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ANNUAL REPORT
to the
UNITED STATES NUCLEAR REGULATORY COMMISSION

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January 1, 1993 to December 31, 1993
Project No. 8010

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TELEDYNE ISOTOPES MIDWEST LABORATORY
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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 Prairie Island Nuclear Generating Plant, 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, 1993. 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, 1993) 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 1993 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 radiation environmental monitoring program at Prairie Island is summarized in Table 5.1 and briefly reviewed below. Table 5.2 defines the sampling location codes used in Table 5.1 and specifies for each location its type (indicator or control) and its distance, direction, and sector relative to the reactor site. To assure that sampling is carried out in a reproducible manner, detailed sampling procedures have been prescribed (Prairie Island Nuclear Generating Plant, 1987). 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 quarterly composite of the particulate filters from each location 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).

Ambient gamma radiation is monitored at fifty (50) 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, eight (8) at special interest locations, sixteen (16) in the area of the Independent Spent Fuel Storage Installation (ISFSI), and one control location, 11.1 miles distant from the plant. They are replaced and measured quarterly. Also, a complete emergency set of TLDs for the inner ring, outer ring and special interest locations are 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, green leafy vegetables (cabbage) are collected annually from the highest D/Q garden and a control location (P-38) and analyzed for iodine-131. Corn is collected annually only if fields are irrigated with river water and analyzed for gamma-emitting isotopes. Well water and ground water are

3.2 Program Description

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:

> No TLD data was available for the second quarter of 1993 for location P-01S. The TLD was lost in the field.
>
> No milk sample was available from location P-37 for the week of July 27, 1993. Redundant samples were collected, but one was lost in shipment and the other was damaged in shipment.

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 involv separation of the element by use of an ion-exchange resin and subsequent beta counting. All gamma-spectroscopic analyses were performed with an HP Ge or Ge(Li) detector. Levels of iodine-131 in cabbage were determined by HP Ge or Ge(Li) spectrometry. Levels of airborne iodine-131 in charcoal samples were measured by HP Ge or Ge(Li) spectrometry

Tritium levels were determined by liquid scintillation technique.

Analytical procedures used by the Teledyne Isotopes Midwest Laboratory are specified in detail elsewhere (Teledyne Isotopes Midwest Laboratory, 1993). 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

3.4 Laboratory Procedures (continued)

Quality Assurance Program are presented elsewhere (Teledyne Isotopes Midwest Laboratory, 1993). 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

Eighteen new locations were added to the TLD monitoring program in the third quarter of 1993. Sixteen are ISFSI area locations (P-01IA to P-08IA and P-01IB to P-08IB), placed inside and outside of the earth berm. Two new indicators (P-07S and P-08S) were added to the special interest areas. A new vegetation control was added in August, 1993. Cabbage was collected from the Cain residence (P-38) .

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 radiation 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 1993 Land Use Census was completed on July 31, 1993. There were no changes in any of the highest D/Q locations for dairy, nearest residence, or garden sites in 1993. The critical receptor location did not change in 1993 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 1993. 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 1993.

4.2 Summary of Preoperational Data

The following constitutes a summary of preoperational studies conducted at the Prairie Island Nuclear Power Plant during the years 1970 to 1973, to determine background levels expected in the environment, and provided, where applicable, as a means for comparison with present day levels. Strict comparisons, however, are difficult, since background levels of radiation were much higher in these years due to radioactive fallout from the atmosphere. Gross beta measurements in fallout declined yearly from a level of 12,167 pCi/m^2 to 1,020 pCi/m^2, and these declining values are reflected throughout the various media tested.

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

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

The aqueous environment was monitored by testing of river , well, and lake waters, bottom sediments, fish , aquatic vegetation, and periphyton. Specific location comparison of drinking, river, and well water concentrations for tritium and gross beta are not possible. However, tritium background levels, measured at eight separate locations, declined steadily from an average concentration of 1020 pCi/L to 490 pCi/L. Levels of tritium measured today are below detection levels, with the exception of the special tritium sampling described in Appendix D. Values for gross beta, measured from 1970 to 1973 , averaged 9.9 pCi/L in downstream Mississippi River water, 8.2 pCi/L for well waters, and 11.0 pCi/L for lake waters. Gamma emitters were below the lower limit of detection (LLD). In bottom sediments, gross beta background levels were determined at 51.0 pCi/g. Cs-137 activity, during preoperational studies in 1973,

4.2 Summary of Preoperational Data (continued).

measured 0.25 pCi/g upstream and 0.21 pCi/g downstream. The lower levels observed today can still be attributed to residual activity from atmospheric fallout. Gross beta in fish, measured in both flesh and skeletal samples, averaged 7.3 and 11.7 pCi/g , respectively. Gross beta background levels in aquatic vegetation, algae, and periphyton samples measured 76.0 pCi/g , 46.0 pCi/g, and 13.6 pCi/g respectively.

4.3 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected in the vicinity of the Prairie Island Nuclear Generating Plant in 1993, 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 the 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 16.5 mR/91 days at outer ring locations. The mean at special locations was 15.3 mR/91 days and 15.4 mR/91 days at the control location. At sixteen new ISFSI area locations, measured inside and outside the earth berm, dose rates measured 15.3 and 16.2 mR/91 days, respectively. 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); in 1991 (14.7 and 14.5 mR/91 days, respectively); and in 1992 (15.1 and 17.1 mR/91 days). 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 (0.022 and 0.019 pCi/m^3), respectively, and was similar to 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), in 1991 (0.025 pCi/m^3) and in 1992 (0.023 and 0.021 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 has not occured since 1983 . In 1986, a spring peak could not be identified because it

was overshadowed by releases of radioactivity from Chernobyl. The highest averages for gross beta were seen in the months of January and December. The increase of beta activity during the winter months was also observed in 1983, 1984. 1985, 1986 (exclusive of the period between May 19, 1986 and June 9, 1986), 1987, 1988, 1989, 1990, 1991, 1992, and 1993.

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, 1994a).

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.

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 reactor 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 1993 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 200 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 7.5 pCi/L and was similar to 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), 1991 (8.0 pCi/L), and 1992 (7.6 pCi/L).

River Water

At the upstream and downstream collection sites, quarterly composite tritium levels were below the LLD level of 195 pCi/L in all samples.

River Water (continued).

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 the LLD level of 193 pCi/L in all but two samples. One sample from location P-9 measured 200 pCi/L, and one sample from the control location (P-25) measured 199 pCi/L.

Gamma-emitting isotopes were below 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 0.028 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 downstream from the Prairie Island Plant. Therefore, it was not necessary to collect and analyze corn samples.

Fish

Fish samples were collected in June and September, 1993, and analyzed for gamma emitting isotopes. Only naturally-occurring potassium-40 was detected, and there was no significant difference between upstream and downstream results. There was no indication of a plant effect.

Aquatic Insects or Periphyton

Aquatic insects (invertebrates) or periphyton were collected in June and September, 1993. The samples were analyzed for gamma-emitting isotopes.

Cs-137 was detected in one downstream sample at a level of 0.13 pCi/g wet weight. Low levels of Cs-137 commonly occur in the environment. The levels observed in both aquatic insect and bottom sediment samples at location P-12 are considered residual activities due to radioactive fallout (Sec. 4.2, Summary of Preoperational Data).

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

Bottom and Shoreline Sediments

Sediment collections were made in May and September, 1993. The samples were analyzed for gamma-emitting isotopes.

Cs-137 was detected in one downstream bottom sediment sample (0.041 pCi/g dry weight). All other gamma-emitting isotopes, except naturally-occurring potassium-40, were below their respective LLDs. No plant effect was indicated.

5.0 TABLES

Table 5.1. Sample collection and analysis program, Prairie Island Nuclear Generating Plant, 1993.

Medium	Locations Number	Locations Codes (and Type)[a]	Collection Type and Frequency[b]	Analysis Type and Frequency[c]
Ambient radiation (TLD's)	50	P-01A - P-10A P-01B - P-15B P-01S - P-08S P-01IA - P-08IA P-01IB - P-08IB 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-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-38(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 D-2. Control stations are indicated by (C). All other stations are indicators.

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

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

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

Table 5-2. Sampling locations, Prairie Island Nuclear Generating Plant, 1993.

Code	Type[a]	Collection Site	Type of Sample[b]	Distance and Direction from Site Stack
P-1	C	Air Station P-1	AP, AI	11.8 mi @ 316°/NNW
P-2		Air Station P-2	AP, AI	0.5 mi @ 294°/WNW
P-3		Air Station P-3	AP, AI	0.8 mi @ 313°/NW
P-4		Air Station P-4	AP, AI	0.4 mi @ 359°/N
P-5	C	Upstream of Plant	RW, BO	2.3 mi @ 348°/NNW
P-6		Lock & Dam #3 & Air Station P-6	AP, AI, RW, WW, BS	1.6 mi @ 129°/SE
P-8		Community Center	WW	1.0 mi @ 321°/WNW
P-9		Plant Well #2	WW	0.3 mi @ 306°/NW
P-11		Red Wing Service Center	DW	3.3 mi @ 158°/SSE
P-12		Downstream of Plant	BO, SS	3.0 mi @ 116°/ESE
P-13		Downstream of Plant	F	3.5 mi @ 113°/ESE
P-14		Gustafson Farm	M	2.3 mi @ 173°/S
P-18		Christiansen 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	12.9 mi @ 352°/N
P-36		Dosdall Farm	M	3.8 mi @ 9°/N
P-37		Welsch Farm	M	4.1 mi @ 90°/E
P-38	C	Cain Residence	VE	14.2 mi @ 359°/N
General Area of the Site Boundary				
P-01A		Property Line	TLD	0.4 mi @ 359°/N
P-02A		Property Line	TLD	0.3 mi @ 10°/N
P-03A		Property Line	TLD	0.5 mi @ 183°/S
P-04A		Property Line	TLD	0.4 mi @ 204°/SSW
P-05A		Property Line	TLD	0.4 mi @ 225°/SW
P-06A		Property Line	TLD	0.4 mi @ 249°/WSW
P-07A		Property Line	TLD	0.4 mi @ 268°/W
P-08A		Property Line	TLD	0.4 mi @ 291°/WNW
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, 1993 (continued).

Code	Type[a]	Collection Site	Type of Sample[b]	Distance and Direction from Site Stack
Approximately 4 to 5 miles Distant from the Plant				
P-01B		Thomas Killian Residence	TLD	4.7 mi @ 355°/N
P-02B		Roy Kinneman Farm	TLD	4.8 mi @ 17°/NNE
P-03B		Wayne Anderson Farm	TLD	4.9 mi @ 46°/NE
P-04B		Nelson Drive (Road)	TLD	4.2 mi @ 61°/ENE
P-05B		County Road E and Coulee	TLD	4.1 mi @ 102°/ESE
P-06B		William Hauschiblt Residence	TLD	4.4 mi @ 112°/ESE
P-07B		Red Wing Public Works	TLD	4.7 mi @ 140°/SE
P-08B		David Wnuk Residence	TLD	4.1 mi @ 165°/SSE
P-09B		Highway 19 South	TLD	4.2 mi @ 187°/S
P-10B		Cannondale Farm	TLD	4.9 mi @ 200°/SSW
P-11B		Wallace Weberg Farm	TLD	4.5 mi @ 221°/SW
P-12B		Ray Gergen Farm	TLD	4.5 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°/S
P-04S		Richard Burt Residence	TLD	2.0 mi @ 202°/SSW
P-05S		Kinney Store	TLD	2.0 mi @ 270°/W
P-06S		Earl Flynn Farm	TLD	2.5 mi @ 299°/WNW
P-07S		Indian Community	TLD	0.7 mi @ 271°/W
P-08S		Indian Community	TLD	0.7 mi @ 287°/NWW
P-01C	C	Robert Kinneman Farm	TLD	11.1 mi @ 331°/NNW

Table 5.2. Sampling locations, Prairie Island Nuclear Generating Plant, 1993 (continued).

Code	Type[a]	Collection Site	Type of Sample[b]	Distance and Direction from ISFSI Center
ISFSI Area Inside Earth Berm				
P-01IA		ISFSI Nuisance Fence	TLD	190' @ 45°/NE
P-02IA		ISFSI Nuisance Fence	TLD	360' @ 82°/E
P-03IA		ISFSI Nuisance Fence	TLD	370' @ 100°/E
P-04IA		ISFSI Nuisance Fence	TLD	200' @ 134°/SE
P-05IA		ISFSI Nuisance Fence	TLD	180' @ 219°/SW
P-06IA		ISFSI Nuisance Fence	TLD	320' @ 258°/WSW
P-07IA		ISFSI Nuisance Fence	TLD	320' @ 281°/WNW
P-08IA		ISFSI Nuisance Fence	TLD	190' @ 318°/NW
ISFSI Area Outside Earth Berm				
P-01IB (01SP)		ISFSI Berm Area	TLD	340' @ 3°/N
P-02IB (02SP)		ISFSI Berm Area	TLD	380' @ 28°/NNE
P-03IB (03SP)		ISFSI Berm Area	TLD	559' @ 85°/E
P-04IB (04SP)		ISFSI Berm Area	TLD	590' @ 165°/SSE
P-05IB (05SP)		ISFSI Berm Area	TLD	690' @ 186°/S
P-06IB (06SP)		ISFSI Berm Area	TLD	720' @ 201°/SSW
P-07IB (07SP)		ISFSI Berm Area	TLD	610' @ 271°/W
P-08IB (08SP)		ISFSI Berm Area	TLD	360' @ 332°/NNW

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

[b] Sample Codes:

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

Table 5.3. Missed collections and analyses, 1993. Prairie Island Nuclear Generating Plant. All required samples were collected and analyzed as scheduled except the following:

Sample	Analysis	Location	Collection Date or Period	Reason for not conducting REMP as required	Plan for Preventing Recurrence
TLD	Ambient Radiation	P-01S	2nd Qtr., 1993	Lost in the field.	Moved TLD about 25' and placed inside locked fenced area near local air sampler.
Milk	Gamma, I-131	P-37	07-27-93	Redundant samples collected, but one lost in shipping and other damaged in shipping.	Issued complaint to UPS concerning damage and loss of shipments. Will continue to ship separate redundant samples.

Table 5.4. Radiation 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 1993

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean: Location[d]	Location with Highest Quarterly Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
TLD (mR/91 days) (Inner Ring, Area at Site Boundary)	Gamma 40	3.0	15.1 (40/40) (11.4-17.5)	P-07A, Property Line 0.4 mi @ 268°/W	15.7 (4/4) (15.0-16.0)	(See Control below.)	0
TLD (mR/91 days) (Outer Ring, 4 - 5 miles distant)	Gamma 60	3.0	16.5 (60/60) (13.2-20.9)	P-02B, Kinneman Farm, 4.8 mi @ 17°/NNE	20.9 (4/4) (19.2-22.7)	(See Control below.)	0
TLD (mR/91 days) (Special Interest Areas)	Gamma 27	3.0	15.3 (27/27) (10.8-20.1)	P-03S, Gustafson Farm, 2.2 mi @ 173°/SSE	16.8 (4/4) (15.6-18.0)	(See Control below.)	0
TLD (mR/91 days) ISFSI Area Inside Earth Berm	Gamma 16	3.0	15.3 (16/16) (12.3-16.9)	P-01IA, ISFSI Nuisance Fence, 190' @ 45°/NE	16.2 (2/2) (15.6-16.9)	(See Control below.)	0
TLD (mR/91 days) ISFSI Area Outside Earth Berm	Gamma 16	3.0	16.2 (16/16) (13.5-20.8)	P-03IB, ISFSI Berm Area, 559' @ 85°/E	20.0 (2/2) (19.3-20.8)	(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 260	0.003	0.022 (208/208) (0.005-0.064)	P-02, P-04, P-06 had identical means	0.022 (156/156) (0.005-0.064)	0.019 (52/52) (0.007-0.058)	0
	GS 20			P-6 , Air Station P-6 1.6 mi. @129°/SE			
	Be-7	0.022	0.068 (16/16) (0.049-0.086)	-	0.071 (4/4) (0.063-0.086)	0.052 (4/4) (0.047-0.057)	0
	Mn-54	0.0028	<LLD	-	-	<LLD	0
	Co-58	0.0031	<LLD	-	-	<LLD	0
	Co-60	0.0041	<LLD	-	-	<LLD	0
	Zn-65	0.0072	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.0057	<LLD	-	-	<LLD	0
	Ru-103	0.0038	<LLD	-	-	<LLD	0
	Ru-106	0.022	<LLD	-	-	<LLD	0
	Cs-134	0.0036	<LLD	-	-	<LLD	0
	Cs-137	0.0026	<LLD	-	-	<LLD	0
	Ba-La-140	0.017	<LLD	-	-	<LLD	0
	Ce-141	0.0039	<LLD	-	-	<LLD	0
	Ce-144	0.012	<LLD	-	-	<LLD	0

Table 5.4. Radiation 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 1993

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean: Location[d]	Location with Highest Quarterly Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Airborne Iodine (pCi/m^3)	I-131 260	0.07	<LLD	-	-	<LLD	0
Milk, (pCi/L)	I-131 89	1.0	<LLD	-	-	<LLD	0
	GS 89						
	K-40	200	1420 (71/71) (1180-1640)	P-14, Gustafson Farm 2.3 mi @ 173°/S	1500 (18/18) (1290-1640)	1360 (18/18) (1090-1550)	0
	Cs-134	15	<LLD	-	-	<LLD	0
	Cs-137	15	<LLD	-	-	<LLD	0
	Other gammas	15	<LLD	-	-	<LLD	0
River Water (pCi/L)	H-3 8	195	<LLD	-	-	<LLD	0
	GS 24						
	Mn-54	15	<LLD	-	-	<LLD	0
	Fe-59	30	<LLD	-	-	<LLD	0
	Co-58	15	<LLD	-	-	<LLD	0
	Co-60	15	<LLD	-	-	<LLD	0
	Zn-65	30	<LLD	-	-	<LLD	0
	Zr-Nb-95	15	<LLD	-	-	<LLD	0
	Cs-134	10	<LLD	-	-	<LLD	0
	Cs-137	10	<LLD	-	-	<LLD	0
	Ba-La-140	15	<LLD	-	-	<LLD	0
	Ce-144	50	<LLD	-	-	<LLD	0

Table 5.4. Radiation Environmental Monitoring Program Summary.

Name of Facility Prairie Island Nuclear Power Station. Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota Reporting Period January - December 1993
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean: Location[d]	Location with Highest Quarterly Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Drinking Water (pCi/L)	GB 12	1.0	7.5 (12/12) (6.0-10.6)	P-11, Red Wing Service Center 3.3 mi @ 178°/SSE	7.5 (12/12) (6.0-10.6)	None	0
	I-131 12	1.0	<LLD	-	-	None	0
	H-3 4	200	<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
Well Water (pCi/L)	H-3 16	193	200 (1/4)	P-9, Plant Well #2 0.3 mi. @ 306°/NW	200 (1/4)	199 (1/4)	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	97	<LLD	-	-	<LLD	0
Crops - Cabbage (pCi/g wet)	I-131 2	0.028	<LLD	-	-	<LLD	0

Table 5.4. Radiation 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 1993

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean: Location[d]	Location with Highest Quarterly Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
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	0.70	<LLD	-	-	<LLD	0
	K-40	0.10	1.28 (2/2) (1.21-1.35)	P-12, Downstream of Plant, 3.0 mi @ 116°/ESE	1.28 (2/2) (1.21-1.35)	1.10 (2/2) (0.66-1.54)	0
	Mn-54	0.078	<LLD	-	-	<LLD	0
	Co-58	0.075	<LLD	-	-	<LLD	0
	Co-60	0.093	<LLD	-	-	<LLD	0
	Zn-65	0.17	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.13	<LLD	-	-	<LLD	0
	Ru-103	0.082	<LLD	-	-	<LLD	0
	Ru-106	0.64	<LLD	-	-	<LLD	0
	Cs-134	0.060	<LLD	-	-	<LLD	0
	Cs-137	0.063	<LLD	P-12, Downstream of Plant, 3.0 mi @ 116°/ESE	0.13 (1/2)	<LLD	0
	Ba-La-140	0.33	<LLD	-	-	<LLD	0
	Ce-141	0.11	<LLD	-	-	<LLD	0
	Ce-144	0.35	<LLD	-	-	<LLD	0

Table 5.4. Radiation 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 1993

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean: Location[d]	Location with Highest Quarterly Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Bottom and Shoreline Sediments (pCi/g dry)	GS 6						
	Be-7	0.31	0.37 (1/4)	P-06, Lock and Dam No.3, 1.6 mi. @ 129°/SE	0.37 (1/2)	<LLD	0
	K-40	0.5	7.62 (4/4) (6.80-9.31)	P-20, Upstream of Plant, 0.9 mi. @ 45°/NE	9.59 (2/2) (9.54-9.64)	9.59 (2/2) (9.54-9.64)	0
	Mn-54	0.032	<LLD	-	-	<LLD	0
	Co-58	0.042	<LLD	-	-	<LLD	0
	Co-60	0.034	<LLD	-	-	<LLD	0
	Zn-65	0.095	<LLD	-	-	<LLD	0
	Zr-Nb-95	0.065	<LLD	-	-	<LLD	0
	Ru-103	0.036	<LLD	-	-	<LLD	0
	Ru-106	0.28	<LLD	-	-	<LLD	0
	Cs-134	0.064	<LLD	-	-	<LLD	0
	Cs-137	0.031	0.041 (1/4)	P-06, Lock and Dam No.3, 1.6 mi. @ 129°/SE	0.041 (1/2)	<LLD	0
	Ba-La-140	0.069	<LLD	-	-	<LLD	0
	Ce-141	0.087	<LLD	-	-	<LLD	0
	Ce-144	0.25	<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.

6.0 REFERENCES CITED

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

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

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

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

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

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

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

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

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

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

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

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

_____. 1983b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1982.

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

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

Northern States Power Company. 1972. Prairie Island Nuclear Generating Plant, Environmental Monitoring and Ecological Studies Program, January 1, 1971 to December 31, 1971. Minneapolis, Minnesota.

_____. 1973. Prairie Island Nuclear Generating Plant, Environmental Monitoring and Ecological Studies Program, January 1, 1972 to December 31, 1972. Minneapolis, Minnesota.

_____. 1974. Prairie Island Nuclear Generating Plant, Environmental Monitoring and Ecological Studies Program, Volume 1, January 1, 1973 to December 31, 1973. Minneapolis, Minnesota.

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

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

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

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

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

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

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

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

_____. 1987. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1986 to

December 31, 1986 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

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

_____. 1989. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1988 to December 31, 1988 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1990. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1989 to December 31, 1989 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1991. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1990 to December 31, 1990 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1992. Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1991 to December 31, 1991 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

_____. 1993 Prairie Island Nuclear Generating Plant, Annual Radiation Environmental Monitoring Report to the U.S. Nuclear Regulatory Commission, January 1, 1992 to December 31, 1992 (prepared by Teledyne Isotopes Midwest Laboratory). Minneapolis, Minnesota.

Teledyne Isotopes Midwest Laboratory. 1993. Quality Control Program, Revision 12. 20 April 1992.

_____. 1993. Quality Control Procedures Manual, Revision 17, 18 May 1993.

_____. 1993. Quality Assurance Program Manual, Revision 1, 20 August 1992.

_____. 1993. Analytical Procedures , Revised 21 August 1992.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

_____. 1992a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1991.

_____. 1992b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1991

_____. 1993a. Radiation Environmental Monitoring for Monticello Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1992.

_____. 1993b. Radiation Environmental Monitoring for Prairie Island Nuclear Generating Plant, Complete Analysis Data Tables, January - December 1992.

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

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

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

APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: Teledyne's Midwest Laboratory 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 four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only. Please refer to March, June, September and December progress reports for information.

January, 1990 through December, 1993

Appendix A

Interlaboratory Comparison Program Results

Teledyne's Midwest Laboratory (formerly Hazleton Environmental Sciences) has participated in interlaboratory comparison (crosscheck) programs since the formulation of it's quality control program in December 1971. These programs are operated by agencies which supply environmental type samples (e.g., milk or water) containing concentrations of radionuclides know 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 and air filters during the period 1990-1993.

This program is conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for Thermoluminescent Dosimeters (TLDs), since 1976 via various International Intercomparisons 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 for the past twelve months. Data for previous years available upon request.

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

Attachment A lists acceptance criteria for "spiked" samples.

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

December, 1993

ATTACHMENT A

ACC 'I..NCE CRITERIA FOR "SPIKED" SAMPLES

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

Analysis	Level	One Standard Deviation for single determinations
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg >30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross alpha	≤20 pCi/liter >20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤100 pCi/liter >100 pCi/liter	5.0 pCi/liter 5% of known value
Tritium	≤4,000 pCi/liter >4,000 pCi/liter	1s = (pCi/liter) = $169.85 \times (\text{known})^{0.0933}$ 10% of known value
Radium-226,-228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	≤55 pCi/liter >55 pCi/liter	6.0 pCi/liter 10% of known value
Uranium-238, Nickel-64[b] Technetium-99[b]	≤35 pCi/liter >35 pCi/liter	6.0 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter >100 pCi/liter	10 pCi/liter 10% of known value
Others[b]	–	20% of known value

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

[b] Teledyne limit.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
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
			The sample was reanalyzed in triplicate for Sr-90; results of reanalyses were 18.8±1.5 pCi/L. No further action is planned.			
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
STW-592	WATER	Jan, 1990				
			Ba-133	78.0 ± 0.0	74.0 ± 7.0	61.9 - 86.1
			Co-60	14.7 ± 2.3	15.0 ± 5.0	6.3 - 23.7
			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
			Ru-106	133.3 ± 13.4	139.0 ± 14.0	114.8 - 163.2
			Zn-65	135.0 ± 6.9	139.0 ± 14.0	114.8 - 163.2
STW-593	WATER	Feb, 1990				
			H-3	4827.0 ± 83.0	4976.0 ± 498.0	4113.0 - 5839.0
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				
			Uranium	4.0 ± 0.0	4.0 ± 6.0	0.0 - 14.4
STAF-596	AIR FILTER	Mar, 1990				
			Cs-137	9.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			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
STW-597	WATER	Apr, 1990				
			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
STW-598	WATER	Apr, 1990				
			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
			Gross 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

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Sr-90	10.3 ± 3.1	10.0 ± 1.5	8.3 - 11.7
STM-599	MILK	Apr, 1990				
			Cs-137	26.0 ± 6.0	24.0 ± 5.0	15.3 - 32.7
			I-131	98.7 ± 1.2	99.0 ± 10.0	81.7 - 116.3
			K	1300.0 ± 69.2	1550.0 ± 78.0	1414.7 - 1685.3
			The K analysis was repeated in triplicate; result of reanalysis was 1421.7±95.3 mg/L. No further action is planned.			
			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
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
			Gross Alpha analysis was repeated in triplicate; results of reanalyses were 13.4±1.0 pCi/L. No further action is planned.			
			Gr. Beta	12.3 ± 1.2	15.0 ± 5.0	6.3 - 23.7
STW-602	WATER	Jun, 1990				
			Ba-133	100.7 ± 8.1	99.0 ± 10.0	81.7 - 116.3
			Co-60	25.3 ± 2.3	24.0 ± 5.0	15.3 - 32.7
			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
			Ru-106	202.7 ± 17.2	210.0 ± 21.0	173.6 - 246.4
			Zn-65	155.0 ± 10.6	148.0 ± 15.0	130.6 - 165.4
STW-603	WATER	Jun, 1990				
			H-3	2927.0 ± 306.0	2933.0 ± 358.0	2312.0 - 3554.0
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				
			Cs-137	19.0 ± 2.0	20.0 ± 5.0	11.3 - 28.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			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
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				
			Cs-137	20.0 ± 2.0	20.0 ± 5.0	11.3 - 28.7
			I-131	63.0 ± 6.0	58.0 ± 6.0	47.6 - 68.4
			K-40	1673.3 ± 70.2	1700.0 ± 85.0	1552.5 - 1847.5
			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
STW-612	WATER	Oct, 1990				
			Ba-133	116.7 ± 9.9	110.0 ± 11.0	90.9 - 129.0
			Co-60	20.3 ± 3.1	20.0 ± 5.0	11.3 - 28.7
			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
			Ru-106	152.0 ± 8.0	151.0 ± 15.0	125.0 - 177.0
			Zn-65	115.3 ± 12.2	115.0 ± 12.0	94.2 - 135.8
STW-613	WATER	Oct, 1990				
			H-3	7167.0 ± 330.0	7203.0 ± 720.0	5954.0 - 8452.0
STW-614	WATER	Oct, 1990				
			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
STW-615	WATER	Oct, 1990				
			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
			Gross 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	6.0 - 23.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b]		
				Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-616	WATER	Nov, 1990				
			Ra-226	6.8 ± 1.0	7.4 ± 1.1	5.5 - 9.3
			Ra-228	5.5 ± 1.7	7.7 ± 1.9	4.4 - 11.0
STW-617	WATER	Nov, 1990				
			U	35.0 ± 0.4	35.5 ± 3.6	29.3 - 41.7
			Sample was analyzed but the results were not submitted to the EPA because the deadline was missed (all data on file).			
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 ± [illegible].2	5.0 ± 5.0	0.0 - 13.7
STW-621	WATER	Feb, 1991				
			Ba-133	85.7 ± 9.2	75.0 ± 8.0	61.1 - 88.9
			Co-60	41.3 ± 8.4	40.0 ± 5.0	31.3 - 48.7
			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
			Ru-106	209.7 ± 18.6	186.0 ± 19.0	153.0 - 219.0
			Zn-65	166.7 ± 19.7	149.0 ± 15.0	123.0 - 175.0
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 ± [illegible].2	31.8 ± 4.8	23.5 - 40.1
			Ra-228		21.1 ± 5.3	11.9 - 30.3
			No data for Ra-228 was reported; sample was lost during analysis.			
STW-625	WATER	Mar, 1991				
			U	6.7 ± 0.4	7.6 ± 3.0	2.4 - 12.8
STAF-626	AIR FILTER	Mar, 1991				
			Cs-137	33.7 ± 4.2	40.0 ± 5.0	31.3 - 48.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Gr. Alpha	38.7 ± 1.2	25.0 ± 6.0	14.6 - 35.4
			The cause of the high Gross Alpha result is the difference in geometry between the standard used in the TIML lab and the EPA filter.			
			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
STW-627	WATER	Apr, 1991				
			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
STW-628	WATER	Apr, 1991				
			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
			Gross 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
STM-629	MILK	Apr, 1991				
			Cs-137	54.7 ± 11.0	49.0 ± 5.0	40.3 - 57.7
			I-131	65.3 ± 14.7	60.0 ± 6.0	49.6 - 70.4
			K-40	1591.7 ± 180.1	1650.0 ± 83.0	1506.0 - 1794.0
			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
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				
			Ba-133	74.0 ± 6.9	62.0 ± 6.0	51.6 - 72.4
			Sample was reanalyzed for Ba-133. Result of the reanalysis was 63.8±6.9 pCi/L; within the EPA control limits.			
			Co-60	11.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			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
			Ru-106	162.3 ± 19.0	149.0 ± 15.0	123.0 - 175.0

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Zn-65	119.3 ± 16.3	108.0 ± 11.0	88.9 - 127.1
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
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				
			Cs-137	26.3 ± 1.2	30.0 ± 5.0	21.3 - 38.7
			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
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				
			Cs-137	33.7 ± 3.2	30.0 ± 5.0	21.3 - 38.7
			I-131	130.7 ± 16.8	108.0 ± 11.0	88.9 - 127.1
			The cause of the high result for the I-131 analysis is unknown. An in-house spike sample was prepared with activity for I-131 of 68.3±6.8 pCi/L. Result of TIML's analysis of the in-house spike was 69.1±9.7 pCi/L.			
			K	1743.3 ± 340.8	1740.0 ± 87.0	1589.1 - 1890.9
			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
STW-642	WATER	Oct, 1991				
			Ba-133	94.7 ± 3.1	98.0 ± 10.0	80.7 - 115.3
			Co-60	29.7 ± 1.2	29.0 ± 5.0	20.3 - 37.7
			Cs-134	9.7 ± 1.2	10.0 ± 5.0	1.3 - 18.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Cs-137	11.0 ± 2.0	10.0 ± 5.0	1.3 - 18.7
			Ru-106	196.3 ± 15.1	199.0 ± 20.0	164.3 - 233.7
			Zn-65	75.7 ± 8.3	73.0 ± 7.0	60.9 - 85.1
STW-643	WATER	Oct, 1991				
			H-3	2640.0 ± 156.2	2454.0 ± 352.0	1843.3 - 3064.7
STW-644	WATER	Oct, 1991				
			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
STW-645	WATER	Oct, 1991				
			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
			Gross 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
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				
			Ba-133	79.0 ± 3.4	76.0 ± 8.0	62.1 - 89.9
			Co-60	40.3 ± 5.0	40.0 ± 5.0	31.3 - 48.7
			Cs-134	31.7 ± 4.2	31.0 ± 5.0	22.3 - 39.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Cs-137	51.0 ± 3.4	49.0 ± 5.0	40.3 - 57.7
			Ru-106	188.7 ± 28.8	203.0 ± 20.0	168.3 - 237.7
			Zn-65	148.0 ± 15.0	150.7 ± 6.1	122.0 - 174.0
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		0.0	
			No Data; Special EPA testing.			
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			
			No Data is available; Special EPA testing.			
STAF-658	AIR FILTER	Mar, 1992				
			Cs-137	10.0 ± 0.0	10.0 ± 5.0	1.3 - 18.7
			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
STW-659	WATER	Apr, 1992				
			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
STW-660	WATER	Apr, 1992				
			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
			Gross 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
STM-661	MILK	Apr, 1992				
			Cs-137	39.3 ± 2.3	39.0 ± 5.0	30.3 - 47.7
			I-131	78.7 ± 9.5	78.0 ± 8.0	64.1 - 91.9

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			K-40	1610.0 ± 72.1	1710.0 ± 86.0	1560.8 - 1859.2
			Sr-89	25.3 ± 7.6	38.0 ± 5.0	29.3 - 46.7
				The cause of the low Sr-89 results is unknown. Data were checked for errors. An in-house spike sample was prepared with activity for Sr-89 of 41.0±10.0 pCi/L. Result of the analysis of the in-house spike sample for Sr-89 was 37.2±3.6 pCi/L.		
			Sr-90	24.3 ± 3.1	29.0 ± 5.0	20.3 - 37.7
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
STW-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				
			Ba-133	92.7 ± 11.0	98.0 ± 10.0	80.7 - 115.3
			Co-60	20.3 ± 1.2	20.0 ± 5.0	11.3 - 28.7
			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
			Ru-106	142.7 ± 23.7	141.0 ± 14.0	116.7 - 165.3
			Zn-65	103.3 ± 10.6	99.0 ± 10.0	81.7 - 116.3
STW-665	WATER	Jun, 1992				
			H-3	2153.3 ± 144.6	2125.0 ± 347.0	1523.0 - 2727.0
STW-666	WATER	Jul, 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	Jul, 1992				
			Uranium	3.6 ± 0.3	4.0 ± 3.0	0.0 - 9.2
STW-668	WATER	Aug, 1992				
			I-131	47.0 ± 3.5	45.0 ± 6.0	34.6 - 55.4
STW-669	WATER	Aug, 1992				
			Pu-239	8.5 ± 0.9	9.0 ± 0.9	7.4 - 10.6
STAF-670	AIR FILTER	Aug, 1992				
			Alpha	25.7 ± 1.2	30.0 ± 8.0	16.1 - 43.9
			Beta	69.0 ± 2.0	69.0 ± 10.0	51.7 - 86.3
			Cs-137	16.0 ± 0.0	18.0 ± 5.0	9.3 - 26.7
			Sr-90	26.0 ± 4.0	25.0 ± 5.0	16.3 - 33.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-671	WATER	Sep, 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	Sep, 1992				
			Alpha	43.0 ± 13.1	45.0 ± 11.0	25.9 - 64.1
			Beta	41.3 ± 18.6	50.0 ± 5.0	14.3 - 58.7
STM-673	MILK	Sep, 1992				
			Cs-137	14.0 ± 3.5	15.0 ± 5.0	6.3 - 23.7
			I-131(gamma	109.7 ± 19.4	100.0 ± 10.0	82.7 - 117.3
			K	1540.0 ± 103.9	1750.0 ± 88.0	1597.3 - 1902.7
			The K 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; within EPA control limits.			
			Sr-89	11.0 ± 3.5	15.0 ± 5.0	6.3 - 23.7
			Sr-90	12.7 ± 1.6	15.0 ± 5.0	6.3 - 23.7
STW-674	WATER	Oct, 1992				
			Ba-133	80.3 ± 9.0	74.0 ± 7.0	61.9 - 86.1
			Co-60	11.3 ± 2.3	10.0 ± 5.0	1.3 - 18.7
			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
			Ru-106	170.7 ± 2.3	175.0 ± 18.0	143.8 - 206.2
			Zn-65	169.7 ± 25.0	148.0 ± 15.0	122.0 - 174.0
STW-675	WATER	Oct, 1992				
			H-3	5896.7 ± 136.2	5962.0 ± 596.0	4928.0 - 6996.0
STW-676	WATER	Oct, 1992				
			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
			Uranium	9.7 ± 0.5	10.2 ± 3.0	5.0 - 15.4
STW-677	WATER	Oct, 1992				
			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
			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	110.0 ± 5.0	1.3 - 18.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-678	WATER	Oct, 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				
			Uranium	15.5 ± 1.1	15.2 ± 3.3	10.0 - 20.4
STW-680	WATER	Jan, 1993				
			Sr-89	15.0 ± 2.0	15.0 ± 5.0	6.3 - 23.7
			Sr-90	10.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
STW-681	WATER	Jan, 1993				
			Pu-239	17.5 ± 1.6	20.0 ± 2.0	16.5 - 23.5
STW-682	WATER	Jan, 1993				
			Alpha	17.1 ± 1.2	34.0 ± 9.0	18.4 - 49.6
			Gross Alpha analysis was repeated with similar results. An investigation of possible causes for the deviation from the EPA was conducted with no cause discovered. The sample was spiked with Th-230; so Alpha Spec Analysis for Th-230 was performed in triplicate with results of 15.5±2.1, 13.4±1.4, and 14.8±2.0. It should be noted that 66% of all participants failed this analysis with a grand average of 17.1. This coupled with the support of the Alpha Spec results leaves TIML cause to believe that there may have been a dilution error at the EPA. It should be noted that on the next Gross Alpha EPA check, TIML reported results that where exactly the known value. Since no apparent cause can be found, and TIML had outstanding results on the following sample, it is felt that no further investigation is needed.				
			Beta	46.7 ± 3.2	44.0 ± 5.0	35.3 - 52.7
STW-683	WATER	Feb, 1993				
			I-131	106.0 ± 10.0	100.0 ± 10.0	82.7 - 117.3
STW-684	WATER	Feb, 1993				
			Uranium	7.2 ± 0.5	7.6 ± 3.0	2.4 - 12.8
STW-685	WATER	Mar, 1993				
			Ra-226	9.3 ± 1.3	9.8 ± 1.5	7.2 - 12.4
			Ra-228	20.8 ± 2.2	18.5 ± 4.6	10.5 - 26.5
STW-686	WATER	Apr, 1993				
			Alpha	88.3 ± 8.1	95.0 ± 24.0	53.4 - 136.6
			Ra-226	25.4 ± 1.4	24.9 ± 3.7	18.5 - 31.3
			Ra-228	17.4 ± 1.2	19.0 ± 4.8	10.7 - 27.3

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Uranium	27.8 ± 2.2	28.9 ± 3.0	23.7 - 34.1
STW-687	WATER	Apr, 1993				
			Beta	141.7 ± 9.0	177.0 ± 27.0	130.2 - 223.8
			Co-60	41.3 ± 1.2	39.0 ± 5.0	30.3 - 47.7
			Cs-134	24.7 ± 1.2	27.0 ± 5.0	18.3 - 35.7
			Cs-137	30.0 ± 0.0	32.0 ± 5.0	23.3 - 40.7
			Sr-89	28.7 ± 9.4	41.0 ± 5.0	32.3 - 49.7
			The EPA report was received 08-16-93. No cause for the low result for Sr-89 was found. The analyst has been observed performing this procedure with no noted descrepancies. Teledyne will continue to monitor this procedure in the future. No further action is anticipated unless conditions warrant.			
			Sr-90	28.0 ± 3.5	29.0 ± 5.0	20.3 - 37.7
STW-688	WATER	Jun, 1993				
			H-3	9613.3 ± 46.2	9844.0 ± 984.0	8136.8 - 11551.2
STW-689	WATER	Jun, 1993				
			Ba-133	101.7 ± 10.3	99.0 ± 10.0	81.7 - 116.3
			Co-60	17.3 ± 4.6	15.0 ± 5.0	6.3 - 23.7
			Cs-134	5.7 ± 1.2	5.0 ± 5.0	0.0 - 13.7
			Cs-137	6.0 ± 2.0	5.0 ± 5.0	0.0 - 13.7
			Ru-106	108.0 ± 8.0	119.0 ± 12.0	98.2 - 139.8
			Zn-65	114.0 ± 13.2	103.0 ± 10.0	85.7 - 120.3
STW-690	WATER	Jul, 1993				
			Sr-89	28.3 ± 2.3	34.0 ± 5.0	25.3 - 42.7
			Sr-90	25.0 ± 1.0	25.0 ± 5.0	16.3 - 33.7
STW-691	WATER	Jul, 1993				
			Alpha	15.0 ± 2.7	15.0 ± 5.0	6.3 - 23.7
			Beta	41.3 ± 4.9	43.0 ± 6.9	31.0 - 55.0
STW-692	WATER	Aug, 1993				
			Uranium	24.9 ± 1.4	25.3 ± 3.0	20.1 - 30.5
STAF-693	AIR FILTER	Aug, 1993				
			Alpha	17.0 ± 1.0	19.0 ± 5.0	10.3 - 27.7
			Beta	47.3 ± 0.6	47.0 ± 5.0	38.3 - 55.7
			Cs-137	10.0 ± 1.0	9.0 ± 5.0	0.3 - 17.7
			Sr-90	19.3 ± 0.6	19.0 ± 5.0	10.3 - 27.7
STW-694	WATER	Sep, 1993				
			Ra-226	15.9 ± 0.7	14.9 ± 2.2	11.1 - 18.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Ra-228	21.0 ± 1.6	20.4 ± 5.1	11.6 - 29.2
STM-695	MILK	Sep, 1993				
			Cs-137	49.0 ± 3.0	49.0 ± 5.0	40.3 - 57.7
			I-131	125.3 ± 4.5	120.0 ± 12.0	99.2 - 140.8
			K	1616.7 ± 37.9	1679.0 ± 84.0	1533.3 - 1824.7
			Sr-89	19.3 ± 1.5	30.0 ± 5.0	21.3 - 38.7
				Report was received 01-18-94; an investigation is underway as to the cause of the low Sr-89 results. In-house spikes have been prepared and the analysis is in progress (see SPM-4848 and SPM-4849 in future reports). There is no apparent cause of the low Sr-89 results. In-house spikes have been prepared and the analysis is in progress. The analyst has been observed performing this procedure with no discrepancies noted. No further action is planned unless the results of the in-house spikes show a problem.		
			Sr-90	22.0 ± 0.0	25.0 ± 5.0	16.3 - 33.7
STW-696	WATER	Oct, 1993				
			I-131	116.7 ± 2.3	117.0 ± 12.0	96.2 - 137.8
STW-697	WATER	Oct, 1993				
			Gr. Alpha	39.7 ± 1.5	40.0 ± 10.0	22.7 - 57.3
			Ra-226	10.6 ± 0.5	9.9 ± 1.5	7.3 - 12.5
			Ra-228	13.2 ± 1.5	12.5 ± 3.1	7.1 - 17.9
			Uranium	15.3 ± 0.6	15.1 ± 3.0	9.9 - 20.3
STW-698	WATER	Oct, 1993				
			Beta	52.0 ± 1.0	58.0 ± 10.0	40.7 - 75.3
			Co-60	10.7 ± 0.6	10.0 ± 5.0	1.3 - 18.7
			Cs-134	10.0 ± 1.0	12.0 ± 5.0	3.3 - 20.7
			Cs-137	12.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			Sr-89	11.3 ± 0.6	15.0 ± 5.0	6.3 - 23.7
			Sr-90	11.0 ± 0.0	10.0 ± 5.0	1.3 - 18.7
STW-699	WATER	Oct, 1993				
			Alpha	18.3 ± 2.5	20.0 ± 5.0	11.3 - 28.7
			Beta	13.7 ± 0.6	15.0 ± 5.0	6.3 - 23.7
STW-700	WATER	Nov, 1993				
			H-3	7310.0 ± 175.2	7398.0 ± 740.0	6114.1 - 8681.9
STW-701	WATER	Nov, 1993				
			Ba-133	75.7 ± 7.6	79.0 ± 8.0	65.1 - 92.9
			Co-60	30.7 ± 2.1	30.0 ± 5.0	21.3 - 38.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
			Cs-134	51.3 ± 5.9	59.0 ± 5.0	50.3 - 67.7
			Cs-137	41.7 ± 1.2	40.0 ± 5.0	31.3 - 48.7
			Ru-106	163.3 ± 3.2	201.0 ± 20.0	166.3 - 235.7
				The report was received on 02-14-94; the cause of the low Ru-106 is under investigation. It should be noted that the grand average of all participants in this analysis was 175.2 pCi/L, with 54% of the participants outside of limits.		
			Zn-65	157.0 ± 8.7	150.0 ± 15.0	124.0 - 176.0

[a] Results obtained by Teledyne Brown Engineering Environmental Services 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, Neveda.

[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.

[c] Unless otherwise indicated, the TBEESML 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 the EPA.

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR Teledyne Results ± 2 Sigma	mR Known Value ± 2 Sigma	mR Average ± 2 Sigma (All Participants)
2nd International Intercomparison						
115-2	CaF_2: Mn Bulb	Apr, 1976				
			Field	17.0 ± 1.9	17.1	16.4 ± 7.7
			Lab	20.8 ± 4.1	21.3	18.8 ± 7.6
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.						
3rd International Intercomparison						
115-3	CaF_2: Mn Bulb	Jun, 1977				
			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
Third International Intercomparison of Environmental Dosimeters conducted in the summer of 1997 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.						
4th International Intercomparison						
115-4	CaF_2: Mn Bulb	Jun, 1979				
			Field	14.1 ± 1.1	14.1 ± 1.4	16.0 ± 9.0
			Lab, High	40.4 ± 1.4	45.8 ± 9.2	43.9 ± 13.2
			Lab, Low	9.8 ± 1.3	12.2 ± 2.4	12.0 ± 7.4
Fourth International Intercomparison of Environmental Dosimeters conducted in the summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas.						
5th International Intercomparison						
115-5A	CaF_2: Mn Bulb	Oct, 1980				
			Field	31.4 ± 1.8	30.0 ± 6.0	30.2 ± 14.6
			Lab, End	96.6 ± 5.8	88.4 ± 8.8	90.7 ± 31.2
			Lab, Start	77.4 ± 5.8	75.2 ± 7.6	75.8 ± 40.4
115-5B	LiF-100 Chips	Oct, 1980				
			Field	30.3 ± 4.8	30.0 ± 6.0	30.2 ± 14.6
			Lab, End	85.4 ± 11.7	88.4 ± 8.8	90.7 ± 31.2
			Lab, Start	81.1 ± 7.4	75.2 ± 7.6	75.8 ± 40.4
Fifth International Intercomparison of Environmental Dosimeters conducted in the 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.						
7th International Intercomparison						
115-7A	LiF-100 Chips	Jun, 1984				
			Field	75.4 ± 2.6	75.8 ± 6.0	75.1 ± 29.8

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR Teledyne Results ± 2 Sigma	mR Known Value ± 2 Sigma	mR Average ± 2 Sigma (All Participants)
			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
115-7B	CaF_2: Mn Bulb	Jun, 1984				
			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	Jun, 1984				
			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

Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Neveda, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency. Teledyne did not participate in the Sixth International Intercomparison of Environmental Dosimeters.

8th International Intercomparison

115-8A	LiF-100 Chips	Jan, 1986				
			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 ± 9.1
			Lab, Cs-137	13.7 ± 0.9	17.2 ± 0.9	16.2 ± 6.8
115-8B	CaF_2: Mn Bulb	Jan, 1986				
			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	Jan, 1986				
			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

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.

10th International Intercomparison

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR Teledyne Results ± 2 Sigma	mR Known Value ± 2 Sigma	mR Average ± 2 Sigma (All Participants)
115-10A	LiF-100 Chips	Aug, 1993				
			Field	25.7 ± 1.4	27.0 ± 1.6	26.4 ± 10.2
			Lab	22.7 ± 1.6	25.9 ± 1.3	25.0 ± 9.4
			Lab	62.7 ± 2.6	72.7 ± 1.9	69.8 ± 20.3
115-10B	$CaSO_4$:Dy Cards	Aug, 1993				
			Field	26.0 ± 2.3	27.0 ± 1.6	26.4 ± 10.2
			Lab	24.1 ± 1.7	25.9 ± 1.3	25.0 ± 9.4
			Lab	69.2 ± 3.0	72.7 ± 1.9	69.8 ± 20.3

Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho State University and sponsored by the U.S. Department of Energy and the Idaho State University. The Ninth International Intercomparison of Environmental Dosimeters was not available to Teledyne's Midwest Laboratory.

Teledyne Testing

89-1	LiF-100 Chips	Sep, 1989				
			Lab	21.0 ± 0.4	22.4	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. in September, 1989

89-2	Teledyne $CaSO_4$:Dy Cards	Nov, 1989				
			Lab	20.9 ± 1.0	20.3	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. in November, 1989.

90-1	Teledyne $CaSO_4$:Dy Cards	Jun, 1990				
			Lab	20.6 ± 1.4	19.6	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on June 19, 1990.

90-2	Teledyne $CaSO_4$:Dy Cards	Sep, 1990				
			Lab	100.8 ± 4.3	100.0	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Dosimetry Associates, Inc., Northville, MI on October 30, 1990.

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR Teledyne Results ± 2 Sigma	mR Known Value ± 2 Sigma	mR Average ± 2 Sigma (All Participants)
91-1	Teledyne $CaSO_4$:Dy Cards	Oct, 1990				
			Lab 1	33.4 ± 2.0	32.0	ND
			Lab 2	55.2 ± 4.7	58.8	ND
			Lab 3	87.8 ± 6.2	85.5	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on October 8, 1991.						
92-1	LiF-100 Chips	Feb, 1992				
			Lab 1	11.1 ± 0.2	10.7	ND
			Lab 2	25.6 ± 0.5	25.4	ND
			Lab 3	46.4 ± 0.5	46.3	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on February 26, 1992.						
92-2	Teledyne $CaSO_4$:Dy Cards	Apr, 1992				
			Reader 1, #1	20.1 ± 0.1	20.1	ND
			Reader 1, #2	40.6 ± 0.1	40.0	ND
			Reader 1, #3	60.0 ± 1.3	60.3	ND
			Reader 2, #1	20.3 ± 0.3	20.1	ND
			Reader 2, #2	39.2 ± 0.3	40.0	ND
			Reader 2, #3	60.7 ± 0.4	60.3	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on April 1, 1992.						
93-1	Teledyne LiF-100 Chips	Mar, 1993				
			Lab 1	10.0 ± 1.0	10.2	ND
			Lab 2	25.5 ± 2.2	25.5	ND
			Lab 3	42.7 ± 5.7	45.9	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards and Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on March 10, 1993. Due to a potential error of 10-12% when cards where irradiated, results of the testing on the cards will not be published. Data is available upon request.						

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCMI-26	MILK	Jan, 1990				
			Cs-134	19.3 ± 1.0	20.8	10.8 - 30.8
			Cs-137	25.2 ± 1.2	22.8	12.8 - 32.8
QCMI-27	MILK	Feb, 1990				
			Sr-90	18.0 ± 1.6	18.8	8.8 - 28.8
QCMI-28	MILK	Mar, 1990				
			I-131	63.8 ± 2.2	62.6	50.1 - 75.1
QCMI-29	MILK	Apr, 1990				
			Cs-134	18.3 ± 1.0	19.7	9.7 - 29.7
			Cs-137	20.3 ± 1.0	18.2	8.2 - 28.2
			I-131	90.7 ± 9.2	82.5	66.0 - 99.0
QCW-61	WATER	Apr, 1990				
			Sr-89	17.9 ± 5.5	23.1	13.1 - 33.1
			Sr-90	19.4 ± 2.5	23.5	13.5 - 33.5
QCW-62	WATER	Apr, 1990				
			Co-60	8.7 ± 0.4	9.4	0.0 - 19.4
			Cs-134	20.0 ± 0.2	19.7	9.7 - 29.7
			Cs-137	28.7 ± 1.4	22.7	12.7 - 32.7
QCW-63	WATER	Apr, 1990				
			I-131	63.5 ± 8.0	66.0	52.8 - 79.2
QCW-64	WATER	Apr, 1990				
			H-3	1941.0 ± 130.0	1826.0	1141.5 - 2510.5
QCW-65	WATER	Jun, 1990				
			Ra-226	6.4 ± 0.2	6.9	4.8 - 9.0
QCW-66	WATER	Jun, 1990				
			Uranium	6.2 ± 0.2	6.0	3.6 - 8.4
QCMI-30	MILK	Jul, 1990				
			Cs-134	46.0 ± 1.3	49.0	39.0 - 59.0
			Cs-137	27.6 ± 1.3	25.3	15.3 - 35.3
			Sr-89	12.8 ± 0.4	18.4	8.4 - 28.4
			Sr-90	18.2 ± 1.4	18.7	8.7 - 28.7
QCW-68	WATER	Jul, 1990				
			Gr. Alpha	9.8 ± 0.3	10.6	0.6 - 20.6
			Gr. Beta	11.4 ± 0.6	11.3	1.3 - 21.3
QCMI-31	MILK	Aug, 1990				
			I-131	68.8 ± 1.6	61.4	49.1 - 73.7

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCW-69	WATER	Sep, 1990				
			Sr-89	17.7 ± 1.6	19.2	9.2 - 29.2
			Sr-90	13.9 ± 1.6	17.4	7.4 - 27.4
QC MI-32	MILK	Oct, 1990				
			Cs-134	25.8 ± 1.2	27.3	17.3 - 37.3
			Cs-137	25.3 ± 2.0	22.4	12.4 - 32.4
			I-131	34.8 ± 0.2	32.4	20.4 - 44.4
QCW-70	WATER	Oct, 1990				
			H-3	2355.0 ± 59.0	2276.0	1577.3 - 2974.7
QCW-71	WATER	Oct, 1990				
			I-131	55.9 ± 0.9	51.8	39.8 - 63.8
QCW-73	WATER	Oct, 1990				
			Co-60	18.3 ± 2.7	16.8	6.8 - 26.8
			Cs-134	28.3 ± 2.3	27.0	17.0 - 37.0
			Cs-137	22.7 ± 1.3	22.4	12.4 - 32.4
QCW-74	WATER	Dec, 1990				
			Gr. Alpha	21.4 ± 1.0	26.1	13.1 - 39.2
			Gr. Beta	25.9 ± 1.0	22.3	12.3 - 32.3
QCMI-33	MILK	Jan, 1991				
			Cs-134	22.2 ± 1.7	19.6	9.6 - 29.6
			Cs-137	26.1 ± 1.6	22.3	12.3 - 32.3
			Sr-89	20.7 ± 3.3	21.6	11.6 - 31.6
			Sr-90	19.0 ± 1.4	23.0	13.0 - 33.0
QCMI-34	MILK	Feb, 1991				
			I-131	40.7 ± 1.8	40.1	28.1 - 52.1
QCW-75	WATER	Mar, 1991				
			Sr-89	18.8 ± 1.5	23.3	13.3 - 33.3
			Sr-90	16.0 ± 0.8	17.2	7.2 - 27.2
QCMI-35	MILK	Apr, 1991				
			Cs-134	19.2 ± 2.0	22.6	12.6 - 32.6
			Cs-137	22.8 ± 2.2	22.1	12.1 - 32.1
			I-131	48.0 ± 0.8	49.2	37.2 - 61.2
QCW-76	WATER	Apr, 1991				
			I-131	56.5 ± 1.7	59.0	47.2 - 70.8
QCW-77	WATER	Apr, 1991				
			Co-60	16.4 ± 2.2	15.7	5.7 - 25.7

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
			Cs-134	23.8 ± 2.5	22.6	12.6 - 32.6
			Cs-137	25.0 ± 2.4	21.1	11.1 - 31.1
QCW-78	WATER	Apr, 1991				
			H-3	4027.0 ± 188.0	4080.0	3264.0 - 4896.0
QCW-79	WATER	Jun, 1991				
			Gr. Alpha	7.4 ± 0.7	7.8	0.0 - 17.8
			Gr. Beta	11.0 ± 0.7	11.0	1.0 - 21.0
SPM-36	MILK	Jul, 1991				
			Cs-137	34.3 ± 3.0	35.1	25.1 - 45.1
			I-131	14.4 ± 1.9	18.3	6.3 - 30.3
			Sr-89	28.1 ± 2.1	34.0	24.0 - 44.0
			Sr-90	11.6 ± 0.7	11.5	1.5 - 21.5
QCMI-37	MILK	Oct, 1991				
			Cs-134	22.7 ± 2.8	22.1	12.1 - 32.1
			Cs-137	38.3 ± 3.0	35.1	25.1 - 45.1
			I-131	23.6 ± 3.2	25.8	13.8 - 37.8
QCW-80	WATER	Oct, 1991				
			Sr-89	27.4 ± 6.9	24.4	14.4 - 34.4
			Sr-90	11.7 ± 1.4	14.1	4.1 - 24.1
QCW-81	WATER	Oct, 1991				
			I-131	19.1 ± 0.7	20.6	8.6 - 32.6
QCW-82	WATER	Oct, 1991				
			Co-60	22.6 ± 2.7	22.1	12.1 - 32.1
			Cs-134	15.5 ± 1.8	17.6	7.6 - 27.6
			Cs-137	17.5 ± 2.1	17.6	7.6 - 27.6
QCW-83	WATER	Oct, 1991				
			H-3	4639.0 ± 137.0	4382.0	3505.6 - 5258.4
QCW-84	WATER	Dec, 1991				
			Gr. Alpha	6.2 ± 6.0	7.8	0.0 - 17.8
			Gr. Beta	11.0 ± 0.7	11.0	1.0 - 21.0
QCMI-39	MILK	Jan, 1992				
			Cs-134	42.1 ± 5.7	49.4	39.4 - 59.4
			Cs-137	55.2 ± 6.4	53.0	43.0 - 63.0
			I-131	76.8 ± 0.9	83.7	67.0 - 100.4
			Sr-89	21.6 ± 6.5	31.2	21.2 - 41.2
			Sr-90	38.7 ± 1.8	42.3	33.8 - 50.8

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCW-85	WATER	Mar, 1992				
			Sr-89	26.2 ± 3.1	32.0	22.0 - 42.0
			Sr-90	24.4 ± 1.4	28.0	18.0 - 38.0
QCMI-40	MILK	Apr, 1992				
			Cs-134	58.0 ± 2.6	55.9	45.9 - 65.9
			Cs-137	43.7 ± 3.0	38.9	28.9 - 48.9
QCMI-41	MILK	Apr, 1992				
			I-131	50.3 ± 0.8	55.9	44.7 - 67.1
QCW-86	WATER	Apr, 1992				
			H-3	4080.0 ± 190.0	4027.0	3221.6 - 4832.4
QCW-87	WATER	Apr, 1992				
			I-131	33.5 ± 0.6	33.2	21.2 - 45.2
QCW-88	WATER	Apr, 1992				
			Co-60	17.5 ± 2.7	19.7	9.7 - 29.7
			Cs-134	28.9 ± 2.5	33.5	23.5 - 43.5
			Cs-137	41.0 ± 3.0	38.9	28.9 - 48.9
QCW-89	WATER	Jun, 1992				
			Gr. Alpha	15.3 ± 0.8	13.6	3.6 - 23.6
			Gr. Beta	17.2 ± 0.9	17.6	7.6 - 27.6
QCMI-42	MILK	Aug, 1992				
			Cs-134	20.1 ± 2.8	20.2	10.2 - 30.2
			Cs-137	26.2 ± 2.7	26.1	16.1 - 36.1
			Sr-89	41.4 ± 5.9	51.2	41.0 - 61.4
			Sr-90	48.9 ± 2.5	51.9	41.5 - 62.3
QCW-90	WATER	Sep, 1992				
			Sr-89	6.7 ± 3.4	12.6	2.6 - 22.6
			Sr-90	16.1 ± 1.4	15.6	5.6 - 25.6
QCMI-43	MILK	Oct, 1992				
			Cs-134	14.2 ± 3.4	12.7	2.7 - 22.7
			Cs-137	14.1 ± 5.2	17.1	7.1 - 27.1
			I-131	19.9 ± 1.0	21.5	9.5 - 33.5
QCMI-44	MILK	Oct, 1992				
			Cs-134	28.2 ± 4.0	25.4	15.4 - 35.4
			Cs-137	38.8 ± 5.1	34.2	24.2 - 44.2
			I-131	36.1 ± 1.2	43.0	31.0 - 55.0

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCW-91	WATER	Oct, 1992				
			I-131	34.9 ± 2.2	34.9	22.9 - 46.9
QCW-92	WATER	Oct, 1992				
			Co-60	11.4 ± 1.9	9.2	0.0 - 19.2
			Cs-134	18.7 ± 2.3	14.3	4.3 - 24.3
			Cs-137	14.1 ± 1.8	15.0	5.0 - 25.0
QCW-93	WATER	Oct, 1992				
			H-3	3704.0 ± 186.0	3904.0	3169.2 - 4638.8
QCW-94	WATER	Oct, 1992				
			H-3	14925.0 ± 339.0	15616.0	12492.8 - 18739.2
QCW-95	WATER	Oct, 1992				
			I-131	64.2 ± 2.7	67.2	53.8 - 80.6
QCW-36	WATER	Dec, 1992				
			Alpha	11.5 ± 2.3	15.2	9.1 - 21.3
			Beta	26.5 ± 2.0	25.7	15.4 - 36.0
QCW-96	WATER	Dec, 1992				
			Gr. Alpha	8.3 ± 0.6	10.4	0.4 - 20.4
			Gr. Beta	19.8 ± 1.5	20.6	10.6 - 30.6
SPM-3341	MILK	Jan, 1993				
			Cs-134	17.1 ± 2.0	21.3	11.3 - 31.3
			Cs-137	21.4 ± 2.0	23.8	13.8 - 33.8
			Sr-89	6.7 ± 3.1	8.7	0.0 - 18.7
			Sr-90	20.0 ± 1.2	19.2	9.2 - 29.2
SPM-3387	MILK	Feb, 1993				
			I-131	72.5 ± 8.4	71.5	57.2 - 85.8
SPVE-3401	VEGETATION (SAW DUST)	Feb, 1993				
			I-131	994.5 ± 53.2	953.7	763.0 - 1144.4
SPCH-3402	CHARCOAL	Feb, 1993				
			I-131	95.2 ± 12.8	95.4	76.3 - 114.5
SPW-3434	WATER	Apr, 1993				
			Gr. Alpha	10.4 ± 1.8	10.4	0.4 - 20.4
			Gr. Beta	22.0 ± 2.0	20.6	10.6 - 30.6
SPW-3556	WATER	Apr, 1993				
			Sr-89	18.2 ± 5.0	22.2	12.2 - 32.2
			Sr-90	20.1 ± 1.8	17.0	7.0 - 27.0

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-3597	WATER	Apr, 1993				
			H-3	5464.0 ± 219.0	5428.0	4342.4 - 6513.6
SPW-3599	WATER	Apr, 1993				
			I-131	149.8 ± 1.9	145.0	116.0 - 174.0
SPW-3606	WATER	Apr, 1993				
			Co-60	24.8 ± 2.3	21.5	11.5 - 31.5
			Cs-134	26.4 ± 1.9	26.4	16.4 - 36.4
			Cs-137	33.9 ± 2.6	31.7	21.7 - 41.7
SPM-3631	MILK	Apr, 1993				
			Cs-134	48.8 ± 2.9	52.8	42.8 - 62.8
			Cs-137	65.2 ± 2.9	63.4	53.4 - 73.4
			I-131	139.8 ± 1.6	145.0	116.0 - 174.0
SPF-3681	FISH (JELLO)	May, 1993				
			Cs-137	68.2 ± 7.7	67.6	57.6 - 77.6
			Concentrations are in pCi/Total Volume (550g).			
SPW-3842	WATER	Jun, 1993				
			Th-230	4.2 ± 0.5	4.5	2.7 - 6.3
SPW-4160	WATER	Jun, 1993				
			Alpha	8.9 ± 1.4	12.9	7.7 - 18.1
			Beta	22.0 ± 1.9	31.9	19.1 - 44.7
SPW-4232	WATER	Aug, 1993				
			Fe-55	1684.0 ± 415.0	1420.0	1136.0 - 1704.0
SPW-4246	WATER	Aug, 1993				
			Sr-90	32.2 ± 2.6	30.4	24.3 - 36.5
SPM-4247	MILK	Aug, 1993				
			Sr-89	29.1 ± 4.9	35.4	25.4 - 45.4
			Sr-90	18.3 ± 1.3	19.2	9.2 - 29.2
SPW-4248	WATER	Aug, 1993				
			H-3	9910.0 ± 300.0	10430.0	8344.0 - 12516.0
SPW-4250	WATER	Aug, 1993				
			Co-60	247.0 ± 23.1	247.7	222.9 - 272.5
			Cs-134	141.6 ± 15.9	141.1	127.0 - 155.2

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
			Cs-137	283.5 ± 27.8	247.2	222.5 - 271.9
			The cause of the high Cs-137 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing this analysis and no deviations from the procedure where observed. The employee's results have been good in the past; no further action is planned.			
SPF-4251	FISH (JELLO)	Aug, 1993				
			Cs-134	68.8 ± 3.3	75.3	65.3 - 85.3
			Cs-137	203.6 ± 8.2	198.1	178.3 - 217.9
SPS-4262	SEDIMENT (BOTTOM)	Aug, 1993				
			Cs-134	74.1 ± 9.9	71.0	61.0 - 81.0
			Cs-137	212.4 ± 14.8	197.8	178.0 - 217.6
SPW-4377	WATER	Sep, 1993				
			I-131	39.0 ± 10.0	42.1	30.1 - 54.1
SPM-4378	MILK	Sep, 1993				
			I-131	44.5 ± 5.5	42.1	30.1 - 54.1
SPCH-4379	CHARCOAL	Sep, 1993				
			I-131	90.3 ± 13.5	84.3	67.4 - 101.2
SPVE-4380	VEGETATION (SAW DUST)	Sep, 1993				
			I-131	193.2 ± 20.0	170.2	136.2 - 204.2
SPW-4381	WATER	Sep, 1993				
			Sr-89	21.9 ± 4.0	28.8	18.8 - 38.8
			Sr-90	19.5 ± 1.8	19.0	9.0 - 29.0
SPW-4382	WATER	Sep, 1993				
			I-129	18.1 ± 1.0	18.6	6.6 - 30.6
SPW-4421	WATER	Oct, 1993				
			H-3	16900.0 ± 368.0	17380.0	13904.0 - 20856.0
SPW-4428	WATER	Oct, 1993				
			Co-60	19.3 ± 3.1	18.3	8.3 - 28.3
			Cs-134	31.5 ± 3.3	33.5	23.5 - 43.5
			Cs-137	44.4 ± 3.6	43.2	33.2 - 53.2
SPM-4426	MILK	Oct, 1993				
			Cs-134	30.8 ± 4.5	33.0	23.0 - 43.0
			Cs-137	43.4 ± 6.0	43.2	33.2 - 53.2
			I-131	49.7 ± 8.6	44.5	32.5 - 56.5

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-4427	WATER	Oct, 1993				
			I-131	95.2 ± 10.6	88.9	71.1 - 106.7

[a] All results are in pCi/L, except elemental potassium (K) data in milk, which are in mg/L.; air filter samples, which are in pCi/Filter; charcoal which are in pCi/charcoal; and food products which are in mg/kg.

[b] All samples prior to January 1991 are the results or three determinations; after January 1991, all determinations are single.

[c] Control Limits are based on EPA publication; "Environmental Radioactive Laboratory Intercomparison Studies Program", Fiscal Year 1981-1982, EPA-600/4-81-004 (see Attachment A) or limits imposed by Teledyne's Midwest Laboratory.

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPW-8039	WATER	Jan 1990				
			Ra-226	< 0.2		< 1.0
SPM-8040	MILK	Jan 1990				
			Sr-89	< 0.8		< 5.0
			Sr-90	< 1.0		< 1.0
SPM-8208	MILK	Jan 1[illegible]				
			Cs-134	< 3.6		< 10.0
			Cs-137	< 4.7		< 10.0
			Sr-89	< 0.8		< 5.0
			Sr-90	N/A	1.6 ± 0.5	< 1.0
			Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			
SPM-8312	MILK	Feb 1990				
			Sr-89	< 0.3		< 5.0
			Sr-90	N/A	1.2 ± 0.3	< 1.0
			Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			
SPW-8312	WATER	Feb 1990				
			Sr-89	< 0.6		< 5.0
			Sr-90	< 0.7		< 1.0
SPM-8314	MILK	Mar 1990				
			I-131	< 0.3		< 1.0
SPM-8510	MILK	May 1990				
			Cs-134	< 4.6		< 10.0
			Cs-137	< 4.8		< 10.0
			I-131	< 0.2		< 1.0
SPW-8511	WATER	May 1990				
			H-3	< 200.0		< 300.0
SPM-8600	MILK	Jul 1990				
			Cs-134	< 5.0		< 10.0
			Cs-137	< 7.0		< 10.0
			I-131	< 0.3		< 1.0
			Sr-89	< 0.8		< 5.0
			Sr-90	N/A	1.7 ± 0.6	< 1.0
			Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPM-8877	MILK	Aug 1990				
			I-131	< 0.2		< 1.0
SPW-8925	WATER	Aug 1990				
			H-3	< 200.0		< 300.0
SPW-8926	WATER	Aug 1990				
			Gr. Alpha	< 0.3		< 1.0
			Gr. Beta	< 0.7		< 5.0
SPW-8927	WATER	Aug 1990				
			U-234	< 0.01		< 1.0
			U-235	< 0.02		< 1.0
			U-238	< 0.01		< 1.0
SPW-8928	WATER	Aug 1990				
			Co-58	< 4.1		< 10.0
			Co-60	< 2.4		< 10.0
			Cs-134	< 3.3		< 10.0
			Cs-137	< 3.7		< 10.0
			Mn-54	< 4.0		< 10.0
SPW-8929	WATER	Aug 1990				
			Sr-89	< 1.4		< 5.0
			Sr-90	< 0.6		< 1.0
SPW-69	WATER	Sep 1990				
			Sr-89	< 1.8		< 5.0
			Sr-90	< 0.8		< 1.0
SPW-106	WATER	Oct 1990				
			H-3	< 180.0		< 300.0
			I-131	< 0.3		< 1.0
SPM-107	MILK	Oct 1990				
			Cs-134	< 3.3		< 10.0
			Cs-137	< 4.3		< 10.0
			I-131	< 0.4		< 1.0
SPW-370	WATER	Oct 1990				
			Co-58	< 2.6		< 10.0
			Co-60	< 1.6		< 10.0
			Cs-134	< 1.7		< 10.0
			Cs-137	< 1.8		< 10.0

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
			Mn-54	< 1.7		< 10.0
SPW-372	WATER	Dec 1990				
			Gr. Alpha	< 0.3		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-406	MILK	Jan 1991				
			Cs-134	< 3.7		< 10.0
			Cs-137	< 5.2		< 10.0
			Sr-89	< 0.4		< 5.0
			Sr-90	N/A	1.8 ± 0.4	< 1.0
			Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			
SPM-421	MILK	Feb 1991				
			I-131	< 0.3		< 1.0
SPM-451	MILK	Feb 1991				
			Ra-226	< 0.1		< 1.0
			Ra-228	< 0.9		< 1.0
SPW-514	WATER	Mar 1991				
			Sr-89	< 1.1		< 5.0
			Sr-90	< 0.9		< 1.0
SPW-586	WATER	Apr 1991				
			Co-60	< 2.5		< 10.0
			Cs-134	< 2.4		< 10.0
			Cs-137	< 2.2		< 10.0
			I-131	< 0.2		< 1.0
SPM-587	MILK	Apr 1991				
			Cs-134	< 1.7		< 10.0
			Cs-137	< 1.9		< 10.0
			I-131	< 0.2		< 1.0
SPW-837	WATER	Jun 1991				
			Gr. Alpha	< 0.6		< 1.0
			Gr. Beta	< 1.1		< 5.0
SPM-953	MILK	Jul 1991				
			Cs-137	< 4.9		< 10.0
			I-131	< 0.2		< 1.0
			Sr-89	< 0.7		< 5.0

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
			Sr-90	N/A	0.4 ± 0.3	< 1.0
			Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			
SPM-1236	MILK	Oct 1991				
			Cs-134	< 3.7		< 10.0
			Cs-137	< 4.6		< 10.0
			I-131	< 0.2		< 1.0
SPW-1254	WATER	Oct 1991				
			Sr-89	< 2.8		< 5.0
			Sr-90	< 0.7		< 1.0
SPW-1256	WATER	Oct 1991				
			Co-60	< 3.6		< 10.0
			Cs-134	< 4.0		< 10.0
			Cs-137	< 3.0		< 10.0
			I-131	< 0.4		< 1.0
SPW-1259	WATER	Oct 1991				
			H-3	< 160.0		< 300.0
SPW-1444	WATER	Dec 1991				
			Gr. Alpha	< 0.4		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-1578	MILK	Jan 1992				
			Cs-134	< 7.2		< 10.0
			Cs-137	< 8.0		< 10.0
			I-131	< 0.2		< 1.0
			Sr-89	< 0.5		< 5.0
			Sr-90	N/A	1.3 ± 0.4	< 1.0
			Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			
SPW-1860	WATER	Mar 1992				
			Sr-89	< 0.6		< 5.0
			Sr-90	< 0.4		< 1.0
SPW-2067	WATER	Apr 1992				
			H-3	< 168.0		< 300.0
SPW-2114	WATER	Apr 1992				
			C-14	< 1.0		< 200.0

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

Lab Code	Sample Type	Sampl. Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPM-2119	MILK	Apr 1992				
			Co-60	< 6.3		< 10.0
			Cs-134	< 4.5		< 10.0
			Cs-137	< 5.4		< 10.0
SPW-2126	WATER	Apr 1992				
			I-131	< 0.2		< 1.0
SPM-2133	MILK	Apr 1992				
			I-131	< 0.2		< 1.0
SPW-2220	WATER	May 1992				
			Co-60	< 2.1		< 10.0
			Cs-134	< 2.1		< 10.0
			Cs-137	< 2.3		< 10.0
SPW-2369	WATER	Jun 1992				
			Gr. Alpha	< 0.4		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-2500	MILK	Aug 1992				
			I-131	< 0.4		< 1.0
			Sr-89	< 1.2		< 5.0
			Sr-90	< 0.9		< 1.0
SPW-2666	WATER	Sep 1992				
			Sr-89	< 0.8		< 5.0
			Sr-90	< 0.5		< 1.0
SPW-2828	WATER	Oct 1992				
			Co-60	< 4.8		< 10.0
			Activity result is not available for this sample.			
			Cs-134	< 6.0		< 10.0
			Activity result is not available for this sample.			
			Cs-137	< 6.1		< 10.0
			Activity result is not available for this sample.			
			H-3	< 177.0		< 300.0
			I-131	< 0.3		< 1.0
			Activity result is not available for this sample.			
SPM-2829	MILK	Oct 1992				
			Co-60	< 9.3		< 10.0
			Cs-134	< 6.4		< 10.0
			Cs-137	< 7.2		< 10.0

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPW-3212	WATER	Oct 1992				
			Ra-228	< 1.0		< 1.0
SPW-3057	WATER	Nov 1992				
			Ra-226	< 0.03		< 1.0
SPW-3294	WATER	Dec 1992				
			Gr. Alpha	< 0.4		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-3342	MILK	Jan 1993				
			Cs-134	< 4.1	-0.9 ± 2.6	< 10.0
			Activity result is not available for this sample.			
			Cs-137	< 3.9	0.8 ± 2.2	< 10.0
			Activity result is not available for this sample.			
			Sr-89	< 0.7	-0.9 ± 1.1	< 5.0
			Sr-90	N/A	1.6 ± 0.5	< 1.0
			Low levels of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			
SPM-3386	MILK	Feb 1993				
			I-131	< 0.2	0.1 ± 0.1	< 1.0
SPW-3557	WATER	Mar 1993				
			Sr-89	< 0.5	0.3 ± 0.5	< 5.0
			Sr-90	< 0.5	0.1 ± 0.2	< 1.0
SPW-3598	WATER	Apr 1993				
			H-3	< 180.0	84.7 ± 94.2	< 300.0
SPW-3600	WATER	Apr 1993				
			I-131	< 0.2	0.1 ± 0.2	< 1.0
SPW-3601	WATER	Apr 1993				
			Co-60	< 4.2		< 10.0
			Activity result is not available for this sample.			
			Cs-134	< 4.4		< 10.0
			Activity result is not available for this sample.			
			Cs-137	< 3.4		< 10.0
			Activity result is not available for this sample.			
			I-131	< 0.4	0.3 ± 0.9	< 1.0
SPM-3651	MILK	May 1993				
			Cs-134	< 4.4		< 10.0
			Activity result is not available for this sample.			

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
			Cs-137	< 6.3		< 10.0
			Activity result is not available for this sample.			
			I-131	< 0.2	0.1 ± 0.1	< 1.0
SPFP-3680	FOOD	May 1993				
			Cs-137	< 6.5	0.0 ± 0.0	< 10.0
SPW-3844	WATER	Jun 1993				
			Th-228	< 0.1	0.0 ± 0.1	< 1.0
			Th-230	< 0.1	0.2 ± 0.1	< 1.0
			Th-232	< 0.1	0.0 ± 0.0	< 1.0
SPW-4234	WATER	Jun 1993				
			Gr. Alpha	< 0.3	0.0 ± 0.2	< 1.0
			Gr. Beta	< 0.8	0.2 ± 0.3	< 5.0
SPS-4059	SEDIMENT (BOTTOM)	Jul 1993				
			Cs-134	< 5.0	0.0 ± 0.0	< 10.0
			Cs-137	< 7.2	0.0 ± 0.0	< 10.0
SPVE-4060	VEGETATION (SAW DUST)	Jul 1993				
			Cs-134	< 4.8	0.0 ± 0.0	< 10.0
			Cs-137	< 6.4	0.0 ± 0.0	< 10.0
			I-131(g)	< 13.5	0.0 ± 0.0	< 20.0
SPM-4061	MILK	Jul 1993				
			Cs-134	< 8.6	0.0 ± 0.0	< 10.0
			Cs-137	< 5.8	0.0 ± 0.0	< 10.0
SPM-4062	MILK	Jul 1993				
			Cs-134	< 3.8	1.5 ± 1.5	< 10.0
			Cs-137	< 4.4	-1.6 ± 3.3	< 10.0
SPW-4063	WATER	Jul 1993				
			Co-60	< 4.0	1.2 ± 2.3	< 10.0
			Cs-134	< 3.7	0.3 ± 1.2	< 10.0
			Cs-137	< 3.2	0.4 ± 3.2	< 10.0
SPAP-4064	AIR FILTER (COMPOSITE)	Jul 1993				
			Cs-134	< 2.1	0.0 ± 0.0	< 10.0
			Cs-137	< 2.8	0.0 ± 0.0	< 10.0

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPCH-406	CHARCOAL	Jul 1993				
			I-131	< 0.1	0.0 ± 0.0	< 1.0
			Based on a volume of 300 m^3			
SPW-4233	WATER	Aug 1993				
			Fe-55	< 506.0	0.0 ± 0.3	< 1000.0
SPM-4235	MILK	Aug 1993				
			Cs-134	< 8.1	1.6 ± 1.8	< 10.0
			Cs-137	< 4.2	-1.7 ± 3.4	< 10.0
			I-131	< 0.1	0.0 ± 0.2	< 1.0
			Sr-89	< 0.8	-1.0 ± 1.1	< 5.0
			Sr-90	N/A	1.8 ± 0.5	< 1.0
			Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.			
SPW-4241	WATER	Aug 1993				
			H-3	< 190.0	72.9 ± 99.1	< 300.0
SPW-4243	WATER	Aug 1993				
			Co-60	< 7.0	0.4 ± 3.1	< 10.0
			Cs-134	< 7.6	0.8 ± 15.6	< 10.0
			Cs-137	< 5.4	-0.7 ± 4.2	< 10.0
			I-131	< 0.5	0.0 ± 0.1	< 1.0
			Sr-89	< 1.1	-0.6 ± 0.9	< 5.0
			Sr-90	< 0.7	0.4 ± 0.4	< 1.0
SPW-4244	WATER	Aug 1993				
			Pu-238	< 1.0	0.4 ± 0.7	< 1.0
			Pu-239/240	< 0.3	0.1 ± 0.2	< 1.0
			Th-228	< 0.4	-0.1 ± 0.3	< 1.0
			Th-230	< 0.1	0.0 ± 0.1	< 1.0
			Th-232	< 0.1	0.0 ± 0.0	< 1.0
			U-233/234	< 0.1	0.1 ± 0.1	< 1.0
			U-235	< 0.1	0.0 ± 0.1	< 1.0
			U-238	< 0.1	0.1 ± 0.1	< 1.0
SPW-4245	WATER	Aug 1993				
			Ra-226	< 0.1	0.0 ± 0.0	< 1.0
			Ra-228	< 0.8	-0.2 ± 0.5	< 1.0
SPW-4422	WATER	Oct 1993				
			H-3	< 180.0	-27.5 ± 88.9	< 300.0

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

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)

[a] All results are in pCi/L, except for air filter samples, which are in pCi/Filter.

[b] Prior to 1993, results where reported as only an LLD, the activity reported is the net activity result.

December, 1993

ATTACHMENT A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

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

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

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

[b] Teledyne limit.

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:

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

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

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
		Gross alpha	30 pCi/L
		Gross beta	100 pCi/L
		Tritium	3×10^6 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, 1993. 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 1993 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 third quarters from the Birch Lake locations (P-31 and P-32) due to high water levels in the lake. The ground seepage sample locations were under water.

2. The Perkin's residence (P-28) had no renters living in the house second quarter, so the water sample was unattainable.

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 a few Suter residence deep well and Birch Lake seepage samples, most of the 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. In 1992, the underground liquid discharge pipe from the plant to the discharge canal piping was replaced with a double walled leak detectable piping system. It is expected that these modifications will eliminate the radioactive effluent flow into the ground water. Overall 1993 sample results show a slight downward trend as compared to 1992 levels.

Table D-4.1 Sample collection and analysis program for special well and surface water samples, Prairie Island Nuclear Generating Plant, 1993.

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 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 = 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, 1993.

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

[a] "C" denotes control location. All other locations are indicators.
[b] Sample codes: 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 Power Station — Docket No. 50-282, 50-306
Location of Facility Goodhue, Minnesota (County, State) — Reporting Period January - December 1993

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean		Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
					Location[d]	Mean (F)[c] Range[c]		
Well Water (pCi/L)	H-3	27	170	293 (10/27) (170-770)	P-24d, Suter's deep well, 0.6 mi @ 158°/SSE	387 (3/4) (230-770)	199	0
Ground Water (pCi/L)	H-3	4	170	573 (3/4) (500-620)	P-32, Birch Lake Seepage #2, 0.7 mi @ 179°/S	560 (2/2) (500,620)	199	0

a H-3 = tritium

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

c Mean and range 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 D-4.2) 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, 1993.

SAMPLE DATES	Feb '93	May '93	Aug '93	Nov '93
SAMPLE LOCATIONS	pCi/L	pCi/L	pCi/L	pCi/L
Suter Residence	770	550	<190	230
Rolh Farm	<170	<187	<193	199
PITC	170	<190	200	<190
Nauer Residence	<170	<190	<190	<190
Perkin Residence	210	--	250	<190
Child Residence	<170	<190	220	<190
Environ Lab	130	<190	<190	<190
Birch Lake Seep 1	600	--	--	<190
Birch Lake Seep 2	620	--	--	500

APPENDIX E

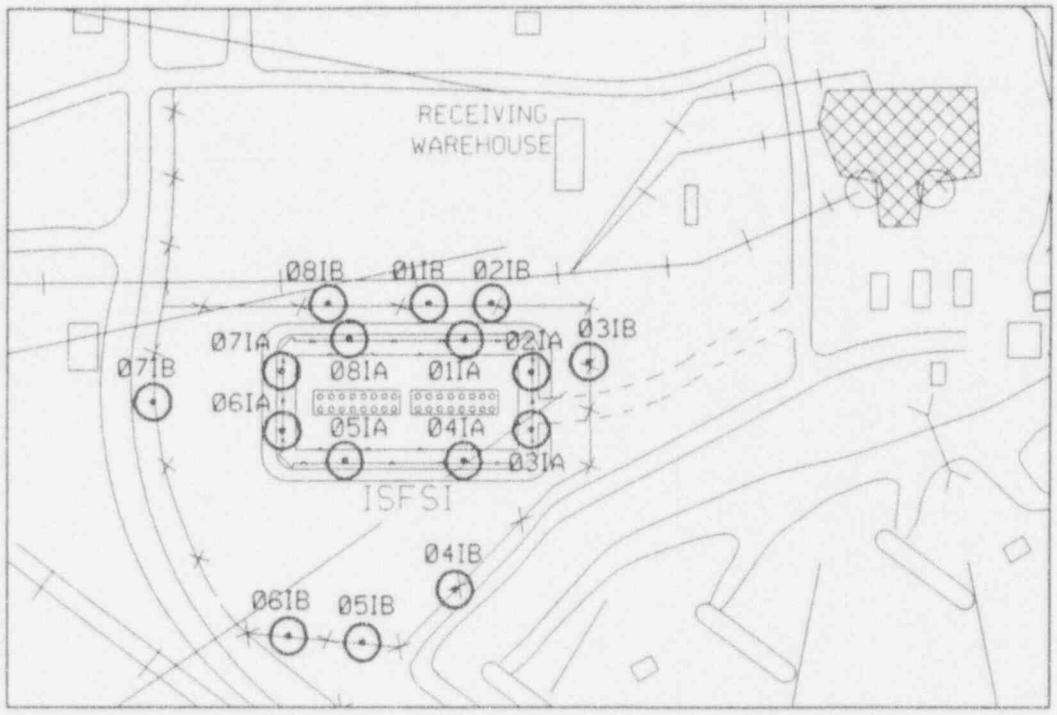
Sampling Location Maps

SITE BOUNDARY TLD LOCATIONS

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

NL-99P1739-1

ISFSI AREA TLD LOCATIONS

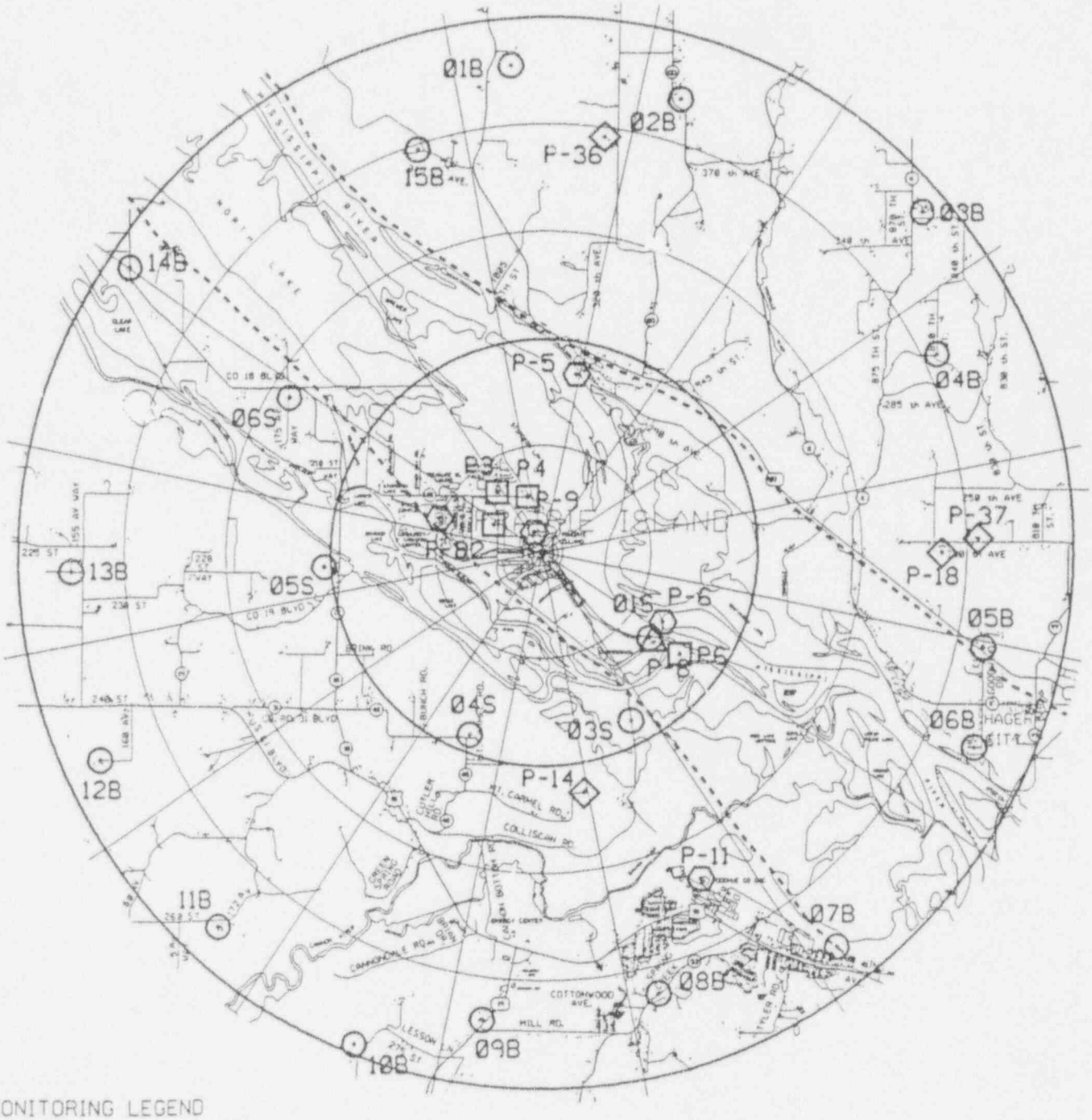


MONITORING LEGEND

⊙ N.S.P. TLD POINTS

NL-ISFSI.DGN

RADIOLOGICAL ENVIRONMENTAL SAMPLE POINTS &TLD POINTS
5 - MILE RADIUS

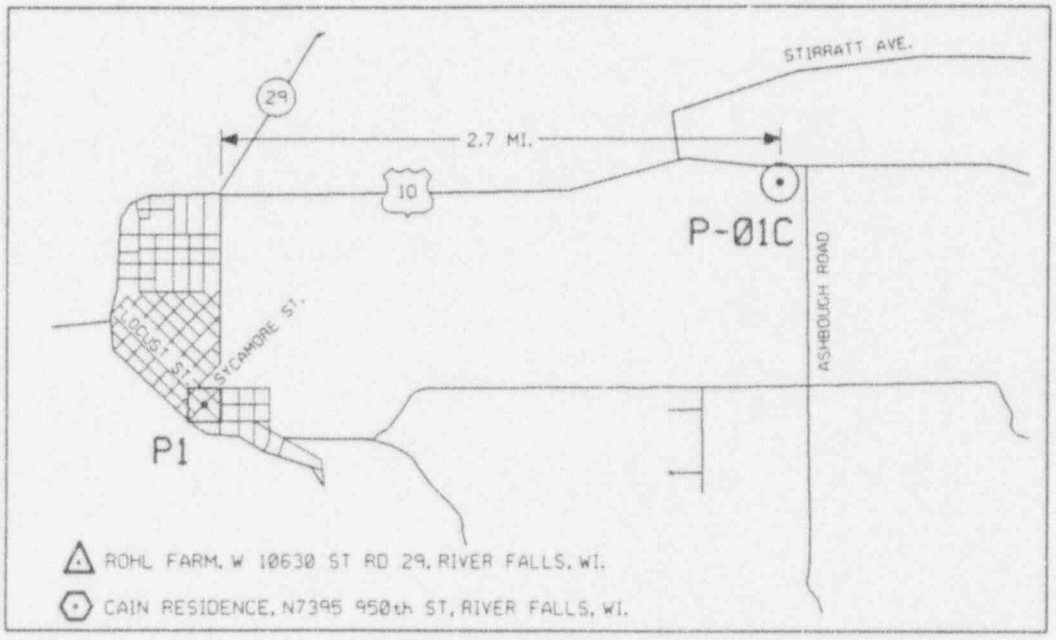


MONITORING LEGEND

- MILK SAMPLING POINT IDENTIFICATION NUMBERS
  P-14, P-18, P-25, P-36, P-37
- AIR SAMPLING POINT IDENTIFICATION NUMBERS
  P-1, P-2, P-3, P-4, P-6
- WATER SAMPLING POINT IDENTIFICATION NUMBERS
  P-5, P-6, P-8, P-9, P-11, P-25
- N.S.P. TLD POINTS

NL-99P1739-2

RADIOLOGICAL ENVIRONMENTAL SAMPLE POINTS
OUTSIDE 10 - MILE RADIUS



CONTROL POINTS
PRESCOTT, WISCONSIN

MONITORING LEGEND

- CULTIVATED CROP SAMPLING POINT
- WATER & MILK SAMPLING POINTS
- N.S.P. TLD POINTS
- N.S.P. AIR MONITORING POINTS

NL-99P1739-3