canal | | | | | | | | | | | 36 | |
| S-3 | Cooling water canal | | | | | | | | | | | 27 | |
| S-4 | Discharge Canal (end) | | | | | | | | | | | 30 | |
| S-5 | Discharge Canal (midway) | | | | | | | | | | | < 19 | |
| S-6 | Stormwater runoff | 132* | | | 124 | | | | | | 26 | | |
| S-7 | Parking Lot runoff | 249* | | | 250 | | | | | | < 19 | | |
| S-8 | P-10 area snow | 101 | | | | | | | | | | | |
| S-9 | MW-7/8 area snow | 302 | | | | | | | | | | | |
| P-31 | Birch Lake Seepage | | | | | | | | < 19 | | | | |

* snow samples

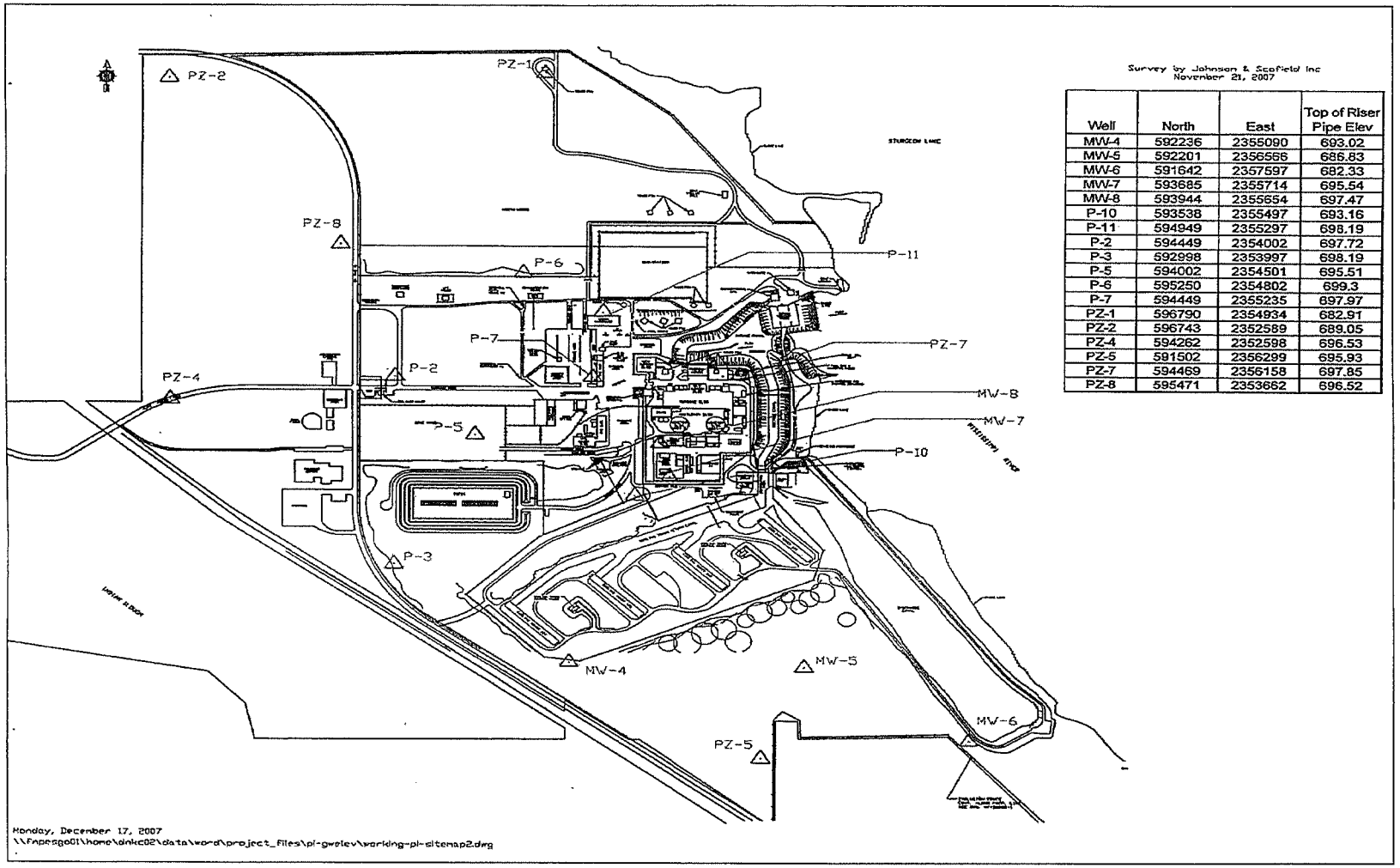
Table E-4.4 Radiological Environmental Monitoring Program , Complete Data Table, 2011 (continued).

| | SAMPLE DATES | JAN 2011 | FEB 2011 | MAR 2011 | APR 2011 | MAY 2011 | JUN 2011 | JUL 2011 | AUG 2011 | SEP 2011 | OCT 2011 | NOV 2011 | DEC 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CODE | SAMPLE LOCATIONS | | | | | | | | | | | | |
| | ONSITE STORAGE TANKS | Tritium Concentration (pCi/L) | | | | | | | | | | | |
| 11 CST | Storage tank | | | | | < 19 | | | | < 19 | | | |
| 21 CST | Storage tank | | | | | < 19 | | | | < 19 | | | |
| 22 CST | Storage tank | | | | | < 19 | | | | < 19 | | | |
| U1/U2 Demin Header | Storage tank | | | | | 24/98 | | | | 28/34 | | | |
| Septic System | Storage tank | 62 | 79 | 80 | 27 | 30 | 202 | 111 | 58 | 68 | 260 | 68 | 47 |
| Warehouse septic | Storage tank | | 62 | 42 | | | | | | | | | |
| D5 Fuel Oil Storage Tank Vault | Concrete Vault | | | | | | | | | 897 | | | |

Table E-4.5. Results of analyses for iron-55, nickel-63, strontium-90, isotopic plutonium, americium-241 and isotopic curium in four samples.

| Location | P-10 | MW-8 | S-6 | S-7 |
|---|---|---|---|---|
| Collection Date | 04-28-11 | 04-28-11 | 04-30-11 | 04-30-11 |
| Lab Code | PXWW-2646 | PXWW-2647 | PXWW-2648 | PXWW-2649 |
| Isotope | Concentration (µCi/mL) | | | |
| Fe-55 | < 7.7 E-07 | < 7.9 E-07 | < 7.7 E-07 | < 8.0 E-07 |
| Ni-63 | < 9.5 E-09 | < 9.1 E-09 | < 8.4 E-09 | < 1.1 E-08 |
| Sr-90 | < 5.1 E-10 | < 5.0 E-10 | < 5.1 E-10 | < 4.8 E-10 |
| Pu-238 | < 2.7 E-10 | < 1.6 E-10 | < 1.8 E-10 | < 3.6 E-10 |
| Pu-239/240 | < 1.6 E-10 | < 1.6 E-10 | < 1.8 E-10 | < 3.6 E-10 |
| Am-241 | < 6.2 E-10 | < 5.6 E-10 | < 4.4 E-10 | < 1.0 E-09 |
| Cm-242 | < 1.5 E-10 | < 1.4 E-10 | < 7.6 E-11 | < 3.1 E-10 |
| Cm-243/244 | < 1.5 E-10 | < 1.4 E-10 | < 7.6 E-11 | < 2.2 E-10 |

The error given is the probable counting error at 95% confidence level. Less than (<), value is based on a 4.66 sigma counting error for the background sample.




Survey by Johnson & Scofield Inc
November 21, 2007

| Well | North | East | Top of Riser Pipe Elev |
|---|---|---|---|
| MW-4 | 592236 | 2355090 | 693.02 |
| MW-5 | 592201 | 2356566 | 686.83 |
| MW-6 | 591642 | 2357597 | 682.33 |
| MW-7 | 593685 | 2355714 | 695.54 |
| MW-8 | 593944 | 2355654 | 697.47 |
| P-10 | 593538 | 2355497 | 693.16 |
| P-11 | 594949 | 2355297 | 698.19 |
| P-2 | 594449 | 2354002 | 697.72 |
| P-3 | 592998 | 2353997 | 698.19 |
| P-5 | 594002 | 2354501 | 695.51 |
| P-6 | 595250 | 2354802 | 699.3 |
| P-7 | 594449 | 2355235 | 697.97 |
| PZ-1 | 596790 | 2354934 | 682.91 |
| PZ-2 | 596743 | 2352589 | 689.05 |
| PZ-4 | 594262 | 2352598 | 696.53 |
| PZ-5 | 591502 | 2356299 | 695.93 |
| PZ-7 | 594469 | 2356158 | 697.85 |
| PZ-8 | 595471 | 2353662 | 696.52 |

Groundwater Monitoring Well Locations