Northern States Power Company

414 Nicollet Mall
Minneapolis, Minnesota 55401-1927
Telephone (612) 330-5500

April 30, 1991

Prairie Island Technical
Specification TS 6.7.C.1

U S Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D C 20555

Prairie Island Nuclear Generating Plant
Docket No. 50-282 License No. DPR-42
Docket No. 50-306 License No. DPR-60

1990 Annual Radiological Environmental Monitoring Report

In accordance with the Prairie Island Technical Specifications, Appendix A to Operating License DPR-42 and DPR-60, we are submitting one copy of the Annual Radiological Environmental Monitoring Report, covering the period January 1 through December 31 of 1990.

Respectfully submitted,

Fred L Fey

F . L. Fey, Jr., Manager
Nuclear Radiological Services

Attachment

IE25
1/1

TELEDYNE ISOTOPES

MIDWEST LABORATORY

700 LANDWEHR ROAD

NORTHBROOK, ILLINOIS 60062-2310

(708) 564-0700 FAX (708) 564-4517

NORTHERN STATES POWER COMPANY
MINNEAPOLIS, MINNESOTA

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket No. 50-282 License No. DPR-42
50-306 DPR-60

ANNUAL REPORT
to the
UNITED STATES NUCLEAR REGULATORY COMMISSION

Radiation Environmental Monitoring Program
January 1, 1990 to December 31, 1990

Prepared Under Contract
by
TELEDYNE ISOTOPES MIDWEST LABORATORY
Project No. 8010

Approved by: L. G. Huebner

L. G. Huebner
General Manager

15 March 1991

PREFACE

The staff of Teledyne Isotopes Midwest Laboratory was responsible for the acquisition of data presented in this report. Samples were collected by the contractor Interpoll Laboratories, Inc. from January 1 to March 15, 1990, and then by members of the staff of the Nuclear Radiological Services Department, Northern States Power Company, from March 16 to December 31, 1990. The report was prepared by L. G. Huebner, General Manager, Teledyne Isotopes Midwest Laboratory. He was assisted in the report preparation by other staff members of this laboratory.

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

This report summarizes and interprets results of the Radiation Environmental Monitoring Program (REMP) conducted by Teledyne Isotopes Midwest Laboratory at the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, during the period January - December, 1990. 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 (Teledyne Isotopes Midwest Laboratory, 1991B) available at Northern States Power Company, Nuclear Generation Department.

Prairie Island Nuclear Generating Plant is located on the Mississippi River in Goodhue County, Minnesota, and operated by Northern States Power Company. The plant has two 550 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 Radiation Environmental Monitoring Program (REMP) required by the U.S. Nuclear Regulatory Commission (NRC) Technical Specifications for the Prairie Island Nuclear Generating Plant is described. Results for 1990 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 some of the additional special ground, well, and surface water samples. These special ground, surface, and well water samples are summarized and documented separately in Appendix D.

3.0 RADIATION ENVIRONMENTAL MONITORING PROGRAM (REMP)

3.1 Program Design and Data Interpretation

The purpose of the Radiation 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 also 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.

Other means of distinguishing sources of environmental radiation can be employed in interpreting the data. Current radiation levels can be 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 environmental radiation 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. To assure that sampling is carried out in a reproducible manner, detailed sampling procedures have been prescribed (Teledyne Isotopes Midwest Laboratory, 1987).

To monitor the air environment, airborne particulates are collected on membrane filters by continuous pumping at five locations. Also, airborne iodine is collected by continuous pumping through charcoal filters at all of these locations. Filters are changed and counted weekly. Particulate filters are analyzed for gross beta activity and charcoal filters for iodine-131. A monthly composite of all particulate filters is gamma-scanned on an HP Ge or Ge(Li) detector. One of the five locations is a control (P-1), and four are indicator (P-2, P-3, P-4, and P-6).

As a "Lessons Learned" commitment, ambient gamma radiation is monitored at thirty-two (32) locations, using $CaSo_4$:Dy dosimeter with four sensitive areas at each location: ten (10) in an inner ring in the general area of the site boundary, fifteen (15) in the outer ring within 4 - 5 mile radius, six (6) at special interest locations and one control location, 11.1 miles distant from the plant. They are replaced and measured quarterly. Also, a complete emergency set of TLDs for all locations is placed in the field at the same time as regular sets. The emergency set is returned to TIML quarterly for annealing and repackaging.

Milk samples are collected monthly from six farms (five indicator and one control). A new milk location (P-36) was added to the program in November, 1990). The milk is collected biweekly during the growing season (June - September), because the milk animals may be on pasture. All samples are analyzed for iodine-131 and gamma-emitting isotopes.

For additional monitoring of the terrestrial environment, leafy green vegetables (cabbage) are collected annually from the highest D/Q garden and a control location (P-25) and analyzed for iodine-131. Corn is collected annually only from fields irrigated with river water and a control location (P-25) and analyzed for gamma-emitting isotopes. Also, well water is collected quarterly from four locations and analyzed for tritium and gamma-emitting isotopes. Additional special well water and ground water is collected monthly from six locations and quarterly from three 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.

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. No air particulate and I-131 data was available for Location P-3 for the collection period ending 02-05-90 because of pump failure.

2. No data was available for vegetation from Location P-24 because the sample was lost in transit.

3. The TLD data for the fourth quarter of 1990 for Location P-14B was not available because TLD was lost in the field.

Deviations from the program are summarized in Table 5.3. The responsibilities of collecting and shipping samples were transferred to Nuclear Radiological Services (NRS) effective January 1, 1990. An additional person has been added to NRS since March 1, 1990. Additional effort will be made to collect any missed milk sample if milk will become available shortly; damaged or missed TLD holders will be investigated, replaced, or relocated which are similar to the actions that have been taken in the past.

3.4 Laboratory Procedures

All iodine-131 analyses in milk and drinking water were made by using a sensitive radiochemical procedure which involves separation of the element by use of an ion-exchange resin and subsequent beta counting.

All gamma-spectroscopic analyses were performed with an HP Ge or Ge(Li) detector. Levels of iodine-131 in cabbage were determined by HP Ge or Ge(Li) spectrometry. Levels of airborne iodine-131 in charcoal samples were measured by HP Ge or Ge(Li) spectrometry.

Tritium levels were determined by liquid scintillation technique.

Analytical procedures used by the Teledyne Isotopes Midwest Laboratory are specified in detail elsewhere (Teledyne Isotopes Midwest Laboratory, 1985). Procedures are based on those prescribed by the National Center for Radiological Health of the U. S. Public Health Service (U. S. Public Health Service, 1967) and by the Health and Safety Laboratory of the U. S. Atomic Energy Commission (U. S. Atomic Energy Commission, 1972).

Teledyne Isotopes Midwest Laboratory has a comprehensive quality control/quality assurance program designed to assure the reliability of data obtained. Details of TIML's Quality Assurance Program are presented elsewhere (Teledyne Isotopes Midwest Laboratory, 1991). The TIML Quality Assurance Program includes participation in Interlaboratory Comparison (Crosscheck) Programs. Results obtained in crosscheck programs are presented in Appendix A.

3.5 Program Modifications

During the growing season, milk producers were monitored to determine when the dairy animals were on pasture or fresh cut feed. The frequency of milk samples was increased to semimonthly during the grazing period because animals were on pasture or fresh cut feed. One milk location was added to the program in November 1990.

3.6 Land Use Census

In accordance with Technical Specification 4.10, paragraph B1, 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. 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 radiation environmental monitoring program should sampling locations change within the 5 mile radius from the plant.

The 1990 Land Use Census was completed on August 30, 1990. This census did not identify any locations of exposure pathways different from those used in the program during the first six months of the year. Milk and garden sample locations did not change due to the requirements of the land use census.

4.0 RESULTS AND DISCUSSION

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

All 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

There were no reported atmospheric nuclear tests in 1990. The last reported test was conducted on October 16, 1980 by the People's Republic of China. The reported yield was in the 200 kiloton to 1 megaton range.

There were no reported accidents at nuclear reactor facilities in 1990.

4.2 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected in the vicinity of the Prairie Island Nuclear Generating Plant in 1990, with the exception of some of the additional special ground water samples and well water samples.

Ambient Radiation (TLDs)

Ambient radiation was measured in the general area of site boundary, at outer ring 4 - 5 mi distant from the Plant, at special interest areas, and at one control location. The means ranged from 15.0 mR/91 days at inner ring locations to 16.6 mR/91 days at outer ring locations. The mean at special locations was 14.9 mR/91 days and 16.3 mR/91 days at the control location. The differences are not statistically significant. The dose rates measured at all indicator and control locations were similar to those observed in 1978 (12.1 and 15.1 mR/91 days, respectively); in 1979 (12.6 and 15.3 mR/91 days, respectively); in 1980 (11.2 and 13.5 mR/91 days, respectively),; in 1981 (13.0 and 14.5 mR/91 days, respectively); in 1982 (12.0 and 13.0 mR/91 days, respectively),; in 1983 (13.0 and 14.9 mR/91 days, respectively); in 1984 (13.9 and 15.3 mR/91 days, respectively); in 1985 (13.9 and 15.3 mR/91 days, respectively); in 1986 (16.6 and 17.0 mR/91 days, respectively), in 1987 (15.4 and 16.0 mR/91 days, respectively), in 1988 (16.2 and 16.7 mR/91

days, respectively), and in 1989 (15.8 and 16.3 mR/91 days, respectively). No plant effect on ambient gamma radiation was indicated.

Airborne Particulates

The average annual gross beta concentration in airborne particulates was nearly identical at both indicator and control locations (0.024 and 0.023 pCi/m^3), respectively and was about the same as the levels observed in 1982 (0.026 pCi/m^3), 1983 (0.023 pCi/m^3), 1984 (0.024 pCi/m^3), 1985 (0.025 pCi/m^3), 1986 (0.025 pCi/m^3), and 1987 (0.024 pCi/m^3). It was slightly lower than in 1988 (0.030 pCi/m^3 at both indicator and control locations) and 1989 (0.028 pCi/m^3). The average of 0.025 pCi/m^3 for 1986 does not include the results from May 19 to June 9, 1986, which were influenced by the accident at Chernobyl.

A spring peak in beta activity had been observed almost annually for many years (Wilson et al., 1969). It had been attributed to fallout of nuclides from the stratosphere (Gold et al., 1964). It was pronounced in 1981, occurred to a lesser degree in 1982, and did not occur in 1983, 1984, 1985, 1987 or 1988. In 1986, the spring peak could not be identified because it was overshadowed by the releases of radioactivity from Chernobyl. The highest averages for gross beta were for the month of January and the first quarter. The increase of beta activity during winter months were also observed in 1983, 1984, 1985, 1986 (exclusive of the period between May 19, 1986 and June 9, 1986), 1987, 1988, and 1989.

Two pieces of evidence indicate conclusively that the elevated activity observed during the fourth quarter was not attributable to the Plant operation. In the first place, elevated activity of similar size occurred simultaneously at both indicator and control locations. Secondly, an identical pattern was observed at the Monticello Nuclear Generating Plant, about 100 miles distant from the Prairie Island Nuclear Generating Plant (Northern States Power Company, 1991a).

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

Airborne Iodine

Weekly levels of airborne iodine-131 were below the lower limit of detection (LLD) of 0.07 pCi/m^3 in all samples.

Milk

Iodine-131 results were below the detection limit of 1.0 pCi/L in all samples.

Cs-137 results were below the LLD level of 15 pCi/L in all samples. No other gamma-emitting isotopes, except potassium-40, were detected in any milk samples. This is consistent with the finding 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 the 1990 show no radiological effects of the plant operation.

Drinking Water

In drinking water from the City of Red Wing well, tritium activity was below the LLD level of 330 pCi/L in all samples. Iodine-131 activity was also below the LLD level at 1.0 pCi/L in all samples. As with the other well water samples, all analyses for gamma-emitting isotopes yielded results below detection limits. Gross beta averaged 7.0 pCi/L and was similar to the levels observed in 1979 (10.5 pCi/L), 1980 (11.8 pCi/L), 1981 (10.7 pCi/L), 1982 (6.9 pCi/L), 1983 (8.0 pCi/L), 1984 (7.9 pCi/L), 1985 (7.1 pCi/L), 1986 (6.8 pCi/L), 1987 (7.9 pCi/L), 1988 (8.0 pCi/L), and 1989 (7.0 pCi/L).

River Water

At the upstream and downstream collection sites, quarterly composite tritium levels were below the LLD level of 330 pCi/L in all but one sample The detected activity was 484 pCi/L in a composite sample for the third quarter from Location P-6. The detected activity was close to the detection level and is not significant.

River water was also analyzed for gamma-emitting isotopes. All gamma-emitting isotopes were below their respective detection limits.

Well Water

At the control well P-25, Rohl Farm and three indicator wells (P-8, Community Center; P-6, Lock and Dam No. 3; and P-9, Plant Well No. 2) no tritium was detected above LLD level of 330 pCi/L in all samples.

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

Crops

One sample of cabbage was collected in September and analyzed for I-131. The I-131 level was below 0.015 pCi/g wet weight in both samples. There was no indication of a plant effect.

The field sampling personnel conducted a survey and found that there was no river water taken for irrigation into fields within 5 miles down stream form Prairie Island Plant. Therefore, it was not necessary to collect and analyze corn samples.

Fish

Fish samples were collected in May and September, 1990. The only isotope detected was naturally-occuring potassium-40 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 May and October, 1990. The samples were analyzed for gamma-emitting isotopes. All gamma-emitting isotopes except potassium-40 were below their respective LLDs. No plant effect was indicated.

Bottom and Shoreline Sediments

Sediment collections were made in May and October, 1990. The samples were analyzed for gamma-emitting isotopes.

Cs-137 was detected in one bottom sediment upstream sample (0.093 pCi/g dry weight).

All other gamma-emitting isotopes, except naturally-occurring potassium-40, were below their respective LLDs. No plant effect was indicated.

5.0 TABLES

Table 5.1 Sample collection and analysis program, Prairie Island Nuclear Generating Plant, 1990.

Medium	Locations No.	Locations Codes (and Type)[a]	Collection Type and Frequency[b]	Analysis Type and Frequency[c]
Ambient radiation (TLDs)	32	P-01A - P-10A P-01B - P-15B P-01S - P-06S P-01C	C/Q	Ambient gamma
Airborne particulates	5	P-1(C), P-2, 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	5	P-16, P-17, P-18 P-14, P-25(C), P-36	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) GS(MC), H-3(QC)
Well water	4	P-25(C), P-6, P-8, P-9	G/Q	H-3, GS
Edible cultivated crops - leafy green vegetables	2	P-25(C), P-24	G/A	I-131
Fish (one species edible portion)	2	P-19(C), P-13	G/SA	GS
Periphyton or invertebrates	2	P-5(C), P-12	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 5.2. 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 (June - October) if milch animals are on pasture.

Table 5.2. Sampling locations, Prairie Island Nuclear Generating Plant, 1990.

Code	Type[a]	Collection Site	Type of Sample[b]	Distance and Direction from Site Stack
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, BO	2.3 mi @ 348°/NNW
P-6		Lock & Dam #3 & Air Station P-6	AP,AI,RW,WW,BS	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	BO, SS	3.0 mi @ 116°/ESE
P-13		Downstream of Plant	F	3.5 mi @ 113°/ESE
P-14		Gustafson Farm	M	2.3 mi @ 173°/SSE
P-16		Johnson Farm	M	2.6 mi @ 60°/ENE
P-17		Place Farm	M	3.5 mi @ 25°/NNE
P-18		Christensen Farm	M	3.8 mi @ 88°/E
P-19		Upstream of Plant	F	1.3 mi @ 0°/N
P-20		Upstream of Plant	F	0.9 mi @ 45°/NE
P-24		Suter Residence	VE	0.6 mi @ 158°/SSE
P-25	C	Rohl Farm	M, WW, VE	12.9 mi @ 352°/N
P-36		Dosdahl Farm	M	3.9 mi @ 9°/N
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°/SSW
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°/NNW
P-09A		Property Line	TLD	0.7 mi @ 317°/NW
P-10A		Property Line	TLD	0.5 mi @ 333°/NNW

Table 5.2. Sampling locations, Prairie Island Nuclear Generating Plant, 1990 (continued)

Code	Type[a]	Collection Site	Type of Sample[b]	Distance and Direction from Site Stack
Approximately 4 to 5 miles Distant from the Plant				
P-01B		Thomas Killian Residence	TLD	4.7 mi @ 355°/N
P-02B		Roy Kinneman Farm	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	4.1 mi @ 102°/ESE
P-06B		William Houschildt 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		Roy Gergen Farm	TLD	4.5 mi @ 247°/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	4.2 mi @ 347°/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°/SSE
P-04S		Richard Burt Residence	TLD	2.0 mi @ 202°/SSW
P-05S		Kenney Store	TLD	2.0 mi @ 270°/W
P-06S		Earl Flynn Farm	TLD	2.5 mi @ 299°/WNW
P-01C		Robert Kinnemen Farm	TLD	11.1 mi @ 331°/NNW

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

[b] Sample codes:

AP = Airborne particulate
AI = Airborne iodine
M = Milk
VE = Vegetation/vegetables
DW = Drinking water
RW = River water
WW = Well water
BS = Bottom (river) sediments
SS = Shoreline Sediments
BO = Bottom organisms (periphyton or macroinvertebrates)
F = Fish

Table 5.3. Missed collections and analyses, 1990, Prairie Island Nuclear Generating Plant. All required samples were collected and analyzed as scheduled except the following.

Sample	Analysis	Location	Collection Date or Period	Comments
Air Particulates and Charcoal	Gross beta I-131	P-3	02-05-90	Pump failure.
Vegetation	I-131	P-24	09-10-90	Sample lost in transit.
Thermoluminescent Dosimeters (TLDs)	Ambient Radiation	P-14B	4th Qtr. 1990	Lost in the field.

Table 5.4. Radiological Environmental Monitoring Program Summary.

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January - December 1990

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 of Non-routine Results[e]
TLD (mR/91 days) (Inner Ring, General Area at Site Boundary)	Gamma 40	3.0	15.0 (40/40) (12.0-18.7)	P-03A, Property Line, 0.5 mi @ 183°/S	17.4 (4/4) (16.5-18.7)	(See Control below.)	0
TLD (mR/91 days) (Outer Ring, 4 - 5 miles distant)	Gamma 59	3.0	16.6 (59/59) (13.2-20.4)	P-03F, W. Anderson Farm, 4.9 mi @ 46°/NE	19.0 (4/4) (17.7-20.3)	(See Control below.)	0
TLD (mR/91 days) (Special Interest Areas)	Gamma 24	3.0	14.9 (24/24) (11.1-19.1)	P-03S, C. Gustafson Farm, 2.2 mi @ 173°/SSE	17.0 (4/4) (14.6-19.1)	(See control below.)	0
TLD (mR/91 days) (Control)	Gamma 4	3.0	None	P-01C, R. Kinneman Farm, 11.1 mi @ 331°/NNW	16.3 (4/4) (15.6-17.5)	16.3 (4/4) (15.6-17.5)	0
Airborne Particulates (pCi/m^3)	GB 264	0.030	0.024 (210/211) (0.007-0.059)	P-2, Station P-2 0.5 mi @ 294°/WNW	0.025 (52/53) (0.009-0.050)	0.023 (53/53) (0.006-0.052)	0
	GS 20						
	Be-7	0.022	0.051 (16/16) (0.040-0.065)	P-3, Station P-3 0.8 mi @ 313°/NW	0.052 (4/4) (0.047-0.058)	0.050 (4/4) (0.042-0.065)	0
				P-4, Station P-4 0.4 mi @ 359°/N	0.052 (4/4) (0.043-0.062)		
	Mn-54	0.0013	<LLD	-	-	<LLD	0
	Cc-58	0.0014	<LLD	-	-	<LLD	0
	Co-60	0.0011	<LLD	-	-	<LLD	0
	Zn-65	0.0026	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.0025	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January - December 1990

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number of Non-routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Airborne Particulates (pCi/m^3)	GS						
	Ru-103	0.0014	<LLD	-	-	<LLD	0
	Ru-106	0.011	<LLD	-	-	<LLD	0
	Cs-134	0.0010	<LLD	-	-	<LLD	0
	Cs-137	0.0013	<LLD	-	-	<LLD	0
	Ba-La-140	0.0038	<LLD	-	-	<LLD	0
	Ce-141	0.0022	<LLD	-	-	<LLD	0
	Ce-144	0.0066	<LLD	-	-	<LLD	0
Airborne Iodine (pCi/m^3)	I-131 264	0.97[f]	<LLD	-	-	<LLD	0
Milk (pCi/L)	I-131 87	1.0	<LLD	-	-	<LLD	0
	GS 87						
	K-40	100	1300 (70/70) (1180-1720)	P-14, Gustafson Farm 2.2 mi @ 173°/SSE	1340 (17/17) (1130-1480)	1240 (17/17) (850-1490)	0
	Cs-134	15	<LLD	-	-	<LLD	0
	Cs-137	15	<LLD	-	-	<LLD	0
	Ba-La-140	15	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January - December 1990

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 of Non-routine Results[e]
Drinking Water (pCi/L)	GB 12	1.0	7.0 (12/12) (5.2-8.7)	P-11, Red Wing Service Center 3.3 mi @ 159°/SSE	7.0 (12/12) (5.2-8.7)	None	0
	I-131 12	1.0	<LLD	-	-	None	0
	H-3 4	330	<LLD	-	-	None	0
	GS 12						
	Mn-54	15	<LLD	-	-	None	0
	Fe-59	30	<LLD	-	-	None	0
	Co-58	15	<LLD	-	-	None	0
	Co-60	15	<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	64	<LLD	-	-	None	0
River Water (pCi/L)	H-3 8	330	484 (1/4)	P-6, Lock and Dam No. 3, 1.6 miles @ 129°/SE	484 (1/4	<LLD	0
	GS 24						
	Mn-54	15	<LLD	-	-	<LLD	0
	Fe-59	30	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January - December 1990

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number of Non-routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
River Water (pCi/L) (continued)	Co-58	15	<LLD	-	-	<LLD	0
	Co-60	15	<LLD	-	-	<LLD	0
	Zn-65	30	<LLD	-	-	<LLD	0
	Cs-134	15	<LLD	-	-	<LLD	0
	Cs-137	18	<LLD	-	-	<LLD	0
	Ba-La-140	15	<LLD	-	-	<LLD	0
	Ce-144	66	<LLD	-	-	<LLD	0
Well Water (pCi/L)	H-3 22	330	<LLD	-	-	<LLD	0
	GS 22						
	Mn-54	15	<LLD	-	-	<LLD	0
	Fe-59	30	<LLD	-	-	<LLD	0
	Co-58	15	<LLD	-	-	<LLD	0
	Co-60	15	<LLD	-	-	<LLD	0
	Zn-65	30	<LLD	-	-	<LLD	0
	Zr-Nb-95	15	<LLD	-	-	<LLD	0
	Cs-134	10	<LLD	-	-	<LLD	0
	Cs-137	10	<LLD	-	-	<LLD	0
	Ba-La-140	15	<LLD	-	-	<LLD	0
	Ce-144	65	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January - December 1990

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 of Non-routine Results[e]
Crops - Cabbage (pCi/g wet)	I-131 1	0.015	<LLD	-	-	<LLD	0
Fish - Flesh (pCi/g wet)	GS 4						
	K-40	0.1	2.52 (2/2) (2.24-2.81)	P-19, Upstream of Plant, 1.3 mi @ 0°/N	2.96 (2/2) (2.57-3.35)	2.96 (2/2) (2.57-3.35)	0
	Mn-54	0.021	<LLD	-	-	<LLD	0
	Fe-59	0.095	<LLD	-	-	<LLD	0
	Co-58	0.030	<LLD	-	-	<LLD	0
	Co-60	0.020	<LLD	-	-	<LLD	0
	Zn-65	0.055	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.057	<LLD	-	-	<LLD	0
	Cs-134	0.019	<LLD	-	-	<LLD	0
	Cs-137	0.025	<LLD	-	-	<LLD	0
	Ba-La-140	0.15	<LLD	-	-	<LLD	0
Invertebrates (pCi/g wet)	GS 4						
	Be-7	4.34	<LLD	-	-	<LLD	0
	K-40	2.57	<LLD	P-5 (C), Upstream of Plant, 2.3 mi @ 348°/NNW	4.54 (1/2)	4.54 (1/2)	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January - December 1990

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number of Non-routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Invertebrates (pCi/g wet) (continued)	GS						
	Mn-54	0.18	<LLD	-	-	<LLD	0
	Co-58	0.26	<LLD	-	-	<LLD	0
	Co-60	0.15	<LLD	-	-	<LLD	0
	Zn-65	0.35	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.51	<LLD	-	-	<LLD	0
	Ru-103	0.40	<LLD	-	-	<LLD	0
	Ru-106	1.40	<LLD	-	-	<LLD	0
	Cs-134	0.15	<LLD	-	-	<LLD	0
	Cs-137	0.16	<LLD	-	-	<LLD	0
	Ba-La-140	2.32	<LLD	-	-	<LLD	0
	Ce-141	0.88	<LLD	-	-	<LLD	0
	Ce-144	1.26	<LLD	-	-	<LLD	0
Bottom and Shoreline Sediments (pCi/g dry)	GS 6						
	Be-7	0.40	<LLD	-	-	<LLD	0
	K-40	1.0	7.44 (4/4) (6.50-8.32)	P-20, Upstream of Plant, 0.9 mi @ 45°/NE	8.30 (2/2) (7.59-9.00)	8.30 (2/2) (7.59-9.00)	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306

Location of Facility Goodhue, Minnesota (County, State) Reporting Period January - December 1990

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number of Non-routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Bottom and Shoreline Sediments (pCi/g dry) (continued)	GS						
	Mn-54	0.031	<LLD	-	-	<LLD	0
	Co-58	0.038	<LLD	-	-	<LLD	0
	Co-60	0.039	<LLD	-	-	<LLD	0
	Zn-65	0.074	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.073	<LLD	-	-	<LLD	0
	Ru-103	0.051	<LLD	-	-	<LLD	0
	Ru-106	0.24	<LLD	-	-	<LLD	0
	Cs-134	0.025	<LLD	-	-	<LLD	0
	Cs-137	0.029	<LLD	P-20, Upstream of Plant, 0.9 mi @ 45°/NE	0.093 (1/2) -	0.093 (1/2) -	0
	Ba-La-140	0.42	<LLD	-	-	<LLD	0
	Ce-141	0.10	<LLD	-	-	<LLD	0
	Ce-144	0.13	<LLD	-	-	<LLD	0

a GB = Gross beta; GS = gamma scan.
b LLD = Nominal lower limit of detection based on 4.66 sigma error for background sample.
c Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
d Locations are specified (1) by name and code (Table 2) and (2) distance, direction, and sector relative to reactor site.
e Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.
f One result for I-131 did not reach LLD (0.51 pCi/m^3) due to very low volume.

6.0 REFERENCES CITED

Arnold, J. R. and H. A. Al-Salih. 1955. Beryllium-7 Produced by Cosmic Rays. Science 121: 451-453.

Eisenbud, M. 1963. Environmental Radioactivity, McGraw-Hill, New York, New York, pp. 213, 275 and 276.

Gold, S., H. W. Barkhau, B. Shlein, and B. Kahn, 1964. Measurement of Naturally Occuring Radionuclides in Air, in the Natural Radiation Environment, University of Chicago Press, Chicago, Illinois, 369-382.

Hazleton Environmental Sciences Corporation. 1979a. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1978.

_____. 1979b. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1978.

_____. 1980a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1979.

_____. 1980b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1979.

_____. 1981a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1980.

_____. 1981b. Radiation Environmental Monitoring for Prarie Island Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1980.

_____. 1982a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1981.

_____. 1982b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1981.

_____. 1983a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1982.

Hohenemser, C.M. Deicher, A. Ernst, H. Hofsass, G. Lindner, E. Racknagel. 1986. "Chernobyl," Chemtech, October 1986, pp. 596-605.

National Center for Radiological Health, 1968. Radiological Health and Data Reports, Vol. 9, Number 12, 730-746.

Northern States Power Company. 1979. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1978 to December 31, 1978 (prepared by Hazleton Environmental Sciences). Minneapolis, Minnesota.

_____. 1980. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1979 to December 31, 1979 (prepared by Hazleton Environmental Sciences). Minneapolis, Minnesota.

_____. 1981. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1980 to December 31, 1980 (prepared by Hazleton Environmental Sciences). Minneapolis, Minnesota.

_____. 1982. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1981 to December 31, 1981 (prepared by Hazleton Environmental Sciences). Minneapolis, Minnesota.

_____. 1983. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1982 to December 31, 1982 (prepared by Hazleton Environmental Sciences). Minneapolis, Minnesota.

_____. 1984. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1983 to December 31, 1983 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1985. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1984 to December 31, 1984 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1986. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1985 to December 31, 1985 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1987. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1986 to December 31, 1986 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1988. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1987 to December 31, 1987 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

Teledyne Isotopes Midwest Laboratory. 971a. Quality Control Program, Revision 7. 20, November 1984.

_____. 1990. Quality Control Procedures Manual, Revision 13, 21 September 1990.

_____. 1991. Quality Assurance Program Manual, Revision 7, 21 January 1991.

_____. 1985. Analytical Procedures Manual, Revision 5, 29 July 1985.

_____. 1984a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1983.

_____. 1984b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant. Complete Analysis Data Tables, January - December 1983.

_____. 1985a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1984.

_____. 1985b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1984.

_____. 1986a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1985.

_____. 1986b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1985.

_____. 1987. Sampling Procedures, Prairie Island Nuclear Generating Plant, Revision 16, 18 December 1987.

_____. 1987a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1986.

_____. 1987b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1986.

_____. 1988a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1987.

_____. 1988b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1987.

_____. 1989a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1988.

_____. 1989b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1988.

_____. 1990a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1989.

_____. 1990b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1989.

_____. 1991a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1990.

_____. 1991b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analyses Data Tables, January - December 1990.

U. S. Atomic Energy Commission. 1972. HASL Procedures Manual, Health and Safety Laboratory, New York, NY., 10014.

U. S. Public Health Service. 1967. Radioassay Procedures for Environmental Samples, National Center for Radiological Health, Rockville, Maryland (Public Health Service Publication No. 999-RH-27).

Wilson, D. W., G. M. Ward and J. E. Johnson. 1969. In Environmental Contamination by Radioactive Materials, International Atomic Energy Agency. p. 125.

APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: TIML participates in intercomparison studies administered by U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. The results are reported in Appendix A. Also reported are results of in-house spikes and blanks. Appendix A is updated twice a year; the complete Appendix is included in January and July monthly reports only. Please refer to January and July Reports for information.

January, 1991

Appendix A

Interlaboratory Comparison Program Results

Teledyne Isotopes Midwest Laboratory (formerly Hazleton Environmental Sciences) has participated in interlaboratory comparison (crosscheck) programs since the formulation of its quality control program in December 1971. These programs are operated by agencies which supply environmental-type samples (e.g., milk or water) 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 the laboratory's analytical procedures and to alert it to any possible problems.

Participant laboratories measure the concentrations 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.

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk, water, air filters, and food samples during the period January 1986 through December, 1990. This program has been conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for thermoluminescent dosimeters (TLDs) during the period 1976, 1977, 1979, 1980, 1984, and 1985-1986 through participation in the Second, Third, Fourth, Fifth, Seventh, and Eighth International Intercomparison of Environmental Dosimeters under the sponsorships listed in Table A-2. Also Teledyne testing results are listed.

Table A-3 lists results of the analyses on in-house spiked samples.

Table A-4 lists results of the analyses on in-house "blank" samples.

Attachment B lists acceptance criteria for "spiked" samples.

Addendum to Appendix A provides explanation for out-of-limit results.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Isotopes Midwest Laboratory results for milk, water, air filters, and food samples, 1986 through 1990.[a]

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STF-447	Food	Jan 1986	Sr-89	24.3±2.5	25.0±5.0	16.3-33.7
			Sr-90	17.3±0.6	10.0±1.5	7.4-12.6
			I-131	22.7±2.3	20.0±0.6	9.6-30.4
			Cs-137	16.3±0.6	15.0±5.0	6.3-23.7
			K	927±46	950±144	701-1199
STW-448	Water	Feb 1986	Cr-51	45.0±3.6	38.0±5.0	29.3-46.7
			Co-60	19.7±1.5	18.0±5.0	9.3-26.7
			Zn-65	44.0±3.5	40.0±5.0	31.3-48.7
			Ru-106	<9.0	0.0±5.0	0.0-8.7
			Cs-134	28.3±2.3	30.0±5.0	21.3-38.7
			Cs-137	23.7±0.6	22.0±5.0	13.3-30.7
STW-449	Water	Feb 1986	H-3	5176±48	5227±525	4317-6137
STW-450	Water	Feb 1986	U total	8.0±0.0	9.0±6.0	0.0-19.4
STM-451	Milk	Feb 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-452	Water	Mar 1986	Ra-226	3.8±0.1	4.1±0.6	3.0-5.2
			Ra-228	11.0±0.5	12.4±1.8	9.2-15.5
STW-453	Water	Mar 1986	Gr. alpha	6.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	7.3±0.6	8.0±5.0	0.0-16.7
STW-454	Water	Apr 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-455 456	Water (Blind)	Apr 1986				
	Sample A		Gr. alpha	15.0±1.0	17.0±5.0	8.3-25.7
			Ra-226	3.1±0.1	2.9±0.4	2.1-3.7
			Ra-228	1.5±0.2	2.0±0.3	1.5-2.5
			Uranium	4.7±0.6	5.0±6.0	0.0-15.4
	Sample B		Gr. beta	28.7±1.2	35.0±5.0	26.3-43.7
			Sr-89	5.7±0.6	7.0±5.0	0.0-15.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
			Co-60	10.7±1.5	10.0±5.0	1.3-18.7
			Cs-134	4.0±1.7	5.0±5.0	0.0-13.7
			Cs-137	5.3±0.6	5.0±5.0	0.0-13.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STAF-457	Air Filter	Apr 1986	Gr. alpha	13.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	46.3±0.6	47.0±5.0	38.3-55.7
			Sr-90	14.7±0.6	18.0±1.5	15.4-20.6
			Cs-137	10.7±0.6	10.0±5.0	1.3-18.7
STU-458	Urine	Apr 1986	Tritium	4313±70	4423±189	4096-4750
STW-459	Water	May 1986	Sr-89	4.3±0.6	5.0±5.0	0.0-13.7
			Sr-90	5.0±0.0	5.0±1.5	2.4-7.6
STW-460	Water	May 1986	Gr. alpha	5.3±0.6	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	15.0±5.0	6.3-23.7
STW-461	Water	Jun 1986	Cr-51	<9.0	0.0±5.0	0.0-8.7
			Co-60	66.0±1.0	66.0±5.0	57.3-74.7
			Zn-65	87.3±1.5	86.0±5.0	77.3-94.7
			Ru-106	39.7±2.5	50.0±5.0	41.3-58.7
			Cs-134	49.3±2.5	49.0±5.0	40.3-57.7
			Cs-137	10.3±1.5	10.0±5.0	1.3-18.7
STW-462	Water	Jun 1986	Tritium	3427±25	3125±361	2499-3751
STM-464	Milk	Jun 1986	Sr-89	<1.0	0.0±5.0	0.0-8.7
			Sr-90	15.3±0.6	16.0±1.5	13.4-18.6
			I-131	48.3±2.3	41.0±6.0	30.6-51.4
			Cs-137	43.7±1.5	31.0±5.0	22.3-39.7
			K	1567±114	1600±80	1461-1739
STW-465	Water	Jul 1986	Gr. alpha	4.7±0.6	6.0±5.0	0.0-14.7
			Gr. beta	18.7±1.2	18.0±5.0	9.3-26.7
STW-467	Water	Aug 1986	I-131	30.3±0.6	45.0±6.0	34.4-55.4
STW-468	Water	Aug 1986	Pu-239	11.3±0.6	10.1±1.0	8.3-11.9
STW-469	Water	Aug 1986	Uranium	4.0±0.0	4.0±6.0	0.0-14.4
STAF-470	Air Filter	Sep 1986	Gr. alpha	19.3±1.5	22.0±5.0	13.3-30.7
471			Gr. beta	64.0±2.6	66.0±5.0	57.3-74.7
472			Sr-90	22.0±1.0	22.0±5.0	19.4-24.6
			Cs-137	25.7±1.5	22.0±5.0	13.3-30.7
STW-473	Water	Sep 1986	Ra-226	6.0±0.1	6.1±0.9	4.5-7.7
			Ra-228	8.7±1.1	9.1±1.4	6.7-11.5

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-474	Water	Sep 1986	Gr. alpha	16.3±3.2	15.0±5.0	6.3-23.7
			Gr. beta	9.0±1.0	8.0±5.0	0.0-16.7
STW-475	Water	Oct 1986	Cr-51	63.3±5.5	59.0±5.0	50.3-67.7
			Co-60	31.0±2.0	31.0±5.0	22.3-39.7
			Zn-657	87.3±5.9	85.0±5.0	76.3-93.7
			Ru-106	74.7±7.4	74.0±5.0	65.3-82.7
			Cs-134	25.7±0.6	28.0±5.0	19.3-36.7
			Cs-137	46.3±1.5	44.0±5.0	35.3-52.7
STW-476	Water	Oct 1986	H-3	5918±60	5973±597	4938-7008
SPW-477	Water (Blind)	Oct 1986				
	Sample A		Gr. alpha	34.0±6.0	40.0±5.0	31.3-48.7
			Ra-226	5.8±0.2	6.0±0.9	4.4-7.6
			Ra-228	2.7±1.0	5.0±0.8	3.7-6.3
			Uranium	11.0±0.0	10.0±6.0	0.0-20.4
	Sample B		Gr. beta	38.7±1.2	51.0±5.0	42.3-59.7
			Sr-89	5.0±0.0	10.0±5.0	1.3-18.7
			Sr-90	3.0±0.0	4.0±1.5	1.4-6.6
			Co-60	24.7±1.2	24.0±5.0	15.3-32.7
			Cs-134	11.0±2.0	12.0±5.0	3.3-20.7
			Cs-137	9.3±1.2	8.0±5.0	0.0-20.4
STM-479	Milk	Nov 1986	Sr-89	7.7±1.2	9.0±5.0	0.3-17.7
			Sr-90	1.0±0.0	0.0±1.5	0.0-2.6
			I-131	52.3±3.1	49.0±6.0	38.6-59.4
			Cs-137	45.7±3.1	39.0±5.0	30.3-47.7
			K	1489±104	1565±78	1430-1700
STU-480	Urine	Nov 1986	H-3	5540±26	5257±912	4345-6169
STW-481	Water	Nov 1986	Gr. alpha	12.0±4.0	20.0±5.0	11.3-28.7
			Gr. beta	20.0±3.5	20.0±5.0	11.3-28.7
STW-482	Water	Dec 1986	Ra-226	6.7±0.2	6.8±1.0	5.0-8.6
			Ra-228	5.2±0.2	11.1±1.7	8.2-14.0
STW-483	Water	Jan 1987	Sr-89	19.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	21.0±2.0	25.0±1.5	22.4-27.6

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-484	Water	Jan 1987	Pu-239	17.0±2.3	16.7±1.7	13.8-19.6
STF-486	Food	Jan 1987	Sr-90	36.0±4.0	49.0±10.0	31.7-66.3
			I-131	78.0±3.4	78.0±8.0	64.1-91.9
			Cs-137	89.7±3.0	84.0±5.0	75.3-92.7
			K	942±56	980±49	895-1065
STF-487	Food (Blank)	Jan 1987	Sr-90	2.0±0.0	---	
			I-131	<3	---	
			Cs-137	<2	---	
			K	993±102	---	
STW-488	Water	Feb 1987	Co-60	49.0±0.0	50.0±5.0	41.3-58.7
			Zn-65	96.0±7.2	91.0±5.0	82.3-99.7
			Ru-106	92.0±20.2	100.0±5.0	91.3-108.7
			Cs-134	53.0±3.4	59.0±5.0	50.3-67.7
			Cs-137	89.3±4.6	87.0±5.0	78.3-95.7
STW-489	Water	Feb 1987	H-3	4130±140	4209±420	3479-4939
STW-490	Water	Feb 1987	Uranium	8.3±1.2	8.0±6.0	0.0-18.4
STM-491	Milk	Feb 1987	I-131	10.0±0.0	9.0±0.9	7.4-10.6
STW-492	Water	Mar 1987	Gr. alpha	3.7±1.2	3.0±5.0	0.0-11.7
			Gr. beta	11.3±1.2	13.0±5.0	4.3-21.7
STW-493	Water	Mar 1987	Ra-226	7.0±0.1	7.3±1.1	5.4-9.2
			Ra-228	7.1±2.3	7.5±1.1	5.5-9.5
STW-494	Water	Apr 1987	I-131	8.0±0.0	7.0±0.7	5.8-8.2
STAF-495	Air Filter	Apr 1987	Gr. alpha	15.0±0.0	14.0±5.0	5.3-22.7
			Gr. beta	41.0±2.0	43.0±5.0	34.3-51.7
			Sr-90	16.3±1.2	17.0±1.5	14.4-19.6
			Cs-137	7.0±0.0	8.0±5.0	0.0-16.7
STW-496 497	Water (Blind)	Apr 1987				
	Sample A		Gr. alpha	30.7±1.2	30.0±8.0	16.1-43.9
			Ra-226	3.9±0.2	3.9±0.6	2.9-4.9
			Ra-228	4.9±0.9	4.0±0.6	3.0-5.0
			Uranium	5.0±0.0	5.0±6.0	0.0-15.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-496 497	Water (Blind)	Apr 1987				
	Sample B		Gr. beta	69.3±9.4	66.0±5.0	57.3-74.7
			Sr-89	16.3±3.0	19.0±5.0	10.3-27.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Co-60	8.3±3.0	8.0±5.0	0.0-16.7
			Cs-134	19.0±2.0	20.0±5.0	11.3-28.7
			Cs-137	14.7±1.2	15.0±5.0	6.3-23.7
STU-498	Urine	Apr 1987	H-3	6017±494	5620±795	4647-6593
STW-499	Water	May 1987	Sr-89	38.0±6.0	41.0±5.0	32.3-49.7
			Sr-90	21.0±2.0	20.0±1.5	17.4-22.6
STW-500	Water	May 1987	Gr. alpha	9.0±3.4	11.0±5.0	2.3-19.7
			Gr. beta	10.3±1.2	7.0±5.0	0.0-15.7
STW-501	Water	Jun 1987	Cr-51	40.0±8.0	41.0±5.0	32.3-49.7
			Co-60	60.3±3.0	64.0±5.0	55.3-72.7
			Zn-65	11.3±5.0	10.0±5.0	1.3-18.7
			Ru-106	78.3±6.4	75.0±5.0	66.3-83.7
			Cs-134	36.7±3.0	40.0±5.0	31.3-48.7
			Cs-137	80.3±4.2	80.0±5.0	71.3-88.7
STW-502	Water	Jun 1987	H-3	2906±86	2895±357	2277-3513
STW-503	Water	Jun 1987	Ra-226	6.9±0.1	7.3±1.1	5.4-9.2
			Ra-228	13.3±1.0	15.2±2.3	11.2-19.2
STM-504	Milk	Jun 1987	Sr-89	57.0±4.3	69.0±5.0	60.3-77.7
			Sr-90	32.0±1.0	35.0±5.0	32.4-37.6
			I-131	64.0±2.0	59.0±6.0	48.6-69.4
			Cs-137	77.7±0.6	74.0±5.0	65.3-82.7
			K	1383±17	1525±76	1393-1657
STW-505	Water	Jul 1987	Gr. alpha	2.3±0.7	5.0±5.0	0.0-13.7
			Gr. beta	4.0±1.0	5.0±5.0	0.0-13.7
STF-506	Food	Jul 1987	I-131	82.7±4.6	80.0±8.0	66.1-93.9
			Cs-137	53.7±3.0	50.0±5.0	41.3-58.7
			K	1548±57	1680±84	1534-1826
STW-507	Water	Aug 1987	I-131	45.7±4.2	48.0±6.0	37.6-58.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TiML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-508	Water	Aug 1987	Pu-239	5.8±0.2	5.3±0.5	4.4-6.2
STW-509	Water	Aug 1987	Uranium	13.3±0.3	13.0±6.0	2.6-23.4
STAF-510	Air Filter	Aug 1987	Gr. alpha	9.7±0.4	10.0±5.0	1.3-18.7
			Gr. beta	28.3±0.6	30.0±5.0	21.3-38.7
			Sr-90	10.0±0.9	10.0±1.5	7.4-12.6
			Cs-137	10.0±1.0	10.0±5.0	1.3-18.7
STW-511	Water	Sep 1987	Ra-226	9.9±0.1	9.7±1.5	7.2-12.2
			Ra-228	8.1±1.4	6.3±1.0	4.6-8.0
STW-512	Water	Sep 1987	Gr. alpha	2.0±0.6	4.0±5.0	0.0-12.7
			Gr. beta	11.3±1.3	12.0±5.0	3.3-20.7
STW-513	Water	Sep 1987	H-3	4473±100	4492±449	3714-5270
STW-514	Water (Blind)	Oct 1987				
	Sample A		Gr. alpha	29.3±2.6	28.0±7.0	15.9-40.1
			Ra-226	4.9±0.1	4.8±0.7	3.6-6.1
			Ra-228	4.2±1.0	3.6±0.5	2.7-4.5
			Uranium	3.0±0.1	3.0±6.0	0.0-13.4
	Sample B		Sr-89	14.3±1.3	16.0±5.0	7.3-24.7
			Sr-90	9.7±0.4	10.0±1.5	7.4-12.6
			Co-60	16.7±3.0	16.0±5.0	7.3-24.7
			Cs-134	16.7±2.3	16.0±5.0	7.3-24.7
			Cs-137	24.3±3.3	24.0±5.0	15.3-32.7
STW-516	Water	Oct 1987	Cr-51	80.3±17.5	70.0±5.0	61.3-78.7
			Co-60	16.0±2.3	15.0±5.0	6.3-23.7
	Sample A		Zn-65	46.3±5.6	46.0±5.0	37.3-54.7
			Ru-106	57.3±15.4	61.0±5.0	52.3-69.7
			Cs-134	23.7±2.5	25.0±5.0	16.3-33.7
			Cs-137	51.7±3.2	51.0±5.0	42.3-59.7
STU-517	Urine	Nov 1987	H-3	7267±100	7432±743	6145-8719
STW-518	Water	Nov 1987	Gr. alpha	3.0±2.0	7.0±5.0	0.0-15.7
			Gr. beta	15.7±2.3	19.0±5.0	10.3-27.7
STW-519	Water	Dec 1987	I-131	26.0±3.0	25.0±6.0	15.6-36.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b]		
				TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-520	Water	Dec 1987	Ra-226	5.1±0.8	4.8±0.7	3.6-6.0
			Ra-228	3.4±0.1	5.3±0.8	3.9-6.7
STW-521	Water	Jan 1988	Sr-89	27.3±5.0	30.0±5.0	21.3-38.7
			Sr-90	15.3±1.2	15.0±1.5	12.4-17.6
STW-523	Water	Jan 1988	Gr. alpha	2.3±1.2	4.0±5.0	0.0-12.7
			Gr. beta	7.7±1.2	8.0±5.0	0.0-16.7
STF-524	Food	Jan 1988	Sr-89	44.0±4.0	46.0±5.0	37.3-54.7
			Sr-90	53.0±2.0	55.0±2.8	50.2-59.8
			I-131	102.3±4.2	102.0±10.2	84.3-119.7
			Cs-137	95.7±6.4	91.0±5.0	82.3-99.7
			K	1011±158	1230±62	1124-1336
STW-525	Water	Feb 1988	Co-60	69.3±2.3	69.0±5.0	60.3-77.7
			Zn-65	99.0±3.4	94.0±9.4	77.7-110.3
			Ru-106	92.7±14.4	105.0±10.5	86.8-123.2
			Cs-134	61.7±8.0	64.0±5.0	55.3-72.7
			Cs-137	99.7±3.0	94.0±5.0	85.3-102.7
STW-526	Water	Feb 1988	H-3	3453±103	3327±362	2700-3954
STW-527	Water	Feb 1988	Uranium	3.0±0.0	3.0±6.0	0.0-13.4
STM-528	Milk	Feb 1988	I-131	4.7±1.2	4.0±0.4	3.3-4.7
STW-529	Water	Mar 1988	Ra-226	7.1±0.6	7.6±1.1	5.6-9.6
			Ra-228	NA[e]	7.7±1.2	5.7-9.7
STW-530	Water	Mar 1988	Gr. alpha	4.3±1.2	6.0±5.0	0.0-14.7
			Gr. beta	13.3±1.3	13.0±5.0	4.3-21.7
STAF-531	Air Filter	Mar 1988	Gr. alpha	21.0±2.0	20.0±5.0	11.3-28.7
			Gr. beta	48.0±0.0	50.0±5.0	41.3-58.7
			Sr-90	16.7±1.2	17.0±1.5	14.4-19.6
			Cs-137	18.7±1.3	16.0±5.0	7.3-24.7
STW-532	Water	Apr 1988	I-131	9.0±2.0	7.5±0.8	6.2-8.8

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-533 534	Water (Blind)	Apr 1988				
	Sample A		Gr. alpha	ND[f]	46.0±11.0	27.0-65.0
			Ra-226	ND	6.4±1.0	4.7-8.1
			Ra-228	ND	5.6±0.8	4.2-7.0
			Uranium	6.0±0.0	6.0±6.0	0.0-16.4
	Sample B		Gr. beta	ND	57.0±5.0	48.3-65.7
			Sr-89	3.3±1.2	5.0±5.0	0.0-13.7
			Sr-90	5.3±1.2	5.0±1.5	2.4-7.6
			Co-60	63.3±1.3	50.0±5.0	41.3-58.7
			Cs-134	7.7±1.2	7.0±5.0	0.0-15.7
			Cs-137	8.3±1.2	7.0±5.0	0.0-15.7
STU-535	Urine	Apr 1988	H-3	6483±155	6202±620	5128-7276
STW-536	Water	Apr 1988	Sr-89	14.7±1.3	20.0±5.0	11.3-28.7
			Sr-90	20.0±2.0	20.0±1.5	17.4-22.6
STW-538	Water	Jun 1988	Cr-51	331.7±13.0	302.0±30.0	250.0-354.0
			Co-60	16.0±2.0	15.0±5.0	6.3-23.7
			Zn-65	107.7±11.4	101.0±10.0	83.7-118.3
			Ru-106	191.3±11.0	195.0±20.0	160.4-229.6
			Cs-134	18.3±4.6	20.0±5.0	11.3-28.7
			Cs-137	26.3±1.2	25.0±5.0	16.3-33.7
STW-539	Water	Jun 1988	H-3	5586±92	5565±557	4600-6530
STM-541	Milk	Jun 1988	Sr-89	33.7±11.4	40.0±5.0	31.3-48.7
			Sr-90	55.3±5.8	60.0±3.0	54.8-65.2
			I-131	103.7±3.1	94.0±9.0	78.4-109.6
			Cs-137	52.7±3.1	51.0±5.0	42.3-59.7
			K	1587±23	1600±80	1461-1739
STW-542	Water	Jul 1988	Gr. alpha	8.7±4.2	15.0±5.0	6.3-23.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STF-543	Food	Jul 1988	Sr-89	ND[f]	33.0±5.0	24.3-41.7
			Sr-90	ND	34.0±2.0	30.5-37.5
			I-131	115.0±5.3	107.0±11.0	88.0-126.0
			Cs-137	52.7±6.4	49.0±5.0	40.3-57.7
			K	1190±66	1240±62	1133-1347

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b]		
				TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-544	Water	Aug 1988	I-131	80.0±0.0	76.0±8.0	62.1-89.9
STW-545	Water	Aug 1988	Pu-239	11.0±0.2	10.2±1.0	8.5-11.9
STW-546	Water	Aug 1988	Uranium	6.0±0.0	6.0±6.0	0.0-16.4
STAF-547	Air Filter	Aug 1988	Gr. alpha	8.0±0.0	8.0±5.0	0.0-16.7
			Gr. beta	26.3±1.2	29.0±5.0	20.3-37.7
			Sr-90	8.0±2.0	8.0±1.5	5.4-10.6
			Cs-137	13.0±2.0	12.0±5.0	3.3-20.7
STW-548	Water	Sep 1988	Ra-226	9.3±0.5	8.4±2.6	6.2-10.6
			Ra-228	5.8±0.4	5.4±1.6	4.0-6.8
STW-549	Water	Sep 1988	Gr. alpha	7.0±2.0	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	10.0±5.0	1.3-18.7
STW-550	Water	Oct 1988	Cr-51	252.0±14.0	251.0±25.0	207.7-294.3
			Co-60	26.0±2.0	25.0±5.0	16.3-33.7
			Zn-65	158.3±10.2	151.0±15.0	125.0-177.0
			Ru-106	153.0±9.2	152.0±15.0	126.0-178.0
			Cs-134	28.7±5.0	25.0±5.0	16.3-33.7
			Cs-137	16.3±1.2	15.0±5.0	6.3-23.7
STW-551	Water	Oct 1988	H-3	2333±127	2316±350	1710-2927
STW-552 553	Water (Blind)	Oct 1988				
	Sample A		Gr. alpha	38.3±8.0	41.0±10.0	23.7-58.3
			Ra-226	4.5±0.5	5.0±0.8	3.6-6.4
			Ra-228	4.4±0.6	5.2±0.8	3.6-6.4
			Uranium	4.7±1.2	5.0±6.0	0.0-15.4
	Sample B		Gr. beta	51.3±3.0	54.0±5.0	45.3-62.7
			Sr-89	3.7±1.2	11.0±5.0	2.3-19.7
			Sr-90	10.7±1.2	10.0±1.5	7.4-12.6
			Cs-134	15.3±2.3	15.0±5.0	6.3-23.7
			Cs-137	16.7±1.2	15.0±5.0	6.3-23.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STM-554	Milk	Oct 1988	Sr-89	40.3±7.0	40.0±5.0	31.3-48.7
			Sr-90	51.0±2.0	60.0±3.0	54.8-65.2
			I-131	94.0±3.4	91.0±9.0	75.4-106.6
			Cs-137	45.0±4.0	50.0±5.0	41.3-58.7
			K	1500±45	1600±80	1461-1739
STU-555	Urine	Nov 1988	H-3	3030±209	3025±359	2403-3647
STW-556	Water	Nov 1988	Gr. alpha	9.0±3.5	9.0±5.0	0.3-17.7
			Gr. beta	9.7±1.2	9.0±5.0	0.3-17.7
STW-557	Water	Dec 1988	I-131	108.7±3.0	115.0±12.0	94.2-135.8
STW-559	Water	Jan 1989	Sr-89	40.0±8.7	40.0±5.0	31.3-48.7
			Sr-90	24.3±3.1	25.0±1.5	24.4-27.6
STW-560	Water	Jan 1989	Pu-239	5.8±1.1	4.2±0.4	3.5-4.9
STW-561	Water	Jan 1989	Gr. alpha	7.3±1.2	8.0±5.0	0.0-16.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STW-562	Water	Feb 1989	Cr-51	245±46	235±24	193.4-276.6
			Co-60	10.0±2.0	10.0±5.0	1.3-18.7
			Zn-65	170±10	159±16	139.2-186.7
			Ru-106	181±7.6	178±18	146.8-209.2
			Cs-134	9.7±3.0	10.0±5.0	1.3-18.7
			Cs-137	11.7±1.2	10.0±5.0	1.3-18.7
STW-563	Water	Feb 1989	I-131	109.0±4.0	106.0±11.0	86.9-125.1
STW-564	Water	Feb 1989	H-3	2820±20	2754±356	2137-3371
STW-565	Water	Mar 1989	Ra-226	4.2±0.3	4.9±0.7	3.7-6.1
			Ra-228	1.9±1.0	1.7±0.3	1.2-2.2
STW-566	Water	Mar 1989	U	5.0±0.0	5.0±6.0	0.0-15.4
STW-567	Air Filter	Mar 1989	Gr. alpha	21.7±1.2	21.0±5.0	12.3-29.7
			Gr. beta	68.3±4.2	62.0±5.0	53.3-70.7
			Sr-90	20.0±2.0	20.0±1.5	17.4-22.6
			Cs-137	21.3±1.2	20.0±5.0	11.3-28.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-568 569	Water (Blind)	Apr 1989				
	Sample A		Gr. alpha	22.7±2.3	29.0±7.0	16.9-41.2
			Ra-226	3.6±0.6	3.5±0.5	2.6-4.4
			Ra-228	2.6±1.0	3.6±0.5	2.7-4.5
			U	3.0±0.0	3.0±6.0	0.0-13.4
	Sample B		Gr. beta	52.3±6.1	57.0±5.0	43.3-65.7
			Sr-89	9.3±5.4	8.0±5.0	0.0-16.7
			Sr-90	7.0±0.0	8.0±1.5	5.4-10.6
			Cs-134	21.0±5.2	20.0±5.0	11.3-28.7
			Cs-137	23.0±2.0	20.0±5.0	11.3-28.7
STW-570	Milk	Apr 1989	Sr-89	26.0±10.0	39.0±5.0	30.3-47.7
			Sr-90	45.7±4.2	55.0±3.0	49.8-60.2
			Cs-137	54.0±6.9	50.0±5.0	41.3-58.7
			K-40	1521±208	1600±80	1461-1739
STW-571	Water	May 1989	Sr-89	<0.7	6.0±5.0	0.0-14.7
			Sr-90	5.0±1.0	6.0±1.5	3.4-8.6
STW-572	Water	May 1989	Gr. alpha	24.0±2.0	30.0±8.0	16.1-43.9
			Gr. beta	49.3±15.6	50.0±5.0	41.3-58.7
STW-573	Water	Jun 1989	Ba-133	50.7±1.2	49.0±5.0.	40.3-57.7
			Co-60	31.3±2.3	31.0±5.0	22.3-39.7
			Zn-65	167±10	165±17	135.6-194.4
			Ru-106	123±9.2	128±13	105.5-150.5
			Cs-134	40.3±1.2	39±5	30.3-47.7
			Cs-137	22.3±1.2	20±5	11.3-28.7
STW-574	Water	Jun 1989	H-3	4513±136	4503±450	3724-5282
STW-575	Water	Jul 1989	Ra-226	16.8±3.1	17.7±2.7	13.0-22.4
			Ra-228	13.8±3.7	18.3±2.7	13.6-23.0
STW-576	Water	Jul 1989	U	40.3±1.2	41.0±6.0	30.6-51.4
STW-577	Water	Aug 1989	I-131	84.7±5.8	83.0±8.0	69.1-96.9
STAF-579	Air Filter	Aug 1989	Gr. alpha	6.0±0.0	6.0±5.0	0.0-14.7
			Cs-137	10.3±2.3	10.0±5.0	1.3-18.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-580	Water	Sep 1989	Sr-89	14.7±1.2	14.0±5.0	5.3-22.7
			Sr-90	9.7±1.2	10.0±1.5	7.4-12.6
STW-581	Water	Sep 1989	Gr. alpha	5.0±0.0	4.0±5.0	0.0-12.7
			Gr. Beta	8.7±2.3	6.0±5.0	0.0-14.7
STW-583	Water	Oct 1989	Ba-133	60.3±10.0	59.0±6.0	48.6-69.4
			Co-60	29.0±4.0	30.0±5.0	21.1-38.7
			Zn-65	132.3±6.0	129.0±13.0	106.5-151.5
			Ru-106	155.3±6.1	161.0±16.0	133.3-188.7
			Cs-134	30.7±6.1	29.0±5.0	20.3-37.7
			Cs-137	66.3±4.6	59.0±5.0	50.3-67.7
STW-584	Water	Oct 1989	H-3	3407±150	3496±364	2866-4126
STW-585 586	Water (Blind)	Oct 1989				
	Sample A		Gr. Alpha	41.7±9.4	49.0±12.0	28.2-69.8
			Ra-226	7.9±0.4	8.4±1.3	6.2-10.6
			Ra-228	4.4±0.8	4.1±0.6	3.1-5.1
			U	12.0±0.0	12.0±6.0	1.6-22.4
	Sample B		Gr. Beta	31.7±2.3	32.0±5.0	23.3-40.7
			Sr-89	13.3±4.2	15.0±5.0	6.3-23.7
			Sr-90	7.0±2.0	7.0±3.0	4.4-9.6
			Cs-134	5.0±0.0	5.0±5.0	0.0-13.7
			Cs-137	7.0±0.0	5.0±5.0	0.0-13.7
STW-587	Water	Nov 1989	Ra-226	7.9±0.4	8.7±1.3	6.4-11.0
			Ra-228	8.9±1.2	9.3±1.2	6.9-11.7
STW-588	Water	Nov 1989	U	15.0±0.09	15.0±6.0	4.6-25.4
STW-589	Water	Jan 1990	Sr-89	22.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	17.3±1.2	20.0±1.5	17.4-22.6
STW-591	Water	Jan 1990	Gr. Alpha	10.3±3.0	12.0±5.0	3.3-20.7
			Gr. Beta	12.3±1.2	12.0±5.0	3.3-20.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-592	Water	Jan 1990	Co-60	14.7±2.3	15±5.0	6.3-23.7
			Zn-65	135.0±6.9	139.0±14.0	114.8-163.2
			Ru-106	133.3±13.4	139.0±14.0	114.8-163.2
			Cs-134	17.3±1.2	18.0±5.0	9.3-26.7
			Cs-137	19.3±1.2	18.0±5.0	9.3-26.7
			Ba-133	78.0±0.0	74.0±7.0	61.9-86.1
STW-593	Water	Feb 1990	H-3	4827±83	4976±498	4113-5839
STW-594	Water	Mar 1990	Ra-226	5.0±0.2	4.9±0.7	4.1-5.7
			Ra-228	13.5±0.7	12.7±1.9	9.4-16.0
STW-595	Water	Mar 1990	U	4.0±0.0	4.0±6.0	0.0-14.4
STW-596	Air Filter	Mar 1990	Gr. Alpha	7.3±1.2	5.0±5.0	0.0-13.7
			Gr. Beta	34.0±0.0	31.0±5.0	22.3-39.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Cs-137	9.3±1.2	10.0±5.0	1.3-18.7
STW-597 598	Water (Blind)	Apr 1990				
	Sample A		Gr. Alpha	81.0±3.5	90.0±23.0	50.1-129.9
			Ra-226	4.9±0.4	5.0±0.8	3.6-6.4
			Ra-228	10.6±0.3	10.2±1.5	7.6-12.8
			U	18.7±3.0	20.0±6.0	9.6-30.4
	Sample B		Gr. Beta	51.0±10.1	52.0±5.0	43.3-60.7
			Sr-89	9.3±1.2	10.0±5.0	1.3-18.7
			Sr-90	10.3±3.1	10.0±1.5	8.3-11.7
			Cs-134	16.0±0.0	15.0±5.0	6.3-23.7
			Cs-137	19.0±2.0	15.0±5.0	6.3-23.7
STM-599	Milk	Apr 1990	Sr-89	21.7±3.1	23.0±5.0	14.3-31.7
			Sr-90	21.0±7.0	23.0±5.0	14.3-31.7
			I-131	98.7±1.2	99.0±10.0	81.7-116.3
			Cs-137	26.0±6.0	24.0±5.0	15.3-32.7
			K	1300.0±69.2	1550.0±78.0	1414.7-1685.3
STW-600	Water	May 1990	Sr-89	6.0±2.0	7.0±5.0	0.0-15.7
			Sr-90	6.7±1.2	7.0±5.0	0.0-15.7
STW-601	Water	May 1990	Gr. Alpha	11.0±2.0	22.0±6.0	11.6-32.4
			Gr. Beta	12.3±1.2	15.0±5.0	6.3-23.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-602	Water	Jun 1990	Co-60	25.3±2.3	24.0±5.0	15.3-32.7
			Zn-65	155.0±10.6	148.0±15.0	130.6-165.4
			Ru-106	202.7±17.2	210.0±21.0	173.6-246.4
			Cs-134	23.7±1.2	24.0±5.0	18.2-29.8
			Cs-137	27.7±3.1	25.0±5.0	16.3-33.7
			Ba-133	100.7±8.1	99.0±10.0	81.7-116.3
STW-603	Water	Jun 1990	H-3	2927±306	2933±358	2312-3554
STW-604	Water	Jul 1990	Ra-226	11.8±0.9	12.1±1.8	9.0-15.2
			Ra-228	4.1±1.4	5.1±1.3	2.8-7.4
STW-605	Water	Jul 1990	U	20.3±1.7	20.8±3.0	15.6-26.0
STW-606	Water	Aug 1990	I-131	43.0±1.2	39.0±6.0	28.6-49.4
STW-607	Water	Aug 1990	Pu-239	10.0±1.7	9.1±0.9	7.5-10.7
STW-608	Air Filter	Aug 1990	Gr. alpha	14.0±0.0	10.0±5.0	1.3-18.7
			Gr. beta	65.3±1.2	62.0±5.0	53.3-70.7
			Sr-90	19.0±6.9	20.0±5.0	11.3-28.7
			Cs-137	19.0±2.0	20.0±5.0	11.3-28.7
STW-609	Water	Sep 1990	Sr-89	9.0±2.0	10.0±5.0	1.3-18.7
			Sr-90	9.0±2.0	9.0±5.0	0.3-17.7
STM-610	Water	Sep 1990	Gr. alpha	8.3±1.2	10.0±5.0	1.3-18.7
			Gr. beta	10.3±1.2	10.0±5.0	1.3-18.7
STM-611	Milk	Sep 1990	Sr-89	11.7±3.1	16.0±5.0	7.3-24.7
			Sr-90	15.0±0.0	20.0±5.0	11.3-28.7
			I-131	63.0±6.0	58.0±6.0	47.6-68.4
			Cs-137	20.0±2.0	20.0±5.0	11.3-28.7
			K	1673.3±70.2	1700.0±85.0	1552.5-1847.5
STW-612	Water	Oct 1990	Co-60	20.3±3.1	20.0±5.0	11.3-28.7
			Zn-65	115.3±12.2	115.0±12.0	94.2-135.8
			Ru-106	152.0±8.0	151.0±15.0	125.0-177.0
			Cs-134	11.0±0.0	12.0±5.0	3.3-20.7
			Cs-137	14.0±2.0	12.0±5.0	3.3-20.7
			Ba-133	116.7±9.9	110.0±11.0	90.9-129.1
STW-613	Water	Oct 1990	H-3	7167±330	7203±720	5954-8452

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-614 615	Water	Oct 1990				
	Sample A		Gr. alpha	68.7±7.2	62.0±16.0	34.2-89.8
			Ra-226	12.9±0.3	13.6±2.0	10.1-17.1
			Ra-228	4.2±0.6	5.0±1.3	2.7-7.3
			U	10.4±0.6	10.2±3.0	5.0-15.4
	Sample B		Gr. beta	55.0±8.7	53.0±5.0	44.3-61.7
			Sr-89	15.7±2.9	20.0±5.0	11.3-28.7
			Sr-90	12.0±2.0	15.0±5.0	6.3-23.7
			Cs-134	9.0±1.7	7.0±5.0	0.0-15.7
			Cs-137	7.7±1.2	5.0±5.0	0.0-13.7
STW-616	Water	Nov 1990	Ra-226	6.8±1.0	7.4±1.1	5.5-9.3
			Ra-228	5.3±1.7	7.7±1.9	4.4-11.0
STW-617[g]	Water	Nov 1990	U	35.0±0.4	35.5±3.6	29.3-41.7

[a] Results obtained by Teledyne Isotopes Midwest Laboratory as a participant in the environmental sample crosscheck program operated by the Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency (EPA), Las Vegas, Nevada.

[b] All results are in the pCi/l, except for elemental potassium (K) data in milk, which are in mg/l; air filter samples, which are in pCi/filter; and food, which is in mg/kg.

[c] Unless otherwise indicated, the TIML results are given as the mean ± 2 standard deviations for three determinations.

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

[e] NA = Not analyzed.

[f] ND = No data; not analyzed due to relocation of the lab.

[g] Sample was analyzed but the results not submitted to EPA because deadline was missed (all data on file).

Table A-2. Crosscheck program results, thermoluminescent dosimeters (TLDs).

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2σ[d] (All Participants)
2nd International Intercomparison[b]					
115-2	CaF_2:Mn Bulb	Field	17.0±1.9	17.1	16.4±7.7
		Lab	20.8±4.1	21.3	18.8±7.6
3rd International Intercomparison[e]					
115-3	CaF_2:Mn Bulb	Field	30.7±3.2	34.9±4.8	31.5±3.0
		Lab	89.6±6.4	91.7±14.6	86.2±24.0
4th International Intercomparison[f]					
115-4	CaF_2:Mn Bulb	Field	14.1±1.1	14.1±1.4	16.0±9.0
		Lab (Low)	9.3±1.3	12.2±2.4	12.0±7.4
		Lab (High)	40.4±1.4	45.8±9.2	43.9±13.2
5th International Intercomparison[g]					
115-5A	CaF_2:Mn Bulb	Field	31.4±1.8	30.0±6.0	30.2±14.6
		Lab at beginning	77.4±5.8	75.2±7.6	75.8±40.4
		Lab at the end	96.6±5.8	88.4±8.8	90.7±31.2
115-5B	LiF-100 Chips	Field	30.3±4.8	30.0±6.0	30.2±14.6
		Lab at beginning	81.1±7.4	75.2±7.6	75.8±40.4
		Lab at the end	85.4±11.7	88.4±8.8	90.7±31.2
7th International Intercomparison[h]					
115-7A	LiF-100 Chips	Field	75.4±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	80.0±3.5	79.9±4.0	77.9±27.6
		Lab (Cs-137)	66.6±2.5	75.0±3.8	73.0±22.2

Table A-2. (continued)

Lab Code	TLD Type	Measurement	mR		
			Teledyne Result ±2σ[a]	Known Value[c]	Average ±2σ[d] (All Participants)
115-7B	CaF_2:Mn Bulbs	Field	71.5±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	84.8±6.4	79.9±4.0	77.9±27.6
		Lab (Cs-137)	78.8±1.6	75.0±3.8	73.0±22.2
115-7C	$CaSO_4$:Dy Cards	Field	76.8±2.7	75.8±6.0	75.1±29.8
		Lab (Co-60)	82.5±3.7	79.9±4.0	77.9±27.6
		Lab (Cs-137)	79.0±3.2	75.0±3.8	73.0±22.2
8th International Intercomparison[i]					
115-8A	LiF-100 Chips	Field Site 1	29.5±1.4	29.7±1.5	28.9±12.4
		Field Site 2	11.3±0.8	10.4±0.5	10.1±9.06
		Lab (Cs-137)	13.7±0.9	17.2±0.9	16.2±6.8
115-8B	CaF_2:Mn Bulbs	Field Site 1	32.3±1.2	29.7±1.5	28.9±12.4
		Field Site 2	9.0±1.0	10.4±0.5	10.1±9.0
		Lab (Cs-137)	15.8±0.9	17.2±0.9	16.2±6.8
115-8C	$CaSO_4$:Dy Cards	Field Site 1	32.3±0.7	29.7±1.5	28.9±12.4
		Field Site 2	10.6±0.6	10.4±0.5	10.1±9.0
		Lab (Cs-137)	18.1±0.8	17.2±0.9	16.2±6.8
Teledyne Testing[j]					
89-1	LiF-100 Chips	Lab	21.0±0.4	22.4	--
89-2	Teledyne $CaSO_4$:Dy Cards	Lab	20.9±1.0	20.3	--

Table A-2. (continued)

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2σ[d] (All Participants)
Teledyne Testing[j]					
90-1[k]	Teledyne $CaSO_4$:Dy Cards	Lab	20.6±1.4	19.6	--
90-1[l]	Teledyne $CaSO_4$:Dy Cards	Lab	100.8±4.3	100.0	--

[a] Lab result given is the mean ±2 standard deviations of three determinations.
[b] Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (GASL), New York, New York, and the School of Public Health of the University of Texas, Houston, Texas.
[c] Value determined by sponsor of the intercomparison using continuously operated pressurized ion chamber.
[d] Mean ±2 standard deviations of results obtained by all laboratories participating in the program.
[e] Third International Intercomparison of Environmental Dosimeters conducted in summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.
[f] Fourth International Intercomparison of Environmental Dosimeters conducted in summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas.
[g] Fifth International Intercomparison of Environmental Dosimeter conducted in fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.
[h] Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.
[i] Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.
[j] Chips were submitted in September 1989 and cards were submitted in November 1989 to Teledyne Isotopes, Inc., Westwood, NJ for irradiation.
[k] Cards were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on June 19, 1990.
[l] Cards were irradiated by Dosimetry Associates, Inc., Northville, MI on October 30, 1990.

Table A-3. In-house spiked samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-MI-6	Milk	Feb 1986	Sr-89	6.0±1.9	6.4±3.0	8.7
			Sr-90	14.2±1.7	12.9±2.0	5.2
			I-131	34.2±3.8	35.2±3.5	10.4
			Cs-134	32.0±1.8	27.3±5.0	8.7
			Cs-137	35.8±2.1	35.0±5.0	8.7
QC-W-14	Water	Mar 1986	Sr-89	1.6±0.4	1.6±1.0	7.1
			Sr-90	2.4±0.2	2.4±2.0	4.2
QC-W-15	Water	Apr 1986	I-131	44.9±2.4	41.5±7.0	10.6
			Co-60	10.6±1.7	12.1±5.0	7.1[b]
			Cs-134	30.2±2.4	25.8±8.0	7.1[b]
			Cs-137	21.9±1.9	19.9±5.0	7.1[b]
QC-MI-7	Milk	Apr 1986	I-131	39.7±3.3	41.5±7.0	10.4
			Cs-134	28.7±2.8	25.8±8.0	8.7
			Cs-137	21.2±2.8	19.9±5.0	8.7
SPW-1	Water	May 1986	Gr. alpha	15.8±1.8	18.0±5.0	5[c]
QC-W-16	Water	Jun 1986	Gr. alpha	16.2±0.7	16.9±2.5	8.7
			Gr. beta	38.4±3.5	30.2±5.0	8.7
QC-MI-9	Milk	Jun 1986	Sr-89	<1.0	0.0	7.1[b]
			Sr-90	12.6±1.8	13.3±3.0	4.2[b]
			I-131	38.9±7.0	34.8±7.0	10.4
			Cs-134	33.0±3.4	36.1±5.0	8.7
			Cs-137	38.5±2.8	39.0±5.0	8.7
SPW-2	Water	Jun 1986	Gr. alpha	16.8±1.8	18.0±5.0	5[c]
SPW-3	Water	Jun 1986	Gr. alpha	17.7±0.8	18.0±5.0	5[c]
QC-W-18	Water	Sep 1986	Cs-134	34.7±5.6	31.3±5.0	8.7
			Cs-137	51.1±7.0	43.3±8.0	8.7
QC-W-19	Water	Sep 1986	Sr-89	13.6±4.1	15.6±3.5	7.1[b]
			Sr-90	6.4±1.6	6.2±2.0	4.2[b]

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-21	Water	Oct 1986	Co-60	19.2±2.2	18.5±3.0	8.7
			Cs-134	31.7±5.2	25.6±8.0	8.7
			Cs-137	23.8±1.0	21.6±5.0	8.7
QC-MI-11	Milk	Oct 1986	Sr-89	12.3±1.8	14.3±3.0	8.7
QC-W-20	Water	Nov 1986	H-3	3855±180	3960±350	520[b]
QC-W-22	Water	Dec 1986	Gr. alpha	9.8±1.4	11.2±4.0	8.7
			Gr. beta	21.7±2.0	23.8±5.0	8.7
QC-W-23	Water	Jan 1987	I-131	29.8±2.5	27.9±3.0	10.4
QC-MI-12	Milk	Jan 1987	I-131	36.5±1.3	32.6±5.0	10.4
			Cs-137	32.6±4.2	27.4±8.0	8.7
QC-MI-13	Milk	Jan 1987	Sr-89	10.4±2.1	12.2±4.0	8.7
			Sr-90	14.6±1.6	12.6±3.0	5.2
			I-131	49.5±1.2	54.9±8.0	10.4
			Cs-134	<1.6	0.0	8.7
			Cs-137	33.3±0.6	27.4±8.0	8.7
QC-W-24	Water	Mar 1987	Sr-89	24.7±3.6	25.9±5.0	8.7
			Sr-90	23.9±3.8	22.8±8.0	5.2
QC-W-25	Water	Apr 1987	I-131	28.0±1.9	29.3±5.0	10.6
QC-MI-14	Milk	Apr 1987	I-131	25.0±2.2	23.9±5.0	10.4
			Cs-134	<2.1	0.0	8.7
			Cs-137	34.2±2.0	27.2±7.0	8.7
QC-W-26	Water	Jun 1987	H-3	3422±100	3362±300	520
			Co-60	24.8±1.4	26.5±7.0	8.7
			Cs-134	<2.0	0.0	8.7
			Cs-137	21.2±0.5	21.6±7.0	8.7
QC-W-27	Water	Jun 1987	Gr. alpha	8.5±1.9	10.1±4.0	8.7
			Gr. beta	22.6±1.9	21.2±5.0	8.7
QC-W-28	Water	Jun 1987	Gr. alpha	8.7±1.3	10.1±4.0	8.7
			Gr. beta	12.2±5.2	9.4±3.0	8.7

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-29	Water	Jun 1987	Gr. alpha	16.4±1.3	18.9±5.0	8.7
			Gr. beta	15.9±4.0	11.8±4.0	8.7
QC-MI-15	Milk	Jul 1987	Sr-90	19.4±1.6	18.8±3.5	5.2
			I-131	43.5±0.7	45.3±7.0	10.4
			Cs-134	17.9±2.2	16.0±5.3	8.7
			Cs-137	25.4±1.8	22.7±5.0	8.7
QC-W-30	Water	Sep 1987	Sr-89	17.5±3.0	14.3±5.0	8.7
			Sr-90	18.4±2.2	17.5±2.2	5.2
QC-W-31	Water	Oct 1987	H-3	2053±939	2059±306	520
QC-W-32	Water	Dec 1987	Gr. alpha	8.6±1.0	10.1±5.0	8.7
			Gr. beta	15.2±0.1	13.1±3.0	8.7
QC-W-33	Water	Dec 1987	Gr. alpha	7.7±1.4	10.1±5.0	8.7
			Gr. beta	10.9±1.0	7.9±3.0	8.7
QC-W-34	Water	Dec 1987	Gr. alpha	4.0±0.9	5.1±3.0	8.7
			Gr. beta	9.4±0.9	7.9±3.0	8.7
QC-MI-16	Milk	Feb 1988	Sr-89	31.8±4.7	31.7±6.0	8.7
			Sr-90	25.5±2.7	27.8±3.5	5.2
			I-131	26.4±0.5	23.2±5.0	10.4
			Cs-134	23.8±2.3	24.2±6.0	8.7
			Cs-137	26.5±0.8	25.1±6.0	8.7
QC-MI-17	Milk	Feb 1988	I-131	10.6±1.2	14.3±1.6	10.4
QC-W-35	Water	Feb 1988	I-131	9.7±1.1	11.6±1.1	10.4
QC-W-36	Water	Feb 1988	I-131	10.5±1.3	11.6±1.0	10.4
QC-W-37	Water	Mar 1988	Sr-89	17.1±2.0	19.8±8.0	8.7
			Sr-90	18.7±0.9	17.3±5.0	5.2
QC-MI-18	Milk	Mar 1988	I-131	33.2±2.3	26.7±5.0	10.4
			Cs-134	31.3±2.1	30.2±5.0	8.7
			Cs-137	29.9±1.4	26.2±5.0	8.7

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-38	Water	Apr 1988	I-131	17.1±1.1	14.2±5.0	10.4
QC-W-39	Water	Apr 1988	H-3	4439±31	4176±500	724
QC-W-40	Water	Apr 1988	Co-60	23.7±0.5	26.1±4.0	8.7
			Cs-134	25.4±2.6	29.2±4.5	8.7
			Cs-137	26.6±2.3	26.2±4.0	8.7
QC-W-41	Water	Jun 1988	Gr. alpha	12.3±0.4	13.1±5.0	8.7
			Gr. beta	22.6±1.0	20.1±5.0	8.7
QC-MI-19	Milk	Jul 1988	Sr-89	15.1±1.6	16.4±5.0	8.7
			Sr-90	18.0±0.6	18.3±5.0	5.2
			I-131	88.4±4.9	86.6±8.0	10.4
			Cs-137	22.7±0.8	20.8±6.0	8.7
QC-W-42	Water	Sep 1988	Sr-89	48.5±3.3	50.8±8.0	8.7
			Sr-90	10.9±1.0	11.4±3.5	5.2
QC-W-43	Water	Oct 1988	Co-60	20.9±3.2	21.4±3.5	8.7
			Cs-134	38.7±1.6	38.0±6.0	8.7
			Cs-137	19.0±2.4	21.0±3.5	8.7
QC-W-44	Water	Oct 1988	I-131	22.2±0.6	23.3±3.5	10.4
QC-W-45	Water	Oct 1988	H-3	4109±43	4153±500	724
QC-MI-20	Milk	Oct 1988	I-131	59.8±0.9	60.6±9.0	10.4
			Cs-134	49.6±1.8	48.6±7.5	8.7
			Cs-137	25.8±4.6	24.7±4.0	8.7
QC-W-46	Water	Dec 1988	Gr. alpha	11.5±2.3	15.2±5.0	8.7
			Gr. beta	26.5±2.0	25.7±5.0	8.7
QC-MI-21	Milk	Jan 1989	Sr-89	25.5±10.3	34.0±10.0	8.7
			Sr-90	28.3±3.2	27.1±3.0	5.2
			I-131	540±13	550±20	10.4
			Cs-134	24.5±2.6	22.6±5.5	8.7
			Cs-137	24.0±0.6	20.5±5.0	8.7

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-47	Water	Mar 1989	Sr-89	15.2±3.8	16.1±5.0	8.7
			Sr-90	16.4±1.7	16.9±3.0	5.2
QC-MI-22	Milk	Apr 1989	I-131	36.3±1.1	37.2±5.0	10.4
			Cs-134	20.8±2.8	20.7±8.0	8.7
			Cs-137	22.2±2.4	20.4±8.0	8.7
QC-W-48	Water	Apr 1989	Co-60	23.5±2.0	25.1±8.0	8.7
			Cs-134	24.2±1.1	25.9±8.0	8.7
			Cs-137	23.6±1.2	23.0±8.0	8.7
QC-W-49	Water	Apr 1989	I-131	37.2±3.7	37.2±5.0	10.4
QC-W-50	Water	Apr 1989	H-3	3011±59	3089±500	724
QC-W-51	Water	Jun 1989	Gr. alpha	13.0±1.8	15.0±5.0	8.7
			Gr. beta	26.0±1.2	25.5±8.0	8.7
QC-MI-23	Milk	Jul 1989	Sr-89	19.4±6.5	22.0±10.0	8.7
			Sr-90	27.6±3.5	28.6±3.0	5.2
			I-131	46.8±3.2	43.4±5.0	10.4
			Cs-134	27.4±1.8	28.3±6.0	8.7
			Cs-137	24.1±1.8	20.8±6.0	8.7
QC-MI-24	Milk	Aug 1989	Sr-89	25.4±2.7	27.2±10.0	8.7
			Sr-90	46.0±1.1	47.8±9.6	8.3
QC-W-52	Water	Sep 1989	I-131	9.6±0.3	9.7±1.9	10.4
QC-W-53	Water	Sep 1989	I-131	19.0±0.2	20.9±4.2	10.4
QC-W-54	Water	Sep 1989	Sr-89	25.8±4.6	24.7±4.0	8.7
			Sr-90	26.5±5.3	29.7±5.0	5.2
QC-MI-25	Milk	Oct 1989	I-131	70.0±3.3	73.5±20.0	10.4
			Cs-134	22.1±2.6	22.6±8.0	8.7
			Cs-137	29.4±1.5	27.5±8.0	8.7
QC-W-55	Water	Oct 1989	I-131	33.3±1.3	35.3±10.0	10.4

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-56	Water	Oct 1989	Co-60	15.2±0.9	17.4±5.0	8.7
			Cs-134	22.1±4.4	18.9±8.0	8.7
			Cs-137	27.2±1.2	22.9±8.0	8.7
QC-W-57	Water	Oct 1989	H-3	3334±22	3379±500	724
QC-W-58	Water	Nov 1989	Sr-89	10.9±1.4[d]	11.1±1.0[d]	8.7
			Sr-90	10.4±1.0[d]	10.3±1.0[d]	5.2
QC-W-59	Water	Nov 1989	Sr-89	101.0±6.0[d]	104.1±10.5[d]	17.5
			Sr-90	98.0±3.0[d]	95.0±10.0[d]	17.0
QC-W-60	Water	Dec 1989	Gr. alpha	10.8±1.1	10.6±4.0	8.7
			Gr. beta	11.6±0.5	11.4±4.0	8.7
QC-MI-26	Milk	Jan 1990	Cs-134	19.3±1.0	20.8±8.0	8.7
			Cs-137	25.2±1.2	22.8±8.0	8.7
QC-MI-27	Milk	Feb 1990	Sr-90	18.0±1.6	18.8±5.0	5.2
QC-MI-28	Milk	Mar 1990	I-131	63.8±2.2	62.6±6.0	6.3
QC-MI-61	Water	Apr 1990	Sr-89	17.9±5.5	23.1±8.7	8.7
			Sr-90	19.4±2.5	23.5±5.2	5.2
QC-MI-29	Milk	Apr 1990	I-131	90.7±9.2	82.5±8.5	10.4
			Cs-134	18.3±1.0	19.7±5.0	8.7
			Cs-137	20.3±1.0	18.2±5.0	8.7
QC-W-62	Water	Apr 1990	Co-60	8.7±0.4	9.4±5.0	8.7
			Cs-134	20.0±0.2	19.7±5.0	8.7
			Cs-137	28.7±1.4	22.7±5.0	8.7
QC-W-63	Water	Apr 1990	I-131	63.5±8.0	66.0±6.7	6.6
QC-W-64	Water	Apr 1990	H-3	1941±130	1826.0±350.0	724
QC-W-65	Water	Jun 1990	Ra-226	6.4±0.2	6.9±1.0	1.0
QC-W-66	Water	Jun 1990	U	6.2±0.2	6.0±6.0	6.0

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-MI-30	Milk	Jul 1990	Sr-89	12.8±0.4	18.4±10.0	8.7
			Sr-90	18.2±1.4	18.7±6.0	5.2
			Cs-134	46.0±1.3	49.0±5.0	8.7
			Cs-137	27.6±1.3	25.3±5.0	8.7
QC-W-68	Water	Jun 1990	Gr. alpha	9.8±0.3	10.6±6.0	8.7
			Gr. beta	11.4±0.6	11.3±7.0	8.7
QC-MI-31	Milk	Aug 1990	I-131	68.8±1.6	61.4±12.3	10.4
QC-W-69	Water	Sep 1990	Sr-89	17.7±1.6	19.2±10.0	8.7
			Sr-90	13.9±1.6	17.4±10.0	5.2
QC-MI-32	Milk	Oct 1990	I-131	34.8±0.2	32.4±6.5	8.7
			Cs-134	25.8±1.2	27.3±10.0	8.7
			Cs-137	25.3±2.0	22.4±10.0	8.7
QC-W-70	Water	Oct 1990	H-3	2355±59	2276±455	605
QC-W-71	Water	Oct 1990	I-131	55.9±0.9	51.8±10.4	10.4
QC-W-73	Water	Oct 1990	Co-60	18.3±2.7	16.8±5.0	8.7
			Cs-134	28.3±2.3	27.0±5.0	8.7
			Cs-137	22.7±1.3	22.4±5.0	8.7
QC-W-74	Water	Dec 1990	Gr. alpha	21.4±1.0	26.1±6.5	11.3
			Gr. beta	25.9±1.0	22.3±5.6	9.7

[a] n = 3 unless noted otherwise.
[b] n = 2 unless noted otherwise.
[c] n = 1 unless noted otherwise.
[d] Concentration in pCi/ml.

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
BL-1	D.I. Water	Nov 1985	Gross alpha	<0.1	<1
			Gross beta	<0.4	<4
BL-2	D.I. Water	Nov 1985	Cs-137 (gamma)	<1.9	<10
BL-3	D.I. Water	Nov 1985	Sr-89	<0.5	<5
			Sr-90	<0.6	<1
BL-5	D.I. Water	Nov 1985	Ra-226	<0.4	<1
			Ra-228	<0.4	<1
SPW-2265	D.I. Water	Apr 1985	Gross alpha	<0.6	<1
			Gross beta	<2.2	<4
			Sr-89	<0.2	<5
			Sr-90	<0.4	<1
			I-131	<0.2	<1
			Cs-137 (gamma)	<7.4	<10
BL-6	D.I. Water	Apr 1986	Gross alpha	<0.4	<1
BL-7	D.I. Water	Apr 1986	Gross alpha	<0.4	<1
BL-8	D.I. Water	Jun 1986	Gross alpha	<0.4	<1
BL-9	D.I. Water	Jun 1986	Gross alpha	<0.3	<1
SPW-3185	D.I. Water	Jan 1987	Ra-226	<0.1	<1
			Ra-228	<0.9	<1
SPS-3292	Milk	Jan 1987	I-131	<0.1	<1
			Cs-134	<6.2	<10
			Cs-137	<6.4	<10
SPW-3554	D.I. Water	Feb 1987	H-3	<180	<300
			Gross beta	<2.6	<4
SPS-3555	Milk	Feb 1987	Sr-89	<0.6	<5
			Sr-90	1.9±0.4[a]	<1
SPS-3731	Milk	Mar 1987	Cs-134	<2.2	<10
			Cs-137	<2.5	<10

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-3732	D.I. Water	Mar 1987	Sr-89	<0.9	<5
			Sr-90	<0.8	<1
			I-131	<0.3	<1
			Co-60	<2.3	<10
			Cs-134	<2.2	<10
			Cs-137	<2.4	<10
			Ra-226	<0.1	<1
			Ra-228	<1.0	<1
			Np-237	<0.04	<1
			Th-230	<0.05	<0.1
			Th-232	<0.02	<0.1
			U-234	<0.05	<0.1
			U-235	<0.03	<0.1
			U-238	<0.03	<0.1
SPS-4023	Milk	May 1987	I-131	<0.1	<1
SPS-4203	D.I. Water	May 1987	Gross alpha	<0.7	<1
			Gross beta	<1.7	<4
SPS-4204	Milk	May 1987	Sr-89	<0.5	<5
			Sr-90	2.4±0.6[a]	<1
SPS-4390	Milk	Jun 1987	Cs-134	<4.7	<10
			Cs-137	<5.2	<10
SPS-4391	D.I. Water	Jun 1987	Sr-89	<0.4	<5
			Sr-90	<0.4	<1
			I-121	<0.1	<1
			Co-60	<3.8	<10
			Cs-137	<5.7	<10
			Ra-226	<0.1	<1
			Ra-228	<0.9	<1
SPW-4627	D.I. Water	Aug 1987	Gross alpha	<0.6	<1
			Gross beta	<1.4	<4
			Tritium	<150	<300
SPS-4628	Milk	Aug 1987	Sr-89	<0.6	<5
			Sr-90	2.4±0.6[a]	<1

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-4847	Milk	Sep 1987	Cs-134	<4.4	<10
			Cs-137	<5.3	<10
SPS-4848	D.I. Water	Sep 1987	I-131	<0.2	<1
SPW-4849	D.I. Water	Sep 1987	Co-60	<4.1	<10
			Cs-134	<4.8	<10
			Cs-137	<4.0	<10
			Sr-89	<0.7	<5
			Sr-90	<0.7	<1
SPW-4850	D.I. Water	Sep 1987	Th-228	<0.04	<1
			Th-232	<0.8	<1
			U-234	<0.03	<1
			U-235	<0.03	<1
			U-238	<0.02	<1
			Am-241	<0.06	<1
			Cm-242	<0.04	<1
			Ra-226	<0.1	<1
			Ra-228	<1.0	<2
SPW-4859	D.I. Water	Oct 1987	Fe-55	<0.5	<1
SPS-5348	Milk	Dec 1987	Cs-134	<2.3	<10
			Cs-137	<2.5	<10
SPW-5384	D.I. Water	Dec 1987	Co-60	<2.8	<10
			Cs-134	<2.6	<10
			Cs-137	<2.8	<10
			I-131	<0.2	<1
			Ra-226	<0.1	<1
			Ra-228	<1.2	<2
			Sr-89	<0.5	<1
			Sr-90	<0.4	<1
SPW-5385	D.I. Water	Nov 1987	Gross alpha	<0.4	<1
			Gross beta	<2.2	<4
			Fe-55	<0.3	<1
SPS-5386	Milk	Jan 1988	I-131	<0.1	<1
SPW-5448	"Dead" Water	Jan 1988	H-3	<177	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-5615	Milk	Mar 1988	Cs-134	<2.4	<10
			Cs-137	<2.5	<10
			I-131	<0.3	<1
			Sr-89	<0.4	<5
			Sr-90	2.4±0.5[a]	<1
SPS-5650	D.I. Water	Mar 1988	Th-228	<0.3	<1
			Th-230	<0.04	<1
			Th-232	<0.05	<1
			U-234	<0.03	<1
			U-235	<0.03	<1
			U-238	<0.03	<1
			Am-241	<0.06	<1
			Cm-242	<0.01	<1
			Pu-238	<0.08	<1
			Pu-240	<0.02	<1
SPS-6090	Milk	Jul 1988	Sr-89	<0.5	<1
			Sr-90	1.8±0.5	<1
			I-131	<0.4	<1
			Cs-137	<0.4	<10
SPW-6209	Water	Jul 1988	Fe-55	<0.8	<1
SPW-6292	Water	Sep 1988	Sr-89	<0.7	<1
			Sr-90	<0.7	<1
SPS-6477	Milk	Oct 1988	I-131	<0.2	<1
			Cs-134	<6.1	<10
			Cs-137	<5.9	<10
SPW-6478	Water	Oct 1988	I-131	<0.2	<1
SPW-6479	Water	Oct 1988	Co-60	<5.7	<10
			Cs-134	<3.7	<10
			Cs-137	<4.3	<10
SPW-6480	Water	Oct 1988	H-3	<170	<300
SPW-6625	Water	Dec 1988	Gross alpha	<0.7	<1
			Gross beta	<1.9	<4

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-6723	Milk	Jan 1989	Sr-89	<0.6	<5
			Sr-90	1.9±0.5[a]	<1
			I-131	<0.2	<1
			Cs-134	<4.3	<10
			Cs-137	<4.4	<10
SPW-6877	Water	Mar 1989	Sr-89	<0.4	<5
			Sr-90	<0.6	<1
SPS-6963	Milk	Apr 1989	I-131	<0.3	<1
			Cs-134	<5.9	<10
			Cs-137	<6.2	<10
SPW-7561	Water	Apr 1989	H-3	<150	<300
SPW-7207	Water	Jun 1989	Ra-226	<0.2	<1
			Ra-228	<0.6	<1
SPS-7208	Milk	Jun 1989	Sr-89	<0.6	<5
			Sr-90	2.1±0.5[a]	<1
			I-131	<0.3	<1
			Cs-134	<6.4	<10
			Cs-137	<7.2	<10
SPW-7558	Water	Jun 1989	Gross alpha	<0.2	<1
			Gross beta	<1.0	<4
SPS-7322	Milk	Aug 1989	Sr-89	<1.4	<5
			Sr-90	4.8±1.0[a]	<1
			I-131	<0.2	<1
			Cs-134	<6.9	<10
			Cs-137	<8.2	<10
SPW-7559	Water	Sep 1989	Sr-89	<2.0	<5
			Sr-90	<0.7	<1
SPW-7560	Water	Oct 1989	I-131	<0.1	<1
SPW-7562	Water	Oct 1989	H-3	<140	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-7605	Milk	Nov 1989	I-131	<0.2	<1
			Cs-134	<8.6	<10
			Cs-137	<10	<10
SPW-7971	Water	Dec 1989	Gross alpha	<0.4	<1
			Gross beta	<0.8	<4
SPW-8039	Water	Jan 1990	Ra-226	<0.2	<1
SPS-8040	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	<1.0	<1
SPS-8208	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	1.6±0.5[a]	<1
			Cs-134	<3.6	<10
			Cs-137	<4.7	<10
SPS-8312	Milk	Feb 1990	Sr-89	<0.3	<5
			Sr-90	1.2±0.3[a]	<1
SPW-8312A	Water	Feb 1990	Sr-89	<0.6	<5
			Sr-90	<0.7	<1
SPS-8314	Milk	Mar 1990	I-131	<0.3	<1
SPS-8510	Milk	May 1990	I-131	<0.2	<1
			Cs-134	<4.6	<10
			Cs-137	<4.8	<10
SPW-8511A	Water	May 1990	H-3	<200	<300
SPS-8600	Milk	Jul 1990	Sr-89	<0.8	<5
			Sr-90	1.7±0.6[a]	<1
			I-131	<0.3	<1
			Cs-134	<5.0	<10
			Cs-137	<7.0	<10
SPM-8877	Milk	Aug 1990	I-131	<0.2	<1
SPW-8925	Water	Aug 1990	H-3	<200	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPW-8926	Water	Aug 1990	Gross alpha	<0.3	<1
			Gross beta	<0.7	<4
SPW-8927	Water	Aug 1990	U-234	<0.01	<1
			U-235	<0.02	<1
			U-238	<0.01	<1
SPW-8928	Water	Aug 1990	Mn-54	<4.0	<5
			Co-58	<4.1	<5
			Co-60	<2.4	<5
			Cs-134	<3.3	<5
			Cs-137	<3.7	<5
SPW-8929	Water	Aug 1990	Sr-89	<1.4	<5
			Sr-89	<0.6	<1
SPW-69	Water	Sep 1990	Sr-89	<1.8	<5
			Sr-90	<0.8	<1
SPW-106	Water	Oct 1990	H-3	<180	<300
SPW-107	Milk	Oct 1990	I-131	<0.4	<1
			Cs-134	<3.3	<5
			Cs-137	<4.3	<5
SPW-370	Water	Oct 1990	Mn-54	<1.7	<5
			Co-58	<2.6	<5
			Co-60	<1.6	<5
			Cs-134	<1.7	<5
			Cs-137	<1.8	<5
SPW-372	Water	Dec 1990	Gross alpha	<0.3	<1
			Gross beta	<0.8	<4

[a] Low level of Sr-90 concentration in milk (1 - 5 pCi/L) is not unusual.

ATTACHMENT B

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

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

Analysis	Level	One Standard Deviation for Single Determination
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg >30 pCi/liter of kg	3.0 pCi/liter 10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross Alpha	<20 pCi/liter >20 pCi/liter	5 pCi/liter 25% of known value
Gross Beta	<100 pCi/liter >100 pCi/liter	5 pCi/liter 5% of known value
Tritium	<4,000 pCi/liter >4,000 pCi/liter	1s = (pCi/liter) = 169.85 x (known).0933 10% of known value
Radium-226, Radium-228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	<55 pCi/liter >55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-63[b], Technetium-99[b]	<35 pCi/liter >35 pCi/liter	6 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter >100 pCi/liter	10 pCi/liter 10% of known value

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

ADDENDUM TO APPENDIX A

The following is an explanation of the reasons why certain samples were outside the control limit specified by the Environmental Protection Agency for the Interlaboratory Comparison Program starting January 1987.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STM-504	Sr-89 Sr-90	57.0±4.3 32.0±1.0	60.3-77.7 32.4-37.6	Milk had high fat content which made analyses difficult. Addition of errors to TIML result would put values within EPA control limits. EPA also had the same problem in analyzing its own sample.
STW-511	Ra-228	8.1±1.4	4.6-8.0	TIML results are usually within EPA control limits. Analysis of the next sample was within EPA control limits. No further action is planned.
STW-516	Cr-51	80.3±17.5	61.3-78.7	Results in the past have been within EPA control limits and TIML will monitor the situation in the future.
STF-524	K	1010.7±158.5[b]	1123.5-1336.5[b]	Error in transference of data. Correct data was 1105±33 mg/kg. Results in the past have been within the limits and TIML will monitor the situation in the future.
STW-532	I-131	9.0±2.0	6.2-8.8	Sample recounted after 12 days. The average result was 8.8±1.7 pCi/L (within EPA control limits). The sample was recounted in order to check the decay. Results in the past have been within the limits and TIML will continue to monitor the situation in the future.

[a] Reported in pCi/L unless otherwise noted.
[b] Concentrations are reported in mg/kg.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STW-534	Co-60	63.3±1.3	41.3-58.7	High level of Co-60 was due to contamination of beaker. Beaker was discarded upon discovery of contamination and sample was recounted. Recount results 53.2±3.6 and 50.9±2.4 pCi/L.
STM-554	Sr-90	51.0±2.0	54.8-65.2	The cause of low result was due to very high fat content in the milk. It should be noted that 63% of all participants failed this test. Also, the average for all participants was 54.0 pCi/L before the Grubb and 55.8 pCi/L after the Grubb.
STW-560	Pu-239	5.8±1.1	3.5-4.9	The cause of high results is not known it is suspected that the standard was not properly calibrated by supplier and is under investigation. New Pu-236 standard was obtained and will be used for the next test.
STW-568	Ra-228	2.6±1.0	2.7-4.5	The cause of low results is not known. Next EPA crosscheck results were within the control limits. No further action is planned.
STM-570	Sr-89 Sr-90	26.0±10.0 45.7±4.2	30.3-47.7 49.8-60.2	The cause of low results was falsely high recovery due to suspected incomplete calcium removal. Since EPA sample was used up, internal spike was prepared and analyzed. The results were within control limits (See table A-3, sample QC-MI-24). No further action is planned.

[a] Reported in pCi/L unless otherwise noted.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STW-589	Sr-90	17.3±1.2	17.4-22.6	Sample was reanalyzed in triplicate; results of reanalyses 18.8±1.5 pCi/L. No further action is planned.
STM-599	K	1300.0±69.2[c]	1414.7-1685.3[c]	Sample was reanalyzed in triplicate. Results of reanalyses, 1421.7±95.3 mg/L. The cause of low results is unknown.
STW-601	Gross Alpha	11.0±2.0	11.6-32.4	Sample was reanalyzed in triplicate. Results of reanalyses, 13.4±1.0 pCi/L.

[a] Reported in pCi/L unless otherwise noted.
[c] Concentrations are reported in mg/L.

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 = 2σ counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is found to be below the lower limit of detection L it is reported as

$$<L$$

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

3.0. Duplicate Analyses

3.1. Individual results: $x_1 \pm s_1$
$x_2 \pm s_2$

Reported result: $x \pm s$

where $x = (1/2)\ (x_1 + x_2)$

$$s = (1/2)\sqrt{s_1^2 + s_2^2}$$

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:

$$\bar{x} = \frac{1}{n} \Sigma x$$

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

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

4.3 If all of the 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 figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2 If the figure following those to be retained is greater than 5, the figure is dropped, and the last retained figure is raised by 1. As an example, 11.446 is rounded off to 11.45.

4.5.3. If the figure following those to be retained is 5, and if there are no figures other than zeros beyond the five, the figure 5 is dropped, and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number. As an example, 11.435 is rounded off to 11.44, while 11.425 is rounded off to 11.42.

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			Water	
Gross alpha	3	pCi/m^3	Strontium-89	3,000 pCi/l
Gross beta	100	pCi/m^3	Strontium-90	300 pCi/l
Iodine-131[b]	0.14	pCi/m^3	Cesium-137	20,000 pCi/l
			Barium-140	20,000 pCi/l
			Iodine-131	300 pCi/l
			Potassium-40[c]	3,000 pCi/l
			Gross alpha	30 pCi/l
			Gross beta	100 pCi/l
			Tritium	3 x 10^6 pCi/l

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

[b] From 10 CFR 20 but 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

Special Ground, Surface, and Well Water Samples

1.0 INTRODUCTION

This appendix to the Radiation Environmental Monitoring Program Annual Report to the United States Nuclear Regulatory Commission summarizes and interprets results of the special well, ground, and surface water samples taken at the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, during the period January - December, 1990. This supplemental special sampling program was establish in December of 1989 when tritium was 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 nearby residerce well water sample. The program is described and the results for 1990 are summarized and discussed.

Program findings show a low level of tritium in a nearby residence well, some ground water seepage samples, and some levels slightly above the LLD in a few other well water samples. None of the samples exceeded any limits and did not qualify as non-routine sample results. However because of the ability to detect tritium at levels above the control locations the discharge canal system was modified to help preclude any further introduction of tritium into the ground water system.

3.0 Special Tritium Sampling Program

3.1 Program Design and Data Interpretation

The purpose of this sampling program was to assess the impact of the tritium leaching into the environment (ground water system) from the discharge canal. For this purpose special water samples are collected and analyzed for radioactive content. After it was determined by collection and analyses that tritium was the only isotope that we would see at this level of leaching the gamma isotopic analyzes of special water samples was suspended.

3.2 Program Description

The sampling and analysis schedule for the special water sampling program is summarized in Table 4.1 and briefly reviewed below. Table 4.2 defines the additional sample locations and codes for the special water sampling program, some samples were not coded due to there one time sampling or they were not offsite samples.

Special well and ground water is collected monthly at six locations, one control sample from the PINGP Biology Station (P-30), two from the nearest residences deep and shallow wells (P-24d and P-24s, Suter Residence), two ground water seepage from near Birch Lake (P-31 and P-32), and well water from the PI Training Center(P-26). Quarterly well water is collected from three other nearby residences (P-27, Nauer Residence; P-28, Perkins Residence; P-29 Childs Residence). Additional non routine samples were collected on a non frequent basis or a one time basis as can be seen in the complete data table Table 4.4.

3.3 Program Execution

The special water sampling was executed as described in the preceding section with the following exception:

1. No water sample was available during the months of March, May, June, and October from the Birch Lake locations (P-31 and P-32) due to high water levels in the lake. The ground seepage sample locations were under water.

3.4 Program Modifications

The sample collection included some one time sampling of surface water locations, both inside the site boundary and outside. Due to these one time sampling and inside site boundary locations they were not added to the sample location list as other samples were.

3.5 Results and Discussion

Results obtained show very low levels of tritium in some well water and ground water samples. While not all of the results can be positively identified as being a result of the operation of the Prairie Island Nuclear Generating Plant due to their levels being very slightly above the Lower Limit of Detection. The reliability of the analysis at this low a level is suspect and not normally obtained in the routine REMP sampling. Several of the higher levels are probably due to the seepage of discharge canal water into the ground water due to elevation difference between the Vermillon River and the discharge canal, this elevation difference is approximately ten feet and due to the lock and dam system downstream. The Suter Residence is directly between the discharge canal and Birch Lake which is attached to the Vermillon River. The discharge piping is being extended to allow effluent discharges to bypass most of the discharge canal and therefore reduce the impact on the ground water due to effluent releases.

Table D-4.1 Sample collection and analysis program for special well, ground, and surface water samples, Prairie Island Nuclear Generating Plant, 1990.

Medium	Locations No.	Codes (and Type)[a]	Collection Type and Frequency[b]	Analysis Type and Frequency[c]
Well water monthly	4	P-30(C), P-26, P-24s, P-24d	G/M	H-3
Well water qtrly	3	P-27, P-28, P-29	G/Q	H-3
Ground water	2	P-31, P-32	G/M	H-3
Surface water	6		G/X	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 coded as follows: C/ = continuous, G/ = grab. Collection frequency is coded as follows: W = weekly, M = monthly, Q = quarterly, SA = semiannually, A = annually, X = no specified frequency or one time.

[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.

Table D-4.2 Sampling locations, for special well, ground, and surface water samples, Prairie Island Nuclear Generating Plant, 1990.

Code	Type[a]	Collection Site	Type of Sample[b]	Distance and Direction from Site Stack
P-24d		Suter Residence, deep well	WW	0.6 mi @ 158°/SSE
P-24s		Suter Residence, shallow well	WW	0.6 mi @ 158°/SSE
P-26		PINGP Training Center	WW	0.4 mi @ 258°/WSW
P-27		Nauer Residence	WW	0.9 mi @ 154°/SSE
P-28		Perkins Residence	WW	1.0 mi @ 152°/SSE
P-29		Childs Residence	WW	1.2 mi @ 149°/SSE
P-30	C	PINGP Biology Station	WW	0.2 mi @ 32°/NNE
P-31		Birch Lake Seepage # 1	GW	0.8 mi @ 169°/SSE
P-32		Birch Lake Seepage # 2	GW	0.7 mi @ 179°/S

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

b Sample codes:

AP = Airborne particulate
AI = Airborne iodine
M = Milk
VE = Vegetation/vegetables
DW = Drinking water
RW = River water
WW = Well water
BS = Bottom (river) sediments
SS = Shoreline Sediments
BO = Bottom organisms (periphyton or macroinvertebrates)
F = Fish
GW = Ground water

Table D-4.3 Radiological Environmental Monitoring Program Summary; Special Well, Ground, Surface Water Samples

Name of Facility Prairie Island Nuclear Generating Plant Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota Reporting Period January - December 1990
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	Locations with highest Annual Mean Location[d]	Range	Control Locations Mean (F)[c] Range	Number of Non-routine Results[e]
Well Water (pCi/L)	H-3 60	210	839 (42/48) (210-1870)	P-24s, Suter's Shallow Well, 0.6 mi @ 158°/SSE	1131 (12/12) (330 - 1870)	< LLD	0
Ground Water (pCi/L)	H-3 16	210	664 (16/16) (510-910)	P-31, Birch Lake Seepage #1, 0.8 mi @ 169°/SSE	702 (8/8) (510-910)	< LLD	0
Surface Water (pCi/L)	H-3 9	210	560 (1/9)	Duck Pond #2, 0.3 mi @ 158°/SSE	560 (1/4)	< LLD	0

[a] GB = Gross beta; GS = gamma scan.

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

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

[d] Locations are specified (1) by name and code (Table 2) and (2) distance, direction, and sector relative to reactor site.

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

TABLE D-4.4.1 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/20	8/9	9/10	10/24	11/12	12/11
	DATES												
Suter's													
Deep		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
Well													
	Sample I.D.	8045	8281	8371	8480	6233	8720	8868	8949	25	144	214	313
P-24d	H-3	1340	1570	1180	1190	1310	1330	1290	1560	1370	1740	1220	1320
	Gross Alpha	<0.6	1.5	<0.8	<0.9								
	Gross Beta	2.2	1.7	2.4	2.8								
	Mn-54	<4.2	<4.9	<5.2	<4.8								
	Fe-59	<14.1	<11.2	<10.4	<9.7								
	Co-58	<4.8	<5.2	<4.3	<4.8								
	Co-60	<4.9	<4.8	<4.7	<3.2								
	Zn-65	<9.5	<10.0	<8.8	<8.6								
	Zr-Nb-95	<5.5	<5.8	<4.9	<6.1								
	Cs-134	<4.1	<4.4	<3.1	<4.3								
	Cs-137	<5.6	<4.4	<4.9	<3.9								
	Ba-La-140	<6.0	<6.9	<6.2	<6.1								
	Ce-144	<52.6	<39.4	<31.6	<27.2								

TABLE D-4.4.2 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING DATES	1/15	2/12	3/12	4/10	5/17	6/12	7/20	8/9	9/10	10/24	11/12	12/11
Suter's Shallow Well		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.	8046	8280	8370	8490	6232	8721	8869	8948	24	145	215	314
P-24s	H-3	890	330	560	610	750	870	1330	1870	1830	1170	1800	1560
	Gross Alpha	<1.0	<1.6	<0.8	<0.9								
	Gross Beta	2.7	2	3.3	2.9								
	Mn-54	<4.9	<4.0	<9.3	<5.3								
	Fe 59	<10.5	<9.8	<17.2	<11.3								
	Co-58	<4.3	<5.2	<8.1	<5.4								
	Co-60	<4.2	<3.6	<6.6	<6.6								
	Zn-65	<9.0	<6.9	<19.0	<12.7								
	Zr-Nb-95	<5.9	<4.8	<8.2	<6.1								
	Cs-134	<3.2	<3.6	<9.2	<5.4								
	Cs-137	<4.5	<5.2	<8.5	<5.9								
	Ba-La-140	<7.3	<5.2	<8.8	<13.4								
	Ce-144	<36.7	<48.0	<68.5	<36.9								

TABLE D-4.4.3 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/20	8/9	9/10	10/24	11/12	12/11
	DATES												
Birch Lake No.1		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sa e I.D.	8050	8276		8495			8872	8952	22		218	317
P-31	H-3	710	770		700			910	800	640		510	580
	Gross Alpha	<0.9	<1.3		<1.1								
	Gross Beta	2.3	1.8		1.7								
	Mn-54	<6.1	<2.6		<3.7								
	Fe-59	<17.5	<6.3		<12.8								
	Co-58	<5.2	<2.3		<3.5								
	Co-60	<6.2	<2.2		<6.4								
	Zn-65	<13.0	<3.8		<8.8								
	Zr-Nb-95	<7.5	<3.1		<6.9								
	Cs-134	<5.3	<2.0		<3.6								
	Cs-137	<6.5	<2.5		<3.5								
	Ba-La-140	<13.6	<2.5		<8.2								
	Ce-144	<51.6	<9.2		<34.1								

TABLE D-4.4.4 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING DATES	1/15	2/12	3/12	4/10	5/17	6/12	7/20	8/9	9/10	10/24	11/12	12/11
Birch Lake No.2		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.	8051	8277		8496			8873	8953	20		219	318
P-32	H-3	520	550		650			600	760	700		510	720
	Gross Alpha	<1.0	<1.0		1.6								
	Gross Beta	1.9	<1.1		1.2								
	Mn-54	<5.5	<3.1		<4.2								
	Fe-59	<14.9	<9.2		<7.2								
	Co-58	<6.4	<3.7		<4.0								
	Co-60	<6.0	<3.9		<4.1								
	Zn-65	<12.4	<8.8		<7.5								
	Zr-Nb-95	<7.6	<4.9		<5.8								
	Cs-134	<4.7	<3.2		<4.0								
	Cs-137	<6.5	<4.4		<5.5								
	Ba-La-140	<13.1	<3.8		<4.6								
	Ce-144	<60.4	<35.0		<47.2								

TABLE D-4.4.5 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING DATES	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
PI Training Center		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.	8044	8278	8369	8488	6230	8719	8876	8950	26	146	216	315
P-26	H-3	390	470	260	290	330	210	450	320	310	330	310	< 190
	Gross Alpha	<0.7	<1.9	<6.7	<0.6								
	Gross Beta	<0.9	2.5	1.6	2.1								
	Mn-54	<4.4	<4.3	<3.8	<4.8								
	Fe-59	<11.4	<8.1	<10.0	<10.5								
	Co-58	<4.5	<3.6	<3.5	<4.0								
	Co-60	<3.1	<3.7	<3.8	<3.9								
	Zn-65	<9.7	<8.8	<8.6	<7.2								
	Zr-Nb-95	<4.5	<4.4	<4.7	<5.2								
	Cs-134	<4.7	<3.7	<3.7	<3.3								
	Cs-137	<5.2	<4.1	<4.9	<4.3								
	Ba-La-140	<9.1	<4.0	<4.0	<5.7								
	Ce-144	<43.4	<42.4	<42.0	<42.3								

TABLE D-4.4.6 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
	DATES												
PI Environ Lab		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.	8052	8282	8372	8494	8584	8722	8874	8954	21	147	217	316
P-30	H-3	< 180	< 180	< 180	< 190	< 210	< 190	< 200	< 190	< 180	< 180	< 180	< 190
	Gross Alpha	<0.8	<1.4	<0.9	<1.1								
	Gross Beta	<0.9	1.2	1	1.5								
	Mn-54	<4.3	<6.0	<5.5	<4.7								
	Fe-59	<8.3	<14.6	<10.5	<13.9								
	Co-58	<3.7	<6.7	<5.8	<6.4								
	Co-60	<3.1	<5.5	<6.5	<5.0								
	Zn-65	<9.2	<11.5	<15.4	<13.0								
	Zr-Nb-95	<6.7	<8.4	<5.8	<7.5								
	Cs-134	<4.8	<5.0	<7.6	<6.7								
	Cs-137	<4.9	<6.6	<6.9	<6.0								
	Ba-La-140	<11.0	<5.4	<8.8	<12.6								
	Ce-144	<39.2	<51.0	<48.2	<40.2								

TABLE D-4.4.7 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
	DATES												
Duck Pond No. 2		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.					8578		8871	8951	23			
	H-3					560		< 200	< 190	< 180			
	Gross Alpha												
	Gross Beta												
	Mn-54												
	Fe-59												
	Co-58												
	Co-60												
	Zn-65												
	Zr-Nb-95												
	Cs-134												
	Cs-137												
	Ba-La-140												
	Ce-144												

TABLE D-4.4.8 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	11/5	11/12	12/11
	DATES												
Res. No. 1													
Nauer		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
Well													
	Sample I.D.	8047			8491			8867			186		
P-27	H-3	< 180			< 190			210			< 180		
	Gross Alpha	<0.8			0.7								
	Gross Beta	1.5			2.2								
	Mn-54	<4.5			<7.4								
	Fe-59	<9.6			<14.0								
	Co-58	<3.3			<6.9								
	Co-60	<4.9			<5.3								
	Zn-65	<9.2			<14.5								
	Zr-Nb-95	<4.9			<8.1								
	Cs-134	<3.1			<7.1								
	Cs-137	<4.1			<7.1								
	Ba-La-140	<5.5			<12.0								
	Ce-144	<30.6			<58.2								

TABLE D-4.4.9 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/29	11/12	12/11
	DATES												
Res. No. 2													
Perkins		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
Well													
	Sample I.D.	8048			8492			8870			175		
P-28	H-3	260			240			250			220		
	Gross Alpha	<1.0			0.8								
	Gross Beta	3.3			6.6								
	Mn-54	<5.4			<3.9								
	Fe-59	<9.4			<10.1								
	Co-58	<6.9			<4.5								
	Co-60	<4.1			<4.3								
	Zn-65	<9.1			<7.6								
	Zr-Nb-95	<7.1			<5.3								
	Cs-134	<3.8			<3.3								
	Cs-137	<6.1			<5.0								
	Ba-La-140	<11.0			<8.8								
	Ce-144	<41.5			<40.8								

TABLE D-4.4.10 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING DATES	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/29	11/12	12/11
Res. No. 3 Childs Well		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.	8049			8493			8875			176		
P-29	H-3	< 180			200			200			< 180		
	Gross Alpha	1.6			1.7								
	Gross Beta	3.9			3.4								
	Mn-54	<4.6			<7.8								
	Fe-59	<11.4			<17.3								
	Co-58	<4.8			<8.9								
	Co-60	<3.0			<6.0								
	Zn-65	<9.2			<15.4								
	Zr-Nb-95	<6.3			<9.7								
	Cs-134	<3.8			<7.6								
	Cs-137	<5.0			<7.6								
	Ba-La-140	<10.4			<10.3								
	Ce-144	<31.7			<63.1								

TABLE D-4.4.11 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
	DATES												
Birch Lake Outlet No. 4		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.					8580							
	H-3					< 210							
	Gross Alpha												
	Gross Beta												
	Mn-54												
	Fe-59												
	Co-58												
	Co-60												
	Zn-65												
	Zr-Nb-95												
	Cs-134												
	Cs-137												
	Ba-La-140												
	Ce-144												

TABLE D-4.4.12 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
	DATES												
Birch Lake													
Inlet		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
No. 5													
	Sample I.D.					8579							
	H-3					< 210							
	Gross Alpha												
	Gross Beta												
	Mn-54												
	Fe-59												
	Co-58												
	Co-60												
	Zn-65												
	Zr-Nb-95												
	Cs-134												
	Cs-137												
	Ba-La-140												
	Ce-144												

TABLE D-4.4.13 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
	DATES												
Discharge Canal No. 1		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.					8581							
	H-3					< 210							
	Gross Alpha												
	Gross Beta												
	Mn-54												
	Fe-59												
	Co-58												
	Co-60												
	Zn-65												
	Zr-Nb-95												
	Cs-134												
	Cs-137												
	Ba-La-140												
	Ce-144												

TABLE D-4.4.14 Radiological Environmental Monitoring Program, Complete Data Tables.

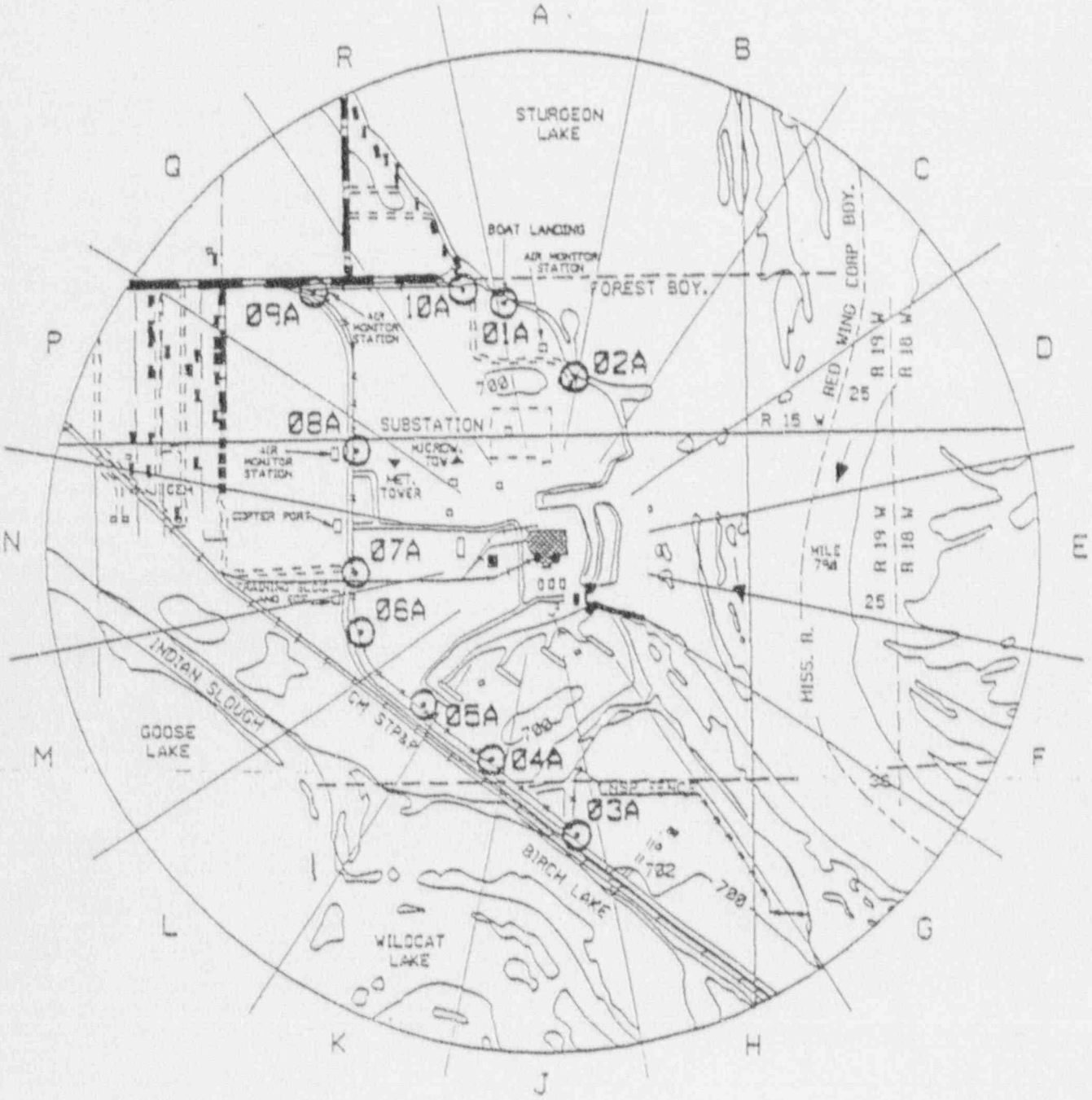
	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
	DATES												
Discharge													
Canal		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
No. 2													
	Sample I.D.					8582							
	H-3					< 210							
	Gross Alpha												
	Gross Beta												
	Mn-54												
	Fe-59												
	Co-58												
	Co-60												
	Zn-65												
	Zr-Nb-95												
	Cs-134												
	Cs-137												
	Ba-La-140												
	Ce-144												

TABLE D-4.4.15 Radiological Environmental Monitoring Program, Complete Data Tables.

	SAMPLING	1/15	2/12	3/12	4/10	5/17	6/12	7/18	8/9	9/10	10/24	11/12	12/11
	DATES												
Vermillion River		pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
	Sample I.D.					3583							
	H-3					< 210							
	Gross Alpha												
	Gross Beta												
	Mn-54												
	Fe-59												
	Co-58												
	Co-60												
	Zn-65												
	Zr-Nb-95												
	Cs-134												
	Cs-137												
	Ba-La-140												
	Ce-144												

FIGURE 5.1-1

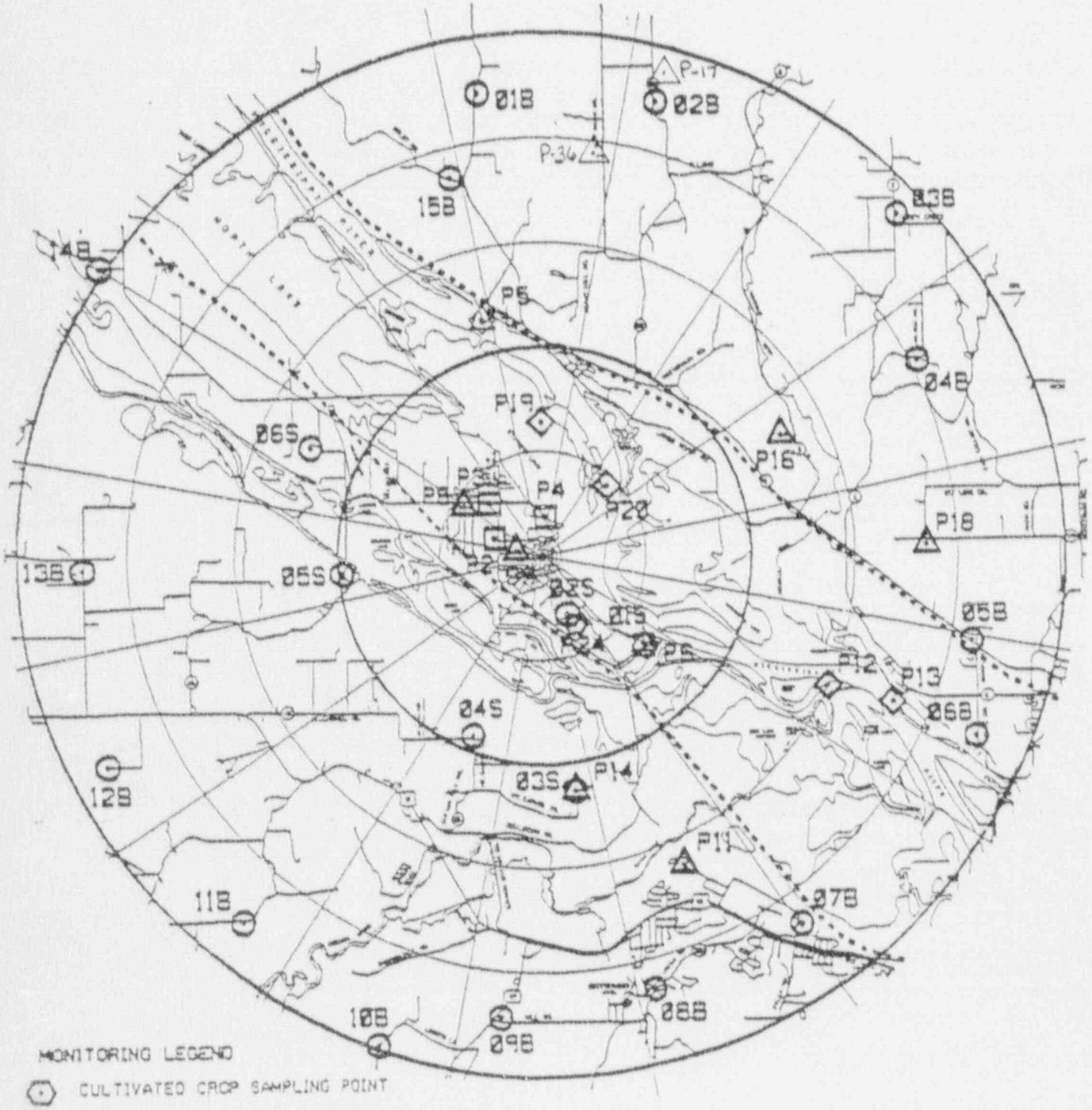
SITE BOUNDARY TLD LOCATIONS



PLANT AREA ENLARGED PLAN (1.00 MILE RADIUS)
(NO SCALE)

NL-99P1739-1

FIGURE 5.1-2
RADIOLOGICAL ENVIRONMENTAL SAMPLE POINTS WITHIN 5 - MILE RADIUS



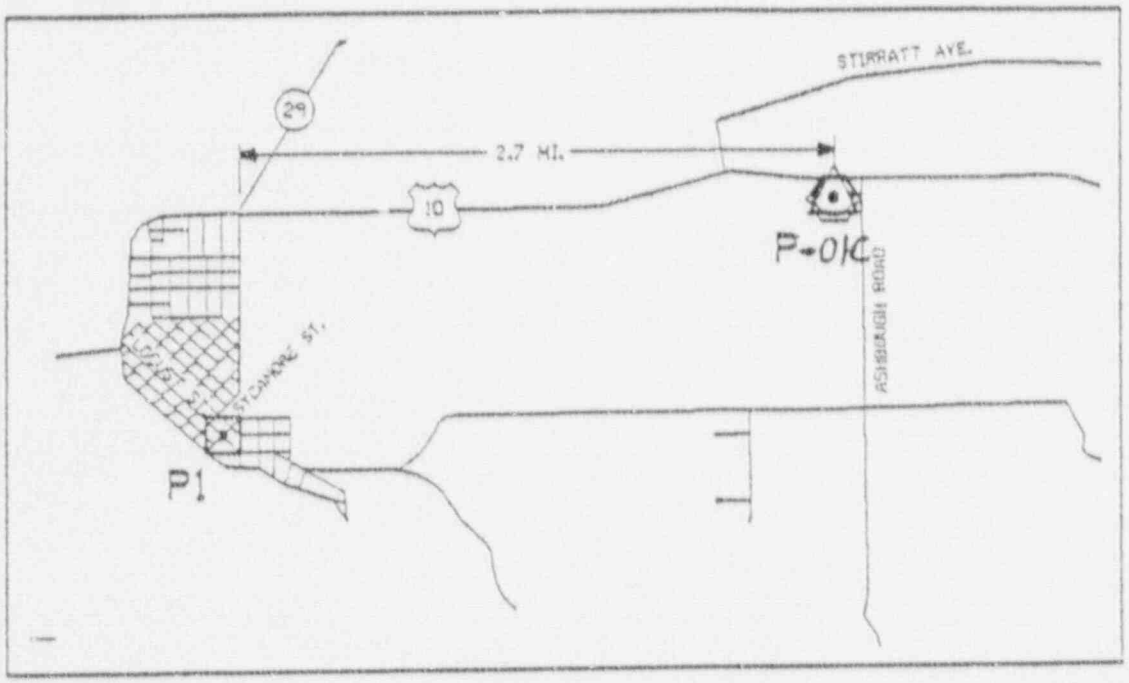
MONITORING LEGEND

- CULTIVATED CROP SAMPLING POINT
- WATER & MILK SAMPLING POINTS
- RIVER SEDIMENT, FISH AND PERIPHYTON OR INVERTEBRATES
- N.S.P. TLD POINTS
- N.S.P. AIR MONITORING POINTS

NL-99P1739-2

FIGURE 5.1-3

RADIOLOGICAL ENVIRONMENTAL SAMPLE POINTS OUTSIDE 10 - MILE RADIUS



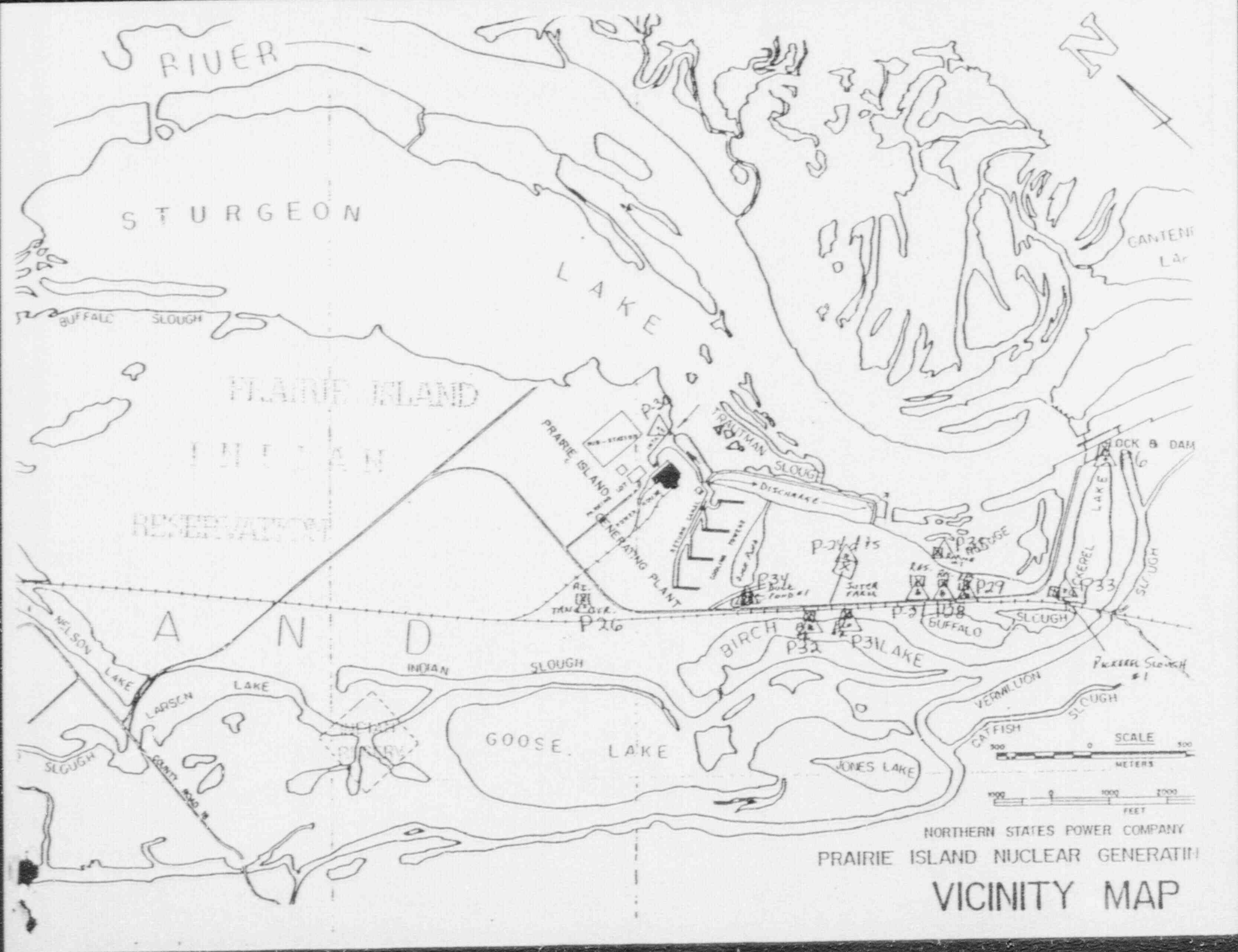
CONTROL POINTS

PRESCOTT, WISCONSIN

MONITORING LEGEND

- CULTIVATED CROP SAMPLING POINT
- WATER & MILK SAMPLING POINTS
- RIVER SEDIMENT, FISH AND PERIPHYTON OR INVERTEBRATES
- N.S.P. TLD POINTS
- N.S.P. AIR MONITORING POINTS

NL-99P1739-3



NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATIN

VICINITY MAP

VALVE DISTRIBUTION LIST

Reg Files

~~R. Baer~~	~~NLS302~~
~~R. J. Bosnak~~	~~NLS007~~
H. L. Brammer	7 E23
E. J. Brown	MNBB 9715
W. E. Campbell, Jr.	NLS217B
K. M. Campe	10 E4
F. C. Cherny	NLS302
T. C. Cintula	MNBB 9715
J. Colaccino	7 E23
K. C. Dempsey	7 E23
W. S. Farmer	NLS217B
~~F. P. Gillespie~~	~~12 G18~~
A. T. Gody	13 E21
~~B. K. Grimes~~	~~9 A2~~
~~C. I. Grimes~~	~~13 H15~~
F. Grubelich	7 E23
C. G. Hammer	7 E23
E. G. Igne	P-315
J. B. Jacobson	9 A1
R. C. Jones	8 E23
P. N. Kadambi	8 D22
R. J. Kiessel	8 D22
N. N. Kondic	NLS217B
Y. C. Li	7 E23
~~B. D. Liaw~~	~~7 D24~~
~~E. M. McKenna~~	~~10 A19~~
T. K. McLellan	7 D4
~~G. C. Millman~~	~~NLS217B~~
~~W. Minners~~	~~NLS007~~
~~F. J. Miraglia~~	~~12 G18~~
~~J. A. Norberg~~	~~7 E23~~
~~I. M. Novak~~	~~MNBB 3701~~
J. D. Page	NLS302
~~J. G. Partlow~~	~~12 G18~~
U. Potapovs	9 D3
~~N. Slosson, OEDO~~	~~17 G21~~
~~J. E. Richardson~~	~~7 D26~~
~~J. E. Rosenthal~~	~~MNBB 9715~~
~~I. M. Ross~~	~~13 N3~~
~~C. E. Rossi~~	~~11 E4~~
O. O. Rothberg	NLS302
~~W. T. Russell~~	~~12 G18~~
T. G. Scarbrough	7 E23
~~L. C. Shao~~	~~NLS007~~
~~J. H. Sniezek~~	~~17 G21~~
E. J. Sullivan	7 E23
~~A. C. Thadani~~	~~8 E2~~
G. Thomas	8 E23
~~M. Vagins~~	~~NLS217B~~
G. H. Weidenhamer	NLS217B
H. W. Woods	NLS314

NRC PDR

Region I:

J. P. Durr
P. K. Eapen

Region II:

E. Girard
F. Jape

Region III:

D. Danielson
M. Huber

Region IV:

I. Barnes
T. Stetka

Region V:

F. R. Huey
M. H. Miller

INEL:

K. G. DeWall
C. Ransom
R. Steele

To: Jim McKnight, Document Control Desk, P1-37
From: Owen Rothberg, DNR/EIB-PBS
Please distribute attached appendices to Kalsi Report 1629 to the above listed individuals. Please put a copy in P.D.R. Thanks O.R.

Revised 3/13/91