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Indiana Michigan
Power Company
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INDIANA
MICHIGAN
POWER

AEP:NRC:0806M

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
ANNUAL ENVIRONMENTAL OPERATING REPORT - 1992

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

Attn: T. E. Murley

April 21, 1993

Dear Dr. Murley:

Attached is the Donald C. Cook Nuclear Plant Annual Environmental Operating Report for the year 1992. This report was prepared in accordance with Section 5.4.1 of Appendix B, Part II and Section 6.9.1.6 of Appendix A Technical Specifications of the Donald C. Cook Nuclear Plant.

Sincerely,

E. E. Fitzpatrick
Vice President

edg

Attachment
cc: A. A. Blind - Bridgman
NFEM Section Chief
J. R. Padgett
G. Charnoff
A. B. Davis - Region III Administrator (2 encl.)
NRC Resident Inspector - Bridgman

290027

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Donald C. Cook Nuclear Plant • Units 1 & 2

Annual Environmental Operating Report

January 1, through December 31, 1992

Indiana Michigan Power Company
Bridgman, Michigan

Docket Nos. 50-315 & 50-316
License Nos. DPR-58 & DPR-74

9304290174

TABLE OF CONTENTS

LIST OF APPENDICES

I. INTRODUCTION

Technical Specification Section 6.9.1.6 and Appendix B, Part II, Section 5.4.1 require that an annual report be submitted to the Nuclear Regulatory Commission which details the results and findings of ongoing environmental radiological and non-radiological surveillance programs. This report serves to fulfill these requirements and represents the Annual Environmental Operating Report for Units 1 and 2 of the Donald C. Cook Nuclear Plant for the operating period from January 1, 1992 through December 31, 1992.

During 1992, based on the monthly operating reports for Unit 1 and Unit 2, the annual gross electrical generation, average unit service factors, and capacity factors were:

Parameter	Unit 1	Unit 2
Gross Electrical Generation (MwH)	5,197,600	1,485,880
Unit Service Factor (%)	64.8	19.5
Unit Capacity Factor - MDC* Net (%)	55.7	14.9

* Maximum Dependable Capacity

II. CHANGES TO THE ENVIRONMENTAL TECHNICAL SPECIFICATIONS

There were no environmental Technical Specification changes in 1992.

III. NON-RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

A.1 Plant Design and Operation

During 1992, no instances of noncompliance with the Environmental Protection Plan occurred, nor were there any changes in station design, operations, tests, or experiments which involved a potentially significant unreviewed environmental issue.

There were seven environmental evaluations during the reporting period. Copies of these evaluations are located in Appendix II of this report. The evaluations determined that there were no unreviewed environmental questions.

A.2 Non-Routine Reports

A summary of the 1992 non-routine events is located in Appendix I of this report. No long-term, adverse environmental effects were noted.

A.3 Environmental Protection Plan

There were no instances of Environmental Protection Plan noncompliance in 1992.

A.4 Potentially Significant Unreviewed Environmental Issues

There were no changes in station design, operations, tests or experiments which involved a potentially significant unreviewed environmental issue.

There were seven environmental evaluations during the reporting period. Copies of these evaluations are located in Appendix II of this report. The evaluations determined that there were no unreviewed environmental questions.

B. Environmental Monitoring - Herbicide Application

Technical Specifications Appendix B, Subsection 5.4.1, states that the Annual Environmental Operating Report shall include: summaries and analyses of the results of the environmental protection activities required by Subsection 4.2 of this Environmental Protection Plan for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous non-radiological environmental monitoring reports, and an assessment of the observed impacts of the plant operation on the environment.

Herbicide applications are the activities monitored in accordance with Subsection 4.2. There were no preoperational herbicide studies to which comparisons could be made. Herbicide applications are controlled by plant procedure 12THP6020.ENV.104.

A summary of the 1992 herbicide applications is contained in Appendix III of this report. Based on observations, there were no negative impacts or evidence of trends toward irreversible change to the environment as a result of the herbicide applications. Based on our review of application records and field observations, the applications conformed with EPA and State requirements for the approved use of herbicides.

C. Macrofouler Monitoring and Treatment

Macrofouler studies and activities during 1992 are discussed in Appendix IV of this report.

IV. SOLID, LIQUID, AND GASEOUS RADIOACTIVE WASTE TREATMENT SYSTEMS

There were no changes in the solid, liquid, or gaseous radioactive waste treatment systems during 1992.

V. RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

The Radiological Environmental Monitoring Program annual report is located in Appendix V of this report.

The objectives of the operational radiological environmental monitoring program are:

1. Identify and measure radiation and radioactivity in the plant environs for the calculation of potential dose to the population.

2. Verify the effectiveness of in-plant measures used for controlling the release of radioactive material.

3. Provide reasonable assurance that the predicted doses, based on radiological effluent data, have not been substantially underestimated and are consistent with applicable standards.

4. Comply with regulatory requirements and Station Technical Specifications and provide records to document compliance.

A.1 Changes to the REMP

There were no changes to the REMP during 1992.

A.2 Radiological Impact of Donald C. Cook Nuclear Plant Operations

This report summarizes the collection and analysis of various environmental sample media in 1992 for the Radiological Environmental Monitoring Program for the Donald C. Cook Nuclear Plant.

Analyses of sample media suggest that there were no discernable impacts associated with operation of the Donald C. Cook Nuclear Plant on the environment. The analyses of air particulate filters, charcoal cartridges, direct radiation by thermoluminescent dosimeters, samples of

fish, water, and sediment from Lake Michigan, drinking water, milk, and food products, either did not detect any radioactivity or measured only naturally occurring radionuclides at normal background levels.

B. Land Use Census and Well Report

The Land Use Census is performed to ensure that significant changes in the immediate vicinity of the Donald C. Cook Nuclear Plant are identified. Any identified changes are evaluated to determine whether a modification must be made to the REMP or other related programs. No such changes were identified during the 1992 Land Use Census. A further discussion of the Land Use Census can be found in Appendix V (F) of this report.

VI. CONCLUSION

Based upon the results of the radiological environmental monitoring program and the radioactive effluent release reports for the 1992 reporting year, it can be concluded that there were no adverse affects to the environment or to the general public due to the operation of the Donald C. Cook Nuclear Plant.

APPENDIX I

NON-ROUTINE REPORTS

1992

1992 Non-Routine Events

February, 1992 - The NPDES Permit limit of 30 mg/l for the monthly average Total Suspended Solids (TSS) on Outfall 00C (Plant Heating Boiler) was exceeded. The analyses indicated an average value of 41.4 mg/l.

First Quarter, 1992 - An internal review of our records revealed that the first quarter 1992 samples for Stormwater Outfall 001S had not been collected.

June 6, 1992 - During intermittent chlorination of the plant service water systems, our NPDES Permit limit of 0.30 mg/l, for a grab sample of Total Residual Chlorine (TRC) was exceeded. The analysis indicated a TRC concentration of 0.76 mg/l.

June 24, 1992 - During intermittent chlorination of the plant service water systems, our NPDES Permit limit of 0.30 mg/l, for a grab sample of Total Residual Chlorine (TRC) was exceeded. The analysis indicated a TRC concentration of 0.33 mg/l.

June 30, 1992 - A minor, inadvertent discharge of the mollusicide Clam-trol CT-1 may have occurred into surface waters.

September 16, 1992 - Noticeable turbidity was visualized in Outfalls 001 and 002 during a forebay Clam-trol treatment, resulting from the initial dosage of bentonite clay which is used as a Clam-trol detoxicant.

Indiana Michigan Power Company
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
616 465 5901

AEP INDIANA MICHIGAN POWER

Michael D. Moore
Deputy Director
Department of Natural Resources
Stevens T. Mason Building
P. O. Box 30028
Lansing, MI 48909

October 30, 1992

Dear Mr. Moore:

Re: Summary of Scaup Events

Per your request, the following is a summary of the sequence of events which led to the unfortunate loss of approximately 400 lesser and greater scaups last winter at the Cook Nuclear Plant.

The Cook Plant is located in Bridgman, Michigan on the southeastern shores of Lake Michigan. We operate two 1100 megawatt Westinghouse Pressurized Water Reactors. Cooling water is supplied via three sixteen foot diameter corrugated steel pipelines located approximately 2250 feet offshore. Three octagonal intake cribs approximately 75 feet in diameter with velocity caps (see Attachments #1, #2, and #3) take suction in approximately 22 feet of water. Design flow at the bar racks on the structures is one foot per second with all three pipelines in use and all seven circulating water pumps in operation. Total flow through the once-through main condenser cooling water system is 1.6 million gallons per minute.

The surrounding lake bottom consists of mostly sand. A limestone rip-rap stabilization zone surrounds the intake cribs, discharge structures and pipeline paths in front of the plant. The limestone and intake cribs have formed a perfect substrate for zebra mussels to attach and provide an abundant food source for lesser and greater scaups.

All seven circulating water pumps were running, when the first scaups were discovered in the plant's screenhouse forebay. The plant was operating in the de-ice mode in which the center intake pipeline was aligned as a discharge pipeline. This alignment necessary for repair work scheduled for the center intake valve.

Initial Scaup Sightings

On December 5, 1991, plant personnel noted that over a 2 to 3 day period, approximately 90 to 100 dead scaups had collected in the screenhouse trash baskets after the screen wash pumps were run. The birds were not mangled or disfigured in any way. Plant personnel investigating the incident dissected one of the scaups in an attempt to determine the cause of death. Zebra mussels (Dreissena polymorpha) were discovered completely filling the esophagus and proventriculus of the animal. The gizzard was found to contain a number of zebra mussel shell fragments. Death appeared to have occurred by drowning. It was hypothesized that the scaups were feeding on the abundant zebra mussel population established on the circulating water intake cribs and surrounding rip rap. The MDNR Plainwell Office was notified by phone of the incident.

Cook Plant Zebra Mussel History

Zebra mussels were first detected at the plant on July 18, 1990 in the plant screenhouse forebay. Initial density estimates ranged from 0.25-0.67 individuals per square meter in the plant screenhouse forebay and intake cribs. In late fall of 1990, zebra mussel densities had increased to approximately 100 individuals per square meter. No migratory ducks were seen around the area of the intake cribs on Lake Michigan or found in the screenhouse trash baskets in 1990.

In the spring of 1991, again, no migratory ducks were seen or found in the plant. During the summer of 1991, southern Lake Michigan underwent a population explosion of zebra mussels. This was confirmed by bio-monitoring studies performed at the plant. By the fall of 1991, zebra mussel densities at the intake cribs had increased to approximately 180,000 to 200,000 per square meter.

The Plant utilizes a number of techniques to control zebra mussel infestation. Presently these include the use of intermittent chlorination and targeted molluscicide treatments to the service and circulating water systems. Divers are contracted to physically remove zebra mussels using water blasters and scrapers from areas where chemical treatment was impossible or not effective with water blasters.

Initial Corrective Actions to Deter Scaups

On December 6, 1991, approximately 250 scaups were seen diving near the intake cribs. Plant biologists attempted to scare the birds away using a small inflatable boat. The scaups left the immediate area, only to return soon after the boat had left the water. Blanks were fired from shore in an attempt to frighten the birds away, but the blasts were drowned out due to the distance to the birds, and the sound of the surf.

On December 7, 1991, plant biologists attempted to scare the scaups (approximately 250) again, utilizing shotgun blanks, fired from the small inflatable boat located at the intake cribs themselves. Again, the birds returned after the boat left the water.

At the request of Mike Bailey of the MDNR Plainwell Office, 86 scaups that had been collected in the trash baskets were stored in the plant freezers for further study by U. S. Fish and Wildlife biologists.

By December 9, 1991, the number of scaups discovered in the screenhouse trash baskets had reached approximately 280. Plant engineers determined that a circulating water pump could be turned off in an attempt to decrease the water velocity at the intake cribs, without reducing reactor power. It was hoped that this would prevent the scaups from being sucked into the plant forebay.

Only ten scaups were found in the plants screenhouse trash baskets during the next four days. This reduced number could have been attributed to the fact that the majority of the scaups had left the immediate area on the 9th. As opposed to over 200 scaups being seen on December 8, only 5-12 scaups were seen the next four days near the intake cribs. Hence, we could not conclude whether operating at a reduced flow using six vs. seven circulating water pumps had made a positive difference.

Numerous bird scare tactics were employed by plant biologists in accordance with permission given by Mike Bailey of the MDNR. Plant biologists deployed Bird Scare Eyes (balloons painted with predatory eyes and reflective ribbons). The balloons were attached to the buoys marking the intake crib locations. Rafts were also deployed and attached to the buoys to simulate boats. These devices seemed to frighten the scaups from the intake crib area temporarily, but high winds, cold water temperature, and wave action soon ended all attempts to keep any type of floating scare device out at the intakes for any extended period of time.

Furthermore, the buildup of shore ice made further deployments of these devices too hazardous for work crews. A utility in Wisconsin that had a similar experience cormorants at their surface level intake structures noted that visual tactics are temporary at best. The birds become accustomed to the objects and soon ignored them.

On December 13, 1992, the plant went off de-ice mode to further reduce the velocity at the intake crib. Cooling waster was therefore drawn from three pipelines instead of two.

From about December 15, 1991, to the end of February, scaup populations seen rafting near the plant's intake cribs ranged from 1 to over 200. From the 15th of December until January 21, 1992, only two scaups were discovered in the trash baskets and no additional ducks have been collected to date (see Attachments #4 and #5). In addition to the scaups, four buffleheads were seen close to shore diving in approximately 10 to 15 feet of water.

Plant personnel made daily observations of migratory birds rafting near the intake crib area, in an attempt to better learn the birds habits to help in mitigating the problem.

On January 19, 1992, the plant was returned to the de-ice mode of operation, taking suction from two pipelines and discharging through the center intake. This became necessary to prevent frazzle ice from blocking the intake crib flow pathway.

On February 4, 1992 in an attempt to permanently relocate the scaups, a helicopter was chartered to herd the ducks, and force them to another less dangerous feeding ground. Unfortunately, the scaups did not cooperate. However, we did discover that the birds found another site where they would congregate. One mile north of the plant on Lake Michigan in front of the Grand Mere Lakes, over 100 scaups were seen on several days rafting and diving in a specific area. We assumed that there must be another colony of zebra mussels in this area that the scaups feed on. We attempted to drive the scaups toward this area with the helicopter with little success. The birds appear to fly back and forth between the two area to feed.

From February 21, 1992 until March 11, no scaups were seen near the intake crib area. On March 12, 1992, approximately 30 scaups were seen rafting at the intake cribs.

On April 1, 1992, a plant biologist noted over 500 scaups, mergansers and a few loons rafting in the area near the intake cribs. No scaups had been seen since March 12, and none had been found in the screenhouse trash baskets since January 21. The waterfowl were seen again on April 2, 10 and 13 in approximately the same numbers.

The fishing traffic near the intakes became heavy in mid-April, and the scaups were not seen again until October 13, 1992.

Hypothesis

Plant biologists believe the scaups are feeding on the intake structures themselves, and may in fact swim right into the tunnels in search of zebra mussels. Plant biologists dove on the intake structures in January to ascertain whether the scaups were making any impact on the zebra mussel population, or if any grazing patches could be seen on the actual cribs themselves. Unfortunately no definitive conclusions could be made.

The autopsy results indicated a high percentage of yearling scaups. They may become disoriented, and simply cannot find their way out against the current. We had hoped by varying the number of operating circulating water pumps and/or the number of pipelines being utilized as suctions, we could determine whether the scaups were sucked in or whether they would just swim in and could not find their way out. A conclusion could not be reached because the number of birds feeding in the area at the time of the plant modifications was relatively small and had little effect.

Future Preventative actions

To prevent further losses of migrating waterfowl, the intake structures will be cleaned of zebra mussels prior to the fall migration of 1992. According to U. S. Fish and Wildlife biologists the scaup migration should begin around November.

When possible, Cook Nuclear Plant will continue to configure the plant's circulating water system in a manner to minimize flow at the intake structures during periods of duck migration. Divers will clean the structure as late in the season as possible (weather permitting), to remove all settled zebra mussels including the 1992 newly settled Dreissena post veligers. We believe by removing the food source near the area where the ducks may become disoriented or swim to close to the plant suctions, the ducks will not become entrapped in the tunnels. The birds will still be able to feed on the mussels on the surrounding half-mile of rip-rap that is covered with zebra mussels, but they will be away from the danger

associated with the intake cribs. Buoys with predator owls have also been deployed.

The Plant has also purchased numerous aviary scare devices to be used if the need arises to frighten the birds away from the intake cribs. These include a multi-detonation LP gas cannon; a 6mm hand held launcher with screaming sirens, bird bangers; shot-tells (bird scaring blanks for shotguns); predator-eye balloons; and a AVA-2 Scare Alarm.

To employ many of these devices, good lake conditions are required to work out near the intake cribs. When the wave heights exceed two feet, or when shore ice is formed, the conditions become too hazardous to perform work. However, the use of scare devices may not become necessary because of the removal of the food source (zebra mussels) from the intake cribs.

In summary, we are confident that the measures being taken to remove zebra mussels from the intake structures will greatly minimize any future duck losses. We will continue to monitor the populations rafting at our intakes.

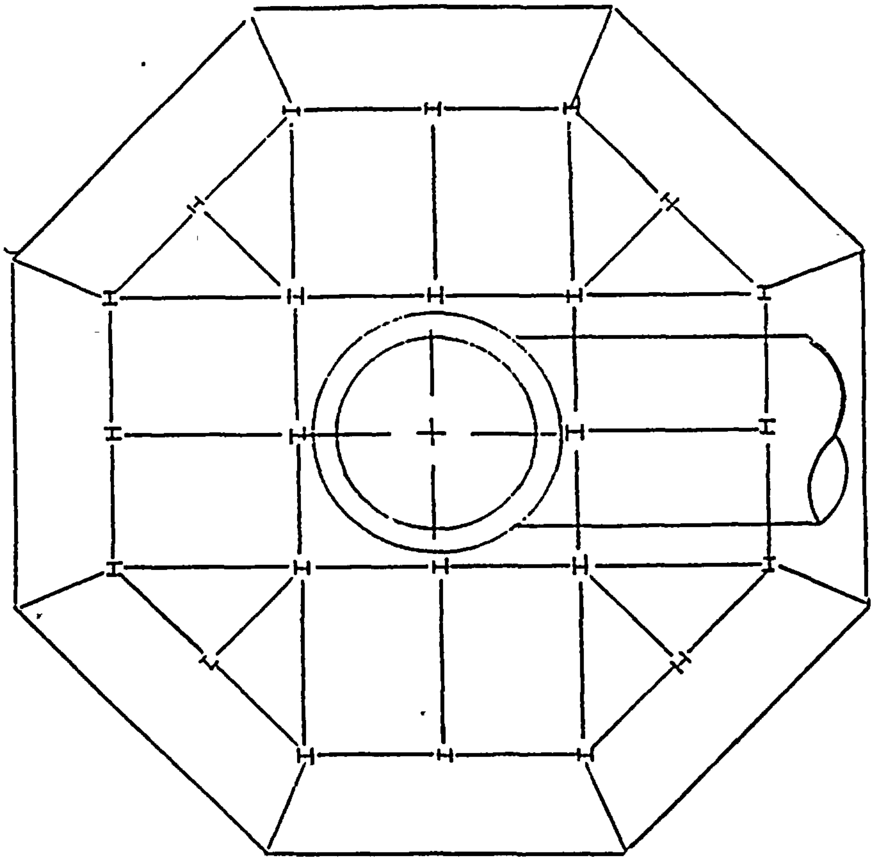
Sincerely,

A. A. Blind
Plant Manager

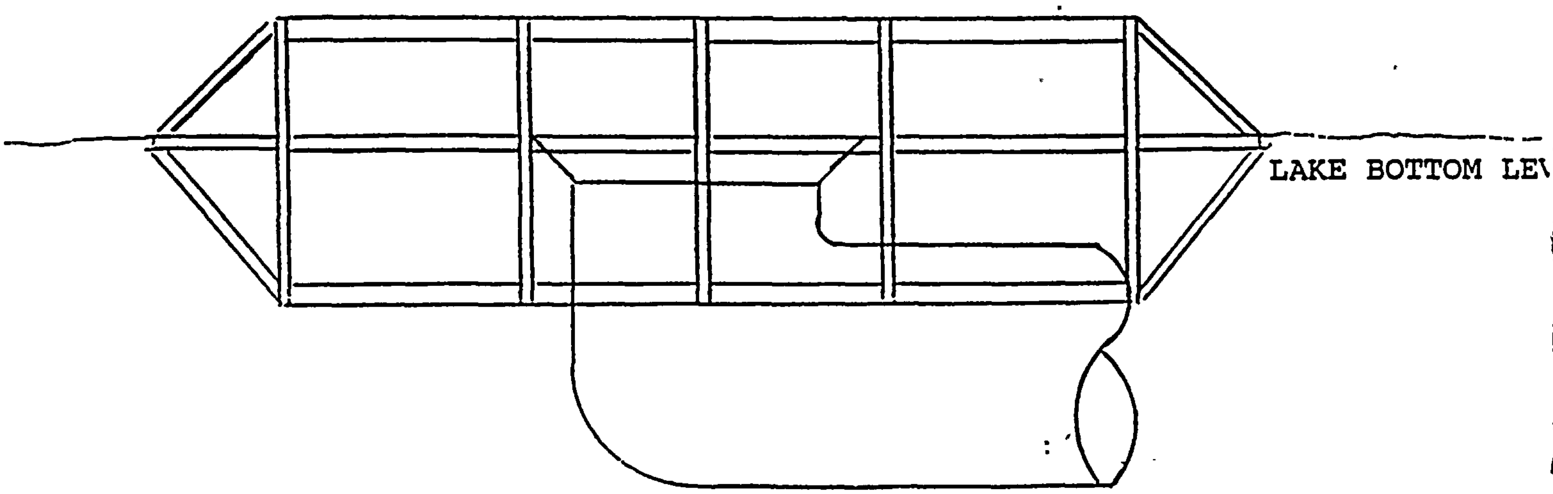
/js

c: M. Bailey, MDNR Plainwell

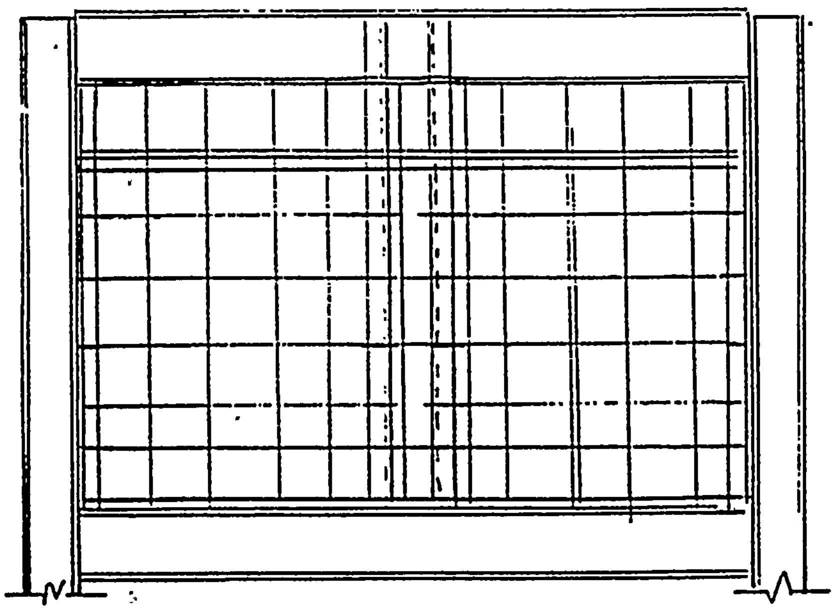
bc: E. E. Fitzpatrick
J. E. Rutkowski
K. R. Baker
L. S. Gibson
J. T. Wojcik
D. M. Fitzgerald
J. P. Carlson
D. L. Baker
A. J. Ahern
A. E. Gaulke



SEE-THRU VIEW FROM THE TOP OF THE INTAKE STRUCTURE. HIGHLIGHTED AREA IS THE INTAKE STRUCTURE CAP.

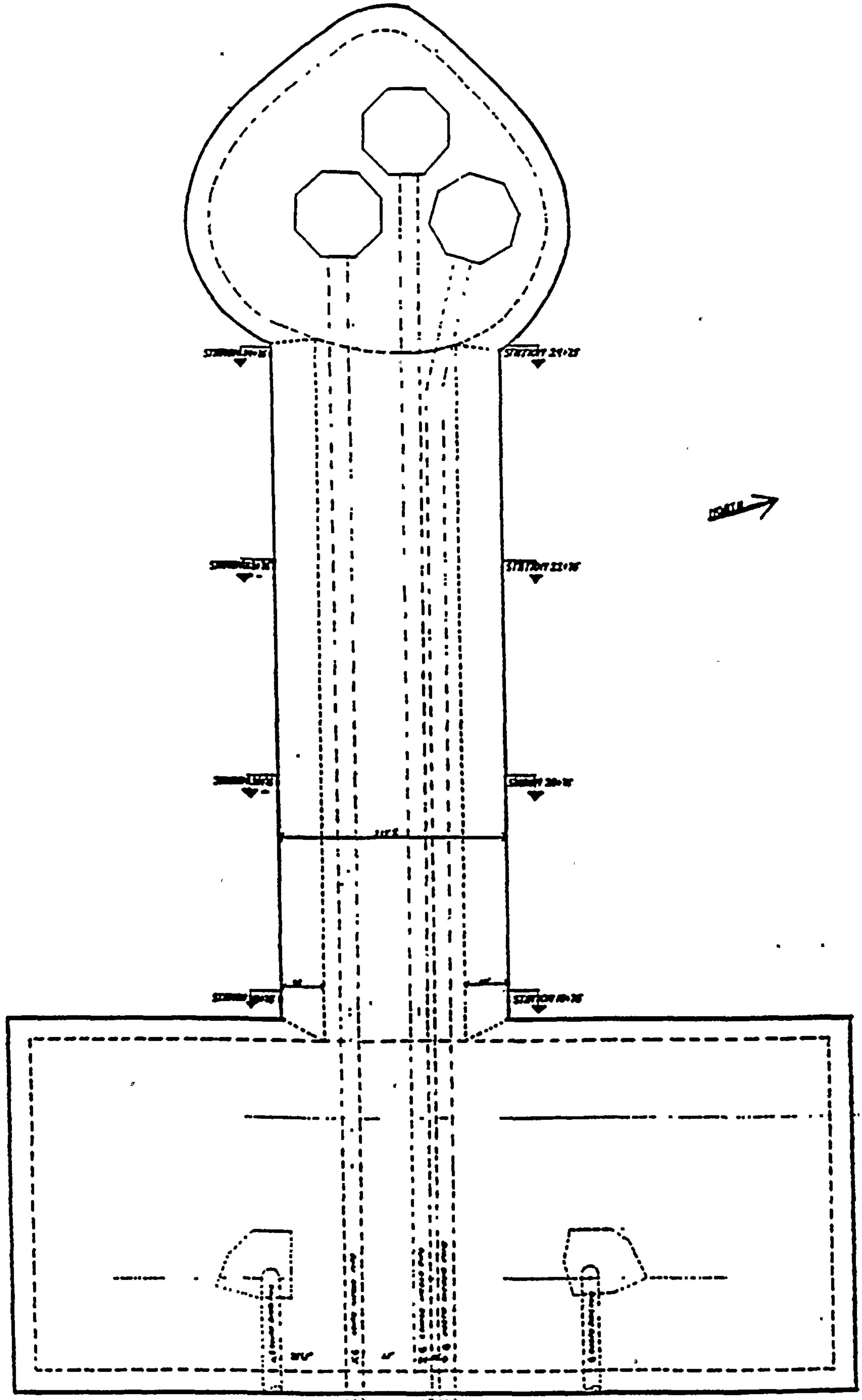


SEE-THRU SIDE VIEW OF INTAKE STRUCTURE



COLLAPSIBLE RACK VIEW. TWO (2) PER SIDE OF OCTAGON - 16 TOTAL RACK. 7" X 7" OPENING.

Attachment 3



PLAN VIEW
SCALE 1"=50'

NOTE:
1. STONE MUST BE FROM 3 LBS TO 150 LBS, WELL-GRADED. AT LEAST ONE HALF OF THE INDIVIDUAL PIECES MUST EXCEED 75 LBS IN WEIGHT.
2. MINIMUM BED THICKNESS IS TO BE 2 FT OR TWICE MAXIMUM STONE SIZE, WHICHEVER IS LARGER. MAXIMUM BED THICKNESS IS TO BE 4 FT.
3. THE TOE OF THE BED IS TO BE PLACED SO THAT THE TOP OF THE STONE LAYER IS AT LEAST 10 FT BELOW THE NOMINAL LAKE BOTTOM.
4. FILTER CLOTH IS TO BE LAUREL EROSION CONTROL CLOTH, TYPE I, OR EQUAL.
5. ALL STONE IS TO BE INSPECTED FOR SIZE AND GRADATION BY OWNER'S ENGINEER PRIOR TO PLACEMENT.
6. FILTER CLOTH OVERLAP MUST BE AT LEAST 2 FT MINIMUM. NO FILTER CLOTH IS TO BE EXPOSED.
7. THE SAND BACKFILL MUST BLEND SMOOTHLY AND CONTINUOUSLY TO THE EXISTING LAKE BOTTOM CONTOURS.

REVISIONS

DONALD C. COOK
NUCLEAR PLANT

PROTECTION AROUND
INTAKE PIP

DR. NO. 12-3

Attachment 4

SCAUP OBSERVATIONS

DATE	# OF DUCKS COLLECTED	# DUCKS ON LAKE
12-02-91	30	*
12-03-91	30	*
12-04-91	30	*
12-05-91	3	>250
12-06-91 AM	59	>250
12-06-91 PM	3	>250
12-07-91 AM	86	>250
12-07-91 PM	6	>200
12-08-91 AM	51	>100
12-08-91 PM	22	>200
12-09-91 AM	52	<50
12-09-91 PM	1	4
12-10-91 AM	1	12
12-10-91 PM	2	5
12-11-91 AM	6	10
12-11-91 PM	0	2
12-12-91 AM	0	3
12-12-91 PM	0	0
12-13-91 AM	0	4
12-13-91 PM	1	2
12-14-91 AM	0	0
12-14-91 PM	0	0
12-15-91 AM	0	>60
12-15-91 PM	1	53
12-16-91 AM	0	>30
12-16-91 PM	0	57
12-17-91 AM	0	0
12-17-91 PM	0	>60
12-18-91	0	>73
12-19-91	0	>110
12-21-91	0	>80
12-22-91	0	>80
12-23-91	0	>100
12-27-91	0	2
12-30-91	0	>120
01-02-92	0	3
01-20-92	0	>50
01-21-92	1	>50
01-22-92	0	>30
01-23-92	0	>20
01-25-92	0	2
01-27-92	0	>300**
01-28-92	0	>15
01-29-92	0	>20
01-30-92	0	>40
02-03-92	0	>40
02-04-92	0	>200***
02-05-92	0	>45
02-06-92	0	>70
02-12-92	0	>100

Attachment 5

DATE	# OF DUCKS COLLECTED	# DUCK ON LAKE
02-13-92	0	>125
02-17-92	0	>40
02-19-92	0	>35
02-21-92	0	>30
03-12-92	0	>30
04-01-92	0	>500
04-02-92	0	>500
04-10-92	0	>400
04-13-92	0	>400
10-19-92		50

Total number of scaups killed 385

* No Lake observations made

** Observations via helicopter over plant and Grand Mere area

*** Observations at Grand Mere area

APPENDIX II

ENVIRONMENTAL EVALUATION REPORTS

1992

There were seven environmental evaluations during the reporting period. The following documents are copies of these evaluations. These environmental evaluations determined that there were no unreviewed environmental questions.

AEP
AMERICAN
ELECTRIC
POWER

Date February 5, 1992

Subject Donald C. Cook Nuclear Plant
Environmental Evaluation
PM-837

From S. L. Colvis SLC

To J. J. Satin/PM-837
DC-RS-7915

As requested, I have reviewed PM-837 for its environmental impact. After discussions with plant personnel, I have determined that this design change does not require an environmental evaluation. This memo is to serve as documentation of this decision as required by Radiological Support Section Procedure RS-34.

The modification only allows for the installation of the diffusers. It does not include the actual injection of any chemical (molluscide, etc.) as part of its scope. It is assumed that this will be dealt with in the development of the procedure for the chemical addition. At that time, an environmental evaluation will be prepared by this section to determine the environmental impact due to the chosen chemical.

If you have any questions regarding this determination, please contact Dane.

Approved by: Dane R. Willia 2/5/92
Radiological Support Section

c: D. M. Fitzgerald/J. Carlson
R. M. Claes
T. R. Satyan-Sharma

Intra-System

AEP AMERICAN ELECTRIC POWER

Date February 18, 1992

Subject Ice Machine Glycol Header Modification, 12-MM-267

From R. M. Claes

To J. E. Trader

Pursuant to Radiological Support Section Procedure RS-34, this memo shall serve to document that an Environmental Evaluation is not required to be performed for the proposed modification of the ice machine glycol header as described in 12-MM-267.

The Design Change Proposal will modify the glycol return and supply header to the ice machine to accommodate supplemental cooling. The installation will require a tie-in utilizing a tee on a six inch diameter section of pipe with a flange and a valve to isolate flow.

Since the proposed location of the modification is the Unit 1 side of the 650' elevation, the concern arises in that any leaks from the system would have a direct route to the environment. It is therefore recommended that a containment structure encompass the proposed modification to mitigate the potential of a glycol leak from the system.

As described above, it can be concluded that there appears to be no unreviewed environmental question as defined in Section 3.1 of Appendix B of the Facility Operating License. The proposed activity would pose no significant adverse effect on the environment. From the scope and responsibility of the Radiological Support Section, an Environmental Evaluation is not required and the activity defined in 12-MM-267 may proceed.

Approved by: [signature] 2/18/92
D. R. Williams, Manager
Radiological Support Section

Concurrence by: [signature] 2/19/92
Nuclear Licensing Section

Concurrence by: [signature] 2/24/92
D. C. Cook Environmental Section

edg
c: S. Hover 12-MM-267 Packet DC-RS-7915

AEP
AMERICAN ELECTRIC POWER

Date February 18, 1992

Subject Ice Machine Glycol Header Modification, 12-MM-267

From R. M. Claes

To J. E. Trader

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Approved by: [signature] 2/18/92
D. R. Williams, Manager
Radiological Support Section

Concurrence by: [signature] 2/19/92
Nuclear Licensing Section

Concurrence by: [signature] 2/24/92
D. C. Cook Environmental Section

edg
c: S. Hover 12-MM-267 Packet DC-RS-7915

Intra-System

AEP
AMERICAN ELECTRIC POWER

Date April 15, 1992

Subject Environmental Evaluation of the Sodium Hypochlorite Injection System

From R. M. Claes

To J. J. Satin
12-PM-801 Package

Pursuant to Radiological Support Section Procedure RS-34, this memo shall serve to document that an Environmental Evaluation is not required to be performed for the proposed installation of a sodium hypochlorite injection system as described in 12-PM-801. This modification will install a permanent liquid sodium hypochlorite injection system to replace the existing gaseous chlorination system. The system shall be used to control microbiological growth and macrofouling infestation in the Circulating Water, ESW, NESW, and Make-up Water systems.

Environmental concerns inherent in this modification have been satisfactorily addressed. The Material Safety Data Sheet for the use of sodium hypochlorite on site is approved and on file. Station personnel cognizant of this system and its function are experienced in the precautions and handling of this chemical solution. Mitigation of significant environmental impact by the installation of this system has been satisfied by the construction of a concrete containment structure surrounding an installed sodium hypochlorite storage tank. The containment structure will retain approximately 100% of the contents of the tank in the event of a breech of integrity. Drainage of the containment structure will be to the Turbine Room Sump preventing a direct release pathway to Lake Michigan. In addition, this modification includes construction of a practical bulk chemical unloading area. This area will be constructed of a poly liner under asphalt with a valved drain. It is graded and curbed to contain approximately 150% of a standard delivered volume.

In accordance with Technical Specification, environmental concerns identified in the Final Environmental Statement which relate to water quality matters are regulated by way of the licensee's NPDES permit. The current NPDES revision recognizes the use of and has established effluent concentration limits for sodium hypochlorite in this application.

The proposed activity will only affect areas of the environment that have been previously disturbed or which have been evaluated for significant adverse environmental impact. As described above, it can be concluded that there appears to be no unreviewed environmental question as defined in Section 3.1 of Appendix B of the Facility Operating License. The proposed activity would pose no significant adverse effect on the environment. From the scope and responsibility of the Radiological Support Section, an Environmental Evaluation is not required and the activity defined in 12-PM-801 may proceed.

Approved By: 4/15/92
D. R. Williams, Manager
Radiological Support Section

Concurrence By: 4/15/92
AEPSC Nuclear Licensing

Concurrence By: 4/16/92
Donald C. Cook Nuclear Plant
Environmental Section

c: DC-RS-7915

AMERICAN ELECTRIC POWER

Date June 12, 1992

Subject Environmental Evaluation Assessment

From J. L. Leichner

To J. P. Carlson
Radiological Support Section File DC-RS-7915

Re: Letter to DNR Dated April 27, 1992 from J. P. Carlson

Pursuant to Radiological Support Section procedure RS-34, this memorandum shall serve to document the environmental evaluation for the proposed nature trails in the vicinity of the visitor center.

Mr. Carlson requested approval from the DNR to construct nature trails located north of the Energy Information Center. A small wooden platform to overlook Lake Michigan and an observation tower near a wetlands area will also be included.

This assessment is based on whether or not this proposed activity involves an unreviewed environmental question. That is, will this activity result in a significant increase in any adverse environmental impact previously evaluated in the final environmental statement (FES). Secondly, does this activity have a significant change in effluents or power level which may have a significant adverse environmental impact.

It is stated in the FES (V-1) Section 2, there was no specific plan for permitting public access to any part of the 650 acre property, except for the Visitor Center grounds and parking lot. These nature trails are nothing more than an extension of the visitor center and the impact of constructing the trails is not significant in comparison to the impacts originally considered in the FES for visitor center construction. It is therefore concluded that addition of the proposed nature trails and observation deck is consistent with the assumptions made in the original FES evaluation of the Visitor's Center facilities.

Intra-System

J. P. Carlson
June 12, 1992
Page 2

Furthermore, the State of Michigan is reviewing and will need to approve this activity and the necessary critical dune permit before we can proceed. Therefore, an unreviewed environmental question does not exist.

Approved by: Dave R Williams 6/15/92
D. R. Williams, Manager
Radiological Support Section

Concurrence: Doug Maler 6/16/92
Nuclear Licensing Section

Concurrence: Diane Ogarda 6/19/92
General Supervisor, Environmental Section

edg

AMERICAN ELECTRIC POWER

Date September 15, 1992

Subject Environmental Evaluation of the Underground Storage Tank Replacement Project

From R. M. Claes

To D. P. Ritzenthaler
12-RFC-4113 Package

Pursuant to Radiological Support Section Procedure RS-34, this memo shall serve to document that an Environmental Evaluation has been performed for the proposed replacement of the underground storage tanks as proposed in 12-RFC-4113.

The underground tanks proposed for removal and replacement are all located within previously disturbed areas and no further significant environmental impacts should be experienced. The RFC package comprehensively details provisions that will mitigate the potential for future environmental degradation due to any associated system failure. The removal of dry wells affected by this project will be rectified under a separate design change package, Transformer Deck Drain Oil Water Separator Modification, for which an environmental evaluation will be performed.

The proposed activity will serve as a site enhancement by reducing the potential for environmental degradation due to on site fuel storage requirements. As described above, it can be concluded that there appears to be no unreviewed environmental question as defined in Section 3.1 of Appendix B of the Facility Operating License. The proposed activity would pose no significant adverse effect on the environment. Initiation of the proposed activity defined in 12-RFC-4113 will be contingent upon obtaining any required permits and authorizations which may include the following items to ensure that there are no adverse environmental effects. Activity, such as concrete work, that will be performed in areas previously disturbed and will impose insignificant environmental impact may proceed as necessary prior to satisfying the contingencies.

NPDES permit for discharging water from dewatering operations

Permission from Michigan DNR to perform work on the plant heating boilers which are located in a known Act 307 oil contamination site

Obtaining Critical Dune and Erosion permits

Notifying the State Fire Marshall

Developing a disposal plan for potentially oil contaminated soil

Approved by: ______________________________
D. R. Williams, Manager, Radiological Support Section

Concurrence By: ______________________________
AEPSC Nuclear Licensing

Concurrence by: ______________________________
Donald C. Cook Nuclear Plant, Environmental Section

edg

c: DC-RS-7915

AMERICAN ELECTRIC POWER

Date	October 9, 1992
Subject	Environmental Evaluation of the Transformer Deck Drain Oil/Water Separator Modification
From	R. M. Claes
To	R. O. Beem 12-PM-1201 Package

Pursuant to Radiological Support Section Procedure RS-34, this memo shall serve to document that an Environmental Evaluation has been performed for the proposed transformer deck drain oil/water separator modification as described in 12-PM-1201.

This modification will serve to enhance the performance of the oil/water separators and thereby mitigate the consequences of fire water deluge combined with a transformer oil spill. No significant adverse environmental impact is identified by the use of this system after the modification is complete.

The dry wells proposed for removal as part of the modification are all located within previously disturbed areas and no further significant environmental impacts should be experienced. The RFC package details provisions that will mitigate the potential for future environmental degradation due to any associated system failure.

The proposed activity will serve as a site enhancement by reducing the potential for environmental degradation due to normal water/oil waste and oil/water deluge to the transformer deck drain. As described above, it can be concluded that there appears to be no unreviewed environmental question as defined in Section 3.1 of Appendix B of the Facility Operating License. The proposed activity would pose no significant adverse effect on the environment. Initiation of the proposed activity defined in 12-PM-1201 will be contingent upon obtaining any required permits and authorizations, which may include the following items to ensure that there are no adverse environmental effects. Activity, such as concrete work, that will be performed in areas previously disturbed and will impose insignificant environmental impact may proceed as necessary prior to satisfying the contingencies:

NPDES permit for directing oil/water separator effluent to the storm water drainage system

NPDES permit for discharging water from dewatering operations

Developing a disposal plan for potentially oil contaminated soil

Approved by: ______________________
D. R. Williams, Manager, Radiological Support Section

Concurrence By: ______________________
AEPSC Nuclear Licensing

Concurrence by: ______________________
Donald C. Cook Nuclear Plant, Environmental Section

edg

c: DC-RS-7915

7915

AMERICAN ELECTRIC POWER

Date March 1, 1993

Subject Environmental Evaluation of the Proposed Installation of Dedicated Fire Water Storage Tanks, RFC 12-3065

From R. M. Claes

To P. J. Russel
12-PM-3065 Package

Pursuant to Radiological Support Section Procedure RS-34, this memo shall serve as the Environmental Evaluation for the proposed installation of dedicated fire water storage tanks as detailed in 12-PM-3065. The RFC is deemed necessary to replace the Lake Michigan supply source. This source has become infested with Zebra Mussels which could potentially pose adverse affects on the fire protection system.

The tanks proposed for installation are located within previously disturbed areas and no further significant environmental impacts should be experienced. The RFC package comprehensively details provisions that will mitigate the potential for future environmental degradation due to any associated system failure.

Each of the two diesel driven pumps will have an associated 250 gallon fuel oil tank within the pump house. Each tank will be located within a concrete block dike inside the individual fire pump rooms. The dikes will sufficiently contain the volume of the associated tank. The pump house internal floor drains will be routed to the condenser pit sump pumps to mitigate any spills within the pump house. In addition, a fuel unloading area will be provided which will be capable of containing the entire volume of the largest compartment of a tanker unloading to the system. A storm water drain in the vicinity of the pump house will be relocated to preclude the potential for fuel oil to enter the drainage system.

In addition, the Michigan Department of Natural Resources' Critical Sand Dunes Permit has been obtained for this work. The MDNR was also notified of a facility modification which will result in a change in conditions, per NPDES Permit MI0005827. Specifically, diesel pump cooling water will be discharged to Lake Michigan via outfall 002S. This modification will not result in a new, different, or increased discharge of pollutants. (See attached memo of January 14, 1992 to MDNR.)

As described above, it can be concluded that there appears to be no unreviewed environmental question as defined in Section 3.1 of Appendix B of the Facility Operating License. The proposed activity would pose no significant adverse effect on the environment. From the scope and responsibility of the Radiological Support Section, the activity defined in 12-PM-3065 may proceed.

Approved By: Dave R Williams 3/1/93
D. R. Williams, Manager, Radiological Support Section

Concurrence By: [signature] for DHM 3/2/93
AEPSC Nuclear Licensing

Concurrence By: [signature] for DMF 3/3/93
Donald C. Cook Nuclear Plant, Environmental Section

c: DC-RS-7915

One Cook Place
Bridgman, MI 49106
616 465 5901

INDIANA MICHIGAN POWER

Fred Morley, District Supervisor
Michigan Department of Natural Resources
621 North Tenth Street
P.O. Box 355
Plainwell, Michigan 49080

January 14, 1992

Dear Mr. Morley,

Re: NPDES Permit No. MI0005827
Cook Plant, Bridgman, Michigan

As required by Part II.A.2 of the Cook Plant National Pollutant Discharge Elimination System (NPDES) Permit No. MI0005827, we are providing notification of a facility modification which will result in a change of conditions. We do not believe that this modification will result in a new, different, or increased discharge of pollutants for reasons discussed below.

Specifically, the Cook Plant's Fire Protection System is being modified as a result of the infestation of Dreissena polymorpha (zebra mussel) in Lake Michigan. The system which now draws supply water from Lake Michigan, will be modified to use chlorinated Lake Township drinking water as the water source.

Electrical pumps will serve as the primary means for maintaining adequate pressure in the fire protection headers. Diesel backup pumps will be installed to ensure adequate system pressure in the event of loss of electrical power or extremely high water demand.

When each diesel pump operates, a design flow of approximately 60 gallons per minute of the discharge water is pumped to cool the engine block via a heat exchanger. (See Attachment #1.) This cooling water will be discharged to the plant stormwater system and reach Lake Michigan via Stormwater Outfall 002S.

The current Cook Plant Fire Protection System configuration is similar in that the initial response pumps are electrically driven, and the diesel driven pumps essentially serve as backups. To date the diesel pumps have never been used to fight a fire at Cook Plant. The pumps are infrequently used to maintain water pressure due to system pressure loss. Should this trend continue, the new diesel pumps will be operated for testing purposes only. Tests are run monthly for approximately 30 minutes per pump. Once every 18 months the pumps are run simultaneously for approximately 15-20 minutes, also for testing purposes. Assuming this schedule, approximately 45,600 gallons per year would be discharged to Lake Michigan. Monthly discharges would be approximately 3,600 gallons.

Due to the relatively small amount of water being discharged, and the fact that it is Lake Township drinking water, we believe that there will be no adverse change in the quality of the discharge flow from Stormwater Outfall 002S. The chlorine content of the water at the point of discharge should be negligible, due to dissipation during the time it will remain in onsite storage tanks prior to discharge, and the chlorine demand which will be encountered in the stormwater system.

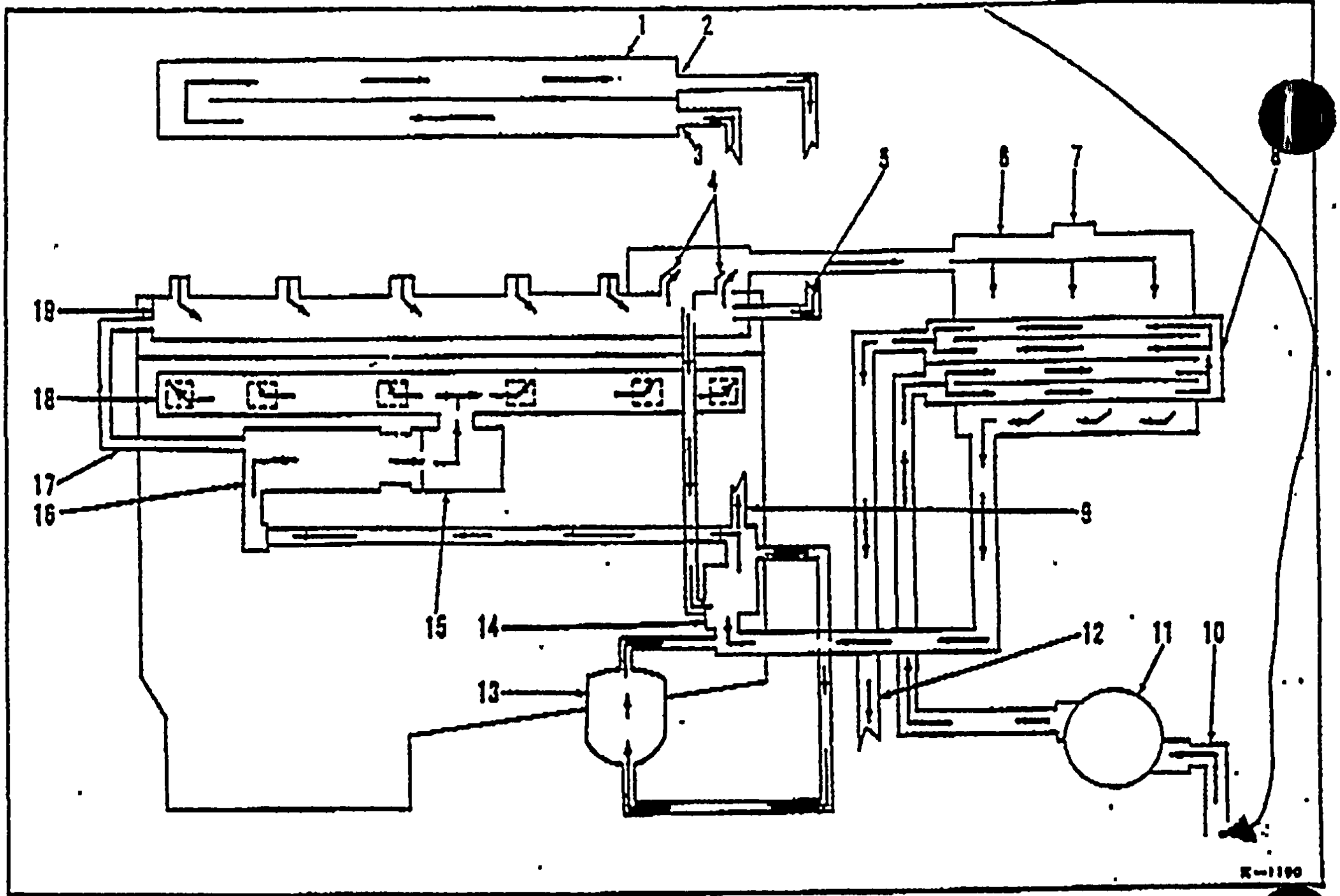
Please let me know if you need further information regarding this notification.

Sincerely,

Diane Fitzgerald
Environmental Supervisor

bc: A.A. Blind
J.R. Rutkowski
J.T. Wojcik
D.L. Baker
P.J. Russell
C.E. Hawk
J.P. Carlson
P.N. Stathakis

Should be an 40-50 PSI
[illegible] 9-20-8



1. Intake manifold and intercooler (25000 MK II only)
2. Intercooler outlet
3. Intercooler inlet
4. Thermostats
5. From intercooler outlet
6. Expansion tank
7. Pressure cap (7 psi)
8. Heat exchanger
9. To inlet of intercooler
10. Customer supplied source of raw water
11. Raw water pump
12. Raw water discharge
13. Coolant filter
14. Water pump
15. Water manifold
16. Oil cooler
17. Bleed tube
18. Water inlet manifold
19. Water cooled exhaust manifold

Figure 2. Cooling System Schematic Diagram (Heat Exchanger Type)

APPENDIX III

HERBICIDE APPLICATION REPORT

1992

AEP
INDIANA MICHIGAN POWER

Date February 2, 1993

Subject 1992 Herbicide Spray Report - Cook Nuclear Plant

From J. S. Lewis

To D. M. Fitzgerald

From June 3 - 7, 1992, Townsend Tree Service applied a mixture of Stomp and Oust to control grass and weed growth on the plant site.

A total of 91.2 quarts Stomp and 91.2 ounces of Oust were applied over 33.4 acres. The manufacturer's label recommends that Stomp be applied at a rate of between 2-4 quarts per acre. Stomp was applied at a rate of 2.7 quarts per acre. The manufacturer's label recommends that Oust be applied up to 12 ounces per acre. Oust was applied at a rate of 2.7 ounces per acre.

In November, the areas treated were inspected and the following observations were made:

1. Sewage Ponds:
   - Sparse patches of weeds growing on the sides of both sewage ponds. Herbicides were only applied to the water's edge. No evidence of overspray was found in or around the sewage ponds.
2. Road to Absorption Pond:
   - No weeds or signs of overspray were found.
3. 765 kV Switchgear Yard:
   - No weeds were found.
4. 345 kV Switchgear Yard:
   - No weeds or signs of overspray were found.
5. Railroad Tracks east of the Training Center:
   - Small patches of weeds were growing. No visible signs of overspray were found.
6. Parking Lot B:
   - Patches of grass were found growing inside the fenced-in area.

7. 69 kV Switchgear Yard:
   - No signs of weeds or overspray were found.

8. North Protected Area Fence:
   - Good weed control.

9. South Protected Area Fence:
   - Weeds are growing along the fence.

10. East Protected Area Fence:
    - Good weed control.

11. ICMS Office Trailer:
    - No weeds were found. No visible signs of overspray were found.

12. ICMS Fabrication Shop:
    - Sparse patches of weeds are growing. No signs of overspray were found.

13. Southwest side of Turbine Building:
    - No weeds were found.

14. South end of Turbine Building:
    - Sparse patches of weeds were found growing. No signs of overspray were found.

15. Unit 1 RWST Area:
    - Moderate weed control. Some areas were not sprayed due to radiation protection restrictions. 80% kill in areas sprayed.

16. Unit 2 RWST Area:
    - Moderate weed control. Some areas were not sprayed due to radiation protection restrictions. 90% kill in areas sprayed.

17. Hydrogen/Nitrogen Storage Tank Area:
    - No signs of weeds or overspray were found.

18. Construction Fabrication Shop:
    - No weeds were found.

19. Road to the Meteorological Towers:
    - Patches of grass were found growing on the roads. No signs of overspray were found.

Based on our review of the application records and observations of the treated areas, it appears that the herbicides were applied in accordance with herbicide label requirements, and no adverse environmental effects occurred.

The following additional areas were identified for the 1993 herbicide treatment program:

- Oil Barn
- Paint Storage Building
- Sandblast Shack
- The road leading to and around the tower from the employee parking lot.
- East sewage plant parking lot.

APPENDIX IV

MACROFOULER MONITORING PROGRAM

1992

Indiana Michigan Power Company

Cook Nuclear Plant

1992 Zebra Mussel and Asiatic Clam Monitoring
and Control Report
March 18, 1993

INTRODUCTION

The large densities of zebra mussels (180,000 - 200,000 per square meter) reported in 1991 actually decreased in 1992 (67,000 per square meter) due to the increase in the average size of the mussels and the formation of clumps on untreated intake structures and components within the circulating water intake forebay areas. A cool summer season in 1992 may have led to a smaller recuitment of zebra mussels in lower Lake Michigan as compared to the 1991 spawning season. (Schloesser & Nichols, East Lansing, MI zebra mussel conference Jan. 11-12, 1993)

A report on the bio-monitoring studies by LMS and data collected by ERM are attached. Of particular note is the revelation that intermittent chlorination of the service water systems at 1.5 - 2.0 ppm for one, 155-minute period each 24 hours was ineffective in controlling zebra mussel infestation in low or no flow areas. Intermittent chlorination of the circulating water system at 0.2 ppm for one, 155-minute period each 24 hours was also ineffective in controlling zebra mussel infestation in low or no flow areas.

ERADICATION AND CONTROL MEASURES

The 1992 control strategy consisted of the use of a proprietary molluscicide (Clam-trol), intermittent chlorination of the service and circulating water systems, and mechanical cleaning.

MECHANICAL CLEANING

Both Unit 1 and Unit 2 underwent refueling outages during the year. This allowed the mechanical cleaning of zebra mussels by divers in the circulating water intake forebay. Hydrolasers and dredge pumps were used to remove 1-2" of zebra mussel growth from the walls and components within the intake forebay. The circulating water intake cribs were also cleaned of zebra mussels.

As a result of targeted molluscicide treatments to the north and center intake pipelines, and a large scale treatment to the intake forebay in 1992, the plant experienced a large influx of dead mussels from these sources when the units were brought up in power in the fall. Over 1,100 cubic yards of zebra mussels were removed from the Cook Nuclear Plant circulating water intake forebays as a result of mechanical cleaning during outages and in the aftermath of molluscicide treatments. Zebra mussel sloughage from the South intake tunnel, which was not treated with molluscicide in 1992, is still occuring. The mussels from this source are being removed

from the circulating water by the traveling screens.

CLAM-TROL TREATMENT RESULTS

Clam-trol (Betz Industrial, Inc.) treatments involving discharges to the surface waters were performed in four phases in 1992 and discussed below. The fire protection system was flushed with Clam-trol involving a groundwater discharge four times in 1992. Whole effluent toxicity testing was performed to demonstrate compliance with water quality standards for treatments to the north and center intake tunnels, and circulating water system. This testing was conducted as a requirement of the Michigan DNR Clam-trol authorization letter of April 24, 1992.

Phases 1 & 2 - Treatments to the North and Center Intake Pipelines

Low demand for circulating water as a result of plant outages allowed for the intake pipelines to be removed from service and target treated with Clam-trol. As a result, chemical usage of both the Clam-trol and the bentonite clay detoxicant was greatly reduced with good results. The north intake pipeline was treated at a target feed concentration of 15 ppm for 12 hours on August 12-13, 1992 and the center intake pipeline was treated on September 11-12, 1992. Zebra mussel mortalities were determined to be >95% as determined by diving inspections performed following the treatments.

Phase 3 - Circulating Water System Treatment

On September 16, 1992, the entire circulating water system was treated for 12 hours using Clam-trol at a target feed rate of 15 ppm. Bentonite clay was injected into the discharge as a detoxicant at a ratio of at least 3:1 clay:Clam-trol before being discharged to Lake Michigan. Zebra mussel mortalities measured by bio-boxes placed throughout the plant ranged from 87-99%. Subsequent intake forebay inspections by divers two weeks after the application, indicated a >95% kill with clean walls and forebay components.

Phase 4 - Spot Treatment of the Containment Spray Heat Exchangers

Routine inspections of the Containment Spray Heat Exchangers during plant outages revealed light colonization of zebra mussels. Three of the four Containment Spray Heat Exchangers were treated for 48 hours each at 50 ppm Clam-trol. Circulating water dilution flows were adequate to ensure that discharge concentrations of active Clam-trol were below the 0.05 ppm at plant outfalls 001 and 002. The Unit 1 and 2 West Containment Spray Heat Exchangers were treated from 11/23/92 to 11/25/92. The Unit 1 East Containment Spray Heat Exhanger was treated from 12/9/92 to 12/11/92. The Unit 2 East Containment Spray Heat Exchanger was not treated due to the need for availability of the heat exchanger during unit start-up. Also falling lake temperatures may have rendered the treatment ineffective if performed at a later date.

Zebra mussel mortalities were not assessed from these spot treatments. Instead, pressure gauges were installed at the inlet and outlet piping to measure the pressure drop across each heat exchanger. A flow improvement of 100 gpm with a corresponding increase in delta P was measured after the treatments to the Unit 1 and Unit 2 West Containment Spray Heat Exchangers. This data showed a slight improvement in heat exchanger performance when hydraulic flow resistance was analyzed. No performance improvements were detected after the treatment to the Unit 1 East Containment Spray Heat Exchanger.

Fire Protection System

The plant's fire protection system was flushed with a target feed of 15 ppm Clam-trol four times during 1992. No mortality studies were performed. Construction of dedicated fire protection water tanks and a pumphouse was begun in 1992 under RFC-3065. The fire protection system water source will be switched to municipal drinking water in 1993, thus eliminating the threat of zebra mussel infestation.

CHLORINATION TREATMENT RESULTS

In 1992, the essential service water (ESW) and non-essential service water (NESW) systems received daily intermittent sodium hypochlorite treatments of 1.5-2.0 ppm total residual chlorine (TRC) for 155 minutes from May until late November. During the same period, the circulating water system received daily intermittent sodium hypochlorite treatments of 0.2 ppm (TRC). The construction of a permanent sodium hypochlorite feed system under PM-801 was completed before the 1992 treatment program. From heat exchanger, condenser water box, and various piping inspections, it was determined that the intermittent chlorination program was effective in areas of adequate flow. In areas of low or no flow, colonization was detected.

Inspections of the circulating water system revealed that the low levels of chlorine at 0.2 ppm (TRC) were effective in slime control, but had little or no effect in controlling zebra mussel colonization in areas of little or no flow. Systems taking suction from the circulating water system which are exposed to this low level of chlorination, including the office building air conditioning, miscellaneous seal & cooling, screenwash pumps, lawn sprinkler pump, and chlorine injector water supply pump, were subject to colonization of zebra mussels. After Clam-trol treatments, mussels residing within these systems would die and cause plugging problems.

The 1993 chlorination strategy calls for the service water systems to be treated continuously at 0.5 ppm to ensure colonization does not occur in the ESW and NESW. Filtration, chlorination, chlorine/bromine and multiple Clam-trol treatments, are being studied for systems which take suction from the circulating water

system.

CONCLUSION

Shock treatments of a proprietary molluscicide to remediate juvenile and adult zebra mussels, in conjunction with the use of sodium hypochlorite to control veliger settlement, has been an effective method in controlling zebra mussels. Mechanical cleaning can be effective in areas where chemical means are impossible or uneconomical. Chemical methods for controlling zebra mussels in low or no flow areas of the service water systems can be improved with continuous chlorination. Switching the fire protection system from raw lake water to municipal drinking water in 1993 will eliminate the threat of zebra mussel infestation in the fire protection system. A bio-monitoring program utilizing side stream and artificial substrate monitors along with diver and heat exchanger inspections will continue to be used to evaluate the effectiveness of chemical and physical control measures.

DONALD C. COOK NUCLEAR PLANT

MOLLUSC BIOFOULING MONITORING DURING 1992

Prepared For:

AMERICAN ELECTRIC POWER SERVICE CORPORATION
One Riverside Plaza
Columbus, Ohio

April 1993

Prepared By:

LMSE-93/0201&652/001

LAWLER, MATUSKY & SKELLY ENGINEERS
Environmental Science & Engineering Consultants
One Blue Hill Plaza
Pearl River, New York 10965

CHAPTER 1

INTRODUCTION

1.1 PAST HISTORY

Indiana and Michigan Power Company (I&M), a subsidiary of American Electric Power (AEP), has been conducting bio-fouling studies at the Donald C. Cook Nuclear Plant (Cook Nuclear Plant) since 1983. Initially, the studies were directed toward Asiatic clams. However, with the recent appearance of zebra mussels in Lake Michigan, the studies were expanded in 1990 to include zebra mussels. The purpose of the studies was to detect the presence of bio-fouling mollusks in the circulating water, essential service water (ESW), nonessential service water (NESW), fire protection system, and proximal Lake Michigan.

The purpose of the 1992 monitoring program conducted by Lawler, Matusky & Skelly Engineers (LMS) was to determine when spawning and settling of zebra mussels occur at the Cook Nuclear Plant and nearby Lake Michigan.

The monitoring program was designed to collect and analyze whole-water samples for planktonic veligers, and artificial substrates set within the circulating water, ESW, and NESW systems for juveniles. In addition, samples were collected from the fire protection system and other randomly selected locations. Beach surveys were conducted along the shoreline of Lake Michigan near the Cook Nuclear Plant and near the confluence of the St. Joseph River and Lake Michigan.

1.2 OBJECTIVES

Specific objectives for the 1992 bio-fouling monitoring program were as follows:

- Whole-water sampling of the circulating and service water systems was conducted on a semi-weekly basis during a four-week period (mid-July to mid-August). The sampling was conducted to determine the presence and concentration of planktonic zebra mussel veligers.

- Fire protection water sampling was conducted for the presence of zebra mussel shells during flow tests.

- Artificial substrates were deployed in the intake forebay and service water systems to detect settlement of postveliger zebra mussels. Samples were taken every two weeks from July through October and every three weeks in November and December.

- Beach inspections were conducted during July, September, and November to detect adult zebra mussel presence and colonization near Cook Nuclear Plant and at the mouth of the St. Joseph River.

- To check on suspected infestations, plant personnel collected samples from within the plant at locations and times that were outside the sample design of the program.

- Temperature and pH were recorded during each whole-water and artificial substrate sampling period.

CHAPTER 2

METHODS

2.1 CIRCULATING AND SERVICE WHOLE-WATER SAMPLING

Whole-water sampling of the circulating and service water systems was conducted over a four-week period between 21 July and 14 August 1992. Samples were taken from the intake forebay and ESW and NESW systems. Eight 24-hr samples from each of the three systems were collected and analyzed. Samples were initiated on Monday and Thursday morning and concluded Tuesday and Friday mornings during the four-week period.

The whole-water sampling procedure for the circulating water system was modified during the four-week sampling period. Initially, a diaphram pump was used to pump water from the Unit 2 discharge forebay. Because of the high flow rate and pulsing action of this pump, the pump was replaced and the sampling location changed. A JABSCO brand centrifugal pump rated at 26 gpm was used to pump water from the plant intake forebay. The JABSCO was able to deliver 13 gpm in use. Both the ESW and NESW whole-water samples were taken from the biomonitor discharge hoses.

Measured flow was directed into No. 20 nets that were suspended in a partially filled 55-gal barrel to minimize organism abrasion. Samples were gently washed from the cod-end into a sample jar and put on ice. For all systems, flow calculations were determined by filling a bucket and timing the filling with a stop watch. This procedure was performed at the beginning and end of each sampling period. Samples were counted live within 24 hrs of collection. Those not analyzed within 24 hrs were first preserved on ice and then with ethanol. Due to the large sample volumes, all samples were subsampled using calibrated disposable Pasteur pipets. Five, 1-ml aliquots were examined in a Sedgewick-Rafter cell. Counting methodologies followed those recommended by Marsden (1992). Raw counts in the aliquots were multiplied by the concentration value, then divided by the total volume to yield number of veligers per 1000 l.

2.2 FIRE PROTECTION SAMPLING

The fire protection systems were sampled by directing the first 3 to 5 min of hydrant flow through a No. 35 sieve during flow testing. The contents of the sieves were examined on-site for the presence of shell or shell fragments. No microscopic examination was required for these samples.

Although a monthly sampling plan was originally scheduled, plant management prohibited flow testing without the introduction of a molluscicide into the system. This requirement restricted the frequency of fire protection sampling to those treatment times.

2.3 ARTIFICIAL SUBSTRATES

A number of artificial substrates were deployed. To assess the degree of zebra mussel settlement within the circulating water, ESW, and NESW systems, three artificial substrates were placed in the intake forebay upstream of the trash racks and two biomonitors were set in the ESW and NESW systems respectively. The forebay samplers consisted of Plexiglass racks (Figure 2-1) designed to hold 40 standard microscope slides that could be removed for analysis. Two slides were placed back to back in each slot, which eliminated the need for scraping. Racks were deployed by ropes to approximately 0.5 m from the bottom, anchored with a cinder block, and oriented such that flow was perpendicular to the vertically placed slides. Deployment of racks followed approved I&M plant equipment installation procedures.

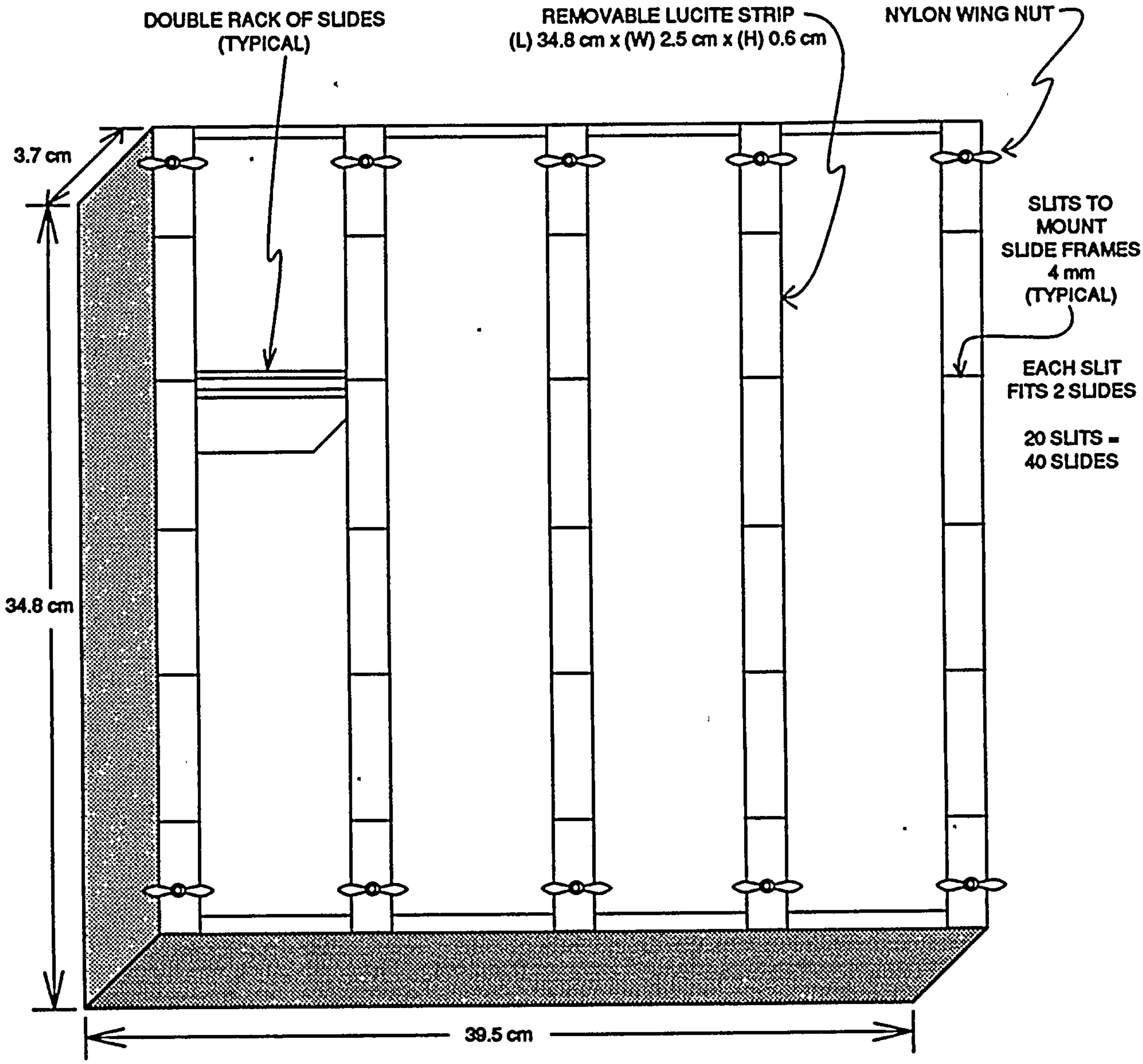
Artificial substrates placed in the ESW and NESW systems consisted of test tube racks equipped with 12 microscope slides each. Two racks were placed within each biomonitor (Figure 2-2).

The slides were examined every two weeks during the months of July, August, September, and October. The set time was extended to three weeks during November and December.

Slides removed from the forebay racks and biomonitors were examined using a low-power (10-40x) dissecting microscope. Mussels that settled on the entire area of one side of a slide

FIGURE 2-1

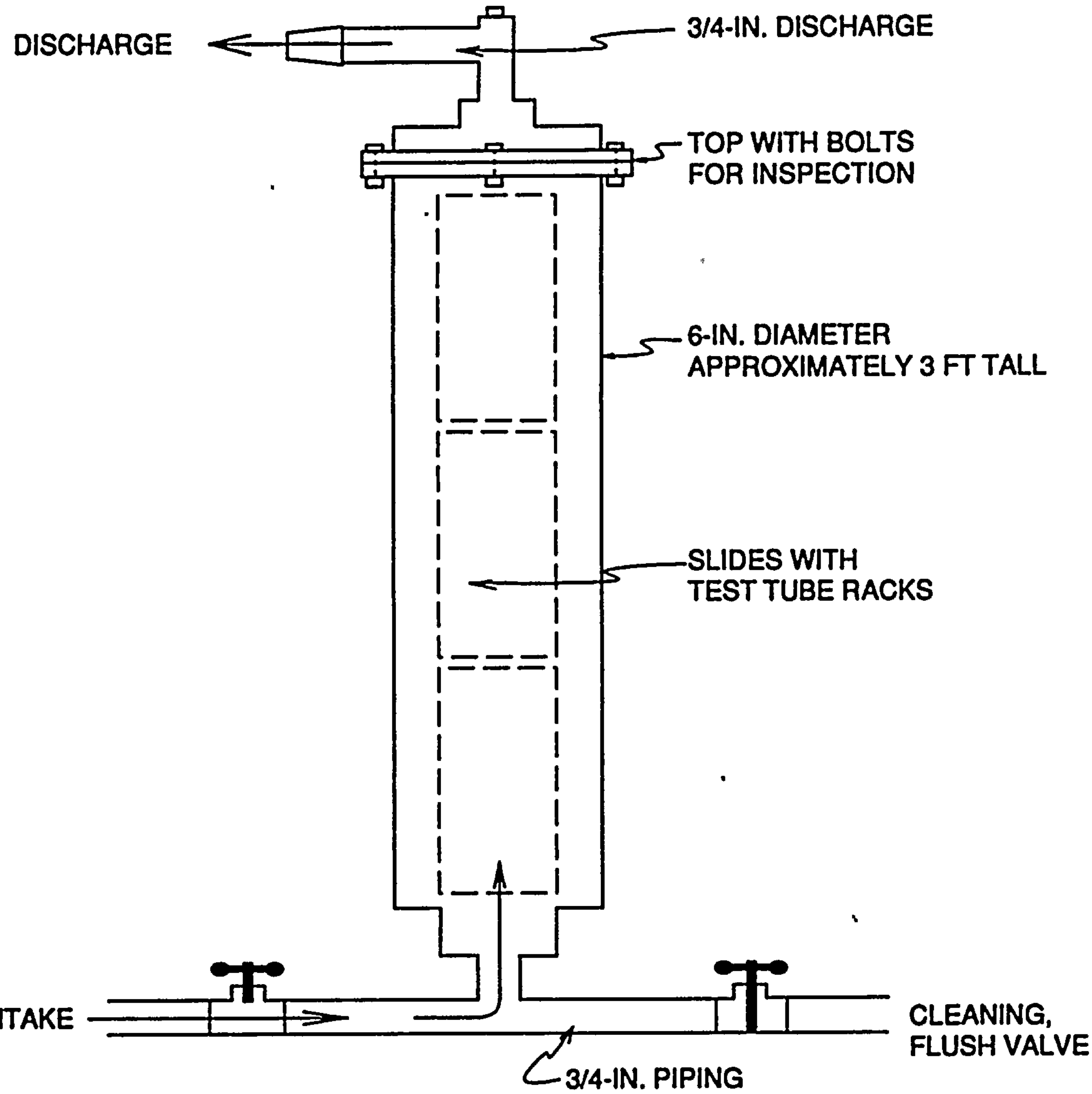
SLIDE RACK FOR DEPLOYMENT IN INTAKE FOREBAY
Donald C. Cook Nuclear Plant 1992



NOT TO SCALE

FIGURE 2-2

ARTIFICIAL SUBSTRATE BIOMONITOR
Donald C. Cook Nuclear Plant 1992



(25 mm x 75 mm) were counted. This value was multiplied by a conversion factor (533) to calculate the number of settled mussels per square meter. These numbers were then averaged for all slides contained within a sampler to compute average settling densities during each sampling interval at each location.

2.4 BEACH WALK SAMPLING

Beach walk sampling was conducted once during each of the months of July, September, and November. The major areas examined were the beach adjacent to the plant and the jetty and riprap at the mouth of the St. Joseph River in St. Joseph, Michigan. Beach walks were limited to 45 min in each area per sampling period.

2.5 INSPECTION SAMPLING ANALYSES

Plant personnel submitted two samples taken from or near the plant for analysis. Sample analysis consisted of inspection for whole mussels and shell fragments.

2.6 RANDOM SAMPLING ANALYSES

Plant personnel deployed substrates treated with experimental protective coatings for a six-week study period (mid-July to early September). Substrates were examined for visible settled juveniles, with the degree of infestation being noted as heavy, medium, light, or none. Those with light or no juvenile settlement were further analyzed under magnification to determine quantitative postveliger settlement densities, if necessary.

2.7 WATER QUALITY MONITORING

During each sampling event (whole water and artificial substrate), water temperatures and pH measurements were taken with calibrated certified ASTM thermometers and pH pens, giving the precision level of ± 0.1°C and ± 0.1 pH units, respectively.

2.8 NONRADIOLOGICAL QUALITY ASSURANCE/QUALITY CONTROL

Nonradiological quality assurance/quality control (QA/QC) was an important aspect of the program. QA was incorporated into the program in several areas. LMS personnel assigned to this project were trained on-site in proper collection and handling techniques. Standard procedures were developed and followed. Laboratory techniques were supervised by Ms. Bardygula-Nonn, our in-house expert. Ms. Bardygula-Nonn served as the QC inspector throughout the study. Field audits were performed on whole-water sampling, artificial substrate sampling, and one beach walk. Laboratory QC inspections showed an average outgoing quality level (AOQL) of <0.05.

The AOQL is based on quality control statistical probability. It denotes the number of defective units (errors) that can be expected in the product. In this case, the accuracy of the product is predicted to be greater than 95% based on inspection of samples and the measures taken to correct defects (errors).

CHAPTER 3

RESULTS

3.1 CIRCULATING AND SERVICE WHOLE-WATER SAMPLING

Sampling of planktonic veligers in the circulating, ESW, and NESW systems was initiated on 20 July and completed 14 August. A total of 24 samples were taken in the three different systems.

The circulating water system sampler was susceptible to mechanical failure. On two occasions, the pump's thermal protector shut down the unit during the 24-hr sampling period. Causes were actual pump failure and a clogged intake. High plankton densities in forebay on 11 and 14 August caused the net to clog and overflow during the night hours. As a result, samples on these dates represent 8 hrs of sampling. All changes were made after approval by I&M personnel. In light of these problems, care must be taken when interpretating the circulating water data, as early counts are likely underestimated.

No similar problems were encountered on the ESW and NESW systems because they were equipped with valves capable of adjusting flow rates. The 21 July sample from the NESW system was not taken because no flow was available at the sampling point. This was a result of an outage. The sampling apparatus was moved to a new location in the system for the next sample period, thereby solving the problem.

Results of sampling are presented in Table 3-1 and Figure 3-1. ESW results showed one major peak on 11 August, when densities were in excess of $7000/m^3$. The NESW system exhibited a peak during each sampling date during the 4-11 August period. Densities in the circulating water system did not exceed $2000/m^3$ during the sampling season but did peak on 11 August.

TABLE 3-1

WHOLE-WATER SAMPLING
VELIGERS/1000 l, TEMPERATURE, AND pH
Donald C. Cook Nuclear Plant

21 July - 14 August 1992

DATE	LOCATION	VELIGER ABUNDANCE	°C	pH
21 July	Forebay	8	21.9	8.4
	ESW	1395	28.9	8.3
	NESW	a	a	a
24 July	Forebay	7	15.6	8.1
	ESW	1693	16.2	8.2
	NESW	1049	19.0	8.0
28 July	Forebay	68	18.5	7.9
	ESW	753	18.7	8.1
	NESW	1280	22.9	7.9
30 July	Forebay	b	18.5	8.2
	ESW	32	21.5	8.4
	NESW	148	25.0	8.2
4 August	Forebay	546	19.8	8.4
	ESW	1925	20.0	8.5
	NESW	5350	21.5	8.5
7 August	Forebay	b	19.3	8.2
	ESW	1610	19.5	8.2
	NESW	6300	20.4	8.2
11 August	Forebay	1967[c]	21.8	8.5
	ESW	7043	22.2	8.7
	NESW	5595	22.3	8.7
14 August	Forebay	1438[c]	18.9	8.1
	ESW	3291	19.3	8.1
	NESW	2373	19.9	8.1

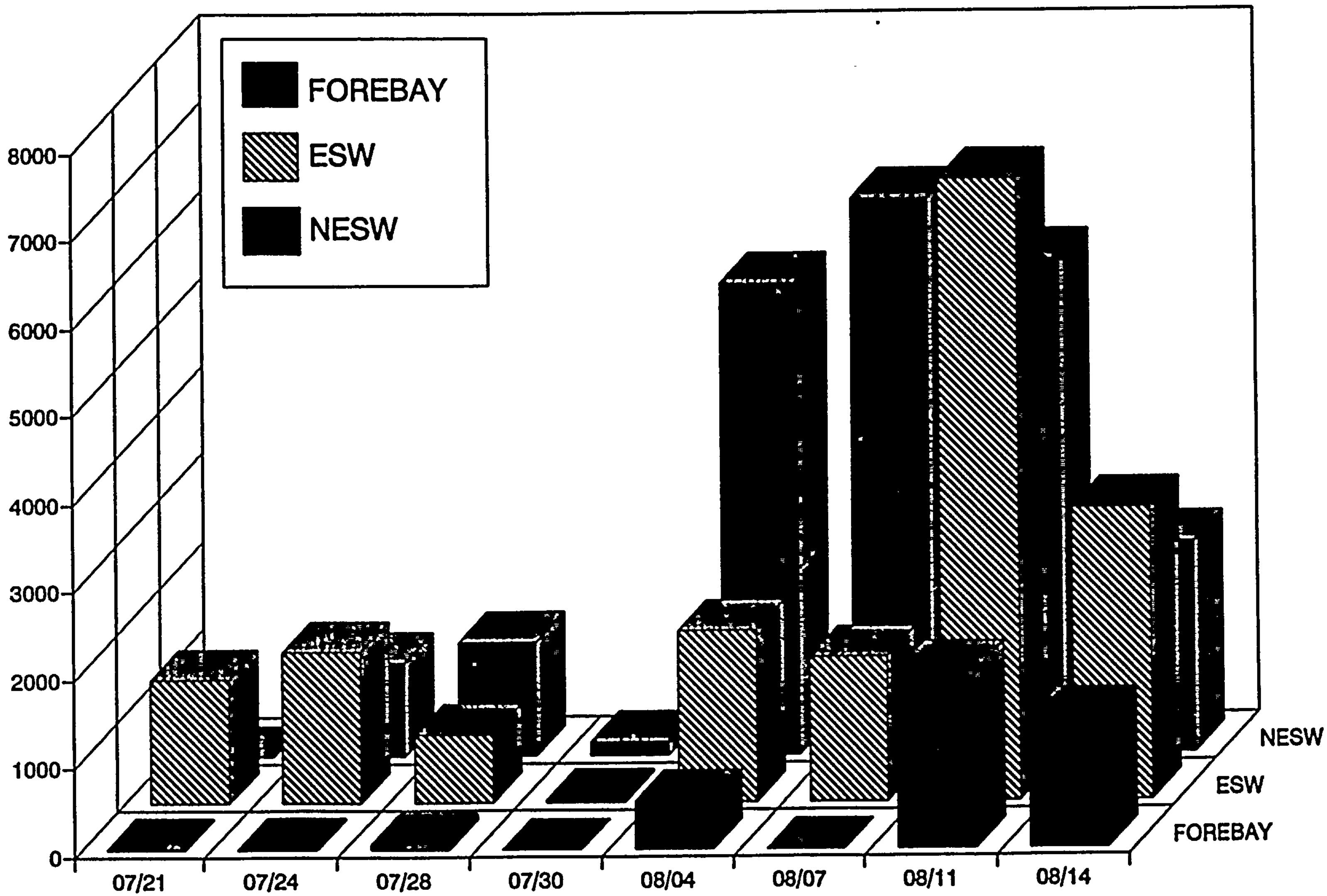
[a]No sample due to inadequate flow.
[b]No sample due to pump clogging or failure.
[c]Represents 8 hrs of sampling.

Figure 3-1

Whole Water Sampling

Veligers Per 1000 Liters

Donald C. Cook Nuclear Plant 1992



3.2 FIRE PROTECTION SYSTEM SAMPLING

No mollusks were found in any of the hydrant samples.

3.3 ARTIFICIAL SUBSTRATE SAMPLING

3.3.1 Forebay Settling

Settling rates for the circulating water system (forebay) are shown in Table 3-2 and Figure 3-2. Averages for the three forebay locations are not presented so that spatial differences in settlement resulting from different flow velocities within the baffles installed in the forebay can be shown.

Peak settlement occurred on 6 October with slightly over 100,000/m^2 detected in the sheltered central forebay location. Other forebay locations peaked simultaneously but at much lower densities (6000 to 8000 m^2). These peaks occurred after the whole-water sampling program had ended; therefore, no inferences can be made. A late peak that occurred on 10 November at the central forebay location was the result of larger juveniles translocating from the Plexiglass frame to the slides. This phenomenon continued until 22 December, suggesting active movement even at low lake temperatures.

No data are presented for the forebay south location for 10 November to 22 December. As the unit came on line successive circulating pumps were turned on, creating the high water velocities and heavy turbulence. This turbulence shattered all slides held at this location.

3.3.2 Service Water Settling

Settling rates for the service water systems are shown in Table 3-2 and F:gure 3-2. An early peak (more than 45,000/m^2) occurred on 25 August in the ESW system, while densities over 5000/m^2 occurred sporadically from early August to the beginning of December. The NESW system exhibited a much lower peak of approximately 8700/m^2 on 8 September.

TABLE 3-2

POSTVELIGER SETTLEMENT - No./m^2
Donald C. Cook Nuclear Plant

July - December 1992

DATE	NESW	ESW	FOREBAY SOUTH	FOREBAY CENTRAL	FOREBAY NORTH
28 July	2,373	0	0	4,160	2,311
11 August	6,044	1,467	461	1,067	313
25 August	5,237	45,262	486	1,397	338
8 September	8,693	6,719	526	871	379
22 September	2,469	1,621	4,101	3,754	3,797
6 October	7,176	5,478	6,019	102,099	8,037
20 October	2,711	a	106	239	133
10 November	711	7,422	b	13,493	5,165
1 December	667	7,155	b	2,320	533
22 December	274	4,522	b	1,573	338

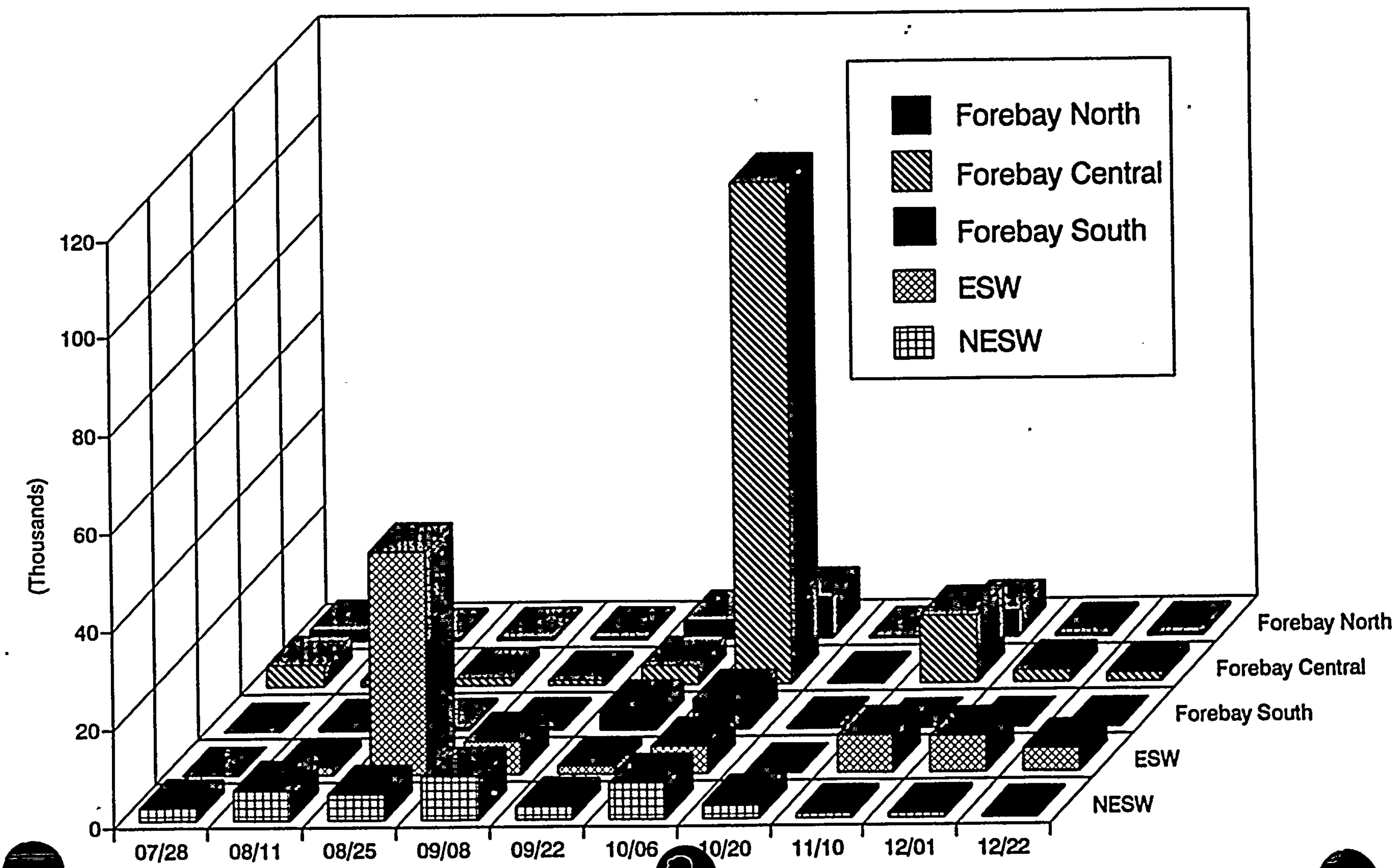
[a]Result of no flow through biomonitor; flow restriction caused by accumulation of zebra mussel shells.
[b]Slides broken by turbulence.

Figure 3-2

Post Veliger Settlement

Individuals Per Square Meter

Donald C. Cook Nuclear Plant 1992



These relatively high values may not be representative of actual settling within the system because of design problems with the biomonitors used to house the slides. Having low flow rates and an upflow design, these biomonitors easily clogged with sand, silt, and zebra mussel shells and shell fragments. Because of the reduced flow, settling data for NESW and ESW should be considered qualitatively.

Visual inspections showed that live juveniles were regularly present inside the biomonitors prior to the Clam-Trol, CT-1 treatment. They reappeared in early October to late December. Juveniles of 3 to 5 mm were abundant during the final inspection on 22 December, indicating survival and growth of zebra mussels within low-flow areas of the service water systems. No zebra mussel settling was observed on the heat exchanger in the condenser tubes at these stations.

3.3.3 Qualitative Effects of Biocide Treatments

Two types of biocides were used to control the zebra mussel within the Cook Nuclear Plant. Chlorine as sodium hydrochlorite, presently permitted under the facility's National Pollutant Discharge Elimination System Permit, was injected into all systems throughout the period of this project. Chlorine was injected continuously for 2 hrs during each 24-hr period. Based on the observations; this was not effective.

Clam-Trol, CT-1, a proprietary molluscicide, was added as a 12-hr treatment on 16 September. Substrates examined on 22 September indicated >90% mortality. This effective treatment was, however, short lived; three weeks later, peak settlement occurred in the forebay.

3.4 BEACH WALK SAMPLING

Two locations were examined as part of the beach walk sampling effort. The first location was the beach adjacent to the Cook Nuclear Plant. Because there is minimal hard substrate present on this beach, the examination focused on searching for loose shells. The second

location was an area of riprap along the south side of the south jetty at the mouth of the St. Joseph River in St. Joseph, Michigan.

On 23 July the beach near the plant was examined. Numerous clumped and single dead zebra mussel adults and shell fragments were found along the storm wash line. Examination along the south jetty in St. Joseph also revealed beach-washed dead adults and shells.

The walks were repeated on 22 September and 10 November with similar findings.

3.5 INSPECTION SAMPLE ANALYSES

Two inspection samples were collected by plant personnel and shipped to LMS for analysis. Results are shown in Table 3-3.

3.6 RANDOM SAMPLE ANALYSES

A test was conducted from July 17, 1992 to September 8, 1992 on several coatings that are marketed as antifouling coatings. Metal coupons with various coatings were placed in the intake forebay for the test period, retrieved, and the settlement rate evaluated. The company is reviewing these data and the results from other research on coatings to determine the usefulness of antifouling coating on intake structures such as trash racks and traveling screen assemblies.

3.7 WATER QUALITY MONITORING

Water temperatures and pH were recorded during each whole-water and artificial substrate sampling period. Values recorded during the collection of whole-water samples are presented in Table 3-1. Those values recorded during the postveliger settlement collections are shown in Table 3-4.

TABLE 3-3

INSPECTION SAMPLE ANALYSES
Donald C. Cook Nuclear Plant

July and September 1992

DATE	SITE DESCRIPTION	RESULTS	
7 July	Traveling Screen Bay 1-2	Adults (8+ mm)	126
	Temp: 18.8 °C	Juveniles (3-8 mm)	216
	pH: 8.1	Shell Fragments	Abundant
30 September	North Side Center Intake	Adults (8+ mm)	6
	Crib - Lake Bottom	Juveniles (3-8 mm)	17
	Temp: 12.2 °C	Shell Fragments	30
	pH: 8.1	Small Snails	4

TABLE 3-4

TEMPERATURE AND pH VALUES, POSTVELIGER SETTLEMENT COLLECTIONS
Donald C. Cook Nuclear Plant

July - December 1992

DATE	FOREBAY		ESW		NESW	
	pH	°C	pH	°C	pH	°C
28 July	8.2	18.2	8.1	18.7	7.9	22.9
11 August	8.5	21.3	8.7	22.2	8.7	22.3
25 August	8.1	22.0	8.2	22.9	8.1	22.7
8 September	7.9	21.5	8.1	22.5	8.1	21.9
22 September	8.1	15.0	8.2	16.7	8.2	18.2
6 October	-[a]	-[a]	8.1	14.6	8.1	15.1
20 October	-[a]	-[a]	8.1	12.5	8.1	12.7
10 November	8.0	10.4	8.0	11.3	8.0	11.5
1 December	8.0	7.2	8.1	8.5	8.1	8.7
22 December	8.0	3.7	8.0	4.3	8.0	5.7

[a]Not available from plant personnel.

CHAPTER 4

DISCUSSION OF RESULTS

4.1 CIRCULATING AND SERVICE WHOLE-WATER SAMPLING

Veliger abundance data presented in Table 3-1 must be viewed with caution. The many mechanical problems encountered sampling the forebay greatly influenced the results. Even though the data reported for 11 and 14 August represent 8- rather than 24-hr samples, these results, when extrapolated to a 24-hr period, may be the most representative of the concentration of veligers in the forebay during the four-week period. These forebay data may reflect the beginning of the spawning peak that resulted in peak settlement during September throughout the region (reported by numerous investigators during the Third International Zebra Mussel Conference, Toronto, February 1993).

Comparison of the extrapolated forebay veliger concentrations to the veliger concentrations reported for the service water systems on 11 and 14 August suggests that forebay and service water concentrations were similar. Based on this comparison, concentrations of veligers in the forebay may have been similar to those reported for the service water systems on the earlier sampling dates when mechanical problems occurred with forebay sampling.

4.2 ARTIFICIAL SUBSTRATE SAMPLING

4.2.1 Forebay

In the forebay, postveliger settlement was low until September, with the exception of the central and north locations on 28 July. These higher concentrations most likely reflect a spawning spate that occurred during the first half of July, before the whole-water monitoring program was initiated. The higher concentrations reported for September follow the trend reported by numerous other investigators working in the southern Lake Michigan region (Third International Zebra Mussel Conference).

The highest concentrations recorded at each location in the forebay occurred on 6 October, approximately three weeks after the Clam-Trol treatment. While reasons for the high settlement are not known at this time, this phenomenon has been observed in previous years.

The secondary peak of settlement recorded at the central and north locations on 10 November reflects the translocation of juveniles rather than settling of a new cohort during the sampling period. This translocation continued at reduced rates until the end of the sampling program in December.

4.2.2 Service Water Systems

Settlement occurred throughout the sampling season on the artificial substrates placed in the NESW and ESW systems. During the period covering the sets made on 28 July through those collected on 8 September, the concentrations in the service water system biomonitors exceeded the concentrations reported in the forebay. At a minimum, this indicates that the chlorine injection that occurred upstream of the biomonitors was ineffective at preventing settling. This is most likely attributable to the 2-hr continuous injection during each 24-hr period rather than intermittent injections throughout each day. A second confounding factor was the low flow, upflow design of the biomonitors. This design was amenable to easily clogging and may not have accurately represented the actual flow conditions in the systems at the monitoring locations, i.e. high velocities in service water pipes. Taken together, these two factors contributed to the high concentrations.

4.3 BEACH WALKS

Beach walk inspections in the vicinity of the plant and St. Joseph's harbor revealed no indication of live, attached adult zebra mussels in these areas. Observations made near the plant revealed that a lack of suitable substrate was available for zebra mussel attachment. Numbers of dead or detached shells in the drift line were observed in both locations. These had washed on shore during storm events.

4.4 WATER QUALITY MONITORING

Water temperatures in the forebay followed expected seasonal trends. Temperatures recorded at the NESW and ESW stations were slightly higher than those reported for the forebay with NESW temperatures being the highest.

Values reported for pH indicate that pH generally ranged between 7.9 and 8.2. Exceptions occurred on 4 and 11 August when recorded pH values were between 8.4 and 8.7. All these values are basic, suggesting that water conditions are conducive to zebra mussel life history success. Actual water concentrations of calcium would be required to verify this condition.

4.5 RECOMMENDATIONS

Based on observations made during the course of this program, several recommendations are being presented to eliminate certain problems and to acquire a more complete data base. These include the following:

- Plate samplers rather than slide samplers are recommended for the forebay stations.
- In-line flowmeters are recommended for all biobox installations. This will eliminate inaccurate flows being estimated when clogging or other mechanical problems prematurely end the sampling.
- Commercially constructed bioboxes should be used for in-plant service water system sampling. These should be located in areas where pipeline flow is slow enough to permit postveliger settling.
- Whole-water sampling should be initiated during the early part of May or when forebay temperatures are 10°C and continue to September. According to Ellen Marsden (pers. commun.), portions of southern Lake Michigan were reported to have veliger densities of approximately 30,000/m^3 by mid-May 1992. This is important to make decisions regarding initiation of preventive control programs.
- Postveliger settlement sampling needs to be conducted from mid-May through December at a minimum. This will allow monitoring of settlement times and preventative control success within the service water or other systems.

APPENDIX A

EXPERIMENTAL COATINGS TEST
Donald C. Cook Nuclear Plant Forebay

17 July - 8 September 1992

NAME	JUVENILE INFESTATION	POSTVELIGER SETTLEMENT (No./m^2)
Rhino-textured red	None	1,599
Rhino-grey mesh	Light	-
Rhino-grey triangle	None	1,599
Porter HKA 800 Sys 2000	None	12,799
Epotech 2000	None	none
Dow Envelon	Heavy	-
Wisconsin C-793	Medium	-
Porter Multi	Light	3,733-5,333
Easy-On	Light	34,133
Zebra Wax	None	5,866
Plastic Bar Grill	Light	-

APPENDIX V

ANNUAL REPORT: RADIOLOGICAL ENVIRONMENTAL

MONITORING PROGRAM

1992

DONALD C. COOK NUCLEAR PLANT

UNITS 1 & 2

OPERATIONAL

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1992 ANNUAL REPORT

JANUARY 1 to DECEMBER 31, 1992

Prepared by

Indiana Michigan Power Company

and

Teledyne Isotopes

April 15, 1993

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INDIANA MICHIGAN POWER COMPANY

DONALD C. COOK POWER NUCLEAR PLANT

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY

This report summarizes the collection and analysis of various environmental sample media in 1992 for the Radiological Environmental Monitoring Program for the Donald C. Cook Nuclear Plant.

The various analyses of most sample media suggest that there was no discernable impact of the nuclear plant on the environment. The analysis of air particulate filters, charcoal cartridges, direct radiation by thermoluminescent dosimeters, fish, water, milk and sediments from Lake Michigan, drinking water, and food products, either did not detect any radioactivity or measured only naturally occurring radionuclides at normal background levels.

Tritium, measured at low levels in on-site wells, appears to be the only radionuclide attributable to the plant operations. However, the associated groundwater does not provide a direct dose pathway to man.

I. INTRODUCTION

I. INTRODUCTION

The Donald C. Cook Nuclear Plant's Radiological Environmental Monitoring Program (REMP) is conducted in compliance with NRC Regulatory Guide 1.21 and 4.1, licensing commitments, and Technical Specifications. The REMP was developed in accordance with the NRC Radiological Assessment Branch Technical Position (BTP), Rev. 1, November 1979. A synopsis of the sampling program and maps can be found in Section II, Sampling and Analysis Program. This report represents the Annual Environmental Operating Report for Units 1 and 2 of the Donald C. Cook Nuclear Plant for the operating period from January 1, 1992 through December 31, 1992.

A. The Donald C. Cook Nuclear Plant of Indiana Michigan Power Company is located on the southeastern shore of Lake Michigan approximately one mile northwest of Bridgman, Michigan. The plant consists of two pressurized water reactors, Unit 1, 1030 MWE and Unit 2, 1100 MWE. Unit 1 achieved initial criticality on January 18, 1975 and Unit 2 achieved initial criticality on March 10, 1978.

B. Objectives

The objectives of the operational radiological environmental monitoring program are:

1. Identify and measure radiation and radioactivity in the plant environs for the calculation of potential dose to the population.

2. Verify the effectiveness of in-plant measures used for controlling the release of radioactive materials.

3. Provide reasonable assurance that the predicted doses, based on effluent data, have not been substantially underestimated and are consistent with applicable standards.

4. Comply with regulatory requirements and Station Technical Specifications and provide records to document compliance.

II. SAMPLING AND ANALYSIS PROGRAM

II. SAMPLING AND ANALYSIS PROGRAM

Table 1 summarizes the sampling and analysis program for the Donald C. Cook Nuclear Plant for 1992. For each sample medium, the table lists the sample locations, including distance and direction from the center of the two units, and the station identification. The station identifications for many of the sampling locations are shown on the maps, Figures 1, 2, and 3. Also for each sample medium the sample collection frequency, type of analysis, and frequency of analysis are listed.

TABLE 1

DONALD C. COOK NUCLEAR PLANT- 1992

RADIOLOGICAL SAMPLING STATIONS

DISTANCE AND DIRECTION FROM PLANT AXIS

Location	Station	Distance	Direction	Degrees	Collection Frequency	Analysis/Frequency
Environmental (TLD's)						
ONS-1	(A-1)	1945 ft.		18°		
ONS-2	(A-2)	2338 ft.		48°		
ONS-3	(A-3)	2407 ft.		90°		
ONS-4	(A-4)	1852 ft.		118°		
ONS-5	(A-5)	1895 ft.		189°		
ONS-6	(A-6)	1917 ft.		210°		
ONS-7	(A-7)	2103 ft.		36°		
ONS-8	(A-8)	2208 ft.		82°		
ONS-9	(A-9)	1368 ft.		149°		
ONS-10	(A-10)	1390 ft.		127°		
ONS-11	(A-11)	1969 ft.		11°		
ONS-12	(A-12)	2292 ft.		63°		
New Buffalo	(NBF)	16.0 mi	SSW		Quarterly	Direct Radiation/Quarterly
South Bend	(SBN)	24.0 mi	SE			
Dowagiac	(DOW)	24.3 mi	ENE			
Coloma	(COL)	18.9 mi	NNE			
Intersection of Red Arrow Hwy. & Marquette Woods Rd, Pole #B294-44	(OFS-1)	4.5 mi	NE			
Stevensville Substation	(OFS-2)	3.6 mi	NE			
Pole #B296-13	(OFS-3)	5.1 mi	NE			
Pole #B350-72	(OFS-4)	4.1 mi	E			
Intersection of Shawnee & Cleveland, Pole #B387-32	(OFS-5)	4.2 mi	ESE			
Snow Rd., East of Holden Rd., #B426-1	(OFS-6)	4.9 mi	SE			
Bridgman Substation	(OFS-7)	2.5 mi	S			
California Rd., Pole #B424-20	(OFS-8)	4.0 mi	S			
Riggles Rd., Pole B369-214	(OFS-9)	4.4 mi	ESE			
Intersection of Red Arrow Hwy., & Hildebrant Rd.,Pole #B422-152	(OFS-10)	3.8 mi	S			
Intersection of Snow Rd. & Baldwin Rd., Pole #B423-12	(OFS-11)	3.8 mi	S			

TABL[illegible]ont.)

DONALD C. COOK NUCLEAR PLANT- 1992

RADIOLOGICAL SAMPLING STATIONS

DISTANCE AND DIRECTION FROM PLANT AXIS

Location	Station	Distance	Direction	Degrees	Collection Frequency	Analysis/Frequency
Air Charcoal/Particulates						
ONS-1	(A-1)	1945 ft.		18°		
ONS-2	(A-2)	2338 ft.		48°		
ONS-3	(A-3)	2407 ft.		90°		
ONS-4	(A-4)	1852 ft.		118°		
ONS-5	(A-5)	1895 ft.		189°		
ONS-6	(A-6)	1917 ft.		210°	Weekly	Gross Beta/Weekly
New Buffalo	(NBF)	16.0 mi	SSW			I-131/Weekly
South Bend	(SBN)	24.0 mi	SE			Gamma Isotopic/
Dowagiac	(DOW)	24.3 mi	ENE			Quarterly Composite
Coloma	(COL)	18.9 mi	NNE			
Groundwater						
Onsite	(W-1)	1969 ft.		11°		
Onsite	(W-2)	2292 ft.		63°		
Onsite	(W-3)	3279 ft.		107°		
Onsite	(W-4)	418 ft.		301°	Quarterly	Gamma Isotopic/Quarterly
Onsite	(W-5)	404 ft.		290°		Tritium/Quarterly
Onsite	(W-6)	424 ft.		273°		
Onsite	(W-7)	1895 ft.		189°		
Onsite	(W-8)	1279 ft.		53°		
Onsite	(W-9)	1447 ft.		22°		
Onsite	(W-10)	4216 ft.		129°		
Onsite	(W-11)	3206 ft.		153°		
Onsite	(W-12)	2631 ft.		162°		
Onsite	(W-13)	2152 ft.		182°		
Non Technical Specification Related Wells						
Steam Generator Storage Facility	(SGRP-1)	0.8 mi		95°		
Steam Generator Storage Facility	(SGRP-2)	0.7 mi		92°		Gross Beta/Monthly
Steam Generator Storage Facility	(SGRP-4)	0.7 mi		93°	Quarterly	Gross Alpha/Monthly
Steam Generator Storage Facility	(SGRP-5)	0.7 mi		92°		Gamma Isotopic/Monthly

TABLE 1 (Cont.)

DONALD C. COOK NUCLEAR PLANT- 1992

RADIOLOGICAL SAMPLING STATIONS

DISTANCE AND DIRECTION FROM PLANT AXIS

Location		Station	Distance	Direction	Degrees	Collection Frequency	Analysis/Frequency
Drinking Water							
St. Joseph Public Intake		(STJ)	9.0 mi	NE		Daily	Gross Beta/14 Day Composite Gamma Isotopic/14 Day Composite I-131/14 Day Composite
Lake Township Public Intake Station		(LTW)	0.4 mi	S			Tritium/Quarterly Composite
Surface Water							
Condenser Circulating Water Intake		L1	Intake				
Lake Michigan Shoreline		L-2	0.3 mi	S		Daily	Gamma Isotopic/Monthly
Lake Michigan Shoreline		L-3	0.2 mi	N			Composite
Lake Michigan Shoreline		L-4	0.1 mi	S			Tritium/Quarterly Composite
Lake Michigan Shoreline		L-5	0.1 mi	N			
Sediment							
Lake Michigan Shoreline		L-2	0.3 mi	S			
Lake Michigan Shoreline		L-3	0.2 mi	N		Semi-annually	Gamma Isotopic/Semi-
Lake Michigan Shoreline		L-4	0.1 mi	S			Annually
Lake Michigan Shoreline		L-5	0.1 mi	N			
Milk-Indicator							
Totzke Farm	Baroda	Totzke	5.1 mi	ENE			
Schuler Farm	Baroda	Schuler	4.1 mi	SE			
Warmbien Farm	Three Oaks	Warmbien	7.7 mi	S		14 Days	I-131 Sample
Zelmer Farm	Bridgman	Zelmer	4.8 mi	SSE			
Lomzack Farm	Gallen	Lozmack	9.5 mi	SSE			
Freehling Farm	Buchanan	Freehling	7.0 mi	SSE			
Milk-Background							
Wyant Farm	Dowagaic	Wyant	20.7 mi	E		Once every	Gamma Isotopic/Sample
Living[illegible]e Farm	La Porte	Livinghouse	20.0 mi	S		14 Days	I-131/ Sample

TABL[illegible] (cont.)

DONALD C. COOK NUCLEAR PLANT- 1992

RADIOLOGICAL SAMPLING STATIONS

DISTANCE AND DIRECTION FROM PLANT AXIS

Location	Station	Distance	Direction	Degrees	Collection Frequency	Analysis/Frequency
Fish						
Lake Michigan	ONS-N	.3 mi	N		2/year	Gamma Isotopic
Lake Michigan	ONS-S	.4 mi	S			2/year
Lake Michigan	OFS-N	3 .5mi	N			
Lake Michigan	OFS-S	5.0 mi	S			
Grapes/Broadleaf						
Nearest sample to Plant in highest D/Q land sector			Sector J		At time of harvest	Gamma Isotopic at time of harvest.
Grapes						
In a land sector containing grapes approximately 20 miles from the Plant and 180° from the sector with the highest D/Q.			Sector J		At time of harvest	Gamma Isotopic at time of harvest.
Approximately 20 miles from the Plant			Sector B		At time of harvest	Gamma Isotopic at time of harvest.

- Composite samples of Drinking and Surface water shall be collected at least daily.

- Particulate sample filters should be analyzed for gross beta activity 24 or more hours following filter removal. This will allow for radon and thoron daughter decay. If gross beta activity in air or water is greater than 10 times the yearly mean of control samples for any medium, gamma isotopic analysis should be performed on the individual samples.

Please note the following defenitions:

Weekly - at least once every seven (7) days
Monthly - at least once every (31) days
Quarterly - at least once every ninety-two (92) days
Semi-annually - at least once every one hundred eighty-four (184) days

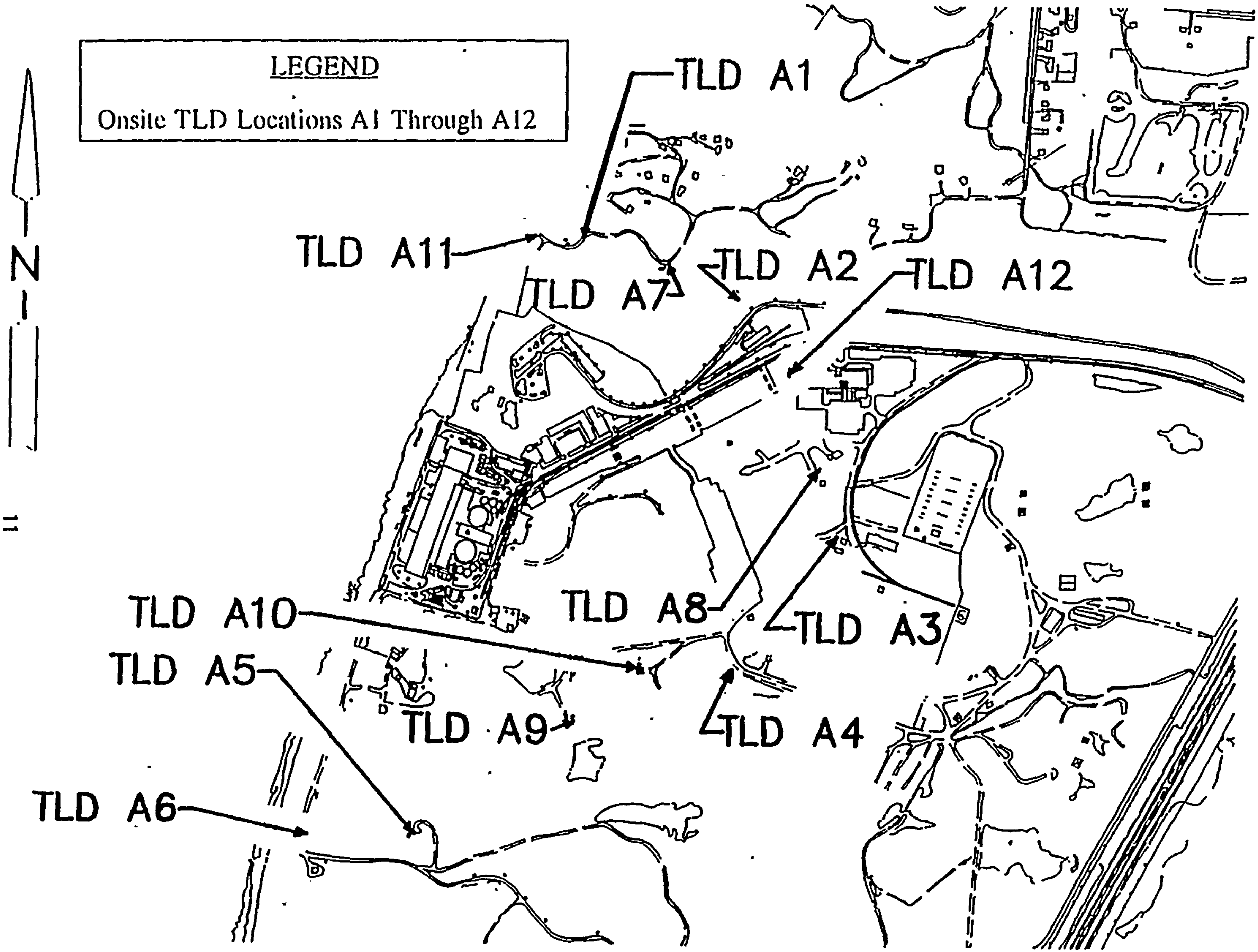
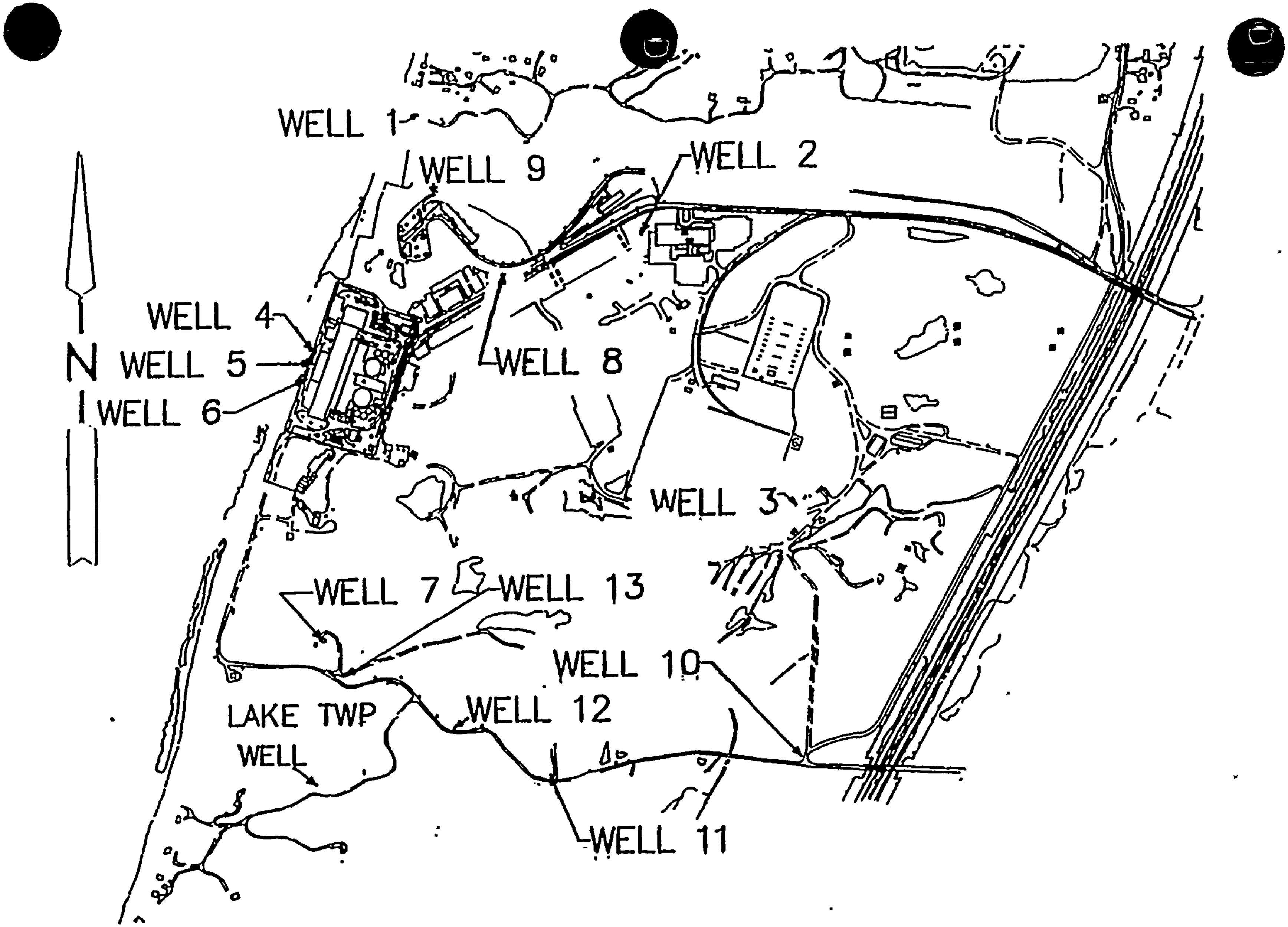

LEGEND
Onsite TLD Locations A1 Through A12
N
TLD A1
TLD A11
TLD A2
TLD A7
TLD A12
TLD A8
TLD A10
TLD A3
TLD A5
TLD A9
TLD A4
TLD A6

Figure 1



LEGEND

Onsite Groundwater Wells W-1 through W-13

Figure 2

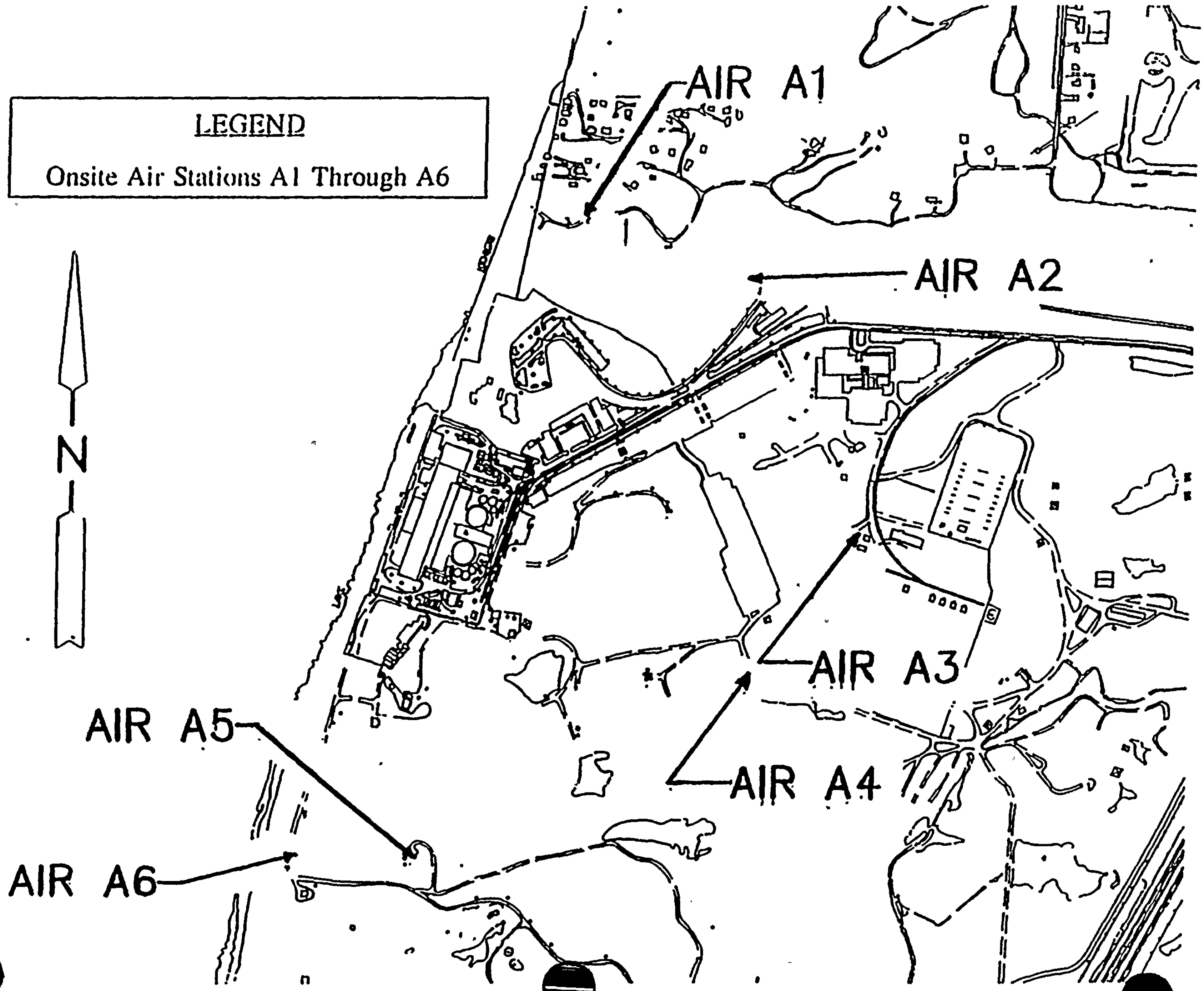

LEGEND
Onsite Air Stations A1 Through A6
N
AIR A1
AIR A2
AIR A3
AIR A4
AIR A5
AIR A6

Figure 3

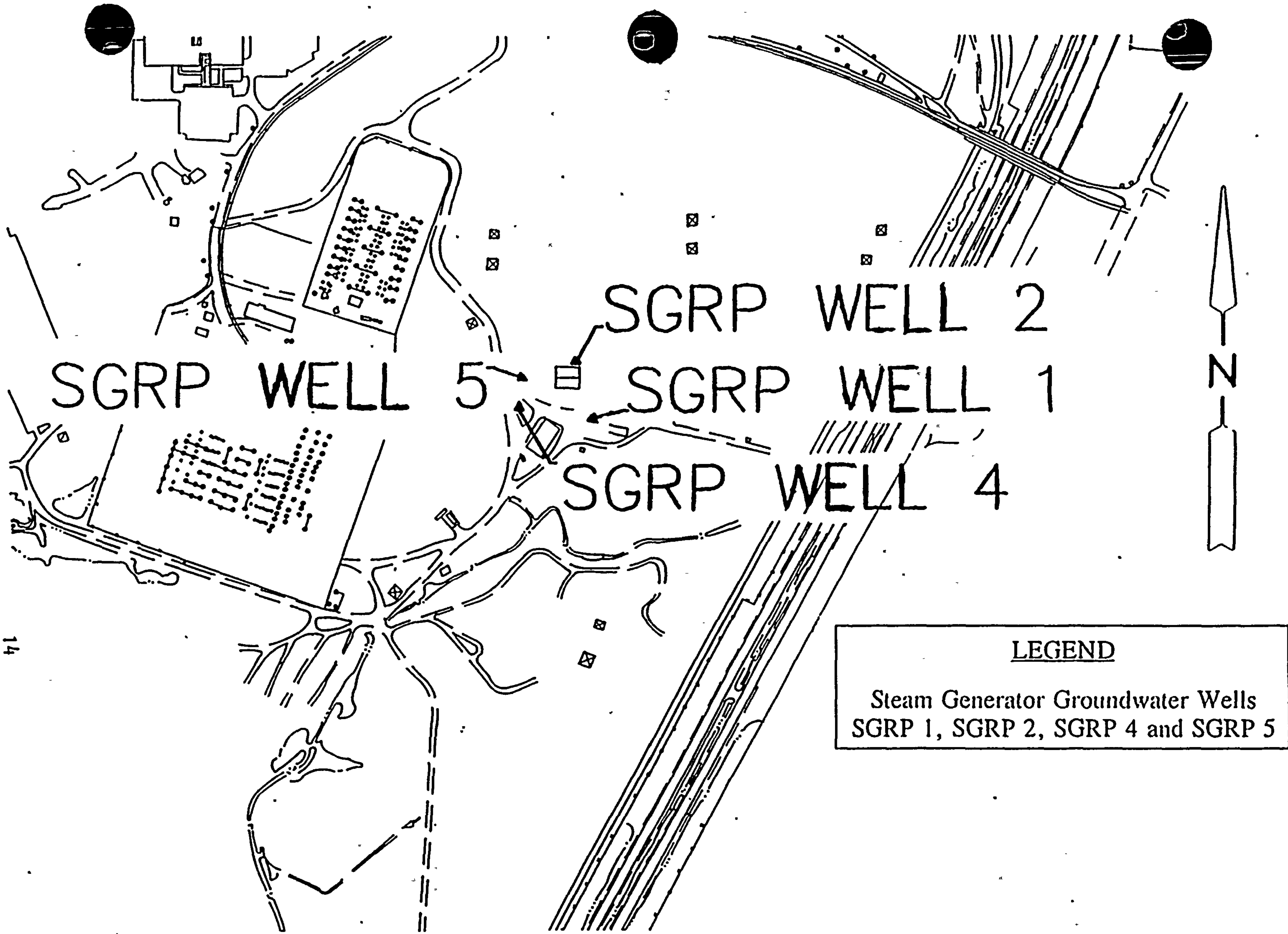

SGRP WELL 2
SGRP WELL 5
SGRP WELL 1
SGRP WELL 4
N
LEGEND
Steam Generator Groundwater Wells
SGRP 1, SGRP 2, SGRP 4 and SGRP 5

Figure 4

Figure 5

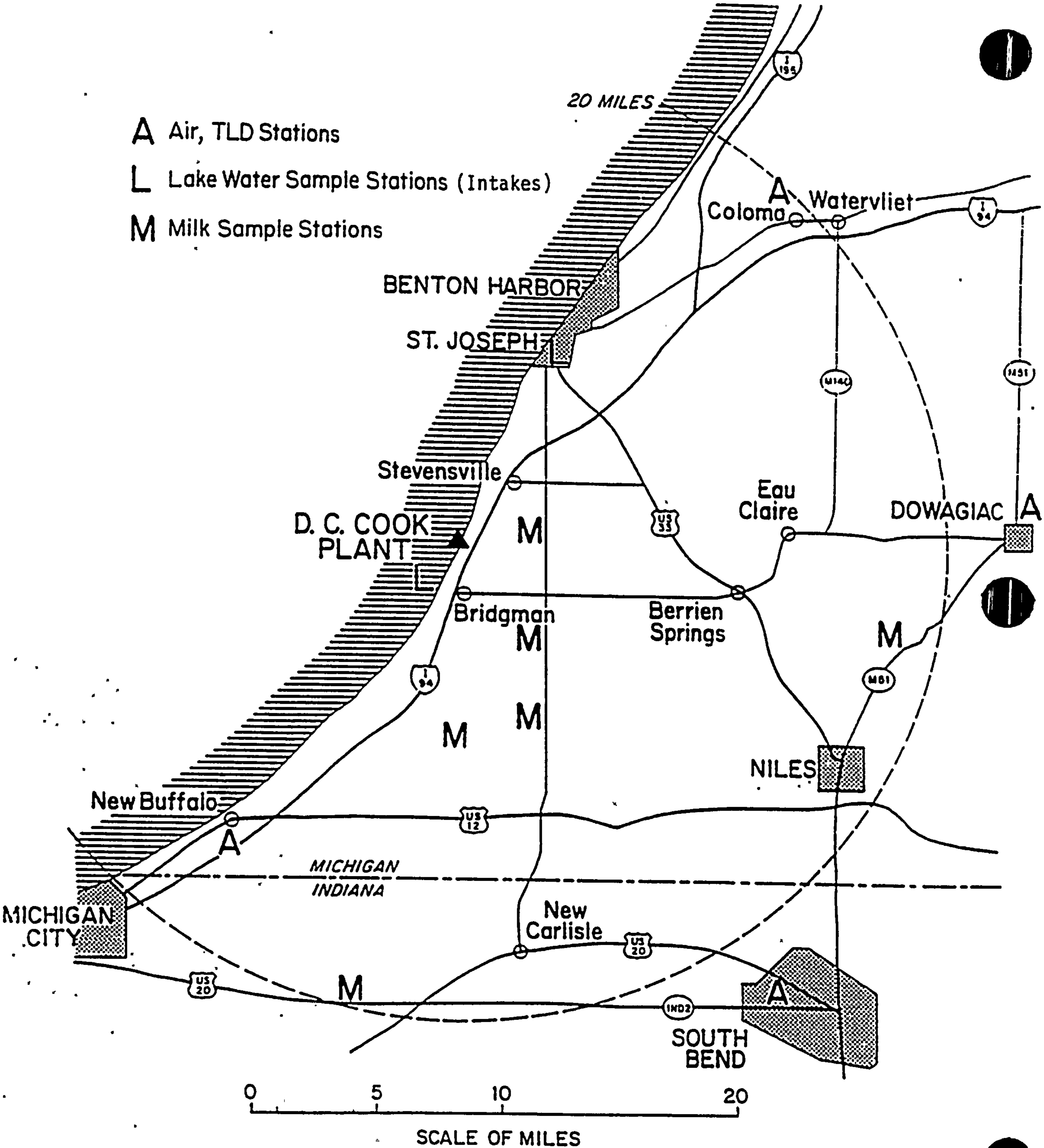

A Air, TLD Stations
L Lake Water Sample Stations (Intakes)
M Milk Sample Stations
20 MILES
BENTON HARBOR
ST. JOSEPH
Coloma
Watervliet
Stevensville
D. C. COOK PLANT
Eau Claire
DOWAGIAC
Bridgman
Berrien Springs
NILES
New Buffalo
MICHIGAN
INDIANA
MICHIGAN CITY
New Carlisle
SOUTH BEND
0
5
10
20
SCALE OF MILES

Figure 6

TLD Stations Within 1-5 Mile Radius of Plant

of Plant

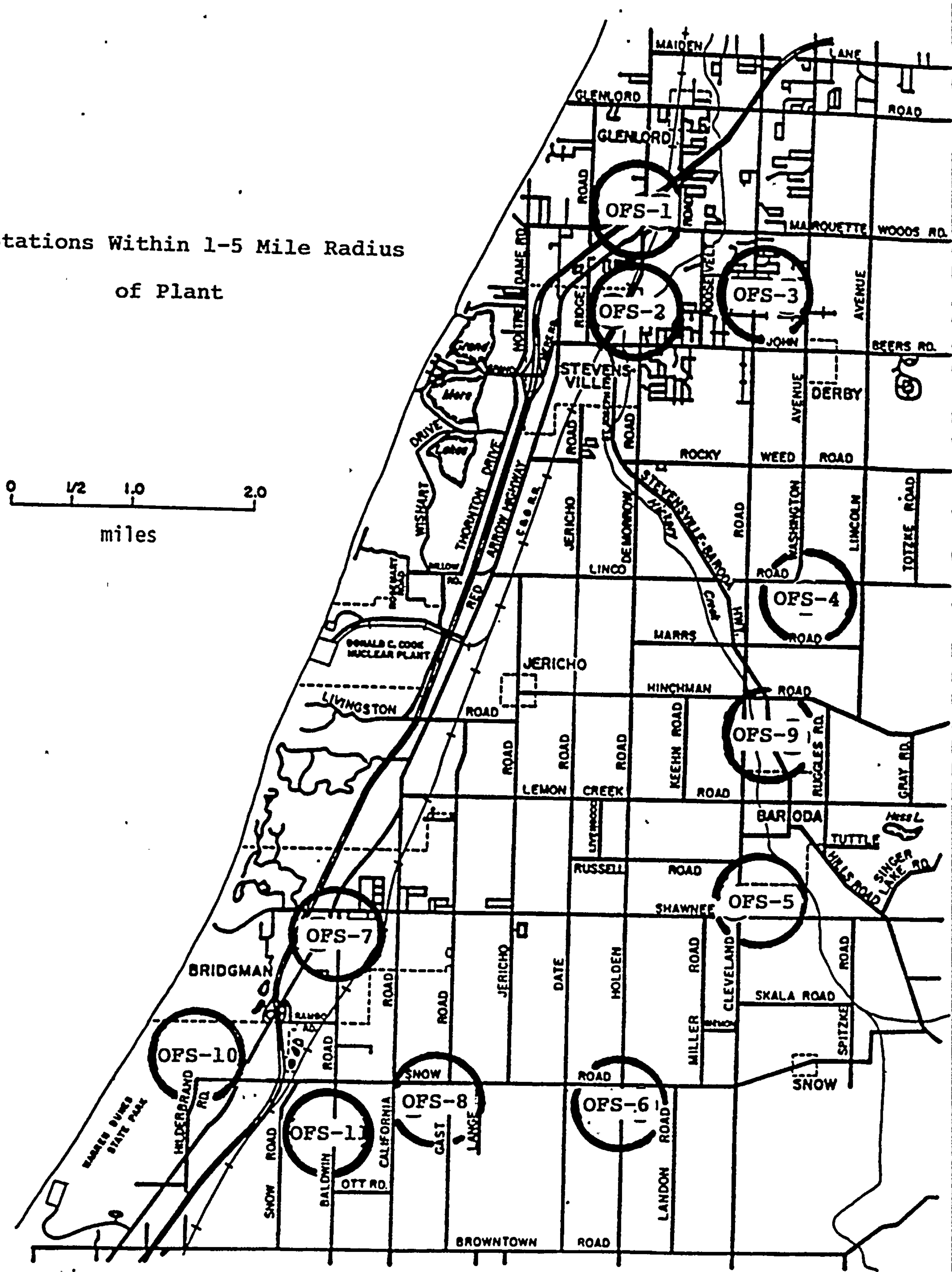
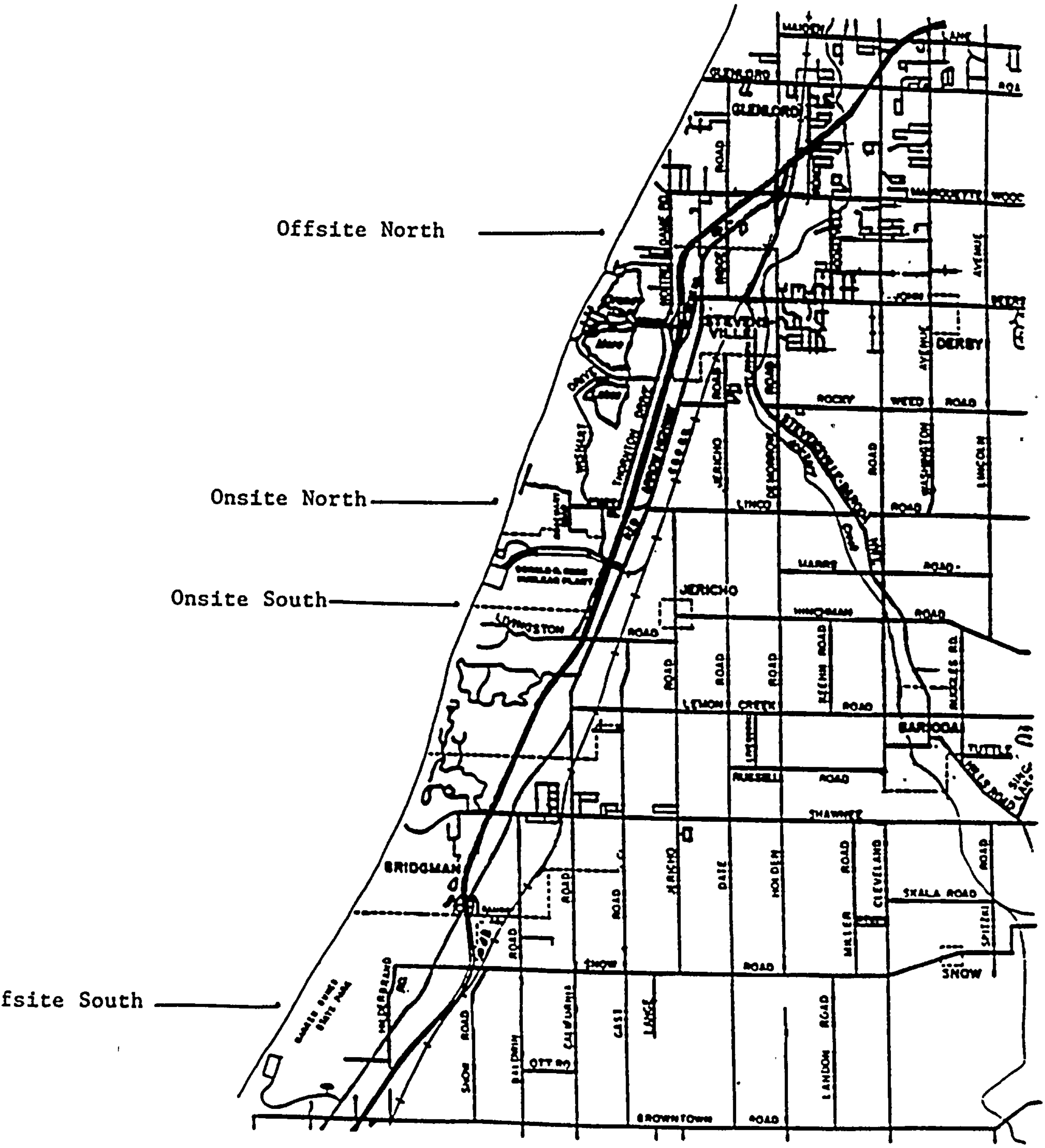


Figure 7

SAMPLING LOCATIONS

FISH COLLECTED FOR RADIOLOGICAL ANALYSIS



III. SUMMARY AND DISCUSSION OF 1992 ANALYTICAL RESULTS

III. SUMMARY AND DISCUSSION OF 1992 ANALYTICAL RESULTS

A discussion of the data from the radiological analyses of environmental media collected during the report period is provided in this section. Analyses of samples for 1992 were analyzed by Teledyne Isotopes, Inc. (TI) in Westwood, New Jersey. The procedures and specifications followed at Teledyne Isotopes are in accordance with the Teledyne Isotopes Quality Assurance Manual and are explained in the Teledyne Isotopes Analytical Procedures. A synopsis of analytical procedures used for the environmental samples are proved in Appendix C. In addition to internal quality control measures performed by Teledyne, the laboratory also participates in the Environmental Protection Agency's Interlaboratory Comparison Program. Participation in this program ensures that independent checks on the precision and accuracy of the measurements of radioactive material in environmental samples are performed. The results of the EPA Interlaboratory Comparison are provided in Appendix D.

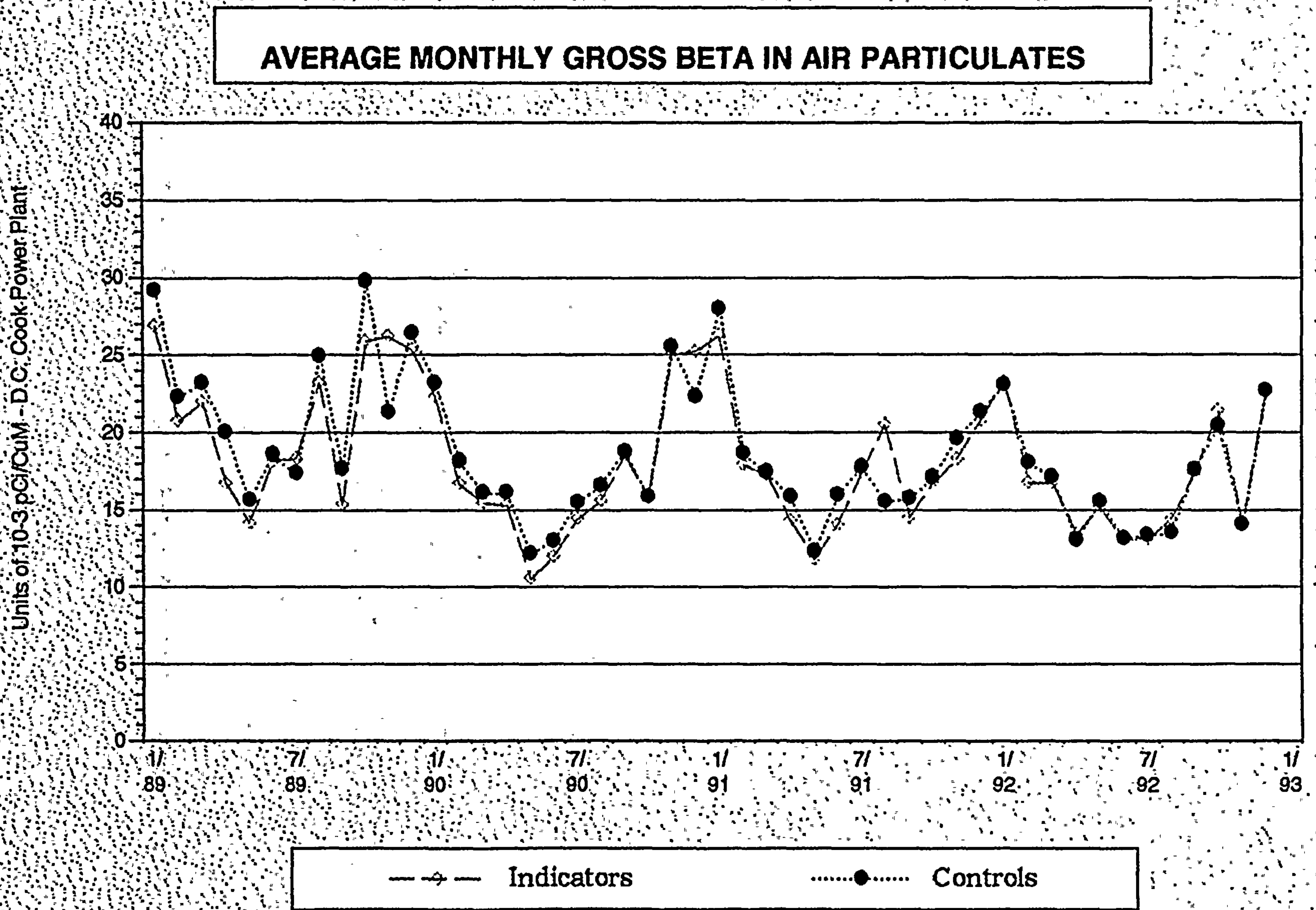
Radiological analyses of environmental media characteristically approach and frequently fall below the detection limits of state-of-the-art measurement methods. Teledyne Isotopes analytical methods meet or exceed the Lower Limit of Detection (LLD) requirements given in Table 2 of the USNRC Branch Technical Position of Radiological Monitoring, Revision 1, November 1979.

The following is a discussion and summary of the results of the environmental measurements performed during the reporting period. Comparison is made where possible with radioactivity concentrations measured in the preoperational period of August 1971 to the initial criticality of Unit 1 on January 12, 1975. A brief summary of the preoperational program is found in Appendix G.

A. Airborne Particulates

Airborne particulate samples are collected with a constant flow oil less pump at 2.0 CFM using a 47 mm particulate filter. Results of gross beta activities are presented in Table B-1. The measurement of

Trending Graph - 1



the gross beta activity on the weekly air particulate filters is a good indication of the levels of natural and or manmade radioactivity in the environment. The average gross beta concentration of the six indicator locations was 0.017 pCi/m^3 with a range of individual values between 0.003 and 0.035 pCi/m^3. The average gross beta concentration of the four control locations was 0.017 pCi/m^3 with a range between 0.007 and 0.035 pCi/m^3. In Trending Graph 1 the monthly average gross beta concentrations for the indicator locations and for the control locations are plotted. The gross beta concentrations in air particulate filters in 1992 were lower than at the end of the preoperational period when the effects of recent atmospheric nuclear tests were being detected.

Air particulate filters were composited by location on a quarterly basis and were analyzed by gamma ray spectroscopy. Beryllium-7 which is produced continuously in the upper atmosphere by cosmic radiation was measured in all forty samples. The average concentration for the control locations was 0.108 pCi/m^3 and the values ranged from 0.088 to 0.177 pCi/m^3. The average concentration for the indicator locations was 0.108 pCi/m^3 with a range of 0.085 to 0.153 pCi/m^3. These values are typical of beryllium-7 measured at various locations throughout the United States. Naturally occurring potassium-40, probably from dust, was measured in six of the twenty-four indicator quarterly composites with an average concentration of 0.006 pCi/m^3 and a range of 0.003 to 0.011 pCi/m^3. Potassium-40 was measured in one of the sixteen control quarterly composites with a concentration of 0.008 pCi/m^3. No other gamma emitting radioactivity was detected.

B. Airborne Iodine

Airborne particulate samples are collected with a constant flow oil less pump at 2.0 CFM using a 47 mm particulate filter. Teda-3B charcoal cartridges are installed downstream of the particulate filters and are used to collect airborne radioiodine. The results of the weekly analysis of the charcoal cartridges are presented in Table B-3. All

results were below the lower level of detection with no positive activity detected.

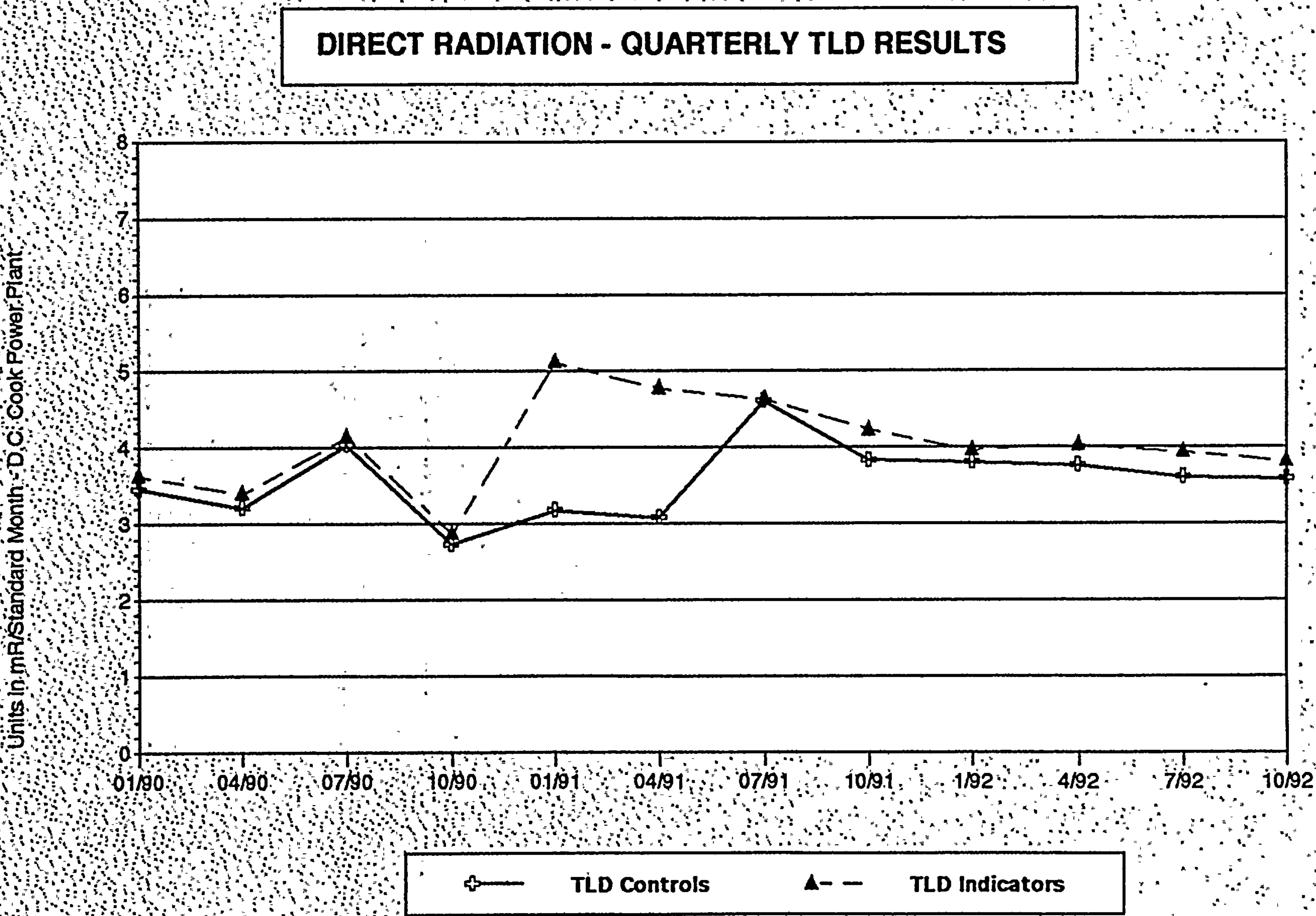
C. Direct Radiation - Thermoluminescent Dosimeters

Thermoluminescent dosimeters (TLDs) measure external radiation exposure from several sources including naturally occurring radionuclides in the air and soil, radiation from cosmic origin, fallout from atomic weapons testing, potential radioactive airborne releases from the power station and direct radiation from the power station. The TLDs record exposure from all of these potential sources. The TLDs are deployed quarterly at 27 locations in the environs surrounding the D. C. Cook Nuclear Plant. The average value of the four areas of each dosimeter (calibrated individually after each field exposure period for response to a known exposure and for transit exposure) are presented in Table B-4. Those exposure rates are quite typical of observed rates at many other locations in the country. The average annual measurement for the control samples was 3.68 mR/standard month with a range of 3.3 to 4.4 mR/standard month. The annual accumulation of indicator samples had a measurement of 3.94 mR/standard month with a range of 3.1 to 5.1 mR/standard month. The 1992 annual average in the environs of the D. C. Cook Plant is at the low range of the exposure rates (1.0 to 2.0 mR/week) measured during the preoperational period. The results of the indicator and control TLDs are in good agreement and are plotted in Trending Graph 2.

D. Surface Water

One liter surface water samples from the intake forebay and from four shoreline locations, all within 0.3 mile of the two reactors were collected and composited daily over a monthly period. The samples were analyzed for iodine-131 by the radiochemical technique described on page 79. No iodine-131 was detected. The quarterly composite was analyzed for tritium by gas counting, described on page 73, during the first and second quarters when this method was

Trending Graph - 2

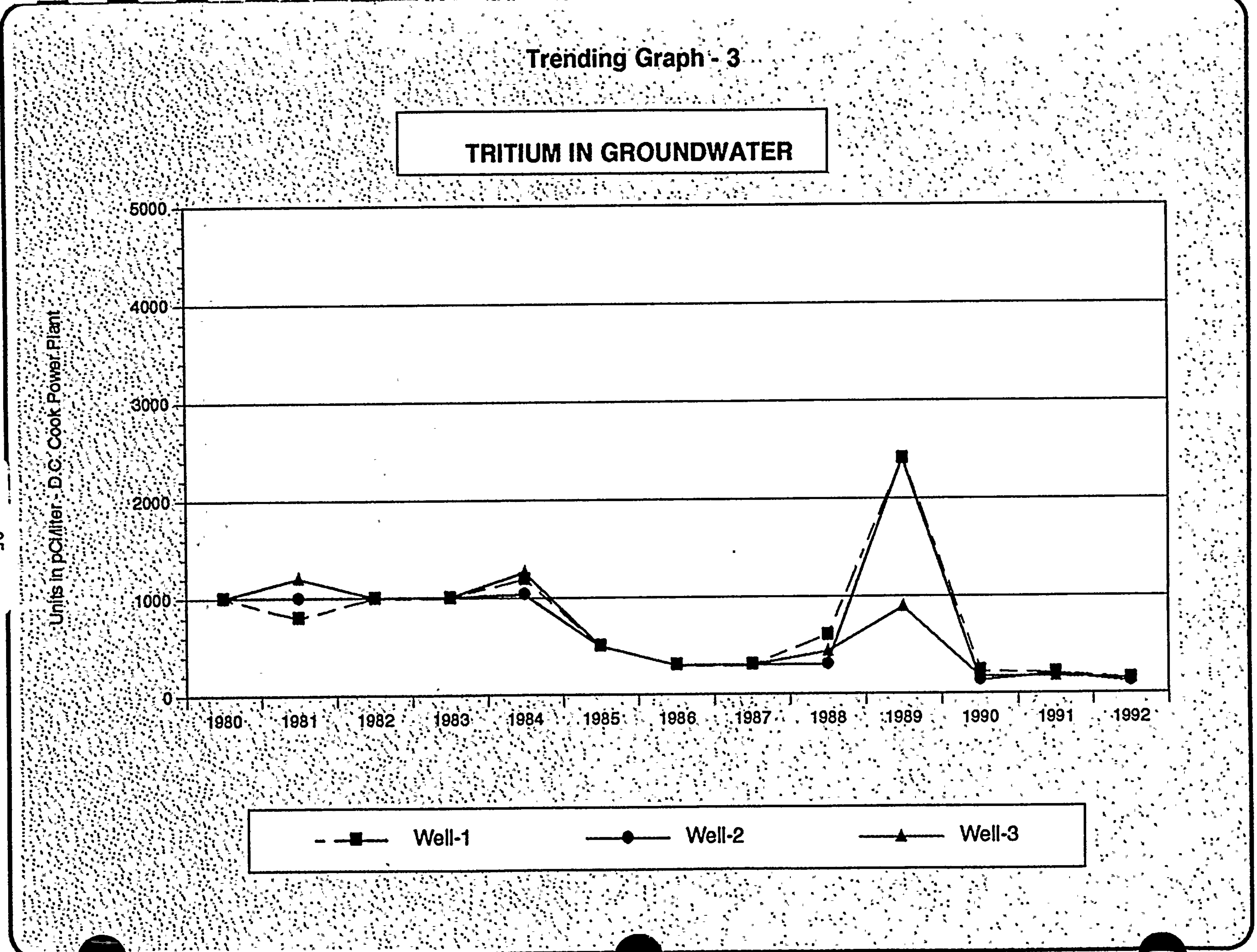


discontinued. The third and fourth quarterly composites were analyzed the by liquid scintillation method described on page 74. Naturally occurring potassium-40 was measured in three samples with an average concentration of 61.5 pCi/liter and a range of 55.9 to 68.0 pCi/liter. Cesium-137 was measured in one sample with an activity of 7.19 pCi/liter. Tritium was detected in 12 of the 20 samples analyzed with an average concentration of 554 pCi/liter and a range of 170 to 1400 pCi/liter. This is higher than the 15 measurements in 1991 which had an average concentration of 239 pCi/liter. During the preoperational period tritium was measured in surface water samples at concentrations of approximately 400 pCi/liter. Naturally occurring gamma emitting isotopes were detected using gamma ray spectroscopy.

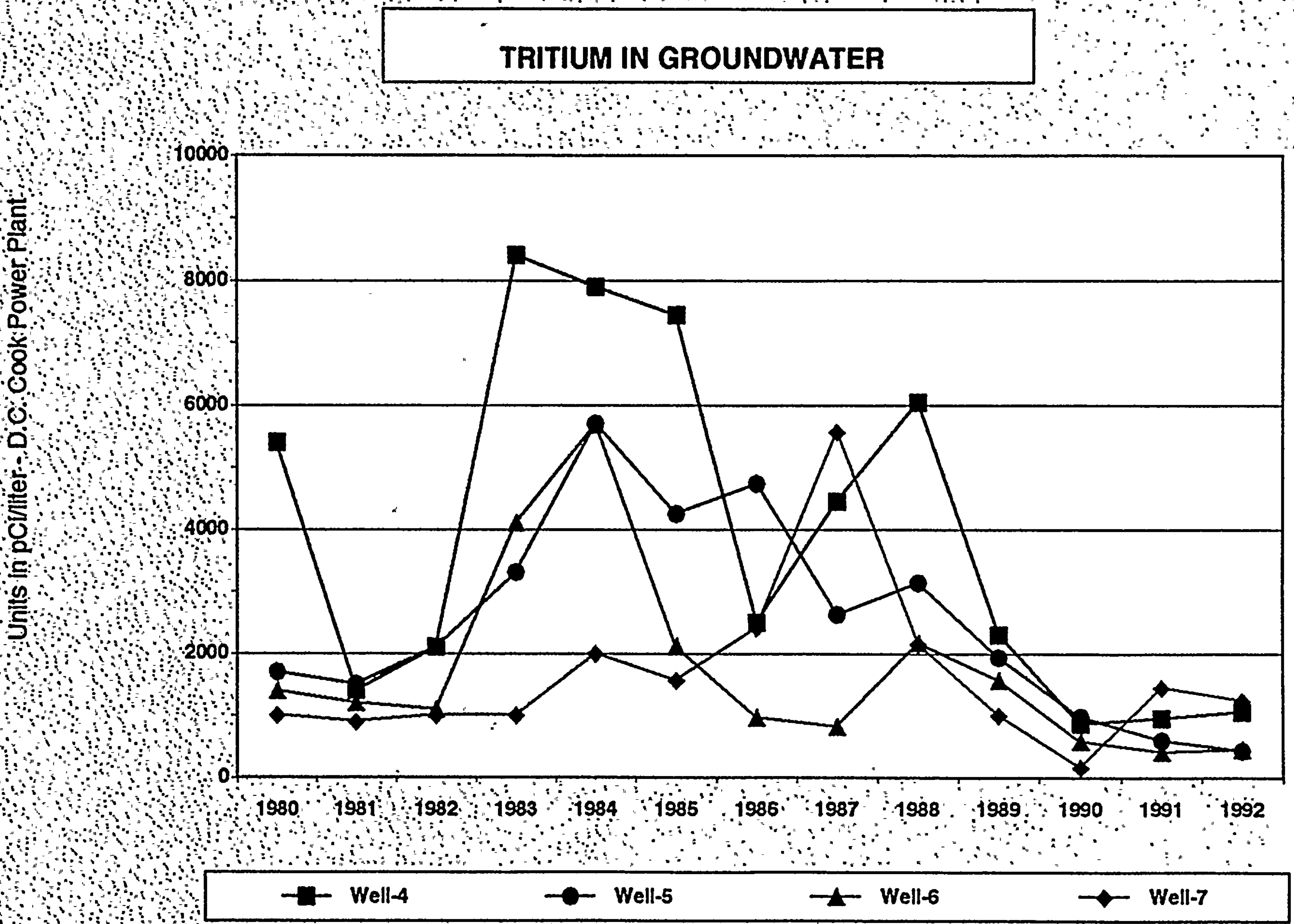
E. Groundwater

Water samples are collected quarterly from thirteen wells, all within 3300 feet of the reactors. First, a static water elevation is determined and three well bore volumes are purged from the well using an air driven bladder style pump. A one gallon sample is then obtained. The samples are analyzed for gamma emitters and tritium. The results are presented in Table B-6. Naturally occurring potassium-40 was measured in four samples with an average concentration of 76.6 pCi/liter and a range of 39.1 to 161 pCi/liter. No other gamma emitting isotopes were detected. The groundwater wells W-4, W-5, W-6, W-7, W-10, W-12 and W-13 had measurable tritium activity throughout 1992. Tritium was measured in three of the sixteen samples at the locations with an average concentration of 662 pCi/liter and a range of 120 to 1500 pCi/liter. The annual concentrations of tritium in wells W-1 through W-7 are plotted from in Trending Graph 3. An additional six wells were added to the program during 1992. The results are plotted quarterly for 1992 in Trending Graph 3.

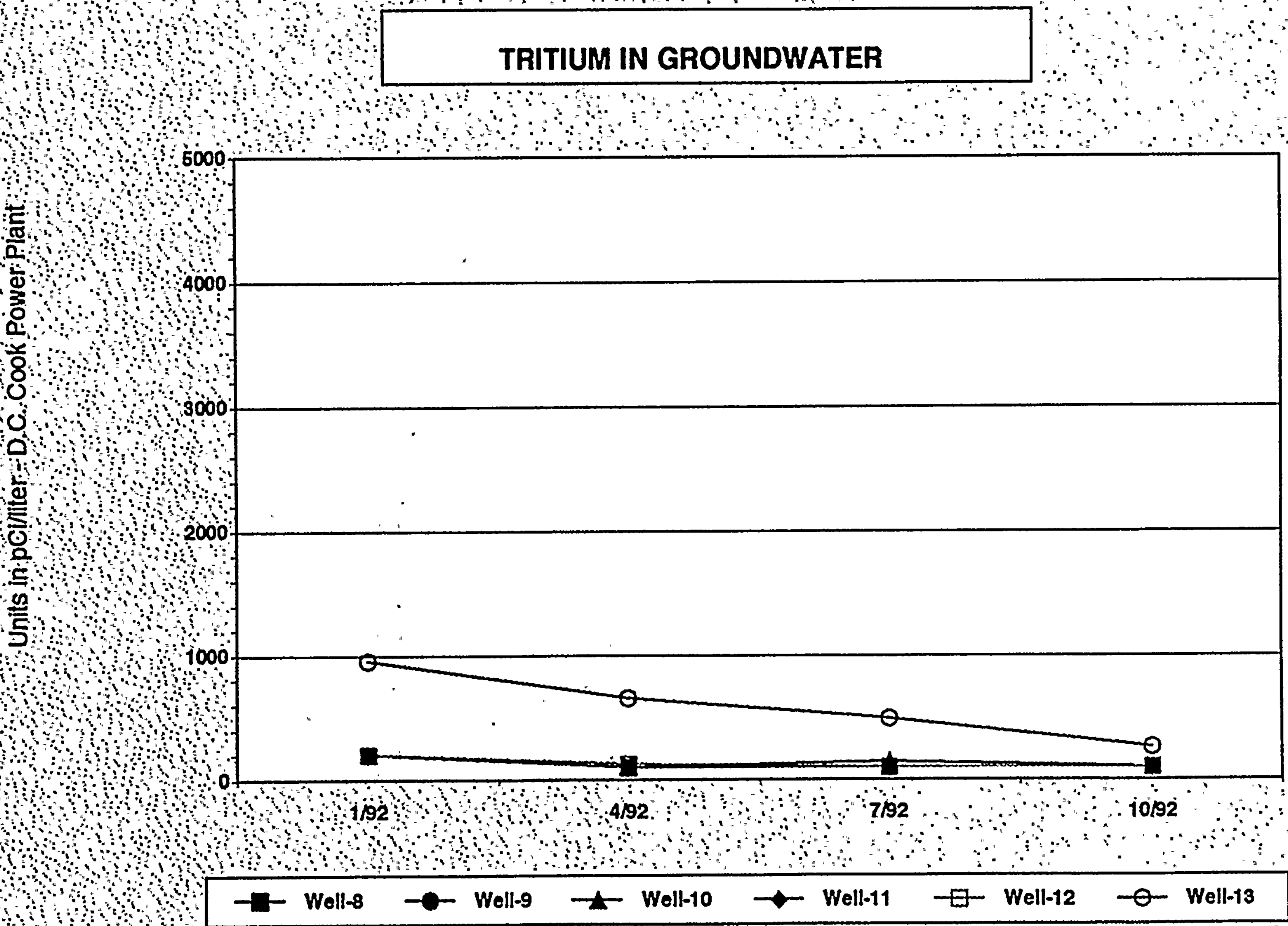
Tritium concentration in groundwater wells during the preoperational period typically averaged 400 pCi/liter.


Trending Graph - 3
TRITIUM IN GROUNDWATER
Units in pCi/liter - D.C. Cook Power Plant
5000
4000
3000
2000
1000
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
Well-1
Well-2
Well-3

Trending Graph - 3 (Cont.)



Trending Graph - 3 (Cont.)



F. Drinking Water

Daily samples are collected at the intake of the purification plants for St. Joseph and Lake Township. The 500 ml daily samples at each location are composited and analyzed for gross beta, iodine-131, and gamma emitters. On a quarterly basis the daily samples are composited and analyzed for tritium. The results of analyses of drinking water samples are shown in Table B-7.

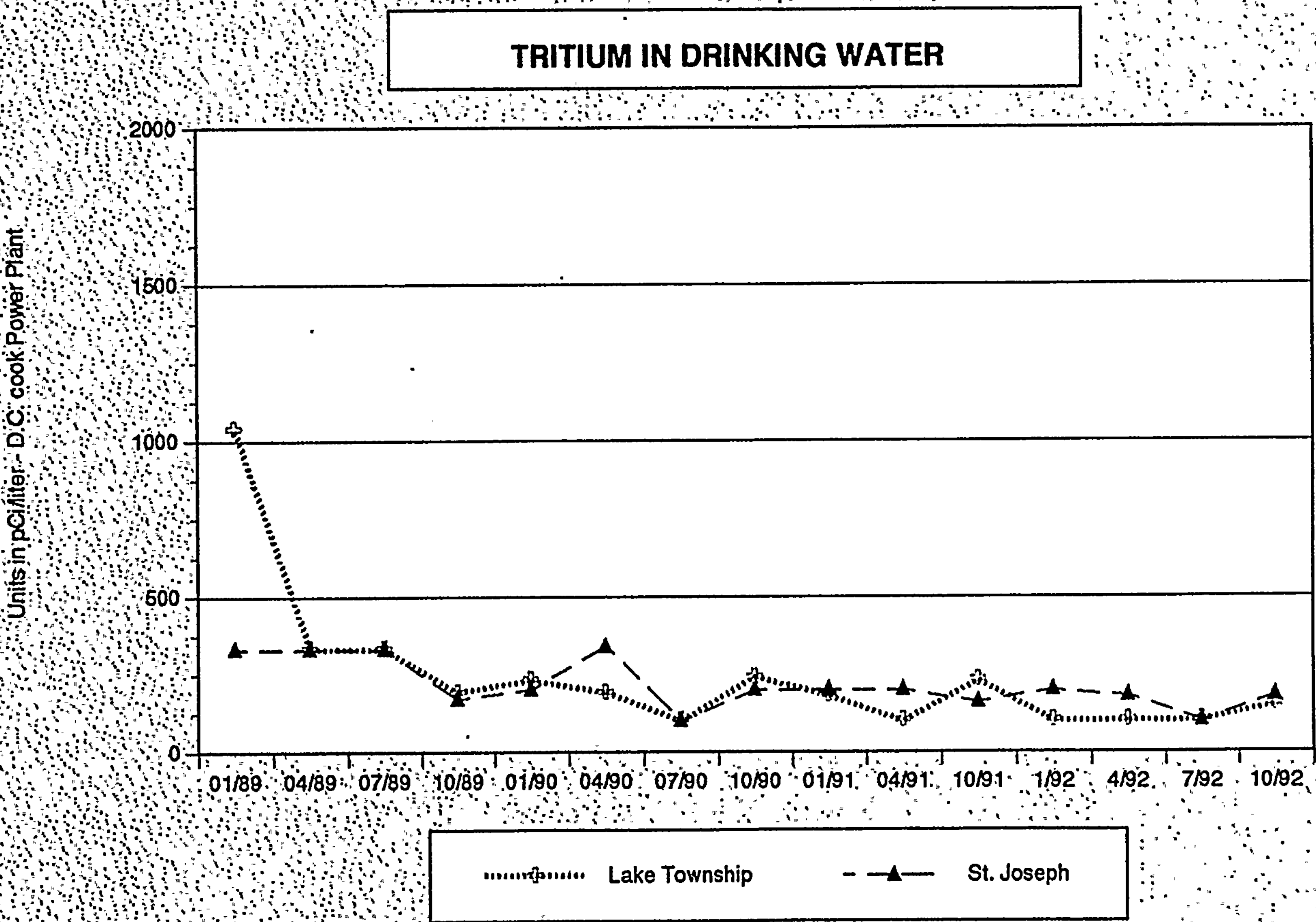
Gross beta activity was measured in all twenty-six samples from the Lake Township intake with an average concentration of 3.6 pCi/liter and a range from 1.9 to 6.2 pCi/liter. Gross beta activity was measured in all twenty-six samples from the St. Joseph intake with an average concentration of 3.7 pCi/liter and a range from 2.6 to 5.1 pCi/liter. No gamma emitting isotopes or iodine-131 were detected. Tritium was measured in one of the four samples from Lake Township intake with a concentration of 150 pCi/liter. Tritium was measured in one samples from St. Joseph intake with a concentration of 180 pCi/liter. Tritium in drinking water is plotted in Trending Graph 4.

There were no drinking water analyses performed in the preoperational program.

G. Sediment

Sediment samples are collected semiannually along the shoreline of Lake Michigan at the same four locations as the surface water samples. Two liters of lake sediment are collected using a small dredge in an area covered part time by wave action. The sediment samples are analyzed by gamma ray spectroscopy, the results of which are shown in Table B-8. In May and November one sample was collected from each location L2, L3, L4 and L5. Gamma ray spectroscopy detected naturally occurring potassium-40 and in all samples. The average potassium-40 concentration was 5628 pCi/kg (dry weight) with a range from 4390 to 6470 pCi/kg (dry weight). Thorium-228, also naturally occurring was measured in seven of the

Trending Graph - 4



29

Thorium-228, also naturally occurring was measured in seven of the eight samples with an average concentration of 130 pCi/kg (dry weight) with a range from 95.3 to 150 pCi/kg (dry weight). Cesium-137, attributed to fallout from previous atmospheric nuclear tests, was not detected during 1992. All other gamma emitters were below the lower limits of detection.

H. Milk

Milk samples of one gallon are collected from a 500 gallon bulk tank every fourteen days from seven farms located between 4.1 miles and 20.7 miles from the site. Milk samples are preserved by adding 40 grams per gallon of sodium bisulfate when the samples are collected. The samples are analyzed for iodine-131 and for gamma emitters. The results are shown in Table B-9. Iodine-131 was not measured in any of the 175 samples analyzed.

During the preoperational period potassium-40 was measured in all samples with a range from 520 to 2310 pCi/liter, a range comparable to that in 1992. Iodine-131 was measured in four samples collected soon after an atmospheric nuclear test with concentrations between 0.2 and 0.9 pCi/liter. Cesium-137 was measured in numerous samples after the nuclear test with concentrations between 7 and 64 pCi/liter.

During 1992 the average potassium-40 concentration for the control locations during was 1347 pCi/liter with a range of 1110 to 1890 pCi/liter. The indicator locations had an average concentration of 1379 pCi/liter and a range of 1020 to 1870. There were no detections of iodine-131 during 1992. Cesium-137 was detected in one background sample with a concentration of 9.34 pCi/liter and one indicator sample with a concentration of 13.4 pCi/liter.

I. Fish

Using gill nets in approximately twenty feet of water in Lake Michigan, 4.5 pounds of fish are collected 2 per/year from each of four locations. The samples are then analyzed by gamma ray spectroscopy. Naturally occurring potassium-40 was measured in all samples with an average concentration of 3113 pCi/kg (wet weight) and a range of 2340 to 4160 pCi/kg (wet weight). Cesium-137 was measured in one of the eight fish samples with a concentration of 48.0 pCi/kg (wet weight).

J. Food Products

Food samples are collected annually at harvest, as near the site boundary as possible, and approximately twenty miles from the plant. They consist of 5 pounds of grapes, 1 pound of grape leaves and 5 pounds of broadleaves. Naturally occurring potassium-40 was measured in all eight samples with an average concentration of 2401 pCi/kg (wet weight) and a range of 1630 to 3850 pCi/kg (wet weight). Cosmogenically produced beryllium-7 was measured in six of the eight samples with an average concentration of 1976 pCi/kg (wet weight) and a range of 58.2 to 4030 pCi/kg (wet weight). Cesium-137 was measured in two samples with an average concentration of 28.1 pCi/kg (wet weight) and a range of 19.9 to 36.2 pCi/kg (wet weight).

IV. CONCLUSIONS

IV. CONCLUSIONS

The results of the 1992 Radiological Environmental Monitoring Program for the Donald C. Cook Nuclear Plant have been presented. The results were as expected for normal environmental samples. Naturally occurring radioactivity was observed in sample media in the expected activity ranges.

Occasional samples of a few media showed the presence of man-made isotopes. These have been discussed individually in the text. Observed activities were at very low concentrations and had no significant dose consequence. Specific examples of sample media with positive analysis results are discussed below.

Air particulate gross beta concentrations of all the indicator locations for 1992 appears to follow the gross beta concentrations at the control locations. The concentration levels are actually lower than during the preoperational period when the influence of atmospheric nuclear tests was being detected. Gamma isotopic analysis of the particulate samples identified the gamma emitting isotopes as natural products (beryllium-7 and potassium-40). No man-made activity was found in the particulate media during 1992. No iodine-131 was detected in charcoal filters in 1992.

Thermoluminescent dosimeters (TLDs) measure external gamma radiation from naturally occurring radionuclides in the air and soil, radiation from cosmic origin and fallout from atmospheric nuclear weapons testing, and radioactive airborne releases and direct radiation from the power plant. The average annual TLD results were at normal background exposure levels.

Surface water samples are collected daily from the intake forebay and four locations in Lake Michigan. The samples are analyzed quarterly for tritium, and monthly for gamma emitting isotopes. Only one gamma emitter, cesium-137, was detected in one sample during 1992. Tritium was measured and the concentrations were at normal background levels.

Groundwater samples were collected quarterly at thirteen wells, all within 3300 feet of the reactors. The three wells within 500 feet had

measurable tritium which is attributed to the operation of the plant. The tritium levels in 1992 compare well with those measured in 1991. The highest concentration measured in 1992 was 1500 pCi/liter while the highest concentration measured during 1991 was 1700 pCi/liter. The tritium levels in groundwater have been plotted for the last decade and indicate decreasing levels of tritium. Potassium-40, a naturally occurring nuclide was observed in four samples during 1992. No other gamma emitting isotopes were detected.

Samples are collected daily at the intakes of the drinking purification plants for St. Joseph and Lake Township. Samples composited daily over a two week period are analyzed for iodine-131, gross beta, and for gamma emitting isotopes and analyzed quarterly for tritium. No iodine-131 or gamma emitting isotopes were detected. Gross beta was measured in all fifty-two samples at normal background concentrations. Tritium was measured in four of the eight quarterly composite samples with background levels that were lower than those measured during 1991.

Sediment samples can be a sensitive indicator of discharges from nuclear power stations. Sediment samples are collected semiannually along the shoreline of Lake Michigan at four locations in close proximity of the reactors. The samples were analyzed by gamma ray spectroscopy and only naturally occurring gamma emitters were detected. There is no evidence of station discharges affecting Lake Michigan, either in the sediments or in the water, as previously discussed.

Milk samples were collected every fourteen days from seven farms up to a distance of 20.7 miles from the site. The samples were measured for iodine-131 and for gamma emitting isotopes. Although I-131 was measured during 1989 there were no measurements of iodine-131 in milk during 1992 or 1991. Potassium-40 was measured in all milk samples at normal background levels. Cesium-137 was detected in two samples.

Fish samples collected in Lake Michigan in the vicinity of the nuclear plant were analyzed by gamma ray spectroscopy. The only gamma emitting isotope measured was cesium-137 which was in a very low concentration in one sample.

Food products, consisting of grapes, grape leaves, and broadleaf vegetation were collected and analyzed by gamma ray spectroscopy. The only gamma emitting isotope measured was cesium-137.

The results of the analyses have been presented. Based on the evidence of the Radiological Environmental Monitoring Program the Donald C. Cook Nuclear Plant is operating within regulatory limits. Tritium in five on-site wells appears to be the only radionuclide which can be directly correlated with the plant. However the associated groundwater does not provide a direct dose pathway to man.

V. REFERENCES

V. REFERENCES

1. United States Nuclear Regulatory Commission, Regulatory Guide 4.8 "Environmental Technical Specifications for Nuclear Power Plants", December 1975.

2. Indiana Michigan Power Company, D. C. Cook Technical Specifications, Units 1 and 2.

3. USNRC Branch Technical Position, "Acceptable Radiological Environmental Monitoring Program", Rev. 1, November 1979.

4. Eberline Instrument Company. Indiana Michigan Power Company, "D. C. Cook Nuclear Plant Radiological Environmental Monitoring Program - 1974 Annual Report", May 1975.

5. Data Tables from 1985-1988 CEP-AEPSC Annual Radiological Environmental Monitoring Program Reports.

6. United States Nuclear Regulatory Commission, Regulatory Guide 1.4 "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants", April 1975.

7. United States Nuclear Regulatory Commission, Regulatory Guide 1.21 "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants, April 1974.

APPENDIX A
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT DOCKET NO. 50-315/50-316

BERRIEN COUNTY JANUARY 1 to DECEMBER 31, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		ALL INDICATOR LOCATIONS MEAN (a/b) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Air Iodine (pCi/m^3)	I-131	531	-(0/317) -	N/A	N/A	-(0/214) -	0
Airborne Particulates (1E-03 pCi/m^3)	Gross Beta (Weekly)	531	16.7(317/317) (2.9-35)	South Bend 24.0 mi SE	17.3(54/54) (7.2-32	16.6(214/214) (6.6-35)	0
	Gamma	40					
	Be-7	40	107.8(24/24) (84.5-153)	Dowagiac 24.3 mi ENE	117.9(4/4) (91.0-177)	108.4(16/16) (87.6-177)	0
	K-40	40	6.31(6/24) (3.16-10.7)	A-5 Onsite 1895 ft.	10.0(2/4) (9.21-10.7)	8.31(1/16) -	0
Direct Radiation (mR/Standard Month)	Gamma Dose Quarterly	108	3.94(92/92) (3.1-5.1)	OFS-6 4.9 mi SE	4.90(4/4) (4.8-5.1)	3.68(16/16) (3.3-4.4)	0

(a/b) Ratio of samples with detectable activity to total number of samples analyzed.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT DOCKET NO. 50-315/50-316

BERRIEN COUNTY JANUARY 1 to DECEMBER 31, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		ALL INDICATOR LOCATIONS MEAN (a/b) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Surface Water (pCi/liter)	Gamma	65					
	K-40	65	61.5(3/65) (55.9-68.0)	L-5 0.1 mi N	62.0(2/13) (55.9-68.0)	-(0/0) -	0
	Cs-137	65	7.19(1/65) -	L-1 Intake Forebay	7.19(1/13) -	-(0/0) -	0
	H-3	20	554(12/20) (170-1400)	L-5 0.1 mi N	670(2/4) (340-1000)	-(0/0) -	0
Groundwater (pCi/liter)	Gamma	51					
	K-40		76.6(4/51 (39.1-161)	Well 10	161(1/4) -	-(0/0) -	0
	H-3	51	666(21/51) (120-1500)	Well 7	1148(4/4) (840-1500)	-(0/0) -	0
Drinking Water (pCi/liter)	Gross Beta	52	3.60(52/52) (1.9-6.2)	STJ 9.0 mi NE	3.65(26/26) (2.6-5.1)	-(0/0)	0
	I-131	52	-(0/52) -	N/A	N/A	-(0/0) -	0
	Gamma	52	-(0/52) -	N/A	N/A	-(0/0) -	0
	H-3	8	165(2/8) (150-180)	STJ 9.0 mi NE	180(1/4) -	-(0/0) -	0

(a/b) Ratio of samples with detectable activity to total number of samples analyzed.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT DOCKET NO. 50-315/50-316

BERRIEN COUNTY JANUARY 1 to DECEMBER 31, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		ALL INDICATOR LOCATIONS MEAN (a/b) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Sediment (pCi/kg dry)	Gamma	8					
	K-40	8	5628(8/8) (4390-6470)	L-2 0.3 mi S	5965(2/2) (5790-6140)	No Control	0
	Ra-226	8	506(1/8) -	L-5 0.1 mi N	506(1/2) -	No Control	0
	Th-228	8	130(7/8) (95.3-150)	L-4 0.1 mi S	144(2/2) (138-150)	No Control	0
Milk (pCi/liter)	Gamma	155					
	K-40	155	1379(104/104 (1020-1870)	Warmbien 7.7 mi S	1407(26/26) (1210-1850)	1347(51/51) (1110-1890)	0
	I-131	155	-(0/104) -	N/A	N/A	-(0/51) -	0
	Cs-137	155	13.4(1/104) -	Freeling	13.4(1/21) -	9.34(1/51) -	0

(a/b) Ratio of samples with detectable activity to total number of samples analyzed.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT DOCKET NO. 50-315/50-316

BERRIEN COUNTY JANUARY 1 to DECEMBER 31, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		ALL INDICATOR LOCATIONS MEAN (a/b) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Fish (pCi/kg wet)	Gamma	8					
	K-40	8	3113(8/8) (2340-4160)	ONS-North 0.3 mi N	3610(2/2) (3060-4160)	-(0/0) -	0
	Cs-137	8	48.0(1/8) -	OFS-North 3.5 mi N	48.0(1/2) -	-(0/0) -	0
Food/Vegetation (pCi/kg wet)	Gamma	8					
	Be-7	8	1976(6/8) (58.2-4030)	Sector B Variable	2360(1/2) -	-(0/0) -	0
	K-40	8	2401(8/8) (1630-3850)	Sector J Variable	2680(4/4 (1820-3850)	-(0/0) -	0
	Cs-137	8	28.1(2/8) (19.9-36.2)	Sector A Variable	28.1(2/2) (19.9-36.2)	-(0/0) -	0

(a/b) Ratio of samples with detectable activity to total number of samples analyzed.

APPENDIX B
DATA TABLES

TABLE B-1

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

	STATION CODES										
COLLECTION DATES	A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buff	South Bend	Average ± 2 s.d.
JANUARY 92											
01/06/92	24 ± 2	23 ± 2	25 ± 2	25 ± 2	27 ± 2	25 ± 2	24 ± 2	27 ± 2	25 ± 2	25 ± 2	25 ± 3
01/13/92	24 ± 2	21 ± 2	21 ± 2	26 ± 2	24 ± 2	23 ± 2	23 ± 2	20 ± 2	26 ± 2	19 ± 2	23 ± 5
01/20/92	19 ± 2	16 ± 2	20 ± 2	21 ± 2	18 ± 2	20 ± 2	19 ± 2	18 ± 2	19 ± 2	18 ± 2	19 ± 3
01/27/92	27 ± 2	21 ± 2	27 ± 2	25 ± 2	27 ± 2	28 ± 2	27 ± 2	28 ± 2	25 ± 2	25 ± 2	26 ± 4
02/03/92	20 ± 2	20 ± 2	20 ± 2	19 ± 2	20 ± 2	14 ± 2	20 ± 2	20 ± 2	19 ± 2	18 ± 2	19 ± 4
FEBRUARY											
02/10/92	20 ± 2	16 ± 2	18 ± 2	19 ± 2	17 ± 2	18 ± 2	19 ± 2	20 ± 2	19 ± 2	19 ± 2	19 ± 3
02/17/92	15 ± 2	19 ± 2	16 ± 2	18 ± 2	16 ± 2	19 ± 2	20 ± 2	18 ± 2	18 ± 2	16 ± 2	18 ± 3
02/24/92	16 ± 2	8.8 ± 1.5	15 ± 2	16 ± 2	16 ± 2	16 ± 2	18 ± 2	16 ± 2	17 ± 2	17 ± 2	16 ± 5
03/02/92	13 ± 2	17 ± 2	16 ± 2	15 ± 2	14 ± 2	15 ± 2	18 ± 2	16 ± 2	14 ± 2	18 ± 2	16 ± 3
MARCH											
03/09/92	20 ± 2	17 ± 2	18 ± 2	19 ± 2	19 ± 2	18 ± 2	22 ± 2	17 ± 2	19 ± 2	20 ± 2	19 ± 3
03/16/92	19 ± 2	19 ± 2	18 ± 2	19 ± 2	17 ± 2	15 ± 2	20 ± 2	17 ± 2	18 ± 2	19 ± 2	18 ± 3
03/23/92	12 ± 1	16 ± 2	17 ± 2	15 ± 2	16 ± 2	19 ± 2	15 ± 2	13 ± 2	19 ± 2	17 ± 2	16 ± 5
03/30/92	13 ± 2	14 ± 2	15 ± 2	15 ± 2	14 ± 2	17 ± 2	17 ± 2	13 ± 2	13 ± 2	14 ± 2	15 ± 3
Quarter Avg.	**19 ± 9**	**18 ± 7**	**19 ± 7**	**19 ± 8**	**19 ± 9**	**19 ± 8**	**20 ± 6**	**19 ± 9**	**19 ± 8**	**19 ± 6**	**19 ± 1**

TABLE B-1 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

COLLECTION DATES	STATION CODES A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buff	South Bend	Average ± 2 s.d.
APRIL											
04/06/92	18 ± 2	18 ± 2	19 ± 2	20 ± 2	15 ± 2	18 ± 2	21 ± 2	16 ± 2	13 ± 2	19 ± 2	18 ± 5
04/13/92	14 ± 2	16 ± 2	15 ± 2	15 ± 2	14 ± 2	16 ± 2	16 ± 2	14 ± 2	16 ± 2	17 ± 2	15 ± 2
04/20/92	13 ± 2	14 ± 2	14 ± 2	11 ± 2	11 ± 2	14 ± 2	12 ± 2	10 ± 2	12 ± 2	13 ± 2	12 ± 3
04/27/92	7.1 ± 1.4	10 ± 2	7.5 ± 1.4	7.4 ± 1.4	6.4 ± 1.3	6.9 ± 1.4	6.6 ± 1.4	7.3 ± 1.4	7.0 ± 1.4	7.2 ± 1.4	7 ± 2
05/04/92	16 ± 2	16 ± 2	17 ± 2	6.9 ± 0.9 (a)	17 ± 2	14 ± 2	16 ± 2	15 ± 2	14 ± 2	18 ± 2	15 ± 6
MAY											
05/08/92 (b)										21 ± 3	21 ± 3
05/15/92 (b)										24 ± 4	24 ± 4
05/11/92	15 ± 2	16 ± 2	15 ± 2	18 ± 2	16 ± 2	14 ± 2	15 ± 2	15 ± 2	14 ± 2	16 ± 3	15 ± 2
05/18/92	16 ± 2	17 ± 2	18 ± 2	19 ± 2	15 ± 2	15 ± 2	14 ± 2	15 ± 2	13 ± 2	24 ± 3	17 ± 6
05/25/92	13 ± 2	12 ± 2	14 ± 2	14 ± 2	13 ± 2	12 ± 2	11 ± 2	11 ± 2	12 ± 2	14 ± 2	13 ± 2
06/01/92	14 ± 2	15 ± 2	15 ± 2	15 ± 2	15 ± 2	12 ± 2	14 ± 2	13 ± 2	14 ± 2	18 ± 2	15 ± 3
JUNE											
06/08/92	16 ± 2	13 ± 2	16 ± 2	15 ± 2	13 ± 2	16 ± 2	15 ± 2	11 ± 2	15 ± 2	15 ± 2	15 ± 3
06/15/92	14 ± 2	14 ± 2	14 ± 2	16 ± 2	14 ± 2	15 ± 2	14 ± 2	14 ± 2	14 ± 2	14 ± 2	14 ± 1
06/22/92	11 ± 2	9.3 ± 1.6	11 ± 2	13 ± 2	3.2 ± 0.8(a)	10 ± 2	11 ± 2	9.2 ± 1.5	9.2 ± 1.5	9.8 ± 1.6	10 ± 5
06/29/92	13 ± 2	13 ± 2	12 ± 2	14 ± 2	13 ± 2	14 ± 2	16 ± 2	14 ± 2	13 ± 2	15 ± 2	14 ± 2
Quarterly Avg.	**14 ± 5**	**14 ± 5**	**14 ± 6**	**15 ± 7**	**13 ± 8**	**14 ± 6**	**14 ± 7**	**13 ± 5**	**13 ± 5**	**16 ± 9**	**14 ± 2**

(a) Equipment malfunction; results in total pCi and not included in averages.
(b) Extra samples collected due to heavy dust.

TABLE B-1 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

COLLECTION DATES	STATION CODES A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buff	South Bend	Average ± 2 s.d.
JULY											
07/06/92	16 ± 2	18 ± 2	17 ± 2	18 ± 2	15 ± 2	16 ± 2	14 ± 2	18 ± 2	15 ± 2	19 ± 2	17 ± 3
07/13/92	12 ± 2	17 ± 2	17 ± 2	18 ± 2	16 ± 2	17 ± 2	18 ± 2	18 ± 2	16 ± 2	19 ± 2	17 ± 4
07/20/92	8.0 ± 1.3	8.6 ± 1.4	9.3 ± 1.4	9.7 ± 1.4	8.6 ± 1.4	9.0 ± 1.4	7.6 ± 1.3	7.2 ± 1.3	8.9 ± 1.3	8.3 ± 1.3	9 ± 2
07/27/92	11 ± 2	9.1 ± 1.5	9.8 ± 1.6	11 ± 2	9.7 ± 1.6	13 ± 2	11 ± 2	11 ± 2	10 ± 2	12 ± 2	11 ± 2
08/03/92	17 ± 2	13 ± 2	14 ± 2	15 ± 2	14 ± 2	13 ± 2	13 ± 2	12 ± 2	13 ± 2	14 ± 2	14 ± 3
AUGUST											
08/10/92	18 ± 2	17 ± 2	16 ± 2	16 ± 2	17 ± 2	16 ± 2	16 ± 2	16 ± 2	16 ± 2	18 ± 2	17 ± 2
08/17/92	14 ± 2	13 ± 2	13 ± 2	13 ± 2	13 ± 2	13 ± 2	12 ± 2	11 ± 2	10 ± 2	11 ± 2 (a)	12 ± 3
08/24/92	20 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 2	15 ± 2	16 ± 2	18 ± 2	19 ± 2	17 ± 3
08/31/92	12 ± 2	11 ± 2	11 ± 2	8.7 ± 2.2	9.7 ± 2.2	8.0 ± 2.1	8.3 ± 2.1	8.6 ± 2.2	10 ± 2	12 ± 2	10 ± 3
SEPTEMBER											
09/07/92	20 ± 2	20 ± 2	20 ± 2	21 ± 2	21 ± 2	20 ± 2	20 ± 2	19 ± 2	20 ± 2	20 ± 2	20 ± 1
09/14/92	16 ± 2	16 ± 2	17 ± 2	2.0 ± 0.5 (b)	16 ± 2	16 ± 2	14 ± 2	13 ± 2	16 ± 2	18 ± 2	16 ± 3
09/21/92	20 ± 2	21 ± 2	22 ± 2	(c)	22 ± 2	21 ± 2	20 ± 2	22 ± 2	22 ± 2	20 ± 2	21 ± 2
09/28/92	14 ± 2	2.9 ± 1.2	15 ± 2	12 ± 2	12 ± 2	16 ± 2	14 ± 2	14 ± 2	15 ± 2	14 ± 2	13 ± 8
Quarterly Avg.	15 ± 8	14 ± 10	15 ± 8	14 ± 8	15 ± 8	15 ± 8	14 ± 8	14 ± 9	15 ± 8	16 ± 8	15 ± 1

(a) Equipment malfunction; low sample volume.
(b) Loss of power to air station; results in total pCi and not included in averages.
(c) Loss of power to air station; sample not available.

TABLE B-1 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

	STATION CODES										
COLLECTION DATES	A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buff	South Bend	Average ± 2 s.d.
OCTOBER											
10/05/92	21 ± 2	20 ± 2	20 ± 2	19 ± 2	21 ± 2	21 ± 2	19 ± 2	20 ± 2	22 ± 2	19 ± 2	20 ± 2
10/12/92	18 ± 2	17 ± 2	18 ± 2	16 ± 2	17 ± 2	16 ± 2	17 ± 2	14 ± 2	16 ± 2	15 ± 2	16 ± 3
10/19/92	19 ± 2	16 ± 2	15 ± 2	17 ± 2	15 ± 2	16 ± 2	15 ± 2	15 ± 2	20 ± 2	16 ± 2	16 ± 4
10/26/92	30 ± 2	34 ± 2	32 ± 2	34 ± 3	30 ± 2	31 ± 2	27 ± 2	31 ± 2	35 ± 2	25 ± 2	31 ± 6
11/02/92	15 ± 2	12 ± 2	11 ± 2	12 ± 2	10 ± 2	12 ± 2	10 ± 2	11 ± 2	11 ± 2	11 ± 2	12 ± 3
NOVEMBER											
11/09/92	8.3 ± 1.5	7.6 ± 1.5	8.4 ± 1.5	9.1 ± 1.6	7.3 ± 1.5	8.1 ± 1.5	7.4 ± 1.4	8.5 ± 1.5	6.8 ± 1.4	8.5 ± 1.5	8 ± 1
11/16/92	18 ± 2	17 ± 2	18 ± 2	19 ± 2	20 ± 2	20 ± 2	25 ± 2	16 ± 2	18 ± 2	18 ± 2	19 ± 5
11/23/92	17 ± 2	15 ± 2	18 ± 2	16 ± 2	15 ± 2	16 ± 2	16 ± 2	14 ± 2	16 ± 2	17 ± 2	16 ± 2
11/30/92	16 ± 2	16 ± 2	15 ± 2	15 ± 2	15 ± 2	16 ± 2	16 ± 2	16 ± 2	17 ± 2	17 ± 2	16 ± 1
DECEMBER											
12/07/92	18 ± 2	17 ± 2	18 ± 2	18 ± 2	16 ± 2	20 ± 2	18 ± 2	18 ± 2	18 ± 2	18 ± 2	18 ± 2
12/14/92	11 ± 2	11 ± 2	11 ± 2	9.8 ± 1.6	9.4 ± 1.6	13 ± 2	12 ± 2	12 ± 2	10 ± 2	13 ± 2	11 ± 3
12/21/92	28 ± 2	30 ± 2	32 ± 2	28 ± 2	28 ± 2	31 ± 2	28 ± 2	31 ± 2	32 ± 2	31 ± 2	30 ± 4
12/28/92	33 ± 2	33 ± 2	35 ± 2	31 ± 2	29 ± 2	31 ± 2	29 ± 2	31 ± 2	29 ± 2	32 ± 2	31 ± 4
Quarter Avg.	19 ± 14	19 ± 17	19 ± 17	19 ± 15	18 ± 15	19 ± 15	18 ± 14	18 ± 16	19 ± 17	19 ± 14	19 ± 15
Annual Avg.	17 ± 11	16 ± 11	17 ± 11	17 ± 11	16 ± 11	17 ± 11	17 ± 10	16 ± 11	17 ± 12	17 ± 10	17 ± 11

TABLE B-2

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIRBORNE PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

Stations	Nuclides	First Quarter 12/30/91-03/30/92	Second Quarter 03/30/92-06/29/92	Third Quarter 06/29/92-09/28/92	Fourth Quarter 09/28/92-12/28/92	Average ± 2 s.d.
A-1	Be-7	92.9 ± 9.3	120 ± 12	118 ± 12	99.7 ± 10.0	108 ± 27
	K-40	< 4	< 4	< 4	< 5	-
	Cs-134	< 0.2	< 0.3	< 0.2	< 0.3	-
	Cs-137	< 0.2	< 0.3	< 0.2	< 0.3	-
A-2	Be-7	91.0 ± 9.1	125 ± 13	101 ± 10	96.2 ± 9.6	103 ± 30
	K-40	< 6	< 7	3.16 ± 1.75	< 8	3.16 ± 1.75
	Cs-134	< 0.3	< 0.3	< 0.2	< 0.3	-
	Cs-137	< 0.3	< 0.2	< 0.2	< 0.3	-
A-3	Be-7	117 ± 12	127 ± 13	107 ± 11	99.7 ± 10.0	113 ± 24
	K-40	< 5	< 10	< 3	5.22 ± 2.70	5.22 ± 2.70
	Cs-134	< 0.3	< 0.3	< 0.2	< 0.4	-
	Cs-137	< 0.3	< 0.3	< 0.2	< 0.4	-
A-4	Be-7	90.4 ± 9.0	153 ± 15	95.8 ± 9.6	101 ± 10	110 ± 58
	K-40	2.95 ± 1.70	< 5	< 4	< 5	2.95 ± 1.70
	Cs-134	< 0.2	< 0.3	< 0.2	< 0.3	-
	Cs-137	< 0.2	< 0.3	< 0.2	< 0.2	-
A-5	Be-7	84.5 ± 8.5	110 ± 11	102 ± 10	87.0 ± 8.7	95.9 ± 24
	K-40	< 8	9.21 ± 2.89	< 7	10.7 ± 3.4	10.0 ± 2.1
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.4	-
	Cs-137	< 0.3	< 0.3	< 0.3	< 0.3	-

* Typical LLDs are found in Table B-12. All other gamma emitters were <LLD.

TABLE B-2 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIRBORNE PARTICULATES

Results in Units of 10^{-3} $pCi/m^3 \pm 2$ sigma

Stations	Nuclides	First Quarter 12/30/91-03/30/92	Second Quarter 03/30/92-06/29/92	Third Quarter 06/29/92-09/28/92	Fourth Quarter 09/28/92-12/28/92	Average ±2 s.d.
A-6	Be-7	92.1 ± 9.2	147 ± 15	120 ± 12	110 ± 11	117 ± 46
	K-40	6.59 ± 2.01	< 6	< 7	< 6	6.59 ± 2.01
	Cs-134	< 0.3	< 0.2	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.3	< 0.2	< 0.3	-
Coloma	Be-7	93.9 ± 9.4	123 ± 12	93.6 ± 9.4	96.7 ± 9.7	102 ± 28
	K-40	< 4	< 5	< 10	< 4	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.2	< 0.3	< 0.2	-
Dowagiac	Be-7	93.4 ± 9.3	177 ± 18	110 ± 11	91.0 ± 9.1	118 ± 81
	K-40	< 20	< 10	< 4	< 6	-
	Cs-134	< 0.5	< 0.4	< 0.2	< 0.3	-
	Cs-137	< 0.4	< 0.4	< 0.2	< 0.3	-
New Buffalo	Be-7	88.6 ± 8.9	126 ± 13	124 ± 12	93.9 ± 9.4	108 ± 39
	K-40	< 10	< 4	< 5	< 5	-
	Cs-134	< 0.3	< 0.2	< 0.2	< 0.3	-
	Cs-137	< 0.3	< 0.2	< 0.3	< 0.4	-
South Bend	Be-7	96.1 ± 9.6	137 ± 14	102 ± 10	87.6 ± 8.8	106 ± 43
	K-40	< 4	< 9	8.31 ± 2.99	< 10	8.31 ± 2.99
	Cs-134	< 0.2	< 0.3	< 0.3	< 0.4	-
	Cs-137	< 0.3	< 0.3	< 0.3	< 0.3	-

* Typical LLDs are found in Table B-12. All other gamma emitters were <LLD.

TABLE B-3

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

IODINE-131 IN WEEKLY AIR CARTRIDGE SAMPLES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

COLLECTION DATES	STATION CODES A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buffalo	South Bend
JANUARY 92										
01/06/92	< 10	< 10	< 10	< 10	< 6	< 10	< 10	< 10	< 9	< 10
01/13/92	< 10	< 10	< 10	< 10	< 8	< 10	< 10	< 10	< 5	< 10
01/20/92	< 10	< 10	< 10	< 10	< 9	< 10	< 10	< 10	< 5	< 10
01/27/92	< 10	< 10	< 10	< 10	< 5	< 10	< 10	< 10	< 9	< 10
02/03/92	< 20	< 20	< 20	< 20	< 10	< 20	< 20	< 20	< 10	< 20
FEBRUARY										
02/10/92	< 10	< 10	< 10	< 10	< 6	< 20	< 20	< 20	< 10	< 20
02/17/92	< 10	< 10	< 10	< 10	< 6	< 10	< 10	< 10	< 9	< 10
02/24/92	< 10	< 10	< 10	< 10	< 8	< 20	< 20	< 20	< 10	< 20
03/02/92	< 10	< 10	< 10	< 10	< 9	< 10	< 10	< 10	< 8	< 10
MARCH										
03/09/92	< 20	< 10	< 10	< 10	< 9	< 10	< 10	< 10	< 8	< 10
03/16/92	< 20	< 20	< 20	< 20	< 7	< 10	< 10	< 10	< 9	< 10
03/23/92	< 6	< 7	< 10	< 5	< 7	< 10	< 10	< 10	< 7	< 10
03/30/92	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 9	< 10

TABLE B-3 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE-131 IN WEEKLY AIR CARTRIDGE SAMPLES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

COLLECTION DATES	STATION CODES A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buffalo	South Bend
APRIL										
04/06/92	< 20	< 20	< 20	< 20	< 9	< 20	< 20	< 20	< 10	< 20
04/13/92	< 20	< 20	< 20	< 20	< 8	< 10	< 20	< 20	< 10	< 20
04/20/92	< 20	< 20	< 20	< 20	< 10	< 20	< 20	< 20	< 10	< 20
04/27/92	< 20	< 20	< 20	< 20	< 8	< 20	< 20	< 20	< 10	< 20
05/04/92	< 20	< 20	< 20	< 10 (a)	< 9	< 20	< 20	< 20	< 10	< 20
MAY										
05/08/92 (b)										< 10
05/14/92 (b)										< 30
05/11/92	< 20	< 20	< 20	< 20	< 9	< 20	< 20	< 20	< 10	< 50
05/18/92	< 20	< 20	< 20	< 20	< 9	< 20	< 20	< 20	< 10	< 40
05/25/92	< 20	< 20	< 20	< 20	< 10	< 30	< 30	< 30	< 20	< 30
06/01/92	< 20	< 20	< 20	< 20	< 10	< 20	< 20	< 20	< 9	< 20
JUNE										
06/08/92	< 20	< 20	< 20	< 20	< 10	< 30	< 30	< 30	< 20	< 30
06/15/92	< 10	< 10	< 10	< 20	< 6	< 10	< 20	< 20	< 7	< 20
06/22/92	< 20	< 10	< 10	< 10	< 4 (a)	< 20	< 20	< 20	< 10	< 20
06/29/92	< 20	< 20	< 20	< 30	< 10	< 20	< 20	< 20	< 10	< 20

(a) Equipment malfunction.
(b) Extra samples collected due to heavy dust.

TABLE B-3 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE-131 IN WEEKLY AIR CARTRIDGE SAMPLES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

	STATION CODES									
COLLECTION DATES	A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buffalo	South Bend
JULY										
07/06/92	< 20	< 20	< 20	< 20	< 10	< 9	< 10	< 10	< 8	< 10
07/13/92	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 6	< 10
07/20/92	< 10	< 10	< 10	< 10	< 6	< 10	< 10	< 10	< 9	< 10
07/27/92	< 20	< 20	< 20	< 20	< 7	< 10	< 10	< 10	< 8	< 10
08/03/92	< 20	< 20	< 20	< 20	< 10	< 20	< 20	< 20	< 8	< 20
AUGUST										
08/10/92	< 20	< 20	< 20	< 20	< 7	< 10	< 10	< 10	< 9	< 10
08/17/92	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10	< 10 (a)
08/24/92	< 10	< 10	< 10	< 10	< 7	< 10	< 10	< 10	< 10	< 20
08/31/92	< 20	< 20	< 20	< 20	< 8	< 20	< 20	< 20	< 10	< 20
SEPTEMBER										
09/07/92	< 20	< 20	< 20	< 20	< 8	< 9	< 9	< 9	< 6	< 9
09/14/92	< 20	< 20	< 20	< 10 (b)	< 9	< 20	< 20	< 20	< 10	< 20
09/21/92	< 10	< 10	< 10	(c)	< 10	< 6	< 10	< 10	< 10	< 10
09/28/92	< 20	< 10	< 20	< 10	< 7	< 20	< 20	< 20	< 7	< 20

(a) Equipment malfunction; low sample volume.
(b) Loss of power to air station.
(c) Loss of power to air station; samaple not available.

TABLE B-3 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE-131 IN WEEKLY AIR CARTRIDGE SAMPLES

Results in Units of 10^{-3} $pCi/m^3 \pm 2$ sigma

COLLECTION DATES	STATION CODES A-1	A-2	A-3	A-4	A-5	A-6	Coloma	Dowagiac	New Buffalo	South Bend
OCTOBER										
10/05/92	< 20	< 20	< 20	< 20	< 10	< 20	< 20	< 20	< 8	< 20
10/12/92	< 20	< 20	< 20	< 20	< 7	< 10	< 10	< 10	< 8	< 10
10/19/92	< 20	< 20	< 20	< 20	< 8	< 10	< 10	< 10	< 10	< 10
10/26/92	< 10	< 10	< 10	< 20	< 9	< 10	< 10	< 10	< 7	< 10
11/02/92	< 20	< 20	< 20	< 20	< 7	< 10	< 10	< 10	< 9	< 20
NOVEMBER										
11/09/92	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 7	< 10
11/16/92	< 10	< 10	< 10	< 10	< 9	< 20	< 20	< 20	< 10	< 20
11/23/92	< 10	< 10	< 10	< 10	< 6	< 10	< 10	< 10	< 7	< 10
11/30/92	< 10	< 10	< 10	< 10	< 7	< 20	< 20	< 20	< 7	< 20
DECEMBER										
12/07/92	< 20	< 20	< 20	< 20	< 7	< 10	< 10	< 10	< 9	< 10
12/14/92	< 20	< 20	< 20	< 20	< 7	< 10	< 10	< 10	< 9	< 10
12/21/92	< 20	< 20	< 20	< 20	< 10	< 30	< 30	< 30	< 20	< 30
12/28/92	< 10	< 10	< 10	< 10	< 9	< 9	< 9	< 9	< 6	< 9

TABLE B-4

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS

Results in Units of mR/standard month

STATION CODES	FIRST QUARTER 01/04/92-04/05/92	SECOND QUARTER 04/05/92-07/05/92	THIRD QUARTER 07/05/92-10/04/92	FOURTH QUARTER 10/04/92-01/03/93	AVERAGE ± 2 s.d.
A-1	3.8 ± 0.7	3.6 ± 0.3	3.7 ± 0.1	3.5 ± 0.2	3.7 ± 0.3
A-2	3.8 ± 0.5	3.8 ± 0.6	3.7 ± 0.2	3.6 ± 0.2	3.7 ± 0.2
A-3	3.2 ± 0.3	3.2 ± 0.6	3.2 ± 0.1	3.1 ± 0.2	3.2 ± 0.1
A-4	3.8 ± 0.3	4.0 ± 0.5	3.9 ± 0.2	3.8 ± 0.2	3.9 ± 0.2
A-5	3.5 ± 0.4	3.7 ± 0.5	3.5 ± 0.1	3.4 ± 0.2	3.5 ± 0.3
A-6	3.4 ± 0.6	3.7 ± 0.2	3.5 ± 0.1	3.3 ± 0.2	3.5 ± 0.3
A-7	3.8 ± 0.4	3.8 ± 0.3	3.9 ± 0.1	3.6 ± 0.3	3.8 ± 0.3
A-8	3.6 ± 0.4	3.8 ± 0.7	3.7 ± 0.2	3.6 ± 0.3	3.7 ± 0.2
A-9	4.2 ± 0.8	4.1 ± 0.5	4.0 ± 0.2	3.8 ± 0.3	4.0 ± 0.3
A-10	3.2 ± 0.4	3.5 ± 0.6	3.2 ± 0.1	3.2 ± 0.2	3.3 ± 0.3
A-11	4.1 ± 0.7	4.2 ± 0.5	4.0 ± 0.2	3.8 ± 0.4	4.0 ± 0.3
A-12	4.0 ± 0.4	4.1 ± 0.5	4.2 ± 0.1	3.8 ± 0.2	4.0 ± 0.3
OFS-1	3.8 ± 0.3	3.7 ± 0.6	3.7 ± 0.3	3.7 ± 0.2	3.7 ± 0.1
OFS-2	4.2 ± 0.3	4.1 ± 0.8	4.0 ± 0.2	3.8 ± 0.1	4.0 ± 0.3
OFS-3	4.0 ± 0.4	4.2 ± 0.4	4.0 ± 0.3	3.8 ± 0.4	4.0 ± 0.3
OFS-4	4.3 ± 0.3	4.3 ± 0.9	4.3 ± 0.3	4.3 ± 0.3	4.3 ± 0.0
OFS-5	4.3 ± 0.3	4.2 ± 0.8	4.2 ± 0.1	4.0 ± 0.3	4.2 ± 0.3
OFS-6	4.8 ± 0.4	5.1 ± 0.9	4.9 ± 0.6	4.8 ± 0.5	4.9 ± 0.3
OFS-7	3.8 ± 0.3	3.8 ± 0.6	3.7 ± 0.1	3.8 ± 0.1	3.8 ± 0.1
OFS-8	4.9 ± 0.4	4.7 ± 0.6	4.7 ± 0.3	4.6 ± 0.3	4.7 ± 0.3
OFS-9	4.2 ± 0.4	4.5 ± 1.0	4.3 ± 0.3	4.2 ± 0.5	4.3 ± 0.3
OFS-10	3.8 ± 0.4	3.8 ± 0.7	3.8 ± 0.2	3.9 ± 0.1	3.8 ± 0.1
OFS-11	4.6 ± 0.5	4.7 ± 0.7	4.5 ± 0.3	4.4 ± 0.2	4.6 ± 0.3
NBF	3.9 ± 0.5	4.1 ± 0.7	3.8 ± 0.1	3.7 ± 0.2	3.9 ± 0.3
SBN	4.4 ± 0.9	4.0 ± 0.8	4.0 ± 0.4	4.0 ± 0.2	4.1 ± 0.4
DOW	3.5 ± 0.1	3.4 ± 0.6	3.3 ± 0.2	3.3 ± 0.1	3.4 ± 0.2
COL	3.4 ± 0.3	3.5 ± 0.3	3.3 ± 0.3	3.3 ± 0.2	3.4 ± 0.2
Average ± 2 s.d.	**3.9 ± 0.9**	**4.0 ± 0.9**	**3.9 ± 0.9**	**3.8 ± 0.8**	**3.9 ± 0.9**

* Standard month = 30.4 days.

TABLE B-5

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE, TRITIUM AND GAMMA EMITTERS* IN SURFACE WATER

Results in Units of pCi/liter ± 2 sigma

STATION	Collection Date	I-131	K-40	Tritium
L-1 (Condenser Circ.)	01/09/92	< 0.3	< 100	< 100
	02/06/92	< 0.4	< 100	
	03/05/92 (a)	< 0.3	< 80	
	04/02/92	< 0.4	< 50	< 100
	04/30/92	< 0.2	< 50	
	05/28/92	< 1	< 50	
	06/25/92	< 0.4	< 80	
	07/23/92	< 0.3	< 60	170 ± 70
	08/20/92	< 0.3	< 70	
	09/17/92	< 0.4	< 90	
	10/15/92	< 0.4	< 70	
	11/12/92	< 0.3	< 60	170 ± 80
	12/10/92	< 0.3	60.5 ± 2.71	
L-2 (South Comp)	01/09/92	< 0.3	< 100	< 200
	02/06/92	< 0.3	< 200	
	03/05/92	< 0.3	< 100	
	04/02/92	< 0.4	< 100	< 100
	04/30/92	< 0.2	< 50	
	05/28/92	< 1	< 60	
	06/25/92	< 0.4	< 80	
	07/23/92	< 0.2	< 60	220 ± 70
	08/20/92	< 0.3	< 70	
	09/17/92	< 0.3	< 200	
	10/15/92	< 0.3	< 90	
	11/12/92	< 0.3	< 90	1100 ± 100
	12/10/92	< 0.3	< 100	

* Typical LLDs are found in Table B-12. All other gamma emitters were below <LLD.

(a) Cesium-137 was measured at 7.19 ± 2.52 pCi/l and confirmed by additional measurements.

TABLE B-5 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE, TRITIUM AND GAMMA EMITTERS* IN SURFACE WATER

Results in Units of pCi/liter ± 2 sigma

STATION	Collection Date	I-131	K-40	Tritium
L-3 (North Comp)	01/09/92	< 0.3	< 100	190 ± 80
	02/06/92	< 0.3	< 80	
	03/05/92	< 0.3	< 50	
	04/02/92	< 0.5	< 50	< 100
	04/30/92	< 0.3	< 60	
	05/28/92	< 0.7	< 70	
	06/25/92	< 0.8	< 80	
	07/23/92	< 0.3	< 100	310 ± 70
	08/20/92	< 0.3	< 70	
	09/17/92	< 0.3	< 70	
	10/15/92	< 0.5	< 70	
	11/12/92	< 0.3	< 50	1400 ± 100
	12/10/93	< 0.3	< 50	
L-4 (South 500)	01/09/92	< 0.3	< 90	190 ± 90
	02/06/92	< 0.3	< 100	
	03/05/92	< 0.3	< 80	
	04/02/92	< 0.4	< 50	< 100
	04/30/92	< 0.3	< 50	
	05/28/92	< 1	< 60	
	06/25/92	< 0.5	< 50	
	07/23/92	< 0.2	< 80	360 ± 70
	08/20/92	< 0.4	< 80	
	09/17/92	< 0.3	< 70	
	10/15/92	< 0.5	< 80	1200 ± 100
	11/12/92	< 0.4	< 80	
	12/10/92	< 0.3	< 100	

* Typical LLDs are found in Table B-12. All other gamma emitters were below <LLD.

TABLE B-5 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE, TRITIUM AND GAMMA EMITTERS* IN SURFACE WATER

Results in Units of pCi/liter ± 2 sigma

STATION	Collection Date	I-131	K-40	Tritium
L-5 (North 500)	01/09/92	< 0.4	68.0 ± 29.6	< 100
	02/06/92	< 0.4	< 60	
	03/05/92	< 0.3	< 100	
	04/02/92	< 0.4	55.9 ± 25.2	< 100
	04/30/92	< 0.3	< 90	
	05/28/92	< 1	< 100	
	06/25/92	< 0.5	< 70	
	07/23/92	< 0.2	< 90	340 ± 70
	08/20/92	< 0.5	< 100	
	09/17/92	< 0.5	< 80	
	10/15/92	< 0.4	< 60	
	11/12/92	< 0.3	< 50	1000 ± 100
	12/10/92	< 0.3	< 60	

* Typical LLDs are found in Table B-12. All other gamma emitters were below <LLD.

TABLE B-6

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF TRITIUM AND GAMMA EMITTERS* IN QUARTERLY GROUNDWATER

Results in Units of pCi/liter ± 2 sigma

STATION	Collection Date	I-131	K-40	Tritium
Well - 1	02/09/92	< 0.1	< 100	< 200
	04/28/92	< 0.2	< 60	< 100
	07/31/92	< 0.2	< 50	< 100
	10/31/92	< 0.2	< 50	< 100
Well - 2	02/09/92	< 0.1	< 100	< 200
	04/28/92	< 0.2	< 90	120 ± 80
	07/31/92	< 0.2	< 50	< 100
	10/31/92	< 0.1	< 50	< 100
Well - 3	02/09/92	< 0.1	< 50	< 200
	04/28/92	< 0.2	< 100	< 100
	07/31/92	< 0.2	< 90	< 200
	10/31/92	< 0.1	< 60	< 100
Well - 4	02/09/92	< 0.1	< 200	1200 ± 110
	04/28/92	< 0.2	< 50	1100 ± 100
	07/31/92	< 0.2	< 50	1100 ± 100
	11/01/92	< 0.1	< 80	840 ± 100
Well - 5	02/09/92	< 0.4	< 100	720 ± 160
	04/28/92	< 0.2	< 90	580 ± 100
	07/31/92	< 0.1	< 50	410 ± 100
	11/01/92	< 0.1	< 50	280 ± 110
Well - 6	02/09/92	< 0.1	< 60	300 ± 100
	04/28/92	< 0.2	< 70	540 ± 100
	07/31/92	< 0.1	< 50	540 ± 100
	11/01/92	< 0.1	< 40	450 ± 90
Well - 7	02/09/92	< 0.1	< 100	1300 ± 100
	04/28/92	< 0.2	< 60	1500 ± 100
	07/31/92	< 0.3	< 50	1200 ± 100
	10/31/92	< 0.2	< 80	950 ± 110

* Typical LLDs are found in Table B-12. All other gamma emitters were <LLD.

TABLE B-6 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF TRITIUM AND GAMMA EMITTERS* IN QUARTERLY GROUNDWATER

Results in Units of pCi/liter ± 2 sigma

STATION	Collection Date	I-131	K-40	Tritium
Well - 8	02/09/92	< 0.1	< 50	< 200
	04/28/92	< 0.2	< 60	< 100
	08/10/92 (a)	< 0.1	< 40	< 100
	10/31/92	< 0.1	< 50	< 100
Well - 9	02/18/92	< 0.3	< 50	< 200
	04/28/92	< 0.1	47.0 ± 24.8	< 100
	07/31/92	< 0.2	< 50	< 100
	10/31/92	< 0.1	< 60	< 100
Well - 10	02/11/92	< 0.4	< 90	< 200
	04/28/92	< 0.2	< 60	< 100
	07/30/92	< 0.2	< 60	140 ± 80
	10/31/92	< 0.1	161 ± 25	140 ± 80
Well - 11	02/11/92	< 0.4	< 100	< 200
	04/28/92	< 0.2	< 50	< 100
	07/30/92	< 0.1	< 90	< 100
	10/31/92	< 0.2	< 70	< 100
Well - 12	02/11/92	< 0.5	< 90	< 200
	04/28/92	< 0.2	< 100	120 ± 80
	07/30/92	< 0.2	< 50	< 100
	10/31/92	< 0.1	39.1 ± 15.5	< 100
Well - 13	02/11/92	< 0.4	< 100	950 ± 140
	04/28/92	< 0.2	< 100	650 ± 110
	07/31/92	< 0.2	< 50	490 ± 100
	10/31/92	< 0.2	59.1 ± 20.6	260 ± 90
Average ± 2 s.d.			76.6 ± 114	662 ± 836

* Typical LLDs are found in Table B-12. All other gamma emitters were <LLD.

(a) Sample unavailable; substitute sample collected 08/10/92.

TABLE B-7

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF GROSS BETA, IODINE, TRITIUM AND GAMMA EMITTERS* IN DRINKING WATER

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATE	Gross Beta	Gamma Spec	Iodine-131	Tritium
Lake Township				
01/09/92	3.0 ± 1.0	< LLD	< 0.3	< 100
01/23/92	2.5 ± 1.0	< LLD	< 0.3	
02/06/92	4.3 ± 1.1	< LLD	< 0.3	
02/20/92	4.1 ± 1.0	< LLD	< 0.4	
03/05/92	6.2 ± 1.2	< LLD	< 0.3	
03/19/92	3.3 ± 1.0	< LLD	< 0.2	
04/02/92	3.4 ± 1.0	< LLD	< 0.3	< 100
04/16/92	5.9 ± 1.2	< LLD	< 0.5	
04/30/92	3.7 ± 1.1	< LLD	< 0.3	
05/14/92	2.3 ± 1.0	< LLD	< 0.4	
05/28/92	3.7 ± 1.0	< LLD	< 0.4	
06/11/92	3.3 ± 1.0	< LLD	< 0.2	
06/25/92	3.4 ± 1.0	< LLD	< 0.3	
07/09/92	2.9 ± 1.0	< LLD	< 0.3	< 100
07/23/92	4.7 ± 1.1	< LLD	< 0.5	
08/06/92	3.5 ± 1.0	< LLD	< 0.3	
08/20/92	2.9 ± 0.9	< LLD	< 0.1	
09/03/92	3.5 ± 1.0	< LLD	< 0.4	
09/17/92	3.6 ± 1.0	< LLD	< 0.4	
10/01/92	4.2 ± 1.1	< LLD	< 0.3	150 ± 80
10/15/92	3.5 ± 0.9	< LLD	< 0.4	
10/29/92	2.4 ± 0.9	< LLD	< 0.3	
11/12/92	2.8 ± 0.9	< LLD	< 0.3	
11/26/92	3.8 ± 0.9	< LLD	< 0.5	
12/10/92	1.9 ± 1.2	< LLD	< 0.2	
12/24/92	3.4 ± 1.0	< LLD	< 0.3	
Average ± 2 s. d.	**3.6 ± 2.0**			**150 ± 80**

* Typical LLDs are found in table B-12.

TABLE B-7 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF GROSS BETA, IODINE, TRITIUM AND GAMMA EMITTERS* IN DRINKING WATER

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATE	Gross Beta	Gamma Spec	Iodine-131	Tritium
St. Joseph				
01/09/92	3.1 ± 1.1	< LLD	< 0.3	< 200
01/23/92	3.1 ± 1.1	< LLD	< 0.2	
02/06/92	3.1 ± 1.0	< LLD	< 0.3	
02/20/92	3.9 ± 1.0	< LLD	< 0.4	
03/05/92	4.6 ± 1.1	< LLD	< 0.4	
03/19/92	2.9 ± 1.0	< LLD	< 0.2	
04/02/92	4.0 ± 1.1	< LLD	< 0.3	180 ± 90
04/16/92	2.6 ± 1.0	< LLD	< 0.3	
04/30/92	3.3 ± 1.1	< LLD	< 0.2	
05/14/92	4.2 ± 1.2	< LLD	< 0.2	
05/28/92	4.7 ± 1.1	< LLD	< 0.4	
06/11/92	3.2 ± 1.0	< LLD	< 0.2	
06/25/92	3.9 ± 1.0	< LLD	< 0.2	
07/09/92	4.4 ± 1.1	< LLD	< 0.3	< 100
07/23/92	2.6 ± 1.0	< LLD	< 0.5	
08/06/92	5.1 ± 1.1	< LLD	< 0.3	
08/20/92	3.0 ± 1.0	< LLD	< 0.2	
09/03/92	5.1 ± 1.1	< LLD	< 0.5	
09/17/92	3.7 ± 1.0	< LLD	< 0.3	
10/01/92	4.7 ± 1.1	< LLD	< 0.4	< 100
10/15/92	3.9 ± 1.0	< LLD	< 0.4	
10/29/92	2.6 ± 1.0	< LLD	< 0.3	
11/12/92	3.4 ± 0.9	< LLD	< 0.3	
11/26/92	3.4 ± 0.9	< LLD	< 0.4	
12/10/92	3.3 ± 1.3	< LLD	< 0.2	
12/24/92	3.2 ± 1.0	< LLD	< 0.2	
Average ± 2 s. d.	**3.7 ± 1.5**			**180 ± 90**

* Typical LLDs are found in table B-12.

TABLE B-8

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF GAMMA EMITTERS* IN SEDIMENT

Results in Units of pCi/kg (dry) ± 2 sigma

Station	Collection Date	Be-7	K-40	Cs-137	Ra-226	Th-228
L-2	05/17/92	< 200	6140 ± 610	< 30	< 400	141 ± 25
L-3	05/17/92	< 200	5170 ± 520	< 20	< 300	133 ± 19
L-4	05/17/92	< 200	4390 ± 440	< 20	< 400	138 ± 32
L-5	05/17/92	< 200	5800 ± 580	< 20	< 400	< 40
L-2	11/19/92	< 200	5790 ± 580	< 20	< 300	139 ± 28
L-3	11/19/92	< 200	6470 ± 650	< 30	< 400	116 ± 21
L-4	11/19/92	< 200	6040 ± 600	< 20	< 400	150 ± 22
L-5	11/19/92	< 200	5220 ± 520	< 30	506 ± 297	95.3 ± 21.7
Average ± 2 s.d.			5628 ± 1332		506 ± 297	130 ± 37

* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.

TABLE B-9

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE AND GAMMA EMITTERS* IN MILK

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	ANALYSIS	STATION CODES SHULER	TOTZKE	FREEHLING (a)	WARMBEIN	ZELMER	LIVINGHOUSE	WYANT
01/10/92	K-40	1140 ± 110	1540 ± 150		1290 ± 130	1430 ± 140	1180 ± 120	(b)
	I-131	< 0.2	< 0.2		< 0.1	< 0.1	< 0.2	
01/25/92	K-40	1120 ± 110	1490 ± 150		1460 ± 150	1280 ± 130	1360 ± 140	1350 ± 140
	I-131	< 0.2	< 0.1		< 0.1	< 0.2	< 0.1	< 0.2
02/07/92	K-40	1200 ± 120	1370 ± 140		1340 ± 130	1240 ± 120	1310 ± 130	1280 ± 130
	I-131	< 0.1	< 0.1		< 0.2	< 0.1	< 0.1	< 0.1
02/21/92	K-40	1020 ± 100	1280 ± 130		1440 ± 140	1420 ± 140	1200 ± 120	1120 ± 110
	I-131	< 0.2	< 0.2		< 0.1	< 0.2	< 0.4	< 0.2
03/06/92	K-40	1220 ± 120	1470 ± 150		1400 ± 140	1390 ± 140	1360 ± 140	1200 ± 120
	I-131	< 0.2	< 0.2		< 0.1	< 0.2	< 0.1	< 0.2
03/20/92	K-40	1360 ± 140	1340 ± 130	1420 ± 140	1210 120	(c)	1380 ± 140	1330 ± 130 (d)
	I-131	< 0.2	< 0.2	< 0.1	< 0.2		< 0.1	< 0.2

(a) Added to the program 03/20/92 to replace Lozmack.
(b) Sample not available.
(c) Zelmer out of business 03/16/92.
(d) Cesium-137 was measured at 9.34 ± 4.63 pCi/liter.
* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.

TABLE B-9 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE AND GAMMA EMITTERS* IN MILK

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	ANALYSIS	STATION CODES SHULER	TOTZKE	FREEHLING	WARMBEIN	ZELMER	LIVINGHOUSE	WYANT
04/03/92	K-40	1170 ± 120	1440 ± 140	1230 ± 120	1300 ± 130		1420 ± 140	1260 ± 130
	I-131	< 0.1	< 0.2	< 0.2	< 0.2		< 0.1	< 0.1
04/17/92	K-40	1870 ± 190	1430 ± 140	1330 ± 130	1710 ± 170		1370 ± 140	1450 ± 140
	I-131	< 0.1	< 0.2	< 0.2	< 0.2		< 0.2	< 0.1
05/01/92	K-40	1510 ± 150	1320 ± 130	1470 ± 150	1850 ± 190		1770 ± 180	1690 ± 170
	I-131	< 0.1	< 0.2	< 0.2	< 0.2		< 0.2	< 0.2
05/15/92	K-40	1290 ± 130	1350 ± 140	1280 ± 130	1300 ± 130		1320 ± 130	1290 ± 130
	I-131	< 0.1	< 0.2	< 0.1	< 0.1		< 0.2	< 0.1
05/29/92	K-40	1700 ± 170	1480 ± 150	1320 ± 130	1370 ± 140		1310 ± 130	1290 ± 130
	I-131	< 0.1	< 0.1	< 0.1	< 0.2		< 0.1	< 0.1
06/12/92	K-40	1340 ± 130	1510 ± 150	1400 ± 140	1400 ± 140		1890 ± 190	1460 ± 150
	I-131	< 0.2	< 0.2	< 0.2	< 0.2		< 0.1	< 0.2
06/26/92	K-40	1300 ± 130	1440 ± 140	1580 ± 160	1360 ± 140		1310 ± 130	1420 ± 140
	I-131	< 0.2	< 0.2	< 0.2	< 0.1		< 0.2	< 0.1

* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.

TABLE B-9 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE AND GAMMA EMITTERS* IN MILK

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	ANALYSIS	STATION CODES						
		SHULER	TOTZKE	FREEHLING	WARMBEIN	ZELMER	LIVINGHOUSE	WYANT
07/10/92	K-40 I-131	1680 ± 170 < 0.3	1510 ± 150 < 0.2	1400 ± 140 < 0.2	1330 ± 130 < 0.2		1320 ± 130 < 0.3	1310 ± 130 < 0.2
07/24/92	K-40 I-131	1370 ± 140 < 0.2	1430 ± 140 < 0.2	1470 ± 150 < 0.1	1340 ± 130 < 0.2		1410 ± 140 < 0.2	1460 ± 150 < 0.2
08/07/92	K-40 I-131	1470 ± 150 < 0.2	1230 ± 120 < 0.1	1480 ± 150 < 0.1	1470 ± 150 < 0.2		1450 ± 140 < 0.2	1310 ± 130 < 0.3
08/21/92	K-40 I-131	1400 ± 140 < 0.1	1450 ± 150 < 0.09	1160 ± 120 (a) < 0.1	1380 ± 140 < 0.1		1340 ± 130 < 0.1	1260 ± 130 < 0.1
09/04/92	K-40 I-131	1250 ± 130 < 0.2	1150 ± 120 < 0.2	1340 ± 130 < 0.2	1450 ± 140 < 0.2		1550 ± 160 < 0.2	1290 ± 130 < 0.2
09/18/92	K-40 I-131	1770 ± 180 < 0.1	1460 ± 150 < 0.1	1330 ± 130 < 0.1	1450 ± 150 < 0.1		1310 ± 130 < 0.1	1110 ± 110 < 0.1

* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.

TABLE B-9 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF IODINE AND GAMMA EMITTERS* IN MILK

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	ANALYSIS	STATION CODES SHULER	TOTZKE	FREEHLING	WARMBEIN	ZELMER	LIVINGHOUSE	WYANT
10/02/92	K-40 I-131	1220 ± 120 < 0.1	1480 ± 150 < 0.3	1300 ± 130 < 0.2	1210 ± 120 < 0.2		1400 ± 140 < 0.2	1180 ± 120 < 0.2
10/16/92	K-40 I-131	1380 ± 140 < 0.7	1490 ± 150 < 0.2	1270 ± 130 < 0.3	1440 ± 140 < 0.2		1390 ± 140 < 0.2	1290 ± 130 < 0.4
10/30/92	K-40 I-131	1370 ± 140 < 0.2	1260 ± 130 < 0.5	1290 ± 130 < 0.2	1330 ± 130 < 0.2		1400 ± 140 < 0.4	1290 ± 130 < 0.2
11/13/92	K-40 I-131	1370 ± 140 < 0.4	1220 ± 120 < 0.2	1160 ± 120 < 0.2	1360 ± 140 < 0.2		1430 ± 140 < 0.2	1160 ± 120 < 0.2
11/27/92	K-40 I-131	1440 ± 140 < 0.2	1390 ± 140 < 0.2	1320 ± 130 < 0.2	1510 ± 150 < 0.2		1390 ± 140 < 0.3	1270 ± 130 < 0.3
12/11/92	K-40 I-131	1070 ± 110 < 0.1	1360 ± 140 < 0.2	1410 ± 140 < 0.2	1490 ± 150 < 0.2		1410 ± 140 < 0.1	1280 ± 130 < 0.2
12/26/92	K-40 I-131	1580 ± 160 < 0.1	1460 ± 150 < 0.2	1130 ± 110 < 0.2	1380 ± 140 < 0.2		1200 ± 120 < 0.2	1180 ± 120 < 0.2

* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.

TABLE B-10

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF GAMMA EMITTERS* IN FISH

Results in Units of pCi/kg (wet) ± 2 sigma

Collection Date	Station	Description	Be-7	K-40	Cs-137	Ra-226	Th-228
05/07/92	OFS-South	Red Horse Sucker	< 300	3000 ± 460	< 30	< 600	< 50
05/07/92	OFS-North	Red Horse Sucker	< 200	2340 ± 370	48.0 ± 24.3	< 400	< 40
05/07/92	ONS-South	Red Horse Sucker	< 200	2970 ± 370	< 30	< 500	< 40
05/07/92	ONS-North.	Red Horse Sucker	< 300	3060 ± 390	< 40	< 500	< 50
10/06/92	OFS-South	Red Horse Sucker	< 300	2930 ± 340	< 30	< 400	< 40
10/06/92	OFS-North	Red Horse Sucker	< 300	3330 ± 390	< 30	< 500	< 40
10/06/92	ONS South	Red Horse Sucker	< 200	3110 ± 310	< 30	< 400	< 30
10/06/92	ONS-North	Red Horse Sucker	< 300	4160 ± 430	< 40	< 600	< 50
Average ± 2 s.d.				3113 ± 1017	48.0 ± 24.3		

* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.

TAB[illegible]-11

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF GAMMA EMITTERS* IN FOOD/VEGETATION

Results in Units of pCi/kg (wet) ± 2 sigma

COLLECTION DATE	Station	Description	Be-7	K-40	I-131	Cs-137
08/09/92	SECTOR-A	Broad Leaves	1460 ± 150	1630 ± 170	< 30	36.2 ± 14.5
08/09/92	SECTOR-A	Broad Leaves	1180 ± 120	2730 ± 270	< 20	19.9 ± 10.5
09/27/92	SECTOR-J (close)	Grape Leaves	2770 ± 280	3220 ± 320	< 40	< 20
09/27/92	SECTOR-J (20 M)	Grape Leaves	4030 ± 400	3850 ± 390	< 40	< 20
09/27/92	SECTOR-J (close)	Grape	58.2 ± 26.2	1820 ± 180	< 10	< 5
09/27/92	SECTOR-J (20 M)	Grape	< 30	1830 ± 180	< 8	< 4
10/09/92	SECTOR-B	Grape	< 40	1660 ± 170	< 8	< 4
10/09/92	SECTOR-B	Grape Leaves	2360 ± 240	2470 ± 250	< 30	< 10
Average ± 2 s.d.			1976 ± 2768	2401 ± 1637		28.1 ± 23.1

* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.

TABLE B-12

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

GAMMA SPECTROMETRY LOWER LIMITS OF DETECTION AND REPORTING LEVELS

Isotope	TI LLD	Tech Spec LLD	Rept Level	TI LLD	Tech Spec LLD	Rept Level
	Vegetation - pCi/Kg-wet			Water - pCi/liter		
Cerium-144	60	N/A	N/A	30	N/A	N/A
Barium/La-140	10	N/A	N/A	50/10	60/15	200
Cesium-134	10	60	1000	7	15	30
Ru,Rh-106	80	N/A	N/A	50	N/A	N/A
Cesium-137	10	60	2000	6	18	50
Zr,Nb-95	10	N/A	N/A	10/15	30/15	400
Manganese-54	10	N/A	N/A	5	15	1000
Iron-59	15	N/A	N/A	15	30	400
Zinc-65	20	N/A	N/A	10	30	300
Cobalt-60	10	N/A	N/A	5	15	300
Cobalt-58	10	N/A	N/A	5	15	1000
Iodine-131	20	60	100	10	1	2
Iodine-131 (a)				1	1	
	Milk - pCi/liter			Air Filter - pCi/m^3		
Cerium-144	30	N/A	N/A	0.007	N/A	N/A
Barium/La-140	50/10	60/15	300	0.005	N/A	N/A
Cesium-134	7	15	60	0.002	0.06	10
Ru,Rh-106	50	N/A	N/A	0.010	N/A	N/A
Cesium-137	6	18	70	0.002	0.06	20
Zr,Nb-95	20	N/A	N/A	0.002	N/A	N/A
Manganese-54	5	N/A	N/A	0.002	N/A	N/A
Iron-59	15	N/A	N/A	0.002	N/A	N/A
Zinc-65	10	N/A	N/A	0.002	N/A	N/A
Cobalt-60	5	N/A	N/A	0.002	N/A	N/A
Cobalt-58	5	N/A	N/A	0.002	N/A	N/A
Iodine-131	10	1	3	0.040	0.07	0.9
Iodine-131 (a)	1	1				

(a) Analysis by radiochemistry and based on the assumptions in Procedure PRO-032-11.

* Charcoal Trap

TABLE [illegible]2 (Cont.)

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

GAMMA SPECTROMETRY LOWER LIMITS OF DETECTION AND REPORTING LEVELS

Isotope	TI LLD	Tech Spec LLD	Rept Level	TI LLD	Tech Spec LLD	Rept Level
	FISH - pCi/Kg-wet (b)			Sediment/Soil - pCi/Kg-dry		
Cerium-144	200	N/A	N/A	150	N/A	N/A
Barium/La-140	200	N/A	N/A	5	N/A	N/A
Cesium-134	20	130	1000	30	150	N/A
Ru,Rh-106	200	N/A	N/A	200	N/A	N/A
Cesium-137	20	150	2000	30	180	N/A
Zr,Nb-95	40	N/A	N/A	40	N/A	N/A
Manganese-54	20	130	30000	9	N/A	N/A
Iron-59	40	260	10000	50	N/A	N/A
Zinc-65	40	260	20000	60	N/A	N/A
Cobalt-60	20	130	10000	20	N/A	N/A
Cobalt-58	20	130	30000	20	N/A	N/A
Iodine-131	100	N/A	N/A	30	N/A	N/A

Gross Beta/Tritium LLDs and Reporting Levels

	Gross Beta		
Air Particulates	0.01 pCi/m^3	0.01 pCi/m^3	N/A
Drinking Water	2 pCi/l	4.0 pCi/l	N/A
	Tritium - pCi/l		
Surface Water	200	2000	20,000
Ground Water	200	2000	20,000
Drinking Water	200	2000	20,000

(b) Based on the assumptions in procedure PRO-042-5.

APPENDIX C
ANALYTICAL PROCEDURES SYNOPSIS

ANALYTICAL PROCEDURES SYNOPSIS

Appendix C is a synopsis of the analytical procedures performed during 1992 on samples collected for the D.C. Cook Plant's Radiological Environmental Monitoring Program. All analyses have been mutually agreed upon by Indiana Michigan and Teledyne Isotopes and include those recommended by the USNRC Regulatory Guide 4.8,BTP, Rev. 1, November 1979.

GROSS BETA ANALYSIS OF SAMPLES

Airborne Particulates

After a delay of five or more days, allowing for the radon-222 and radon-220 (thoron) daughter products to decay, the filters are counted in a gas-flow proportional counter. An unused air particulate filter, supplied by the customer, is counted as the blank.

Calculations of the results, the two sigma error and the lower limit of detection (LLD):

RESULT (pCi/m^3) = $((S/T) - (B/t))/(2.22\ V\ E)$

TWO SIGMA ERROR (pCi/m^3) = $2((S/T^2) + (B/t^2))^{1/2}/(2.22\ V\ E)$

LLD (pCi/m^3) = $4.66\ (B/t/T)^{1/2}/(2.22\ V\ E)$

where:

S = Gross counts of sample including blank
B = Counts of blank
E = Counting efficiency
T = Number of minutes sample was counted
t = Number of minutes blank was counted
V = Sample aliquot size (cubic meters)

DETERMINATION OF GROSS BETA ACTIVITY IN WATER SAMPLES

1.0 INTRODUCTION

The procedures described in this section are used to measure the overall radioactivity of water samples without identifying the radioactive species present. No chemical separation techniques are involved.

One liter of the sample is evaporated on a hot plate. A smaller volume may be used if the sample has a significant salt content. If requested by the customer, the sample is filtered through No. 54 filter paper before evaporation, removing particles greater than 30 microns in size.

After evaporating to a small volume in a beaker, the sample is rinsed into a 2-inch diameter stainless steel planchet which is stamped with a concentric ring pattern to distribute residue evenly. Final evaporation to dryness takes place under heat lamps.

Residue mass is determined by weighing the planchet before and after mounting the sample. The planchet is counted for beta activity on an automatic proportional counter. Results are calculated using empirical self-absorption curves which allow for the change in effective counting efficiency caused by the residue mass.

2.0 DETECTION CAPABILITY

Detection capability depends upon the sample volume actually represented on the planchet, the background and the efficiency of the counting instrument, and upon self-absorption of beta particles by the mounted sample. Because the radioactive species are not identified, no decay corrections are made and the reported activity refers to the counting time.

The minimum detectable level (MDL) for water samples is nominally 1.6 picocuries per liter for gross beta at the 4.66 sigma level (1.0 pCi/l at the 2.83 sigma level), assuming that 1 liter of sample is used and that $\frac{1}{2}$ gram of sample residue is mounted on the planchet. These figures are based upon a counting time of 50 minutes and upon representative values of counting efficiency and background of 0.2 and 1.2 cpm, respectively.

The MDL becomes significantly lower as the mount weight decreases because of reduced self-absorption. At a zero mount weight, the 4.66 sigma MDL for gross beta is 0.9 picocuries per liter. These values reflect a beta counting efficiency of 0.38.

ANALYSIS OF SAMPLES FOR TRITIUM

(Gas Counting)

Water

Approximately 2 ml of water are converted to hydrogen by passing the water, heated to its vapor state, over a granular zinc conversion column heated to 400° C. The hydrogen is loaded into a one liter proportional detector and the volume is determined by recording the pressure.

The proportional detector is passively shielded by lead and steel and an electronic, anticoincidence system provides additional shielding from cosmic rays.

Calculation of the results, the two sigma error and the lower limit detection (LLD) in pCi/l:

RESULT = $3.234\ T_N\ V_N(C_G - B)/(C_N\ V_S)$

TWO SIGMA ERROR = $2((C_G + B)\Delta t)^{1/2} 3.234\ T_N\ V_N/((C_N\ V_S)\ (C_G - B))$

LLD = $4.66\ (3.234) T_N\ V_N (C_G)^{1/2}/(\Delta t\ C_N\ V_S)$

where:

T_N	=	tritium units of the standard
3.234	=	conversion factor changing tritium units to pCi/l
V_N	=	volume of the standard used to calibrate the efficiency of the detector in psia
V_S	=	volume of the sample loaded into the detector in psia
C_N	=	the cpm activity of the standard of volume V_N
C_G	=	the gross activity in cpm of the sample of volume V_S and the detector volume
B	=	the background of the detector in cpm
Δt	=	counting time for the sample

ANALYSIS OF SAMPLES FOR TRITIUM

(Liquid Scintillation)

Water

Ten milliliters of water are mixed with 10 ml of a liquid scintillation "cocktail" and then the mixture is counted in an automatic liquid scintillator.

Calculation of the results, the two sigma error and the lower limit detection (LLD) in pCi/l:

RESULT	=	$(N-B)/(2.22\ V\ E)$
TWO SIGMA ERROR	=	$2((N + B)/\Delta t)^{1/2}/\ (2.22\ V\ E)$
LLD	=	$4.66\ (B/\Delta t)^{1/2}/(2.22\ V\ E)$

where:	N	=	the gross cpm of the sample
	B	=	the background of the detector in cpm
	2.22	=	conversion factor changing dpm to pCi
	V	=	volume of the sample in ml
	E	=	efficiency of the detector
	Δt	=	counting time for the sample

ANALYSIS OF SAMPLES FOR STRONTIUM-89 AND -90

Water

Stable strontium carrier is added to 1 liter of sample and the volume is reduced by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using nitric acid. A barium scavenge and an iron (ferric hydroxide) scavenge are performed followed by addition of stable yttrium carrier and a minimum of 5 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Milk

Stable strontium carrier is added to 1 liter of sample and the sample is first evaporated, then ashed in a muffle furnace. The ash is dissolved and strontium is precipitated as phosphate, then is dissolvedin 3M HNO_3. This solution is passed through a crown ether extraction column to isolate elemental strontium. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Soil and Sediment

The sample is first dried under heat lamps and an aliquot is taken. Stable strontium carrier is added and the sample is leached in hydrochloric acid. The mixture is filtered and strontium is precipitated from the liquid

portion as phosphate. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. A barium chromate scavenge and an iron (ferric hydroxide) scavenge are then performed. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Organic Solids

A wet portion of the sample is dried and then ashed in a muffle furnace. Stable strontium carrier is added and the ash is leached in hydrochloric acid. The sample is filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(NO_3)$ using fuming (90%) nitric acid. An iron (ferric hydroxide) scavenge is performed, followed by addition of stable yttrium carrier and a minimum of 5 days period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Air Particulates

Stable strontium carrier is added to the sample and it is leached in nitric acid to bring deposits into solution. The mixture is then filtered and the filtrate is reduced in volume by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. A barium scavenge is used to remove some interfering species. An iron (ferric hydroxide) scavenge is performed, followed addition of stable yttrium carrier and a 7 to 10 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide,

dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with 80 mg/cm^2 aluminum absorber for level beta counting.

Calculations of the results, two sigma errors and lower limits of detection (LLD) are expressed in activity of pCi/volume or pCi/mass:

RESULT Sr-89 = $(N/\Delta t-B_C-B_A)/(2.22\ V\ Y_S\ DF_{SR-89}\ E_{SR-89})$

TWO SIGMA ERROR Sr-89 = $2((N/\Delta t+B_C+B_A)/\Delta t)^{1/2}/(2.22\ V\ Y_S\ DF_{SR-89}\ E_{SR-89}$

LLD Sr-89 = $4.66((B_C+B_A)/\Delta t)^{1/2}/(2.22\ V\ Y_S\ DF_{SR-89}\ E_{SR-89})$

RESULT Sr-90 = $(N/\Delta t - B)/(2.22\ V\ Y_1\ Y_2\ DF\ IF\ E)$

TWO SIGMA ERROR Sr-90 = $2((N/\Delta t+B)/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ DF\ E\ IF))$

LLD Sr-90 = $4.66(B/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ IF\ DF\ E)$

where:

N	=	total counts from sample (counts)
Δt	=	counting time for sample (min)
B_C	=	background rate of counter (cpm) using absorber configurati
2.22	=	dpm/pCi
V	=	volume or weight of sample analyzed
B_A	=	background addition from Sr-90 and ingrowth of Y-90
B_A	=	$0.016\ (K) + (K)\ (E_{Y/abs})\ (IG_{Y\text{-}90})$
Y_S	=	chemical yield of strontium
$DF_{SR\text{-}89}$	=	decay factor from the mid collection date to the counting date for SR-89
$E_{SR\text{-}89}$	=	efficiency of the counter for SR-89 with the 80 mg/cm.sq. aluminum absorber
K	=	$(N/\Delta t - B_C)_{Y\text{-}90}/(E_{Y\text{-}90}\ IF_{Y\text{-}90}\ DF_{Y\text{-}90} Y_1)$
$DF_{Y\text{-}90}$	=	the decay factor for Y-90 from the "milk" time to the mid count time
$E_{Y\text{-}90}$	=	efficiency of the counter for Y-90
$IF_{Y\text{-}90}$	=	ingrowth factor for Y-90 from scavenge time to milking tim
$IG_{Y\text{-}90}$	=	the ingrowth factor for Y-90 into the strontium mount from "milk" time to the mid count time
0.016	=	the efficiency of measuring SR-90 through a No. 6 absorber
$E_{Y/abs}$	=	the efficiency of counting Y-90 through a No. 6 absorber
B	=	background rate of counter (cpm)
Y_1	=	chemical yield of yttrium
Y_2	=	chemical yield of strontium
DF	=	decay factor of yttrium from the radiochemical milking time to the mid count time
E	=	efficiency of the counter for Y-90
IF	=	ingrowth factor for Y-90 from scavenge time to the radio-chemical milking time

ANALYSIS OF SAMPLES FOR IODINE-131

Milk or Water

Two liters of sample are first equilibrated with stable iodide carrier. A batch treatment with anion exchange resin is used to remove iodine from the sample. The iodine is then stripped from the resin with sodium hypochlorite solution, reduced with hydroxylamine hydrochloride and extracted into toluene as free iodine. It is then back-extracted as iodide into sodium bisulfite solution and is precipitated as palladium iodide. The precipitate is weighed for chemical yield and is mounted on a nylon planchet for low level beta counting. The chemical yield is corrected by measuring the stable iodide content of the milk or the water with a specific ion electrode.

Calculations of results, two sigma error and the lower limit of detection (LLD) in pCi/l:

RESULT		=	$(N/\Delta t\text{-}B)/(2.22\ E\ V\ Y\ DF)$
TWO SIGMA ERROR		=	$2((N/\Delta t+B)/\Delta t)^{1/2}(2.22\ E\ V\ Y\ DF)$
LLD		=	$= 4.66(B/\Delta t)^{1/2}/(2.22\ E\ V\ Y\ DF)$
where:	N	=	total counts from sample (counts)
	Δt	=	counting time for sample (min)
	B	=	background rate of counter (cpm)
	2.22	=	dpm/pCi
	V	=	volume or weight of sample analyzed
	Y	=	chemical yield of the mount or sample counted
	DF	=	decay factor from the collection to the counting date
	E	=	efficiency of the counter for I-131, corrected for self absorption effects by the formula
	E	=	$E_s(\exp{-0.0085M})/(\exp{-0.0085M_s})$
	E_s	=	efficiency of the counter determined from an I-131 standard mount
	Ms	=	mass of PdI_2 on the standard mount, mg
	M	=	mass of PdI_2 on the sample mount, mg

GAMMA SPECTROMETRY OF SAMPLES

Milk and Water

A 1.0 liter Marinelli beaker is filled with a representative aliquot of the sample. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Dried Solids Other Than Soils and Sediments

A large quantity of the sample is dried at a low temperature, less than 100°C. As much as possible (up to the total sample) is loaded into a tared 1-liter Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Fish

As much as possible (up to the total sample) of the edible portion of the sample is loaded into a tared Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Soils and Sediments

Soils and sediments are dried at a low temperature, less than 100°C. The soil or sediment is loaded fully into a tared, standard 300 cc container and weighed. The sample is then counted for approximately six hours with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height and analysis.

Charcoal Cartridges (Air Iodine)

Charcoal cartridges are counted up to five at a time, with one positioned on the face of a Ge(Li) detector and up to four on the side of the Ge(Li) detector. Each Ge(Li) detector is calibrated for both positions. The detection limit for I-131 of each charcoal cartridge can be determined

(assuming no positive I-131) uniquely from the volume of air which passed through it. In the event I-131 is observed in the initial counting of a set, each charcoal cartridge is then counted separately, positioned on the face of the detector

Airborne Particulates

The thirteen airborne particulate filters for a quarterly composite for each field station are aligned one in front of another and then counted for at least six hours with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

A mini-computer software program defines peaks by certain changes in the slope of the spectrum. The program also compares the energy of each peak with a library of peaks for isotope identification and then performs the radioactivity calculation using the appropriate fractional gamma ray abundance, half life, detector efficiency, and net counts in the peak region. The calculation of results, two sigma error and the lower limit of detection (LLD) in pCi/volume of pCi/mass:

RESULT	=	(S-B)/2.22 t E V F DF)
TWO SIGMA ERROR	=	$2(S+B)^{1/2}/(2.22\ t\ E\ V\ F\ DF)$
LLD	=	$4.66(B)^{1/2}/(2.22\ t\ E\ V\ F\ DF)$

where:

S = Area, in counts, of sample peak and background (region of spectrum of interest)

B = Background area, in counts, under sample peak, determined by a linear interpolation of the representative backgrounds on either side of the peak

t = length of time in minutes the sample was counted

2.22 = dpm/pCi

E = detector efficiency for energy of interest and geometry of sample

V = sample aliquot size (liters, cubic meters, kilograms, or grams)

F = fractional gamma abundance (specific for each emitted gamma)

DF = decay factor from the mid-collection date to the counting date

ENVIRONMENTAL DOSIMETRY

Teledyne Isotopes uses a $CaSO_4$:Dy thermoluminescent dosimeter (TLD) which the company manufactures. This material has a high light output, negligible thermally induced signal loss (fading), and negligible self dosing. The energy response curve (as well as all other features) satisfies NRC Reg. Guide 4.13. Transit doses are accounted for by use of separate TLDs.

Following the field exposure period the TLDs are placed in a Teledyne Isotopes Model 8300. One fourth of the rectangular TLD is heated at a time and the measured light emission (luminescence) is recorded. The TLD is then annealed and exposed to a known Cs-137 dose; each area is then read again. This provides a calibration of each area of each TLD after every field use. The transit controls are read in the same manner.

Calculations of results and the two sigma error in net milliRoentgen (mR):

RESULT $D = (D_1+D_2+D_3+D_4)/4$

TWO SIGMA ERROR $= 2((D_1-D)^2+(D_2-D)^2+(D_3-D)^2+(D_4-D)^2)/3)^{1/2}$

WHERE: D_1 = the net mR of area 1 of the TLD, and similarly for D_2, D_3, and D_4

$D1 = I_1 K/R_1 - A$

I_1 = the instrument reading of the field dose in area 1

K = the known exposure by the Cs-137 source

R_1 = the instrument reading due to the Cs-137 dose on area 1

A = average dose in mR, calculated in similar manner as above, of the transit control TLDs

D = the average net mR of all 4 areas of the TLD.

APPENDIX D
SUMMARY OF EPA INTERLABORATORY COMPARISONS

EPA INTERLABORATORY COMPARISON PROGRAM

Teledyne Isotopes participates in the EPA Interlaboratory Comparison Program to the fullest extent possible. That is, we participate in the program for all radioactive isotopes prepared and at the maximum frequency of availability. In this section trending graphs (since 1981) and the 1992 data summary tables are presented for isotopes in the various sample media applicable to the Donald C. Cook Plant's Radiological Environmental Monitoring Program. The footnotes of the table discuss investigations of problems encountered in a few cases and the steps taken to prevent reoccurrence.

US EPA INTERLABORATORY COMPARISON PROGRAM 1992
Environmental

Collection Date	Media	Nuclide	EPA Result(a)		Teledyne Isotopes Result(b)		
01/17/92	Water	Sr-89	51.0 ±	5.0	45.67 ±	1.53	
		Sr-90	20.0 ±	5.0	18.67 ±	1.53	
01/31/92	Water	Gr-Alpha	30.0 ±	8.0	25.00 ±	4.00	
		Gr-Beta	30.0 ±	5.0	31.67 ±	0.58	
02/07/92	Water	I-131	59.0 ±	6.0	61.00 ±	1.73	
02/14/92	Water	Co-60	40.0 ±	5.0	38.00 ±	2.65	
		Zn-65	148.0 ±	15.0	145.00 ±	1.73	
		Ru-106	203.0 ±	20.0	191.00 ±	21.66	
		Cs-134	31.0 ±	5.0	29.00 ±	2.00	
		Cs-137	49.0 ±	5.0	53.67 ±	2.52	
		Ba-133	76.0 ±	8.0	75.67 ±	7.51	
02/21/92	Water	H-3	7904.0 ±	790.0	7800.00 ±	100.00	
03/06/92	Water	Ra-226	10.1 ±	1.5	5.30 ±	0.95	(c)
		Ra-228	15.5 ±	3.9	20.00 ±	2.00	(c)
03/27/92	Air Filter	Gr-Alpha	7.0 ±	5.0	11.33 ±	0.58	
		Gr-Beta	41.0 ±	5.0	43.00 ±	1.00	
		Sr-90	15.0 ±	5.0	12.67 ±	0.58	
		Cs-137	10.0 ±	5.0	11.00 ±	1.73	
04/14/92	Water	Gr-Beta	140.0 ±	21.0	98.00 ±	2.00	(d)
		Sr-89	15.0 ±	5.0	16.00 ±	1.00	
		Sr-90	17.0 ±	5.0	14.33 ±	1.15	
		Co-60	56.0 ±	5.0	55.00 ±	1.73	
		Cs-134	24.0 ±	5.0	22.67 ±	1.53	
		Cs-137	22.0 ±	5.0	24.67 ±	3.06	
		Gr-Alpha	40.0 ±	10.0	34.33 ±	2.08	
		Ra-226	14.9 ±	2.2	13.33 ±	2.08	
		Ra-228	14.0 ±	3.5	15.33 ±	0.58	

US EPA INTERLABORATORY COMPARISON PROGRAM 1992
Environmental

Collection Date	Media	Nuclide	EPA Result(a)		Teledyne Isotopes Result(b)		
04/24/92	Milk	Sr-89	38.0 ±	5.0	36.00 ±	4.58	
		Sr-90	29.0 ±	5.0	26.00 ±	0.00	
		I-131	78.0 ±	8.0	71.67 ±	4.04	
		Cs-137	39.0 ±	5.0	46.67 ±	2.31	(e)
		K	1710.0 ±	86.0	1680.00 ±	72.11	
05/08/92	Water	Sr-89	29.0 ±	5.0	24.00 ±	1.73	
		Sr-90	8.0 ±	5.0	6.33 ±	0.58	
05/15/92	Water	Gr-Alpha	15.0 ±	5.0	10.00 ±	1.00	
		Gr-Beta	44.0 ±	5.0	44.67 ±	1.15	
06/05/92	Water	Co-60	20.0 ±	5.0	21.33 ±	0.58	
		Zn-65	99.0 ±	10.0	107.00 ±	3.61	
		Ru-106	141.0 ±	14.0	127.00 ±	11.53	
		Cs-134	15.0 ±	5.0	15.00 ±	1.00	
		Cs-137	15.0 ±	5.0	16.00 ±	1.00	
		Ba-133	98.0 ±	10.0	93.33 ±	6.03	
06/19/92	Water	H-3	2125.0 ±	347.0	2100.00 ±	0.00	
07/17/92	Water	Ra-226	24.9 ±	3.7	23.33 ±	1.15	
		Ra-228	16.7 ±	4.2	17.33 ±	0.58	
08/07/92	Water	I-131	45.0 ±	6.0	43.33 ±	6.03	
08/28/92	Air Filter	Gr-Alpha	30.0 ±	8.0	27.33 ±	0.58	
		Gr-Beta	69.0 ±	10.0	69.00 ±	1.00	
		Sr-90	25.0 ±	5.0	22.67 ±	1.15	
		Cs-137	18.0 ±	5.0	16.67 ±	2.31	
		Co-60	10.0 ±	5.0	11.00 ±	1.00	
		Zn-65	148.0 ±	15.0	156.67 ±	0.58	
		Ru-106	175.0 ±	18.0	164.33 ±	7.51	
		Cs-134	8.0 ±	5.0	8.67 ±	0.58	
		Cs-137	8.0 ±	5.0	8.67 ±	0.58	
		Ba-133	74.0 ±	7.0	75.67 ±	9.29	

US EPA INTERLABORATORY COMPARISON PROGRAM 1992
Environmental

Collection Date	Media	Nuclide	EPA Result(a)		Teledyne Isotopes Result(b)	
09/18/92	Water	Gr-Alpha	45.0 ±	11.0	45.00 ±	2.00
		Gr-Beta	50.0 ±	5.0	45.00 ±	1.73
09/11/92	Water	Sr-89	20.0 ±	5.0	16.00 ±	1.00
		Sr-90	15.0 ±	5.0	13.00 ±	1.0
09/25/92	Milk	Sr-89	15.0 ±	5.0	16.00 ±	2.00
		Sr-90	15.00 ±	5.0	12.67 ±	1.15
		I-131	100.0 ±	10.0	99.00 ±	7.21
		Cs-137	15.0 ±	5.0	15.67 ±	1.15
		K	1750.0 ±	88.0	1660.00 ±	85.44
10/23/92	Water	H-3	5962.0 ±	596.0	5666.67 ±	57.74

Footnotes:

(a) EPA Results-Expected laboratory precision (1 sigma). Units are pCi/liter for water and milk except K is in mg/liter. Units are total pCi for air particulate filters.

(b) Teledyne Results - Average ± one sigma. Units are pCi/liter for water and milk except K is in mg/liter. Units are total pCi for air particulate filters.

(c) All lab data sheets were verified for accuracy. Three different detectors were used with aliquot ingrowth times of 9 and 19 days. Results ranged from 4 to 6 pCi/l. Dilution error has been determined to be the probable cause for the deviation from the spike value. Internal biweekly spike analyses have been in control. Corrective action includes implementation of a dilution form to record aliquot and solvent volumes. Entries will be made by the technician and reviewed by the supervisor.

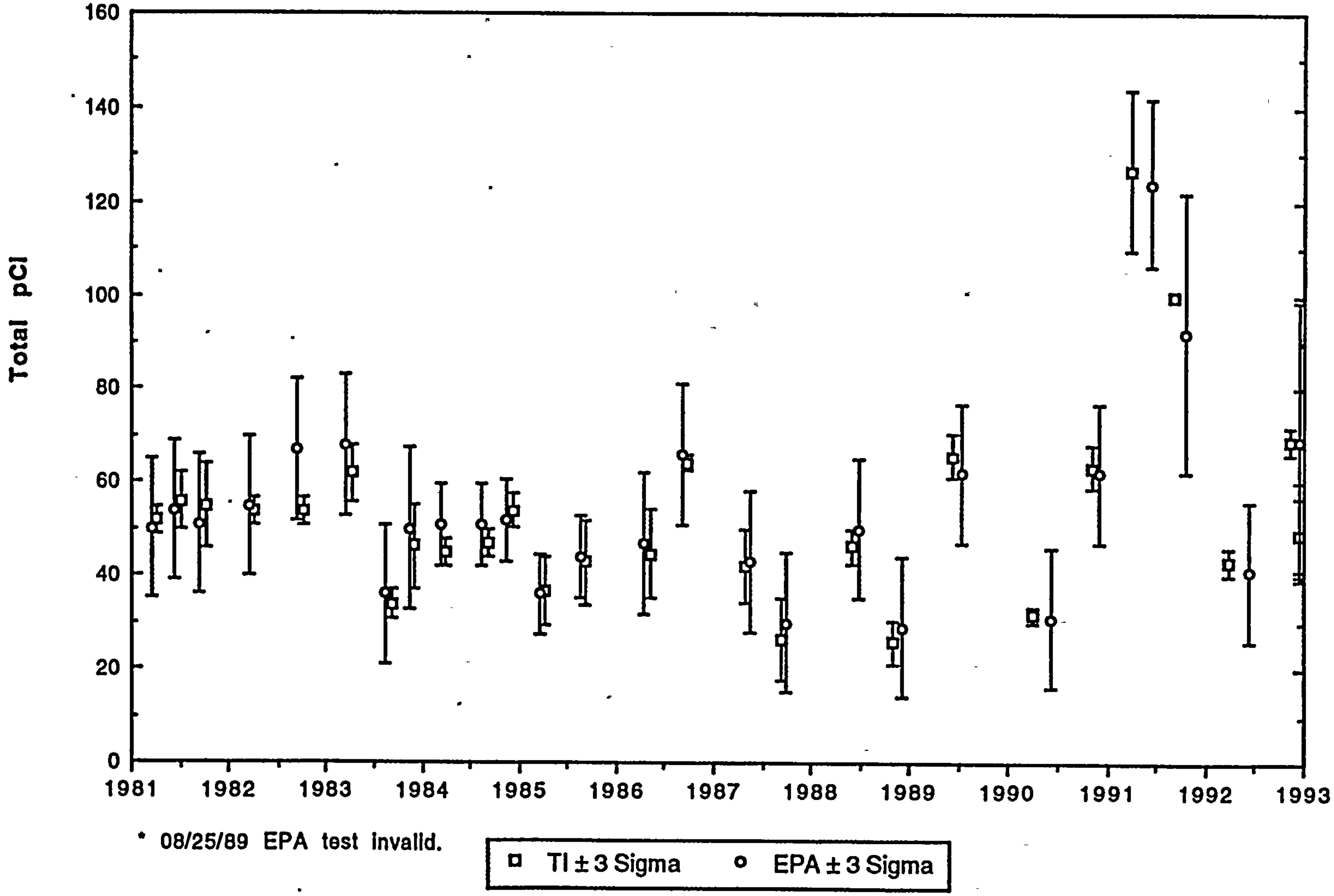
(d) There was large fraction of low energy beta emitters (Co-60 and Cs-134) in the sample. Detector efficiency decreases with decreasing energy. We are required to calibrate with the high energy beta emitters (Cs-137 and Sr-90). No corrective action necessary.

(e) There is no apparent reason for the high Cs-137 results. The sample geometry and detector efficiencies were verified to be correct. The Total K and I-131 by gamma spectroscopy were in good agreement with EPA values. There is no trend and results were within ± 3 sigma so no action taken.

TRENDING GRAPH 5

EPA CROSS CHECK PROGRAM

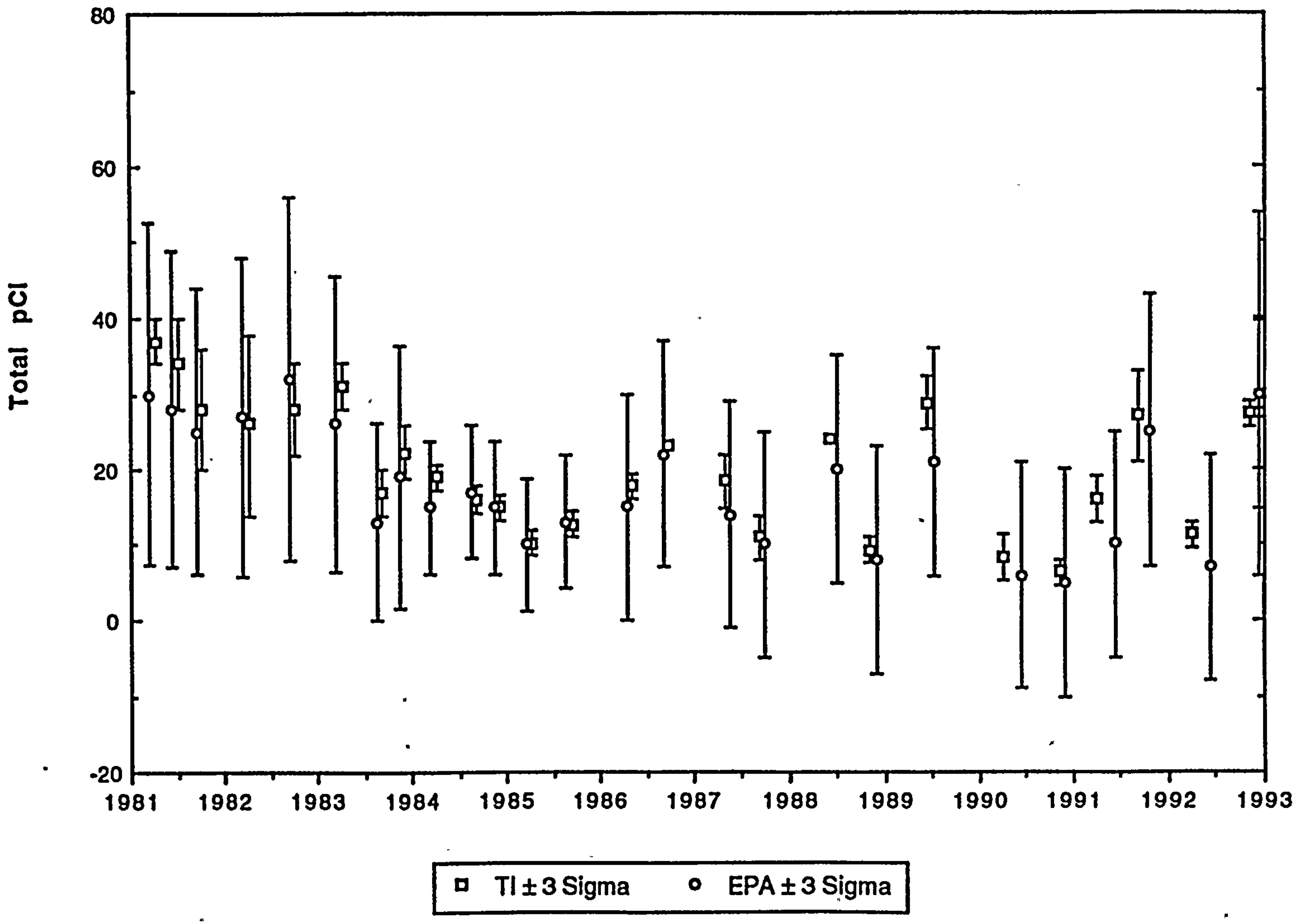
GROSS BETA IN AIR PARTICULATES



* 08/25/89 EPA test invalid.

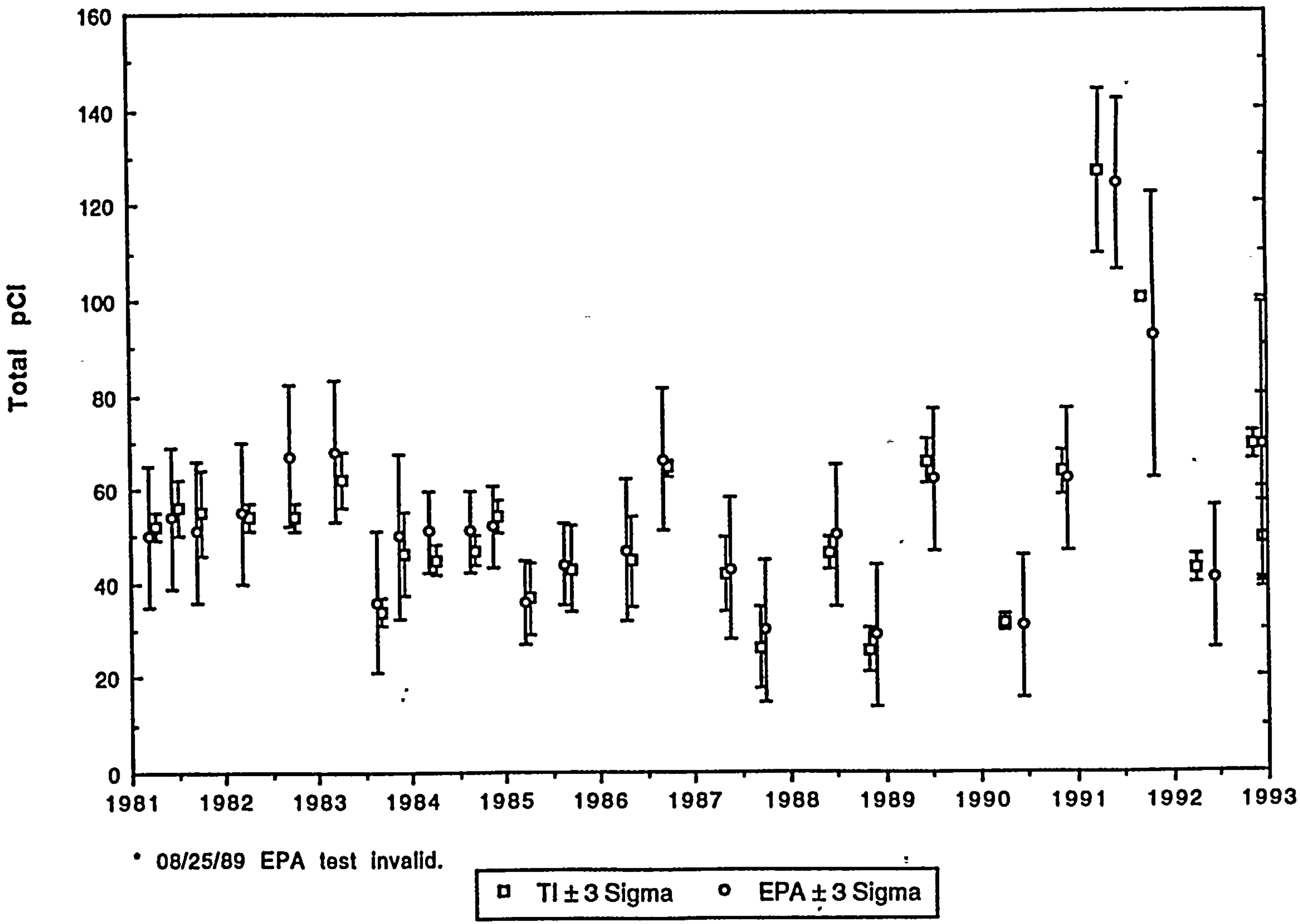
EPA CROSS CHECK PROGRAM

GROSS ALPHA IN AIR PARTICULATES



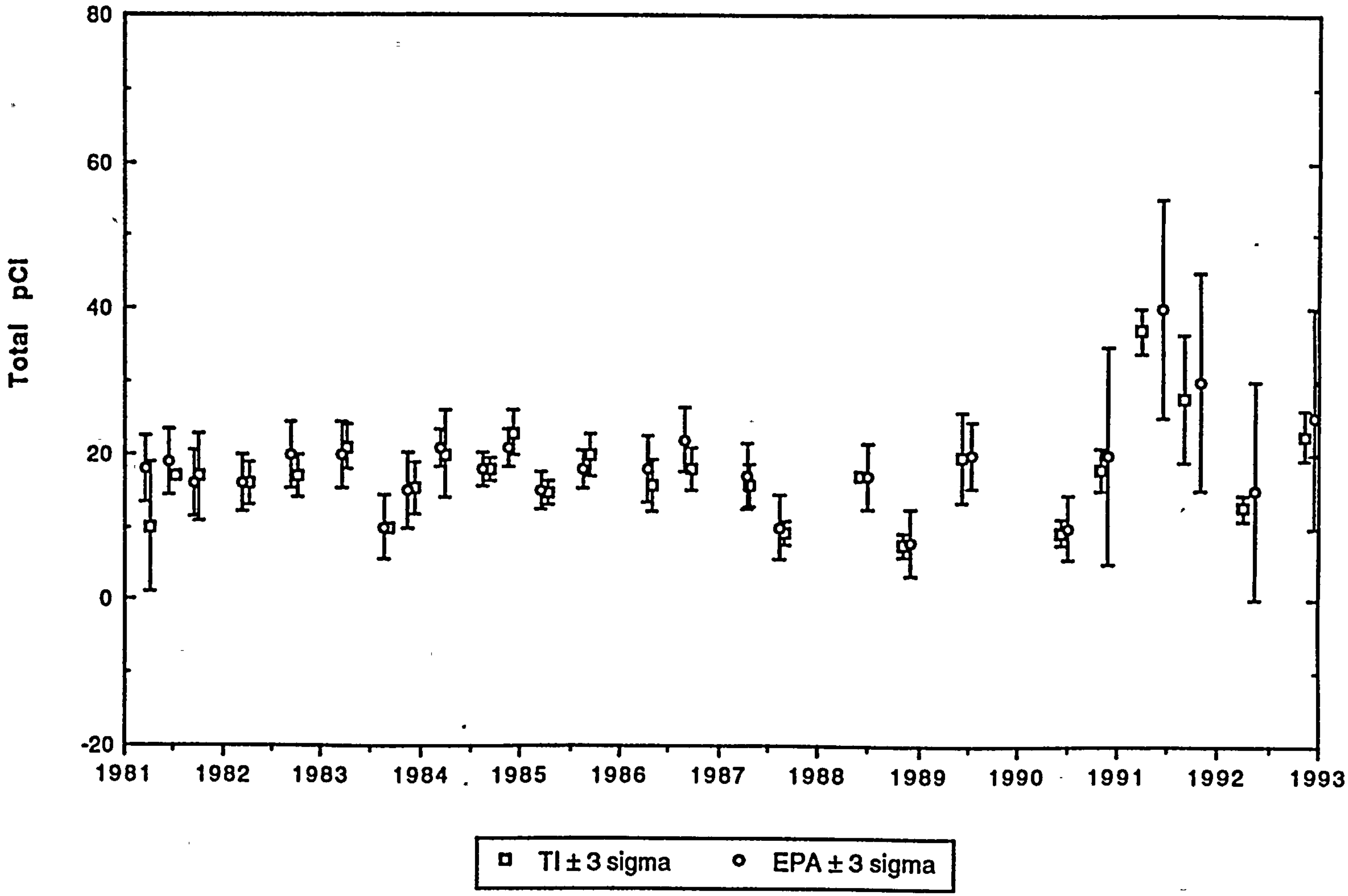
EPA CROSS CHECK PROGRAM

GROSS BETA IN AIR PARTICULATES



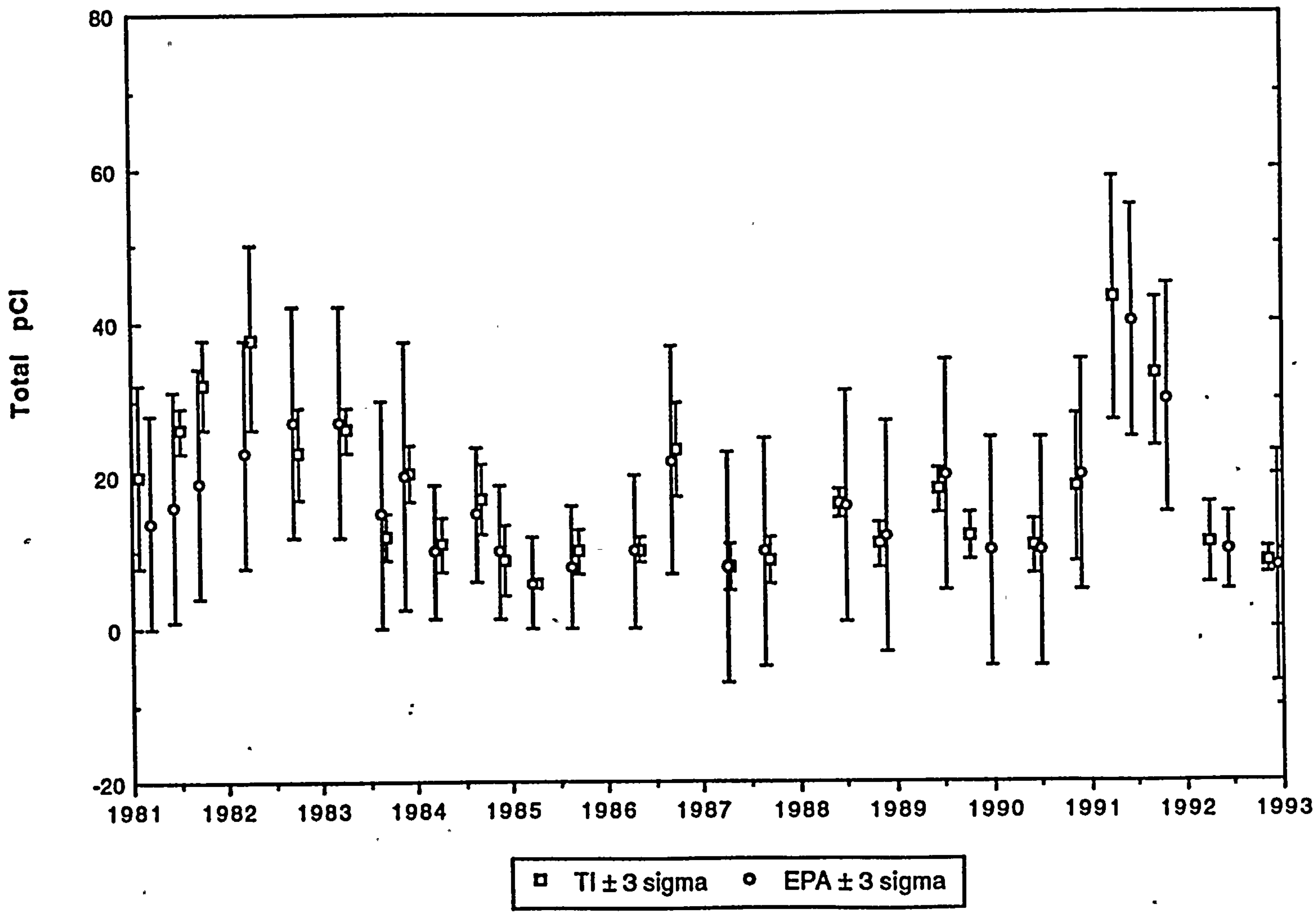
EPA CROSS CHECK PROGRAM

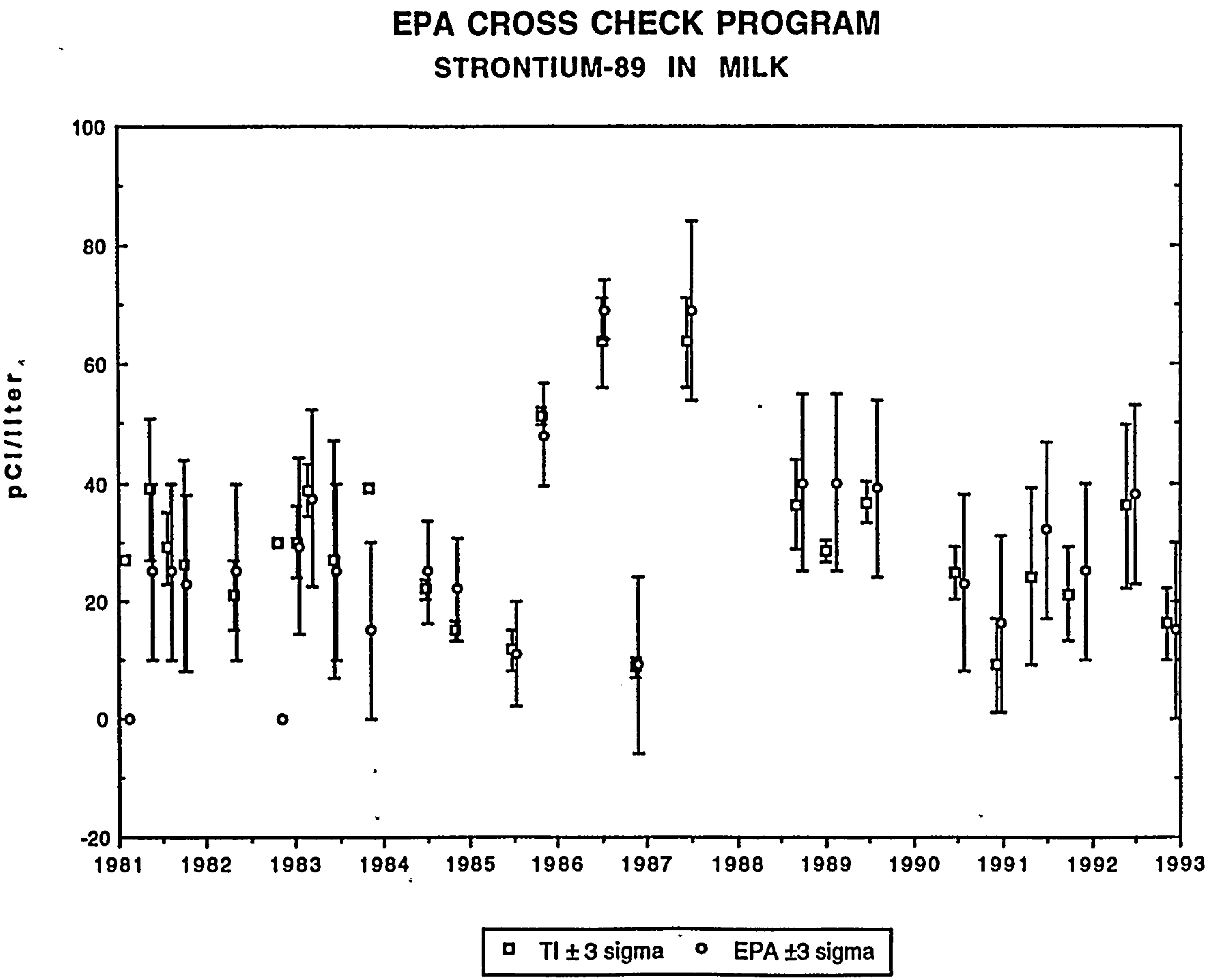
STRONTIUM-90 IN AIR PARTICULATES



EPA CROSS CHECK PROGRAM

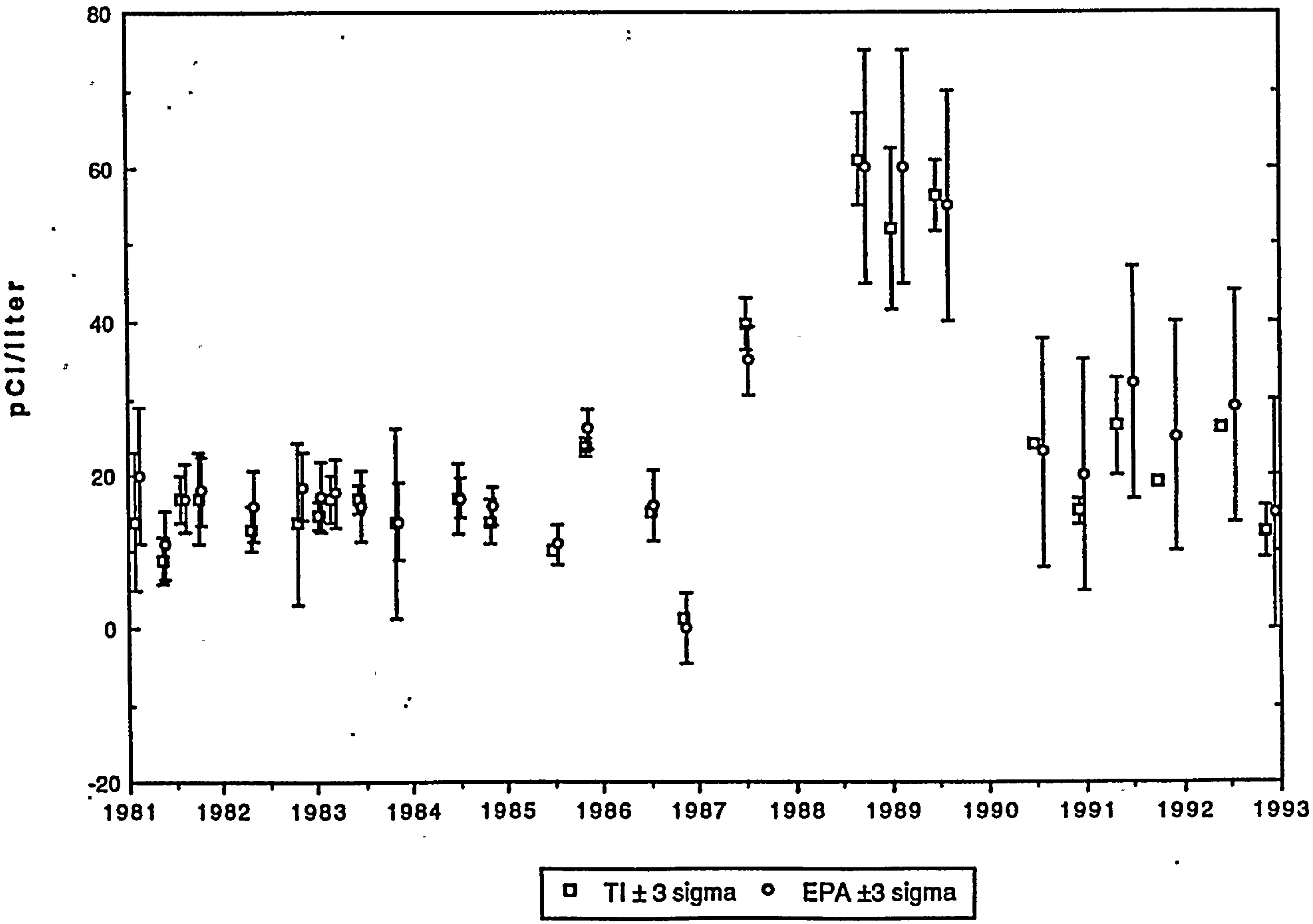
CESIUM-137 IN AIR PARTICULATES



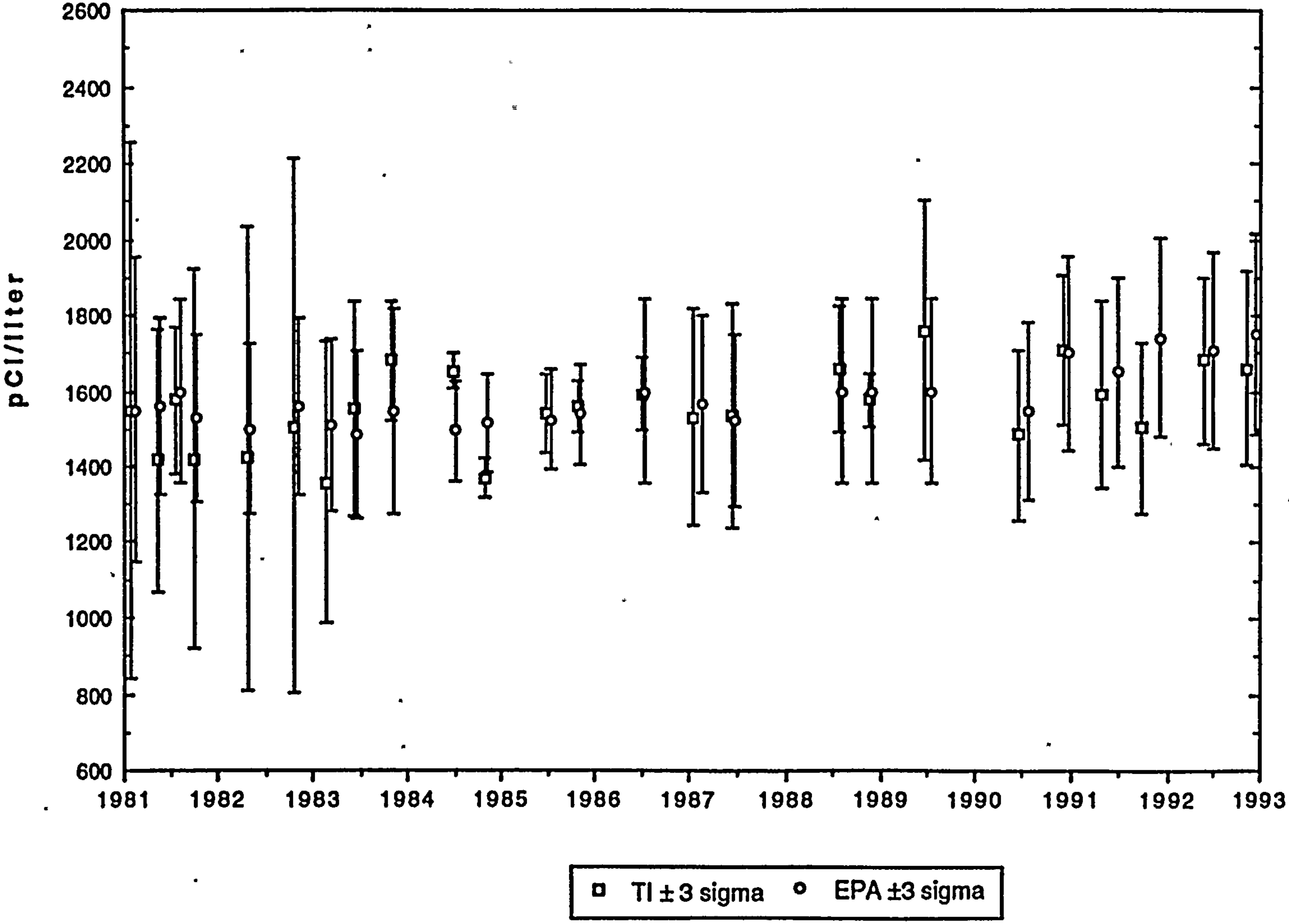

EPA CROSS CHECK PROGRAM
STRONTIUM-89 IN MILK
pCi/liter
100
80
60
40
20
0
-20
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
TI ± 3 sigma
EPA ±3 sigma

EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN MILK

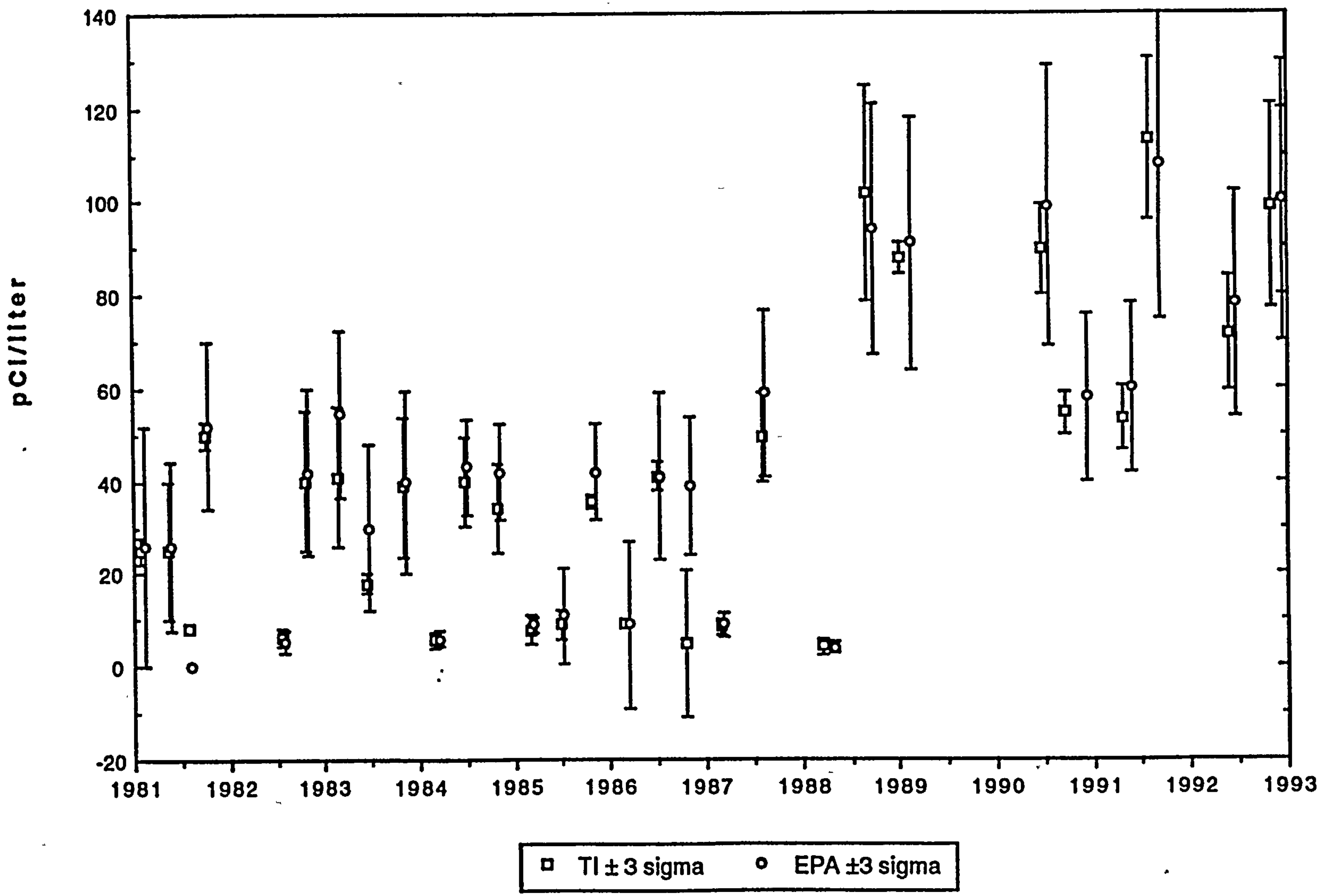


EPA CROSS CHECK PROGRAM
POTASSIUM-40 IN MILK



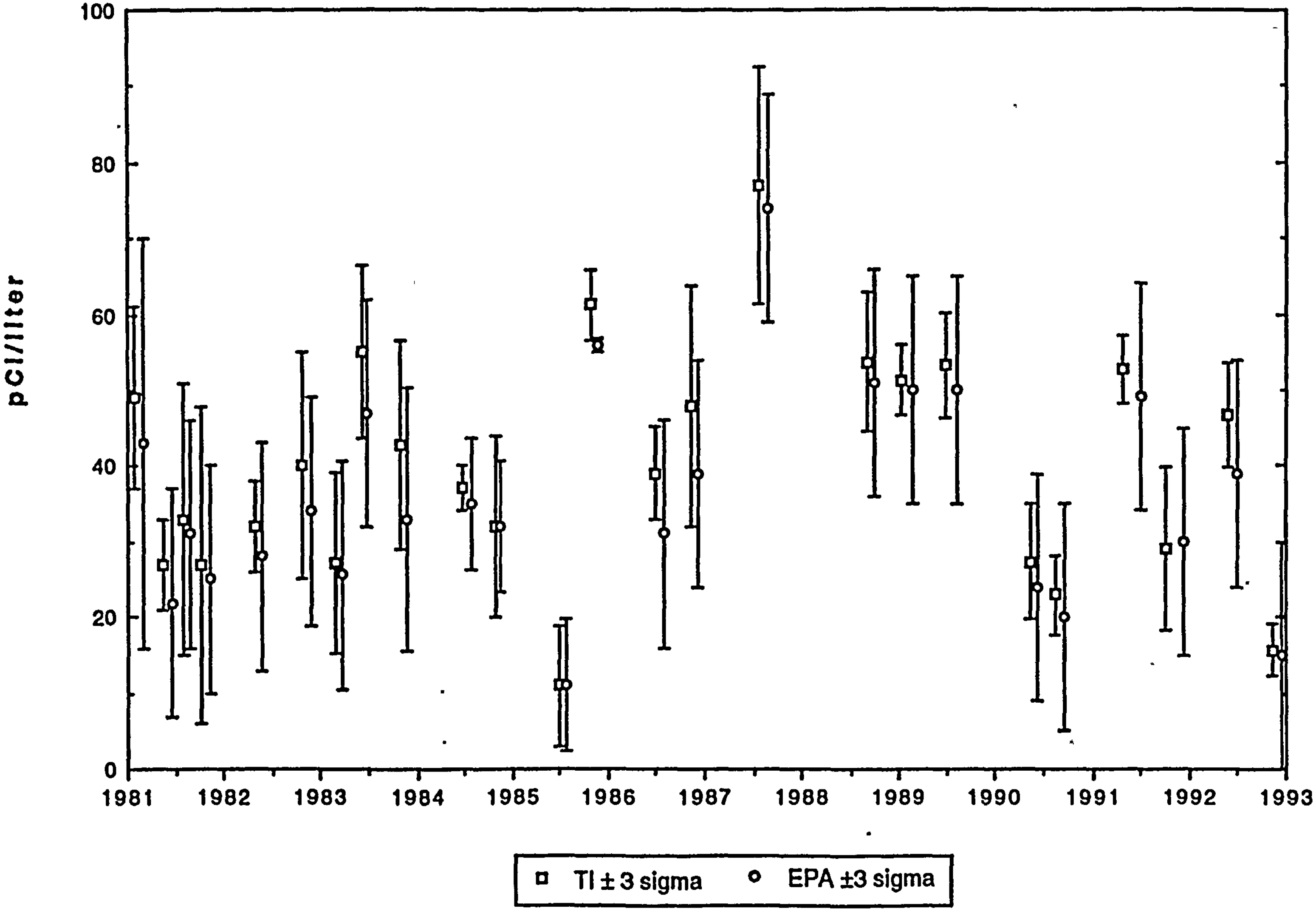
EPA CROSS CHECK PROGRAM

IODINE-131 IN MILK



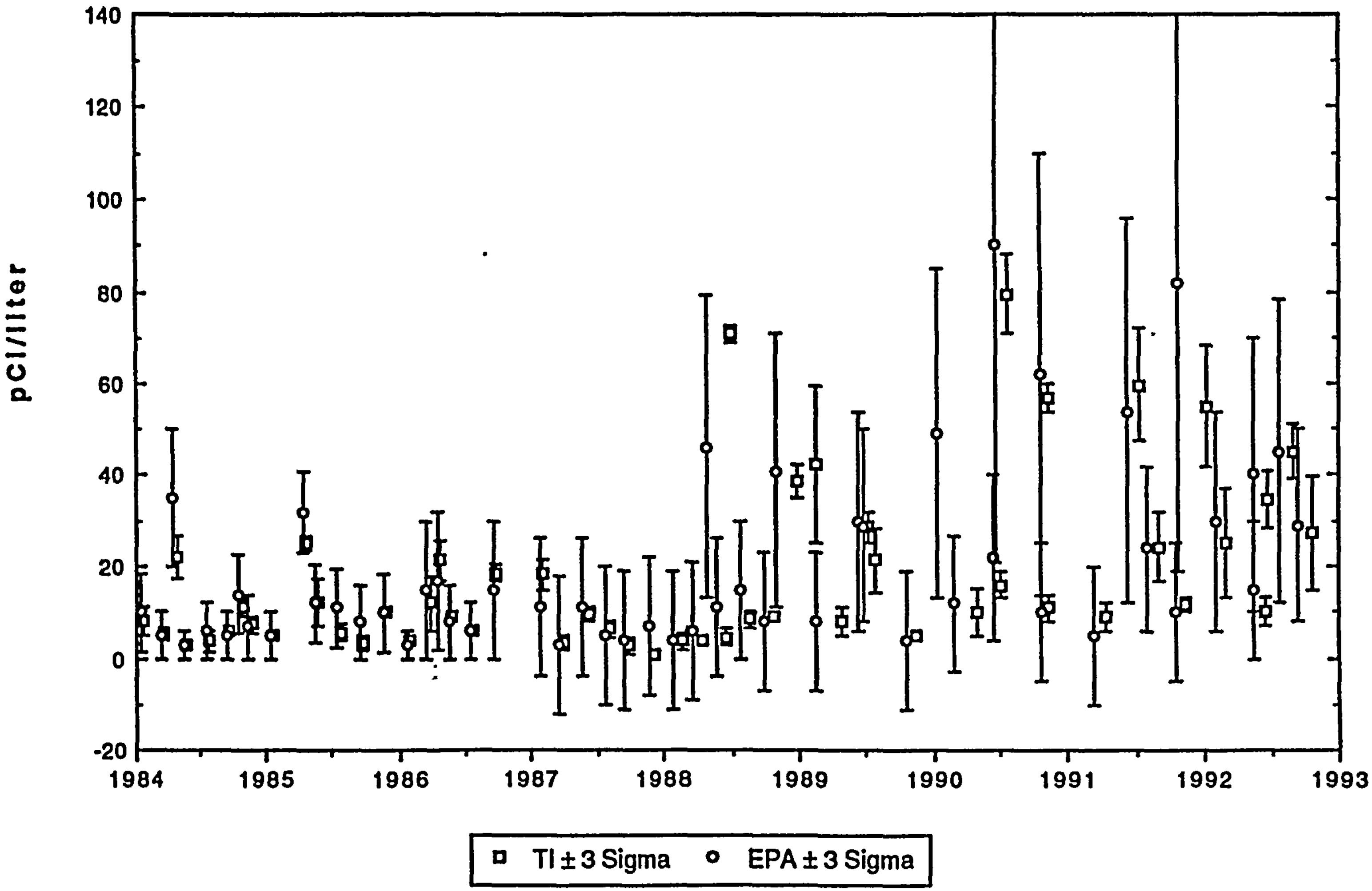
EPA CROSS CHECK PROGRAM

CESIUM-137 IN MILK



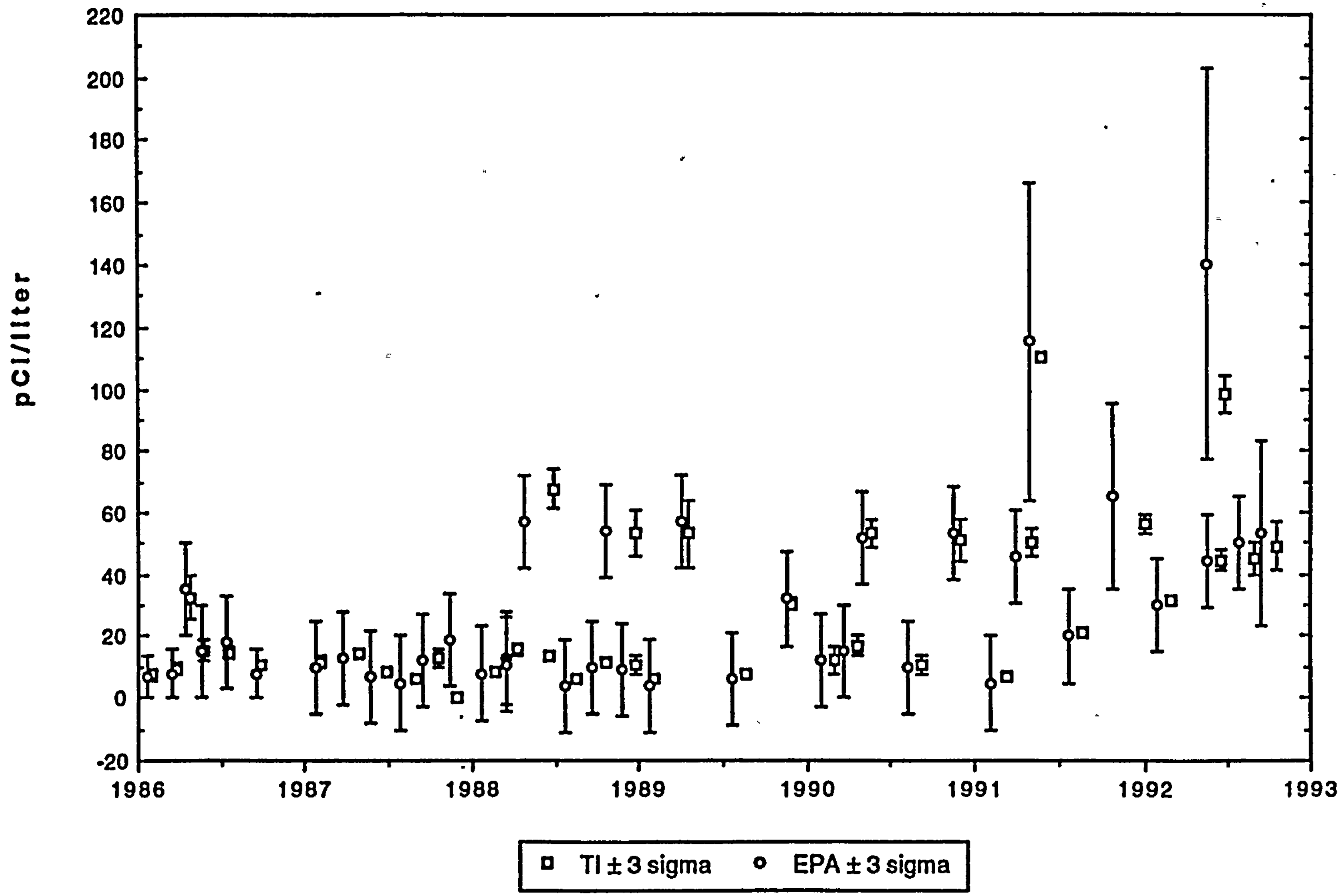
EPA CROSS CHECK PROGRAM

GROSS ALPHA IN WATER



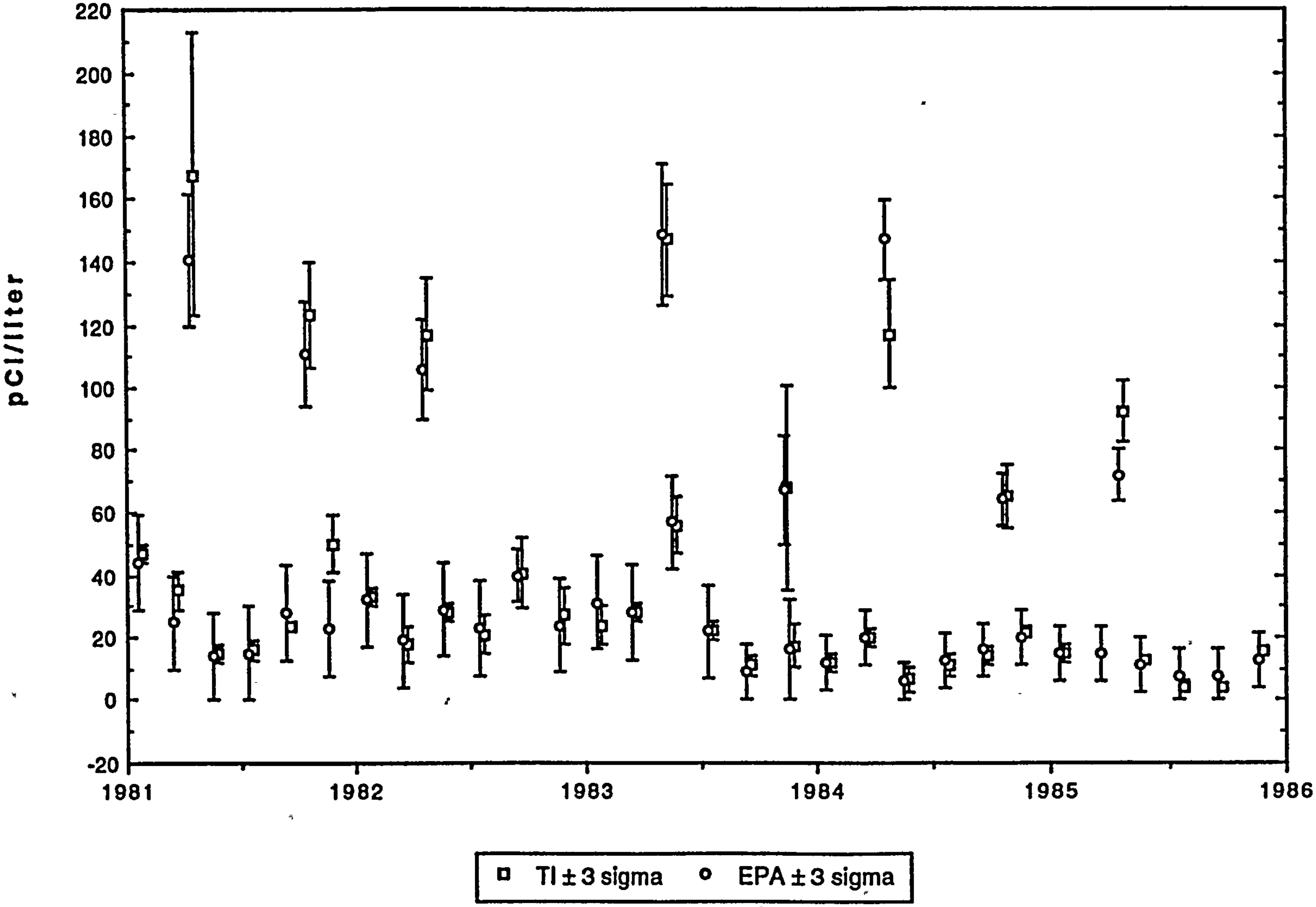
EPA CROSS CHECK PROGRAM

GROSS BETA IN WATER (pg. 2 of 2)



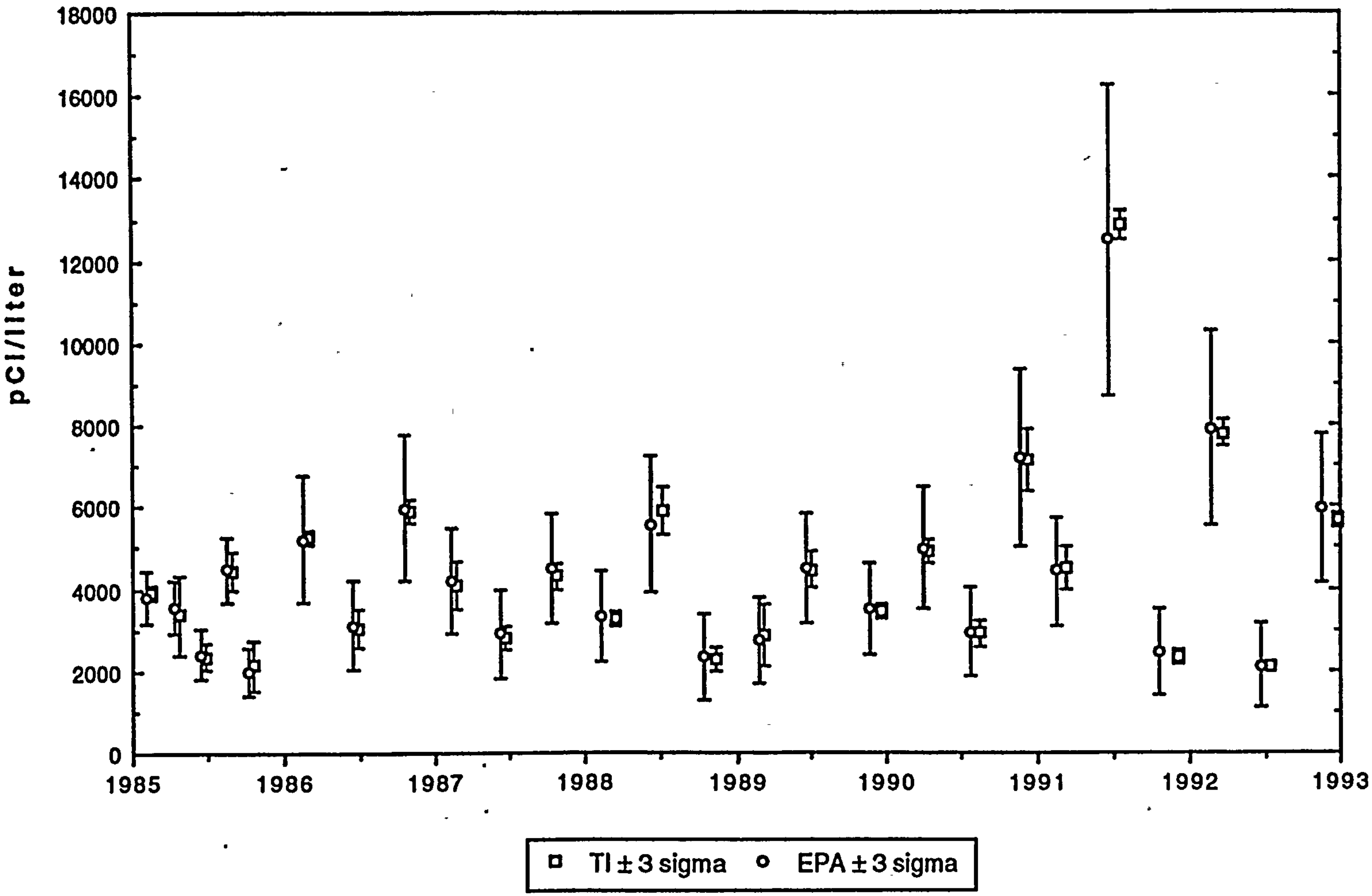
EPA CROSS CHECK PROGRAM

GROSS BETA IN WATER (pg. 1 of 2)



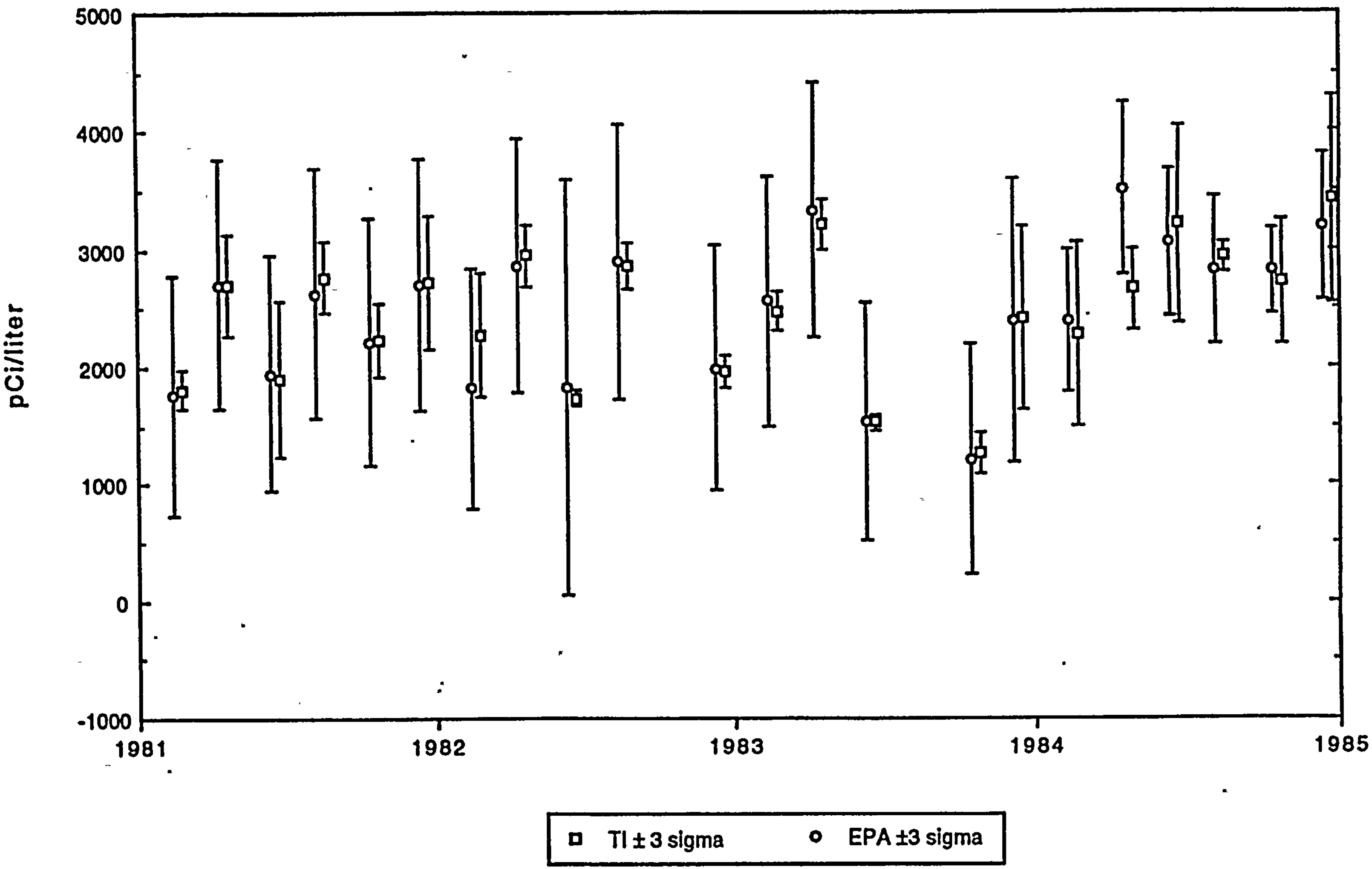
EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (pg. 2 of 2)



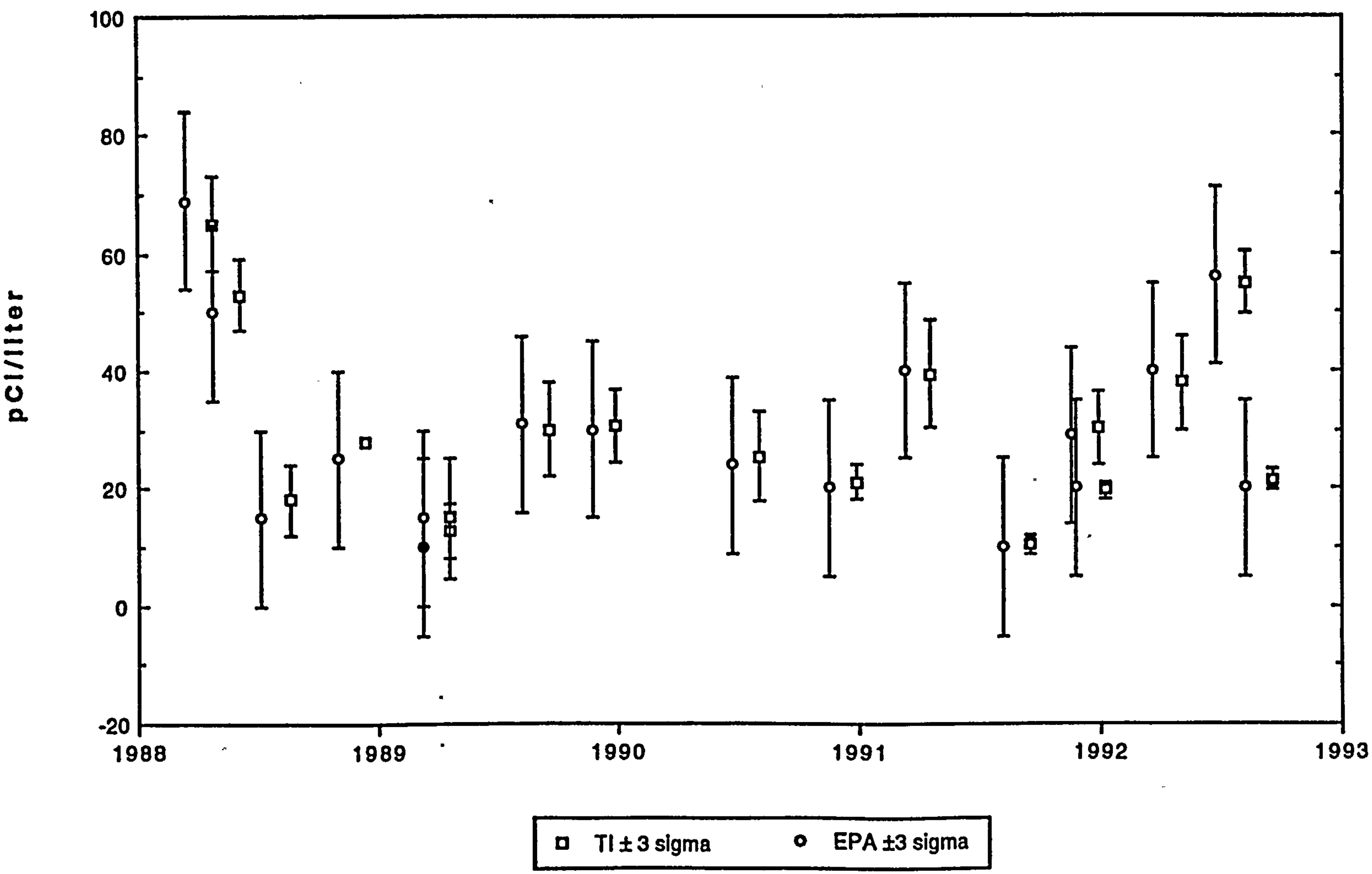
EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (pg. 1 of 2)



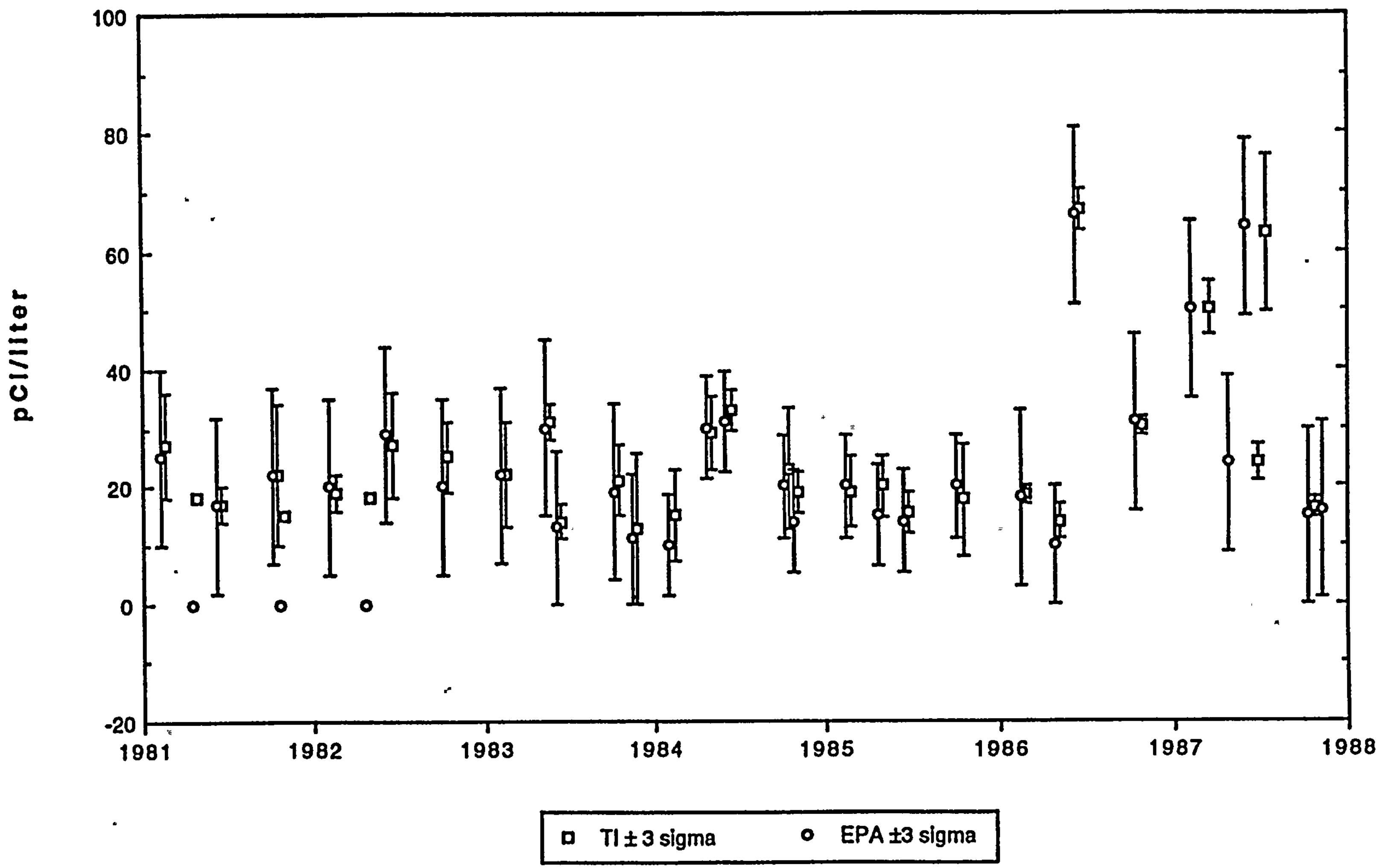
EPA CROSS CHECK PROGRAM

COBALT-60 IN WATER (pg. 2 of 2)



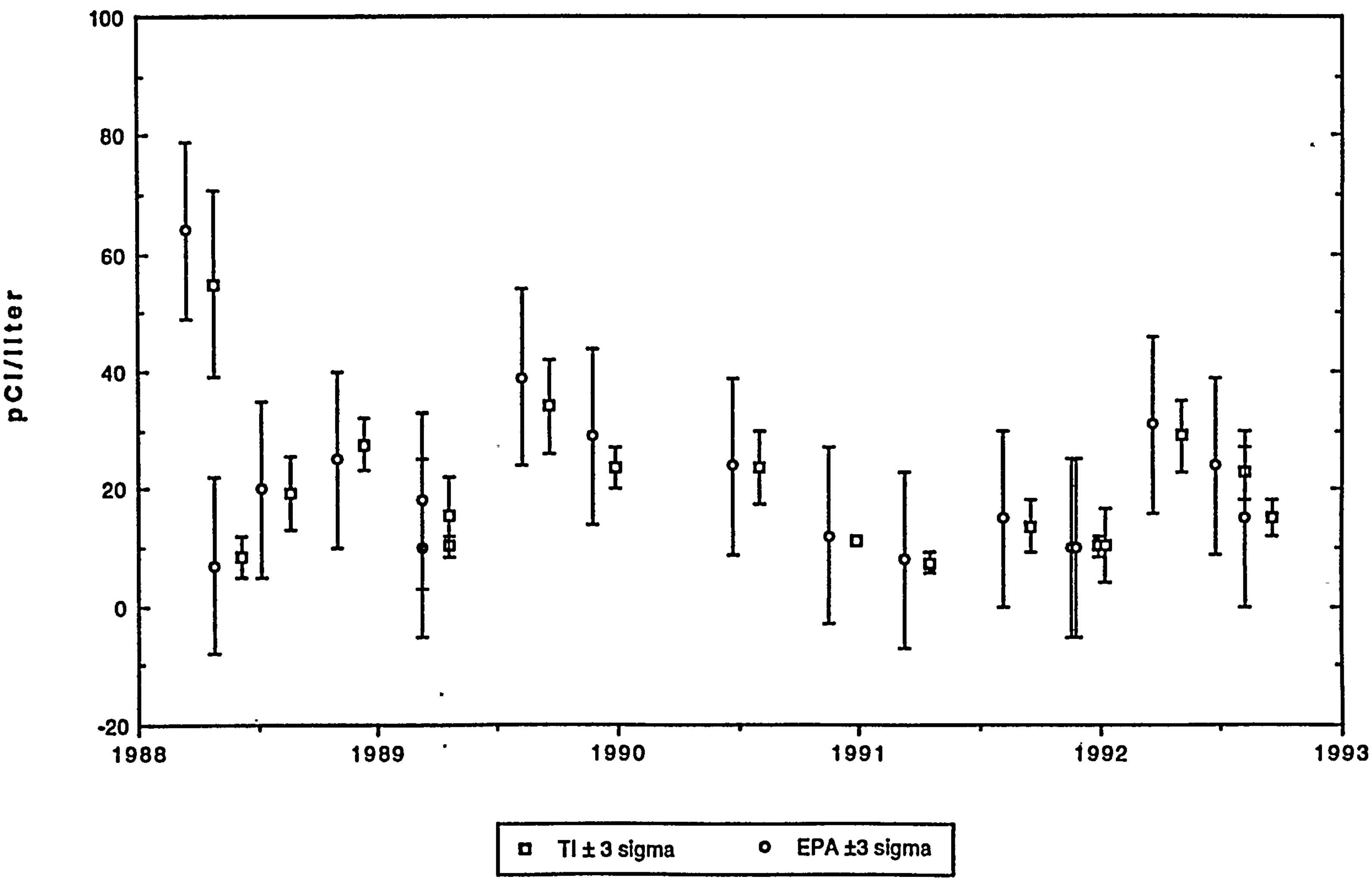
EPA CROSS CHECK PROGRAM

COBALT-60 IN WATER (pg 1 of 2)



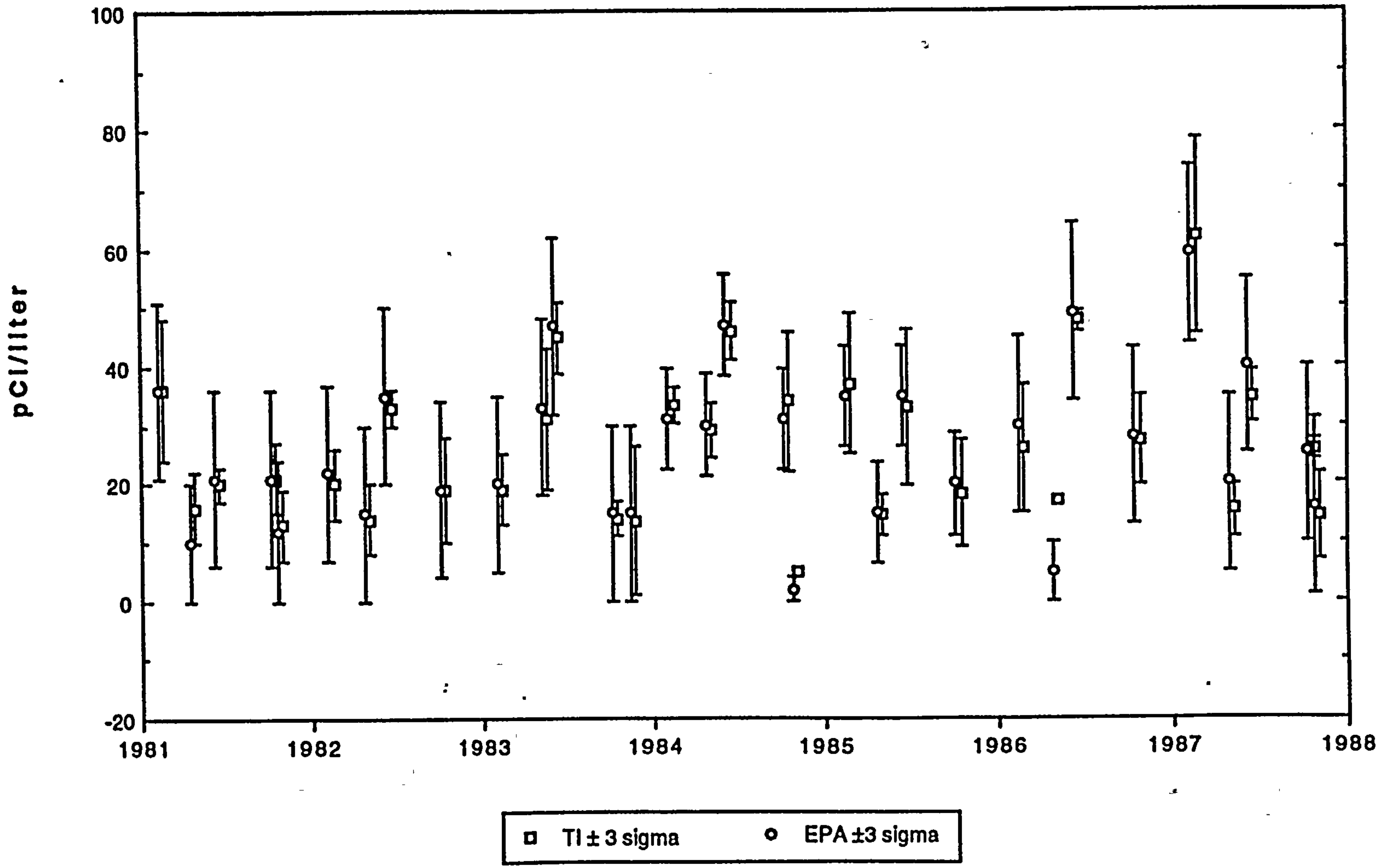
EPA CROSS CHECK PROGRAM

CESIUM-134 IN WATER (pg. 2 of 2)



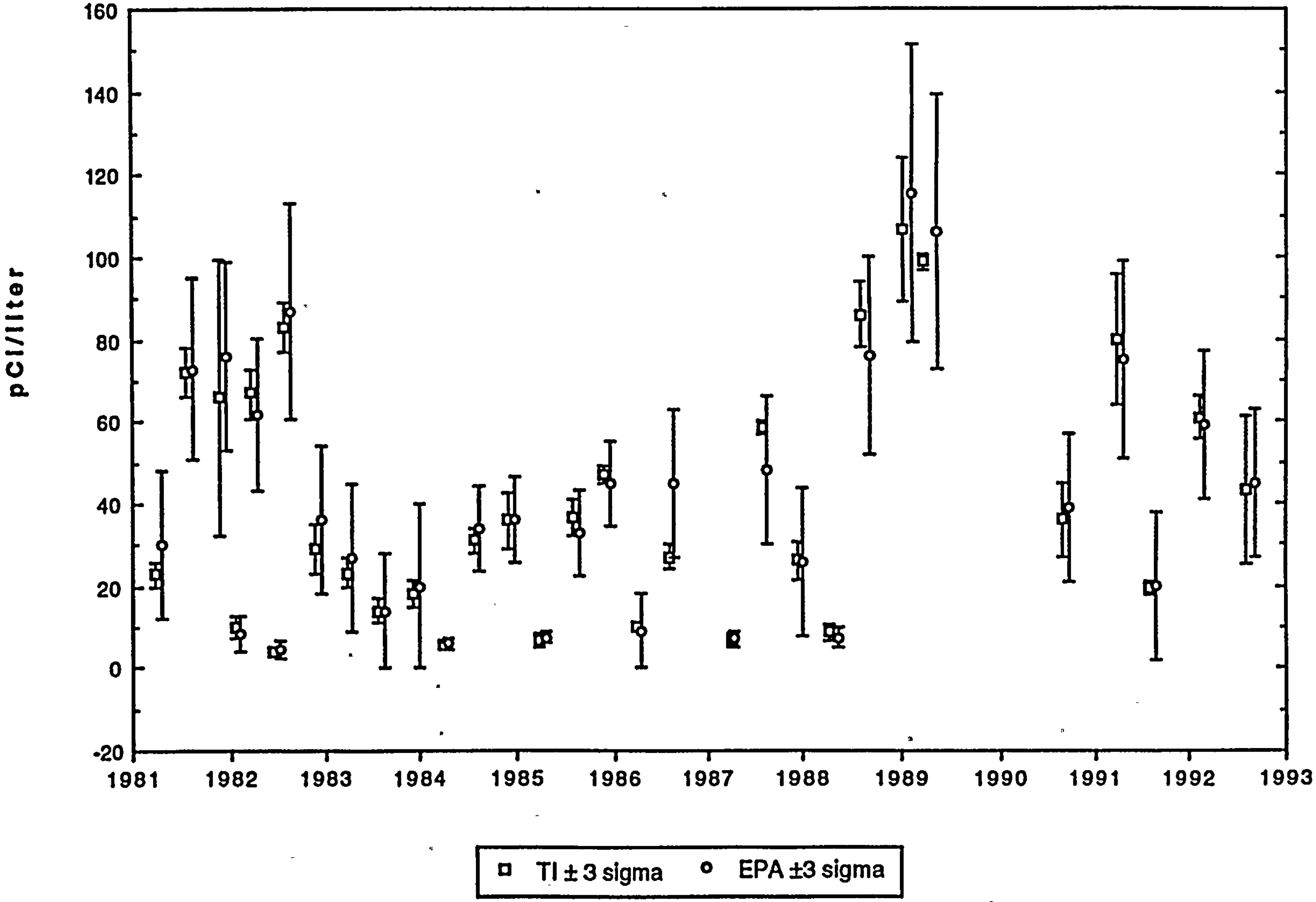
EPA CROSS CHECK PROGRAM

CESIUM-134 IN WATER (pg. 1 of 2)



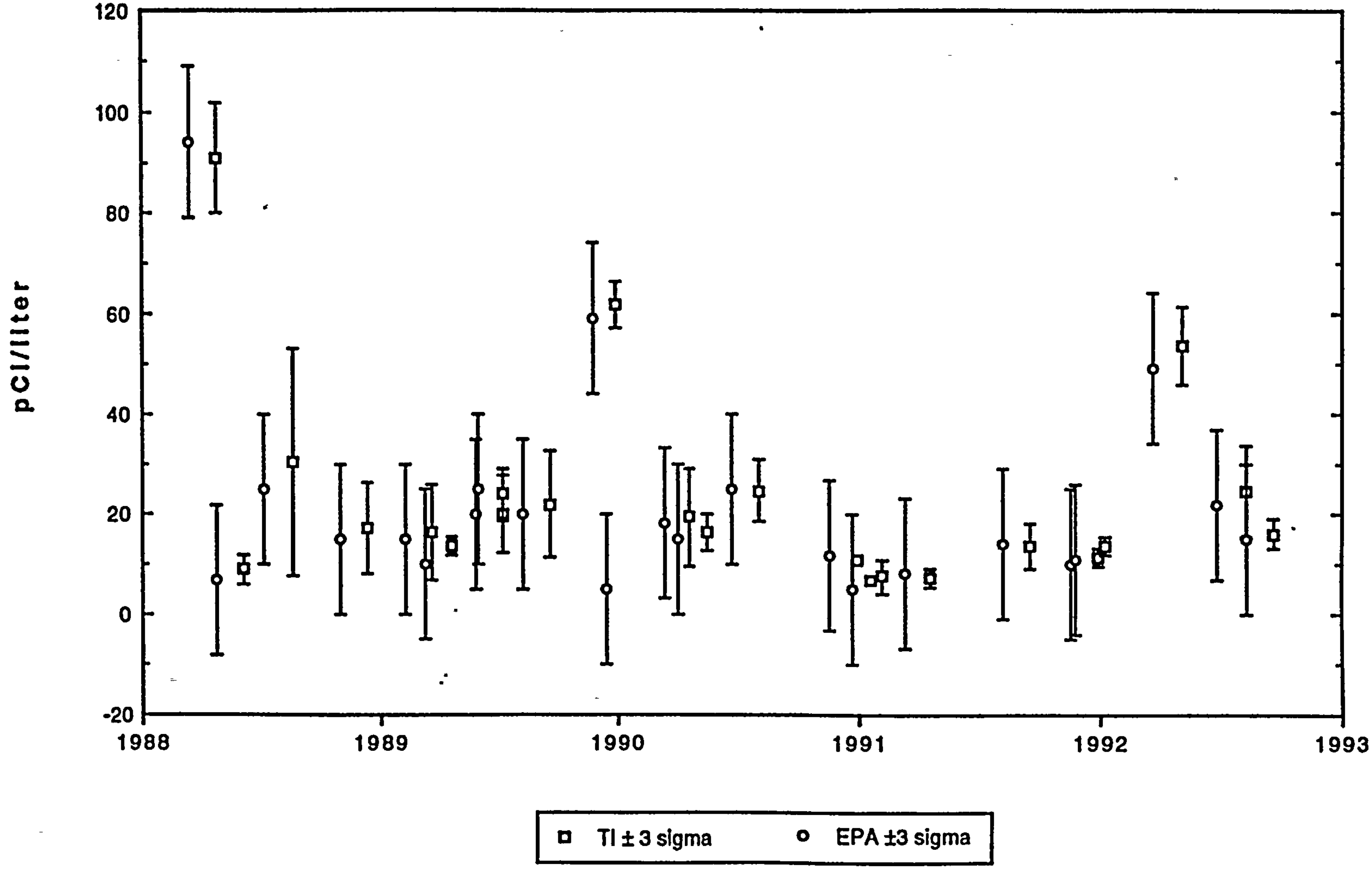
EPA CROSS CHECK PROGRAM

IODINE-131 IN WATER



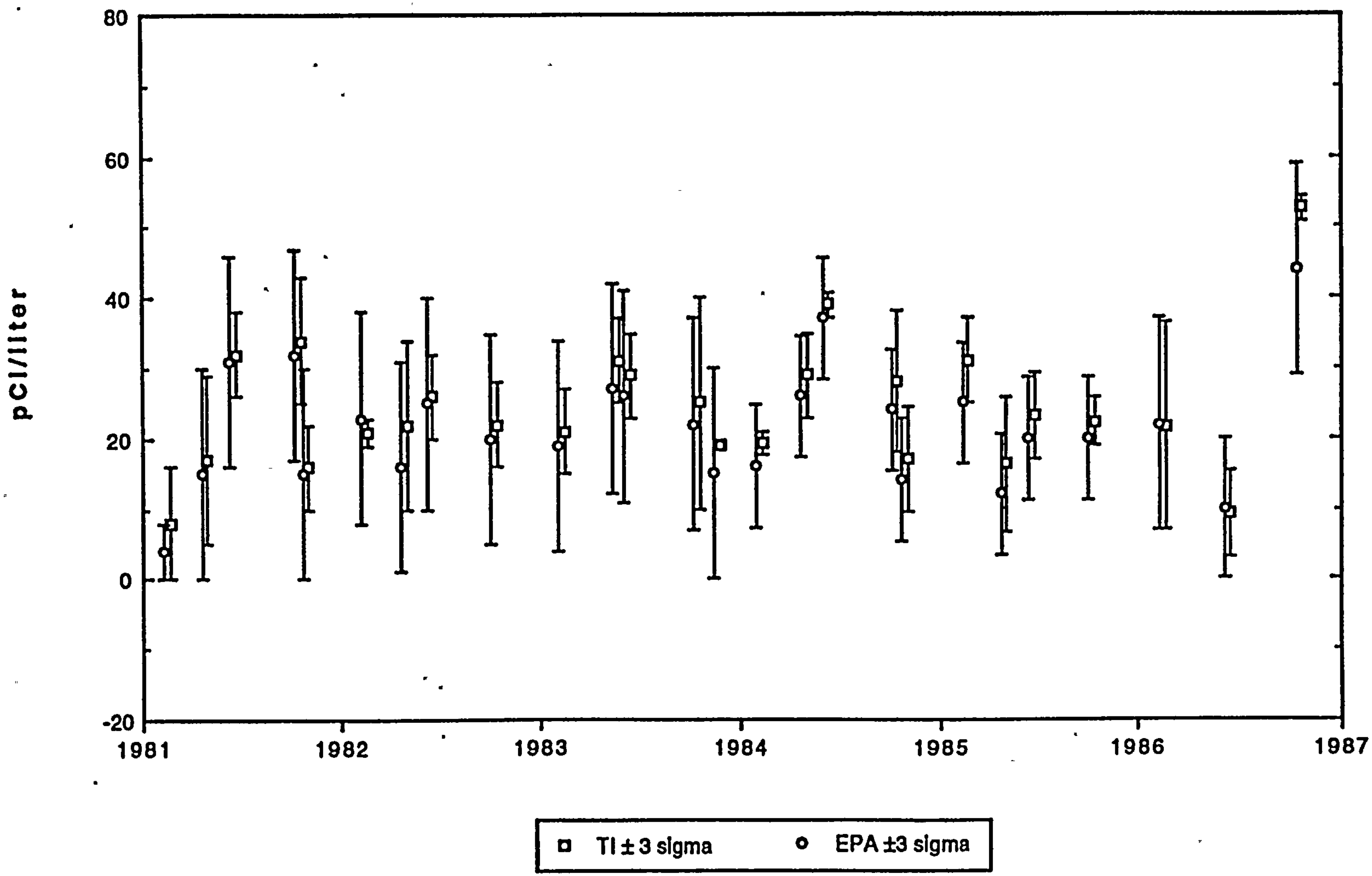
EPA CROSS CHECK PROGRAM

CESIUM-137 IN WATER (pg. 2 of 2)



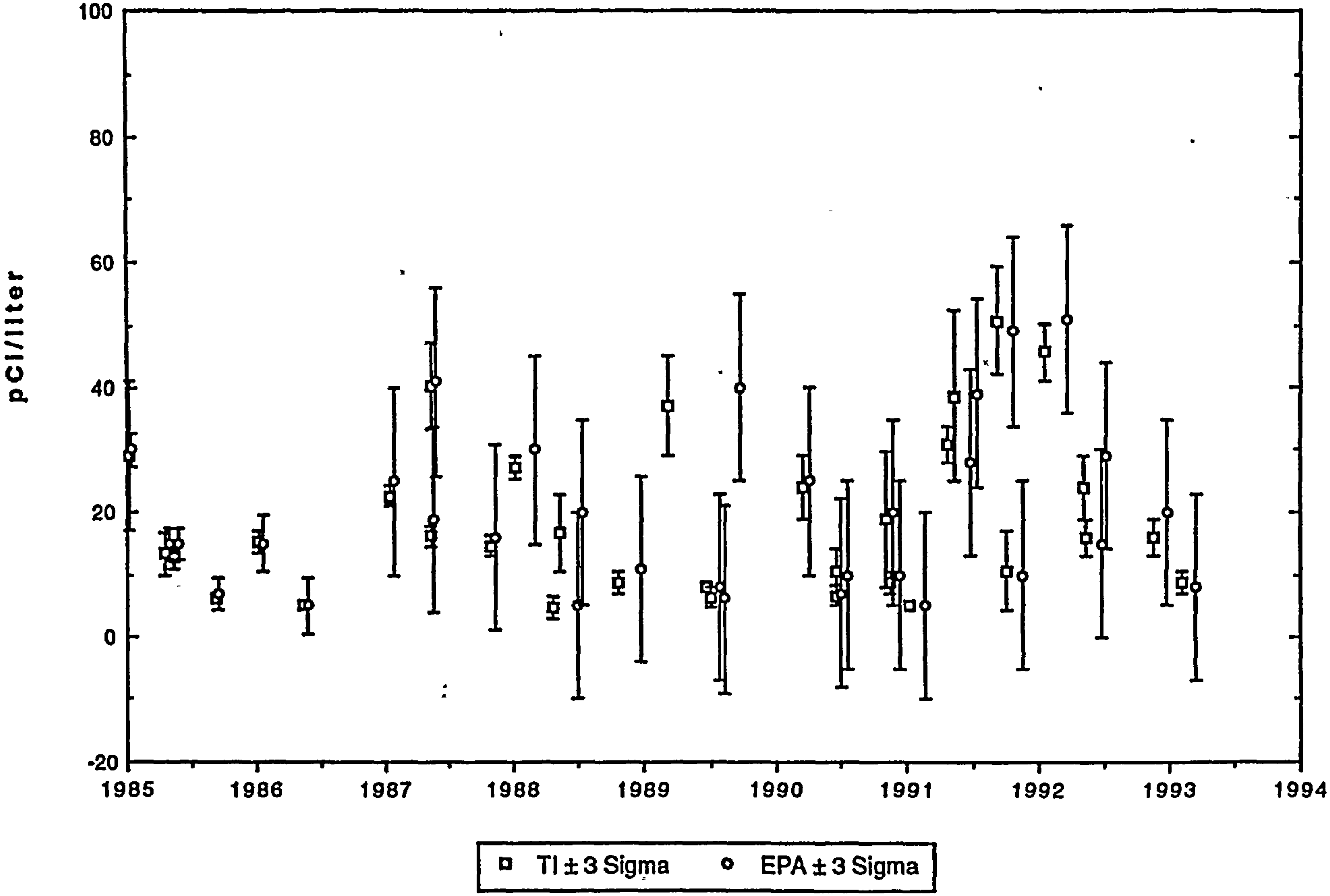
EPA CROSS CHECK PROGRAM

CESIUM-137 IN WATER (pg. 1 of 2)



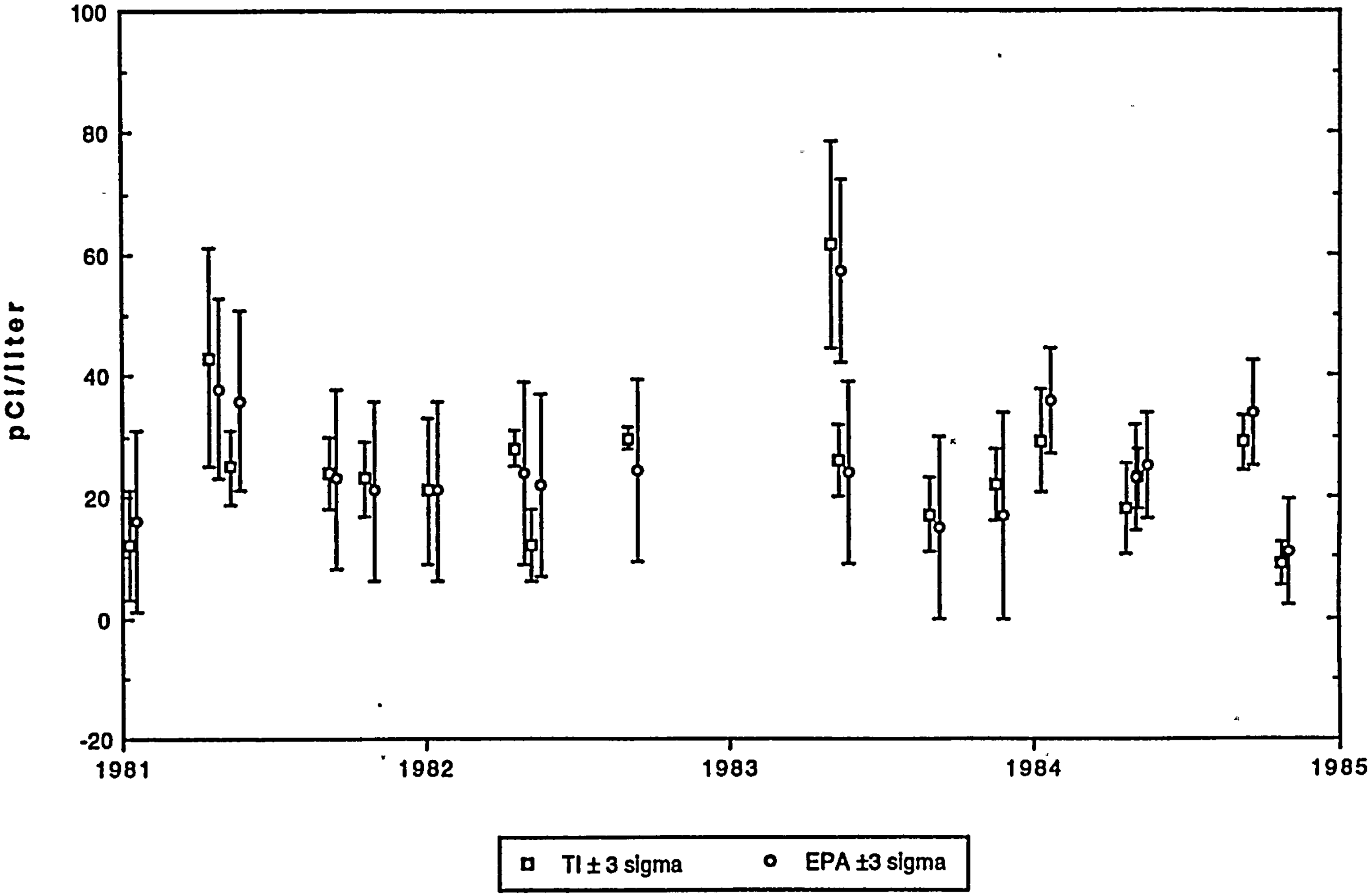
EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER (pg. 2 of 2)



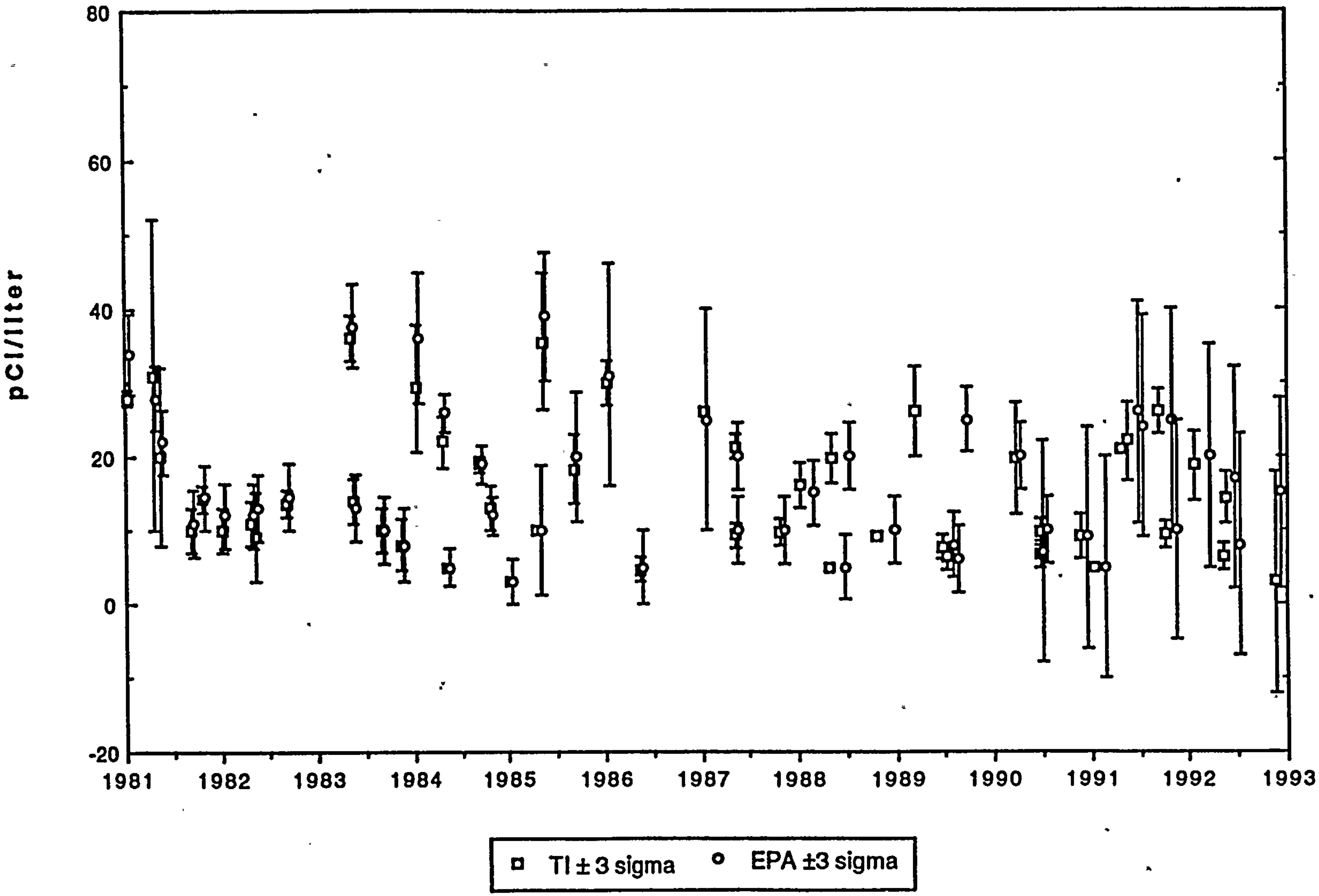
EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER (pg. 1 of 2)



EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN WATER



APPENDIX E
REMP SAMPLING AND ANALYTICAL EXCEPTIONS

PROGRAM EXCEPTIONS

REMP deviations for 1992 are listed at the end of this appendix. Where possible, the causes of the deviations have been corrected to prevent recurrence.

There were five incidents in 1992 involving air samplers. Three of the five incidents involved actual malfunction of air sampling equipment. This is a marked improvement over 1991 and is well below the industry average. The remaining two incidents resulted from a power surge during a thunderstorm which disabled the power supply to the air station.

On 1/10/92 a milk sample was not obtained from the Wyant Farm. The wholesaler, who collects milk from dairy farmers, changed his route and arrived at the Wyant Farm earlier than usual. The REMP sample collector modified his collection route to prevent recurrence.

The Zelmer Farm notified the D.C. Cook Plant of their intention to go out of the dairy business. The Freehling Farm agreed to participate in the REMP Milk Sampling Program, thus replacing the Zelmer Farm. The Lozmack Farm was discontinued to prevent redundant sampling in the same land sector.

During 1992 there were three occurrences involving the change in differential pressure (Delta 'P') measured across air sample filter media. Two of these occurrences involved "settling" of the charcoal inside the TEDA charcoal cartridges. This issue was resolved by utilizing more efficient TEDA cartridges, which are less prone to "settling".

An increase in the Delta 'P' was measured at the South Bend air station and was attributed to dust loading. The sampling frequency was increased to semi-weekly for two sample periods which resolved the issue. Each of the air samplers are equipped with a pressure compensated regulator which adjusts the differential pressure when flow is impeded.

REMP EXCEPTIONS FOR SCHEDULED SAMPLING AND ANALYSIS DURING 1992

Station	Description	Date of Sampling	Reason(s) for Loss/ Exception
A-2	Air Particulate/ Air Iodine	02/24/92/ 03/02/92	Low Delta 'P' readings due to "settling" of charcoal media.
South Bend	Air Particulate/ Air Iodine	03/09/92	High Delta 'P' readings due to "settling" of charcoal media.
A-4	Air Particulate/ Air Iodine	05/04/92	Blown fuse; low sample volume.
South Bend	Air Particulate/ Air Iodine	05/08/92/ 05/14/92	Collection frequency semi-weekly due to dust loading.
A-5	Air Particulate/ Air Iodine	06/22/92	Unit found off.
South Bend	Air Particulate/ Air Iodine	08/17/92	Blown fuse; low sample volume.
A-4	Air Particulate/ Air Iodine	09/14/92	Electricity off; low sample volume.
A-4	Air Particulate/ Air Iodine	09/21/92	Power outage; no sample available.
Lozmack	Milk	01/01/92	Sampling at Lozmack Farm discontinued. Freehling Farm closer to Plant.
Wyant	Milk	01/10/92	Sample unavailable.
Zelmer	Milk	03/20/92	Sample unavailable due to farmer going out of dairy business. Replaced by Freehling Farm.

APPENDIX F
1992 LAND USE CENSUS

APPENDIX F
SUMMARY OF THE 1992 LAND USE CENSUS

The Land Use Census is performed to ensure that significant changes in the areas in the immediate vicinity of the plant site are identified. Any identified changes are evaluated to determine whether modifications must be made to the REMP or other related programs. No such changes were identified during the 1992 Land Use Census. The following is a summary of the 1992 results.

Milk Farm Survey

The milk farm survey is performed to update the list of milk farms located in the plant area, to identify the closest milk farm in each land sector, and to identify the nearest milk animal whose milk is used for human consumption. The milk farm survey for the Cook Power Plant was conducted on September 24, 1992.

In 1992 there were no additions and five deletions from the list of area milk farms. None of the deleted milk farms were involved in the Cook Plant milk sampling program.

The previously identified milk animal continues to be the closest milk animal to the plant. The milk animal is located 2.5 miles from the plant's centerline axis to the closest edge of the animal's pasture.

Residential Survey

The residential survey is performed to identify the closest residence to the plant in each land sector. The 1992 Annual Residential Land Use Survey was completed on September 28, 1992. This survey was conducted per procedure 12 THP 6010 ENV.059, using an updated list of new residential building permits from Lake Township and previous survey maps.

The residence closest to the Plant in each land sector remains unchanged from the previous reporting year.

Broadleaf Survey

In accordance with Technical Specification (T/S) 3.12.2, broadleaf vegetation sampling is performed in lieu of a garden census. Broadleaf sampling is performed to monitor for plant impact on the environment. The samples are obtained at the site boundary. The broadleaf analytical results for 1992 were less than the Technical Specification LLDs.

Figure 8

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

Milk and Animal Survey - 1992

Sector	Survey Year	Distance Miles	Name	Address
A	a	N/A	No milk animals	N/A
	b	N/A	No milk animals	N/A
B	a	N/A	No milk animals	N/A
	b	N/A	No milk animals	N/A
C	a	N/A	No milk animals	N/A
	b	N/A	No milk animals	N/A
D	a	5.1	Gerald Totzke	6744 Totzke Rd., Baroda
	b	5.1	Gerald Totzke	6744 Totzke Rd., Baroda
E	a	10.5	Andrews University	Berrien Springs
	b	10.5	Andrews University	Berrien Springs
F	a	6.8	Lee Nelson	RFD 1, Box 390A, Snow Rd. Baroda
	b	6.8	Lee Nelson	RFD 1, Box 390A, Snow Rd. Baroda
G	a	4.1	G. G. Shuler & Sons	RFD 1, Snow Rd., Baroda
	b	4.1	G. G. Shuler & Sons	RFD 1, Snow Rd., Baroda
H	a	7.0	George Freehling	2221 W. Glendora Rd., Buchanan
	b	7.0	George Freehling	2221 W. Glendora Rd., Buchanan
J	a	7.7	Jerry Warmbein	14143 Mill Rd., Three Oaks
	b	7.7	Jerry Warmbein	14143 Mill Rd., Three Oaks
K	a	12	Kenneth Tappan	Rt. 2, Kruger Rd, Three Oaks
	b	12	Kenneth Tappan	Rt. 2, Kruger Rd, Three Oaks

All other sectors are over water.
(a) Reporting Year
(b) Year prior to reporting year.

F[illegible]9

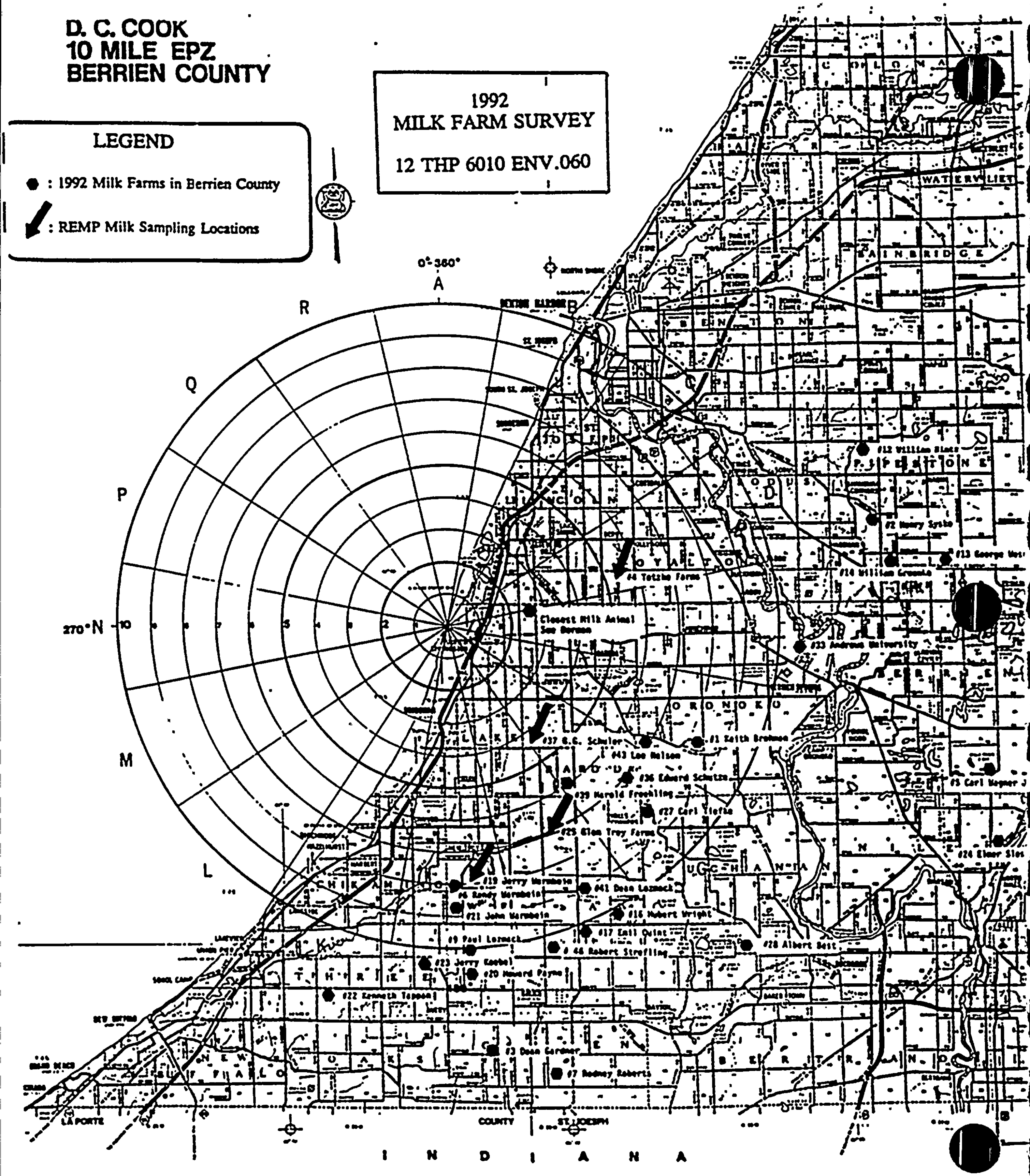
INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

Residential Land Use Survey - 1992

Sector	Year	House (1)	In Feet	Property #	Street Address
A	a	1	2161	11-11-0006-0004-01-7	Iler Drive, Rosemary Beach
	b	1	2161	11-11-0006-0004-01-7	Iler Drive, Rosemary Beach
B	a	2	2165	11-11-0006-0004-09-2	Iler Drive, Rosemary Beach
	b	2	2165	11-11-0006-0004-09-2	Iler Drive, Rosemary Beach
C	a	3	3093	11-11-6800-0028-00-0	Lake Road, Rosemary Beach
	b	3	3093	11-11-6800-0028-00-0	Lake Road, Rosemary Beach
D	a	4	5733	11-11-0005-0036-01-8	7500 Thorton Drive
	b	4	5733	11-11-0005-0036-01-8	7500 Thorton Drive
E	a	5	5631	11-11-0005-0009-07-0	7927 Red Arrow Highway
	b	5	5631	11-11-0005-0009-07-0	7927 Red Arrow Highway
F	a	6	5392	11-11-0008-0015-03-1	8197 Red Arrow Highway
	b	6	5392	11-11-0008-0015-03-1	8197 Red Arrow Highway
G	a	7	3728	11-11-0007-0013-01-4	Livingston Road
	b	7	3728	11-11-0007-0013-01-4	Livingston Road
H	a	8	4944	11-11-8600-0004-00-1	Wildwood
	b	8	4944	11-11-8600-0004-00-1	Wildwood
J	a	9	3366	11-11-0007-0010-02-3	Livingston Hills
	b		3366	11-11-0007-0010-02-3	Livingston Hills
K	a	10	3090	11-11-0007-0010-03-1	Livingston Hills
	b	10	3090	11-11-0007-0010-03-1	Livingston Hills

(1) House # indicated is the reference number used on map when obtaining the raw field data.
(a) Reporting Year
(b) Year prior to reporting year.

Figure 10


D. C. COOK
10 MILE EPZ
BERRIEN COUNTY
1992
MILK FARM SURVEY
12 THP 6010 ENV.060
LEGEND
: 1992 Milk Farms in Berrien County
: REMP Milk Sampling Locations
0°-360°
A
R
Q
P
270° N
M
L
Closest Milk Animal
#4 Tetzke Farms
#12 William Simes
#2 Henry Sysko
#13 George
#14 William Groenke
#33 Andrews University
#37 G.C. Schuler
#1 Keith Brohman
#43 Lee Nelson
#36 Edward Schultz
#39 Harold Froehling
#27 Carl Tiefke
#25 Glen Troy Farms
#5 Carl Wegner J
#24 Elmer Sies
#19 Jerry Warmbein
#6 Randy Warmbein
#41 Dean Lozmack
#21 John Warmbein
#15 Hubert Wright
#17 Emil Quint
#9 Paul Lozmack
#46 Robert Streffling
#28 Albert Best
#23 Jerry Koebel
#20 Howard Payne
#22 Kenneth Tapson
#3 Dean Gardner
#7 Rodney Roberts
WATERVLIET
BAINBRIDGE
BENTON
PIPESTONE
ROYALTON
LINCOLN
ORONOKO
BERRIEN
LAKE
BARODA
CHIKAMING
BUCHANAN
THREE OAKS
NEW BUFFALO
GALIEN
BERTRAND
NILES
LA PORTE
COUNTY
ST. JOSEPH
I N D I A N A

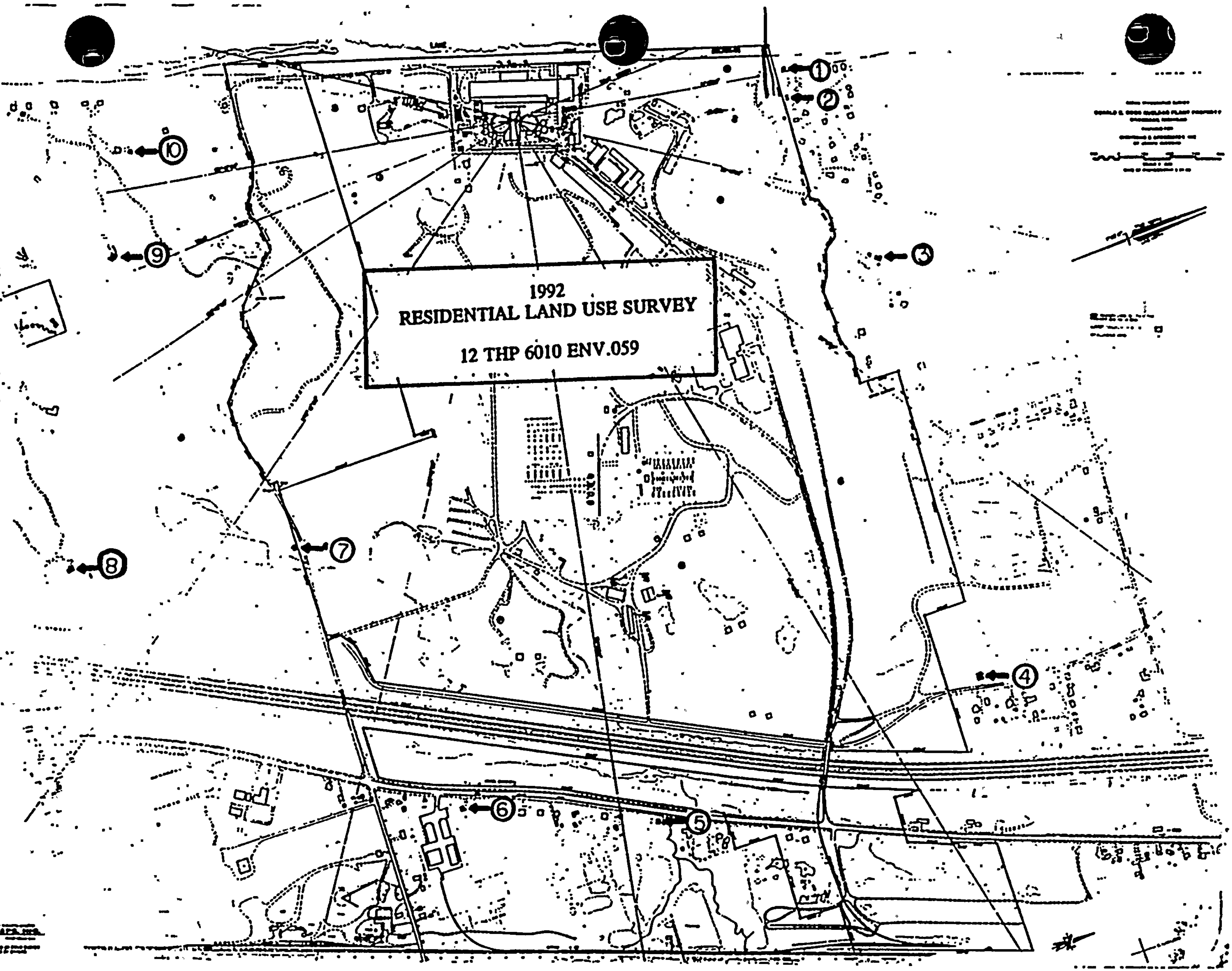

1992
RESIDENTIAL LAND USE SURVEY
12 THP 6010 ENV.059
1
2
3
4
5
6
7
8
9
10

Figure 11

APPENDIX G
SUMMARY OF THE PRE-OPERATIONAL RADIOLOGICAL MONITORING PROGRAM

SUMMARY OF THE PREOPERATIONAL RADIOLOGICAL MONITORING PROGRAM

A preoperational radiological environmental monitoring program was performed for the Donald C. Cook Nuclear Plant from August 1971 until the initial criticality of Unit 1 on January 18, 1975. The analyses of samples collected in the vicinity of the nuclear power plant were performed by Eberline Instrument Corporation. The summary of the preoperational program presented in this appendix is based on the seven semi-annual reports covering the period. The purpose of this summary is to provide a comparison of the radioactivity measured in the environs of the plant during the pre-start up of Unit 1 and the radioactivity measured in 1992.

As stated in the report for the period of July 1 to December 31, 1971, the purposes of a preoperational radiological monitoring program include:

(a) "To yield average values of radiation levels and concentrations of radioactive material in various media of the environment.

(b) To identify sample locations and/or types of samples that deviate from the averages.

(c) To document seasonal variations that could be erroneously interpreted when the power station is operating.

(d) To indicate the range of values that should be considered "background" for various types of samples.

(e) To "proof test" the environmental monitoring equipment and procedures prior to operation of the nuclear power station.

(h) To provide baseline information that will yield estimates of the dose to man, if any, which will result from plant operation."

The discussion that follows is for the various sample media collected and analyzed in both the preoperational period and during

1992. Analyses performed during the preoperational but not required in 1992, are not discussed.

The gross beta activity in air particulate filters ranged from 0.01 to 0.17 pCi/m^3 from the middle of 1971 to the middle of 1973. In June of 1973 and in June of 1974 the People's Republic of China detonated atmospheric nuclear tests. As a result there were periods during which the gross beta results were elevated to as high as 0.45 pCi/m^3 with no statistically significant differences between indicator and background stations. By the end of the preoperational period the values were approximately 0.06 pCi/m^3.

The gamma ray analyses of composited air particulate filters showed "trace amounts" of fission products, Ce-144, Ru-106, Ru-103, Zr-95, and Nb-95, the results of fallout from previous atmospheric nuclear tests. Cosmogenically produced beryllium-7 was also detected.

The direct radiation background as measured by thermoluminescent dosimeters (TLD) ranged between 1.0 and 2.0 mRem/week during the three and one-half years period.

Milk samples during the preoperational period were analyzed for iodine-131 and by gamma ray spectroscopy (and for strontium-89 and strontium-90). All samples had naturally occurring potassium-40 with values ranging between 520 and 2310 pCi/liter. Cesium-137 was measured in many samples after the two atmospheric nuclear tests mentioned above. The cesium-137 activity ranged from 8 to 33 pCi/liter. Iodine-131 was measured in four milk samples collected July 9, 1974. The values ranged between 0.2 and 0.9 pCi/liter.

Lake water samples were collected and analyzed for tritium and by gamma ray spectroscopy. Tritium activities were below 1000 pCi/liter and typically averaged about 400 pCi/liter. No radionuclides were detected by gamma ray spectroscopy.

Gamma ray spectroscopy analyses of lake sediment detected natural abundances of potassium-40, uranium and thorium daughters, and traces of cesium-137 below 0.1 pCi/g which is attributed to fallout.

Gamma spectroscopy analyses of fish detected natural abundances of potassium-40 and traces of cesium-137, the latter attributed to fallout.

Drinking water analysis was not part of the preoperational program.

APPENDIX H

SUMMARY OF THE REMP QUALITY CONTROL PROGRAM

SUMMARY OF THE REMP QUALITY CONTROL PROGRAM

The plant procedure for implementing the quality control program references Regulatory Guide 4.15. The program utilizes blank, replicate and spiked samples within four different parameters; gamma isotopic, tritium, iodine and gross beta. The blank and replicate samples are prepared at the D.C. Cook Plant and the spiked samples are prepared by Teledyne Isotopes.

Twenty five quality control analyses were performed during 1992. Over ninety percent (23) of the samples analyzed gave acceptable results, however two samples did not meet the acceptance criteria of ± two standard deviations from the known value.

The third quarter tritium sample did not meet the acceptance criteria. Teledyne conducted an investigation which included reviewing lab procedures, technician protocol and verification of instrument control charts. A new sample was prepared and gave acceptable results.

The fourth quarter gross beta sample did not meet the acceptance criteria. Teledyne Isotopes conducted an acceptable investigation to determine the root cause. The analyses was repeated with acceptable results.

APPENDIX I
SUMMARY OF THE SPIKE AND BLANK SAMPLE PROGRAM

SUMMARY OF THE SPIKE AND BLANK SAMPLE PROGRAM

The following tables list the blanks and spiked water samples analyzed during 1992 for the Teledyne Isotopes In-house Quality Assurance Program. Analysis date is analogous to collection date to identify weekly analysis of samples.

Three analyses for gross beta activity were reported outside the specified acceptable ranges. No documented corrective action was taken because in accordance with Section 9.1 of our Quality Control Manual (IWL-0032-365), the acceptance criteria for a particular analysis "is within 3 standard deviations of the EPA one sigma, one determination as specified in the Environmental Radioactive Laboratory Studies Program EPA-600/4-81-004, Table 3, Page 8". For gross beta activity below 100 pCi/l the control level at which corrective action must be taken is ± 15 pCi/l. The quality assurance department operationally investigates gross beta spike results which exceed the one standard deviation, one determination levels (± 5 pCi/l), because of previous experience in reporting results within that level. Control charts for gross alpha and beta spikes did not indicate any bias in results.

For the tritium spikes by gas analysis the three standard deviations of the EPA one sigma, one determination would be greater than 1000 pCi/l for a spike level of 1500 pCi/l. The quality assurance department operationally investigates tritium spike results which exceed ± 200 pCi/l. Control charts indicated a low bias in tritium spike results with only five out of thirty-seven measurements outside the 15% operational acceptance criteria. In August 1992 the gas counters were removed from service (not as a consequence of the quality control sample results) and was not returned to service. Samples were counted on the liquid scintillation counter which exhibited excellent performance without any obvious bias in quality control sample results throughout 1992.

Teledyne Isotopes In-House Spiked Sample Results - 1992
Water

Analysis	Spike Levels (pCi/L)	Acceptable Range (pCi/l)
Gross Alpha	11 ± 5	6 - 16
Gross Beta	22 ± 5	17-27
Gamma (Eu-154)	1.4 ± 0.2 E 05	1.2 - 1.6 E 05
H-3 (G)	1.4 ± 0.3 E 03	1.1 - 1.7 E 03
H-3 (LS)	1.4 ± 0.3 E 04	1.1 - 1.7 E 04

GROSS ALPHA

TI #	Analysis Date	Activity (pCi/l)
62037	01/02/92	1.3 ± 0.2 E 01
62372	01/08/92	1.1 ± 0.2 E 01
63240	01/15/92	8.8 ± 1.6 E 00
64223	01/22/92	1.5 ± 0.3 E 01
64802	01/29/92	9.5 ± 1.8 E 00
65404	02/05/92	9.0 ± 1.9 E 00
66201	02/12/92	1.0 ± 0.2 E 01
66965	02/19/92	1.1 ± 0.2 E 01
67704	02/26/92	9.4 ± 1.7 E 00
68187	03/04/92	1.3 ± 0.2 E 01
68967	03/11/92	1.1 ± 0.2 E 01
69941	03/18/92	1.4 ± 0.2 E 01
70399	03/25/92	1.6 ± 0.2 E 01
71154	04/01/92	9.5 ± 1.6 E 00
71804	04/08/92	8.9 ± 1.5 E 00
72815	04/15/92	8.6 ± 1.7 E 00
74501	04/22/92	9.8 ± 1.6 E 00
75113	04/29/92	1.2 ± 0.2 E 01
76137	05/06/92	1.2 ± 0.2 E 01
75706	05/13/92	1.2 ± 0.2 E 01
76686	05/20/92	1.4 ± 0.2 E 01
77458	05/27/92	1.6 ± 0.2 E 01
78081	06/03/92	1.4 ± 0.2 E 01
79224	06/10/92	1.3 ± 0.2 E 01
79918	06/17/92	1.4 ± 0.2 E 01
80653	06/24/92	8.3 ± 1.6 E 00
81487	07/01/92	1.2 ± 0.2 E 01
82604	07/08/92	1.2 ± 0.2 E 01
83361	07/15/92	1.1 ± 0.2 E 01
84237	07/22/92	1.3 ± 0.2 E 01
84256	07/29/92	1.2 ± 0.2 E 01
85164	08/05/92	1.0 ± 0.2 E 01

Teledyne Isotopes In-House Spiked Sample Results - 1992
Water

Analysis	Spike Levels (pCi/L)	Acceptable Range (pCi/l)
Gross Alpha	11 ± 5	6 - 16
Gross Beta	22 ± 5	17-27
Gamma (Eu-154)	1.4 ± 0.2 E 05	1.2 - 1.6 E 05
H-3 (G)	1.5 ± 0.3 E 03	1.3 - 1.7 E 03
H-3 (LS)	1.5 ± 0.3 E 04	1.3 - 1.7 E 04

GROSS ALPHA

TI #	Analysis Date	Activity (pCi/l)
62037	01/02/92	1.3 ± 0.2 E 01
62372	01/08/92	1.1 ± 0.2 E 01
63240	01/15/92	8.8 ± 1.6 E 00
64223	01/22/92	1.5 ± 0.3 E 01
64802	01/29/92	9.5 ± 1.8 E 00
65404	02/05/92	9.0 ± 1.9 E 00
66201	02/12/92	1.0 ± 0.2 E 01
66965	02/19/92	1.1 ± 0.2 E 01
67704	02/26/92	9.4 ± 1.7 E 00
68187	03/04/92	1.3 ± 0.2 E 01
68967	03/11/92	1.1 ± 0.2 E 01
69941	03/18/92	1.4 ± 0.2 E 01
70399	03/25/92	1.6 ± 0.2 E 01
71154	04/01/92	9.5 ± 1.6 E 00
71804	04/08/92	8.9 ± 1.5 E 00
72815	04/15/92	8.6 ± 1.7 E 00
74501	04/22/92	9.8 ± 1.6 E 00
75113	04/29/92	1.2 ± 0.2 E 01
76137	05/06/92	1.2 ± 0.2 E 01
75706	05/13/92	1.2 ± 0.2 E 01
76686	05/20/92	1.4 ± 0.2 E 01
77458	05/27/92	1.6 ± 0.2 E 01
78081	06/03/92	1.4 ± 0.2 E 01
79224	06/10/92	1.3 ± 0.2 E 01
79918	06/17/92	1.4 ± 0.2 E 01
80653	06/24/92	8.3 ± 1.6 E 00
81487	07/01/92	1.2 ± 0.2 E 01
82604	07/08/92	1.2 ± 0.2 E 01
83361	07/15/92	1.1 ± 0.2 E 01
84237	07/22/92	1.3 ± 0.2 E 01
84256	07/29/92	1.2 ± 0.2 E 01
85164	08/05/92	1.0 ± 0.2 E 01

GROSS ALPHA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
86554	08/12/92	1.2 ± 0.2 E 01
87756	08/19/92	1.2 ± 0.2 E 01
87896	08/26/92	1.8 ± 0.3 E 01
88926	09/02/92	1.3 ± 0.2 E 01
88943	09/09/92	1.3 ± 0.2 E 01
90049	09/16/92	1.3 ± 0.2 E 01
90712	09/23/92	1.1 ± 0.2 E 01
91019	09/30/92	8.7 ± 1.4 E 00
91750	10/07/92	1.2 ± 0.2 E 01
93281	10/14/92	1.4 ± 0.2 E 01
93449	10/21/92	1.0 ± 0.2 E 01
93958	10/28/92	6.1 ± 1.4 E 00
94594	11/04/92	1.4 ± 0.2 E 01
95282	11/11/92	1.3 ± 0.2 E 01
96008	11/18/92	1.0 ± 0.2 E 01
96803	11/25/92	9.1 ± 1.5 E 00
97309	12/02/92	1.4 ± 0.2 E 01
98048	12/09/92	1.2 ± 0.2 E 01
99065	12/16/92	1.1 ± 0.2 E 01
00109	12/23/92	1.1 ± 0.2 E 01
00123	12/30/92	1.3 ± 0.2 E 01

GROSS BETA

TI #	Analysis Date	Activity (pCi/l)
62036	01/02/92	1.9 ± 0.1 E 01
62371	01/08/92	1.8 ± 0.1 E 01
63239	01/15/92	2.1 ± 0.2 E 01
64222	01/22/92	2.6 ± 0.2 E 01
64801	01/29/92	1.6 ± 0.1 E 01
65403	02/05/92	1.5 ± 0.1 E 01
66200	02/12/92	2.7 ± 0.2 E 01
66964	02/19/92	1.7 ± 0.1 E 01
67704	02/26/92	2.1 ± 0.2 E 01
68187	03/04/92	1.8 ± 0.2 E 01
68967	03/11/92	2.0 ± 0.1 E 01
69941	03/18/92	2.1 ± 0.2 E 01
70399	03/25/92	2.5 ± 0.2 E 01
71154	04/01/92	1.9 ± 0.1 E 01
71804	04/08/92	2.0 ± 0.1 E 01
72815	04/15/92	2.3 ± 0.2 E 01
74501	04/22/92	2.3 ± 0.2 E 01
75113	04/29/92	2.4 ± 0.2 E 01
76137	05/06/92	2.1 ± 0.1 E 01

GROSS BETA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
75706	05/13/92	2.6 ± 0.2 E 01
76686	05/20/92	1.9 ± 0.1 E 01
77458	05/27/92	2.3 ± 0.2 E 01
78081	06/03/92	2.5 ± 0.2 E 01
79224	06/10/92	1.9 ± 0.1 E 01
79918	06/17/92	1.8 ± 0.1 E 01
80653	06/24/92	2.3 ± 0.2 E 01
81487	07/01/92	1.2 ± 0.1 E 01
82604	07/08/92	2.0 ± 0.2 E 01
83361	07/15/92	2.3 ± 0.2 E 01
84237	07/22/92	2.3 ± 0.2 E 01
84256	07/29/92	2.1 ± 0.2 E 01
85164	08/05/92	1.9 ± 0.1 E 01
86554	08/12/92	2.3 ± 0.2 E 01
87756	08/19/92	2.3 ± 0.2 E 01
87896	08/26/92	2.5 ± 0.2 E 01
88926	09/02/92	2.3 ± 0.2 E 01
88943	09/09/92	2.3 ± 0.2 E 01
90049	09/16/92	2.5 ± 0.2 E 01
90712	09/23/92	2.3 ± 0.2 E 01
91019	09/30/92	2.0 ± 0.1 E 01
91750	10/07/92	2.2 ± 0.2 E 01
93281	10/14/92	2.4 ± 0.2 E 01
93449	10/21/92	2.5 ± 0.2 E 01
93958	10/28/92	2.0 ± 0.2 E 01
94594	11/04/92	2.3 ± 0.2 E 01
95282	11/11/92	2.2 ± 0.2 E 01
96008	11/18/92	2.9 ± 0.2 E 01
96803	11/25/92	2.0 ± 0.1 E 01
97309	12/02/92	2.0 ± 0.1 E 01
98048	12/09/92	1.7 ± 0.1 E 01
99065	12/16/92	2.3 ± 0.2 E 01
00109	12/23/92	2.2 ± 0.2 E 01
00123	12/30/92	2.3 ± 0.2 E 01

GAMMA (Eu-154)

TI #	Analysis Date	Activity (pCi/l)
62042	01/02/92	1.41 ± 0.14 E 05
62377	01/08/92	1.36 ± 0.14 E 05
63245	01/15/92	1.43 ± 0.14 E 05
64228	01/22/92	1.38 ± 0.14 E 05
64807	01/29/92	1.44 ± 0.14 E 05
65409	02/05/92	1.46 ± 0.15 E 05
66206	02/12/92	1.45 ± 0.15 E 05

GAMMA (Eu-154)

TI #	Analysis Date	Activity (pCi/l)
66970	02/19/92	1.36 ± 0.14 E 05
67709	02/26/92	1.43 ± 0.14 E 05
68192	03/04/92	1.40 ± 0.14 E 05
68972	03/11/92	1.40 ± 0.14 E 05
69946	03/18/92	1.43 ± 0.14 E 05
70404	03/25/92	1.48 ± 0.14 E 05
71159	04/01/92	1.41 ± 0.14 E 05
71809	04/08/92	1.40 ± 0.14 E 05
72820	04/15/92	1.42 ± 0.14 E 05
74506	04/22/92	1.42 ± 0.14 E 05
75118	04/29/92	1.46 ± 0.15 E 05
76142	05/06/92	1.41 ± 0.14 E 05
75711	05/13/92	1.46 ± 0.15 E 05
76691	05/20/92	1.39 ± 0.14 E 05
77463	05/27/92	1.43 ± 0.14 E 05
78086	06/03/92	1.46 ± 0.15 E 05
79229	06/10/92	1.42 ± 0.14 E 05
79923	06/17/92	1.46 ± 0.15 E 05
80658	06/24/92	1.50 ± 0.15 E 05
81492	07/01/92	1.46 ± 0.15 E 05
82609	07/08/92	1.44 ± 0.40 E 05
83366	07/15/92	1.48 ± 0.15 E 05
84242	07/22/92	1.47 ± 0.15 E 05
84531	07/29/92	1.48 ± 0.15 E 05
85169	08/05/92	1.45 ± 0.15 E 05
86559	08/12/92	1.36 ± 0.14 E 05
87761	08/19/92	1.49 ± 0.15 E 05
87901	08/26/92	1.47 ± 0.15 E 05
88931	09/02/92	1.40 ± 0.14 E 05
88948	09/09/92	1.46 ± 0.15 E 05
90054	09/16/92	1.45 ± 0.15 E 05
90717	09/23/92	1.49 ± 0.15 E 05
91024	09/30/92	1.28 ± 0.13 E 05
91755	10/07/92	1.45 ± 0.15 E 05
93286	10/14/92	1.48 ± 0.15 E 05
93454	10/21/92	1.39 ± 0.14 E 05
93961	10/28/92	1.48 ± 0.15 E 05
94597	11/04/92	1.49 ± 0.15 E 05
95285	11/11/92	1.48 ± 0.15 E 05
96806	11/25/92	1.48 ± 0.15 E 05
97312	12/02/92	1.43 ± 0.14 E 05
98052	12/09/92	1.51 ± 0.15 E 05
00112	12/23/92	1.50 ± 0.15 E 05
00126	12/30/92	1.45 ± 0.15 E 05

TRITIUM - (H-3)

TI #	Analysis Date	Activity (pCi/l)
62039	01/02/92	1.4 ± 0.1 E 03
62374	01/08/92	1.4 ± 0.1 E 03
63242	01/15/92	1.3 ± 0.1 E 03
64225	01/22/92	1.2 ± 0.1 E 03
64804	01/29/92	1.3 ± 0.1 E 03
65406	02/05/92	1.5 ± 0.1 E 03
66203	02/12/92	1.4 ± 0.1 E 03
66967	02/19/92	1.3 ± 0.1 E 03
67706	02/26/92	1.4 ± 0.1 E 03
68189	03/04/92	1.4 ± 0.1 E 03
68969	03/11/92	1.4 ± 0.1 E 03
69943	03/18/92	1.4 ± 0.2 E 03
70401	03/25/92	1.4 ± 0.1 E 03
71156	04/01/92	1.4 ± 0.1 E 03
71806	04/08/92	1.3 ± 0.1 E 03
72817	04/15/92	1.3 ± 0.1 E 03
74503	04/22/92	1.5 ± 0.1 E 03
75115	04/29/92	1.2 ± 0.1 E 03
75708	05/13/92	1.3 ± 0.2 E 03
76139	05/06/92	1.3 ± 0.1 E 03
76688	05/20/92	1.4 ± 0.1 E 03
77460	05/27/92	1.4 ± 0.1 E 03
78083	06/03/92	1.2 ± 0.1 E 03
79226	06/10/92	1.3 ± 0.3 E 03
79920	06/17/92	1.2 ± 0.1 E 03
80655	06/24/92	1.3 ± 0.1 E 03
81489	07/01/92	1.4 ± 0.1 E 03
82606	07/08/92	1.3 ± 0.1 E 03
83363	07/15/92	1.4 ± 0.1 E 03
84239	07/22/92	1.2 ± 0.3 E 03
84528	07/29/92	1.3 ± 0.2 E 03
85166	08/05/92	1.3 ± 0.1 E 04 (a)
86556	08/12/92	1.4 ± 0.1 E 04
87758	08/19/92	1.4 ± 0.1 E 04
87898	08/26/92	1.5 ± 0.1 E 04
88927	09/02/92	1.5 ± 0.1 E 04
88944	09/09/92	1.3 ± 0.1 E 04
90050	09/16/92	1.5 ± 0.1 E 04
90713	09/23/92	1.6 ± 0.1 E 04
91020	09/30/92	1.4 ± 0.1 E 04
91751	10/07/92	1.3 ± 0.1 E 04
93282	10/14/92	1.4 ± 0.1 E 04
93450	10/21/92	1.6 ± 0.1 E 04
93959	10/28/92	1.4 ± 0.1 E 04

(a) The measurement of a weekly spiked tritium sample was discontinued after July 29, 1992. In its place was substituted the liquid scintillation method. The spiked activity is ten times greater in the liquid scintillation samples.

TRITIUM - (H-3)

TI #	Analysis Date	Activity (pCi/l)
94595	11/04/92	1.4 ± 0.1 E 04
95283	11/11/92	1.6 ± 0.1 E 04
96009	11/18/92	1.4 ± 0.1 E 04
96804	11/25/92	1.4 ± 0.1 E 04
97310	12/02/92	1.4 ± 0.1 E 04
98049	12/09/92	1.4 ± 0.1 E 04
99066	12/16/92	1.4 ± 0.1 E 04
00110	12/23/92	1.3 ± 0.1 E 04
00124	12/30/92	1.5 ± 0.1 E 04

Teledyne Isotopes In-House Blanks Sample Results - 1992

Water

GROSS ALPHA

TI #	Analysis Date	Activity (pCi/l)
62035	01/02/92	L. T. 9. E-01
62370	01/08/92	L. T. 5. E-01
63238	01/15/92	L. T. 1. E 00
64221	01/22/92	L. T. 1. E 00
64800	01/29/92	L. T. 9. E-01
65402	02/05/92	L. T. 9. E-01
66199	02/12/92	L. T. 2. E 00
66963	02/19/92	L. T. 4. E-01
67703	02/26/92	L. T. 6. E-01
68186	03/04/92	L. T. 9. E-01
68966	03/11/92	L. T. 7. E-01
69940	03/18/92	L. T. 9. E-01
70398	03/25/92	L. T. 8. E-01
71153	04/01/92	L. T. 6. E-01
71803	04/08/92	L. T. 7. E-01
72814	04/15/92	L. T. 3. E-01
74500	04/22/92	L. T. 6. E-01
75112	04/29/92	L. T. 7. E-01
76136	05/06/92	L. T. 7. E-01
75705	05/13/92	L. T. 7. E-01
76685	05/20/92	L. T. 9. E-01
77457	05/27/92	L. T. 6. E-01
78080	06/03/92	L. T. 6. E-01
79223	06/10/92	L. T. 7. E-01
79917	06/17/92	L. T. 9. E-01
80652	06/24/92	L. T. 7. E-01
81486	07/01/92	L. T. 9. E-01
82603	07/08/92	L. T. 8. E-01
83360	07/15/92	L. T. 8. E-01
84236	07/22/92	L. T. 7. E-01
84525	07/29/92	L. T. 8. E-01
85163	08/05/92	L. T. 8. E-01
86553	08/12/92	L. T. 6. E-01
87755	08/19/92	L. T. 6. E-01
87895	08/26/92	L. T. 6. E-01
88925	09/02/92	L. T. 5. E-01
88942	09/09/92	L. T. 7. E-01
90048	09/16/92	L. T. 1. E 00
90711	09/23/92	L. T. 7. E-01
91018	09/30/92	L. T. 7. E-01
91749	10/07/92	L. T. 6. E-01
93280	10/14/92	L. T. 5. E-01
93448	10/21/92	L. T. 8. E-01

GROSS ALPHA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
93957	10/28/92	L. T. 4. E-01
94593	11/04/92	L. T. 8. E-01
95281	11/11/92	L. T. 4. E-01
96007	11/18/92	L. T. 5. E-01
96802	11/25/92	L. T. 6. E-01
97308	12/02/92	L. T. 7. E-01
98047	12/09/92	L. T. 5. E-01
99064	12/16/92	L. T. 6. E-01
00108	12/23/92	L. T. 7. E-01
00122	12/30/92	L. T. 8. E-01

GROSS BETA

TI #	Analysis Date	Activity (pCi/l)
62035	01/02/92	L. T. 7. E-01
62370	01/08/92	L. T. 8. E-01
63238	01/15/92	L. T. 1. E 00
64221	01/22/92	L. T. 1. E 00
64800	01/29/92	L. T. 1. E 00
65402	02/05/92	L. T. 9. E-01
66199	02/12/92	L. T. 1. E 00
66963	02/19/92	L. T. 7. E-01
67703	02/26/92	L. T. 8. E-01
68186	03/04/92	L. T. 1. E-00
68966	03/11/92	L. T. 1. E-00
69940	03/18/92	L. T. 9. E-01
70398	03/25/92	L. T. 8. E-01
71153	04/01/92	L. T. 8. E-01
71803	04/08/92	L. T. 7. E-01
72814	04/15/92	L. T. 8. E-01
74500	04/22/92	L. T. 8. E-01
75112	04/29/92	L. T. 8. E-01
76136	05/06/92	L. T. 7. E-01
75705	05/13/92	L. T. 9. E-01
76685	05/20/92	L. T. 8. E-01
77457	05/27/92	L. T. 9. E-01
78080	06/03/92	L. T. 8. E-01
79223	06/10/92	L. T. 8. E-01
79917	06/17/92	L. T. 8. E-01
80652	06/24/92	L. T. 9. E-01
81486	07/01/92	L. T. 8. E-01
82603	07/08/92	L. T. 9. E-01
83360	07/15/92	L. T. 8. E-01
84236	07/22/92	L. T. 9. E-01
84525	07/29/92	L. T. 8. E-01
85163	08/05/92	L. T. 8. E-01
86553	08/12/92	L. T. 8. E-01
87755	08/19/92	L. T. 7. E-01

GROSS BETA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
87895	08/26/92	L. T. 8. E-01
88925	09/02/92	L. T. 9. E-01
88942	09/09/92	L. T. 8. E-01
90048	09/16/92	L. T. 9. E-01
90711	09/23/92	L. T. 8. E-01
91018	09/30/92	L. T. 9. E-01
91749	10/07/92	L. T. 8. E-01
93280	10/14/92	L. T. 8. E-01
93448	10/21/92	L. T. 8. E-01
93957	10/28/92	L. T. 1. E 00
94593	11/04/92	L. T. 8. E-01
95281	11/11/92	L. T. 7. E-01
96007	11/18/92	L. T. 8. E-01
96802	11/25/92	L. T. 7. E-01
97308	12/02/92	L. T. 8. E-01
98047	12/09/92	L. T. 7. E-01
99064	12/16/92	L. T. 1. E 00
00108	12/23/92	L. T. 7. E-01
00122	12/30/92	L. T. 8. E-01

TRITIUM - (H-3)

TI #	Analysis Date	Activity (pCi/l)
62041	01/02/92	L. T. 1. E 02
62376	01/08/92	L. T. 1. E 02
63244	01/15/92	L. T. 8. E 01
64277	01/22/92	L. T. 7. E 01
64806	01/29/92	L. T. 1. E 02
65408	02/05/92	L. T. 1. E 02
66205	02/12/92	L. T. 2. E 02
66969	02/19/92	L. T. 2. E 02
67708	02/26/92	L. T. 1. E 02
68191	03/04/92	L. T. 1. E 02
68971	03/11/92	L. T. 1. E 02
69945	03/18/92	L. T. 2. E 02
70403	03/25/92	L. T. 1. E 02
71158	04/01/92	L. T. 1. E 02
71808	04/08/92	L. T. 2. E 02
72819	04/15/92	L. T. 1. E 02
74505	04/22/92	L. T. 1. E 02
75117	04/29/92	L. T. 1. E 02
76141	05/06/92	L. T. 1. E 02
75710	05/13/92	L. T. 2. E 02
76690	05/20/92	L. T. 2. E 02
77462	05/27/92	L. T. 2. E 02
78085	06/03/92	L. T. 9. E 02 (a)
79227	06/10/92	L. T. 9. E 02 (a)

(a) Tritium by liquid scintillation.

TRITIUM - (H-3) (Cont.)

TI #	Analysis Date	Activity (pCi/l)
79922	06/17/92	L. T. 2. E 02
80657	06/24/92	L. T. 1. E 02
81491	07/01/92	L. T. 3. E 02
82608	07/08/92	L. T. 8. E 01
83365	07/15/92	L. T. 2. E 02
84241	07/22/92	L. T. 2. E 02
84530	07/29/92	L. T. 2. E 02
85168	08/05/92	L. T. 2. E 02
86558	08/12/92	L. T. 1. E 02
87760	08/19/92	L. T. 2. E 02
87900	08/26/92	L. T. 1. E 02
88929	09/02/92	L. T. 1. E 03 (b)
88947	09/09/92	L. T. 9. E 02
90053	09/16/92	L. T. 1. E 03
90716	09/23/92	L. T. 1. E 03
91023	09/30/92	L. T. 1. E 03
91754	10/07/92	L. T. 1. E 03
93285	10/14/92	L. T. 2. E 03
93435	10/21/92	L. T. 1. E 03
93960	10/28/93	L. T. 2. E 03
94596	11/04/92	L. T. 2. E 03
95284	11/11/92	L. T. 1. E 03
96010	11/18/92	L. T. 1. E 03
96805	11/25/92	L. T. 1. E 03
97311	12/02/92	L. T. 1. E 03
98050	12/09/92	L. T. 1. E 03
99067	12/16/92	L. T. 1. E 03
00111	12/23/92	L. T. 1. E 03
00125	12/30/92	L. T. 1. E 03

(b) The gas counting method for tritium analysis was discontinued as of September 1, 1992. It was replaced by a liquid scintillation method which has the equivalent measurement sensitivity. However, the weekly blank measurements continued with the lower measurement sensitivity until the end of the year. In 1993 the tritium blank analysis will be performed by the more sensitive liquid scintillation method.

APPENDIX J

TLD QUALITY CONTROL PROGRAM

TLD QUALITY CONTROL PROGRAM

Teledyne Isotopes performs an in-house quality assurance testing program for the environmental TLD laboratory. On a quarterly basis the QA manager or a qualified designate exposes groups of TLDs to three different doses using a known cesium-137 exposure rate. The performance of the second quarter test in the early part of the third quarter had no impact on TLD results reported throughout the year.

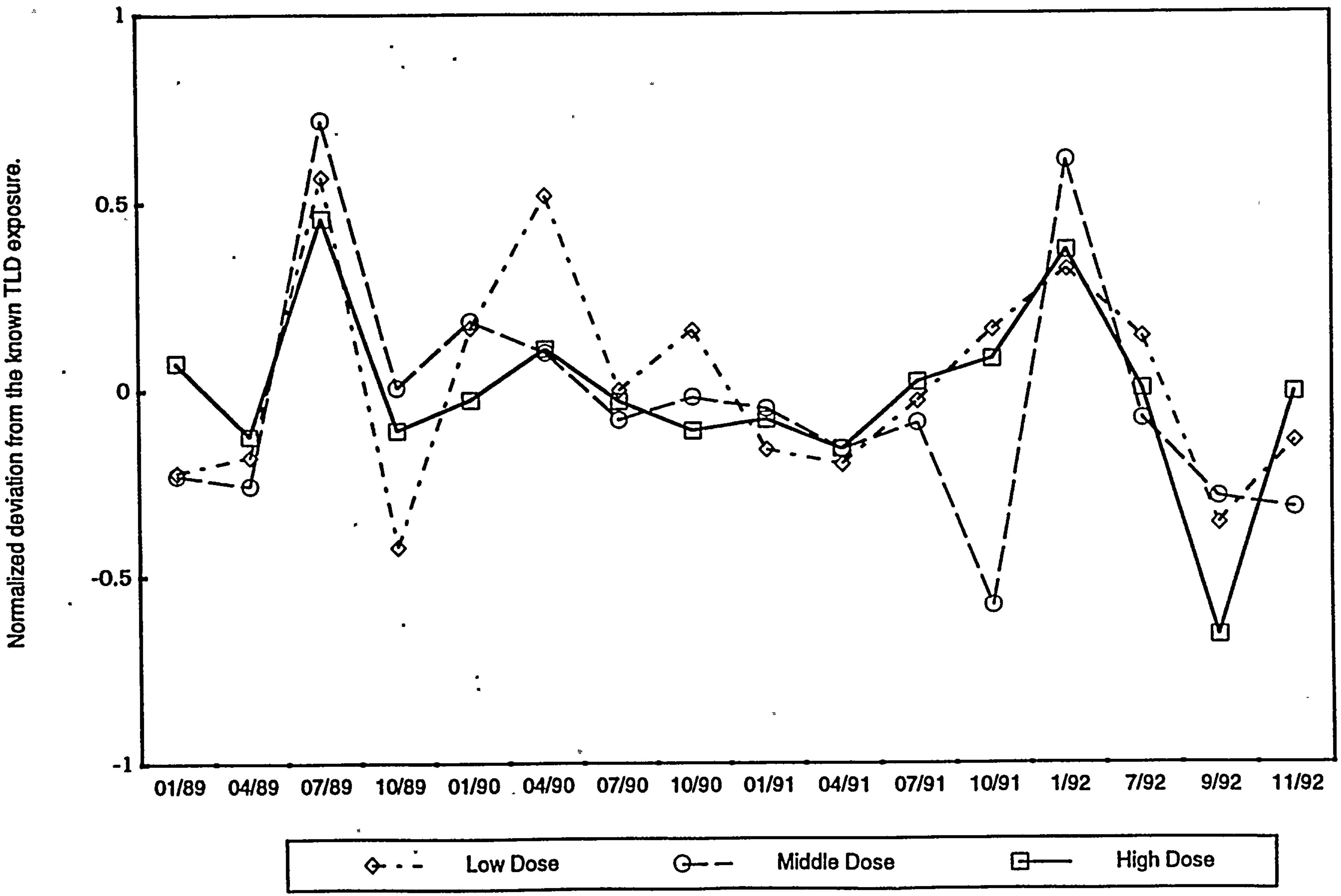
Due to an increased workload, the QA manager performed the second quarter exposures on July 14, 1992. Subsequent third and fourth quarter exposures were performed in September and November to ensure four tests would be performed for 1992.

Typical exposures are between 20 and 80 mR. The TLDs are readout on each of the three Model 8300 Readers in the environmental TLD laboratory and the calculated results are reported to the QA manager. The QA manager evaluates the results and writes a report discussing the performance of the labs.

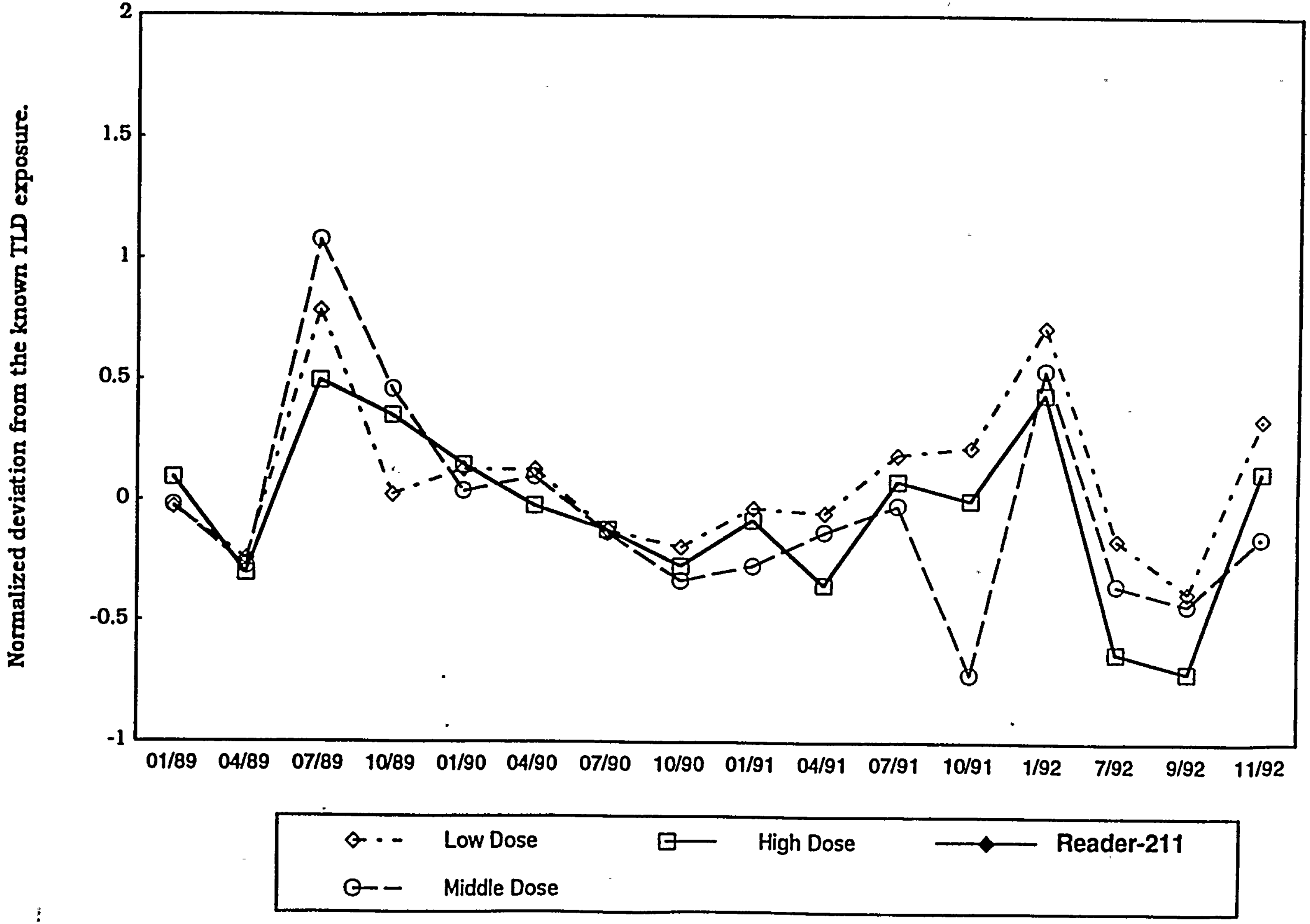
For 1992 all results were within the requirements of Regulatory Guide 4.13, Section C. The standard deviations were less than 7.5% and the variations from the known were less than 30%. The accompanying graphs show the normalized deviations of the measured doses to the exposure doses for each of the three readers.

TRENDING GRAPH 6

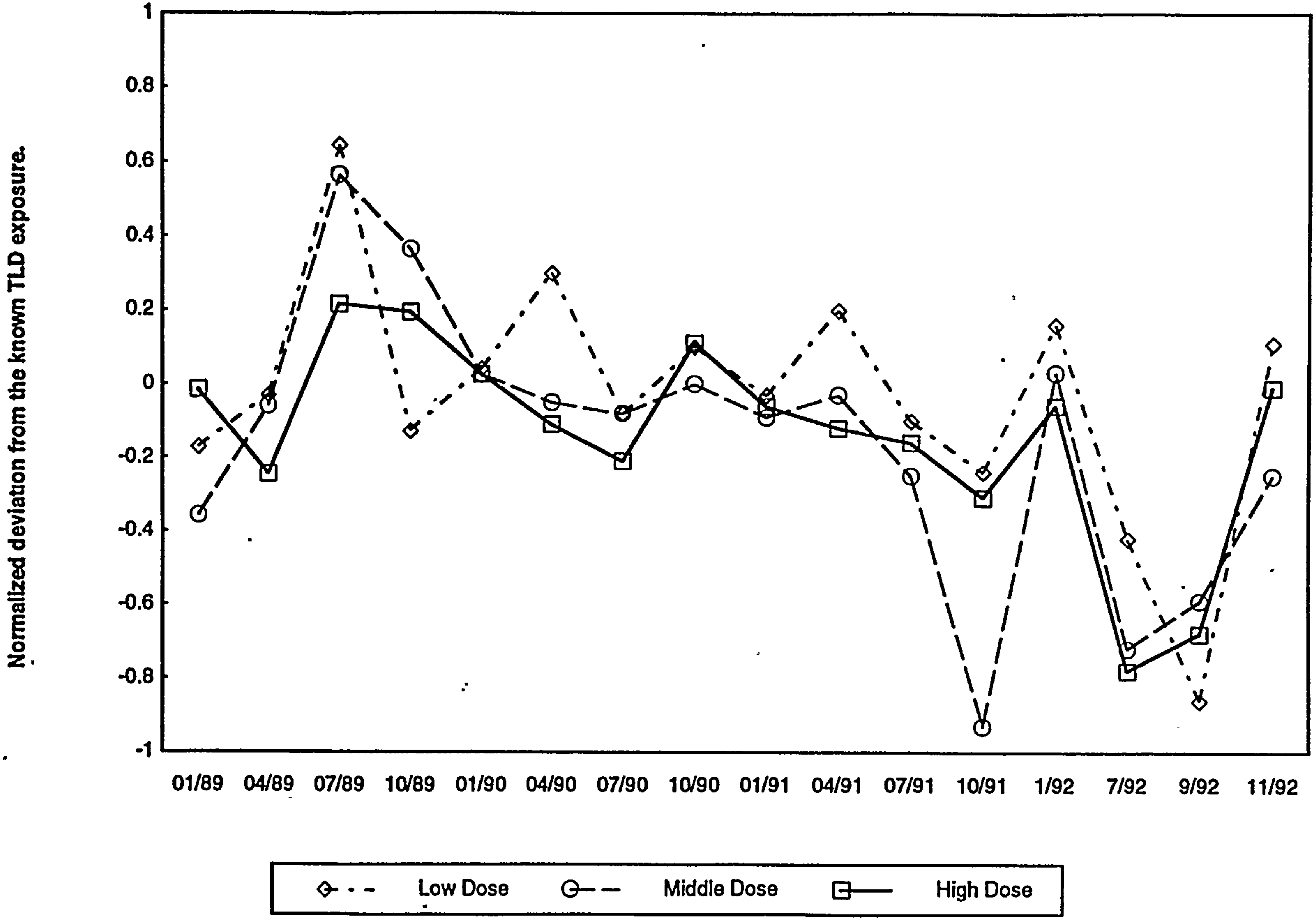
QUALITY CONTROL - TLDS
TLD READER 205



QUALITY CONTROL - TLDS
TLD READER 211



QUALITY CONTROL - TLDs
TLD READER 242



QUALITY CONTROL - TLDs

TLD READER 9150