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MINNEAPOLIS, MINNESOTA

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ANNUAL REPORT
to the
UNITED STATES NUCLEAR REGULATORY COMMISSION

Radiation Environmental Monitoring Program
January 1, 1992 to December 31, 1992
Project No. 8010

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

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PREFACE

The staff of Teledyne Isotopes Midwest Laboratory was responsible for the acquisition of data presented in this report. Samples were collected by members of the staff of the Nuclear Radiological Services Department, Northern States Power Company. 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.

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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, 1992. 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, 1992) 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 1992 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 and well water samples. These special ground 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 are employed in interpreting the data. Current radiation levels are compared with previous levels, including those measured before the Plant became operational. Results of the plant's monitoring program can be related to those obtained in other parts of the world. Finally, results can be related to events known to cause elevated levels of radiation in the environment, e.g., atmospheric nuclear detonations.

3.2 Program Description

The sampling and analysis schedule for the 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, 1992). Maps of sampling locations are included in Appendix E.

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 indicators (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 dosimeters 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 a 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

3.2 Program Description (continued)

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 five farms (four indicator and one control). The milk is collected biweekly during the growing season (May - October), 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. Well water and ground water is collected 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.

A summary of special tritium sampling of ground and well water is included in Appendix D.

3.3 Program Execution

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

(1) TLD data for the first quarter of 1992 was not available for location P-01A. The TLD was lost in the field.

Deviations from the program are summarized in Table 5.3.

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.

3.4 Laboratory Procedures (continued)

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, 1992). 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, 1992). 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

The Johnson Dairy Farm (P-16) was replaced by the Welsch Dairy Farm (P-37) in June, 1992.

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 1992 Land Use Census was completed on August 27, 1992. One milk location was changed during 1992. The Johnson Dairy Farm (P-16) went out of business in June, 1992, and was replaced by the Welsch Dairy Farm (P-37). Garden sample locations did not change in 1992. The critical receptor location did not change in 1992 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 1992. 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 1992.

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 1992, with the exception of some of the additional special ground and well water samples (see Appendix D).

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 15.1 mR/91 days at inner ring locations to 17.1 mR/91 days at outer ring locations. The mean at special locations was 14.7 mR/91 days and 14.8 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 15.4 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); in 1989 (15.8 and 16.3 mR/91 days, respectively); in 1990 (15.9 and 16.3 mR/91 days, respectively); and in 1991 (14.7 and 14.5 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 (0.023 and 0.021 pCi/m^3), respectively, and it was similar to 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), 1987 (0.024 pCi/m^3) 1990 (0.024 pCi/m^3) and in 1991 (0.025 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 1988, 1989, 1990, 1991, or 1992. 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 December. The increase of beta activity during the winter months were also observed in 1983, 1984, 1985, 1986 (exclusive of the period between May 19, 1986 and June 9, 1986), 1987, 1988, 1989, 1990, and 1991.

Two pieces of evidence indicate conclusively that the elevated activity observed during the winter months 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, 1993a).

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

Airborne Iodine

Weekly levels of airborne iodine-131 were below the lower limit of detection (LLD) of 0.07 pCi/m^3 in all samples, except one (<1.48 pCi/m^3). The LLD was not reached due to very low volume.

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 findings of the National Center for Radiological Health that most radiocontaminants in feed do not find their way into milk due to the selective

Milk (continued)

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 1992 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. As with the other well water samples, all analyses for gamma-emitting isotopes yielded results below detection limits. Gross beta averaged 7.6 pCi/L and was similar to the levels observed in 1979 (10.5 pCi/L), 1980 (11.8 pCi/L), 1981 (pCi/L), 1982 (8.9 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),1989 (7.0 pCi/L), 1990 (7.0 pCi/L), and 1991 (8.0 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 samples.

River water was also analyzed for gamma-emitting isotopes. All gamma-emitting isotopes were below their respective detection limits. There was no indication of a plant effect.

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

Two samples of cabbage were collected in August and analyzed for I-131. The I-131 level was below 0.033 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 from Prairie Island Plant. Therefore, it was not necessary to collect and analyze corn samples.

Fish

Fish samples were collected in May and September, 1992. The only isotope detected was naturally-occurring 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 July and November, 1992. The samples were analyzed for gamma-emitting isotopes. All gamma-emitting isotopes were below their respective LLDs. No plant effect was indicated.

Bottom and Shoreline Sediments

Sediment collections were made in May and September, 1992. The samples were analyzed for gamma-emitting isotopes.

Cs-137 was detected in both upstream and downstream bottom sediment samples (0.062 and 0.080 pCi/g dry weight respectively). There was no significant difference between upstream and downstream results. There is no indication of a plant effect.

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, 1992.

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-14, P-16, P-18, P-25(C),P-36, P-37	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 code as follows: GB = gross beta, GS = gamma spectroscopy, H-3 = tritium, I-131 = iodine 131. Analysis frequency is coded as follows: MC = monthly composite, QC = quarterly composite.

[d] Milk is collected biweekly during the grazing season (May - October) if milch animals are on pasture.

Table 5.2. Sampling locations, Prairie Island Nuclear Generating Plant, 1992.

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	W W	1.0 mi @ 321°/WNW
P-9		Plant Well #2	W W	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-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		Dosdall Farm	M	3.9 mi @ 9°/N
P-37		Welsch Farm	M	4.1 mi @ 90°/E
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, 1992 (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				
General Area of the Site Boundary				
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 Kinneman Farm	TLD	11.1 mi @ 331°/SE

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

[b] Sample Codes:

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

Table 5.3. Missed collections and analyses, 1992. 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
Thermoluminescent Dosimeters (TLDs)	Ambient Radiation	P-01A	1st Qtr. 1992	Lost in the field.

Table 5.4. Radiological Environmental Monitoring Program Summary.

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

Location of Facility: Goodhue, Minnesota (County, State) — Reporting Period: January - December 1992

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 39	3.0	15.1 (39/39) (11.6-18.0)	P-03A, Property Line, 0.5 mi @ 183°/S	16.2 (4/4) (14.7-17.8)	(See Control below.)	0
				P-07A, Property Line 0.4 mi @ 268°/W	16.2 (4/4) (13.4-18.0)		
TLD (mR/91 days) (Outer Ring, 4 - 5 miles distant)	Gamma 60	3.0	17.1 (60/60) (12.4-22.6)	P-02B, R. Kinneman Farm, 4.8 mi @ 17°/NNE	19.2 (4/4) (16.3-21.9)	(See Control below.)	0
TLD (mR/91 days) (Special Interest Areas)	Gamma 2	3.0	14.7 (24/24) (10.6-18.8)	P-03S, C. Gustafson Farm, 2.2 mi @ 173°/SSE	16.6 (4/4) (12.4-18.5)	(See Control below.)	0
TLD (mR/91 days) (Control)	Gamma 4	3.0	None	P-01C, R. Kinneman Farm, 11.1 mi @ 331°/NNW	14.8 (4/4) (13.1-19.1)	14.8 (4/4) (13.1-19.1)	0
Airborne Particulates (pCi/m^3)	GB 265	0.003	0.023 (211/212) (0.008-0.059)	P-4, Station P-4 0.4 mi @ 359°/N	0.024 (52/53) (0.008-0.059)	0.021 (53/53) (0.009-0.048)	0
	GS 20						
	Be-7	0.022	0.062 (16/16) (0.027-0.093)	P-4, Station P-4 0.4 mi @ 359°/N	0.072 (4/4) (0.060-0.084)	0.054 (4/4) (0.034-0.067)	0
	Mn-54	0.0024	<LLD	-	-	<LLD	0
	Co-58	0.0030	<LLD	-	-	<LLD	0
	Co-60	0.0032	<LLD	-	-	<LLD	0
	Zn-65	0.0059	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.0054	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Power Station — Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota (County, State) — Reporting Period January - December 1992

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]
Airborne Particulates (pCi/m^3)	GS						
	Ru-103	0.0027	<LLD	-	-	<LLD	0
	Ru-106	0.019	<LLD	-	-	<LLD	0
	Cs-134	0.0021	<LLD	-	-	<LLD	0
	Cs-137	0.0022	<LLD	-	-	<LLD	0
	Ba-La-140	0.0092	<LLD	-	-	<LLD	0
	Ce-141	0.0040	<LLD	-	-	<LLD	0
	Ce-144	0.013	<LLD	-	-	<LLD	0
Airborne Iodine (pCi/m^3)	I-131 265	0.07[f]	<LLD	-	-	<LLD	0
Milk, (pCi/L)	I-131 90	1.0	<LLD	-	-	<LLD	0
	GS 90						
	K-40	100	1330 (72/72 (1160-1640)	P-14, Gustafson Farm 2.2 mi @ 173°/SSE	1400 (18/18) (1270-1640)	1250 (18/18) (1120-1380)	0
	Cs-134	15	<LLD	-	-	<LLD	0
	Cs-134	15	<LLD	-	-	<LLD	0
	Other gammas	15	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Power Station   Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota (County, State)   Reporting Period January - December 1992

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]		
Drinking Water (pCi/L)	GB	12	1.0	7.6 (12/12) (6.6-9.7)	P-11, Red Wing Service Center 3.3 mi @ 158°/SSE	7.6 (12/12) (6.6-9.7)	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		54	<LLD	-	-	None	0
River Water (pCi/L)	H-3	8	330	<LLD	-	-	None	0
	GS	24						
	Mn-54		15	<LLD	-	-	None	0
	Fe-59		30	<LLD	-	-	None	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Power Station — Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota (County, State) — Reporting Period January - December 1992

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]
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		10	<LLD	-	-	<LLD	0
	Cs-137		10	<LLD	-	-	<LLD	0
	Ba-La-140		15	<LLD	-	-	<LLD	0
	Ce-144		54	<LLD	-	-	<LLD	0
Well Water (pCi/L)	H-3	16	330	<LLD	-	-	<LLD	0
	GS	16						
	Mn-54		15	<LLD	-	-	<LLD	0
	Fe-59		30	<LLD	-	-	<LLD	0
	Co-58		15	<LLD	-	-	<LLD	0
	Co-60		15	<LLD	-	-	<LLD	0
	Zn-65		30	<LLD	-	-	<LLD	0
	Zr-Nb-95		15	<LLD	-	-	<LLD	0
	Cs-134		15	<LLD	-	-	<LLD	0
	Cs-137		18	<LLD	-	-	<LLD	0
	Ba-La-140		15	<LLD	-	-	<LLD	0
	Ce-144		50	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Power Station　　Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota (County, State)　　Reporting Period January - December 1992

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]		
Crops - Cabbage (pCi/g wet)	I-131 2	0.033	<LLD	-	-	<LLD	0
Fish - Flesh (pCi/g wet)	GS 4						
	K-40	0.1	2.78 (2/2) (2.59-2.97)	P-19, Upstream of Plant, 1.3 mi @ 0° N	2.80 (2/2) (2.75-2.85)	2.80 (2/2) (2.75-2.85)	0
	Mn-54	0.024	<LLD	-	-	<LLD	0
	Fe-59	0.12	<LLD	-	-	<LLD	0
	Co-58	0.033	<LLD	-	-	<LLD	0
	Co-60	0.034	<LLD	-	-	<LLD	0
	Zn-65	0.070	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.068	<LLD	-	-	<LLD	0
	Cs-134	0.022	<LLD	-	-	<LLD	0
	Cs-137	0.022	<LLD	-	-	<LLD	0
	Ba-La-140	0.23	<LLD	-	-	<LLD	0
Invertebrates (pCi/g wet)	GS 4						
	Be-7	1.16	<LLD	-	-	<LLD	0
	K-40	2.23	<LLD	-	-	<LLD	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Power Station
Location of Facility Goodhue, Minnesota
(County, State)

Docket No. 50-282, 50-306
Reporting Period January - December 1992

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 4						
	Mn-54	0.15	<LLD	-	-	<LLD	0
	Co-58	0.13	<LLD	-	-	<LLD	0
	Co-60	0.10	<LLD	-	-	<LLD	0
	Zn-65	0.27	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.18	<LLD	-	-	<LLD	0
	Ru-103	0.14	<LLD	-	-	<LLD	0
	Ru-106	1.04	<LLD	-	-	<LLD	0
	Cs-134	0.11	<LLD	-	-	<LLD	0
	Cs-137	0.11	<LLD	-	-	<LLD	0
	Ba-La-140	0.25	<LLD	-	-	<LLD	0
	Ce-141	0.31	<LLD	-	-	<LLD	0
	Ce-144	1.07	<LLD	-	-	<LLD	0
Bottom and Shoreline Sediments (pCi/g dry)	GS 6						
	Be-7	0.50	<LLD	P-20, Upstream of Plant, 0.9 mi @ 45° NE	0.73 (1/2)	0.73 (1/2)	0
	K-40	1.0	9.98 (4/4) (6.80-12.95)	P-20, Upstream of Plant, 0.9 mi @ 45°NE	11.38 (2/2) (10.05-12.70)	11.38 (2/2) (10.05-12.70)	0

Table 5.4. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Prairie Island Nuclear Power Station — Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota (County, State) — Reporting Period January - December 1992

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	0.057	<LLD	-	-	<LLD	0
	Co-58	0.040	<LLD	-	-	<LLD	0
	Co-60	0.036	<LLD	-	-	<LLD	0
	Zn-65	0.090	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.11	<LLD	-	-	<LLD	0
	Ru-103	0.097	<LLD	-	-	<LLD	0
	Ru-106	0.26	<LLD	-	-	<LLD	0
	Cs-134	0.032	<LLD	-	-	<LLD	0
	Cs-137	0.019	0.080 (1/4)	P-6, Lock and Dam No. 3 1.6 mi @ 129°	0.080 (1/2)	0.062 (1/2)	0
	Ba-La-140	4.10	<LLD	-	-	<LLD	0
	Ce-141	0.24	<LLD	-	-	<LLD	0
	Ce-144	0.22	<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 are based on detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F).
[d] Locations are specified: (1) by name, and code (Table 2) and (2) by 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 typical pre-operational value for the medium or location.
[f] One result exceeded the required LLD for I-131 due to low volume (2 m^3). I-131 concentration <1.48 pCi/m^3.

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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 quarterly; the complete Appendix is included in January, April, July and October monthly reports only. Please refer to these reports for information.

January, 1993

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

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 1988 through December 1992. 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 fc hermoluminescent dosimeters (TLDs) during the period 1976, 1977, 1979, 1980, 1984, and 1985-86 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, 1988 through 1992.[a]

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b]		
				TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
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	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±6.0	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	60.4-229.6
			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	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	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	22.4-27.6
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	06.0±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
STAF-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	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
STM-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[g]	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	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±0.0	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	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
STAF-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	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
STAF-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
STW-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
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	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
STW-618	Water	Jan 1991	Sr-89	4.3±1.2	5.0±5.0	0.0 -13.7
			Sr-90	4.7±1.2	5.0±5.0	0.0-13.7
STW-619	Water	Jan 1991	Pu-239	3.6±0.2	3.3±0.3	2.8-3.8
STW-620	Water	Jan 1991	Gr. alpha	6.7±3.0	5.0±5.0	0.0-13.7
			Gr. beta	6.3±1.2	5.0±5.0	0.0-13.7
STW-621	Water	Feb 1991	Co-60	41.3±8.4	40.0±5.0	31.3-48.7
			Zn-65	166.7±19.7	149.0±15.0	123.0-175.0
			Ru-106	209.7±18.6	186.0±19.0	153.0-219.0
			Cs-134	9.0±2.0	8.0±5.0	0.0-16.7
			Cs-137	9.7±1.2	8.0±5.0	0.0-16.7
			Ba-133	85.7±9.2	75.0±8.0	61.1-88.9
STW-622	Water	Feb 1991	I-131	81.3±6.1	75.0±8.0	61.1-88.9
STW-623	Water	Feb 1991	H-3	4310.0±144.2	4418.0±442.0	3651.2-5184.8
STW-624	Water	Mar 1991	Ra-226	31.4±3.2	31.8±4.8	23.5-40.1
			Ra-228	ND[h]	21.1±5.3	11.9-30.3
STW-625	Water	Mar 1991	U	6.7±0.4	7.6±3.0	2.4-12.8

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	Control Limits
STAF-626	Air Filter	Mar 1991	Gr. alpha	38.7±1.2	25.0±6.0	14.6-35.4
			Gr. beta	130.0±4.0	124.0±6.0	113.6-134.4
			Sr-90	35.7±1.2	40.0±5.0	31.3-48.7
			Cs-137	33.7±4.2	40.0±5.0	31.3-48.7
STW-627 628	Water	Apr 1991				
	Sample A		Gr. alpha	51.0±6.0	54.0±14.0	29.7-78.3
			Ra-226	7.0±0.8	8.0±1.2	5.9-10.1
			Ra-228	9.7±1.9	15.2±3.8	8.6-21.8
			U	27.7±2.4	29.8±3.0	24.6-35.0
	Sample B		Gr. beta	93.3±6.4	115.0±17.0	85.5-144.5
			Sr-89	21.0±3.5	28.0±5.0	19.3-36.7
			Sr-90	23.0±0.0	26.0±5.0	17.3-34.7
			Cs-134	27.3±1.2	24.0±5.0	15.3-32.7
			Cs-137	29.0±2.0	25.0±5.0	16.3-33.7
STM-629	Milk	Apr 1991	Sr-89	24.0±8.7	32.0±5.0	23.3-40.7
			Sr-90	28.0±2.0	32.0±5.0	23.3-40.7
			I-131	65.3±14.7	60.0±6.0	49.6-70.4
			Cs-137	54.7±11.0	49.0±5.0	40.3-57.7
			K	1591.7±180.1	1650.0±83.0	1506.0-1794.0
STW-630	Water	May 1991	Sr-89	40.7±2.3	39.0±5.0	30.3-47.7
			Sr-90	23.7±1.2	24.0±5.0	15.3-32.7
STW-631	Water	May 1991	Gr. alpha	27.7±5.8	24.0±6.0	13.6-34.4
			Gr. beta	46.0±0.0	46.0±5.0	37.3-54.7
STW-632	Water	Jun 1991	Co-60	11.3±1.2	10.0±5.0	1.3-18.7
			Zn-65	119.3±16.3	108.0±11.0	88.9-127.1
			Ru-106	162.3±19.0	149.0±15.0	123.0-175.0
			Cs-134	15.3±1.2	15.0±5.0	6.3-23.7
			Cs-137	16.3±1.2	14.0±5.0	5.3-22.7
			Ba-133	74.0±6.9	62.0±6.0	51.6-72.4
STW-633	Water	Jun 1991	H-3	13470.0±385.8	12480.0±1248.0	10314.8-14645.2
STW-634	Water	Jul 1991	Ra-226	14.9±0.4	15.9±2.4	11.7-20.1
			Ra-228	17.6±1.8	16.7±4.2	9.4-24.0

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	Control Limits
STW-635	Water	Jul 1991	U	12.8±0.1	14.2±3.0	9.0-19.4
STW-636	Water	Aug 1991	I-131	19.3±1.2	20.0±6.0	9.6-30.4
STW-637	Water	Aug 1991	Pu-239	21.4±0.5	19.4±1.9	16.1-22.7
STAF-638	Air Filter	Aug 1991	Gr. alpha	33.0±2.0	25.0±6.0	14.6-35.4
			Gr. beta	88.7±1.2	92.0±10.0	80.4-103.6
			Sr-90	27.0±4.0	30.0±5.0	21.3-38.7
			Cs-137	26.3±1.2	30.0±5.0	21.3-38.7
STW-639	Water	Sep 1991	Sr-89	47.0±10.4	49.0±5.0	40.3-57.7
			Sr-90	24.0±2.0	25.0±5.0	16.3-33.7
STW-640	Water	Sep 1991	Gr. alpha	12.0±4.0	10.0±5.0	1.3-18.7
			Gr. beta	20.3±1.2	20.0±5.0	11.3-28.7
STM-641	Milk	Sep 1991	Sr-89	20.3±5.0	25.0±5.0	16.3-33.7
			Sr-90	19.7±3.1	25.0±5.0	16.3-33.7
			I-131	130.7±16.8	108.0±11.0	88.9-127.1
			Cs-137	33.7±3.2	30.0±5.0	21.3-38.7
			K	1743.3±340.8	1740.0±87.0	1589.1-1890.9
STW-642	Water	Oct 1991	Co-60	29.7±1.2	29.0±5.0	20.3-37.7
			Zn-65	75.7±8.3	73.0±7.0	60.9-85.1
			Ru-106	196.3±15.1	199.0±20.0	164.3-233.7
			Cs-134	9.7±1.2	10.0±5.0	1.3-18.7
			Cs-137	11.0±2.0	10.0±5.0	1.3-18.7
			Ba-133	94.7±3.1	98.0±10.0	80.7-115.3
STW-643	Water	Oct 1991	H-3	2640.0±156.2	2454.0±352.0	1843.3-3064.7
STW-644	Water	Oct 1991				
645	Sample A		Gr. alpha	73.0±13.1	82.0±21.0	45.6-118.4
			Ra-226	20.9±2.0	22.0±3.3	16.3-27.7
			Ra-228	19.6±2.3	22.2±5.6	12.5-31.9
			U	13.5±0.6	13.5±3.0	8.3-18.7
	Sample B		Gr. beta	55.3±3.1	65.0±10.0	47.7-82.3
			Sr-89	9.7±3.1	10.0±5.0	1.3-18.7
			Sr-90	8.7±1.2	10.0±5.0	1.3-18.7
			Co-60	20.3±1.2	20.0±5.0	11.3-28.7
			Cs-134	9.0±5.3	10.0±5.0	1.3-18.7
			Cs-137	14.7±5.0	11.0±5.0	2.3-19.7

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	Control Limits
STW-646	Water	Nov 1991	Ra-226	5.6±1.2	6.5±1.0	4.8-8.2
			Ra-228	9.6±0.5	8.1±2.0	4.6-11.6
STW-647	Water	Nov 1991	U	24.7±2.3	24.9±3.0	19.7-30.1
STW-648	Water	Jan 1992	Sr-89	42.7±6.4	51.0±5.0	42.3-59.7
			Sr-90	18.3±3.1	20.0±5.0	11.3-28.7
STW-649	Water	Jan 1992	Pu-239	16.1±0.8	16.8±1.7	13.9-19.7
STW-650	Water	Jan 1992	Gr. alpha	23.7±9.2	30.0±8.0	16.1-43.9
			Gr. beta	27.7±4.2	30.0±5.0	21.3-38.7
STW-651	Water	Feb 1992	I-131	60.3±4.2	59.0±6.0	48.6-69.4
STW-652	Water	Feb 1992	Co-60	40.3±5.0	40.0±5.0	31.3-48.7
			Zn-65	148.0±15.0	150.7±6.1	122.0-174.0
			Ru-106	188.7±28.8	203.0±20.0	168.3-237.7
			Cs-134	31.7±4.2	31.0±5.0	22.3-39.7
			Cs-137	51.0±3.4	49.0±5.0	40.3-57.7
			Ba-133	79.0±3.4	76.0±8.0	62.1-89.9
STW-653	Water	Feb 1992	H-3	7714.0±119.6	7904.0±790.0	6533.4-9274.6
STW-654	Water	Mar 1992	Ra-226	9.0±0.4	10.1±1.5	7.5-12.7
			Ra-228	18.8±0.6	15.5±3.9	8.7-22.3
STW-655	Water	Mar 1992	Rn-222[i]			
STW-656	Water	Mar 1992	U	25.1±1.9	25.3±3.0	20.1-30.5
STW-657	Water	Mar 1992	Rn-222[i]			
STAF-658	Air Filter	Mar 1992	Gr. alpha	7.0±0.0	7.0±5.0	0.0-15.7
			Gr. beta	39.3±1.6	41.0±5.0	32.3-49.7
			Sr-90	13.7±1.6	15.0±5.0	6.3-23.7
			Cs-137	10.0±0.0	10.0±5.0	1.3-18.7
STW-659	Water	Apr 1992				
660	Sample A		Gr. alpha	35.7±6.1	40.0±10.0	22.7-57.3
			Ra-226	12.7±1.2	14.9±2.2	11.1-18.7
			Ra-228	14.5±2.1	14.0±3.5	7.9-20.1
			U	3.9±0.2	4.0±3.0	0.0-9.2

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	Control Limits
STW-659	Water	Apr 1992				
660	Sample B		Gr. beta	113.0±7.2	140.0±21.0	103.6-176.4
			Sr-89	12.3±4.2	15.0±5.0	6.3-23.7
			Sr-90	15.0±1.2	17.0±5.0	8.3-25.7
			Co-60	61.0±4.0	56.0±5.0	47.3-64.7
			Cs-134	24.3±1.2	24.0±5.0	15.3-32.7
			Cs-137	24.0±2.0	22.0±5.0	13.3-30.7
STM-661	Milk	Apr 1992	Sr-89	25.3±7.6	38.0±5.0	29.3-46.7
			Sr-90	24.3±3.1	29.0±5.0	20.3-37.7
			I-131	78.7±9.5	78.0±8.0	64.1-91.9
			Cs-137	39.3±2.3	39.0±5.0	30.3-47.7
			K	1610.0±72.1	1710.0±86.0	1560.8-1859.2
STW-662	Water	May 1992	Sr-89	24.0±4.0	29.0±5.0	20.3-37.7
			Sr-90	6.7±1.2	8.0±5.0	0.0-16.7
STM-663	Water	May 1992	Gr. alpha	12.3±2.1	15.0±5.0	6.3-23.7
			Gr. beta	46.0±5.0	44.0±5.0	35.3-52.7
STW-664	Water	Jun 1992	Co-60	20.3±1.2	20.0±5.0	11.3-28.7
			Zn-65	103.3±10.6	99.0±10.0	81.7-116.3
			Ru-106	142.7±23.7	141.0±14.0	116.7-165.3
			Cs-134	14.3±2.3	15.0±5.0	6.3-23.7
			Cs-137	15.0±2.0	15.0±5.0	6.3-23.7
			Ba-133	92.7±11.0	98.0±10.0	80.7-115.3
STW-665	Water	Jun 1992	H-3	2153.3±144.6	2125.0±347.0	1523.0-2727.0
STW-666	Water	July 1992	Ra-226	22.3±2.2	24.9±3.7	18.5-31.3
			Ra-228	16.7±3.1	16.7±4.2	9.4-24.0
STW-667	Water	July 1992	U	3.6±0.3	4.0±3.0	0.0-9.2
STW-668	Water	August 1992	I-131	47.0±3.5	45.0±6.0	34.6-55.4
STW-669	Water	August 1992	Pu-239	8.5±0.9	9.0±0.9	7.4-10.6
STAF-670	Air Filter	August 1992	Gr. alpha	25.7±1.2	30.0±8.0	16.1-43.9
			Gr. beta	69.0±2.0	69.0±10.0	51.7-86.3
			Sr-90	26.0±4.0	25.0±5.0	16.3-33.7
			Cs-137	16.0±0.0	18.0±5.0	9.3-26.7

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	Control Limits
STW-671	Water	Sept. 1992	Sr-89	16.0±4.0	20.0±5.0	11.3-28.7
			Sr-90	14.3±3.1	15.0±5.0	6.3-23.7
STW-672	Water	Sept. 1992	Gr. alpha	43.0±13.1	45.0±11.0	25.9-64.1
			Gr. beta	41.3±18.6	50.0±5.0	41.3-58.7
STM-673	Milk	Sept. 1992	Sr-89	11.0±3.5	15.0±5.0	6.3-23.7
			Sr-90	12.7±1.2	15.0±5.0	6.3-23.7
			I-131	109.7±19.4	100.0±10.0	82.7-117.3
			Cs-137	14.0±3.5	15.0±5.0	6.3-23.7
			K	1540.0±103.9	1750.0±88.0	1597.3-1902.7
STW-674	Water	Oct. 1992	Co-60	11.3±2.3	10.0±5.0	1.3-18.7
			Zn-65	169.7±25.0	148.0±15.0	122.0-174.0
			Ru-106	170.1±2.3	175.0±18.0	143.8-206.2
			Cs-134	9.7±2.3	8.0±5.0	0.0-16.7
			Cs-137	9.7±1.2	8.0±5.0	0.0-16.7
			Ba-133	80.3±9.0	74.0±7.0	61.9-86.1
STW-675	Water	Oct. 1992	H-3	5896.7±136.2	5962.0±596.0	4928.0-6996.0
STW-676 -677	Water	Oct. 1992				
	Sample A		Gr. alpha	24.7±5.0	29.0±7.0	16.9-41.1
			Ra-226	7.1±0.4	7.4±1.1	5.5-9.3
			Ra-228	11.5±1.0	10.0±2.5	5.7-14.3
			U	9.7±0.5	10.2±3.0	5.0-15.4
	Sample B		Gr. beta	42.7±8.1	53.0±10.0	35.7-70.3
			Sr-89	6.7±1.2	8.0±5.0	0.0-16.7
			Sr-90	10.0±2.0	10.0±5.0	1.3-18.7
			Co-60	15.0±2.0	15.0±5.0	6.3-23.7
			Cs-134	5.7±1.2	5.0±5.0	0.0-13.7
			Cs-137	8.0±2.0	8.0±5.0	0.0-16.7

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	Control Limits
STW-678	Water	Nov. 1992	Ra-226	7.5±0.8	7.5±1.1	5.6-9.4
			Ra-228	5.8±0.7	5.0±1.3	2.7-7.3
STW-679	Water	Nov. 1992	U	15.5±1.1	15.2±3.0	10.0-20.4

[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 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 lab.

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

[h] ND = No data; sample lost during analyses.

[i] ND = No data; special EPA testing.

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

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value	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
		Field 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 Comparison[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. Crosscheck program results, thermoluminescent dosimeters (TLDs).

Lab Code	TLD Type	Measurement	mR Teledyne Result $\pm2\sigma^a$	Known Value	Average $\pm2\sigma^d$ (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	32.2±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					
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	mR: Average ±2σ[d] (All Participants)
Teledyne Testing					
90-1[k]	Teledyne $CaSO_4$:Dy Cards	Lab	20.6±1.4	19.6	–
90-2[l]	Teledyne $CaSO_4$:Dy Cards	Lab	100.8±4.3	100.0	–
91-1[m]	Teledyne $CaSO_4$:Dy Cards	Lab	33.4±2.0	32.0	–
			55.2±4.7	58.8	–
			87.8±6.2	85.5	–
92-1[n]	LiF-100 Chips	Lab	11.1±0.2	10.7	–
			25.6±0.5	25.4	–
			46.4±0.5	46.3	–
92-2[o]	Teledyne $CaSO_4$:Dy Cards	Lab (Reader #1)	20.1±0.1	20.1	–
			40.6±0.1	40.0	–
			60.0±1.3	60.3	–
		Lab (Reader #2)	20.3±0.3	20.1	–
			39.2±0.3	40.0	–
			60.7±0.4	60.3	–

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 (HASL), 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 Dosimeters 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.

Table A-2. (continued)

Lab Code	TLD Type	Measurement	mR Teledyne Result ±2σ[a]	Known Value	Average ±2σ[d] (All Participants)

Footnotes (continued)

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.

m Irradiated cards were provided by Teledyne Isotopes, INC., Westwood, NJ. Irradiated on October 8, 1991.

n Chips were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on February 26, 1992.

o Cards were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on April 1, 1992.

Table A-3. In-house spiked samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L: TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
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	Mar 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
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

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
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
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	5.2
QC-W-52	Water	Sep 1989	I-131	9.6±0.3	9.7±1.9	10.4

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
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
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]	18.0
			Sr-90	98.0±3.0[d]	95.0±10.0[d]	16.4
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	10.8
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

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
QC-W-63	Water	Apr 1990	I-131	63.5±8.0	66.0±6.7	11.4
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	1.8
QC-W-66	Water	Jun 1990	U	6.2±0.2	6.0±6.0	10.4
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	8.7

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

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L: TIML Result 2s, n=1[e]	Known Activity	Expected Precision 1s, n=1[e]
QC-MI-33	Milk	Jan 1991	Sr-89	20.7±3.3	21.6±5.0	5.0
			Sr-90	19.0±1.4	23.0±3.0	3.0
			Cs-134	22.2±1.7	19.6±5.0	5.0
			Cs-137	26.1±1.6	22.3±5.0	5.0
QC-MI-34	Milk	Feb 1991	I-131	40.7±1.8	40.1±6.0	6.0
QC-W-75	Water	Mar 1991	Sr-89	18.8±1.5	23.3±5.0	5.0
			Sr-90	16.0±0.8	17.2±3.0	3.0
QC-W-76	Water	Apr 1991	I-131	56.5±1.7	59.0±5.9	5.9
QC-W-77	Water	Apr 1991	Co-60	16.4±2.2	15.7±5.0	5.0
			Cs-134	23.8±2.5	22.6±5.0	5.0
			Cs-137	25.0±2.4	21.1±5.0	5.0
QC-W-78	Water	Apr 1991	H-3	4027±188	4080±408	408
QC-MI-35	Milk	Apr 1991	I-131	48.0±0.8	49.2±6.0	6.0
			Cs-134	19.2±2.0	22.6±5.0	5.0
			Cs-137	22.8±2.2	22.1±5.0	5.0
QC-W-79	Water	Jun 1991	Gr. alpha	7.4±0.7	7.8±5.0	5.0
			Gr. beta	11.0±0.7	11.0±5.0	5.0
QC-MI-36	Milk	Jul 1991	Sr-89	28.1±2.1	34.0±10.0	5.0
			Sr-90	11.6±0.7	11.5±3.0	3.0
			I-131	14.4±1.9	18.3±5.0	5.0
			Cs-137	34.3±3.0	35.1±5.0	5.0
QC-W-80	Water	Oct 1991	Sr-89	27.4±6.9	24.4±5.0	5.0
			Sr-90	11.7±1.4	14.1±5.0	3.0
QC-W-81	Water	Oct 1991	I-131	19.1±0.7	20.6±4.2	6.0
QC-W-82	Water	Oct 1991	Co-60	22.6±2.7	22.1±5.0	5.0
			Cs-134	15.5±1.8	17.6±5.0	5.0
			Cs-137	17.5±2.1	17.6±5.0	5.0
QC-W-83	Water	Oct 1991	H-3	4639±137	4382±438	438
QC-MI-37	Milk	Oct 1991	I-131	23.6±3.2	25.8±5.0	6.0
			Cs-134	22.7±2.8	22.1±5.0	5.0
			Cs-137	38.3±3.0	35.1±5.0	5.0
QC-W-84	Water	Dec 1991	Gr. alpha	6.2±0.6	7.8±5.0	5.0
			Gr. beta	11.0±0.7	11.0±5.0	5.0

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=1[e]	Known Activity	Expected Precision 1s, n=1[e]
QC-MI-39	Milk	Jan 1992	Sr-89	21.6±6.5	31.2±10.0	5.0
			Sr-90	38.7±1.8	42.3±8.5	4.2
			I-131	76.8±0.9	83.7±16.0	8.4
			Cs-134	42.1±5.7	49.4±10.0	5.0
			Cs-137	55.2±6.4	53.0±10.0	5.0
QC-W-85	Water	Mar 1992	Sr-89	26.2±3.1	32.0±10.0	5.0
			Sr-90	24.4±1.4	28.0±6.0	3.0
QC-W-86	Water	Apr 1992	H-3	4080±190	4027±403	403
QC-W-87	Water	Apr 1992	I-131	33.5±0.6	33.2±12.0	6.0
QC-W-88	Water	Apr 1992	Co-60	17.5±2.7	19.7±10.0	5.0
			Cs-134	28.9±2.5	33.5±10.0	5.0
			Cs-137	41.0±3.0	38.9±10.0	5.0
QC-MI-40	Milk	Apr 1992	Cs-134	58.0±2.6	55.9±10.0	5.0
			Cs-137	43.7±3.0	38.9±10.0	5.0
QC-W-41	Milk	Apr 1992	I-131	50.3±0.8	55.9±11.2	5.6
QC-W-89	Water	Jun 1992	Gr. alpha	15.3±0.8	13.6±10.0	5.0
			Gr. beta	17.2±0.9	17.6±10.0	5.0
QC-MI-42	Milk	Aug. 1992	Sr-89	41.4±5.9	51.2±10.2	5.0
			Sr-90	48.9±2.5	51.9±10.4	5.2
			Cs-134	20.1±2.8	20.2±10.0	5.0
			Cs-137	26.2±2.7	26.1±10.0	5.0
QC-W-90	Water	Sept. 1992	Sr-89	6.7±3.4	12.6±10.0	5.0
			Sr-90	16.1±1.4	15.6±6.0	3.0
QC-W-91	Water	Oct. 1992	I-131	34.9±2.2	34.9±10.0	6.0
QC-W-92	Water	Oct. 1992	Co-60	11.4±1.9	9.2±10.0	5.0
			Cs-134	18.7±2.3	14.3±10.0	5.0
			Cs-137	14.1±1.8	15.0±10.0	5.0

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=1[e]	Known Activity	Expected Precision 1s, n=1[e]
QC-W-93	Water	Oct. 1992	H-3	3704±186	3904±390	367
QC-W-94	Water	Oct. 1992	H-3	14,925±339	15,616±1,562	1562
QC-W-95	Water	Oct. 1992	I-131	64.2±2.7	67.2±10.0	6.7
QC-MI-43	Milk	Oct. 1992	I-131	19.9±1.0	21.5±6.0	6.0
			Cs-134	14.2±3.4	12.7±10.0	5.0
			Cs-137	14.1±5.2	17.1±10.0	5.0
QC-MI-44	Milk	Oct. 1992	I-131	36.1±1.2	43.0±10.0	6.0
			Cs-134	28.2±4.0	25.4±10.0	5.0
			Cs-137	38.8±5.1	34.2±10.0	5.0

[e] Starting in January 1991, all determinations are single.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPS-5386	Milk	Jan 1988	I-131	<0.1	<1
SPW-5448	"Dead" Water	Jan 1988	H-3	<177	<300
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-241	<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[a]	<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	<5
			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

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPW-6625	Water	Dec 1988	Gr. alpha	<0.7	<1
			Gr. beta	<1.9	<4
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-7588	Water	Jun 1989	Gr. alpha	<0.2	<1
			Gr. 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)	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	Gr. alpha	<0.4	<1
			Gr. 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	<5
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)	Acceptance Criteria (4.66 σ)
SPW-8926	Water	Aug 1990	Gr. alpha	<0.3	<1
			Gr. 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	<10
			Co-58	<4.1	<10
			Co-60	<2.4	<10
			Cs-134	<3.3	<10
			Cs-137	<3.7	<10
SPW-8929	Water	Aug 1990	Sr-89	<1.4	<5
			Sr-90	<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
			I-131	<0.3	<1
SPM-107	Milk	Oct 1990	I-131	<0.4	<1
			Cs-134	<3.3	<10
			Cs-137	<4.3	<10
SPW-370	Water	Oct 1990	Mn-54	<1.7	<10
			Co-58	<2.6	<10
			Co-60	<1.6	<10
			Cs-134	<1.7	<10
			Cs-137	<1.8	<10
SPW-372	Water	Dec 1990	Gr. alpha	<0.3	<1
			Gr. beta	<0.8	<4
SPS-406	Milk	Jan 1991	Sr-89	<0.4	<5
			Sr-90	1.8±0.4 [a]	<1
			Cs-134	<3.7	<10
			Cs-137	<5.2	<10
SPS-421	Milk	Feb 1991	I-131	<0.3	<1
SPW-451	Water	Feb 1991	Ra-226	<0.1	<1
			Ra-228	<0.9	<1

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPW-514	Water	Mar 1991	Sr-89	<1.1	<5
			Sr-90	<0.9	<1
SPW-586	Water	Apr 1991	I-131	<0.2	<1
			Co-60	<2.5	<10
			Cs-134	<2.4	<10
			Cs-137	<2.2	<10
SPS-587	Milk	Apr 1991	I-131	<0.2	<1
			Cs-134	<1.7	<10
			Cs-137	<1.9	<10
SPW-837	Water	Jun 1991	Gr. alpha	<0.6	<1
			Gr. beta	<1.1	<4
SPM-953	Milk	Jul 1991	Sr-89	<0.7	<5
			Sr-90	0.4±0.3[a]	<1
			I-131	<0.2	<1
			Cs-137	<4.9	<10
SPM-1236	Milk	Oct 1991	I-131	<0.2	<1
			Cs-134	<3.7	<10
			Cs-137	<4.6	<10
SPW-1254	Water	Oct 1991	Sr-89	<2.8	<5
			Sr-90	<0.7	<1
SPW-1256	Water	Oct 1991	I-131	<0.4	<1
			Co-60	<3.6	<10
			Cs-134	<4.0	<10
			Cs-137	<3.6	<10
SPW-1259	Water	Oct 1991	H-3	<160	<300
SPW-1444	Water	Dec 1991	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4
SPM-1578	Milk	Jan 1992	Sr-89	<0.5	<5
			Sr-90	1.3±0.4[a]	<1
			I-131	<0.2	<1
			Cs-134	<7.2	<10
			Cs-137	<8.0	<10

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPW-1860	Water	Mar 1992	Sr-89	<0.6	<5
			Sr-90	<0.4	<1
SPW-2067	Water	Apr 1992	H-3	<168	<300
SPW-2114	Water	Apr 1992	C-14	<1.0	<200
SPW-2119	Milk	Apr 1992	Co-60	<6.3	<10
			Cs-134	<4.5	<10
			Cs-137	<5.4	<10
SPW-2126	Water	Apr 1992	I-131	<0.2	<1
SPM-2133	Milk	Apr 1992	I-131	<0.2	<1
SPW-2220	Water	May 1992	Co-60	<2.1	<10
			Cs-134	<2.1	<10
			Cs-137	<2.3	<10
SPW-2369	Water	Jun 1992	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4
SPM-2500	Milk	Aug 1992	I-131	<0.4	<1
			Sr-89	<1.2	<5
			Sr-90	<0.9	<1
SPW-2666	Water	Sept. 1992	Sr-89	<0.8	<5
			Sr-90	<0.5	<1
SPW-2828	Water	Oct. 1992	Co-60	<4.8	<10
			Cs-134	<6.0	<10
			Cs-137	<6.1	<10
			I-131	<0.3	<1
			H-3	<177	<300
SPM-2829	Milk	Oct. 1992	Co-60	<9.3	<10
			Cs-134	<6.4	<10
			Cs-137	<7.2	<10
SPW-3212	Water	Oct 1992	Ra-228	<1.0	<1
SPW-3057	Water	Nov. 1992	Ra-226	<0.03	<1
SPW-3294	Water	Dec. 1992	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4

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 or 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 $(\text{known})^{.0933}$ 10% of known value
Radium-226, -228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	<55 pCi/liter >55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-64[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 Comparions Program starting January 1988.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
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.
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 were 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 of 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 though 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 cross check results were within the control imits. No further action is planned.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STM-570	Sr-89	26.0±10.0	30.3-47.7	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.
	Sr-90	45.7±4.2	49.8-60.2	
STW-589	Sr-90	17.3±1.2	17.4-22.6	Sample was reanalyzed in triplicate; results of reanalyses were 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 were 1421.7±95.3 mg/L. The cause of low results was using wrong volume.
STW-601	Gr. alpha	11.0±2.0	11.6-32.4	Sample was reanalyzed in triplicate. Results of reanalyses were 13.4±1.0 pCi/L.
STAF-626	Gr. alpha	38.7±1.2	14.6-35.4	The cause of high results is the difference in geometery between standard used in the TIML lab and EPA filter.
STW-632	Ba-133	74.0±6.9	51.6-72.4	Sample was reanalyzed. Results of the reanalyses were 63.8±6.9 pCi/L within EPA limit.
STM-641	I-131	130.7±16.8	88.9-127.1	The cause of high result is unknown. In-house spike sample was prepared with activity of I-131 68.3±6.8 pCi/L. Result of the analysis was 69.1±9.7 pCi/L.
STM-661	Sr-89	25.3±7.6	29.3-46.7	The cause of low result is unknown. Data was checked for errors. The In-house spike sample was prepared with activity of Sr-89 41.0±10.0 pCi/L. Result of the analysis was 37.2±3.6 pCi/L.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STM-673	K	1540.0±103.9[c]	1597.3-1902.7	Activity was calculated using the wrong volume (3.5 L), instead of 3.25 L. Correction for volume resulted in a value of 1660.0±110.1 mg/L; within EPA control limits.

[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;

$s = 2\sigma$ 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 = the lower limit of detection based on 4.66σ uncertainty for a background sample.

3.0. Duplicate analyses

3.1 Individual results: $x_1 \pm s_1$

$x_1 \pm s_2$

Reported result: $x \pm s$

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

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

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:

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

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

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 five 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
		Cross 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

and Well Water Samples

1.0 INTRODUCTION

This appendix to the Radiation Environmental Monitoring Program Annual Report to the United States Regulatory Commission summarizes and interprets results of the special well and surface water samples taken at the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, during the period January - December, 1992. This supplement special sampling program was established 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 residence well water sample nearby the PINGP, during 1989. This program is described and the results for 1992 are summarized and discussed.

Program findings show a low level of tritium in a nearby residence well, some ground water seepage samples and a few other well water samples that are just above the lower limit of detection (LLD). None of these samples qualified as non-routine sample results.

3.0 Special Tritium Sampling Program

3.1 Program Design and Data Interpretation

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

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.

Special well and ground water is collected quarterly at eight locations: one sample from the PINGP Biology Station (P-30); one from the nearest residence deep well (P-24d, Suter residence); two ground water seepage from near Birch Lake (P-31 and P-32); well water from the Prairie Island Training Center (P-26); and three other nearby residences (P-27, Nauer residence; P-28, Perkins residence; P-29, Childs residence). The Rohl farm well (part of the quarterly REMP sampling) is used as a control location for these special samples.

3.3 Program Execution

The special water sampling was executed as described in the preceeding section with the following exceptions:

1. No water sample was available during the second and fourth quarters from the Birch Lake locations (P-31 and P-32) due to high and low water levels in the lake. The ground seepage sample locations were under water.

3.4 Program Modifications

The special water sampling program was modified during the year to a quarterly schedule to correspond to the regular REMP sampling for tritium in water.

3.5 Results and Discussion

Results obtained continue to show very low levels of tritium in some well water and ground water samples. Except for the Suter residence deep well, most of counting results for the samples are at or near the analysis laboratory's lower limit of detection (LLD). Sample results at the higher levels (Suter's and Birch Lake) are probable due to previous seepage from the PINGP discharge canal water into the ground water. This is thought to occur due to the elevation difference between the Vermillion River and the discharge canal. The Suter residence is between the discharge canal and Birch Lake, which is attached to the Vermillion River. The PINGP discharge canal discharge piping was lengthened during 1991, so that liquid discharges from the plant are released near the end of the discharge canal. It is expected that this modification will eventually eliminate the radioactive effluent flow into the ground water. Overall 1992 sample results show a slight downward trend as compared to 1991 levels.

Table D-4.1 Sample collection and analysis program for special well and surface water samples, Prairie Island Nuclear Generating Plant, 1992.

Medium	No.	Location codes and type[a]	Collection type and frequency[b]	Analysis type[c]
Well water quarterly	7	P-24d, P-25 (C), P-26, P-27, P-28, P-29, P-30	G/Q	H-3
Ground water	2	P-31, P-32	G/Q	H-3

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

[b] Collection type is codes as follows: C/ = continuous; G/ = grab. Collection frequency is coded as follows: W = weekly; M = monthly; Q = quarterly; SA = semi-annually; 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.

Table D-4.2. Sampling locations for special well and surface water samples, Prairie Island Nuclear Generating Plant, 1992.

Code type[a]		Collection site	Type of sample[b]	Distance and direction from site stack
P-24d		Suter residence, deep well	W W	0.6 mi. @ 158°/SSE
P-25	C	Rohl farm	W W	12.9 mi @ 352°/N
P-26		PITC	W W	0.4 mi. @ 258°/WSW
P-27		Nauer residence	W W	0.9 mi. @ 154°/SSE
P-28		Perkins residence	W W	1.0 mi. @ 152°/SSE
P-29		Childs residence	W W	1.2 mi. @ 149°/SSE
P-30		PINGP Biology Station	W W	0.2 mi. @ 32°/NNE
P-31		Birch Lake Seepage #1	G W	0.8 mi. @ 169°/SSE
P-32		Birch Lake Seepage #2	G W	0.7 mi. @ 179°/S

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

b Sample codes: WW = Well water; GW = Ground Water.

Table D-4.3 Radiological Environmental Monitoring Program Summary: Special well and 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, 1992

Sample type (units)	Type and number of analyses[a]		LLD[b]	Indicator locations means (F)[c] range	Locations with highest annual mean			Control locations mean (F)[c] range	Number of non-routine results[e]
					Location[d]		Range		
Well water (pCi/L)	H-3	36	160	542 (12/29) (160-930)	P-24d, Suter's deep well, 0.6 mi. @ 158°/SSE	835	(6/6) (710-930)	170	0
Ground water (pCi/L)	H-3	6	160	600 (3/3) (530-680)	P-31, Birch Lake Seepage #1 0.8 mi. @ 169°/SSE	600	(3/3) (530-680)	170	0

[a] H-3 = Tritium

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

[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.

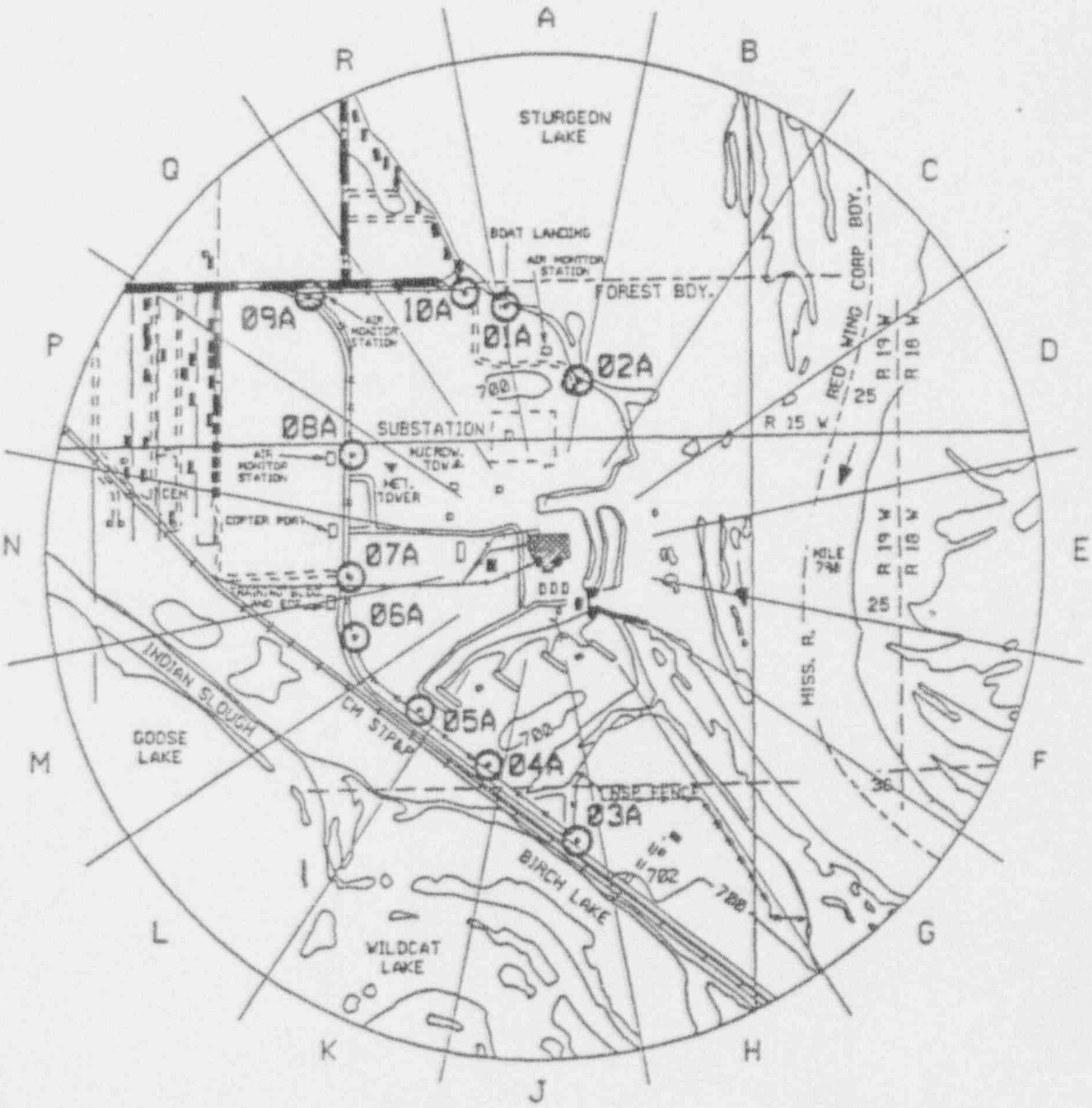
Table D - 4.4 Radiological Environmental Monitoring Program, Complete Data Table, 1992.

SAMPLE DATES	Jan-92	Feb-92	Mar-92	May-92	Aug-92	Nov-92
SAMPLE LOCATIONS	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L
Suter residence	790	830	930	840	710	910
Rohl farm	<180	170	<180	<170	<180	<180
PITC	<180	160	180	<170	<180	200
Nauer residence	<180			<170	<180	<180
Perkins residence	360			<170	<180	180
Child's residence	<180			<170	<180	<180
Biology Station	<180	400	200	<170	<180	<180
Birch Lake Seep 1	590	530			680	
Birch Lake Seep 2	340	590			470	

APPENDIX E

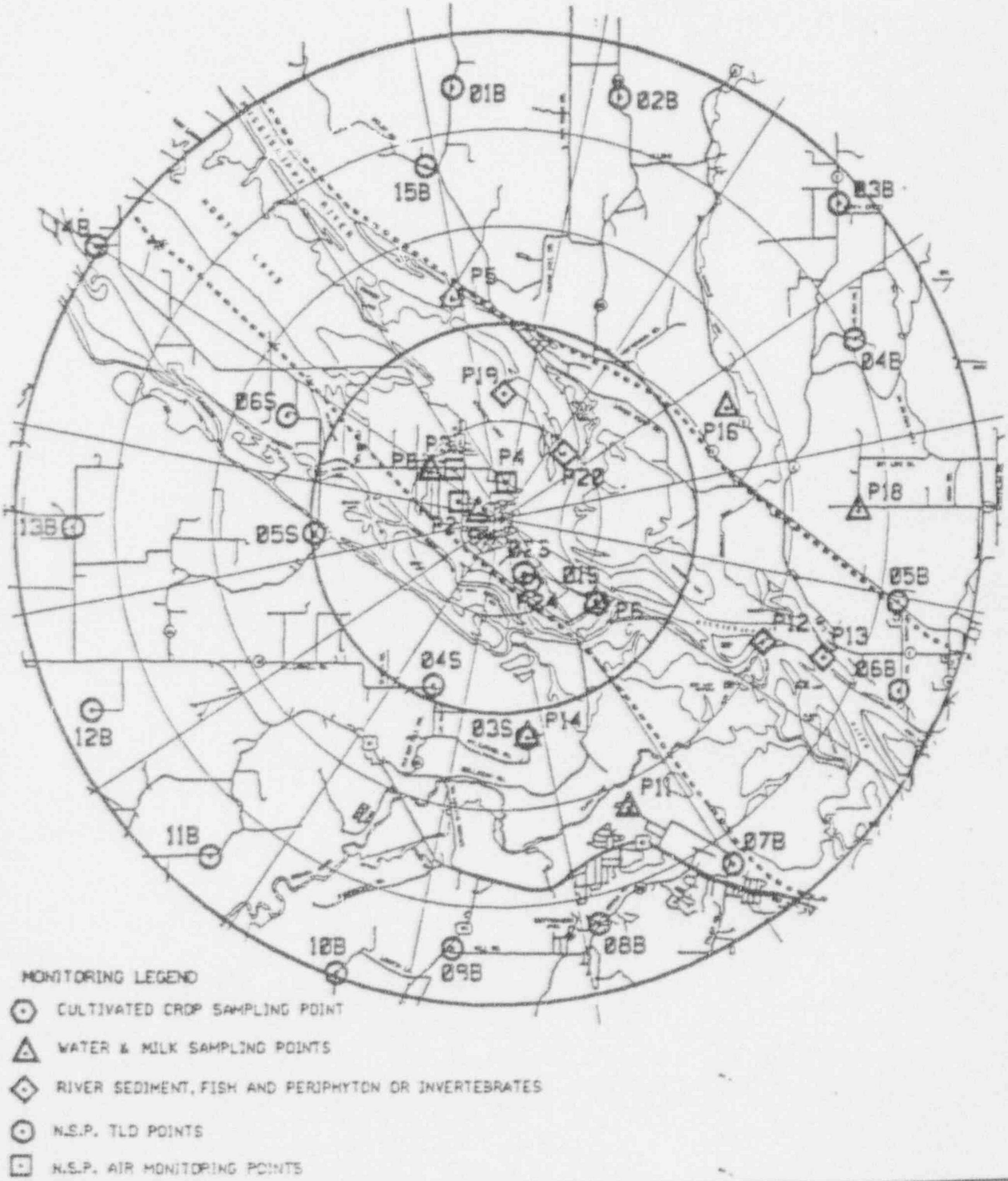
Sampling Location Maps

SITE BOUNDARY TLD LOCATIONS

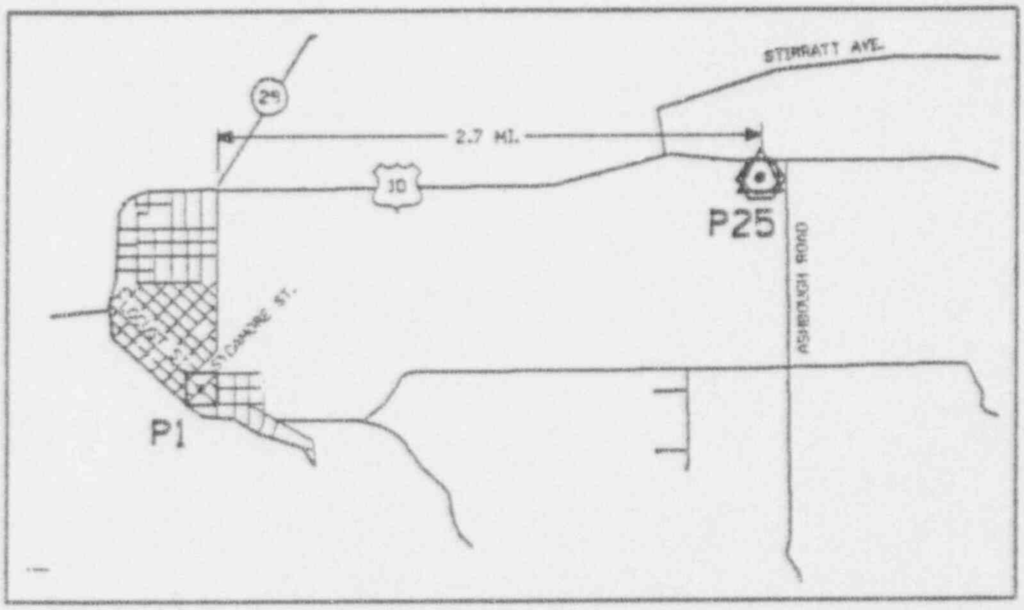


PLANT AREA ENLARGED PLAN (1.00 MILE RADIUS)
(NO SCALE)

RADIOLOGICAL ENVIRONMENTAL SAMPLE POINTS WITHIN 10 - MILE RADIUS



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