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INDIANA
MICHIGAN
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AEP:NRC:0806L

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 - 1991

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

Attn: T. E. Murley

April 24, 1992

Dear Dr. Murley:

Attached is the Donald C. Cook Nuclear Plant Annual Environmental Operating Report for the year 1991. 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.

This document has been prepared following Corporate procedures that incorporate a reasonable set of controls to ensure its accuracy and completeness prior to signature by the undersigned.

Sincerely,

E. E. Fitzpatrick
Vice President

edg

cc: D. H. Williams, Jr.
A. A. Blind - Bridgman
NFEM Section Chief
J. R. Padgett
G. Charnoff
A. B. Davis - Region III
NRC Resident Inspector - Bridgman

IE25
11

Donald C. Cook Nuclear Plant • Units 1 & 2

Annual Environmental Operating Report

January 1, Through December 31, 1991

Indiana & Michigan Electric Company
Bridgman, Michigan

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

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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, 1991 through December 31, 1991.

During 1991, 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)	7,614,530	8,481,310
Unit Service Factor (%)	85.9	91.5
Unit Capacity Factor - MDC* Net (%)	83.2	85.7

* Maximum Dependable Capacity

II. CHANGES TO THE ENVIRONMENTAL TECHNICAL SPECIFICATIONS

There were no environmental Technical Specification changes in 1991.

III. NON-RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

A.1 Plant Design and Operation

During 1991 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 five construction activities during the reporting period which required environmental assessments. In all cases, it was concluded that there were no significant adverse environmental impacts. Copies of the environmental evaluations are located in Appendix III of this report.

A.2 Non-Routine Reports

A summary of the 1991 non-routine events, including corrective actions, is located in Appendix I of this report.

A.3 Environmental Protection Plan

There were no instances of Environmental Protection Plan noncompliance in 1991.

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 five construction activities during the reporting period which required environmental assessments. In all cases, it was concluded that there were no significant adverse environmental impacts. Copies of the environmental evaluations are located in Appendix III of this report.

A.5 Cook Nuclear Plant Act 307 Remedial Status Report

An underground fuel oil storage tank release status report was sent to the Michigan Department of Natural Resources. A copy of this report is located in Appendix II.

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 1991 herbicide applications is contained in Appendix IV 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 1991, are discussed in Appendix V 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 1991.

V. RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

The Radiological Environmental Monitoring Program annual report is located in Appendix VI 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 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 1991.

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

This report summarizes the collection and analysis of various environmental sample media in 1991 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, milk and sediment 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 Donald C. Cook Nuclear Plant operations. However, the associated aquifer does not provide a direct dose pathway to man.

A.3 Tritium Migration in the Aquifer

An evaluation of tritium migration in the aquifer of the Donald C. Cook Nuclear Plant and surrounding communities was performed. It was concluded that any offsite impact is minimized and there is no threat to the safety and welfare of the public. The summary of this report is in Appendix VII.

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 1991 Land Use Census. A further discussion of the Land Use Census can be found in Appendix VI (F) of this report.

VI. CONCLUSION

Based upon the results of the radiological environmental monitoring program and the radioactive effluent release reports for the 1991 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

1991

1991
NON-ROUTINE REPORTS

EVENT	CORRECTIVE ACTION
February 20 and 21, 1991 - Turbine Room Sump discharge was not monitored for pH on three occasions, due to an inoperable pH meter.	Discharges from the sump were manually sampled for pH until the meter was repaired and placed back into service.
April 26 to May 5, 1991 - An estimated 860 gallons of lubricating oil was discharged to Lake Michigan.	The leaking heat exchanger was isolated and plugged. The heat exchanger has since been replaced.
June 3, 7, 8 and 10, 1991 - Turbine Room Sump pH monitoring was performed but not available for reporting.	No corrective action possible - the strip chart paper was inadvertently discarded when the meter was replaced by a new unit.
July 1 through 5, 1991 - The NPDES Permit limit for heat addition to Lake Michigan was exceeded.	Unit power was reduced to bring the heat addition within permit limits. Administrative controls were established to ensure thermal discharge calculations are performed promptly and unit operation is reduced if necessary.
July 4, 1991 - Turbine Room Sump discharge was not monitored for pH while the meter was valved out of service.	The pH meter was cleared and valved into service. Engineering measures were taken to reduce the potential for clogging or unintentional closure of the valve.
November 29 to December 2, 1991 - Sodium nitrite and glutaraldehyde were discharged to Lake Michigan when a heat exchanger failed.	The leaking heat exchanger was isolated and repaired. It will be inspected for integrity in 1992.
Beginning December 5, 1991 - Diving ducks were collected in the circulating water system screenwash baskets.	See attached correspondence dated January 3, 1992.

Indiana Michigan
Power Company
P.O. Box 16631
Columbus, OH 43216

INDIANA MICHIGAN POWER

AEP:NRC:1171

Donald C. Cook Nuclear Plant Units 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
UNUSUAL OR IMPORTANT ENVIRONMENTAL EVENT -
APPROXIMATELY 400 DIVING DUCKS COLLECTED
IN THE CIRCULATING WATER SYSTEM SCREENWASH BASKETS

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

January 3, 1992

Gentlemen:

The purpose of this report is to inform you that as of December 19, 1991 approximately 400 diving ducks (lesser and great *scaups*) were collected in the circulating water system screenwash baskets at Cook Nuclear Plant. This event constitutes an "Unusual or Important Environmental Event" per Cook Nuclear Plant Technical Specifications (T/Ss) Appendix B, Paragraphs 4.1 and 5.4.2. As such, a verbal notification was made to Nuclear Regulatory Commission (NRC) Resident Inspector, David Passehl, and to the Michigan Department of Natural Resources (MDNR) on December 5, 1991. In addition, Cook Nuclear Plant T/Ss stipulate that a written report to the NRC is due within 30 days of occurrence. As such, we are submitting the attached report.

This document has been prepared following Corporate procedures that incorporate a reasonable set of controls to ensure its accuracy and completeness prior to signature of the undersigned.

Sincerely,

E. E. Fitzpatrick
Vice President

tjw

Attachment

cc: D. H. Williams, Jr.
A. A. Blind - Bridgman
A. B. Davis, Region III
P. A. Barrett
B. F. Henderson
R. F. Kroeger
B. Walters - Ft. Wayne
NRC Resident Inspector
T. Colburn - NRC
J. G. Keppler
J. R. Padgett
G. Charnoff
D. Hahn
ANI Library
INPO
B. A. Svensson

bc: S. J. Brewer/J. B. Kingseed/D. F. Walker/R. A. Green
M. L. Horvath - Bridgman - w/o attachment
J. J. Markowsky
J. B. Shinnock - w/o attachment
W. G. Smith, Jr.
S. H. Steinhart/S. P. Hodge
AEP:NRC:1171
DC-N-6015.1

Report of Unusual or Important Environmental Event

Conditions Prior to Occurrence

Unit 1 and 2 in Mode 1 (Power Operation) at 100% power.

Description of Event

On December 5, 1991, it was noted that approximately 90 to 100 dead lesser and greater *scaups* (diving ducks) had been collected in the screenhouse fish baskets (EIIS/NN-SCN). It was found that a zebra mussel population, which provided an abundant food supply for the ducks, had been established on the circulating water intake structures and surrounding rip rap. The ducks became caught up in the intake water flow while diving to feed on the zebra mussels.

Cause of Event

The event was caused by the abundant food supply and warm water environment provided by the circulating water discharge. As ducks dove down to feed on the zebra mussels, they became caught up in the circulating water intake flow. The presence of zebra mussels in the digestive tract of the ducks was verified by dissection.

It should be noted that this is the first occurrence of this type and is related to the fact that the past summer was the first season of major zebra mussel infestation.

A factor contributing to the event was the closure of the circulating water intake shutoff valve (12-WMO-30) for repair work. This reduced the circulating water intake pathway from three sixteen foot intake pipes to two sixteen foot pipes, resulting in an increase in the flow velocity from the other two intake pipes.

Analysis of Event

This event is considered reportable pursuant to Technical Specification Appendix B, paragraphs 4.1 and 5.4.2 as an unusual or important environmental event which indicates or could result in a significant environmental impact related to plant operation.

In response to the event, one of the Nuclear Regulatory Commission's resident inspectors at Cook Nuclear Plant, David Passehl, was verbally notified on December 5, 1991. Other agencies notified include the Michigan Department of Natural Resources (MDNR), and the US Department of Fish and Wildlife (DFW). Both the MDNR and the DFW responded to the site to retrieve duck remains for research purposes. In addition, the DFW evaluated the site for a possible observation station.

In the summer months, the combined numbers of lesser and greater *scaups* form a population larger than any other species of duck in North America, with the exception of the *mallard*. Frank C. Bellrose states in his book Ducks, Geese and Swans of North America that the average population of the *scaups* is about 7,415,000. The total number of ducks recovered from the screenhouse fish baskets was 400, representing 0.00545% of the total *scaup* population. Consequently, the effect of this event on the *scaup* population has been negligible.

Corrective Action

Several interim actions have been taken to discourage ducks from populating the area. These measures include chasing the ducks with a boat, firing blank shells at the ducks, and locating rafts and predator-eye balloons at the circulating water intake structures. In addition, to reduce flow rates at the intake structure screens, circulating water pump #21 was removed from service on December 9, 1991 and 12-WMO-30 was returned to its fully open position on December 13, 1991.

Since these measures have been taken, a dramatic decrease has been noted in duck impingement. No ducks have been found in the fish baskets since 12/15/91.

As a more permanent solution to prevent recurrence, the intake structures will be thoroughly hydrolazed during the 1992 refueling outages to remove the zebra mussels. This should prevent the ducks from accumulating at the intake structures. The effectiveness of hydrolazing the intake structures will be evaluated to determine whether it is necessary to take additional measures to prevent recurrence of this problem.

Failed Component Identification

None.

Previous Similar Events

None.

APPENDIX II

COOK NUCLEAR PLANT

ACT 307 REMEDIAL STATUS REPORT

Indiana Michigan
Power Company
One Summit Square
P.O. Box 60
Fort Wayne, IN 46801
219 425 2111

INDIANA
MICHIGAN
POWER

Lorraine Pockrandt
Environmental Response Division
Michigan Department of Natural Resources
621 N. 10th Street
Plainwell, MI 49080

November 14, 1991

Dear Ms. Pockrandt:

RE: Cook Nuclear Plant
Act 307 Remedial Status Report

On August 28, 1991, Pat Crowley sent an information request letter to Diane Fitzgerald, Environmental Supervisor at the Indiana Michigan Power Company (I&M) Cook Nuclear Plant regarding the underground fuel oil storage tank release which occurred during the mid-1970's. We understand that you have recently assumed the duties of Ms. Crowley as they relate to this issue and, therefore, we are responding directly to you.

Each of Ms. Crowley's six items noted in her letter are addressed in the following enclosures:

1. "Status Report for the Mid 1970's Fuel Oil Release at the Cook Nuclear Plant"

* 2. American Environmental Services' "Subsurface Fuel Oil Contamination Assessment and Demonstration Recovery Technology"

I&M's voluntary remedial actions have been effective and will continue as described in the status report. We would be glad to answer any questions you might have either in a meeting or by telephone at your convenience. Feel free to call me at (219) 425-2118 or Dave Shipe at (219) 425-2123.

Very truly yours,

Donald L. Baker

Donald L. Baker
Environmental Affairs Director

DLB/sdb/009

Attachments

* This report is not included in the Annual Environmental Operating Report. However, it can be made available upon request.

wells was left over from the auxiliary oil tank system release. The results of this assessment are included in their final report which is attached.

The contaminated area in the vicinity of the auxiliary boiler oil tanks was selected for the operation of a small scale, demonstration oil recovery system. The system was designed to depress the water table, recover free product, and treat the discharge for free, emulsified and dissolved product. An NPDES discharge permit was obtained from the Michigan DNR to operate the system. The small amount of free and dissolved product within the depression cone was removed within a short time after operation began on 9/20/89. The system continued to operate for two months but did not affect the isolated pocket of free product by RP Well #5 since it was outside the depression cone. AES recommended recovering the free product in this well by using a narrow well, pneumatic pump.

AES also investigated fuel oil contamination of the beach area. Soil samples were collected at 20 locations and were analyzed for oil and grease by an independent lab. A contamination plume approximately 40 feet wide was identified in the area west of RP Well #4 that extended west just beyond the second sheet piling wall. The contamination consisted of oil saturated soil close to the east wall with no noticeable free product present. The plume ended approximately 70 feet east of the Lake Michigan water line. AES concluded that this was old oil.

Recent monitoring and remediation efforts have consisted of sampling and analysis of well water and continued bailing of free product from RP Well #5. The most recent well water analysis results are attached for your review. The results indicate a continued degradation of the oil as shown by reduced BTX concentrations in Recovery Well samples when compared to 1989 data from the AES report. In addition, there are no traces of free product in any of the wells except RP Well #5 and Dry Well #2. Only an oil sheen remains in the dry well.

Soil contamination levels range from isolated pockets of oil saturated soil to relatively clean soil due to remediation efforts and natural degradation. The soil gas maps indicate that the majority of the area has petroleum hydrocarbon soil gas levels below 10 ppm.

Remediation and Monitoring Goals

The company has assessed the historical aspects of the spill, remediation progress, and the current status of the fuel oil contamination. AES's report recommendations were also considered when developing our future course of action. The following actions were determined to be essential:

bc:	A. J. Ahern/T. E. Webb -	Status	Report	Attachment	only
	A. A. Blind	"	"	"	"
	✓D. M. Fitzgerald/R. Beem	"	"	"	"
	D. E. Heydlauff	"	"	"	"
	D. W. Kemp/K. D. Mack	"	"	"	"
	M. R. Robida/C. E. Hawk .	"	"	"	"
	W. E. Walters/D. A. Shipe	"	"	"	"

STATUS REPORT FOR THE MID 1970's
FUEL OIL RELEASE AT THE COOK NUCLEAR PLANT
November 14, 1991

Site Description

The Cook Nuclear Plant is located three miles north of Bridgman, Michigan on the shores of Lake Michigan. The plant was placed on the Michigan Act 307 list of contaminated sites due to the release of fuel oil to subsurface soils in the mid 1970's. The fuel oil tank system is located on the west side of the plant within the Protected Area (fenced security zone). A detailed map of the site is attached to the back of the American Environmental Services Co., Inc. (AES) report which will be discussed later. The tanks are identified in the report as Auxiliary Boiler Fuel Oil Storage Tanks, but may also be identified as heating boiler tanks on drawings and in correspondence.

Approximately 50 feet west of the tanks is a sheet piling wall which separates the plant from the Lake Michigan beach area. A second, parallel sheet piling wall is located about 45 feet west of the first wall. The Service and Turbine Buildings border the tank site on the north and east sides, respectively. The four tanks are connected to form two sets, an east set and a west set. The fill pipes for the two sets of underground tanks were remotely located on the east side of the plant in the mid 1970's and were relocated adjacent to the tanks to reduce the likelihood of further overfills. Two vent pipes with an overflow catch basin are also located adjacent to the tanks.

Site History

The oil release was discovered in September 1976 by a diver who found oil in a water intake tunnel manway. Approximately 130 gallons of oil were removed from the manway and core borings were immediately initiated to determine the boundaries of the contamination. The Auxiliary Boiler Fuel Oil Storage Tank system was determined to be the source of the release. An oil plume extended west to the sheet piling wall and then south along the wall possibly as far as RP Well #6. The quantity of oil released was not known since it apparently occurred over several years during tank filling and oil transfer operations.

Recovery of free product continued by digging a recovery trench parallel and just east of the first sheet piling wall. Oil was removed as it accumulated in the trench. The trench was located between Dry Wells #1 and #2. The two dry wells were constructed to continue recovery operations once the majority of oil had been recovered and the trench was backfilled. Oil has also been removed from RP Well #5 since the release.

Oil recovery efforts have been successful in limiting oil migration in the groundwater. The amount of oil recovered has continued to decline over the years. To date, approximately 8,000 gallons of oil have been recovered from the site. Currently, oil is being bailed from RP Well #5, the only known area of recoverable oil. Approximately 3 gallons per month are being removed from the well by this method. While excavating for system repair and oil recovery, an undetermined quantity of contaminated soil was removed from the site.

Several techniques were employed to determine the cause of the oil release. Initially, a static fluid level test was performed on the auxiliary boiler oil tank system. The tests indicated a manhole cover and a fill line gasket located underground were two sources of the release which were subsequently repaired. Follow-up hydrostatic testing conducted in 1979, 1980 and every two years since then has indicated the tanks are leak-free as defined by NFPA 329. The west set of tanks was also visually inspected in 1979 and was found to be in good condition.

The point where the tank vent pipes project through the bottom of the overflow catch basin was also found to be leaking. Whenever overfilling the tanks occurred, leakage from the vent catch basin may have contributed to the problem. The tanks were overfilled when trucks were off-loaded at the remote location on the east side of the plant and when oil was recirculated to a full set of tanks. To preclude recurrence, the leak was sealed, fill lines were relocated next to the tanks tto ensure closer monitoring and formal procedures were issued to direct filling and recirculating operations.

Following our initial report submitted to the Michigan Department of Natural Resources in October 1976, the company has kept the DNR informed of the status of our remediation efforts. Follow-up reports were submitted which described our clean-up efforts and tank testing results. In 1981, the Michigan DNR agreed to the company's plan to continue monitoring the site and the collecting any recoverable oil. The Michigan DNR recommended the Cook Plant for inclusion on Michigan's Act 307 list of pollution sites in 1984 due to this oil release.

In 1987, the company formed a task force to identify the extent of the oil contamination onsite and to research alternatives for remediating contaminated areas. As a result of the task force's recommendations, the company employed the services of AES. In May 1989, AES began using soil gas survey techniques and constructing observation wells (OW) in potentially contaminated areas as part of a hydrogeological assessment. The goal was to determine the location, quantity and thickness of any free product on site. Samples from RP Wells #4, 5 and 6 and Dry Wells #1 and 2 were also cross-matched with fuel oil standards to determine the type of oil and its relative age. The well samples were identified as fuel oil but were obviously aged oils based on the loss of the more volatile fuel oil components over time. AES concluded that the oil in the

- accelerate the removal of free product from RP Well #5
- continue monitoring wells in the area to demonstrate the effectiveness of our remediation efforts
- develop a beach monitoring program to trend the degradation and/or migration of oil contamination
- continue to leak-test the Auxiliary Boiler Fuel Oil Storage Tanks to ensure that additional releases do not occur

Our proposed specific actions and schedule are as follows:

1. Establish a beach monitoring program incorporating a formal sampling grid, which will be used to track the degradation and/or migration of oil, and from which we can determine what actions need to be taken to remediate the area. Establish contracts for needed analytical and sample collection support.

   Date: Sampling Plan: Completed
   Initial sample collection: 12/1/91

2. Install a small diameter oil recovery pumping system in RP Well #5.

   Date: Target operational date is 12/1/91

3. Continue quarterly groundwater monitoring of selected onsite wells. Results will be used to build a data base to demonstrate the effectiveness of past remediation work.

   Date: Ongoing

4. Use the improved tank leak testing technology developed by Tanknology Corporation to again verify the Auxiliary Boiler Fuel Oil Storage Tanks are leak free. This sytem was tested on our underground waste oil tank and found to be very effective.

   Date: Second Quarter - 1992

<u>Conclusion</u>

From the time of the spill discovery in 1976 to the present, the company has taken positive steps to deal with the oil release. Over the years, we communicated verbally and in writing with the Michigan DNR on the nature of the release and progress in remediation. Oil collection efforts have continued and achieved an ongoing reduction in the amount of product retrieved. The he[illegible]g boiler oil tank system was repaired early in the process an[illegible]s

integrity has been demonstrated several times since. The company actively sought to accelerate oil collection with the 1989 demonstration project, which indicated that recoverable product has diminished significantly and the remainder appears to be localized.

The past responses together with our future course of action will ensure continued remediation and monitoring of the site. We believe that our voluntary action to remediate the site is a demonstration of our commitment to the long term environmental protection of the area.

APPENDIX III

ENVIRONMENTAL EVALUATION REPORTS

1991

DONALD C. COOK NUCLEAR PLANT

ENVIRONMENTAL EVALUATION

FOR

THE CLAM-TROL ADDITION HEATUP PROCEDURE

March 11, 1991

Prepared by: Steven L. Colvis [signature] 3/14/91
Steven L. Colvis
Radiological Support Section Date
Date

Approved by: [signature] 3/14/91
Dane R. Williams, Manager
Radiological Support Section
Date

Concurred by: [signature] 3/14/91
Diane Fitzgerald
Donald C. Cook Environmental Coordinator
Date

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I. Executive Summary

Zebra mussels (Dreissna polymorpha), a known macro-biofouler, were discovered at the Cook Nuclear Plant in July 1990. Without treatment, the mussel population is expected to multiply in 1991 to the point as to cause unacceptable blockage of the Cook Nuclear Plant intake systems.

To preclude such an event from occurring, a proprietary molluscicide (Betz Clam-Trol) is to be added to the affected systems. Experience has shown that the chemical is not effective unless the water temperature is above 60°F. Therefore, the temperature of the circulating water discharge is to be increased to enhance the effectiveness of the process (per procedure 12 OHP 4021.057.008, Operation of the Circulating Water System to Increase Forebay Temperature).

This environmental evaluation was conducted to determine if an increase in discharge temperature would constitute an unreviewed environmental question or a change to the Environmental Protection Plan.

Based on the research conducted, it is concluded that the heatup activities do not constitute an unreviewed environmental question or a change to the Environmental Protection Plan. Based on this conclusion, no NRC approval is required prior to beginning the program.

II. Purpose of the Environmental Evaluation

The purpose of this environmental evaluation is to determine if the proposed heatup procedure constitutes an unreviewed safety question as defined by Part II, Section 3.1 of the Donald C. Cook Nuclear Plant Technical Appendix B Technical Specifications. The procedure does not involve a change to the Environmental Protection Plan.

III. Description of Activity

Indiana Michigan Power Company proposes to artificially increase the temperature of the circulating water system. This heatup is being performed to increase the effectiveness of the Clam-trol chemical addition. The ambient water temperature is not sufficient to allow the Clam-trol to effectively kill the zebra mussel population now infesting the Cook Nuclear Plant systems.

IV. Description of the Affected Area

A. Location and Size

The area affected by the increased temperature program is shown on Attachment 1. This drawing was taken from a memo issued by the Environmental Engineering Division. Only the plume area in Lake Michigan will be affected.

B. Geology and Soils

No effect will be seen on the geology and soils, since the only affected area is in Lake Michigan.

C. Groundwater and Surface Water

No effect will be seen on groundwater and surface water, since the plume is only exiting to Lake Michigan.

D. Biological Resources

1. Terrestrial Ecology

No effect on terrestrial ecology will be seen because the only affected area is Lake Michigan.

2. Aquatic Ecology

The main concern with this program is the possibility of killing large numbers of fish due to the change in temperatures. Based on the analysis provided by the AEPSC Environmental Division in their March 4, 1991 memo (attached), no fish kills of any significance should occur if the guidelines provided are followed. Procedure 12 OHP 4021.057.008 does follow the guidelines delineated in this memo.

The memo mentions the possibility of a large scale fish kill if one of the Units is tripped. However, based on the operating history of the plant and discussions with Nuclear Safety & Licensing, it is concluded that a trip is not considered to be a likely occurrence. Therefore, no significant fish kill is probable based on the analysis performed.

E. Cultural Resources

1. Land Use

No impact on the use of land is anticipated since the area affected only includes Lake Michigan.

2. Archaeology

Only the area of the thermal plume in Lake Michigan will be affected; therefore, no disturbances to any possible archaeological finds are possible.

3. Water Use

As stated earlier, the only possible impact anticipated is on the fish population. Based on the previously referenced analysis, no impact is expected.

V. Environmental Impacts

A. Geology and Soils

No impact is expected, since the affected area is restricted to the Lake.

B. Surface and Groundwater

No impact is expected, since the affected area is restricted to the Lake.

C. Biological Resources

1. Terrestrial Ecology

No impact is expected, since the affected area is restricted to the Lake.

2. Aquatic Ecology

As stated previously, no significant effect to the aquatic ecological system is expected.

D. Cultural Resources

1. Land Use

No effect is expected on any land use.

2. Archaeology

No effect is expected on any archaeological finds.

E. Noise

The increased temperature program should not provide any increased noise levels to the area.

VI. Alternatives to the Proposed Activity

Four alternatives were considered.

The first alternative was to proceed with the Clam-trol addition without the associated heatup of the water. However, experience has shown that Clam-trol additions at low temperatures are not effective in killing the mussel population.

The second alternative considered was to delay the Clam-trol addition until the ambient temperature of the water reaches a point where the Clam-trol addition would be effective. Zebra mussel reproduction occurs at about the same water temperature as is needed for Clam-Trol effectiveness. Delaying the Clam-Trol application (eradication strategy) until this time would mean that the control strategy (use of low level chlorine/bromine) must immediately follow to prevent a reestablishment of a zebra mussel population. This cannot practicably be done, as both the eradication and control strategies require separate and demanding resource outlays, equipment installations, etc. Therefore, this alternative was rejected because it poses too great a resource outlay.

Chlorine additions were also considered as a measure to eliminate the mussels. However, there is a major concern regarding stress corrosion cracking that is associated with large chlorine infusions into a system. Also, the current Cook Nuclear Plant National Pollutant Discharge Elimination System (NPDES) permit does allow discharges of chlorine at the concentrations required for eradication of adult mussels, but the plant is not equipped with dechlorination equipment. Therefore, because of the concern for the integrity of the plant systems and the inability to dechlorinate to discharge permit requirement levels, this option is not being pursued presently.

The final option considered was to do nothing. As with option 2, there is a very real danger of the mussel population increasing in size to the point that plant water systems (such as the Essential Service Water System) could become blocked. Therefore, this option will not be pursued.

VII. Summary Cost-Benefit Analysis

The environmental impact of the heatup program will be minimal. The main concern is with the likelihood of killing a significant number of fish. Using the environmental controls described below, this is highly unlikely. The benefit of the continued operation of Cook Nuclear Plant far outweighs the small potential for a large scale fish kill.

VIII. Environmental Controls

The following controls are to be implemented during the heatup procedure at Cook Nuclear Plant. These controls are designed to minimize the impact to the environment from the heatup process and are contained in Procedure 12 OHP 4021.057.008.

1. The plant is to be operated at or below the NPDES-permitted discharge limit of 15.5E+09 BTU/hr. This limit will not be exceeded under the plant's forebay heat-up plan.

2. All seven of the circulating water pumps should be operated at maximum pumping capacity. This will ensure that the water velocity of the thermal discharge is high enough to exceed the swimming speeds of fish. This, in turn, will exclude them from the warmest portion of the plume.

3. The temperature of the discharge should be increased (and subsequently decreased) at a gradual rate of no more than 11°F/24 hr and no more than 0.5°F/hr. The analyses performed by the Environmental Division also assume that the maximum discharge temperature is increased to about 82° F. The analysis also assumes that the variations in the ambient water temperatures could push the discharge temperatures as high as 87°F.

4. The water temperatures are to be held at the maximum only as long as absolutely required for the Clam-trol process to be completed effectively. The higher temperatures will create a larger thermal plume. This increases the probability that fish will become acclimated to the increased temperatures, which increases the likelihood of problems occurring.

The increased temperature program will not cause Cook Nuclear Plant to exceed the limits of our NPDES permit. However, a notice is to be sent to the Michigan Department of Natural Resources to inform them of our treatment plans.

IX. Conclusion

American Electric Power Service Corporation concludes that if the above environmental controls are followed, the proposed heatup program will not cause a significant environmental impact. Based upon this determination, it is concluded that the activity does not constitute an unreviewed environmental question. Therefore, it will not be necessary to obtain approval from the Nuclear Regulatory Commission prior to the start of the process.

This Environmental Evaluation shall be included as part of the 1991 Annual Environmental Operating Report.

X. References

Memo, T. E. Webb to S. J. Brewer, et. al. dated March 4, 1991

INDIANA & MICHIGAN ELECTRIC COMPANY

DONALD C. COOK NUCLEAR PLANT

ENVIROMENTAL EVALUATION

FOR

THE INSTALLATION OF A MAKE-UP PLANT NEUTRALIZATION SYSTEM 12-PM-0818

Prepared by: Robert M Cla______ 12-9-91
Date

Approved by: ______ 12/12/91
Radiological Support Section
Date

Concurred by: ______ 12/12/91
D.C. Cook Environmental Coordinator
Date

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I. Executive Summary

Proposed modifications to Donald C. Cook Nuclear Plant require this Environmental Evaluation due to construction of a one hundred and ten thousand gallon waste neutralization tank, the transposition of a waste stream to an alternative point of discharge and necessary NPDES permit modification dictated thereby. Waste water from the make-up plant demineralizers will be neutralized and diverted from the present pathway into the station absorption field process waste pond to a point directly into the circulating water discharge tunnel. This configuration will eliminate the turbine room sump corrosion concern and, in addition, be of a direct benefit to the station absorption field process waste pond loading as well as the hydrogeological aspects of that immediate area. A waste characterization study of the demineralizer effluent is being conducted and the results will be presented to the Michigan Department of Natural Resources. Considering the large volume of water in the circulating water discharge tunnel into which the demineralizer waste water will be expelled, the proposed activity should not present a significant increase in an adverse environmental impact previously evaluated in the Final Environmental Statement. Utilization of the proposed activity is contingent upon approval of all required permits by the State of Michigan and other regulatory bodies.

II. Purpose of this Environmental Evaluation

Pursuant to Section 3.1 of Appendix B of the Donald C. Cook Nuclear Plants Unit Nos. 1 and 2 Facility Operating License, before engaging in any changes in the Donald C. Cook design, or operation or performing any test or experiment, it must be determined if the proposed activity has the potential for affecting the environment. In accordance with Radiological Support Section Procedure RS-34, the purpose of this environmental evaluation is to determine if the proposed activity defined in 12-PM-818 involves an unreviewed environmental question which may significantly increase any adverse environmental impact previously evaluated in the Final Environmental Statement.

III. Description of the Proposed Activity

Described in 12-PM-818 is the installation of a system to receive and neutralize the acid and caustic wastes from the make-up plant regeneration process prior to these wastes being discharged. Currently, the waste stream is causing a consistent decimation of the turbine room sump resulting in frequent and costly repair. The system will consist of a small intermediate sump tank to accept the waste drainage and pump it to a large holding tank. The liquid will be neutralized in the large tank with appropriate acid or caustic solutions. Subsequently, the final disposition of this waste stream will be to Lake Michigan via the Unit 1 or Unit 2 circulating water system.

IV. Description of the Affected Area

The areas that are directly affected by the proposed activity are Lake Michigan, station absorption field process waste pond, and a small area on the plant s where the proposed tank is to be installed (see attached).

Lake Michigan is the third largest of the Great Lakes with an area of 22,400 square miles and a volume of 173 trillioncubic feet. The southern basin of the lake has a mean depth of approximately 276 feet and a maximum depth of 540 feet. The thirty foot depth contour, which is the outer limit of the beach water zone, lies approximately one half mile offshore. Process waste streams currently discharged to the lake derive from the circulating water system, the liquid radwaste processing system, the heating boiler blowdown, and the steam generator blowdown treatment system.

The station absorption field process waste pond has an approximate gross area of 31,100 square feet with depths of 7 to 10 feet in the depressions. The pond is located about 1000 feet from the shoreline of Lake Michigan (see attached). The site lies on former dunelands on the southwest flank of the Michigan Basin and within the Grand Marais Embayment, formerly a huge bay coextensive with the meltwaters which formed Lake Chicago. Potable water supplies exist in unconsolidated Pleistocene drift deposits which lie at depths of 19 to 54 feet. These sediments are fine dune and lake sands which are underlain by thick impermeable clays with occasional sand or gravel lenses and a shale bedro The water table gradient is nearly flat with ground water flow averaging one to t feet per day in the direction of Lake Michigan.

An area within the protected area, south of the station pump house will be the proposed site of a one hundred and ten thousand gallon holding and neutralization tank. The structure will require a poured concrete foundation approximately twenty five feet in diameter and situated on ground that is in the vicinity of an access road, existing structures and trailers. Excavation for a foundation should not penetrate the water table and no other virgin aquatic or terrestrial ecologies will be perturbated.

V. Environmental Impacts

During normal operation, it is estimated that a maximum of approximately 3200 pounds per day of salts from the regeneration process will constitute the discharge. These salts will contain about 80 percent sodium sulfate with the remainder of the ionic species originating from the constituencies of present day Lake Michigan water. The maximum concentration of the waste is estimated to be around 9600 milligrams per liter total dissolved solids. The daily volume of regeneration waste discharged to the turbine room sump is estimated at fo thousand gallons with a maximum daily volume of 1,000,000 gallons. Consideri

the proposed activity, directing the waste stream to the Unit1 or Unit2 circulating water discharge, which has a nominal flow rate of 935,000 gallons per minute, will in effect diminish the waste stream concentration sufficiently such that the chemical concentration of the circulating water is approximately the same as that of Lake Michigan.

The system design of the station absorption field process waste pond was developed on the basis of infiltration considering the topography of the specific area and the operational demands of the plant. The absorption field inventory includes two sanitary waste ponds in addition to the process waste pond.

It is believed by some agencies that a ground water mounding phenomena exists beneath the absorption field site. Ground water monitoring wells have indicated elevated constituent concentrations of several parameters. Elimination of the make up plant regeneration process waste stream will greatly enhance the water quality of the absorption field and could remedy the concerns of offsite potentially contaminated water migration.

Though Lake Michigan will experience an environmental impact, the potential consequences presented by the regeneration waste will be of lesser detriment if the waste is directed to this pathway.

The neutralization tank will be sited on an area that has previously been disturbed. Construction of the tank will not degrade the immediate ecology further.

VI. Alternatives to the Proposed Activity

One option exists as an alternative to the proposed activity. After neutralization, the make up plant regeneration waste could be directed to the turbine building sump and succeedingly to the station absorption field process waste pond. In this case ground water quality would continue to be a concern. To subsequently remedy the ground water concern may require the station to meet the specified effluent limits for the station absorption field process waste pond or to seek a variance permit contingent upon receiving deed restrictions and easements from neighboring property owners in conjunction with a comprehensive hydrogeological site assessment of the ground water mounding.

VII. Summary Cost-Benefit Analysis

The Civil Engineering Department has calculated that approximately $ 1.4 million could be saved over the life of the plant by installing the neutralization system. This is based on conservative estimates of the repair frequency and repair cost of the turbine room sump with and without the proposed neutralization system. Redirection of the neutralized waste stream to the circulating water discharge will

represent a virtual no cost remedy to the station absorption field process waste pond concern. Other viable solutions to this concern will demand multi-million dollar cost estimates.

VIII. Environmental Controls

Utilization of the system installed in the proposed activity is strictly contingent upon approval of a revised NPDES permit by the State of Michigan Department of Natural Resources since the constituencies of the circulating water discharge will be modified to some degree.

To mitigate the consequences of a neutralization tank rupture, a containment structure will be erected around the tank site (see attached).

IX. Conclusion

The proposed activity defined in 12-PM-818 should not present a significant increase in an adverse environmental impact previously evaluated in the Final Environmental Statement. The physical structure and location of the neutralization tank does not present a significant environmental impact. By neutralizing and discharging the make-up plant regeneration waste to Lake Michigan, this system will eliminate the major source of the station absorption field process waste pond inventory. Therefore, the potential migration of these wastes to the ground water concurrent with the station absorption field process waste pond will be eliminated. The general environmental impact to Lake Michigan will not be profound and in considering the alternatives will be the best option for presenting the least adverse influence to the environment.

It is concluded that the proposed activity does not involve an unreviewed environmental question. Consequently, approval by the NRC will not be necessary to initiate the project.

X. References

Nuclear Operations Division Procedures, RS-34
Donald C. Cook Nuclear Plant Technical Specifications, App. B
Donald C. Cook Nuclear Plant Final Environmental Statement

INDIANA & MICHIGAN ELECTRIC COMPANY

DONALD C. COOK NUCLEAR PLANT

ENVIROMENTAL EVALUATION

FOR

THE NEW PROJECT ENGINEERING AND SITE DESIGN OFFICE BUILDING

12-PM-1159

Prepared by: ______________________ 11-7-91
Date

Approved by: ______________________ 11/7/91
Radiological Support Section
Date

Concurred by: ______________________ 11/11/91
D.C. Cook Environmental Coordinator
Date

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I. Executive Summary

This Environmental Evaluation was conducted to determine if construction of the proposed new office building for the Project Engineering/Site Design Group constitutes an unreviewed environmental question pursuant to Part II Section 3.1 of the Donald C. Cook Nuclear Plant Appendix B, Environmental Technical Specifications.

The new office building is necessary to accommodate Project Engineering/Site Design Group personnel who are being displaced due to RFC-DC-12-3065, which requires dedicated fire protection tanks to be installed where the Project Engineering/Site Design Group is presently located.

The construction of the new building will have minimal environmental impact due to locating the building in a previously disturbed area. All excavation will be minimal and take place in an existing gravel parking lot and roadway. The Michigan Department of Natural Resources has granted a permit so the building can be built in the Critical Dune area at the Cook Nuclear Plant.

Based on this Environmental Evaluation, it is concluded that the construction of the new office building does not constitute an unreviewed environmental question. Therefore, it will not be necessary to obtain approval from the Nuclear Regulatory Commission prior to the start of construction.

II. Purpose of the Environmental Evaluation

The purpose of this Environmental Evaluation is to determine if the proposed new office building construction constitutes an unreviewed environmental question as defined by Part II, Section 3.1 of the Donald C. Cook Nuclear Plant Appendix B, Environmental Technical Specifications. The change does not involve a change in the Environmental Protection Plan.

III. Description of Activity and Affected Area

Indiana Michigan Power Company proposes to construct a two-story office building at its Cook Nuclear Plant. The building will house Project Engineering Department and the Site Design Group personnel. Electrical service, fire protection, potable water, sewer connections and tele-communications are included in the environmental evaluation. The building is necessary because RFC-DC-12-~~3665~~ 3065 requires dedicated fire protection tanks to be installed where the Project Engineering Department and Site Design Group Building is presently located.

The proposed location of the New Project Engineering and Site Design Group shown on Attachment 1. The site is located next to the A-36 Steel Yard. The proposed site had been used to store miscellaneous parts used on the plant site, as a roadway, and as a parking lot. The building will cover an area approximately 10,000 square feet. It is a pre-fabricated building which will be placed on 2 feet by 3 feet. deep concrete footers. The dimensions of the two story building are 60 feet by 153 feet (Attachment 2). Electrical service will be connected via two oil-free 167 KV transformers. All sewage, fire protection, and potable water connections will be made via underground connections in the existing gravel parking lot. There will be minimal impact to the geological, hydrological, biological and cultural resources associated with the underground connections.

IV. Environmental Impacts

A. Geological and Soils

The building site was previously used as a parking lot, storage area, and roadway, therefore, storage compaction of the soils beneath the area has already occurred. Since the building will be placed on concrete pads, no further compaction will take place. In addition, all excavation for service connections to the building will be done in the existing roadway. Therefore, there will be no impact to the geological formations or soils in the area of the building.

B. Surface Water and Groundwater

The building will not have an impact on either the water table or surface water in the area of the building.

C. Biological Resources

1. Terrestrial Ecology

There will be no impacts to the terrestrial ecology as a result of the upgrade because no habitat will be removed and the area is already subjected to the intrusion of man and machinery, therefore animals residing in the area adjacent to the construction should not be disturbed by the increased activity. The approved Dunes Permit has been received from the Michigan Department of Natural Resources with limitations and conditions which apply to construction (Attachment 3).

D. Cultural Resources

There will be no change in land use as a result of the proposed building. No archaeological resources are known to exist in the area based on previous construction excavations.

E. Noise

Noise levels generated by construction are considered to be minimal due to prefabrication, and only a temporary impact due to the short construction time.

V. Environmental Controls

The following environmental controls shall be utilized to minimize impact to the environmental resulting from the construction of the building. These environmental controls will be reviewed and enforced by Cook Nuclear Plant Environmental Section.

A. Construction of this building shall correspond to the site plan received by the DNR.

B. No construction equipment or materials shall impact the dune slopes east of the proposed site project site.

C. All disturbed areas shall be re-stabilized following project completion.

D. Excess excavated soil will be deposited offsite in a legal manner and out of regulated critical dune areas or wetlands.

VI. Conclusions

Through proper mitigation practices, as outlined in the Environmental Controls Section of this evaluation, it can be concluded that significant adverse environmental impact will not result from the proposed construction.

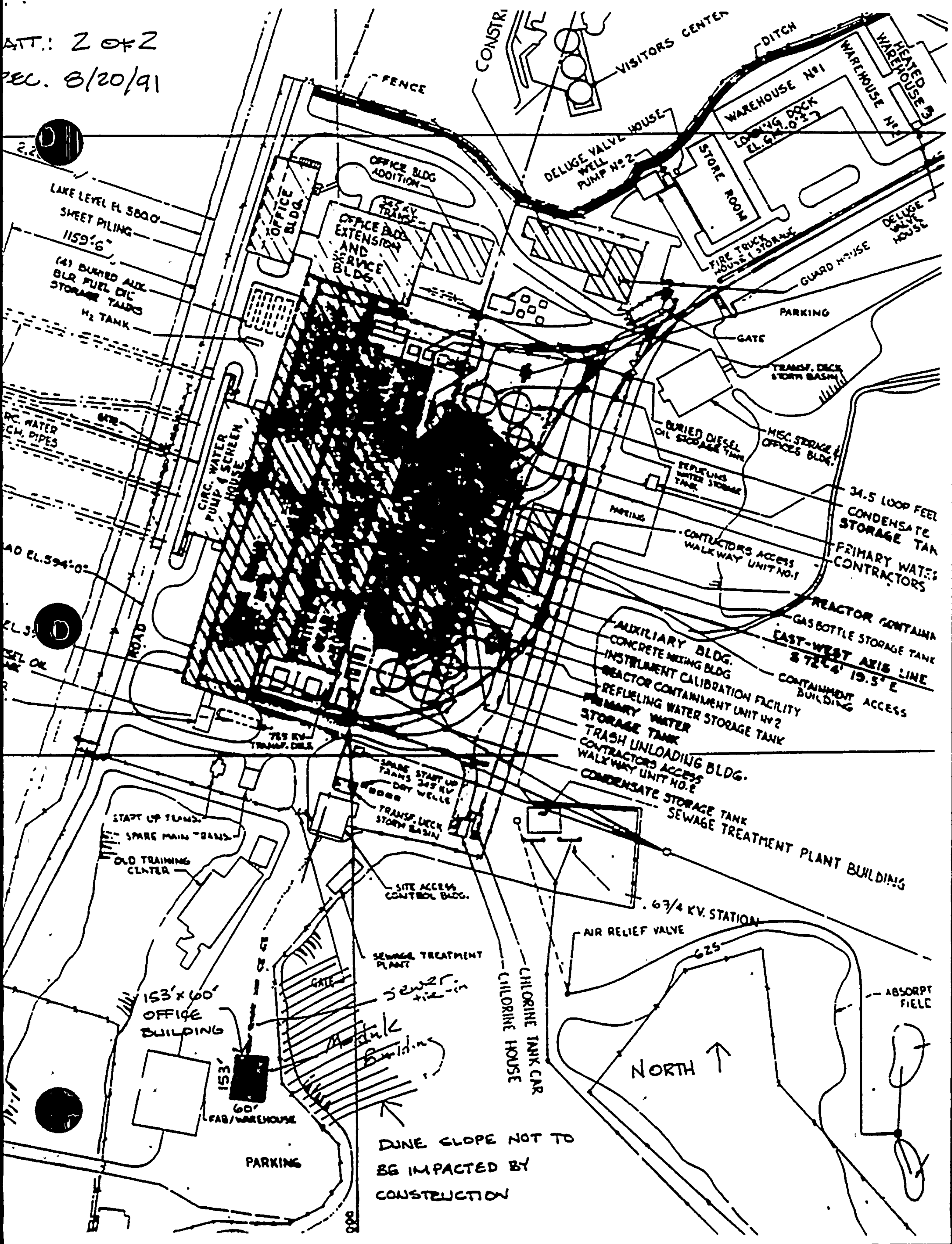
It is further concluded that the construction of this building does not involve an unreviewed environmental question. Therefore, it will not be necessary to obtain approval from the Nuclear Regulatory Commission to construct the new office building.

However, it should be noted that this Environmental Evaluation shall be included as part of the 1991 Annual Environmental Operating Report.

tjw

cc: DC-RS-7915

ATT.: 2 OF 2
REC. 8/20/91



MICHIGAN DEPARTMENT OF NATURAL RESOURC
PERMIT

Indiana/Michigan Power Co.
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
Attn: John Carlson, Environmental Section

Permit No. 91-BR-275- SC
Date Issued 08/29/91
Extended
Expires 08/29/92

Under the provisions of:

[ ] The Shorelands Protection and Management Act, 1970 P.A. 245 as amended

[X] The Sand Dunes Protection and Management Act, 1989 P.A. 146 and 1989 P. A. 147, amending 1976 P.A. 222

Permission is hereby granted, based on permittee assurance of adherence to State requirements and permit conditions to: Construct a 153' x 60' temporary modular office building according to the attached plans and subject to the following conditions.

Property Description: County Berrien, Township Lake,
Section 6, Property Tax No. 11-11-0005-0002-00-8.

This permit is granted under the conditions and requirements marked with an (x) below and und limitations and conditions appearing on the attached sheet:

[X] 1. This permit does not fulfill requirements of other state and local construction regulations.

[X] 2. This permit expires 365 days after the Date Issued.

[X] 3. Notification shall be provided to the Department by telephone 72 hours prior to:

[X] commencing construction Contact Steve Sutton at 517-373-1950
[ ] commencing vegetation removal or grading activity

[ ] 4. Location of structure, including any septic tank and tile field must be 250 feet or more landward of the bluffline on the date construction begins.

[X] 5. See attached sheets(s) for additional limitations and conditions.

Director, Department of Natural Resources

By [signature]
James G. Ribbens, In Charge
Coastal Programs Unit
Great Lakes Shorelands Section

cc: Lowell Bruce, CEA
Leslie Hainey, SCD
Richard Kading, BCE
Plainwell District Office, LWMD

Interim form 8/89

91-BP-275-C

Additional limitations and conditions:

[x] Construction of this 153' x 50' building shall correspond to site plan received by the DNR on 8/20/91 (Attachment 2 of 2).

[x] No construction equipment or materials shall impact the dune slopes east of the proposed project site.

[x] All disturbed areas shall be restabilized following project completion.

[x] Excess excavated soil shall be deposited off-site in a legal manner and out of regulated critical dune areas or wetlands.

AUTHORITY GRANTED BY THIS PERMIT IS SUBJECT TO THE FOLLOWING LIMITATIONS:

A. Initiation of any work on the permitted project confirms the permittee's acceptance and agreement comply with all terms and conditions of this permit. Non-compliance with these terms and condition and/or the initiation of other regulated activities. not specifically authorized by this permit shall cause for the modification, suspension or revocation of this permit, in whole or in part. Further, t Department of Natural Resources may initiate criminal and/or civil proceedings as may be deemed necessa to correct project deficiencies to protect natural resource values, and secure compliance with statutes

B. This permit shall be kept at the site of the work and available for inspection at all times during t duration of the project or until its date of expiration and authorizes representatives of the Departme to enter upon said property in order to inspect project progress.

C. This permit does not convey property rights in either real estate or material, nor does it authorize a injury to private property or invasion of public or private rights, nor does it waive the necessity seeking all local permits or complying with other State statutes.

D. This permit shall not be assigned or transferred without the written approval of the D[illegible]ent Natural Resources.

E. In issuing this permit, the Department of Natural Resources has relied on the information and data whi the permittee has provided in connection with the permit application. If, subsequent to the issuance this permit, such information and data prove to be false, incomplete, or inaccurate, the Department m modify, revoke, or suspend the permit, in whole or in part, in accordance with the new information.

F. Authority granted by this permit does not waive permit requirements under the Soil Erosion a Sedimentation Control Act (1972, P.A. 347).

DONALD C. COOK NUCLEAR PLANT

ENVIRONMENTAL EVALUATION

FOR

PROPOSED ABOVE GROUND FUEL STORAGE TANKS/REFUELING STATION

Prepared By: ____________________ / 5/21/91
H. W. Jones — Date
Radiological Support Section

Approved By: ____________________ / 5/21/91
D. R. Williams, Manager — Date
Radiological Support Section

Concurred By: S J Brewer 5/24/91 in accordance with 5/17/91 SRM / 5/24/91
(Safety Review Only) S. J. Brewer, Manager — Date
Nuclear Safety & Licensing

Concurred By: ____________________ / 5/29/91
D. M. Fitzgerald — Date
Environmental Coordinator
Donald C. Cook Nuclear Plant

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I. Executive Summary

The Donald C. Cook Nuclear Plant requires an on-site vehicle refueling station so that facility vehicles are assured a readily accessible fuel supply at all times. In addition, the previously underground gasoline tank is several years old and presents a potential problem with respect to leakage, thereby presenting a potentially significant environmental hazard. By EPA regulations, the Cook Plant has been required to remove or upgrade, by December 1, 1990, the underground gasoline tank. The underground gasoline tank was removed from the Plant site on September 24, 1990 in compliance with EPA regulations. At the time of the removal of the underground gasoline tank, an above ground diesel fuel tank was also removed to be upgraded with a new above ground tank in an improved refueling facility. Thus the use of containerized above ground storage tanks in a curbed base slab will significantly reduce the potential for significant environmental impacts either from construction or operation over the replacement of the underground storage tank with a new underground tank. Replacement of old underground tanks with new underground tanks, while not resulting in any additional environmental impact due to the construction activities, would impose a significant cost penalty due to the need to install additional monitoring devices as well as special type tanks in order to meet the current Environmental Protection Agency requirements for underground tank usage. Thus the most cost effective, as well as environmentally benign, method of ensuring a readily available on-site fuel supply for facility vehicles is the construction and use of containerized above ground diesel fuel and gasoline storage tanks/refueling island.

This environmental evaluation was conducted to determine if the construction and utilization activities associated with a containerized above ground diesel fuel and gasoline storage tanks/refueling island would constitute an unreviewed environmental question pursuant to Part II, Section 3.1 of Appendix B to the Donald C. Cook Nuclear Plant Technical Specifications (Environmental Technical Specifications).

Based on this environmental evaluation, it is concluded that the activities associated with the construction of the refueling station does not constitute an unreviewed environmental question. Consequently, it will not be necessary to obtain approval from the NRC prior to the start of the construction of the refueling station.

In the initial environmental evaluation, the impact of over-pressurization pulse following an explosion of the gasoline tank on the Radioactive Material Storage Building's (RMSB) structual integrity was identified as a potential concern which could result in a significant increase in the potential for an accidental release of radioactive material to the environment due to the failure of the exterior surfaces of the RMSB. Based on an evaluation of the proposed scenario by the AEPSC

Technical Assessment (TA) Department, it has been demonstrated that the over-pressurization pulse resulting from an explosion of the above ground gasoline tank would not result in a over-pressure in excess of the limit specified in Regulatory Guide 1.91. The calculations and supporting documentation to substantiate the conclusions of the Technical Assessment Department's evaluation have been reviewed by Nuclear Safety and Licensing (NS&L) Section and their conclusions are documented in the Safety Review Memorandum for this project.

II. Purpose of this Environmental Evaluation

The purpose of this environmental evaluation is to determine if the proposed construction of the above ground fuel storage tanks/refueling station for the Donald C. Cook Nuclear Plant constitutes an unreviewed environmental question as defined by Part II, Section 3.1 of Appendix B of the Donald C. Cook Nuclear Plant's Technical Specifications.

As stated in Part II, Section 3.1 of Appendix B of the Donald C. Cook Nuclear Plant's Technical Specifications:

A proposed change, test or experiment shall be deemed to involve an unreviewed environmental question if it concerns:

(1) a matter which may result in a significant increase in any adverse environmental impact previously evaluated in the final environmental statement (FES) as modified by staff's testimony to the Atomic Safety and Licensing Board, or

(2) a significant change in effluents or power level [in accordance with 10 CFR Part 51.5(b)(2)], or

(3) a matter not previously reviewed and evaluated in the documents specified in (1) of the Subsection which may have a significant adverse environmental impact.

III. Description of Activity

Indiana Michigan Power Company (IMPCo) proposes to construct and operate an on-site above ground containerized diesel fuel and gasoline storage tank refueling island at its Donald C. Cook Nuclear Plant. This facility will be used to ensure that facility vehicles have a readily available source of fuel at all times. This facility is intended to replace the previous above ground diesel fuel and underground gasoline storage tanks The underground gasoline storage tank which presented a potential for significant environmental impact due to underground tank leakage and contamination of ground water supplies was removed on September 24, 1990 in compliance with EPA regulations concerning underground tank storage facilities. The above ground diesel fuel storage tank was also removed at this time to be incorporated into an improved unified refueling island which can provide both types of fuel.

IV. Description of Affected Area

A. Location and Size

The proposed location of the above ground storage tanks/ refueling island is shown on Figures 1 and 2. The site is that of the former concrete batch plant, that was used during the original construction of the Donald C. Cook Nuclear Plant; and is located south of the Cook Plant Training Building and southeast of the proposed Radioactive Material Storage Building. The base plate of the structure will cover an area

of approximately 1224 square feet. Access to the facility will be via the access road for the 345 KV switch-yard.

B. Geology and Soils

Soils in the location of the proposed refueling station are comprised of dune sands, glacial and lake till deposits.

Underlying the sands and till is bedrock consisting of shale, limestone, sandstone, and dolomite.

C. Surface and Ground Water

The groundwater table generally rises gradually eastward away from Lake Michigan. The water table is less than 30 feet above the level of the lake and occurs within the dune sand or beach sand which overlays impermeable glacial lake clays. The overall direction of groundwater flow is toward Lake Michigan.

There are no significant surface water resources associated with the proposed refueling island.

D. Biological Resources

1. Terrestrial Ecology

The area of the proposed refueling island was the previous site of a concrete batch plant and lay-down area during original construction of the Cook Plant. The area is currently being used as a lay-down area and storage for construction of the Radioactive Material Storage Building. As such, the only vegetation is dune grass and scattered bushes. This vegetation offers only a very limited wildlife habitat, and no mammals have been observed to reside in the area. The dune grass does provide minimal cover for small animals as they transverse the area.

2. Aquatic Ecology

As stated earlier in this evaluation, no significant surface water resources are associated with the proposed refueling station.

E. Cultural Resources

1. Land Use

The entire site of the proposed refueling island is owned by IMPCo and is the site of the former concrete batch plant. None of the area is previously undisturbed.

2. Archaeology

Previous construction excavations in the immediate area of the proposed refueling island have not unearthed any artifacts or other examples of archaeological significance. These previous excavations include the construction of the Donald C. Cook Nuclear Plant, the construction of the access roads, the installation of security lights, the construction of the Training Building, the construction of the Steam Generator Lower Internals Storage Facility, and the on-going construction of the Radioactive Material Storage Building.

V. Environmental Impacts

A. Geology and Soils

The building will be constructed on a mat type foundation thus limiting the extent of excavation. Soil removal during excavation will be stored in the immediate area and used for backfill and grading purposes.

B. Surface and Ground Water

The excavation is not expected to be deep enough to cause any impact to the area water table. Surface run off from the site will be handled by the in-place storm drainage system that was installed during the construction of the Training Building.

C. Biological Resources

1. Terrestrial Ecology

As the entire construction area of the proposed Refueling Island will be confined to previously disturbed areas, no significant impact to the terrestrial ecology is anticipated. The area is already subject to the continual intrusion of man and machinery, therefore wildlife in adjacent areas should not be disturbed by any increased activity.

2. Aquatic Ecology

No significant surface water resources exist close enough to the construction site to be affected by the proposed project.

D. Cultural Resources

1. Land Use

The site is currently used as a lay-down area and for storage. The refueling island and associated activities should not significantly alter the permanent impact to the area.

2. Archaeology

No archaeological resources are known to exist in the area based on previous construction activities.

E. Noise

Appropriate noise reduction measures will be employed so that noise levels from construction activities should not exceed the EPA's recommendations for rural areas. As the construction site is well within the confines of IMPCo property, noise levels should not be such as to create any annoyance to local residents.

VI. Environmental Controls

The following environmental controls shall be utilized to minimize construction impacts. These environmental controls shall be reviewed by the contractor prior to the start of any construction in the area discussed by this assessment. In addition, it is recommended that these environmental controls be included as part of the construction contract.

A. Final Grading Plan

Those areas disturbed by the proposed excavation and construction shall be contoured to meet the original grade and elevation that existed prior to construction. Any area disturbed outside of the marked construction zone will also be revegetated.

B. Noise

To reduce the impact of noise on the surrounding community, the majority of construction activities shall only take place during the day shift in this area. Noise will also be controlled from internal combustion engines by the use of exhaust mufflers. If blasting is required for construction, it shall be done during the day shift only.

C. Slash Disposal

Any vegetation slash materials will be stored on-site on the edges of wooded areas to provide wildlife habitat.

In no case will burning or incineration of solid trash or waste be permitted.

D. Environmental Monitoring

The D. C. Cook Environmental Section shall conduct and document periodic inspections of the affected area. If any of the construction activities appear to be causing significant environmental impacts, appropriate action will be taken.

E. Permits

After reviewing the applicable Federal, State, and local requirements and regulations, it has been determined that the only permit required to conduct this construction activity is the Critical Dune Area Permit as required per the The Sand Dunes Protection and Management Act, 1980 P. A. 146 and 1989 P. A. 147. All requirements of said permit shall be strictly adhered to. Permit #90-BR-413-C was issued by the Michigan Department of Natural Resources to the Cook Plant on January 28, 1991 for the construction of the refueling island.

As indicated in the Executive Summary of this evaluation, prior to utilizing this facility, calculations and associated documentation demonstrated that the peak over-pressure resulting from a design basis explosion of the gasoline storage tank will not exceed the limit specified in Regulatory Guide 1.91. NS&L has reviewed the Technical Assessment's evaluation and their conclusions have been documented in the Safety Review Memorandum for this project, which is included in this Environmental Evaluation as Attachment 1.

VII. Conclusions

American Electric Power Service Corporation concludes that with the proper mitigation practices as outlined in the Environmental Controls Section of this evaluation, no significant adverse environmental impact will result from the proposed construction of the above ground diesel fuel/gasoline storage tanks - refueling island.

It is further concluded that the proposed refueling island and associated construction activity does not involve an unreviewed environmental question. Consequently, it will not be necessary to obtain prior NRC approval to construct this facility.

This environmental evaluation shall be included in the 1991 Annual Environmental Operating Report.

DONALD C. COOK NUCLEAR PLANT

ENVIRONMENTAL EVALUATION

FOR

THE RADIOACTIVE MATERIAL BUILDING

February 8, 1991

Prepared by: ______________________________ 2-8-91
Walter T. MacRae, Radiological Support Section — Date

Approved by: ______________________________ 2/8/91
Dane R. Williams, Radiological Support Section — Date

Concurred by: ______________________________ 2/18/91
Diane Fitzgerald
Donald C. Cook Environmental Coordinator — Date

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I. Executive Summary

Under federal law, on January 1, 1993 the three present low level radioactive waste disposal facilities will be closed. In November 1990, access to these facilities to Michigan radioactive waste generators was denied because the State of Michigan did not move forward to meet its obligations. The facility where the Cook Plant is to dispose of its low level waste is to be built in Michigan, but it will not be available until, at the earliest, 1996. The Cook Plant is responsible for temporarily storing all the radioactive waste generated by the plant until an offsite facility is available. To do this we will need a facility to be built on site capable of storing the waste generated. Because of uncertainties in the ability of the State of Michigan to meet its schedule and complete a facility by 1996, it is intended to build the maximum size facility allowed by the NRC. The size allowed by the NRC is based on five years of waste generation. For the Cook Plant this would be a building with a low level radioactive waste capacity of about 80,000 cubic feet.

This environmental evaluation was conducted to determine if the construction activities and subsequent use of the Radioactive Material Building would constitute an unreviewed environmental question or a change in the Environmental Protection Plan.

Based on this environmental evaluation it is concluded that the activities associated with the Radioactive Material Building are not an unreviewed environmental question or a change in the Environmental Protection Plan. Therefore, it will not be necessary to obtain approval from the NRC prior to the start of construction.

II. Purpose of Environmental Evaluation

The purpose of this environmental evaluation is to determine if the proposed Radioactive Material Building for the Donald C. Cook Nuclear Plant constitutes an unreviewed environmental question as defined by Part II, Section 3.1 of the Donald C. Cook Plant Appendix B Environmental Technical Specifications. The change does not involve a change in the Environmental Protection Plan.

As stated in Appendix B, Part II, Section 3.1 of the Donald C. Cook Nuclear Plant Environmental Technical Specifications, "A proposed change, test or experiment shall be deemed to involve an unreviewed environmental question if it concerns (1) a matter which may result in a significant increase in any adverse environmental impact previously evaluated in the final environmental statement (FES) as modified by staff's testimony to the Atomic Safety and Licensing Board, supplements to the FES, environmental impact appraisals, or in any decision of the Atomic Safety and Licensing Board; or (2) a significant change in effluents or power level [in accordance with 10 CFR part 51.5(b)(2)] or (3) a matter not previously reviewed and evaluated in the documents specified in (1) of the Subsection which may have a significant adverse environmental impact.

III. Description of Activity

Indiana Michigan Power Company proposes to construct a Radioactive Material Building at its Donald C. Cook Nuclear Plant. The facility will be used to temporarily store radioactive material, primarily low level radioactive waste that is prepared for transport to a disposal site in accordance with applicable regulations. The building is necessary for the storage of waste during an interim period when disposal will not be available.

IV. Description of Affected Area

A. Location and Size

The proposed location of the Radioactive Material building is shown on Attachment 1. The site is directly behind the Training Facility on the site of the former concrete batch mixing plant, that was used during the original construction. The radioactive material building covers an area of approximately 20,000 ft^2.

B. Geology and Soils

Soils in the area are comprised of dune sands, and glacial and lake till deposits. Underlying the sands and till is bedrock consisting of shale, limestone, sandstone and dolomite.

C. Groundwater and Surface Water

The groundwater table generally rises gradually eastward away from Lake Michigan. The water table is less than 30 feet above the level of the lake and occurs within the dune sand or beach sand which overlays impermeable glacial lake clays. The overall direction of groundwater flow is toward Lake Michigan. There are no significant surface water resources in the vicinity of the new construction.

D. Biological Resources

1. Terrestrial Ecology

The area of the Radioactive Material Building was the previous site of a concrete batch plant and lay-down area during original construction. The area is currently used for storage and as a lay-down area for major projects associated with the Plant. As such, the only vegetation is dune grass and scattered bushes. This vegetation offers a very limited wildlife habitat, and no mammals have been observed to reside in the area. The vegetation does provide minimal cover for small animals as they travel to the lake shore.

2. Aquatic Ecology

As stated, no significant surface water resources are associated with the area.

E. Cultural Resources

1. Land Use

The entire site is owned by Indiana Michigan Power Company, and it is the site of the former concrete batch plant. The site is centrally located on the property among existing buildings. None of the areas are previously undisturbed.

2. Archaeology

Previous construction excavations in the immediate area have not unearthed any artifacts or other examples of archaeological significance. These previous excavations include the construction of the Training Building, the Donald C. Cook Nuclear Plant, and various other facilities used to support the Plant.

V. Environmental Impacts

A. Geology and Soils

The building will be constructed on a mat type foundation thus limiting the extent of excavation. Soil removed during the excavation will be stored in the immediate area and used for backfill and grading.

B. Surface and Groundwater

The excavation is not expected to be deep enough to cause any impact to the area water table. Surface run off from the site will be handled by installing a storm drainage system and directing the flow to existing natural drainage ravines. The building is designed with a closed sump system. The packages anticipated to be placed in this building are to be prepared for transport and disposal in accordance with applicable regulations. They should be packaged in strong tight containers and free of standing liquids. If any liquids are released in the building they would drain to a closed sump. If a large amount of water were collected in the sump, it would to be trucked back to the plant to the plant's water processing systems.

C. Biological Resources

1. Terrestrial Ecology

The entire area will be confined to previously disturbed areas. No significant impact to the terrestrial ecology is anticipated. The area is already subject to the continual intrusion of man and machinery, therefore wildlife in adjacent areas should not be disturbed by any increased activity. The external building dose rate will be closely monitored and controlled such that it is kept below 10% of the minimum allowed by federal regulation for access to an unrestricted area. The allowable dose rate for any external surface of the building is 0.2 mrem/hr. This

is the same limit used for other facilities not within the plant protected area.

2. Aquatic Ecology

No significant surface water resources exist close enough to the site to be affected by the project.

D. Cultural Resources

1. Land Use

The site is currently used as a lay-down area and for storage. The Radioactive Material Building should not significantly alter the permanent impact to the area.

2. Archaeology

No archaeological resources are known to exist in the area based on previous excavation activity.

E. Noise

Appropriate noise reduction measures will be employed, so that noise levels from construction should not exceed the U. S. Environmental Protection Agency recommendations for rural areas. The site is well within the confines of the plant property. Noise levels should not be such to create any annoyance to local residents.

VI. Alternatives to the Proposed Activity

Two alternatives were considered.

First was the alternative of finding an offsite location to store the wastes. Finding a location to store our waste offsite is not feasible because there is no place today that will accept our waste for temporary storage. Vendors were contacted and either they are unable to do it or they could only store a very limited volume. Some that are unable to do it, are considering opening a storage facility but they do not have any definite plans. There are many legal, regulatory and political conditions that could deter a vendor from establishing their own storage facility. Since no facility exists today, a new facility would have to be built somewhere. The impact to the environment is minimum at a location selected, and because of other concerns, it is best built on the plant property.

The second alternative considered was to use temporary on site storage containers for highly radioactive material. These containers are typically concrete. They are used to store liners or 55 gallon drums temporarily. Their intended design use is short term, on the order of months not years. Depending on the amount of shielding required they could be very large and would be difficult to move without some kind of crane. Their exposure to the environment has not been proven, so they would have to be stored inside existing buildings or in their own warehouse. Transporting them would be very difficult. The largest are designed with 23 inch walls. It has been determined that the maximum thickness that would be required for the Cook Plant is 30 inches. A 23 inch walled container unloaded would weigh over 40 tons.

The second alternative was not chosen for the following reasons. First, the maximum dose rate they are designed to shield against is 50 R/hr. Based on our operating experience, it is expected to have material with a dose rate of greater than 100 R/hr. They would have to be kept out of the weather, so a building will still have to be built. They could weigh in excess of 40 tons. They will need a special system to move them, such as the crane planned for the proposed project. The design required for the proposed project allows for uncontrolled access to the exterior wall of the building. Since the same shielding is not available with the storage containers a buffer zone would have to be maintained around the building to limit radiation exposures. This requirement would increase the area needed for the storage of waste by about a factor of four. There is a requirement to inspect routinely the waste containers; it would be impractical to inspect the waste containers within the storage containers.

From an environmental impact viewpoint, the second alternative may appear to have a lesser impact, but there are many factors that show that the impact is not minimized. Using the second alternative will require more space. The use of individual containers to store the waste makes it mor difficult to control water that could get into the containers. The containers would havde to be protected from the weather, therefore some construction would still be required. The packages will have to be inspected. Without the use of the remote cameras or shield walls ohter than the containers, the dose to the worker, the public and the environment would be higher. The impact from the second alternative would be greater than the planned project.

VII. Summary Cost-Benefit Analysis

The environmental impact of the project are minimal. No dollar amount has been assigned the impact, and the impact is small. THe benifits include the continued operation of the plant, and a specially designed facility for the greater control of the waste and control of exposures. The benefits greatly out weigh the environmental cost.

VIII. Environmental Controls

The following environmental controls shall be used to minimize construction and operational impacts on the environment. The environmental controls for the construction impact shall be reviewed by the contractor prior to the start of any construction in the area discussed by this assessment.

A. Final Grading Plans

Those areas disturbed by the proposed excavation and construction shall be contoured to meet the original grade and elevation that existed prior to construction or to meet the requirements set forth in the construction drawings. Any area disturbed outside the marked construction zone will also be revegetated.

B. Noise

To reduce the impact of noise on the surrounding community, most of the construction activity shall only take place during the day shift in this area. Noise will also be controlled from internal combustion engines by exhaust mufflers. If blasting is required for construction, it shall be done during the day shift only.

C. Slash Disposal

Any vegetation slash materials will be stored on-site on the edge of wooded areas to provide wildlife habitat. Burning of solid trash or waste will not be permitted. This material shall be disposed of in dumpsters and waste receptacles.

D. Environmental Monitoring

During construction the Donald C. Cook Nuclear Plant Environmental Section shall conduct periodic inspections of the affected area. If any of the construction activities appear to be causing significant environmental impacts, appropriate actions will be taken.

During the operation of the facility, it shall be the responsibility of the Radioactive Material Control Section to assure that the building maintains a minimum impact on the environment. They shall conduct periodic inspections of the sump and external building surfaces to document the impact on the environment. They shall conduct an inspection of the external surface of the building after the placement or movement of the packages put in storage in the building.

E. Permits

No Federal permits or licenses are required for the construction or first five years of use. There are four State permits required. Three state permits are for construction and the fourth permit is an environmental permit required for work in a critical dune area. Two local construction permits are required. Concerning the affect on the environment, only one plant permit is required for digging. Other permits may be required (i.e welding) but these have no affect on the environmental requirements.

F. Dose Limits

All external surfaces of the Radioactive Material Building shall be less than 0.2 mrem/hr on contact at closest easily accessible points.

IX. Conclusion

American Electric Power Service Corporation concludes that with the proper mitigation practices as outlined in the Environmental Controls Section of this evaluation no significant adverse environmental impact will result from the proposed activity.

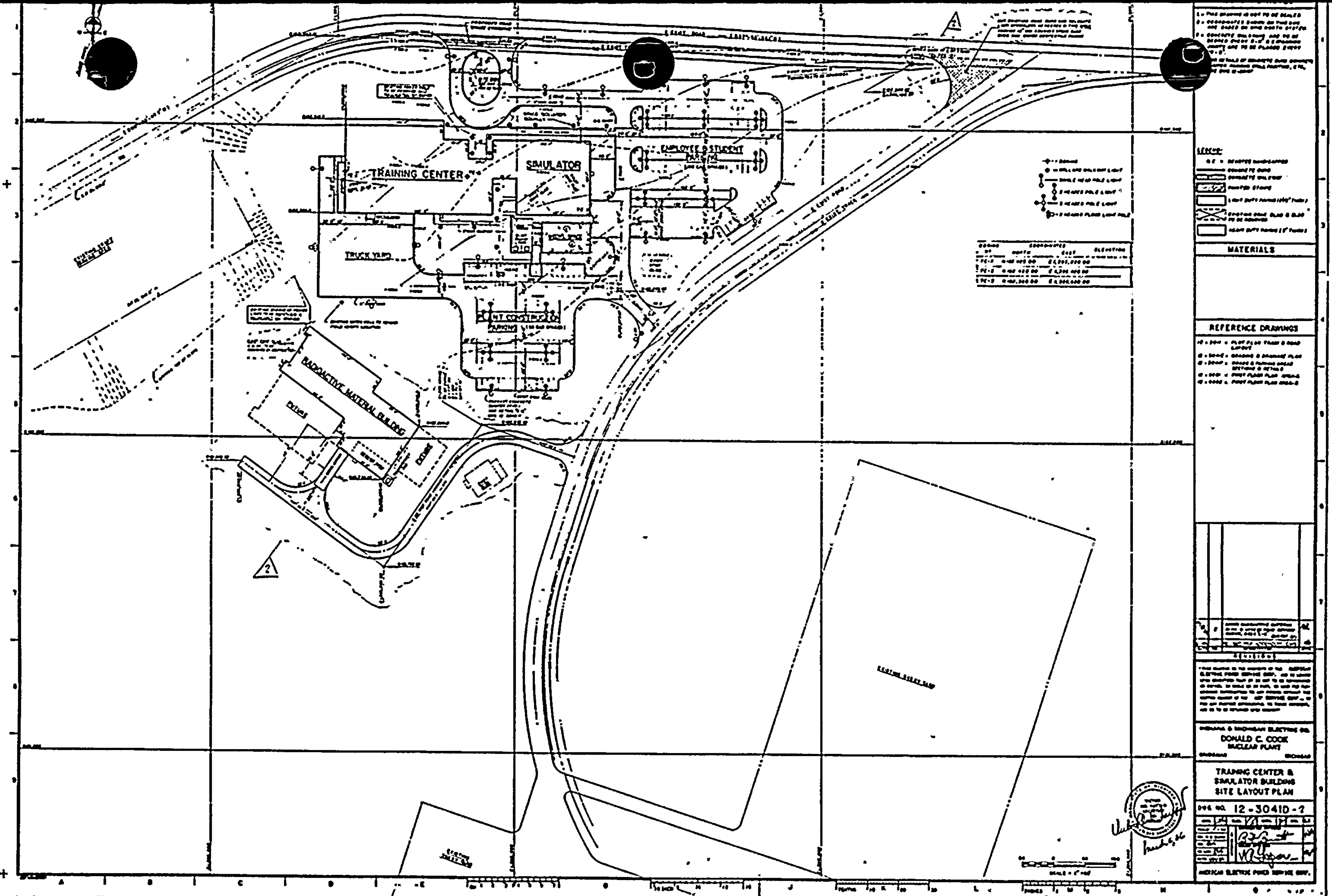
It is further concluded that the proposed project, associated construction activity and operation does not involve an unreviewed environmental question. Therefore, it will not be necessary to obtain approval from the Nuclear Regulatory Commission prior to the start of construction.

This Environmental Evaluation shall be included as part of the 1991 Annual Environmental Operating Report.

X. References

1. The Donald C. Cook Nuclear Plant Updated Final Safety Analysis Report, Volume 1, July 1990, Section 2.3

2. The Donald C. Cook Nuclear Plant Environmental Report, February 1971, Appendix A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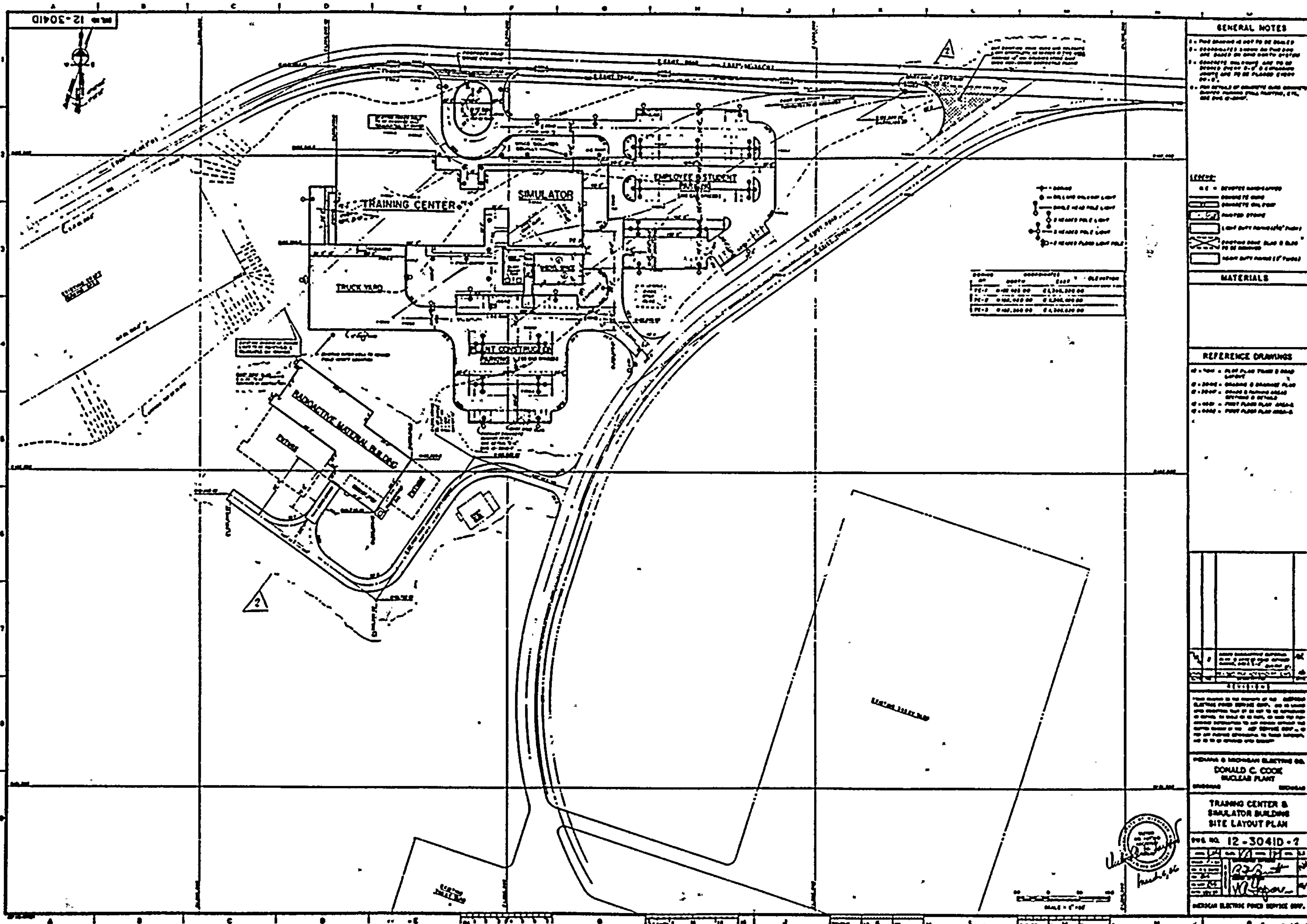
SIMULATOR
EMPLOYEE & STUDENT PARKING
TRUCK YARD
PLANT CONSTRUCTION PARKING
RADIOACTIVE MATERIAL BUILDING
MATERIALS
REFERENCE DRAWINGS
INDIANA & MICHIGAN ELECTRIC CO.
DONALD C. COOK
NUCLEAR PLANT
TRAINING CENTER &
SIMULATOR BUILDING
SITE LAYOUT PLAN
DWG. NO. 12-30410-7
AMERICAN ELECTRIC POWER SERVICE CORP.



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GENERAL NOTES
MATERIALS
REFERENCE DRAWINGS
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SIMULATOR
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SITE LAYOUT PLAN
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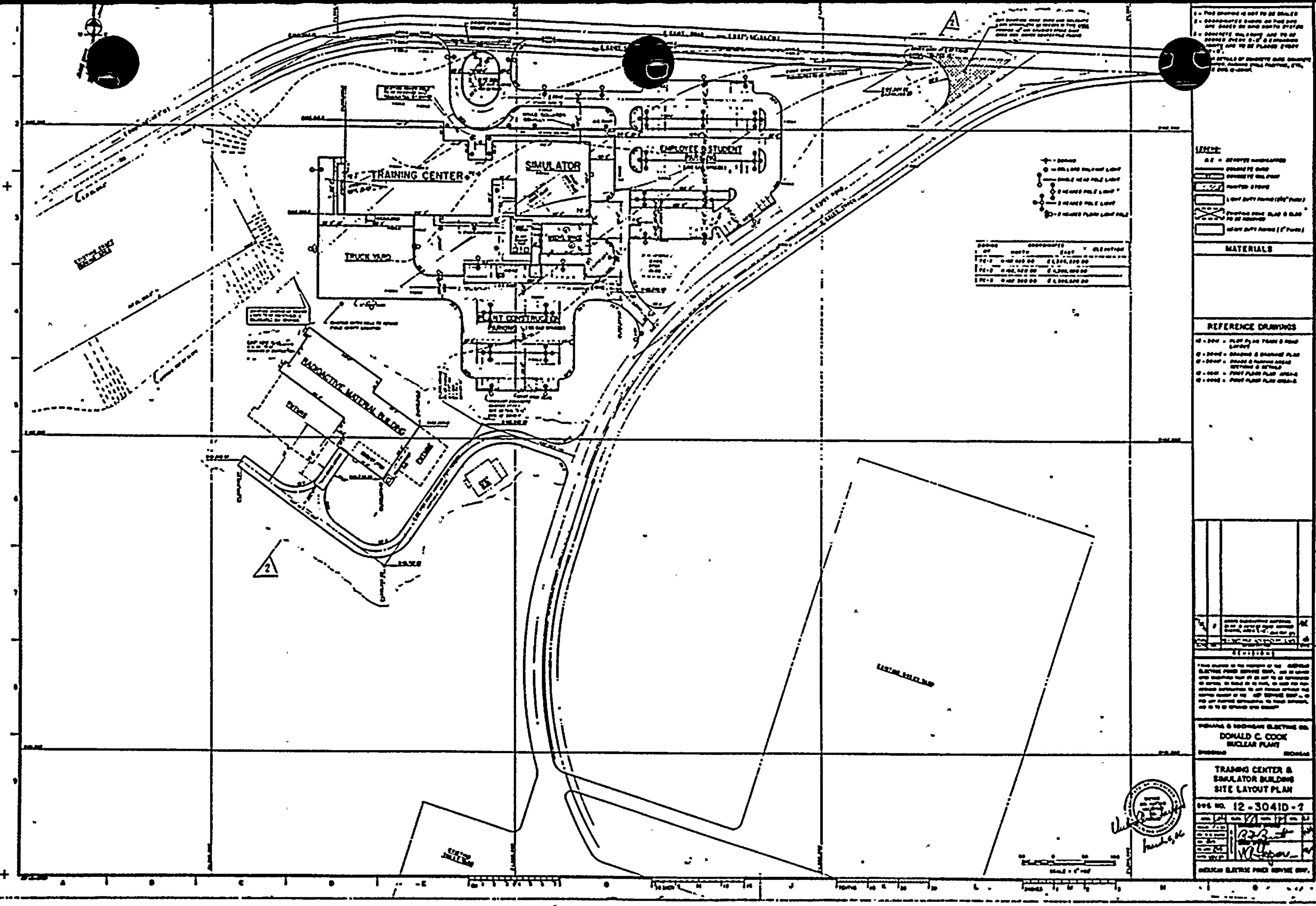

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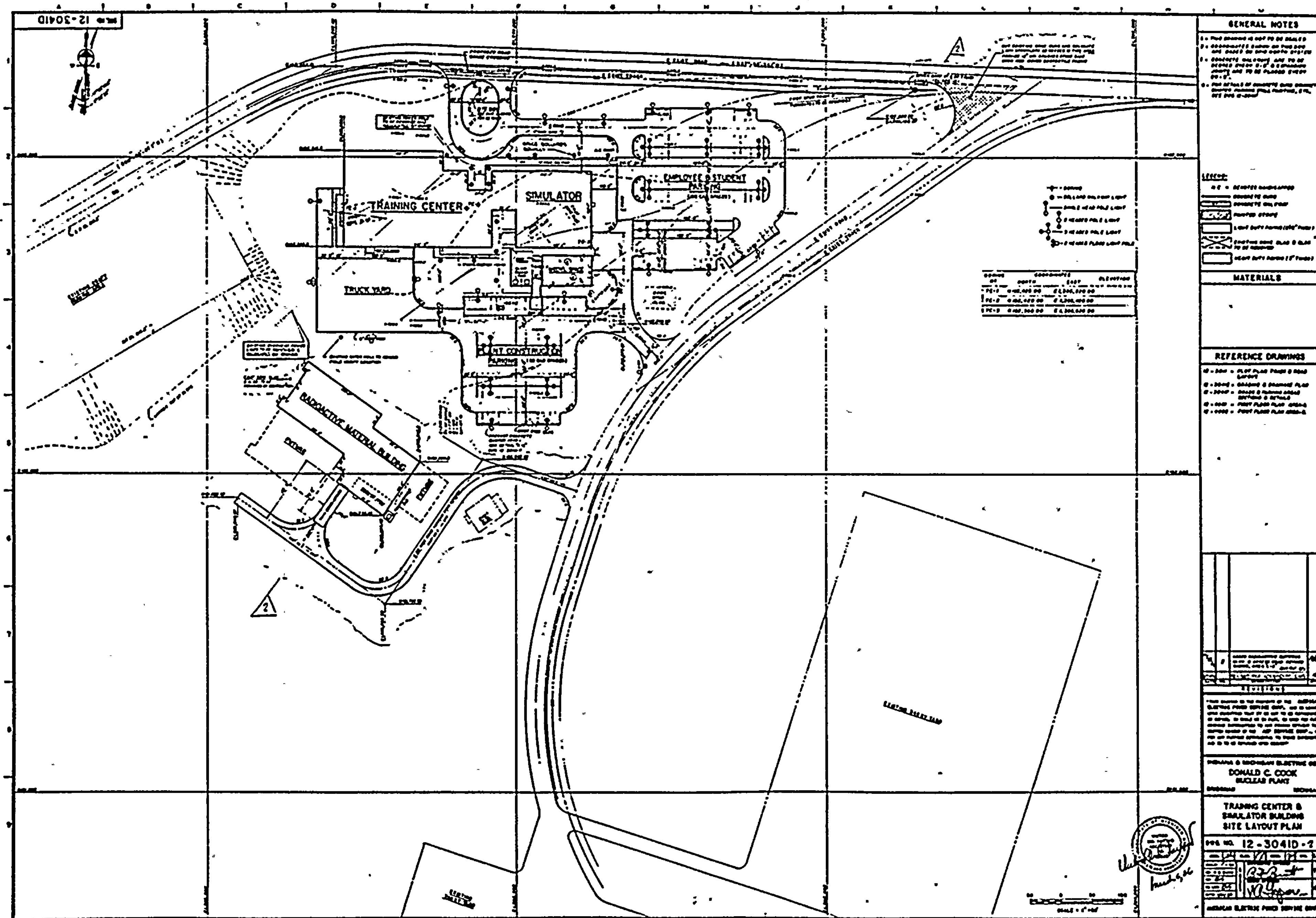

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AMERICAN ELECTRIC POWER

Date September 24, 1991

Subject Environmental Assessment of Plant Modification 12-PM-1158; Installation of New Anchor Bolts for the Circulating Water Intake Structures Collapsible Racks

From R. M. Claes

To 12-PM-1158 Packet
Radiological Support Section File DC-RS-7915

Pursuant to Radiological Support Section Procedure RS-34, the purpose of this memo is to document that there is no need to perform an Environmental Evaluation of the installation of new anchorage bolts for the circulating water intake structures collapsible racks as delineated in Plant Modification 12-PM-1158.

Plant modification 12-PM-1158 proposes to install new bolts to secure the collapsible racks to the circulating water intake. The racks were collapsing prematurely due to the cycle loading effects of lake surges and currents. This permitted rocks and other debris to enter the intake pipeline and screenhouse intake forebay. Accumulation of debris affects flow in the pipeline and impacts the operation of the travelling screens. Specifically, the proposed modification includes replacing the existing 1/4" A307 bolts with 7/16" A307, Grade B bolts. This modification should not diminish the screens intended capabilities as detailed in 12-PM-1158 Safety Review Packet.

Because the premise of the project merely replaces undersized bolts and associated reinforcements that have been accounted for in the Final Environmental Statement with larger bolts of the same type and composition, there should be no significant environmental impact associated with this activity.

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 described project should pose no adverse affects on the environment and will, in all practicality, serve as an enhancement to the system. From the scope and responsibility of the Radiological Support Section, an Environmental Evaluation is not required and the project as herein described may proceed as planned.

Prepared by: [signature]
Robert M. Claes, Radiological Support Section

Approved by: [signature] for
Dane R. Williams, Manager, Radiological Support Section

Concurance by: [signature] for SJB
Steven J. Brewer, Manager, Nuclear Safety and Licensing

cc: K. Tamms
T. Zelina
D. Fitzderald

AEP
AMERICAN ELECTRIC POWER

Date October 22, 1991

Subject Environmental Evaluation for 12-PM-1000, Revision and Upgrade of the Yard Drainage System

From R. M. Claes

To 12-PM-1000 Package
Radiological Support Section File DC-RS-7915

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 revision of the yard drainage system as described in 12-PM-1000.

With the recent additions of the new guard house, training center, and paved lots, the current yard drainage system is overloaded during heavy and seasonal precipitation. The system requires this upgrade to prevent frequent localized flooding during these events. A cursory review by Mechanical Design Plumbing identified some problem areas, subsequent to which 12-PM-641 was issued. The proposed activity will upgrade the 15" diameter line from catch basins "AL to "F"and the line from catch basins "U-3" to "F". In addition, the proposed activity will add two new drainage lines to the system. One line will extend from the North East corner of the Unit 1 Turbine Building to catch basin "AM" and the other will extend from the Unit 1 Turbine Building near the overhead door to catch basin "202". These segments of the yard drainage system are confined within the boundaries of the protected area. The new drainage lines will traverse previously disturbed ecologies and existing structures. (See attached drawing, SK-1)

As the proposed activity involves an area previously disturbed and evaluated for, there would be no further significant associated environmental impacts. The proposed activity will serve as a site enhancement by reducing the potential for soil erosion and any additional detriment to the dunes area. 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-1000 may proceed.

Approved by: [signature] 10/23/91
D. R. Williams, Manager, Radiological Support Section

Concurrence By: [signature]
~~Nuclear Safety and Licensing~~

Intra-System

APPENDIX IV

HERBICIDE APPLICATION REPORT

1991

AEP
INDIANA
MICHIGAN
POWER

Date February 11, 1992

Subject 1991 Herbicide Spray Report - Cook Nuclear Plant

From S. R. Watkins

To H. E. Brooks

SUMMARY OF PROGRAM

From April 22-May 1, 1991, Townsend Tree Service applied a mixture of Karmex, Amizine and Oust to control grass and weed growth on the plant site.

A total of 48 lbs. of Karmex, 560 lbs. of Amizine and 2 lbs. of Oust was applied over 36 acres.

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

1. Sewage Ponds:
   Weeds are growing on the sides of both sewage ponds. The herbicides were applied only to the water's edge.

2. Road to absorption pond:
   No weeds found.

3. 765 KV Switchgear Yard:
   Sparse patches of grass growing throughout yard. Perimeter fence is clear of grass and weeds.

4. 345 KV Switchgear Yard:
   Sparse patches of grass growing throughout yard. Perimeter fence is clear of grass and weeds.

5. Railroad Tracks east of Training Center:
   Good weed control.

6. Parking Lot B:
   Patches of grass growing along the east fence.

7. 69 KV Switchgear Yard:
   No grass or weeds growing in the yard or along the fence.

8. North Protected Area Fence:
   Good weed control.

9. South Protected Area Fence:
   Weeds growing along fence.

10. East Protected Area Fence:
    Weeds growing along the fence.

11. ICMS Office Trailer:
    Good weed control. No weeds found at all.

12. ICMS Fab Shop:
    Moderate weed control, weeds growing around building.

13. Southwest Side of Turbine Building:
    Good weed control. No weeds found at all.

14. South End of Turbine Building:
    Moderate weed control. Patches of weeds growing throughout the area.

15. Unit 1 RWST Area: Moderate weed control. Sparse patches of weeds growing.

16. Unit 2 RWST Area: Moderate weed control. Patches of growing weeds throughout the area.

17. Hydrogen/Nitrogen Storage Tank Area:
    Moderate weed control. Sparse patches of weeds growing in area.

18. Construction Fab Shop:
    Grass is growing on north and west sides of the building.

19. Road to Met Towers:
    Patches of weeds on the road. Gravel along access road - no weeds found.

Based on our review of 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 1992 treatment program:

Barrel and Scrap Metal Yards

Fire Protection Training Area

South Guard House Portal

CESA

East Sewage Plant

South Sewage Plant

Site Design Building

Contractors Trailer Complex

Met Tower Building

Air Stations

Environmental Warehouse

Environmental Polebarn

Please ensure that the 1992 contract takes into consideration these additional areas.

/js

c: D. M. Fitzgerald

APPENDIX V

MACROFOULER MONITORING PROGRAM

1991

INDIANA MICHIGAN POWER COMPANY

Cook Nuclear Plant

1991 Zebra Mussel and Asiatic Clam Monitoring and Control Report

April 8, 1992

Since 1982, Cook Nuclear Plant has had in place a macrofouler monitoring program to detect the presence of asiatic clams. In 1990, a program was instituted to detect the presence of zebra mussels (Dreissena polymorpha) as well as asiatic clams. By late 1990, zebra mussel populations on the walls and structures in the Screenhouse intake forebay were estimated to be 100 individuals per square meter. In 1991, a population explosion of zebra mussels was noted in the Screenhouse intake forebays and offshore intake structures. Densities were measured between 180,000 to 200,000 individuals per square meter. A report on the bio-monitoring studies by Environmental Resources Management (ERM) is attached.

ERADICATION AND CONTROL MEASURES

A joint plant/corporate task force was formed in late 1990 to develop a zebra mussel eradication/control plan which was implemented in 1991. This program centered around targeted treatments to the Circulating Water, Essential Service Water and Non-Essential Service water systems with a proprietary molluscicide (Betz Clam-trol, CT-1) for control of juveniles and adults, followed by intermittent chlorination treatments using sodium hypochlorite to control veliger settlement. The Fire Protection system was given periodic treatments of Clam-trol but not treated with chlorine.

CLAM-TROL TREATMENT RESULTS

Essential Service Water System (ESW)

The ESW System was treated with Clam-trol at a concentration of 10-15 ppm for 24 hours from 4/4 to 4/5/91. Critical heat exchangers that received the treatment included the Unit #1 and #2 Component Cooling Water, Containment Spray, and Diesel Generator heat exchangers. The critical piping from ESW to Auxilliary Feedwater also received treatment. Bio-box mortality results ranged from 84-100%.

Non-Essential Service Water System (NESW)

The NESW System was treated with Clam-trol at a concentration of 15 ppm for 24 hours from 4/10 to 4/11/91. Bio-box mortality results ranged from 81-100%.

Fire Protection System

The plant's Fire Protection system was flushed with Clam-trol at approximately 6 week intervals from April to November with a target feed of 15 ppm Clam-trol. When mortality studies were performed, bio-box results were 100% in all flushes.

Circulating Water System

The Circulating Water system was treated with Clam-trol which was fed at the offshore intake structures at a concentration of 15 ppm for 12 hours from 9/13 to 9/14/91. Bio-box mortality results were 99%. Though not targeted during the treatment, sufficient Clam-trol residuals were achieved in the ESW and NESW systems. Diver assessment of the zebra mussel mortality in the intake forebay of 99% compared favorably to the Circulating Water bio-box results. Diver assessment of mortality in the first 350 ft. of travel from the structures inward in the plant's center intake pipeline averaged 40%. This could be attributed to inadequate mixing of chemical within the first 350 ft. of travel in the 2,250 ft. pipeline. It is interesting to note that those zebra mussels which survived the treatment both in the intake forebay and pipeline were at least 3/4" or longer in length.

CHLORINATION TREATMENT RESULTS

In 1991, the ESW and NESW systems received daily intermittent sodium hypochlorite treatments of 1.5-2.0 ppm total residual chlorine (TRC) for 155 minutes from May thru mid-October. During the same period, the Circulating Water system received daily intermittent sodium hypochlorite treatments of 0.2 ppm (TRC). A temporary feed system was used to deliver the sodium hypochlorite while a permanent feed system was being designed and constructed. This permanent sodium hypochlorite feed system will be operational in 1992. Monitoring of artificial substrates in side-stream monitors placed within the ESW and NESW systems revealed that the chlorination program was effective in reducing zebra mussel settlement within these systems by approximately 95% downstream of the pump inlets. This was confirmed by visual inspections of heat exchangers within these systems.

CONCLUSION

Shock treatments by 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 for controlling macrofouling in the Cook Plant raw water systems. Capital upgrades to improve the delivery and dispersal of molluscicides in 1992 along with the construction of dedicated fire protection water tanks (1993) will further minimize the risks associated with macrofouling in the plant. The plant will also utilize mechanical cleaning during unit outages in 1992 to control infestation. 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.

MOLLUSC BIOFOULING MONITORING AT THE DONALD C. COOK NUCLEAR PLANT DURING 1991

April 1992

Robert L. Dwyer, Ph.D.
Project Manager

Christine Blundell
Project Scientist

Prepared for:

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio

Prepared by:

Environmental Resources Management, Inc.
116 Defense Highway, Suite 300
Annapolis, Maryland

The ERM Group

SECTION 1
INTRODUCTION

1.1 Background

Indiana Michigan Power Company (I&M), a wholly owned subsidiary of the American Electric Power Service Corporation (AEP), owns and operates, under license from the Nuclear Regulatory Commission (NRC), the Donald C. Cook Nuclear Plant. The NRC issued IE Bulletin 81-03 regarding Asiatic clam (*Corbicula fluminea*) biofouling in 1981 and IE Notice 89-13 regarding zebra mussel (*Dreissena polymorpha*) biofouling in 1989. I&M and AEP responded to the NRC on both occasions that monitoring programs would be conducted to detect the presence of either of these bivalve molluscs. The Asiatic clam monitoring began in 1982 and the zebra mussel monitoring in 1990. Asiatic clams had caused biofouling problems at a number of power plants, prompting NRC to issue IE Bulletin 81-03. Only about a dozen Asiatic clam shells and shell fragments have been found at the Cook Plant since monitoring began in 1982.

The zebra mussel, indigenous to Europe and Asia, entered the Great Lakes probably as a result of ship traffic. Since being introduced to the Great Lakes in the mid-1980s, zebra mussels have caused serious biofouling problems at a number of water intakes. Zebra mussels were first found at the Cook Plant in 1990.

In September, 1990, AEP contracted with Environmental Resources Management, Inc. (ERM) to undertake an abbreviated monitoring program beginning in October 1990. Some qualitative evidence of the presence of both the zebra mussel and the asiatic clam was found in water systems within the Cook Nuclear Plant, but the late initiation of the program in the first year of monitoring prevented a systematic assessment of the abundance and distribution of the organisms (ERM, 1990).

1.2 1991 Objectives

ERM initiated a second year of monitoring in July 1991. The objectives of the 1991 monitoring program were to complete

the following tasks:

- Task 1: Circulating and Service Water Sampling - intensive daily sampling over four weeks for the presence of planktonic veliger stages of the zebra mussel.
- Task 2: Fire Protection Sampling - sampling of one fire hydrant monthly from July through November for the presence of adults or shells.
- Task 3: Artificial Substrates - deployment of quantitative artificial substrates in the intake forebay and in locations in the essential and nonessential service water systems in the plant, and sampling of these locations at 3-week and 6-week intervals.
- Task 4: Beach Walk Sampling - monthly qualitative examination of hard substrates along the Lake Michigan shore for the presence of attached adults.
- Task 5: Inspection Sampling Analyses - analysis of up to six samples collected by plant personnel.

SECTION 2
METHODS AND PROCEDURES

2.1 Circulating and Service Water Sampling

The circulating and service water sampling occurred over a four-week period between July 17 and August 13. Samples were collected from the intake forebay and from the Essential Service Water (ESW) and Non-essential Service water (NESW) systems. A total of 16 samples at each of three locations were collected and counted. Each sample consisted of a 24-hour sampling of flow; a 24-hour sample would integrate any diel periodicities or patchiness exhibited by the organisms in Lake Michigan and manifested in the intake circulating water supply.

ERM constructed two of the water sampling and filtration systems (see Appendix A).

The samples of circulating and service waters were collected by filtering a measured volume of water over 24 hours through a No. 20 plankton net. In the circulating water sampling, water volume was measured using a totalizing water meter that recorded the total amount of water discharged by the sampling apparatus. For the service water samples, periodic flow measurements, using bucket and stopwatch, were made during the 24-hour interval.

The fine mesh No. 20 plankton net is needed because the early life stages of zebra mussels and asiatic clams are very small, on the order of 70 to 80 µm. However, the fine mesh net also collected a large amount of extraneous material such as sediment entrained by the plant's pumps, zooplankton, and filamentous algae. Because of the large amounts of this material, it was necessary to use subsampling techniques. Enough multiple subsamples were taken (using a standard Stempfel plankton pipette) so that the plankton from at least 500-1000 liters of water were analyzed. The experience of Dr. Peter McCall (an expert on the population dynamics of the zebra mussel and a subcontractor on this project) and other zebra mussel researchers indicates that larval densities of less than 1-2 per 1000 liters are not accompanied by detectable adult fouling densities on hard substrates (Greenberg & McCall, 1991).

Samples were collected daily from each location, and generally counted live within 24 hours. Those that could not be counted within 24 hours were preserved in ethanol for later counting. Because of the large volumes of the filtered samples, all were subsampled using a Stempfel pipette to examine a series of 1 ml aliquots in a Sedgewick-Rafter cell, or 5 ml in a Circular Counting Chamber. Counting methods generally followed the provisional sampling methods recommended by Marsden (1991). Raw counts of the organism in the subsample(s) were multiplied by the concentrated volume of the sample, and then divided by the volume of water filtered by the apparatus, to yield the number of organisms per m^3 of water filtered.

In addition to direct quantitative counting, a semiquantitative method, differential settling through a dense sugar solution (Marsden 1991, pp. 11-12) was attempted. The method involves the addition of a plankton subsample to the top of the solution in a separatory pipette, and counting of the fast-settling veligers in an aliquot taken from the bottom of the separatory column. In practice, however, since all samples had varying amounts of sand and sediment drawn into the water by the system pumps, the rapidly settling sediment obscured the settling of any veligers, making the method ineffective for samples taken in the plant's water systems.

2.2 Fire Protection Sampling

The fire protection system was sampled using a No. 35 sieve to filter the first 10 minutes of hydrant flow during flow testing. The presence of any juvenile or adult Asiatic clams on the sieve indicates whether or not any of the organisms have in fact invaded the fire protection system and pose a danger to the safe operation of the plant. The contents of the sieve were decanted and examined at the site, or if time was not available, the sample was placed into a container of buffered formalin. Later, the entire contents would be examined under a dissecting microscope at low power to identify the presence of any organisms or shells.

Although sampling of fire hydrants was intended to be done monthly between July and November, plant management in practice prohibited the testing and flushing of any fire protection systems unless a molluscicide could also be

introduced with the replacement water drawn from Lake Michigan as a protective measure. This requirement reduced the number of times that fire protection sampling could be performed.

2.3 Artificial Substrates

In order to assess the rate of settling of zebra mussel larvae within the circulating and service water water systems, ERM deployed three artificial substrate samplers in the intake forebay area upstream of the trash racks and travelling screens. and two more in sidestream biomonitors on the Essential and Non-essential Service Water systems. The samplers were designed similar to those used by Peter Fraleigh of the University of Toronto (Marsden 1991). They consisted of cinder blocks containing test tube racks secured within the voids in the blocks. As settling surfaces, 24 microscope slides were secured to each test tube rack with rubber bands, and changed on a regular basis. Deployment of all the samplers followed approved I & M plant equipment installation procedures.

The artificial substrates within the samplers and biomonitors were examined every three weeks from July to November for settled molluscs. After visual examination, the devices were gently washed or brushed clean of molluscs in a bucket or tank, and replaced.

In addition, ERM also deployed and monitored artificial substrates in Lake Michigan (this was an out-of-scope activity, but was undertaken because ERM perceived the importance of interpreting in-plant mollusc abundances with respect to abundances in the lake near the intake structures as a baseline). A cinder block sampler was deployed on a three-week schedule from July until October using boat traffic to and from the dive barge moored near the intake structure on an as-available basis. The recovery of this sampler was discontinued in mid-October because of adverse weather conditions.

Two test tube racks were deployed in each cinder block holder at each location. One rack was recovered and replaced on a three-week cycle, while the second rack was recovered on a six-week cycle. The two deployment lengths were used in order to determine which deployment interval provided the best estimate of the sparse settlement rates expected during 1991.

Each rack held 24 microscope slides. After recovery, sample racks were placed in a water bath until the individual slides could be removed and counted under a dissecting microscope using 30-50X magnification. At low settling densities (less than 100 per slide), the whole area of one side of the slide (25 cm x 75 cm) was counted and the value multiplied by a conversion factor to estimate the number of settled organisms per square meter. At higher densities, five random 1 cm^2 subsamples were counted on each slide. The five subsamples were added, and multiplied by a conversion factor to calculate the number of settled organisms per m^2. These estimates were averaged for the 24 slides per rack to obtain the average settling density for each location and sampling interval.

2.4 Beach Walk Sampling

Beach walk sampling was conducted monthly from July to November. The major areas monitored were the beach adjacent to the plant, and the jetty and rock riprap at the mouth of the St. Joseph River in St. Joseph, Michigan. Localized areas where zebra mussels were likely to settle were identified in July. In order to maintain consistency, the same ERM scientist monitored the undersides of the same rocks in the areas over the duration of the project, with Dr. Peter McCall of Geo-Science Associates providing QA/QC for the examination on September 26, 1991 (see Section 2.6 below).

2.5 Inspection Sampling Analyses

Plant personnel submitted three samples taken in the plant for analysis. These consisted of shells, whole molluscs, and shell fragments. These samples were submitted to Cove Corporation, ERM's taxonomy subcontractor, for identification to the lowest practical taxon.

2.6 Quality Assurance/Quality Control (QA/QC) Procedures

Quality Assurance/Quality Control (QA/QC) continued to be an extremely important aspect of the program. Quality assurance was designed into the project at several points. Initially, all primary and backup ERM personnel were trained on site in proper methods for the collection, preservation, and storing of all samples. A standard operating procedure was adhered to on

a day-by-day basis by the personnel performing the sampling and by laboratory personnel processing the samples. After counting, all data were entered into spreadsheets for reduction. All spreadsheet algorithms were checked by two scientists, and data entries were compared to original data sheets for accuracy.

On September 26, 1991, Dr. Peter McCall of Geo-Science Associates, visited the Cook Nuclear Plant to conduct an independent audit of ERM's procedures. A copy of his report is attached as Appendix B.

During the circulating and service water sampling, the large amount of sediment in the samples and the presence of ostracods in the sample, made identification difficult. In order to confirm the identification of zebra mussel veligers in the sample, a fresh unpreserved sample was sent to Dr. Ellen Marsden, a taxonomist with the Illinois Natural History Survey, for confirmatory identification.

In addition, ten percent of all of the samples were split and were sent to another laboratory, Cove Corporation of Lusby, Maryland, for independent verification of both the counts and taxonomic identifications of the two individual organisms. However, the delicate veliger valves apparently deformed after preservation, and became curled up and clumped with the sediment in the samples. Despite prolonged efforts, Cove Corporation taxonomists were unable to obtain reliable counts. Subsequently, the effort was abandoned.

Finally, type specimens of individual species and individual life stages were preserved and permanently archived for later confirmation of species identifications, in order to ensure the quality of data submitted to the NRC.

SECTION 3
RESULTS

3.1 Circulating and Service Water Sampling

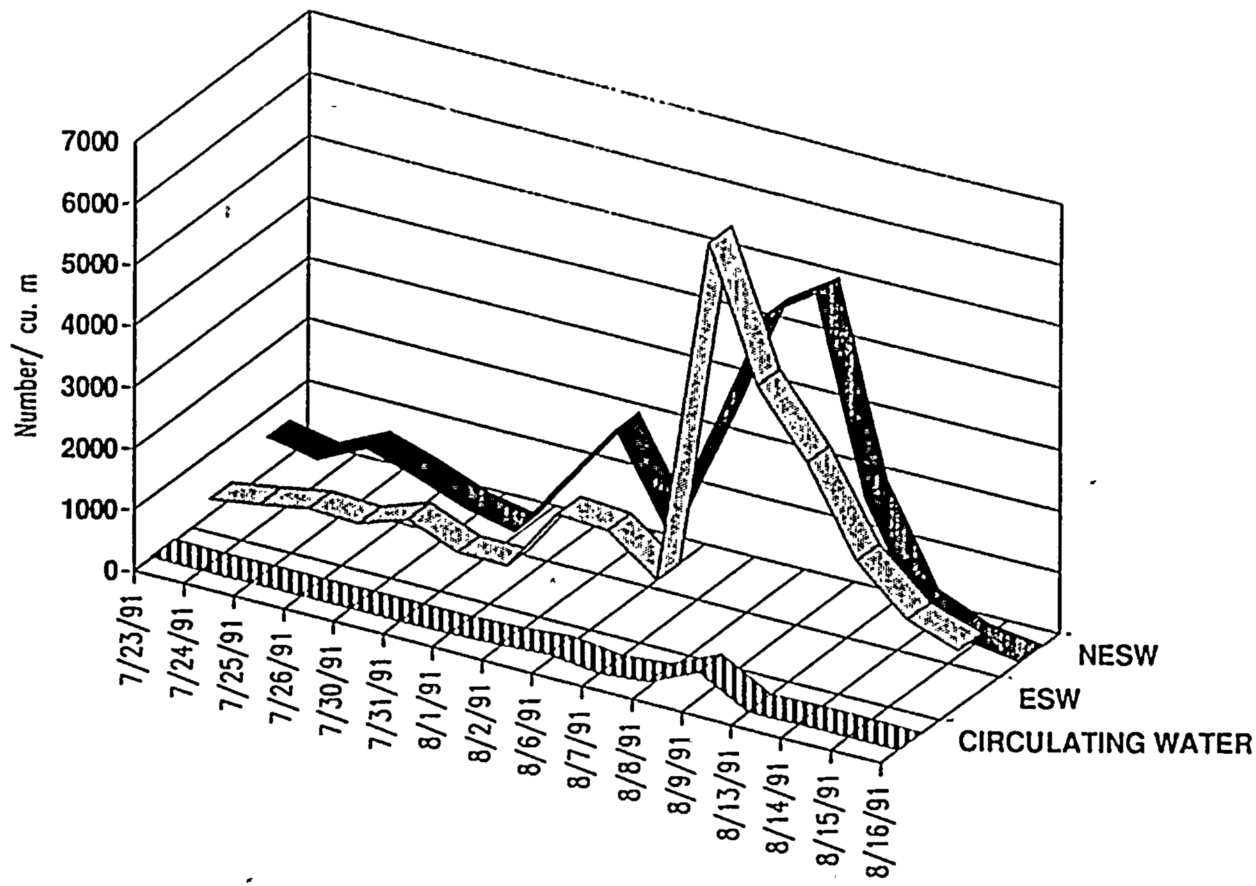
Sampling of planktonic veligers in the circulating and service water systems was begun on July 22 and completed on August 15. A total of 16 samples were taken in the circulating water intake (a pump apparatus withdrawing water from the intake forebay near Travelling Screen 1-1), the Non-Essential Service Water (NESW) system, and the Essential Service Water (ESW) system.

Sampling of the circulating water system was plagued by mechanical problems. The pump for the system had apparently been rebuilt over the previous winter, and its flow had been markedly increased over its 1990 operating flow. The new flow rate was about 150–230 L/min. This large flow rate, combined with the fine mesh size of the No. 20 net, caused frequent hydraulic overloading of the system's capacity. The hydraulic overloading of the net resulted in the bypass of water around the net and underestimates of the veliger density. High Flow velocities in the circulating water system also caused mechanical abrasion or tearing of the plankton net. This also bypassed unfiltered water around the net, causing underestimates of veliger densities. Because of these problems, the circulating water data must be interpreted with caution.

No apparent problems were observed during the ESW and NESW sampling.

The results of the sampling are presented in Figure 1. Both the ESW and NESW data show major peaks about August 8-9 with densities in excess of 5,000/m^3. Although no measurements of veliger densities in Lake Michigan were made as part of this monitoring program densities recorded elsewhere in southern Lake Michigan by other investigators were over 30,000/m^3 at about the same time (E. Marsden, pers. comm.). Densities in the circulating water system were always less than 1,000/m^3. The low densities in the circulating water samples may be the result of the low filtering efficiency of the circulating water sampler.

Figure 1 Veliger Densities



The service water results indicate that veliger densities in the systems are significant, and can probably result in dense attachment of adults, especially in areas of reduced flow in the system.

3.2 *Fire Protection System Sampling*

Four hydrants were sampled on September 25, 1991. The four hydrants were 2A, 11, 12, and 21.

Each hydrant was flushed for 10 minutes, with the discharge collected in a 208 L drum. The flows of the hydrants over the 10-minute discharge was estimated to be about 2000 to 4000 L. The discharge was sieved through a No. 35 benthos sieve and the material was examined under a dissecting microscope for the shells of the zebra mussel and the asiatic clam. In addition, water in the drum was sieved and examined for organisms.

No organisms were observed in any of the samples.

3.3 *Artificial Substrate Sampling*

3.3.1 *Lake Settling*

Substrates were deployed and recovered from Lake Michigan (a location about 100 m inshore of the intake structure) between July and mid-October (when the effort was suspended because of weather conditions). Settling densities varied between 5,000 and 311,000/m^2 (Table 1), with the peak occurring in August (i.e., settling in the weeks prior to the September 3 sampler recovery; Figure 2). These densities provide a baseline dataset against which the densities measured within the plant can be compared.

Length ranges of the settled adults are shown in Figure 3. In general, shells less than about 2 mm can be considered to have settled on the slides over the 3-week deployment interval. This is based on early growth rates of 0.6 to 0.9 mm/week. Conversely, larger organisms probably migrated onto the slide from adjacent substrates, and are obviously too old to have settled during the deployment interval.

Figure 2 Forebay and Lake Settling

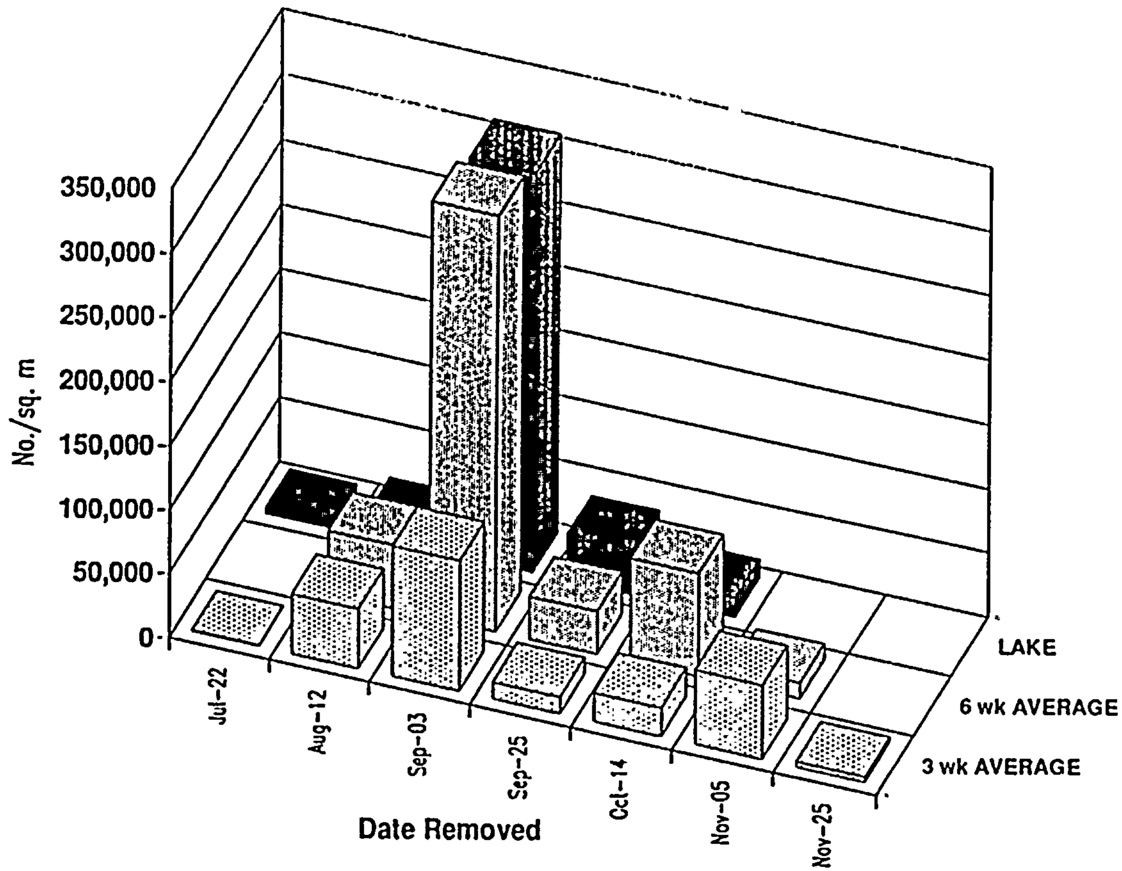
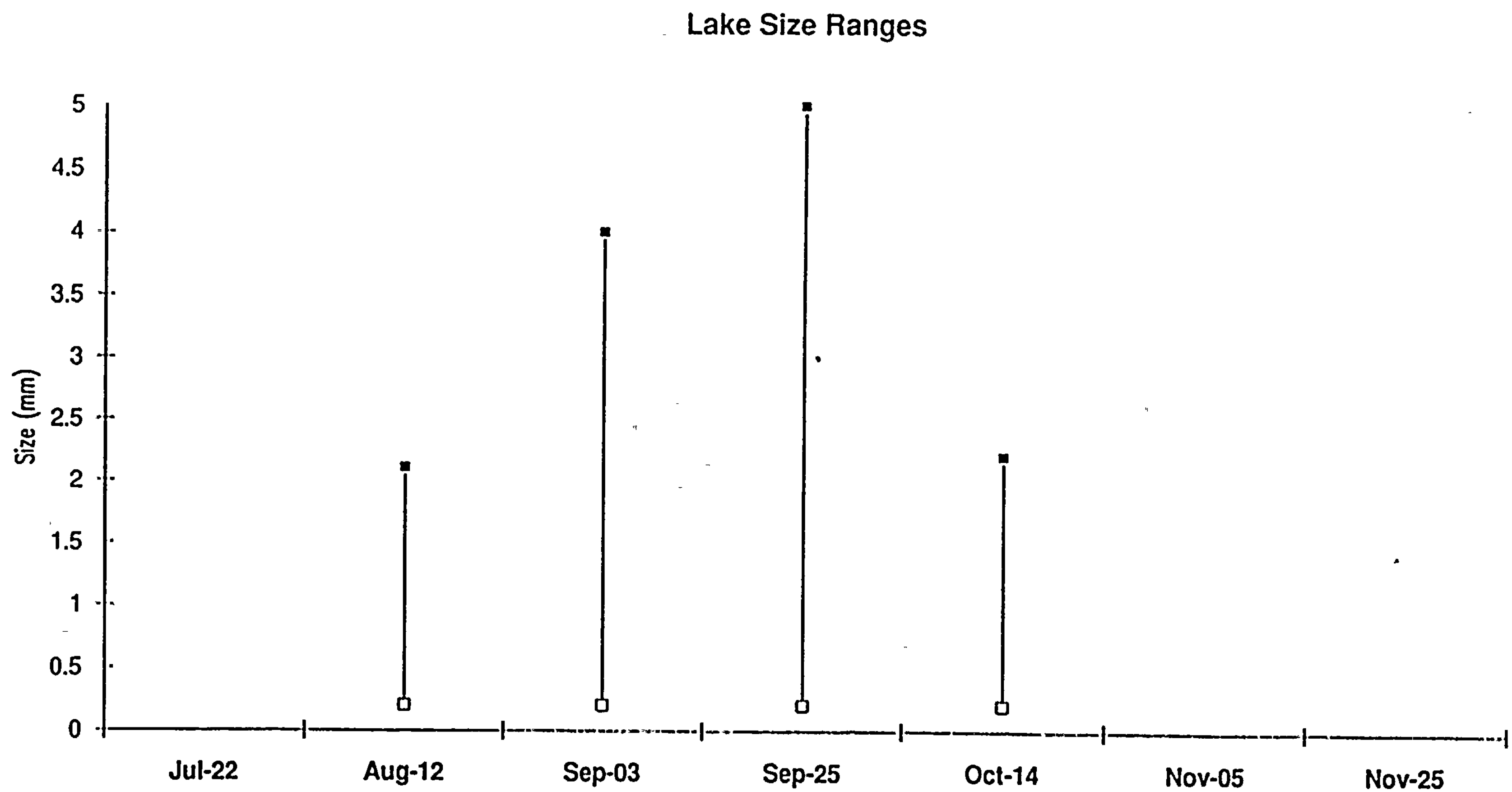


Figure 3


Lake Size Ranges
Size (mm)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jul-22
Aug-12
Sep-03
Sep-25
Oct-14
Nov-05
Nov-25

3.3.2 Forebay Settling

Settling rates for the average of the three forebay locations are also shown on Figure 2. Both the 3-week and 6-week deployment show similar patterns, with a peak that corresponds to the peak lake settling, and the peak abundance of veligers in plankton sampling (Fig. 1).

The averages of the three forebay locations mask significant spatial differences (Figure 4).

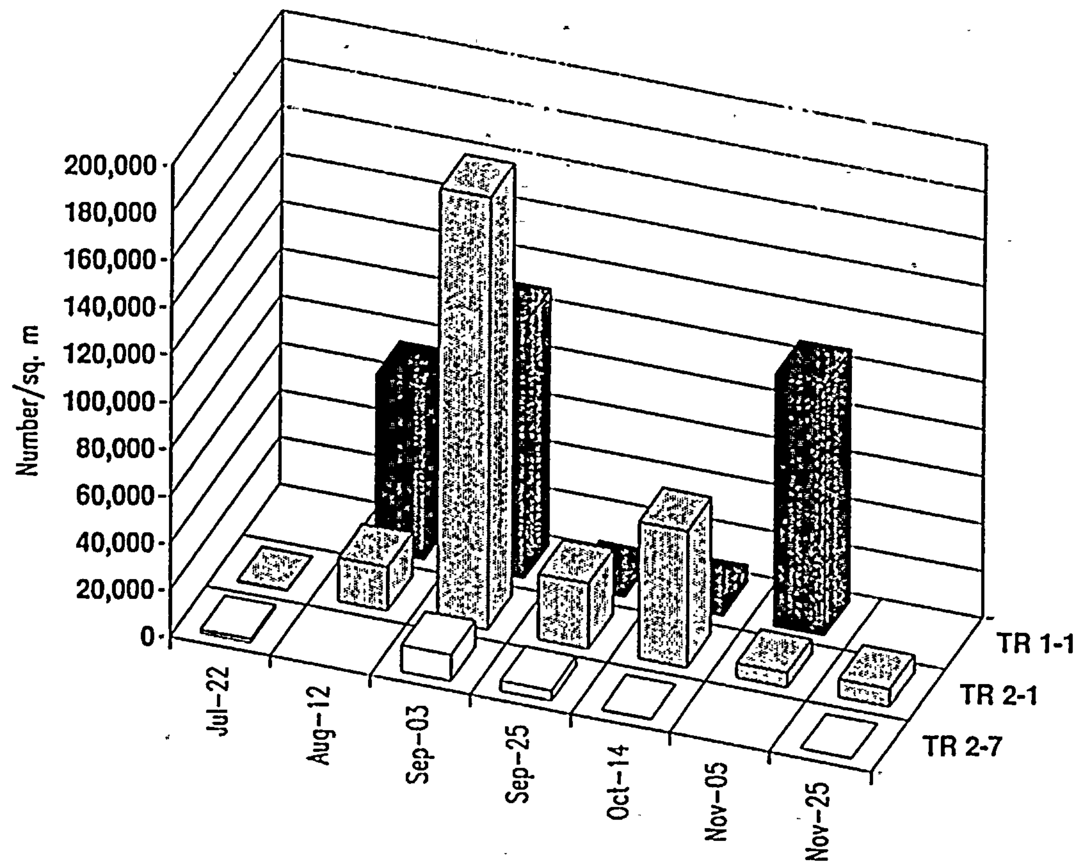
3.3.3 Service Water Settling

Zebra mussel settling rates in the service water systems are presented in Figure 5, with the lake settling rate data also presented for comparison. Note that the lake settling rates for September 3 and September 25 have been truncated on the figure in order to expand the scale for the service water samples; actual settling in the lake was 311.333/m^2 on September 2, and 36,155 on September 25.

In the service water systems, settling rates dropped dramatically after the deployment recovered on September 25. Some of the decrease is attributable to decreased spawning of the organism as water temperatures decreased in the fall. However, significant settling rates were still observed on the forebay substrates after September 25, indicating that the organism was still capable of settling.

Another contributor to the decreased counts in the service water systems was due to clogging of the sidestream ports feeding the biomonitors on the two systems. Based on material found in the bottom of the biomonitors, it appeared that sand and other sediment were significant sources of clogging material. However, it was also not possible to rule out biofouling by attached zebra mussels in the systems as contributors to the flow reduction, since at that time the systems had not been opened for visual inspection. Because of the flow reduction due to sediment and debris restricting flow in the sample line, ESW and NESW settling data after September 25 should be treated qualitatively. Absence of evidence of zebra mussel settling does not conclusively indicate that no zebra mussel settling is occurring in the service water systems. At the same time, the

Figure 4 Forebay Settling, by Location



presence of small, newly settled postveligers is an indication of potential settling within the systems.

Data for the ESW on November 25 did show an indication of recent settling. Small postveligers, about 0.5 mm in length. were observed on the artificial substrate on the Essential Service Water system. The presence of newly spawned mussels so late in the fall, when ambient water temperatures would be too low to permit lake populations to spawn, suggests that organisms somewhere inside the plant's water systems were finding favorable conditions for spawning and thus may serve as a continued source of settling organisms over the winter, or veligers spawned late in the normal spawning period in the lake may be maturing very slowly due to the cooler water temperatures.

3.3.4 Qualitative Effects of Biocide Treatments

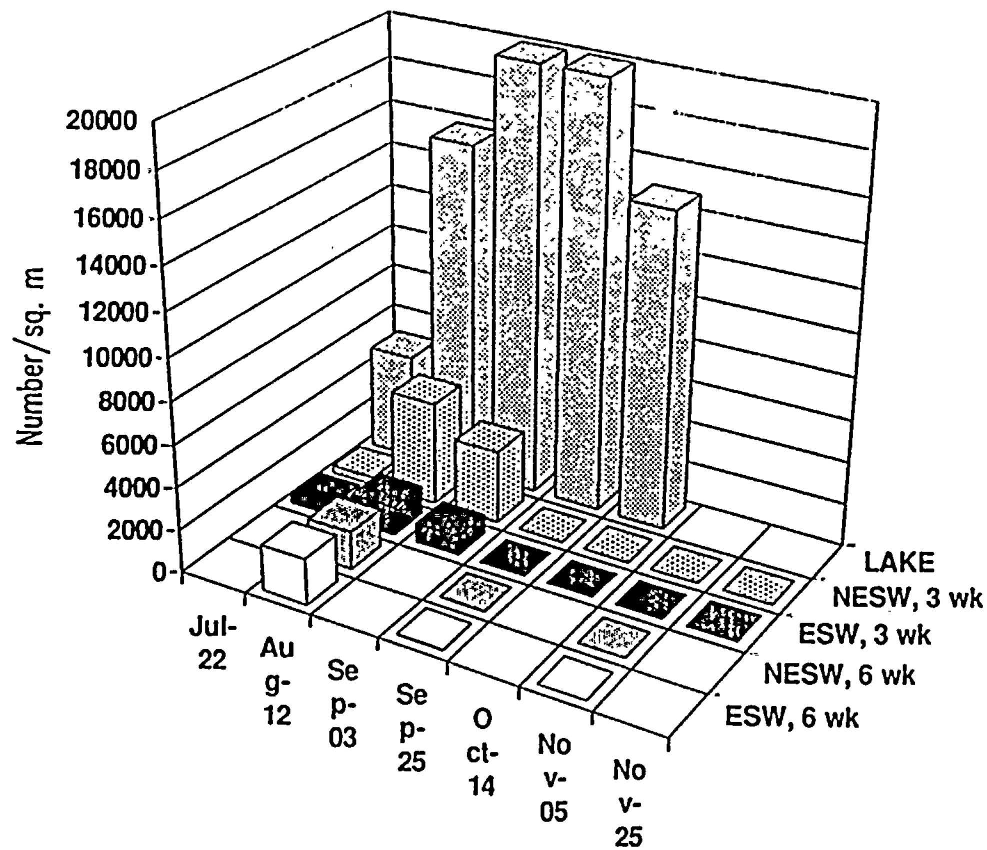
Two types of biocides were used to control the zebra mussel within the Cook Nuclear Plant. Chlorine, presently permitted under the facility's Michigan state discharge permit, was added to all systems beginning in April, and extending into November (E. Mallen, Pers. comm.). Although chlorine was added throughout the monitoring period of this project, the dosages were evidently not sufficient to completely control the settling of the zebra mussel, since mussels still settled throughout the plant. Plant personnel conducted inspections of heat exchangers and piping in the ESW and NESW systems and found no zebra mussels.

ClamTrol, a proprietary molluscicide, was added as a 12-hr treatment on September 13-14. Substrates recovered on September 25 showed marked decreases in settling (Figures 2, 4, and 5), and some of the subsequent settling rates increased. This may be an indication of at least a temporary period of effectiveness for this pulse treatment.

3.4 Beach Walk Sampling

Beach walk analyses were conducted from July to November. Two primary locations were examined on a regular basis. The first location is the beach adjacent to the Cook Nuclear Plant. Since there is little hard substrate present on this beach, the type of substrate required for successful settlement of zebra

Figure 5 Service Water Lake Settling



Note: Lake settling data truncated at 20,000 for clarity

mussel post-veligers, the beach examination focused on searching for loose shells, or shells attached to loose stones or other debris. The second location is an area of limestone riprap along the south side of the south jetty at the mouth of the St. Joseph River in St. Joseph.

On July 2, a 500 meter reach of the beach near the plant was walked. No zebra mussels or asiatic clams were observed.

On July 30, the beach was again walked, but no organisms were observed. On August 1, the St. Joseph jetty was examined. Zebra mussels were observed in crypts in the rocks in densities up to about 5 or 6 per cm^2. Sizes ranged from 700 μm to 3mm.

On August 14, the beach near the plant was examined, but no organisms were observed. At the St. Joseph jetty, zebra mussels in the same locations as seen on August 1 were observed in slightly increased densities (zero to 8-10 per cm^2). No appreciable increase in size was observed.

On September 26, Christine Blundell of ERM, accompanied by Dr. Peter McCall of Geo-Science Associates, Inc., examined both locations. On the beach, a large log about 300 m south of the plant revealed some zebra mussels, averaging 4mm in length, with the largest at 8 mm. At the St. Joseph jetty, the mussels averaged 5 mm in length, and the largest were 8 mm. Qualitatively, about 200 mussels covered a 20 x 25 cm rock.

Dr. McCall made recommendations to systematize the beach walk analyses; these are presented in his audit report (Appendix B). The recommendations were followed in subsequent beach walks.

On October 16, rocks north of the steel pilings by the plant revealed the sparse presence of zebra mussels, averaging 8 mm in length. At the St. Joseph jetty, mussels remained relatively rare, with the largest up to 1 cm in length.

On November 26, mussels were not observed on the rocks by the steel pilings, and may have been dislodged by the heavy surf during the preceding weeks. Drift wood on the beach revealed rare mussels, averaging 8 mm in length. At the St. Joseph jetty, mussel abundances decreased relative to summer densities, but the survivors averaged 1 cm in length.

The beach walk examinations, although necessarily qualitative in nature because of the irregular nature of the sparse hard substrate, did reveal valuable information. First, zebra mussels were observed beginning in late July. In the future, the zebra mussel will likely be a ubiquitous presence in the southern portion of Lake Michigan. The data also indicate that the mussels appeared to settle mainly on protected surfaces like the undersides or crypts of rocks. This would imply that areas of low flow or dead spots in the plant (e.g., the forebay area between Units 1 and 2) may experience the greatest fouling.

3.5 Inspection Samples

Three inspection samples were collected by plant personnel and shipped to ERM for taxonomic analysis. Results of the inspection sampling analyses are presented in Appendix C.

SECTION 4
DISCUSSION AND CONCLUSIONS

The results of the 1991 sampling of veliger densities in the circulating and service water systems, and adult settling rates in the same locations, clearly demonstrate the invasion of the zebra mussel in large numbers, relative to 1990 observations. Veliger densities in the service water systems (to some extent an indicator of planktonic veliger abundances in the nearby lake) showed densities exceeding 5,000/m^3. Similarly, the settling of postveligers on artificial substrates in the forebay and in the service water systems exceeded 300,000/m^2, and mirrored settling rates measured in the lake near the intake structures.

The seasonal pattern of abundance is reflected in the data on settling. Significant settling was observed in the first samples in July, and continued through October. Afterwards, measurable settling was observed through the last samples in late March 1992. Two possible sources for these winter-settling mussels were postulated. This late settling could have been derived from residual veliger populations in the lake that had spawned there late in the natural spawning season and were developing slowly because of the low water temperatures. Alternatively, the veligers could have been spawned from spawning adult populations within the plant water systems. The data were not sufficient to allow a discrimination between these possible causes. In any case, the winter settling densities were low, and the possibility of a major biofouling event (sufficient to restrict plant flows) is considered remote.

SECTION 5
REFERENCES

Greenberg, A., and P. McCall. 1991. *Zebra mussel settling rates in municipal water supply intakes in southern Lake Erie.* 1991 International Zebra Mussel Conference, Toronto, Ont. Canada. February 1991.

Marsden, E. 1991. *Standard Sampling Protocols for Monitoring and Sampling Zebra Mussels.* Illinois Natural History Survey. Center for Aquatic Ecology, Zion, Illinois.

Appendix A

Directions for Construction of Plankton Collection Apparatus (for ESW and NESW Systems)

Directions for Assembling the Plankton Collector

The Plankton Collector is in three basic parts (Figure 1):

1. Top steel frame assembly
2. Bottom steel frame assembly with roller dolly
3. 55 gallon polyurethane can with 3 inch side drain

(*Note:* Package contains two full assemblies plus a box with wheels, nuts, screws and tools. Read through each step before proceeding to assemble.)

Step 1 Steel Frame Assembly

a) Lay top and bottom steel assembly on their sides.

b) Place the wheels in using the pins provided.

Note: On one steel bar on both the top and bottom sections, there are white lines; make sure that they line up. Each set of frames is uniquely fitted to each other. There is duck tape on the white marked pieces of one set.

Step 2 Attach the Top and Bottom Sections

a) Place the bottom bar on the inner side and the top bar on the ou (Figure 2).

b) Attach <u>3 sets of bars only</u>!

c) Turn assembly upright.

Step 3 Fit 55 Gallon Can into Steel Assembly

a) Place the 55 gallon can into the steel assembly through the opening by pushing the unattached bars aside.

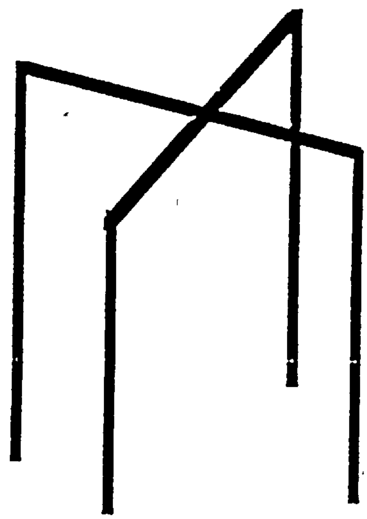
b) Once the can is in the steel assembly, pull out on each bar so that the bottom bar clears the top of the can (Figure 3).

c) Attach the fourth set of bars with two screws and nuts. Place the top screw in first and tighten. Then place the bottom in and tighten.

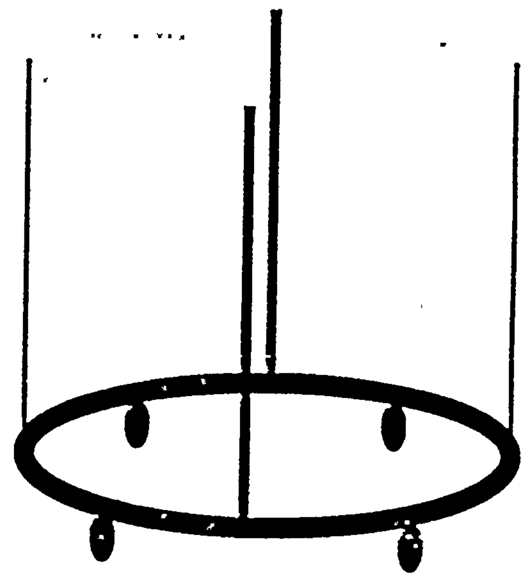
d) Once the can is in place and all the bars are attached, tighten all screws and nuts.

Figure 1 : Three Main Sections of the Plankton Collector

1. Top Steel FrameAssembly



2. Bottom Steel Frame Assembly with dolly



3. 55 Gallon Polyurethane Can with 3 inch drain

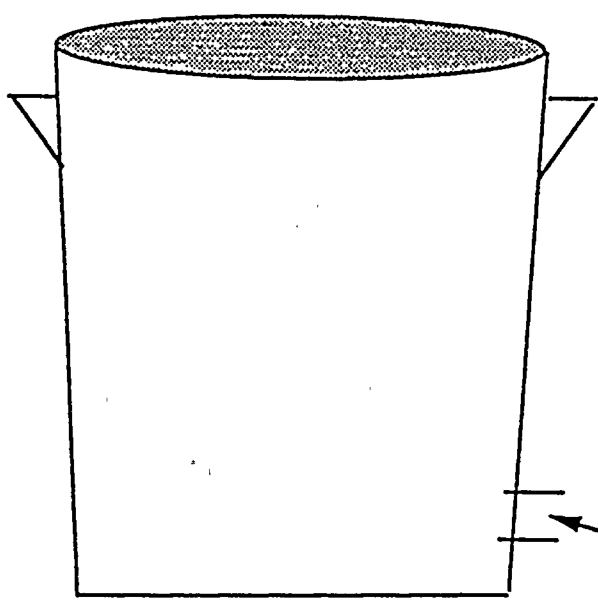


Figure 2: Attachment of the top and bottom steel assemblies

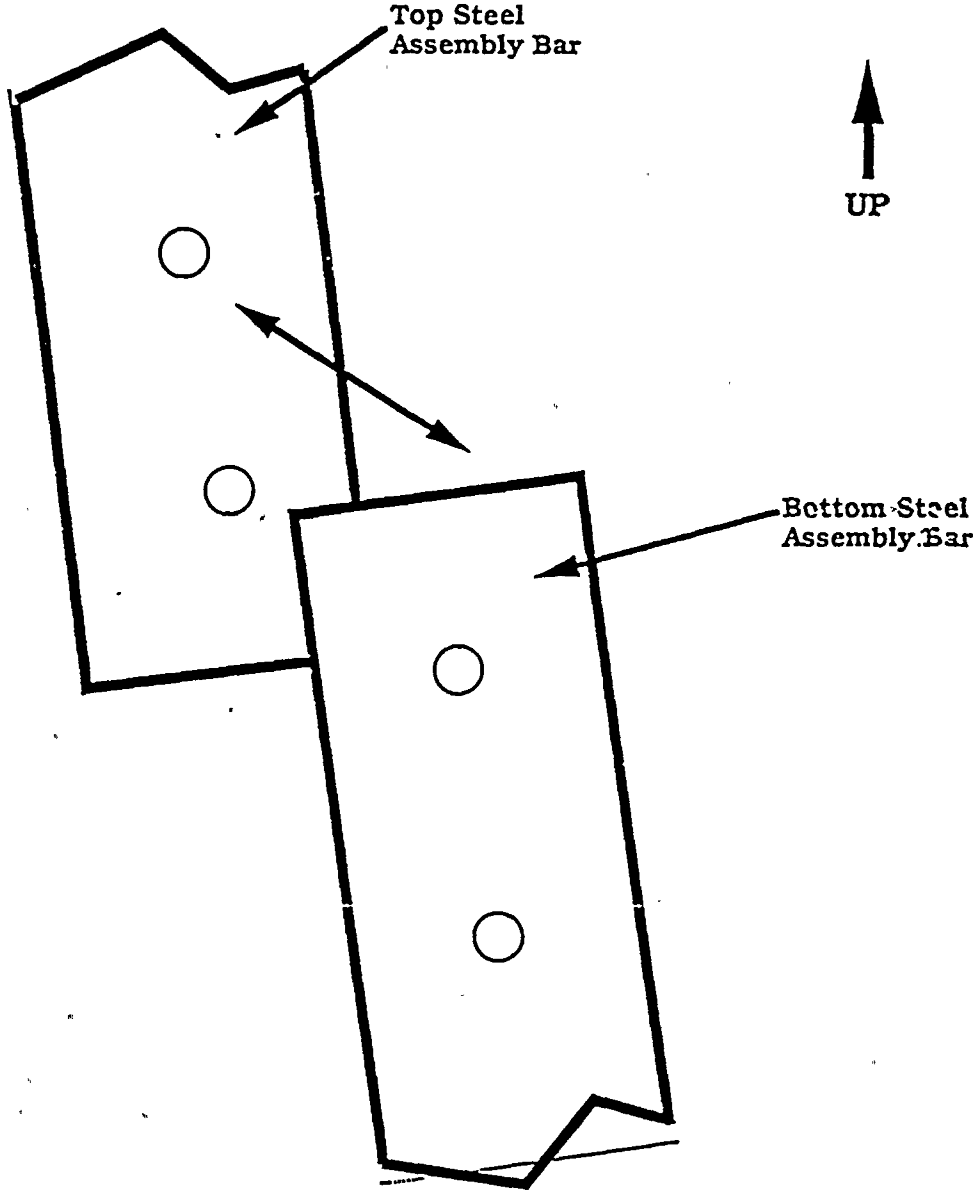
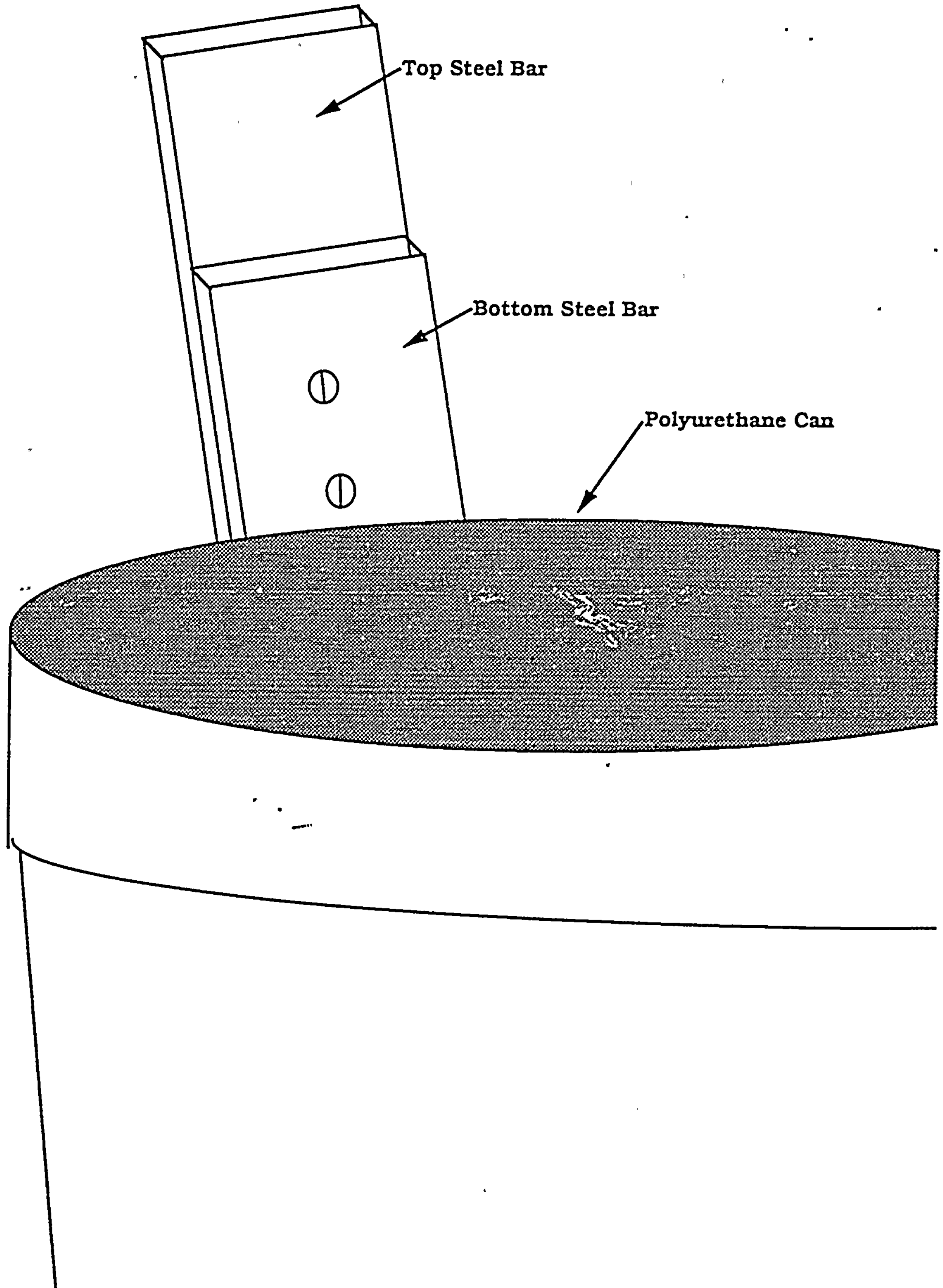


Figure 3: Fitting Can into the Steel Frame Assembly



Step 4 Attach the 6 Foot Drain Hose

a) Place one end of the 6 foot hose over the 3 inch bottom drain of the can (Figure 4 - Diagram A).

b) Attach 2 hose clamps marked "Drain Hose Clamps" as shown in Figure 4 - Diagram B. Tighten screws in clamps.

c) Check for leaking around the pipe drain before the plankton collector is in full operation. If it does leak, make sure that the clamps are tightened. If the leak develops around the pipe itself, there is a tube of pipe corking enclosed which can be used to stop pipe leaks.

Step 5 Attach Pipe Inlet

a) Using the 2 pipe clamps marked "Inlet Pipe Clamps", place them around the 2 inch PVC pipe and one of the top steel horizontal bars. The PVC pipes were taped inside one of the cans. The pipe will have to be placed to one side of the vertical steel bar (Figure 5).

b) Place the clamp closest to the vertical bar between the two screws that attach the top steel bar to the "L" bracket (Figure 5).

c) Tighten the clamp screws.

d) Use the clamps marked "Inlet Hose Clamps" to attach the inlet pipe to the inlet hose at the facility. Note that there is a small and large hose clamp for each set. There are two sizes so that if the larger clamp does not fit completely around the pipe and hose, use both clamps together to increase its size.

Step 6 Attach Plankton Net

a) Tie the strings from the plankton net to the "I" loop on the top center of the steel bars.

Figure 4: Drain Hose Connection

Diagram A

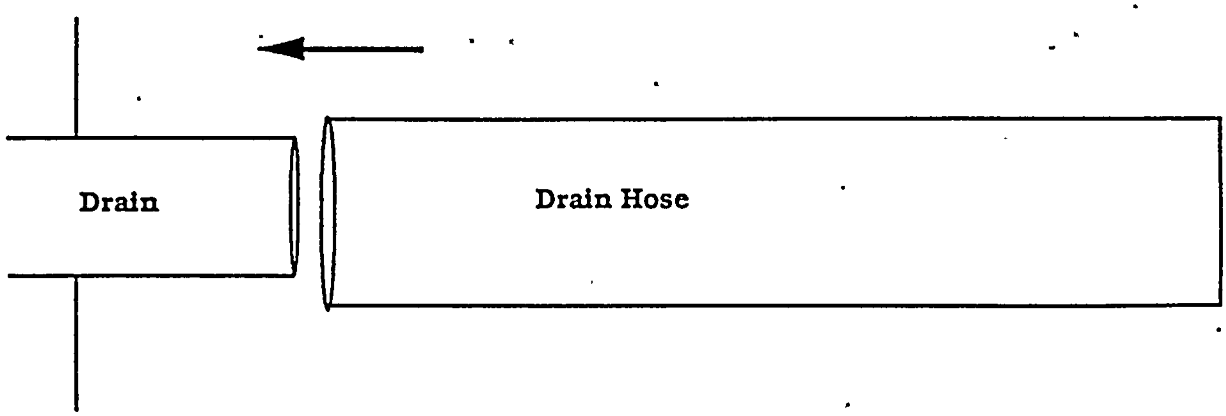


Diagram B

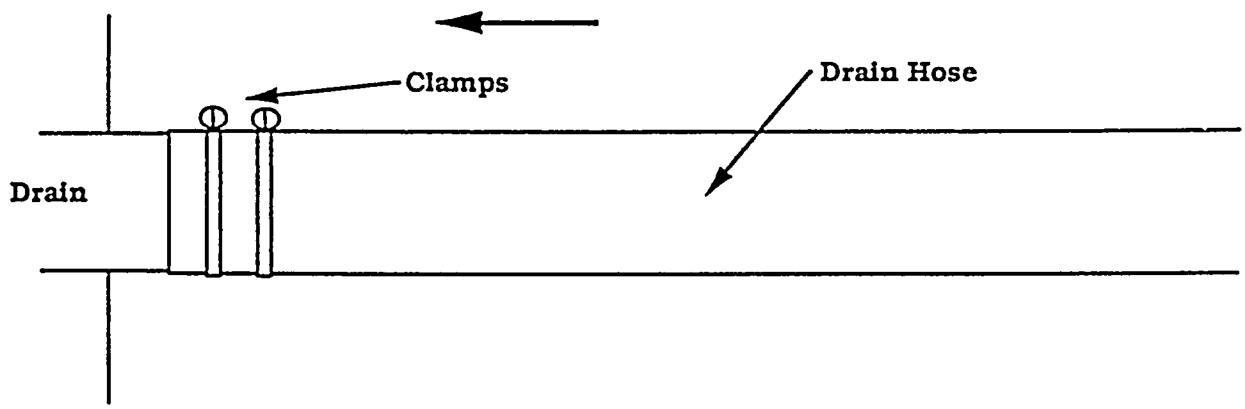
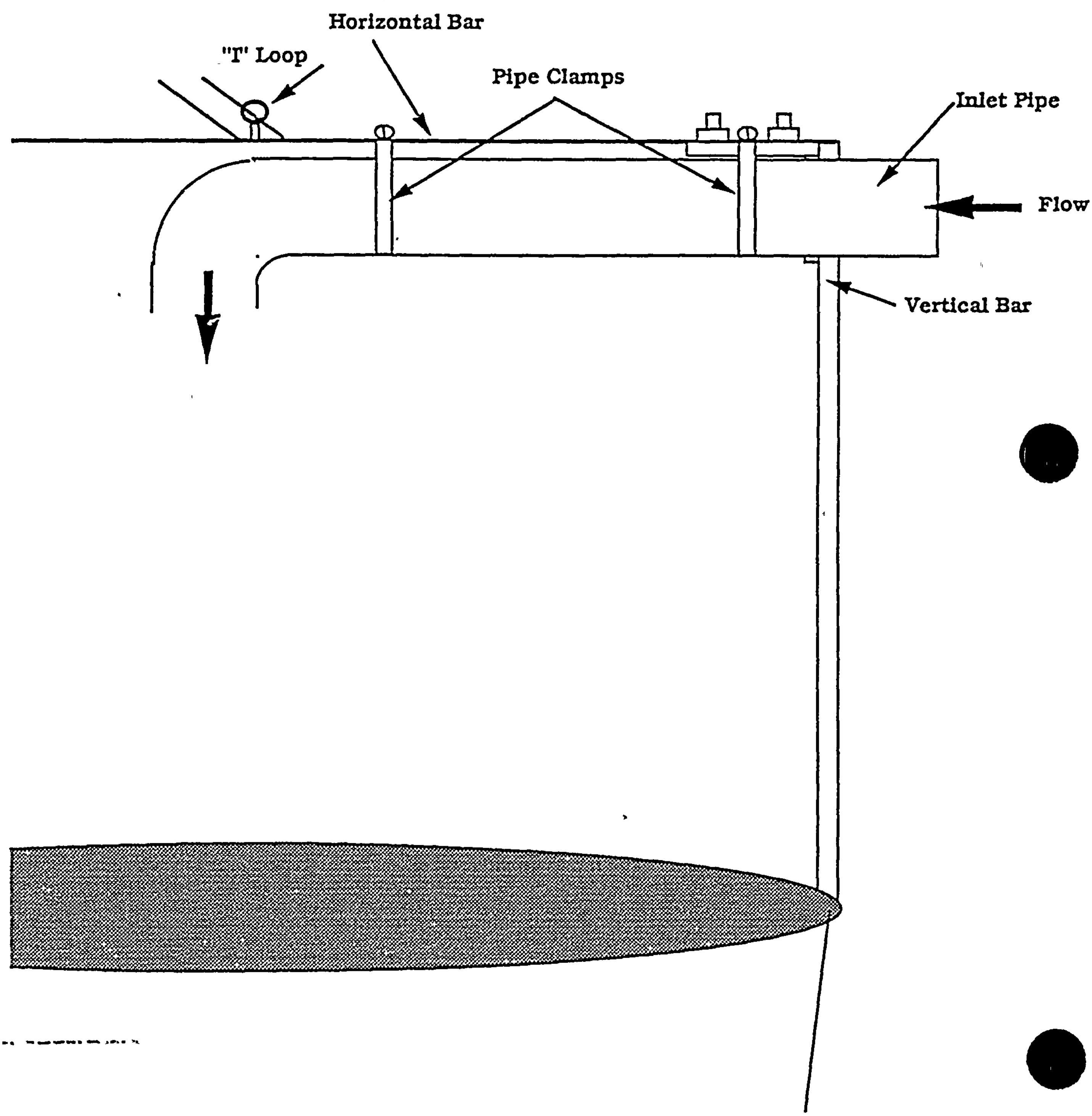


Figure 5: Inlet Pipe Attachment



Appendix B

Report on Cook Plant Quality Visit

prepared by
Peter McCall, Ph.D.
GeoScience Associates, Inc.

Report on Cook Power Plant Visit

I visited the Cook Nuclear Power Plant in Bridgman, Michigan on September 26, 1991 and met with Christine Blendel to review procedures used in the examination of zebra mussel distribution in and around the plant. Christine appears to be a competent, careful, conscientious worker who is doing a very good job.

Settlement Plate Procedures

The construction of the microscope slide plate holders is adequate. I was unable to see their operation in the field because all the plates had been pulled by the time that I arrived. The only potential difficulty I saw was that all the glass microscope slides appear to be oriented in the same direction in their holder, and this may or may not be the most efficient orientation to promote settlement. However, since quite large numbers of veligers are settling out on the slides this year, this is most likely not going to be a problem. It is important of course that in the absence of evidence concerning the effect of slide orientation all comparisons be made of slides with the same orientation.

Christine's counting is accurate, but it could be made more efficient. She counts entire slides when the total mussel population is less than 50, and counts 'randomly' selected portions of the slide when the population is more than 50. I agree with the procedure, but I have a few suggestions. The delineation and selection of counted regions should be regularized. I suggest gluing some graph paper with numbered square regions to the underside

of a petri dish, and putting the glass slide into the petri dish. Now the slide is easily regionated and can still be moved around for counting. A random number table should be used to pick the regions to be counted.

I think at least 100 individuals should be sized (unless you size them all – I neglected to discover this) per sampler to get good length-frequency histograms. Probably the first 100 individuals encountered should be selected for sizing to prevent bias. It is important to get Christine an ocular eyepiece micrometer for the dissecting scope. It is a large waste of time to pick individuals off the slide and place them onto your stage micrometer. These eyepiece inserts are pretty cheap. Fewer individuals can be counted – maybe 30 -- if all you want is a decent estimate of maximum and mean size.

With regard to size-age relations, I have told Christine the following based on observations of Lake Erie populations: 1) if you find mussels greater than 7 mm or so at the beginning of the summer, they are from an overwintering population; 2) during the first two months after settling, we find growth rates of 0.7-0.9 mm/wk; 3) this rate slows with time after settlement; 4) one year old individuals are commonly less than 20 mm maximum size; two year olds are commonly less than 30 mm; after this its difficult to say how old the individuals are axcept that they are 3+ years old. By the way, we find that the maximum size of individuals on the slides is about twice the mean size, which would mean that growth rates are linear over the sampling time (3 wks-2mos.), if we assume settling rate is constant. See if you find the same thing. Growth rates aren't really linear of course, but approximately piecewise linear over short time spans. I hope this is helpful for your age determinations.

Beach Walks

The weather was pretty awful for beach walks – gale force winds, 8-10 ' seas, 6' swells in the St. Joseph's river channel – but we got some things accomplished nevertheless. As before, there were no zebra mussels discovered in the immediate vicinity of the plant along the high water debris zone of the beach. We did find a 12' long 9 inch diameter log washed ashore about 200 yards south of the plant that did have mussels attached to one side of it (maximum size ~10mm). We did locate a new site adjacent to the plant property that is worth visiting on a regular basis . It is a rubble zone of boulders located just north of the steel sea wall on the north boundary of the plant's beach. There are some partially submerged boulders that provide a suitable substrate for settling. We couldn't get a close look at these rocks because of the high waves.

The rubble zone on the south side of the St. Joseph river mouth is a good location to examine mussel growth. As you know, there is a population of mussels there. The largest individual was 12 mm, which indicates that all have settled within the last few months. Coverage on the rocks is such that the use of meter square grids or point counts along linear transects to get percent cover are useless. The mussels are relatively few and crowded onto sheltered parts of rocks in cryptic habitats. The best technique I can suggest is a variation of what paleontologists sometimes do to estimate fossil abundance at rock outcrops: Search for a fixed time at a site (~30 minutes), estimate abundances, and use log abundances for comparisons. Maximum individual shell length can be measured and mean shell length can be estimated. A site like the St. Joseph River site south of the plant wouls be useful. I drove several miles south of the plant at the end of the day and searched the shoreline, but I found no good locations. I think we might have to go all the way to Michigan City to find a suitable

southern site at which to monitor in situ growth, unless there are some rivers with jetties at their mouths in between.

Plankton Work

We did no plankton work on this visit. The net was not available, and anyway, it would have been unsafe to use it in those seas.

Appendix C

Data Report on Taxonomy of Three Inspection Samples

prepared by
Cove Corporation
Lusby, MD

The ERM Group

SURVEY: ERM - DC Cook Plant DATE: Call 7/91 Page ___ of ___

STATION NO: ___ LOCATION: ___ DEPTH: ___

COMMENTS: counts are of dead shells

AREA:

TAXA	Replicate No. / Cove Corp No. / SPECIES CODE	25,906	25,907	25,908		
Dreissena polymorpha		6	9.5	2		
Corbicula fluminea			1	1		
Sphaeridae (not corbicula)		3	5			
Pleuroceridae			1			
Gastropoda (too eroded to ID)		1	4			
Planorbidae		1				

CC 25,906 = Bottom Sample Trv Scr. 1-7 & 2-1 7/9/91

25,907 = Bottom Sample Vicinity Plant Intake Structures 7/12/91

25,908 = Unit #1 PAC Plant Air compresser 8-[illegible]-91

APPENDIX VI

ANNUAL REPORT: RADIOLOGICAL ENVIRONMENTAL

MONITORING PROGRAM

1991

DONALD C. COOK NUCLEAR PLANT

UNITS 1 & 2

OPERATIONAL

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1991 ANNUAL REPORT

JANUARY 1 to DECEMBER 31, 1991

Prepared by

INDIANA MICHIGAN POWER COMPANY
and
TELEDYNE ISOTOPES

April 15, 1992

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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 1991 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 ground water does not provide a direct dose pathway to man.

I. INTRODUCTION

The Donald C. Cook Nuclear Power Station'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, 1991 through December 31, 1991.

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 I summarizes the sampling and analysis program for the Donald C. Cook nuclear plant for 1991. 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- 1991
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)	9.5 mi	NNE			
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			

TABLE 1 (Cont.)

DONALD C. COO[illegible]LEAR PLANT- 1991

RADIOLOGICAL [illegible]PLING 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			
Ground/Well Water						
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°		I-131/Quarterly
Onsite	(W-7)	1895 ft.		189°		
Non Technical Specification Related Wells						
Steam Generator Storage Facility	(SGRP-1)	0.8 mile		95°		
Steam Generator Storage Facility	(SGRP-2)	0.7 mile		92°		
Steam Generator Storage Facility	(SGRP-4)	0.7 mile		93°	Quarterly	Gross Beta/Quarterly
Steam Generator Storage Facility	(SGRP-5)	0.7 mile		92°		Gross Alpha/Quarterly
						Gamma Isotopic/Quarterly
						I-131/Quarterly

TABLE 1 (Cont.)

DONALD C. COOK NUCLEAR PLANT- 1991

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)	0.40 mi	S			Tritium/Quarterly Composite
Surface Water							
Condenser Circulating Water Intake		L1					
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			I-131/Monthly Composite
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							
Totzke Farm	Baroda	Totzke	5.1 mi	ENE			
Wyant Farm	Dowagaic	Wyant	20.7 mi	E			
Schuler Farm	Baroda	Schuler	4.1 mi	SE			
Livinghouse Farm	La Porte	Livinghouse	20.0 mi	S		Once per every	Gamma Isotopic/per Sample
Warmbien Farm	Three Oaks	Warmbien	7.7 mi	S		14 Days	I-131 per Sample
Zeimer Farm	Bridgman	Zeimer	4.8 mi	SSE			
Lomzac[illegible]m	Galien	Lozmack	9.5 mi	[illegible]			

TABLE 1 (Cont.)

DONALD C. COOK NUCLEAR PLANT- 1991

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		Semi-annually	Gamma Isotopic/
Lake Michigan		ONS-S	.4 mi	S			Semi-annually
Lake Michigan		OFS-N	3 .5mi	N			
Lake Michigan		OFS-S	5.0 mi	S			
Food							
Grapes,Grape Leaves,	Offsite	Indicator	Plant site	Determined from offsite			
Grapes,Grape Leaves,	Offsite	Control	20 miles	Dose Calculation manual		At time of harvest	Gamma Isotopic/
Broadleaf Vegetation	Onsite		Plant site				At time of harvest

- Composite samples of Drinking and Surface water shall be collected at intervals not to exceed 24 hours.
- 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.

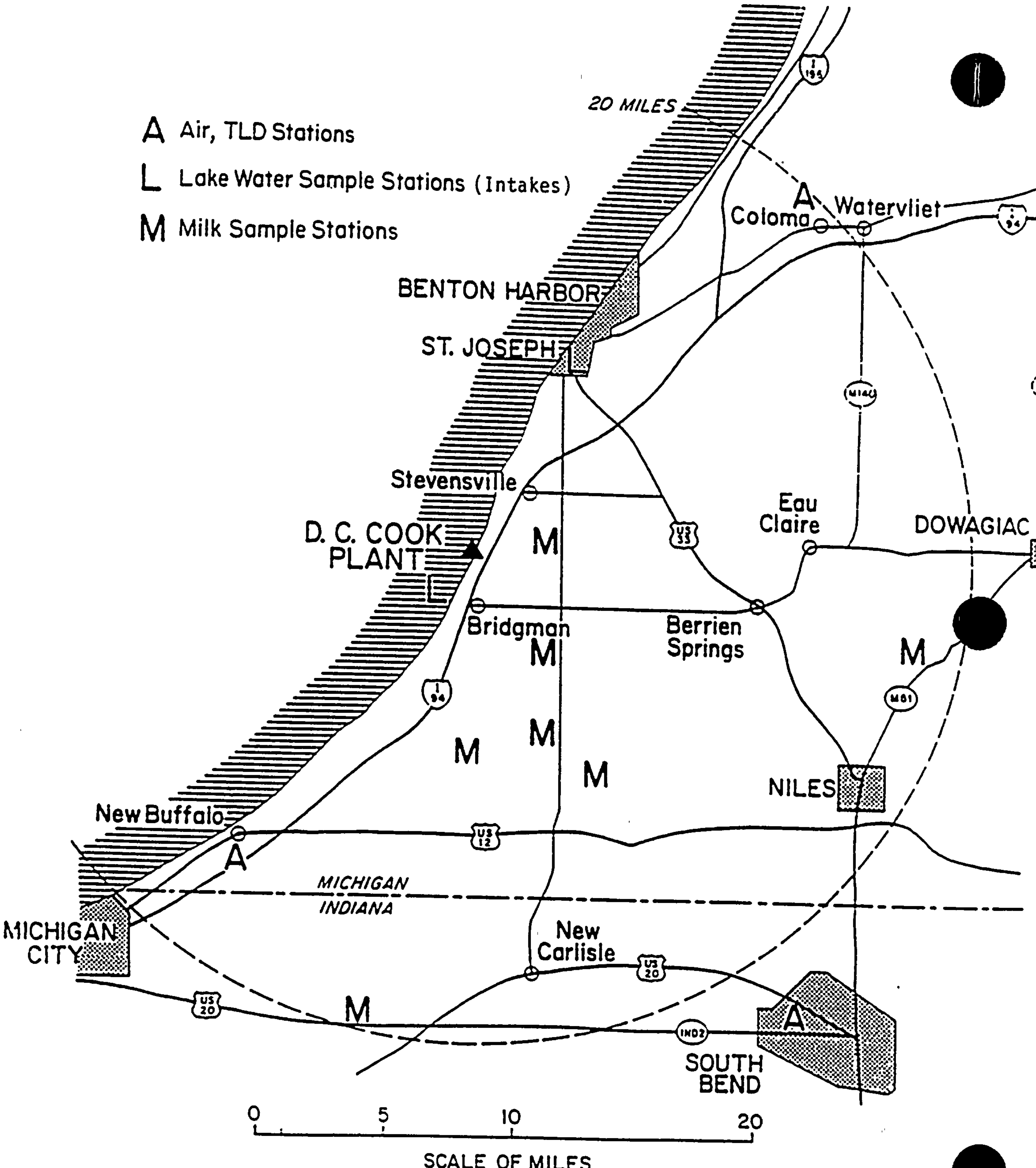
Please note the following defenitions:

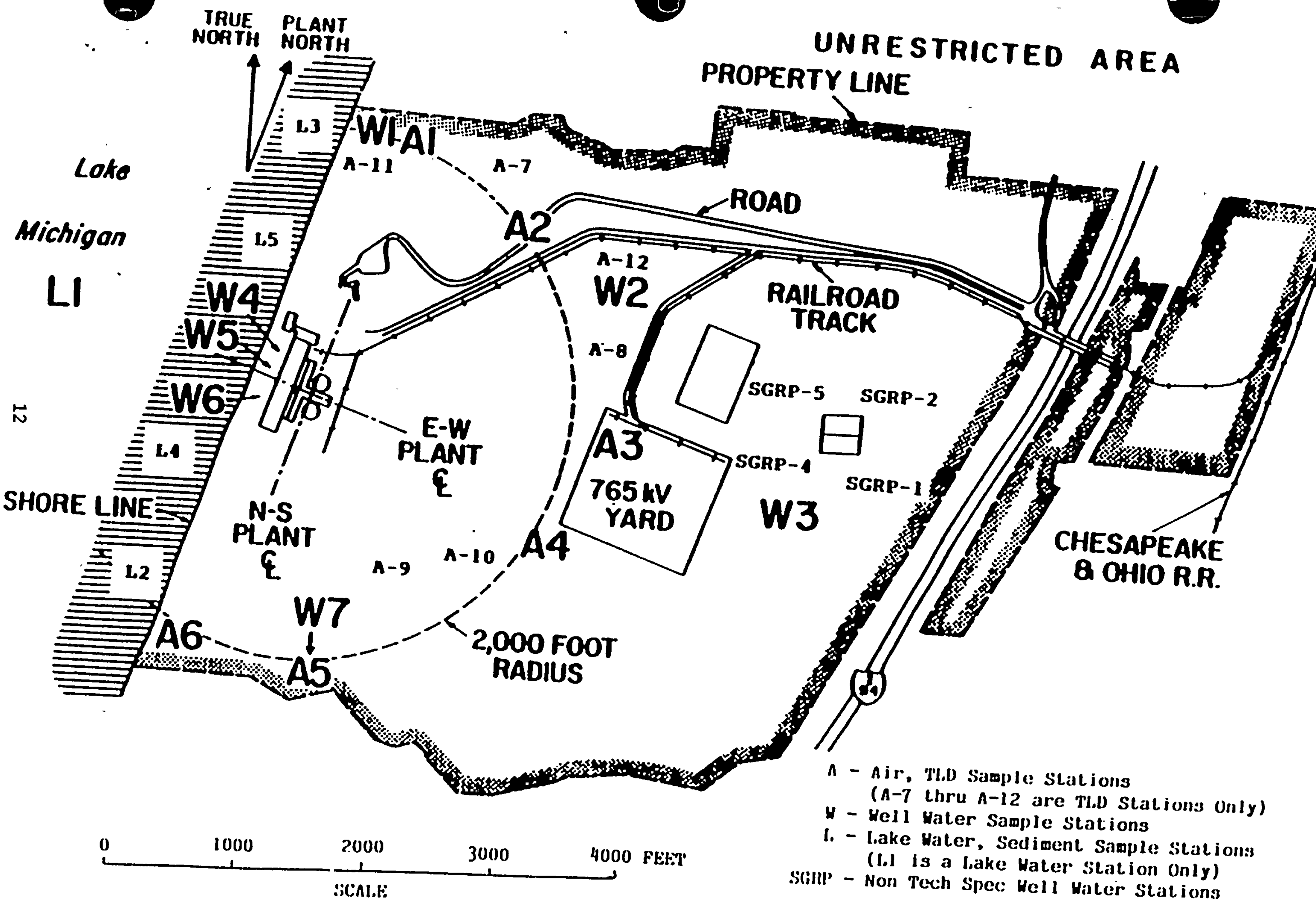
Weekly - at least once per every seven (7) days

Quarterly - at least once per every ninety-two (92) days

Semi-annually - at least once every one hundred eighty-four (184) days

Figure 1


A Air, TLD Stations
L Lake Water Sample Stations (Intakes)
M Milk Sample Stations
20 MILES
Coloma
Watervliet
BENTON HARBOR
ST. JOSEPH
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



TRUE NORTH
PLANT NORTH
UNRESTRICTED AREA
PROPERTY LINE
Lake Michigan
L1
L3
L5
L4
L2
W1-A1
A-11
A-7
A2
ROAD
A-12
W2
RAILROAD TRACK
W4
W5
W6
A-8
SGRP-5
SGRP-2
E-W PLANT ℄
A3
765 kV YARD
SGRP-4
SGRP-1
W3
SHORE LINE
N-S PLANT ℄
A-9
A-10
A4
CHESAPEAKE & OHIO R.R.
W7
A6
A5
2,000 FOOT RADIUS
94
0
1000
2000
3000
4000 FEET
SCALE
A - Air, TLD Sample Stations
(A-7 thru A-12 are TLD Stations Only)
W - Well Water Sample Stations
L - Lake Water, Sediment Sample Stations
(L1 is a Lake Water Station Only)
SGRP - Non Tech Spec Well Water Stations

Figure 2

Figure 3

TLD Stations Within 1-5 Mile Radius

of Plant

0 1/2 1.0 2.0

miles

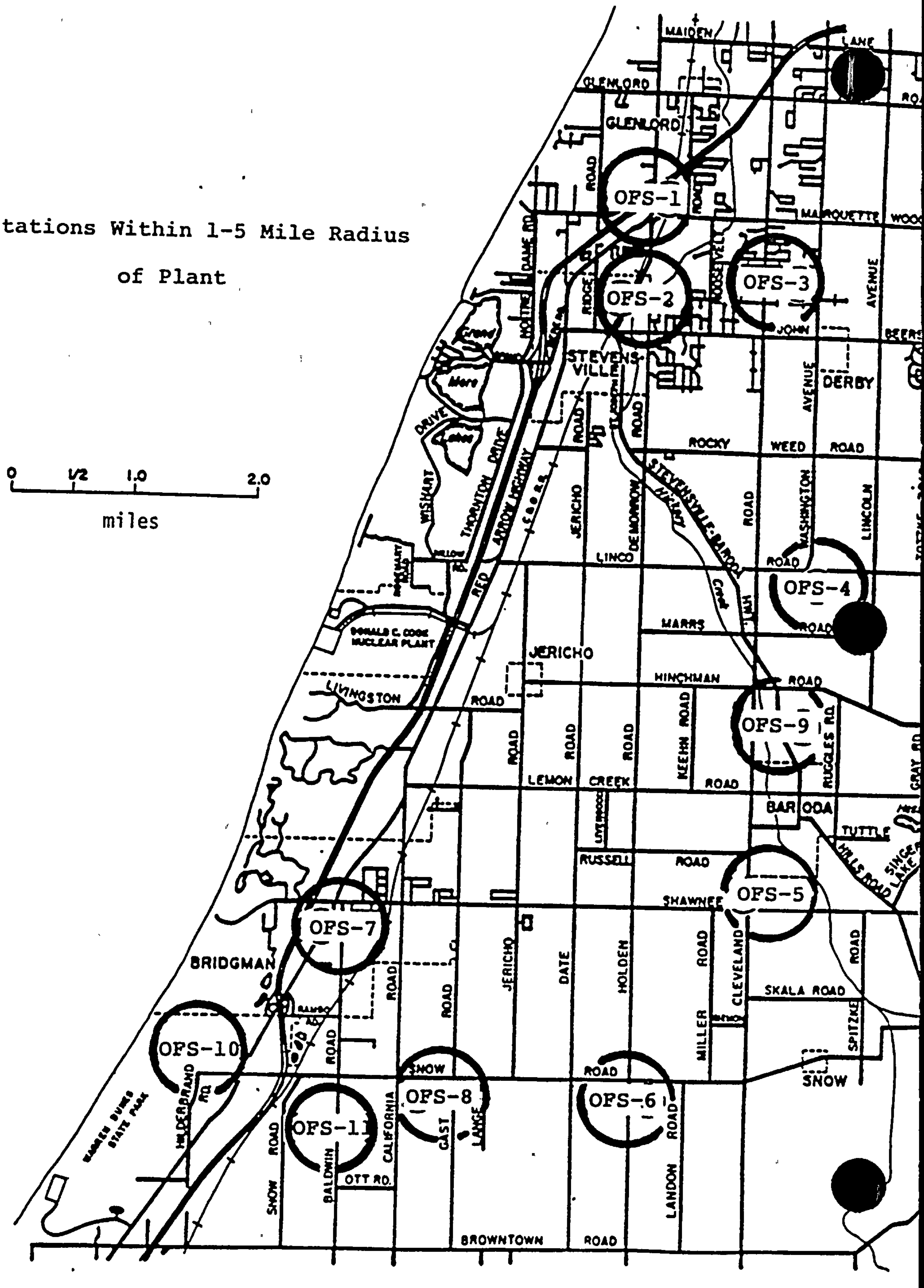
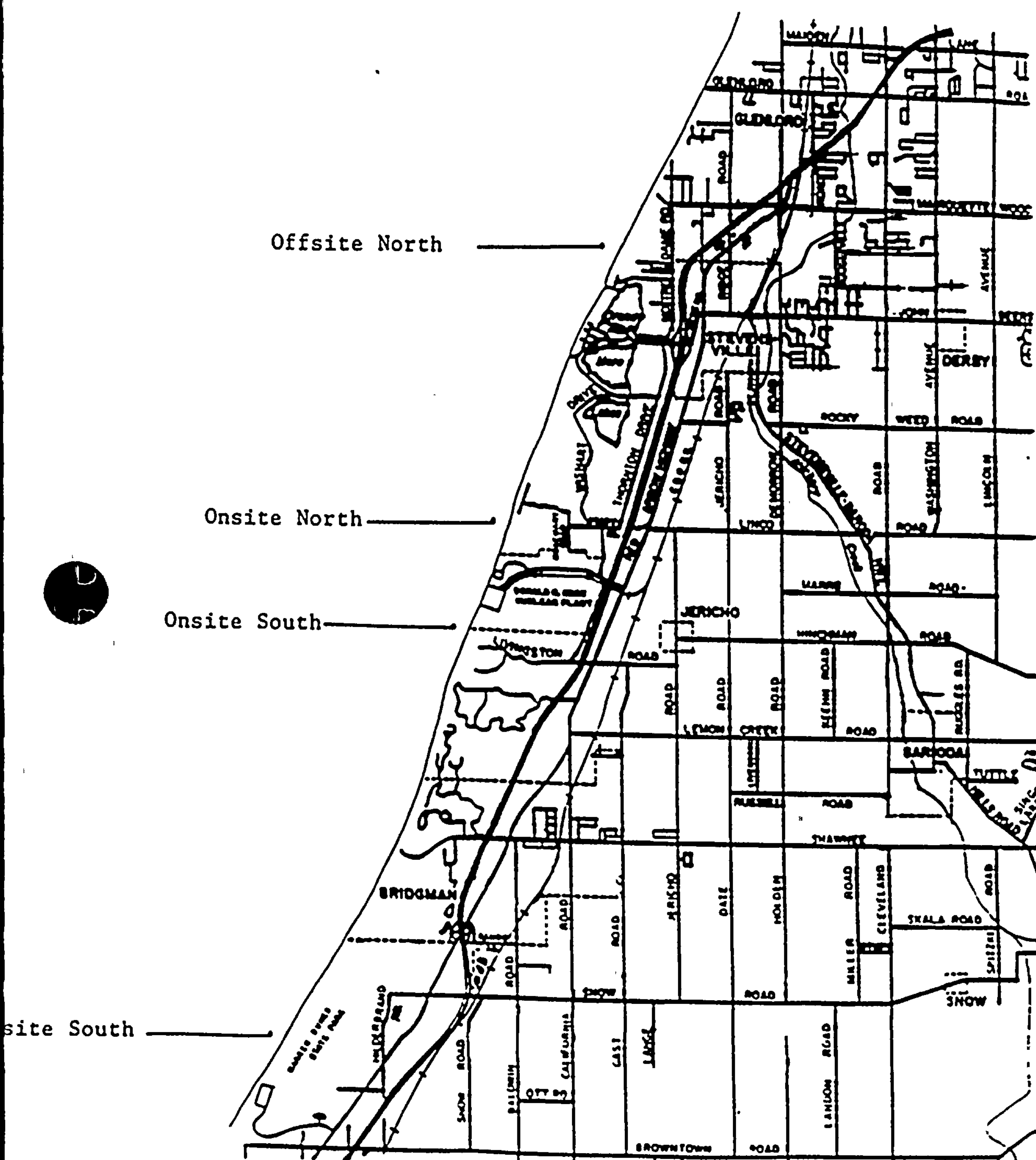


Figure 4

SAMPLING LOCATIONS

FISH COLLECTED FOR RADIOLOGICAL ANALYSIS



III. SUMMARY AND DISCUSSION OF 1991 ANALYTICAL RESULTS

III. SUMMARY AND DISCUSSION OF 1991 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 1991 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.

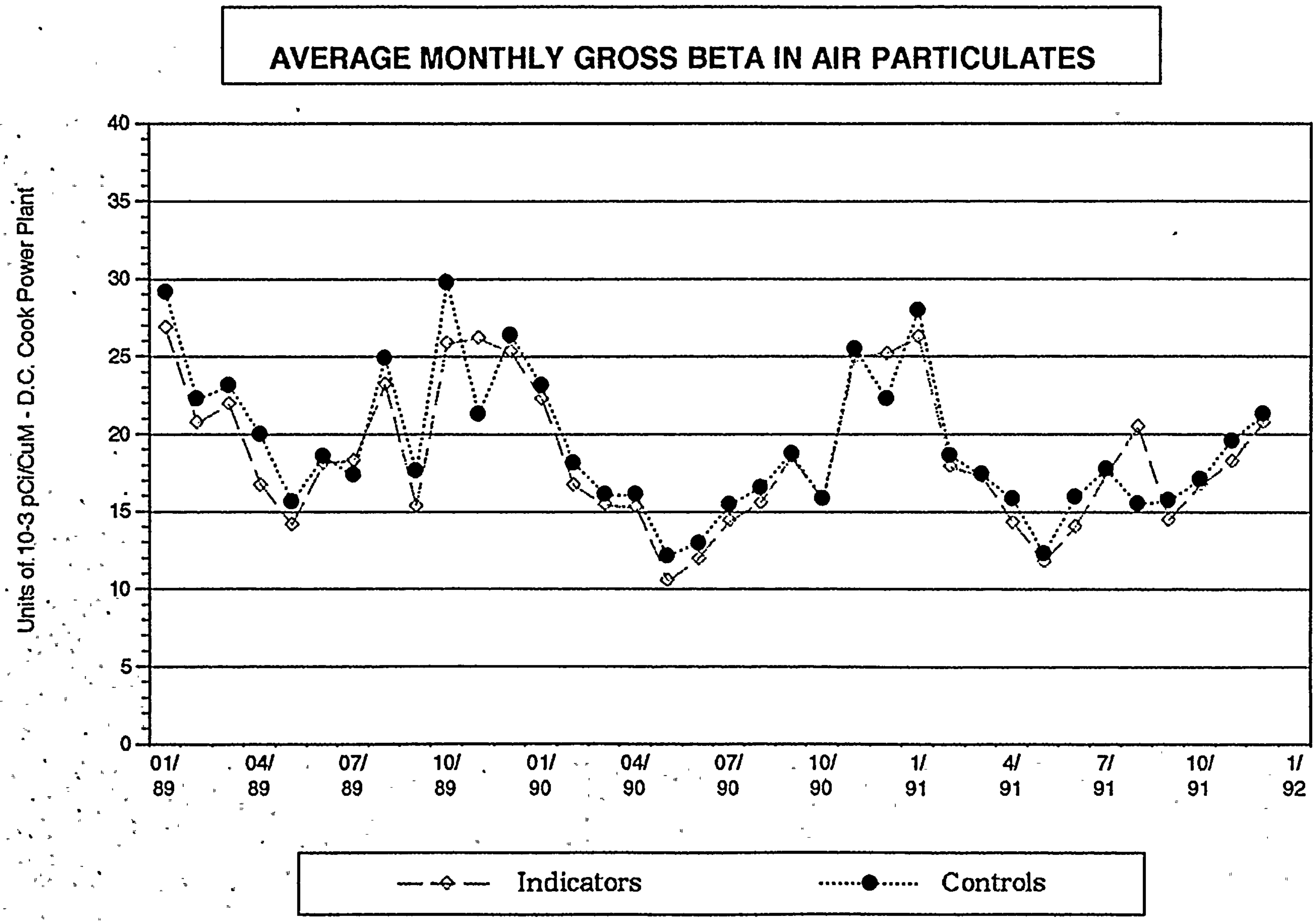
Radiological analyses of environmental media characteristically approach and frequently fall below the detection limits of state-of-the-art measurement methods. Teledyne Isotopes analytical methods meet or exceed the Lower Limit of Detection (LLD) requirements given in Table 2 of the USNRC Branch Technical Position of Radiological Monitoring, Revision I, 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 0.002 and 0.033 pCi/m^3. The average gross beta concentration of the four control locations was 0.018 pCi/m^3 with a range between 0.004 and 0.039 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 1991 were lower than at the end of the preoperational period when the effects of the 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 0.100 pCi/m^3 and the values ranged from 0.058 to 0.136 pCi/m^3. The average concentration for the indicator locations was 0.102 pCi/m^3 with a range of 0.063 to 0.137 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 three of the twenty-four indicator quarterly composites with an average concentration of 0.009 pCi/m^3 and a range of 0.004 to 0.012 pCi/m^3. Potassium-40 was not measured in any of the sixteen control quarterly composites. No other gamma emitting radioactivity was detected.

B. <u>Airborne Iodine</u>

Airborne particulate samples are collected with a constant flow oil less pump at 2.0 CFM using a 47 mm particulate filter. 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.

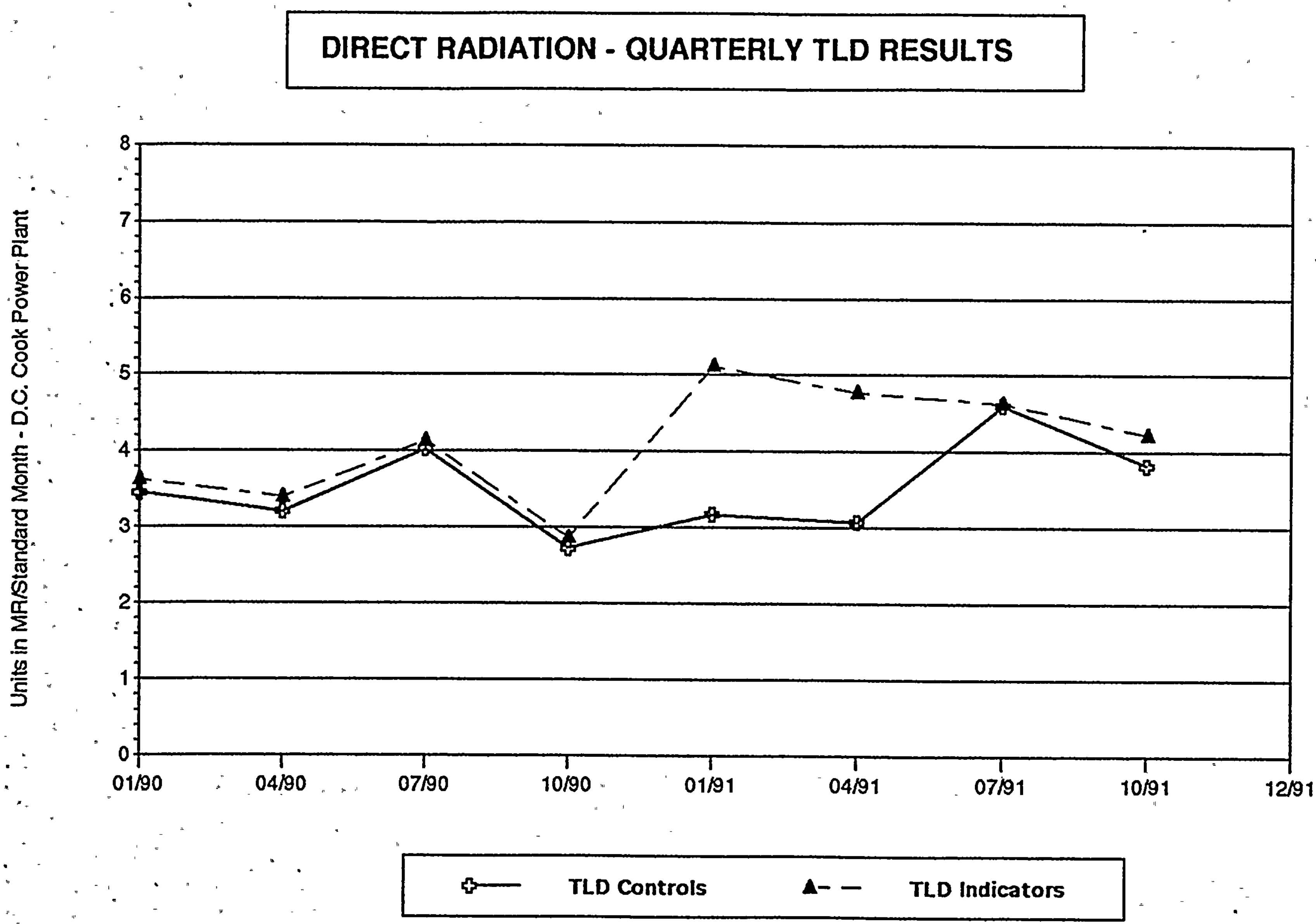
C. Direct Radiation - Thermoluminescent Dosimeters

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 the exposure from all of these potential sources. The TLDs are deployed quarterly at 27 locations in the environs of the D. C. Cook Nuclear Plant site. The average value of the readings of the four areas of each dosimeter (calibrated individually after each field exposure period for response to a known exposure and for intransit 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 measurement for the 16 control samples was 4.07 mR/standard month and a range of 2.8 to 5.4 mR/standard month. The 92 indicator samples had a measurement of 4.28 mR/standard month and a range of 2.3 to 6.5 mR/standard month. The 1991 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

Lake Michigan one liter surface water samples from the condenser circulating water intake 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 76. The quarterly composite was analyzed for tritium by gas counting according to the procedure described on page 71. No iodine-131 was detected. Naturally occurring potassium-40 was measured in one sample with an activity of 40.6 pCi/liter. Cobalt-60 was also measured in one sample with an activity of 3.71 pCi/liter. Tritium was detected in 15 of the 20 samples analyzed with an average concentration of 239 pCi/liter and

Trending Graph - 2



range of 130 to 400 pCi/liter. This is slightly lower than the average concentration in 1990 of 254 pCi/liter. During the preoperational period tritium was measured in surface water samples concentrations of approximately 400 pCi/liter. Naturally occurring gamma emitting isotopes were detected by gamma ray spectroscopy.

E. <u>Ground/Well Water</u>

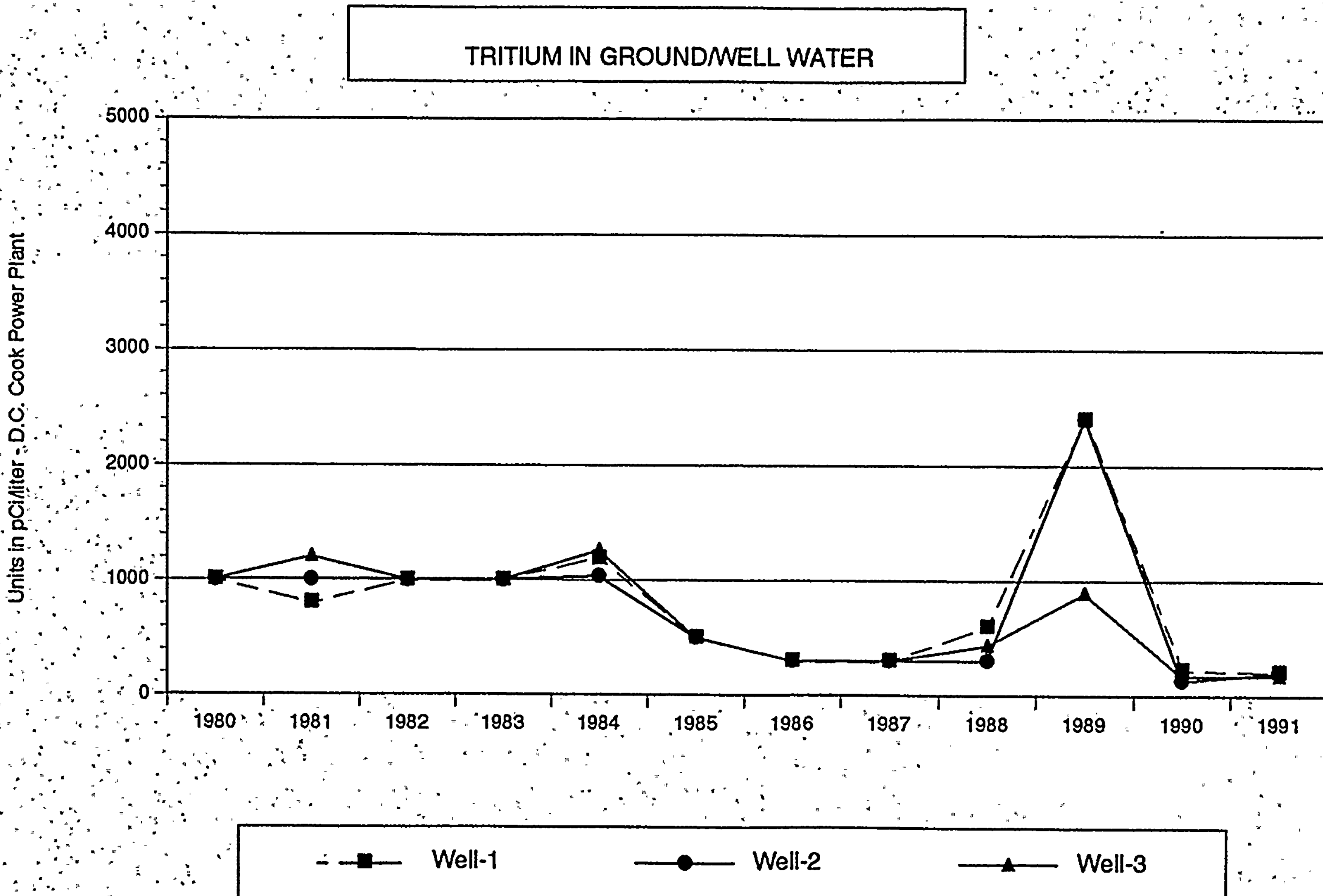
Water samples are collected quarterly from seven wells, all within 3300 feet of the reactors. First, a static water elevation is determined and three well bore volumes are purged from the well using an air driven bladder style pump. A one gallon sample is then obtained. The samples are analyzed for gamma emitters and for tritium. The results are presented in Table B-6. Naturally occurring potassium-40 was measured in one sample with a concentration of 57.2 pCi/liter. No other gamma emitting isotopes were detected. The on-site wells 4, 5, and 6 had measurable tritium activity throughout 1991. However, these measurements are lower than those detected during 1989 and 1990. Tritium was measured in three of the sixteen samples at the off-site locations with an average concentration of 103[illegible] pCi/liter and a range of 210 to 1700 pCi/liter. The annual concentrations of tritium in the seven wells are plotted from 1979 through 1991 in Trending Graph 3.

Tritium concentration in wells in the preoperational period were typically about 400 pCi/liter.

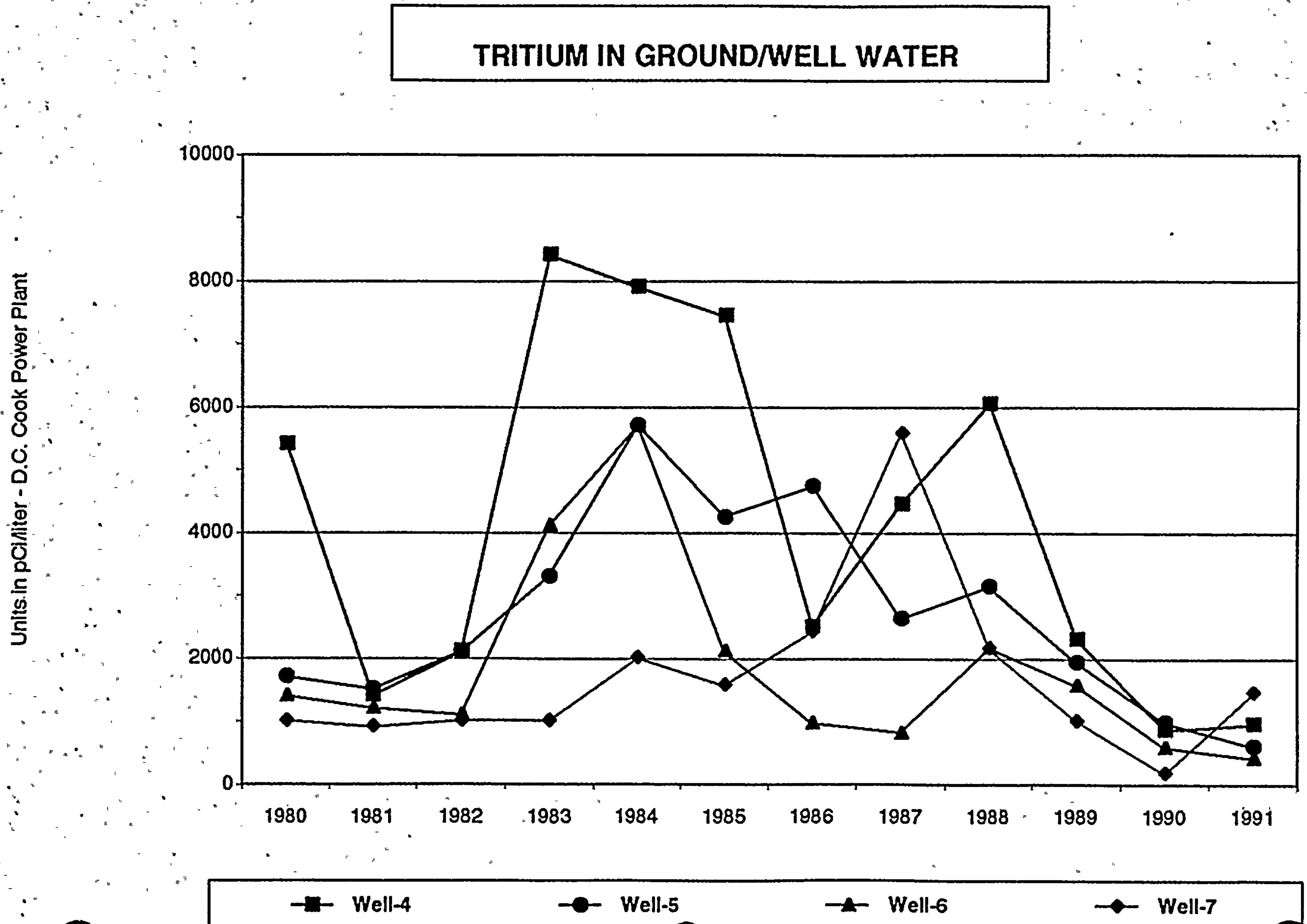
F. <u>Drinking Water</u>

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 for 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.

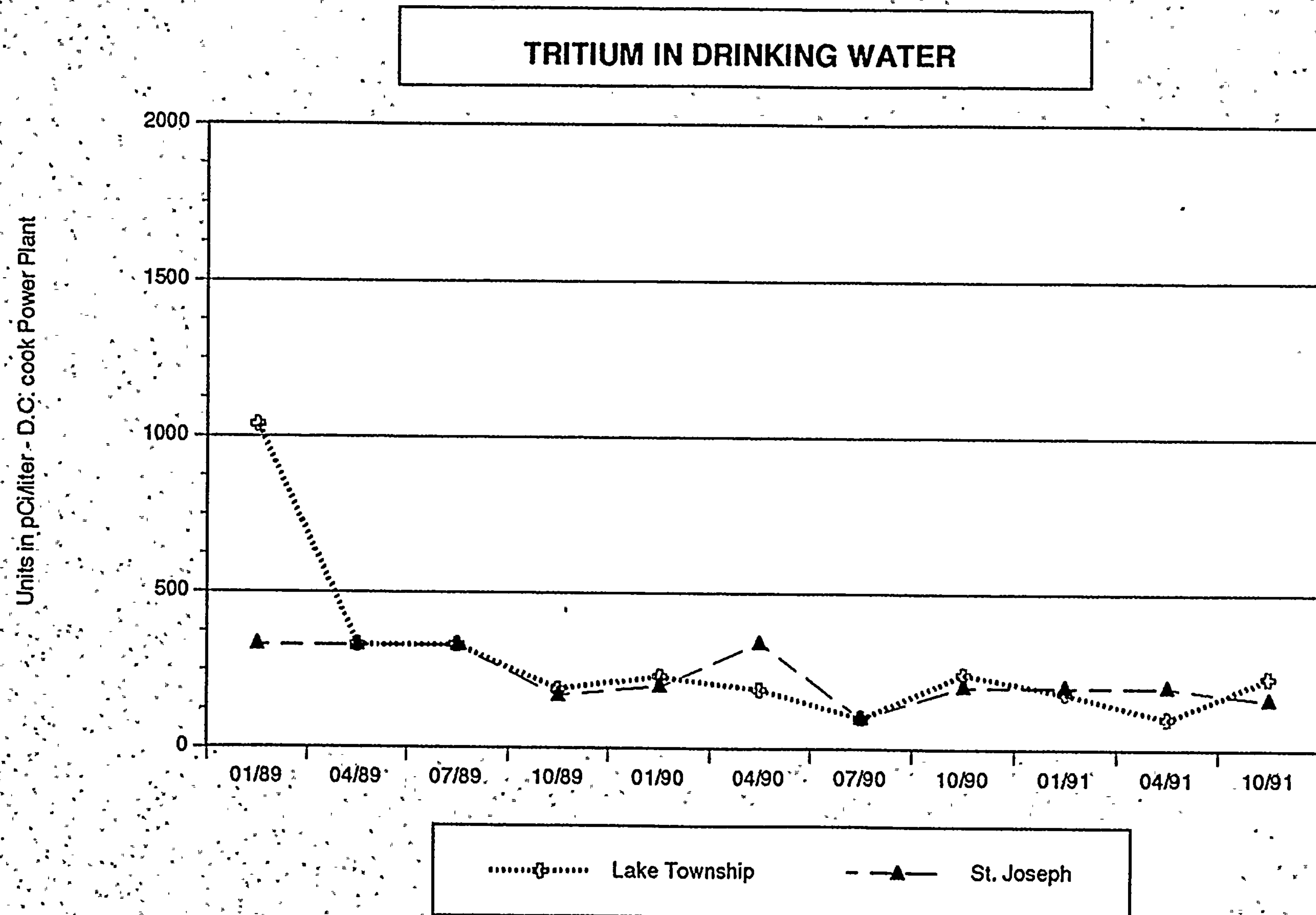
Trendi[illegible]raph - 3



Trending Graph - 3 (Cont.)



Trending Graph - 4



Gross beta activity was measured in all twenty-six samples from the Lake Township intake with an average concentration of 4.8 pCi/liter and a range from 2.8 to 8.3 pCi/liter. Gross beta activity was measured in all twenty-six samples from the St. Joseph intake with an average concentration of 4.1 pCi/liter and a range from 2.2 to 6.9 pCi/liter. No gamma emitting isotopes or iodine-131 were detected. Tritium was measured in three of the four samples from Lake Township intake with an average concentration of 197 pCi/liter and a range of 180 to 230 pCi/liter. Tritium was measured in two samples from St. Joseph intake with an average activity of 185 pCi/liter and a range of 160 to 210 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 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 5861 pCi/kg with a range from 4960 to 6740 pCi/kg. Thorium-228, also naturally occurring was measured in seven of the eight samples with an average concentration of 121 pCi/kg with a range from 89.0 to 157 pCi/kg. Cesium-137, attributed to fallout from previous atmospheric nuclear tests, was detected in one of the eight samples with an activity of 37.5 pCi/kg. That activity level is often observed in soils and sediments. All other gamma emitters were below their detection levels.

H. Milk

Milk samples of one gallon are collected every fourteen days from seven farms located between 4.1 miles and 20.7 miles from the site. 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 1991. 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 1991 the average potassium-40 concentration for the control locations during was 1243 pCi/liter with a range of 688 to 1410 pCi/liter. The indicator locations had an average concentration of 1315 pCi/liter and a range of 881 to 1600. There were no detections of iodine-131 during 1991. Cesium-137 was detected in one control sample with an activity of 4.73 pCi/liter. There were two measurements of cesium-137 in indicator samples with an average of 6.11 pCi/liter and a range of 3.29 to 8.93 pCi/liter.

I. Fish

Using gill nets in twenty feet of water in Lake Michigan, 4.5 pounds of fish are collected semiannually from each of the 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 2609 pCi/kg (wet weight) and a range of 2040 to 3190 pCi/kg (wet weight). Cesium-137, attributed to previous atmospheric nuclear tests was measured in one of the eight fish samples with a concentration of 65.8 pCi/kg (wet weight).

J. Food Products

Food samples are collected annually at harvest, as near the s[illegible] 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 samples with an average concentration of 2852 pCi/kg (wet weight) and a range of 1710 to 3880 pCi/kg (wet weight). Cosmogenically produced beryllium-7 was measured in three of the five samples with an average concentration of 914 pCi/kg (wet weight) and a range of 906 to 920 pCi/kg (wet weight). Cesium-137 was measured in one sample with a concentration of 45.1 pCi/kg (wet weight).

IV. CONCLUSIONS

IV. CONCLUSIONS

The results of the 1991 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 1991 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 1991. No iodine-131 was detected in charcoal filters in 1991.

Thermoluminescent dosimeters (TLD) 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 potential radioactive airborne releases and direct radiation from the power station. The average annual TLD results were at normal background exposure levels.

Surface water samples collected monthly from five locations in Lake Michigan were analyzed for iodine, tritium, and gamma emitting isotopes. Only one gamma emitter, cobalt-60 was detected in one sample during 1991. Tritium was measured and the concentrations were at normal background levels.

Ground water samples were collected quarterly at seven wells, all within 1009 meters of the reactors. The three wells within 130 meters had measurable tritium which is attributed to the operation of the plant. The tritium levels in 1991 compare well with those measured in 1990. The highest concentration measured in 1991 was 1700 pCi/liter which was also the highest measured in 1990. The tritium levels in ground water have been plotted for the last decade and indicate decreasing levels of tritium. Potassium-40, a naturally occurring nuclide was observed in one sample during 1991. 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 samples with background levels that were lower than those measured during 1990.

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. Cesium-137 was measured in one sample during 1991. No other 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 in 1990 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 very low concentrations,

typical of those found in other parts of the country and which are attributed to previous atmospheric nuclear tests.

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, again attributed to previous atmospheric nuclear tests.

The results of the analyses have been presented. Based on the evidence of the radiological environmental monitoring program the Donald C. Cook nuclear plant appears to be 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 ground water 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, 1991

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	519	-(0/311) -	N/A	N/A	-(0/208) -	0
Airborne Particulates ($1E\text{-}03\ pCi/m^3$)	Gross Beta (Weekly)	519	17.1(311/311) (2.4-33)	SBN 24 mi SE	18.1(52/52) (8.6-35)	17.8(208/208) (4.2-39)	0
	Gamma	40					
	Be-7	40	101.7(24/24) (63.1-137)	ONS-5 578 m	113.4(4/4) (82.4-137)	99.8(16/16) (57.8-136)	0
	K-40	40	8.87(3/24) (3.82-12.4)	ONS-6	12.4(1/4) -	-(0/16) -	0
Direct Radiation (mR/Standard Month)	Gamma Dose Quarterly	108	4.28(92/92) (2.3-6.5)	OFS-6	5.25(4/4) (4.4-5.7)	4.07(16/16) (2.8-5.4)	0

(a/b) [illegible] of samples with detectable activity to total number of samp[illegible]alyzed.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY
INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT **DOCKET NO. 50-315/5[illegible]8**
BERRIEN COUNTY JANUARY 1 to DECEMBER 31, 1991

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	57					
	K-40	57	40.6(1/57) -	L-5 0.1 mi NNE	40.6(1/11) -	-(0/0) -	0
	Co-60	57	3.71(1/57) -	L-1	3.71(1/13)	-(0/0) -	0
	H-3	20	239(15/20) (130-400)	L-3 0.44 mi N	303(3/4) (200-400)	-(0/0) -	0
Ground Water (pCi/liter)	Gamma	28					
	K-40		57.2(1/28) -	Well 6	57.2(1/4) -	-(0/0) -	0
	H-3	28	783(11/28) (210-1700)	Well 7	1450(2/4) (1200-1700)	-(0/0) -	0
Drinking Water (pCi/liter)	Gross Beta	52	4.2(52/52) (2.2-8.3)	LTW 0.40 mi S	4.3(26/26) (2.8-8.3)	-(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	192(5/8) (160-230)	LTW 0.40 mi S	197(3/4) (180-230)	-(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, 1991

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	5861(8/8) (4960-6740)	L-5 0.1 mi NNE	6450(2/2) (6160-6740)	No Control	0
	Cs-137	8	37.5(1/8) -	L-4 0.1 mi SSW	37.5(1/2) -	No Control	0
	Th-228	8	121(7/8) (89.0-157)	L-5 0.1 mi NNE	153(1/2) -	No Control	0
Milk (pCi/liter)	Gamma	182					
	K-40	182	1315(130/130) (881-1600)	Totzke 5.1 mi ENE	1374(26/26) (931-1600)	1243(52/52) (688-1410)	0
	I-131	182	-(0/130) -	N/A		-(0/52) -	0
	Cs-137	182	6.11(2/130) (3.29-8.93)	Zelmer 4.8 mi SSE	6.11(2/26) (3.29-8.93)	4.73(1/52) -	0

(a/b) [illegible]o of samples with detectable activity to total number of sam[illegible]nalyzed.

RADIOLOGICAL ENVIRONME[illegible] MONITORING PROGRAM SUMMARY

INDIANA MICHIGAN POWER COMPANY - DONA[illegible]. COOK NUCLEAR PLANT DOCKET NO. 50-315/50-3[illegible]

BERRIEN COUNTY JANUARY 1 to DECEMBER 31, 1991

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
Fish (pCi/kg wet)	Gamma	8					
	K-40	8	2609(8/8) (2040-3190)	OFS-North 35 mi N	2875(2/2) (2800-2950)	-(0/0) -	0
	Cs-137	8	65.8(1/8) -	OFS-North 5.0 mi N	65.8(1/1) -	-(0/0) -	0
Food/Vegetation (pCi/kg wet)	Gamma	5					
	Be-7	5	914(3/5) (906-920)	Sector J Variable	914(3/5) (906-920)	-(0/0) -	0
	K-40	5	2852(5/5) (1710-3880)	Sector J Variable	2852(5/5 (1710-3880)	-(0/0) -	0
	Cs-137	5	45.1(1/5) -	Sector J Variable	45.1(1/5) -	-(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

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.
JANUARY 91											
01/07/91	27 ± 2	27 ± 2	24 ± 2	27 ± 2	28 ± 2	26 ± 2	28 ± 2	22 ± 2 (a)	25 ± 2	30 ± 2	26 ± 5
01/14/91	26 ± 2	27 ± 2	27 ± 2	28 ± 2	26 ± 2	23 ± 2	25 ± 2	39 ± 3	27 ± 2	24 ± 2	27 ± 9
01/21/91	30 ± 2	33 ± 2	33 ± 2	25 ± 2	31 ± 2	29 ± 2	33 ± 2	34 ± 2	35 ± 2	35 ± 2	32 ± 6
01/28/91	22 ± 2	23 ± 2	21 ± 2	23 ± 2	23 ± 2	21 ± 2	23 ± 2	24 ± 2	24 ± 2	19 ± 2	22 ± 3
FEBRUARY											
02/04/91	21 ± 2	22 ± 2	21 ± 2	22 ± 2	22 ± 2	22 ± 2	23 ± 2	23 ± 2	22 ± 2	23 ± 2	22 ± 2
02/11/91	23 ± 2	23 ± 2	24 ± 2	22 ± 2	19 ± 2	8 ± 2	23 ± 2	19 ± 2	19 ± 2	20 ± 2	20 ± 9
02/18/91	13 ± 2	12 ± 2	11 ± 2	13 ± 2	13 ± 2	11 ± 2	13 ± 2	12 ± 2	13 ± 2	14 ± 2	13 ± 2
02/25/91	23 ± 2	20 ± 2	16 ± 2	18 ± 2	19 ± 2	17 ± 2	19 ± 2	18 ± 2	20 ± 2	16 ± 2	19 ± 4
03/04/91	17 ± 2	20 ± 2	19 ± 2	14 ± 2	18 ± 2	14 ± 2	18 ± 2	24 ± 3 (b)	17 ± 2	16 ± 2	18 ± 6
MARCH											
03/11/91	23 ± 2	26 ± 2	23 ± 2	26 ± 3	24 ± 2	21 ± 2	23 ± 2	27 ± 2	26 ± 2	24 ± 2	24 ± 4
03/18/91	11 ± 2	10 ± 2	(c)	10 ± 2	12 ± 2	9 ± 2	8 ± 2	13 ± 2	12 ± 2	10 ± 2	11 ± 3
03/25/91	18 ± 2	17 ± 2	15 ± 2	17 ± 2	16 ± 2	16 ± 2	17 ± 2	17 ± 2	20 ± 2	15 ± 2	17 ± 3
04/01/91	11 ± 2	20 ± 2	19 ± 2	20 ± 2	17 ± 2	16 ± 2	17 ± 2	16 ± 2	17 ± 2	17 ± 2	17 ± 5
Quarter Avg.	20 ± 12	22 ± 12	21 ± 12	20 ± 11	21 ± 11	18 ± 13	21 ± 13	22 ± 16	21 ± 12	20 ± 14	21 ± 2

(a) Timer malfunction; low sample volume.
(b) Unit Serviced.
(c) Sample was not placed.

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											
04/08/91	22 ± 2	20 ± 2	19 ± 2	19 ± 2	18 ± 2	18 ± 2	19 ± 2	20 ± 2	21 ± 2	27 ± 3	20 ± 5
04/15/91	11 ± 2	10 ± 2	10 ± 2	11 ± 2	9 ± 2	10 ± 2	12 ± 2	11 ± 2	11 ± 2	6 ± 1 (a)	11 ± 2
04/22/91	13 ± 2	13 ± 2	15 ± 2	13 ± 2	13 ± 2	11 ± 2	13 ± 2	13 ± 2	13 ± 2	14 ± 2	13 ± 2
04/29/91	16 ± 2	13 ± 1	15 ± 2	13 ± 2	17 ± 2	14 ± 2	16 ± 2	16 ± 2	16 ± 2	15 ± 2	15 ± 3
MAY											
05/06/91	7 ± 1	7 ± 1	7 ± 1	6 ± 1	7 ± 1	8 ± 2	7 ± 1	8 ± 1	8 ± 1	9 ± 1	7 ± 2
05/13/91	18 ± 2	16 ± 2	15 ± 2	13 ± 2	8 ± 1 (b)	4 ± 1 (b)	16 ± 2	15 ± 2	16 ± 2	16 ± 2	16 ± 3
05/20/91	13 ± 2	16 ± 2	16 ± 2	24 ± 3	15 ± 2	11 ± 3	16 ± 2	9 ± 2	11 ± 3 (b)	15 ± 2	15 ± 8
05/27/91	12 ± 2	10 ± 2	11 ± 2	10 ± 2	11 ± 2	11 ± 2	13 ± 2	11 ± 2	11 ± 2	12 ± 2	11 ± 2
06/03/91	12 ± 2	13 ± 2	14 ± 2	13 ± 2	14 ± 2	12 ± 2	12 ± 2	13 ± 2	14 ± 2	14 ± 2	13 ± 2
JUNE											
06/10/91	9 ± 2	8 ± 2	9 ± 2	8 ± 2	10 ± 2	8 ± 2	8 ± 2	10 ± 2	4 ± 2	10 ± 2	8 ± 4
06/17/91	16 ± 2	15 ± 2	15 ± 2	19 ± 3	18 ± 3 (a)	16 ± 2	29 ± 4	14 ± 2	13 ± 2	16 ± 2	17 ± 9
06/24/91	18 ± 2	15 ± 2	16 ± 2	16 ± 2	9 ± 1 (a)	15 ± 2	17 ± 2	15 ± 2	17 ± 2	18 ± 2	16 ± 2
07/01/91	20 ± 2	21 ± 2	24 ± 2	18 ± 2	2 ± 1 (a)	11 ± 2	19 ± 2	20 ± 2	23 ± 2	22 ± 2	20 ± 8
Quarterly Avg.	**14 ± 9**	**14 ± 8**	**14 ± 9**	**14 ± 10**	**13 ± 8**	**11 ± 7**	**15 ± 11**	**13 ± 8**	**14 ± 10**	**16 ± 10**	**14 ± 3**

(a) Timer malfunction; result in total pCi and not included in averages.
(b) Bl[illegible]use; unit found off. Results in total pCi.

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} $pCi/m^3 \pm 2$ 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											
07/08/91	19 ± 2	18 ± 2	16 ± 2	17 ± 2	18 ± 2	18 ± 2	18 ± 2	18 ± 2	18 ± 2	19 ± 2	18 ± 2
07/15/91	15 ± 2	14 ± 2	13 ± 2	12 ± 2	14 ± 2	14 ± 2	10 ± 2	14 ± 2 (a)	15 ± 2	16 ± 2	14 ± 3
07/22/91	27 ± 2	27 ± 2	28 ± 2	26 ± 2	21 ± 2	32 ± 2	30 ± 2	26 ± 2	30 ± 2	29 ± 2	28 ± 6
07/29/91	11 ± 2	11 ± 2	11 ± 2	11 ± 2	12 ± 2	12 ± 2	11 ± 2	9 ± 2	11 ± 2	10 ± 2	11 ± 2
AUGUST											
08/05/91	10 ± 2	13 ± 2	13 ± 2	14 ± 2	26 ± 3	13 ± 2	13 ± 2	13 ± 2	15 ± 2	14 ± 2	14 ± 9
08/12/91	14 ± 2	14 ± 2	12 ± 2	14 ± 2	67 ± 9 (b)	15 ± 2	11 ± 2	13 ± 2	13 ± 2	15 ± 2	13 ± 3
08/19/91	21 ± 2	21 ± 2	15 ± 2	21 ± 2	78 ± 7 (b)	17 ± 2	19 ± 2	19 ± 2	22 ± 2	23 ± 2	20 ± 5
08/26/91	16 ± 2	16 ± 2	17 ± 2	16 ± 2	16 ± 2	16 ± 2	16 ± 2	15 ± 2	17 ± 2	17 ± 2	16 ± 1
09/02/91	20 ± 2	19 ± 2	19 ± 2	18 ± 2	24 ± 2	18 ± 2	12 ± 2	11 ± 2	16 ± 2	16 ± 2	17 ± 8
SEPTEMBER											
09/09/91	22 ± 2	22 ± 2	18 ± 2	19 ± 2	18 ± 2	21 ± 2	21 ± 2	20 ± 2	21 ± 2	22 ± 2	20 ± 3
09/16/91	15 ± 2	16 ± 2	17 ± 2	16 ± 2	13 ± 2	18 ± 2	15 ± 2	17 ± 2	18 ± 2	16 ± 2	16 ± 3
09/23/91	12 ± 2	11 ± 2	11 ± 2	14 ± 2	12 ± 2	11 ± 2	13 ± 2	12 ± 2	13 ± 2	13 ± 2	12 ± 2
09/30/91	10 ± 2	10 ± 2	9 ± 2	11 ± 2	10 ± 2	11 ± 2	11 ± 2	12 ± 2	13 ± 2	14 ± 2	11 ± 3
Quarterly Avg.	16 ± 10	16 ± 10	15 ± 10	16 ± 9	17 ± 10	17 ± 11	15 ± 11	15 ± 9	17 ± 10	17 ± 10	16 ± 2

(a) Clock disconnected.
(b) Elevated result due to low volume. Not included in averages.

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.
OCTOBER											
10/07/91	17 ± 2	19 ± 2	14 ± 2	18 ± 2	23 ± 3	18 ± 2	18 ± 2	21 ± 2	19 ± 2	19 ± 2	19 ± 5
10/14/91	20 ± 2	21 ± 2	20 ± 2	20 ± 2	23 ± 2	21 ± 2	22 ± 2	22 ± 2	22 ± 2	15 ± 1	21 ± 4
10/21/91	13 ± 2	12 ± 2	14 ± 2	13 ± 2	12 ± 2	12 ± 2	13 ± 2	14 ± 2	15 ± 2	14 ± 2	13 ± 2
10/28/91	15 ± 2	14 ± 2	16 ± 2	17 ± 2	14 ± 2	16 ± 2	16 ± 2	14 ± 2	14 ± 2	15 ± 2	15 ± 2
NOVEMBER											
11/04/91	15 ± 2	12 ± 2	13 ± 2	14 ± 2	15 ± 2	14 ± 2	11 ± 2	17 ± 2	15 ± 2	16 ± 2	14 ± 4
11/11/91	18 ± 2	18 ± 2	17 ± 2	20 ± 2	18 ± 2	21 ± 2	21 ± 2	20 ± 2	21 ± 2	20 ± 2	19 ± 3
11/18/91	29 ± 2	26 ± 2	25 ± 2	28 ± 2	29 ± 2	27 ± 2	28 ± 2	27 ± 2	28 ± 2	32 ± 2	28 ± 4
11/25/91	15 ± 2	15 ± 2	15 ± 2	14 ± 2	9 ± 2	14 ± 2	15 ± 2	15 ± 2	15 ± 2	15 ± 2	14 ± 4
12/02/91	17 ± 2	18 ± 2	18 ± 2	17 ± 2	17 ± 2	19 ± 2	19 ± 2	19 ± 2	19 ± 2	18 ± 2	18 ± 2
DECEMBER											
12/09/91	17 ± 2	20 ± 2	18 ± 2	17 ± 2	20 ± 2	20 ± 2	21 ± 2	19 ± 2	21 ± 2	22 ± 2	19 ± 3
12/16/91	23 ± 2	23 ± 2	23 ± 2	22 ± 2	23 ± 2	26 ± 2	24 ± 2	23 ± 2	22 ± 2	23 ± 2	23 ± 2
12/23/91	18 ± 2	16 ± 2	15 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 2	16 ± 2	17 ± 2	18 ± 2	17 ± 2
12/30/91	24 ± 2	22 ± 2	24 ± 2	24 ± 2	26 ± 2	26 ± 2	26 ± 2	23 ± 2	26 ± 2	22 ± 2	24 ± 3
Quarter Avg.	**19 ± 9**	**18 ± 9**	**18 ± 8**	**19 ± 9**	**19 ± 12**	**19 ± 10**	**19 ± 10**	**19 ± 8**	**20 ± 9**	**19 ± 10**	**19 ± 9**
Annual Avg.	**17 ± 11**	**17 ± 11**	**17 ± 11**	**17 ± 11**	**17 ± 13**	**16 ± 12**	**18 ± 12**	**18 ± 12**	**18 ± 12**	**18 ± 11**	**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 12/31/90-04/01/91	Second Quarter 04/01/91-07/01/91	Third Quarter 07/01/91-09/30/91	Fourth Quarter 09/30/91-12/30/91	Average ± 2 s.d.
A-1	Be-7	97.9 ± 9.8	98.9 ± 9.9	86.2 ± 8.6	64.6 ± 6.5	86.9 ± 31.9
	K-40	< 4	< 4	< 4	3.82 ± 2.12	3.82 ± 2.12
	Cs-134	< 0.2	< 0.2	< 0.2	< 0.3	-
	Cs-137	< 0.2	< 0.3	< 0.3	< 0.3	-
A-2	Be-7	129 ± 13	119 ± 12	99.6 ± 10.0	63.1 ± 6.3	103 ± 58
	K-40	< 5	< 5	< 9	< 8	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.3	< 0.3	< 0.3	-
A-3	Be-7	115 ± 12	117 ± 12	98.8 ± 9.9	74.4 ± 7.4	101 ± 39
	K-40	< 9	< 10	< 10	< 10	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.3	< 0.4	< 0.3	-
A-4	Be-7	122 ± 12	121 ± 12	114 ± 11	77.9 ± 7.8	109 ± 42
	K-40	< 5	< 5	< 5	< 4	-
	Cs-134	< 0.3	< 0.3	< 0.2	< 0.2	-
	Cs-137	< 0.3	< 0.2	< 0.2	< 0.2	-
A-5	Be-7	137 ± 14	125 ± 13	109 ± 11	82.4 ± 8.2	113 ± 47
	K-40	< 6	< 20	10.4 ± 4.1	< 5	104 ± 4.1
	Cs-134	< 0.3	< 0.5	< 0.4	< 0.3	-
	Cs-137	< 0.3	< 0.5	< 0.4	< 0.3	-

* Typical LLDs are found in Table B-12.

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 ± 2 sigma

Stations	Nuclides	First Quarter 12/31/90-04/01/91	Second Quarter 04/01/91-07/01/91	Third Quarter 07/01/91-09/30/91	Fourth Quarter 09/30/91-12/30/91	Average ± 2 s.d.
A-6	Be-7	112 ± 11	97.4 ± 9.7	109 ± 11	70.9 ± 7.1	97.3 ± 37.4
	K-40	< 10	< 6	< 5	12.4 ± 3.5	12.4 ± 3.5
	Cs-134	< 0.4	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.3	< 0.2	< 0.3	-
Coloma	Be-7	111 ± 11	101 ± 10	87.1 ± 8.7	76.9 ± 7.7	94.0 ± 30.1
	K-40	< 10	< 4	< 4	< 3	-
	Cs-134	< 0.3	< 0.2	< 0.2	< 0.2	-
	Cs-137	< 0.3	< 0.2	< 0.2	< 0.2	-
Dowagiac	Be-7	130 ± 13	113 ± 11	87.8 ± 8.8	61.0 ± 6.8	98.0 ± 60.2
	K-40	< 10	< 6	< 7	< 4	-
	Cs-134	< 0.4	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.4	< 0.3	< 0.3	< 0.3	-
New Buffalo	Be-7	136 ± 14	101 ± 10	107 ± 11	57.8 ± 5.8	100 ± 65
	K-40	< 5	< 5	< 5	< 4	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.2	-
	Cs-137	< 0.4	< 0.4	< 0.4	< 0.2	-
South Bend	Be-7	123 ± 13	117 ± 12	110 ± 11	76.6 ± 7.7	107 ± 42
	K-40	< 5	< 9	< 9	< 8	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.3	< 0.3	< 0.3	-

* Typical LLDs are found in Table B-12.

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 91										
01/07/91	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 200 (a)	< 10	< 20
01/14/91	< 10	< 10	< 10	< 10	< 9	< 10	< 20	< 20	< 10	< 20
01/21/91	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	< 10	< 20
01/28/91	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10	< 10
FEBRUARY										
02/04/91	< 10	< 10	< 10	< 30	< 10	< 20	< 20	< 20	< 10	< 20
02/11/91	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 6	< 10
02/18/91	< 20	< 20	< 20	< 20	< 10	< 20	< 20	< 20	< 10	< 10
02/25/91	< 20	< 10	< 10	< 10	< 10	< 20	< 20	< 20	< 10	< 20
03/04/91	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 20 (b)	< 6	< 10
MARCH										
03/11/91	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10	< 10
03/18/91	< 20	< 20	(c)	< 20	< 10	< 10	< 10	< 10	< 10	< 10
03/25/91	< 10	< 10	< 10	< 10	< 9	< 20	< 20	< 20	< 10	< 20
04/01/91	< 10	< 10	< 10	< 10	< 9	< 9	< 0.6	< 10	< 6	< 9

(a) Timer malfunction; low sample volume.
(b) Unit serviced.
(c) Sample was not placed.

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										
04/08/91	< 10	< 10	< 10	< 10	< 8	< 10	< 20	< 20	< 10	< 20
04/15/91	< 9	< 9	< 9	< 9	< 5	< 10	< 10	< 10	< 10	< 8 (a)
04/22/91	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 6	< 10
04/29/91	< 10	< 9	< 10	< 10	< 6	< 10	< 10	< 10	< 10	< 10
MAY										
05/06/91	< 6	< 7	< 6	< 6	< 4	< 10	< 8	< 8	< 7	< 8
05/13/91	< 20	< 20	< 20	< 20	< 5 (b)	< 6 (b)	< 10	< 10	< 5	< 10
05/20/91	< 10	< 9	< 9	< 20	< 7	< 10	< 10	< 10	< 20 (b)	< 10
05/27/91	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 7	< 10
06/03/91	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 5	< 10
JUNE										
06/10/91	< 10	< 10	< 10	< 10	< 9	< 20	< 20	< 20	< 10	< 20
06/17/91	< 10	< 10	< 10	< 10	< 9 (a)	< 20	< 20	< 20	< 10	< 20
06/24/91	< 10	< 10	< 10	< 10	< 5 (a)	< 9	< 9	< 9	< 5	< 9
07/01/91	< 10	< 10	< 10	< 10	< 3 (a)	< 10	< 10	< 10	< 9	< 10

(a) Timer malfunction; results in total pCi.
(b) [illegible] fuse; unit found off. Results in total pCi.

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
JULY										
07/08/91	< 10	< 10	< 10	< 10	< 7	< 20	< 20	< 20	< 10	< 20
07/15/91	< 10	< 10	< 20	< 10	< 6	< 20	< 20	< 20 (a)	< 10	< 20
07/22/91	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 6	< 10
07/29/91	< 10	< 10	< 10	< 10	< 9	< 10	< 10	< 10	< 6	< 10
AUGUST										
08/05/91	< 10	< 10	< 10	< 10	< 8	< 10	< 10	< 10	< 9	< 10
08/12/91	< 20	< 20	< 20	< 20	< 50 (b)	< 10	< 10	< 10	< 9	< 10
08/19/91	< 10	< 10	< 10	< 10	< 30 (b)	< 10	< 10	< 10	< 20	< 10
08/26/91	< 20	< 10	< 20	< 20	< 5	< 20	< 20	< 20	< 10	< 20
09/02/91	< 10	< 10	< 10	< 10	< 6	< 10	< 10	< 10	< 6	< 10
SEPTEMBER										
09/09/91	< 10	< 10	< 10	< 10	< 9	< 10	< 10	< 10	< 6	< 10
09/16/91	< 10	< 10	< 10	< 10	< 9	< 10	< 10	< 10	< 6	< 10
09/23/91	< 10	< 10	< 10	< 10	< 6	< 10	< 10	< 10	< 5	< 10
09/30/91	< 10	< 10	< 10	< 10	< 5	< 10	< 10	< 10	< 9	< 10

(a) Clock disconnected.
(b) Elevated result due to low volume.

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										
10/07/91	< 9	< 9	< 9	< 9	< 8	< 10	< 10	< 10	< 6	< 10
10/14/91	< 10	< 10	< 10	< 10	< 20	< 20	< 20	< 20	< 10	< 10
10/21/91	< 20	< 20	< 20	< 20	< 6	< 20	< 20	< 20	< 10	< 20
10/28/91	< 9	< 9	< 9	< 9	< 5	< 10	< 10	< 10	< 9	< 10
NOVEMBER										
11/04/91	< 10	< 10	< 10	< 10	< 8	< 10	< 10	< 10	< 9	< 10
11/11/91	< 10	< 10	< 10	< 10	< 5	< 9	< 9	< 9	< 6	< 10
11/18/91	< 10	< 10	< 10	< 10	< 9	< 10	< 10	< 10	< 5	< 10
11/25/91	< 20	< 20	< 20	< 20	< 7	< 6	< 6	< 6	< 3	< 6
12/02/91	< 10	< 10	< 20	< 20	< 8	< 20	< 20	< 10	< 10	< 20
DECEMBER										
12/09/91	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 60	< 10
12/16/91	< 10	< 10	< 10	< 10	< 5	< 10	< 10	< 10	< 9	< 10
12/23/91	< 20	< 20	< 20	< 20	< 9	< 10	< 10	< 10	< 5	< 9
12/30/91	< 10	< 10	< 10	< 10	< 6	< 10	< 10	< 10	< 7	< 10

TABLE B-4

INDIANA MICHIGAN POWER C[illegible]NY - DONALD C. COOK NUCLEAR PLANT

DIRECT MEASUREM[illegible]S - QUARTERLY TLD RESULTS

Results in Units of mR/standard month

STATION CODES	FIRST QUARTER 01/27/91-04/28/91	SECOND QUARTER 04/28/91-07/28/91	THIRD QUARTER 07/28/91-10/13/91	FOURTH QUARTER 10/13/91-01/04/92	AVERAGE ± 2 s.d.
A-1	6.5 ± 0.5	3.0 ± 0.3	4.5 ± 0.6	3.9 ± 0.5	4.5 ± 3.0
A-2	5.7 ± 0.6	3.1 ± 0.2	4.4 ± 0.2	4.0 ± 0.3	4.3 ± 2.2
A-3	6.1 ± 0.7	3.0 ± 0.4	4.2 ± 0.2	4.1 ± 0.2	4.4 ± 2.6
A-4	4.6 ± 0.7	2.6 ± 0.3	4.2 ± 0.3	4.0 ± 0.2	3.9 ± 1.7
A-5	6.0 ± 0.3	2.8 ± 0.5	4.1 ± 0.4	3.9 ± 0.2	4.2 ± 2.7
A-6	5.1 ± 0.4	2.3 ± 0.2	4.2 ± 0.2	3.9 ± 0.2	3.9 ± 2.3
A-7	5.0 ± 0.4	3.1 ± 0.4	4.4 ± 0.2	4.2 ± 0.3	4.2 ± 1.6
A-8	4.5 ± 0.6	3.1 ± 0.5	4.1 ± 0.3	4.0 ± 0.5	3.9 ± 1.2
A-9	5.1 ± 1.2	3.2 ± 0.4	4.9 ± 1.0	4.2 ± 0.2	4.4 ± 1.7
A-10	4.4 ± 0.6	2.5 ± 0.2	4.0 ± 0.3	3.6 ± 0.3	3.6 ± 1.6
A-11	4.2 ± 0.5	3.2 ± 0.4	4.4 ± 0.4	4.1 ± 0.2	4.0 ± 1.1
A-12	4.5 ± 0.9	3.3 ± 0.4	4.5 ± 0.5	4.2 ± 0.4	4.1 ± 1.1
OFS-1	4.4 ± 0.7	2.9 ± 0.4	4.4 ± 0.3	3.9 ± 0.8	3.9 ± 1.4
OFS-2	4.5 ± 0.5	3.1 ± 0.2	4.5 ± 0.5	4.1 ± 0.2	4.1 ± 1.3
OFS-3	4.7 ± 0.6	3.3 ± 0.3	4.7 ± 0.5	4.2 ± 0.5	4.2 ± 1.3
OFS-4	5.0 ± 0.9	3.3 ± 0.2	5.0 ± 0.6	4.4 ± 0.4	4.4 ± 1.6
OFS-5	4.7 ± 0.6	3.3 ± 0.4	4.9 ± 0.3	4.5 ± 0.4	4.4 ± 1.4
OFS-6	5.3 ± 0.6	4.4 ± 0.6	5.7 ± 0.7	5.6 ± 0.9	5.3 ± 1.2
OFS-7	4.5 ± 0.5	2.9 ± 0.2	4.5 ± 0.3	4.0 ± 0.1	4.0 ± 1.5
OFS-8	4.9 ± 0.6	4.1 ± 0.7	5.5 ± 0.7	5.1 ± 0.4	4.9 ± 1.2
OFS-9	6.5 ± 0.3	3.4 ± 0.2	5.0 ± 0.5	4.6 ± 0.2	4.9 ± 2.6
OFS-10	6.1 ± 0.5	3.0 ± 0.3	4.7 ± 0.8	3.9 ± 0.2	4.4 ± 2.6
OFS-11	5.5 ± 0.8	3.9 ± 0.4	5.6 ± 0.5	4.8 ± 0.6	5.0 ± 1.6
NBF	4.9 ± 1.1	3.2 ± 0.4	4.6 ± 0.5	4.2 ± 0.6	4.2 ± 1.5
SBN	5.4 ± 0.9	3.4 ± 0.3	5.2 ± 0.5	4.1 ± 0.2	4.5 ± 1.9
DOW	4.4 ± 0.7	2.9 ± 0.3	4.6 ± 0.7	3.5 ± 0.1	3.9 ± 1.6
COL	4.4 ± 0.6	2.8 ± 0.3	4.0 ± 0.2	3.5 ± 0.1	3.7 ± 1.4
Average ± 2 s.d.	**5.1 ± 1.4**	**3.2 ± 0.9**	**4.6 ± 0.9**	**4.2 ± 0.9**	**4.3 ± 1.6**

• 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.)	01/10/91	< 0.2	< 90	< 100
	02/07/91	< 0.2	< 100	
	03/07/91	< 0.2	< 100	
	04/04/91	< 0.3	< 100	170 ± 90
	05/02/91	< 0.3	< 10 (a)	
	05/30/91	< 0.2	< 40	
	06/27/91	< 0.1	< 70	
	07/25/91	< 0.09	< 50	220 ± 80
	08/22/91	< 0.2	< 40	
	09/19/91	< 0.2	< 50	
	10/17/91	< 0.2	< 100	130 ± 70
	11/14/91	< 0.1	< 100	
	12/12/91	< 0.5	< 90	
L-2 (South Comp)	01/10/91	< 0.1	< 60	< 100
	02/07/91 (b)			
	03/07/91 (b)			
	04/04/91	< 0.3	< 200	200 ± 110
	05/02/91	< 0.2	< 20	
	05/30/91	< 0.2	< 60	
	06/27/91	< 0.2	< 100	
	07/25/91	< 0.1	< 100	320 ± 80
	08/22/91	< 0.1	< 100	
	09/19/91	< 0.2	< 50	
	10/17/91	< 0.2	< 100	230 ± 70
	11/14/91	< 0.2	< 100	
	12/12/91	< 0.3	< 100	

* Typical LLDs are found in Table B-12. All other gamma emitters were below <LLD.
(a) [illegible]balt-60 was measured at 3.71 ± 0.95 pCi/l and confirmed by [illegible]cond aliquot.
([illegible] [illegible]nple not available due to ice on the shoreline.

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)	01/10/91	< 0.2	< 50	< 100
	02/07/91 (a)			
	03/07/91 (a)			
	04/04/91	< 0.2	< 100	400 ± 80
	05/02/91	< 0.2	< 20	
	05/30/91	< 0.2	< 100	
	06/27/91	< 0.2	< 60	
	07/25/91	< 0.1	< 100	200 ± 80
	08/22/91	< 0.1	< 100	
	09/19/91	< 0.2	< 200	
	10/17/91	< 0.2	< 100	310 ± 80
	11/14/91	< 0.1	< 50	
	12/12/91	< 0.2	< 100	
L-4 (South 500)	01/10/91	< 0.2	< 100	< 100
	02/07/91 (a)			
	03/07/91 (a)			
	04/04/91	< 0.2	< 60	180 ± 80
	05/02/91	< 0.3	< 50	
	05/30/91	< 0.2	< 50	
	06/27/91	< 0.2	< 100	
	07/25/91	< 0.1	< 60	180 ± 110
	08/22/91	< 0.1	< 50	
	09/19/91	< 0.1	< 100	
	10/17/91	< 0.2	< 50	200 ± 110
	11/14/91	< 0.1	< 50	
	12/12/91	< 0.2	< 80	

* Typical LLDs are found in Table B-12. All other gamma emitters were below <LLD.
(a) Sample not available due to ice on the shoreline.

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)	01/10/91	< 0.2	< 100	< 100
	02/07/91 (a)			
	03/07/91 (a)			
	04/04/91	< 0.2	< 100	320 ± 80
	05/02/91	< 0.2	40.6 ± 12.8	
	05/30/91	< 0.2	< 100	
	06/27/91	< 0.2	< 100	
	07/25/91	< 0.1	< 60	310 ± 110
	08/22/91	< 0.1	< 40	
	09/19/91	< 0.1	< 60	
	10/17/91	< 0.2	< 100	210 ± 110
	11/14/91	< 0.1	< 60	
	12/12/91	< 0.3	< 90	

* Typical LLDs are found in Table B-12.
(a) Sample not available due to ice on the shoreline.

TABLE B-6

INDIANA MICHIGAN POW[illegible]MPANY - DONALD C. COOK NUCLEAR PLANT

CONCENTRATIONS OF TRITIUM A[illegible]AMMA EMITTERS* IN QUARTERLY GROUND WATER

Results in Units of pCi/liter ± 2 sigma

STATION	Collection Date	I-131	Gamma Spec	Tritium
Well - 1	02/03/91	< 0.1	< LLD	< 200
Rosemary Beach	05/05/91	< 0.1	< LLD	210 ± 110
	08/04/91	< 0.1	< LLD	< 200
	11/02/91	< 0.2	< LLD	< 100
Well - 2	02/03/91	< 0.1	< LLD	< 200
Training Center	05/05/91	< 0.1	< LLD	< 200
	08/04/91	< 0.1	< LLD	< 200
	11/02/91	< 0.2	< LLD	< 200
Well - 3	02/03/91 (a)	< 0.2	< LLD	< 100
Firearms Range	05/05/91	< 0.1	< LLD	< 200
	08/04/91	< 0.1	< LLD	< 200
	11/02/91	< 0.2	< LLD	< 200
Well - 4	02/03/91	< 0.1	< LLD	< 2000
Onsite	05/05/91	< 0.1	< LLD	350 ± 120
	08/04/91	< 0.1	< LLD	1200 ± 100
	11/02/91	< 0.3	< LLD	1300 ± 100
Well - 5	02/03/91	< 0.2	< LLD	< 2000
Onsite	05/05/91	< 0.1	< LLD	570 ± 120
	08/04/91	< 0.1	< LLD	560 ± 140
	11/02/91	< 0.2	< LLD	686 ± 160
Well - 6	02/03/91	< 0.1	< LLD	< 2000
Onsite	05/05/91	< 0.1	< LLD	610 ± 130
	08/04/91	< 0.1	K-40 = 57.2 ± 27.3	< 200
	11/02/91	< 0.2	< LLD	230 ± 100
Well - 7	02/03/91	< 0.1	< LLD	< 100
Livingston Beach	05/05/91	< 0.1	< LLD	< 200
	08/04/91	< 0.1	< LLD	1200 ± 100
	11/02/91	< 0.2	< LLD	1700 ± 200
Average ± 2 s.d.			**K-40 = 57.2 ± 27.3**	**783 ± 982**

* Typical LLDs are found in Table B-12.

(a) Hole in sample container. Bottle was empty upon arrival at TI. Substitute sample received 2/11/92.

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				
01/10/91	5.5 ± 1.1	< LLD	< 0.3	180 ± 110
01/24/92	3.0 ± 1.0	< LLD	< 0.2	
02/07/91	3.6 ± 1.0	< LLD	< 0.4	
02/21/91	3.2 ± 1.0	< LLD	< 0.3	
03/07/91	7.3 ± 1.3	< LLD	< 0.2	
03/21/91	4.9 ± 1.1	< LLD	< 0.3	
04/04/91	3.2 ± 1.0	< LLD	< 0.4	
04/18/91	3.6 ± 0.9	< LLD	< 0.3	< 100
05/02/91	6.4 ± 1.2	< LLD	< 0.3	
05/16/91	3.7 ± 1.0	< LLD	< 0.2	
05/30/91	4.3 ± 0.9	< LLD	< 0.2	
06/13/91	4.4 ± 1.1	< LLD	< 0.2	
06/27/91	4.4 ± 1.0	< LLD	< 0.2	
07/11/91	4.3 ± 1.1	< LLD	< 0.3	180 ± 100
07/25/91	8.3 ± 1.3	< LLD	< 0.2	
08/08/91	2.8 ± 1.0	< LLD	< 0.2	
08/22/91	3.9 ± 1.0	< LLD	< 0.2	
09/05/91	3.2 ± 1.0	< LLD	< 0.2	
09/19/91	6.1 ± 1.2	< LLD	< 0.1	
10/03/91	3.4 ± 0.9	< LLD	< 0.2	230 ± 100
10/17/91	5.4 ± 1.1	< LLD	< 0.2	
10/31/91	3.2 ± 1.1	< LLD	< 0.2	
11/14/91	4.1 ± 1.1	< LLD	< 0.2	
11/28/91	2.8 ± 0.9	< LLD	< 0.1	
12/12/91	3.9 ± 1.0	< LLD	< 0.5	
12/26/91	2.8 ± 0.9	< LLD	< 0.2	
Average ± 2 [illegible]	**4.3 ± 2.9**			**197 ± 58**

* 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				
01/10/91	5.1 ± 1.1	< LLD	< 0.3	< 200
01/24/91	3.0 ± 1.0	< LLD	< 0.3	
02/07/91	4.9 ± 1.7	< LLD	< 0.3	
02/21/91	2.2 ± 1.0	< LLD	< 0.3	
03/07/91	6.9 ± 1.3	< LLD	< 0.3	
03/21/91	5.9 ± 1.2	< LLD	< 0.3	
04/04/91	3.1 ± 1.1	< LLD	< 0.4	
04/18/91	5.7 ± 1.1	< LLD	< 0.4	< 200
05/02/91	4.4 ± 1.1	< LLD	< 0.3	
05/16/91	3.4 ± 1.0	< LLD	< 0.2	
05/30/91	5.4 ± 1.0	< LLD	< 0.3	
06/13/91	3.2 ± 1.0	< LLD	< 0.2	
06/27/91	2.6 ± 0.9	< LLD	< 0.2	
07/11/91	5.6 ± 1.2	< LLD	< 0.3	210 ± 100
07/25/91	5.9 ± 1.1	< LLD	< 0.2	
08/08/91	2.5 ± 1.0	< LLD	< 0.2	
08/22/91	3.6 ± 0.9	< LLD	< 0.2	
09/05/91	4.0 ± 1.0	< LLD	< 0.2	
09/19/91	3.5 ± 1.0	< LLD	< 0.1	
10/03/91	3.3 ± 1.0	< LLD	< 0.2	160 ± 90
10/17/91	3.1 ± 0.9	< LLD	< 0.2	
10/31/91	3.4 ± 1.1	< LLD	< 0.3	
11/14/91	4.5 ± 1.1	< LLD	< 0.3	
11/28/91	3.8 ± 1.0	< LLD	< 0.4	
12/12/91	3.9 ± 1.0	< LLD	< 0.2	
12/26/91	3.7 ± 1.0	< LLD	< 0.4	
Average ± 2 s. d.	4.1 ± 2.5			185 ± 71

* 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	05/18/91	< 200	4980 ± 500	< 30	< 400	107 ± 18
L-3	05/18/91	< 200	6450 ± 650	< 30	< 400	112 ± 36
L-4	05/18/91	< 200	5640 ± 560	37.5 ± 19.0	< 500	153 ± 37
L-5	05/18/91	< 200	6160 ± 620	< 30	< 400	108 ± 22
L-2	11/17/91	< 200	5710 ± 570	< 20	< 300	157 ± 30
L-3	11/17/91	< 200	6250 ± 620	< 20	< 400	118 ± 20
L-4	11/17/91	< 200	4960 ± 500	< 30	< 400	< 50
L-5	11/17/91	< 200	6740 ± 670	< 20	< 300	89.0 ± 14.7
Average ± 2 s.d.			5861 ± 1314	37.5 ± 19.0		121 ± 50

* [illegible]cal LLDs are found in table B-12.

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	SHULER	TOTZKE	STATION CODES LOZMACK	WARMBIEN	ZELMER	LIVINGSTON	WYANT
01/11/91	K-40	1230 ± 120	1530 ± 150	1290 ± 130	1290 ± 130	1350 ± 130	1200 ± 120	1030 ± 100
	I-131	< 0.3	< 0.3	< 0.3	< 0.4	< 0.2	< 0.3	< 0.3
01/25/91	K-40	1420 ± 140	1390 ± 140	1300 ± 130	1390 ± 130	1450 ± 150	1360 ± 140	1240 ± 120
	I-131	< 0.1	< 0.2	< 0.1	< 0.2	< 0.2	< 0.1	< 0.2
02/08/91	K-40	1360 ± 140	1270 ± 130	1300 ± 130	1340 ± 130	881 ± 88	911 ± 91	945 ± 94
	I-131	< 0.3	< 0.3	< 0.3	< 0.4	< 0.4	< 0.3	< 0.3
02/22/91	K-40	927 ± 93	1180 ± 120	1230 ± 120	1360 ± 140	1260 ± 130	1410 ± 140	1320 ± 130
	I-131	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1
03/08/91	K-40	1250 ± 130	1360 ± 140	1300 ± 130	1280 ± 130	1380 ± 140	1250 ± 130	1210 ± 120
	I-131	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
03/22/91	K-40	1150 ± 120	1360 ± 140	1310 ± 130	1270 ± 130	1400 ± 140	1200 ± 120	1220 ± 120
	I-131	< 0.2	< 0.2	< 0.2	< 0.1	< 0.1	< 0.1	< 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	LOZMACK	WARMBIEN	ZELMER	LIVINGSTON	WYANT
04/05/91	K-40	1370 ± 140	1280 ± 130	1320 ± 130	1310 ± 130	1260 ± 130	1030 ± 100	1270 ± 130
	I-131	< 0.5	< 0.3	< 0.3	< 0.2	< 0.5	< 0.2	< 0.5
04/19/91	K-40	1190 ± 120	1520 ± 150	1270 ± 130	1320 ± 130	1430 ± 140	1310 ± 130	1130 ± 110
	I-131	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
05/03/91	K-40	1310 ± 130	1500 ± 150	1270 ± 130	1290 ± 130	1210 ± 120 (a)	1400 ± 140	1400 ± 140
	I-131	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.2
05/17/91	K-40	1200 ± 120	1330 ± 130	1400 ± 140	1420 ± 140	1230 ± 120	1400 ± 140	1340 ± 130
	I-131	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.2	< 0.2
05/31/91	K-40	1320 ± 130	1400 ± 140	1380 ± 140	1240 ± 120	1310 ± 130	1400 ± 140	1180 ± 120
	I-131	< 0.1	< 0.1	< 0.1	< 0.09	< 0.1	< 0.1	< 0.1
06/14/91	K-40	1300 ± 130	1210 ± 120	1320 ± 130	1400 ± 140	1430 ± 140	1270 ± 130	688 ± 69
	I-131	< 0.1	< 0.6	< 0.5	< 0.6	< 0.2	< 0.1	< 0.2
06/28/91	K-40	1380 ± 140	1390 ± 140	1340 ± 130	1320 ± 130	1250 ± 120	1320 ± 130	1300 ± 130
	I-131	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

* Typ[illegible]LDs are found in table B-12. All other gamma emitters were [illegible].
(a) Ces[illegible]37 was measured at 3.29 ± 1.63 pCi/liter.

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	LOZMACK	WARMBIEN	ZELMER	LIVINGSTON	WYANT
07/12/91	K-40 I-131	1050 ± 100 < 0.1	1390 ± 140 < 0.1	1210 ± 120 < 0.1	1400 ± 140 < 0.1	1520 ± 150 < 0.1	1330 ± 130 < 0.1	1170 ± 120 < 0.1
07/26/91	K-40 I-131	919 ± 92 < 0.1	931 ± 93 < 0.1	1190 ± 120 < 0.1	1320 ± 130 < 0.1	1310 ± 130 < 0.1	1320 ± 130 < 0.1	1300 ± 130 < 0.1
08/09/91	K-40 I-131	1230 ± 120 < 0.1	1320 ± 130 < 0.1	1290 ± 130 < 0.1	1360 ± 140 < 0.1	1450 ± 150 (a) < 0.1	1250 ± 130 < 0.2	1090 ± 100 < 0.1
08/23/91	K-40 I-131	1350 ± 130 < 0.1	1370 ± 140 < 0.1	1350 ± 140 < 0.2	1330 ± 130 < 0.1	1280 ± 130 < 0.1	1310 ± 130 < 0.1	1320 ± 130 (b) < 0.2
09/06/91	K-40 I-131	1400 ± 140 < 0.1	1290 ± 130 < 0.1	1260 ± 130 < 0.1	1330 ± 130 < 0.1	1340 ± 130 < 0.1	1180 ± 120 < 0.2	1330 ± 130 < 0.1
09/20/91	K-40 I-131	1350 ± 140 < 0.1	1460 ± 150 < 0.1	1310 ± 130 < 0.2	1270 ± 130 < 0.1	1170 ± 120 < 0.1	1400 ± 140 < 0.2	1260 ± 130 < 0.1

* Typical LLDs are found in table B-12. All other gamma emitters were <LLD.
(a) Cesium-137 was measured at 8.93 ± 4.82 pCi/liter.
(b) Cesium-137 was measured at 4.73 ± 2.72 pCi/liter.

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	SHULER	TOTZKE	STATION CODES LOZMACK	WARMBIEN	ZELMER	LIVINGSTON	WYANT
10/04/91	K-40	1140 ± 110	1440 ± 140	1490 ± 150	1130 ± 110	1260 ± 130	1370 ± 140	1210 ± 120
	I-131	< 0.1	< 0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2
10/18/91	K-40	1370 ± 140	1520 ± 150	1200 ± 120	1180 ± 120	1340 ± 130	1270 ± 130	1340 ± 130
	I-131	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2
11/01/91	K-40	1380 ± 140	1480 ± 150	1040 ± 100	1420 ± 140	1480 ± 150	1250 ± 130	1100 ± 110
	I-131	< 0.1	< 0.1	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2
11/15/91	K-40	1380 ± 140	1600 ± 160	1160 ± 120	1500 ± 150	1480 ± 150	1300 ± 130	1240 ± 120
	I-131	< 0.2	< 0.2	< 0.2	< 0.1	< 0.1	< 0.2	< 0.2
11/29/91	K-40	1160 ± 120	1420 ± 140	1300 ± 130	1380 ± 140	1400 ± 140	1320 ± 130	1230 ± 120
	I-131	< 0.4	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
12/13/91	K-40	1390 ± 140	1450 ± 140	1230 ± 120	1340 ± 130	1390 ± 140	1250 ± 130	1240 ± 120
	I-131	< 0.1	< 0.2	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1
12/27/91	K-40	1250 ± 130	1330 ± 130	1180 ± 120	1410 ± 140	1400 ± 140	1370 ± 140	1200 ± 120
	I-131	< 0.2	< 0.1	< 0.1	< 0.3	< 0.1	< 0.2	< 0.1

* Ty[illegible]LLDs are found in table B-12. All other gamma emitters we[illegible]D.

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
05/22/91	ONS-North	White Sucker	< 400	2100 ± 460	< 40	< 700	< 60
05/16/90	OFS-North	Long Nose Sucker	< 300	2800 ± 530	65.8 ± 25.9	< 500	< 50
05/16/90	ONS-South	Yellow Long Nose	< 400	2040 ± 350	< 40	< 900	< 70
05/16/90	OFS-South	Yellow Long Nose	< 400	2450 ± 480	< 40	< 700	< 70
10/03/91	ONS -North	White Sucker	< 400	3010 ± 390	< 40	< 500	< 50
10/03/91	OFS-North	Lake Trout	< 300	2950 ± 380	< 30	< 500	< 40
10/03/91	ONS-South	White Sucker	< 400	2330 ± 330	< 30	< 600	< 50
10/03/91	OFS-South	Long Nose Sucker	< 400	3190 ± 470	< 40	< 600	< 60
Average ± 2 s.d.				2609 ± 874	65.8 ± 25.9		

* Typical LLDs are found in table B-12.

TABLE B-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
08/10/91	SECTOR-J	Broad Leaves	906 ± 126	3790 ± 380	< 5	45.1 ± 12.3
08/11/91	SECTOR-J	Grapes	< 100	2170 ± 240	< 40	< 20
08/11/91	SECTOR-J	Grapes	< 100	1710 ± 190	< 40	< 20
08/11/91	SECTOR-J	Leaves	915 ± 127	3880 ± 390	< 60	< 10
08/11/91	SECTOR-J	Leaves	920 ± 175	2710 ± 280	< 50	< 20
Average ± 2 s.d.			914 ± 14	2852 ± 1930		45.1 ± 12.3

* ...ical LLDs are found in table B-12.

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 B-12 (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	0.01 pCi/m^3	N/A
Surface Water (c)	2	4.0 pCi/l	N/A
Ground Water	2	4.0 pCi/l	N/A
Drinking Water	2	4.0 pCi/l	N/A
	Tritium		
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.
(c) Based on the assumptions in procedure PRO-032-1.

APPENDIX C
ANALYTICAL PROCEDURES SYNOPSIS

ANALYTICAL PROCEDURES SYNOPSIS

Appendix C is a synopsis of the analytical procedures perform[ed] during 1991 on samples collected for the D.C. Cook Power Statio[n] 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.

ANALYSIS TITLE — **PAGE**

GROSS BETA ANALYSIS OF SAMPLES

Air 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 D. C. Cook, 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) = $4.66\ (B^{1/2})/(2.22\ V\ E\ t)$

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 as measured by a conductivity meter. 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

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	=	$2(3.234)\ T_N V_N (E)^{1/2}/(C_N V_S)$
LLD	=	$3.3\ (3.234) T_N V_N (E)^{1/2}/(C_N V_S)$

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 net cpm of the standard of volume V_N
CG	=	the gross cpm of the sample of volume V_S
B	=	the background of the detector in cpm
Δt	=	counting time for the sample
E	=	$S/T^2 + B/t^2$

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 dissolved and precipitated as $SrNO_3$ 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 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 hydrachloric 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/cm2 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 by 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 low 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 = $(N/Dt-B_C-B_A)/(2.22\ V\ Y_S\ DF_{SR-89}\ E_{SR-89})$

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

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

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 configura
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 fror "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 tim 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, is reduced with hydroxylamine hydrochloride and is extracted into carbon tetrachloride as free iodine. It is then back-extracted as iodide into sodium bisulfite solution and is precipitated as palladium iodide. The 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 = $(N/\Delta t - B)/(2.22\ E\ V\ Y\ DF)$

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	=	$E_s(\exp{-0.0061M})/(\exp{-0.0061M_s})$
E_s	=	efficiency of the counter determined from an I-131 standard mount
Ms	=	mass of $Pd1_2$ on the standard mount, mg
M	=	mass of PDI_2 on the sample mount, mg

Air Particulate

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

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.

ENVIRONMENTAL DOSIMETRY

Teledyne Isotopes uses a $CaSO_4$:Dy thermoluminescent dosime (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 US 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 1991 data summary tables are presented for isotopes in the various sample media applicable to the Donald C. Cook Power Stations 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 1991
(Environmental)

Collection Date	Media	Nuclide	EPA Result(a)		Teledyne Isotopes Result(b)		
01/11/91	Water	Sr-89	5.00 ±	5.0	5.00 ±	0.00	
		Sr-90	5.00 ±	5.0	5.00 ±	0.00	
01/25/91	Water	Gr-Alpha	5.0 ±	5.0	9.00 ±	1.00	
		Gr-Beta	5.0 ±	5.0	7.00 ±	0.00	
02/08/91	Water	Co-60	40.0 ±	5.0	39.33 ±	3.06	
		Zn-65	149.0 ±	15.0	147.00 ±	1.00	
		Ru-106	186.0 ±	19.0	176.67 ±	17.56	
		Cs-134	8.0 ±	5.0	7.33 ±	0.58	
		Cs-137	8.0 ±	5.0	7.67 ±	3.21	
		Ba-133	75.0 ±	8.0	75.67 ±	5.51	
02/15/91	Water	I-131	75.0 ±	8.0	80.00 ±	5.29	
02/22/91	Water	H-3	4418.0 ±	442.0	4500.0 ±	173.21	
03/08/91	Water	Ra-226	31.8 ±	4.8	28.33 ±	4.73	
		Ra-228	21.1 ±	5.3	16.67 ±	2.08	
03/29/91	Air Filter	Gr-Alpha	25.0 ±	6.0	42.67 ±	0.58	(c)
		Gr-Beta	124.0 ±	6.0	126.67 ±	5.77	
		Sr-90	40.0 ±	5.0	37.00 ±	1.00	
		Cs-137	40.0 ±	5.0	43.00 ±	5.29	
04/16/91	Lab Perf. Water	Gr-Alpha	54.0 ±	14.0	59.67 ±	4.04	
		Ra-226	8.0 ±	1.2	7.33 ±	0.81	
		Ra-228	15.2 ±	3.8	10.00 ±	0.00	(d)
		Gr-Beta	115.0 ±	17.0	110.00 ±	0.00	
		Sr-89	28.0 ±	5.0	31.00 ±	1.00	
		Sr-90	26.0 ±	5.0	21.00 ±	0.00	
		Cs-134	24.0 ±	5.0	25.00 ±	1.00	
		Cs-137	25.0 ±	5.0	24.00 ±	1.73	
04/26/91	Milk	Sr-89	32.0 ±	5.0	24.00 ±	3.00	(e)
		Sr-90	32.0 ±	5.0	26.33 ±	2.08	
		I-131	60.0 ±	6.0	53.33 ±	2.31	
		Cs-137	49.0 ±	5.0	52.67 ±	1.53	
		K	1650.0 ±	83.0	1590.00 ±	81.85	

See footnotes at end of table.

US EPA INTERLABORATORY COMPARISON PROGRAM 1991
(Environmental)

Collection Date	Media	Nuclide	EPA Result(a)		Teledyne Isotopes Result(b)		
05/10/91	Water	Sr-89	39.0 ±	5.0	38.67 ±	4.51	
		Sr-90	24.0 ±	5.0	22.00 ±	1.73	
05/17/91	Water	Gr-Alpha	24.0 ±	6.0	24.33 ±	2.52	
		Gr-Beta	46.0 ±	5.0	50.33 ±	1.53	
06/07/91	Water	Co-60	10.0 ±	5.0	10.33 ±	0.58	
		Zn-65	108.0 ±	11.0	106.00 ±	2.65	
		Ru-106	149.0 ±	15.0	136.67 ±	3.79	
		Cs-134	15.0 ±	5.0	13.67 ±	1.53	
		Cs-137	14.0 ±	5.0	13.67 ±	1.53	
		Ba-133	62.0 ±	6.0	56.33 ±	1.53	
06/21/91	Water	H-3	12480 ±	1248.0	12833.33 ±	115.50	
07/12/91	Water	Ra-226	15.9 ±	2.4	15.0 ±	1.00	
		Ra-228	16.7 ±	4.2	14.33 ±	2[illegible]	
08/09/91	Water	I-131	20.0 ±	6.0	19.33 ±	0.58	
08/30/91	Air Filter	Gr-Alpha	25.0 ±	6.0	27.00 ±	2.00	
		Gr-Beta	92.0 ±	10.0	100.00 ±	0.00	
		Sr-90	30.0 ±	5.0	27.67 ±	2.89	
		Cs-137	30.0 ±	5.0	33.33 ±	3.21	
09/13/91	Water	Sr-89	49.0 ±	5.0	50.67 ±	2.89	
		Sr-90	25.0 ±	5.0	26.00 ±	1.00	
09/20/91	Water	Gr-Alpha	10.0 ±	5.0	11.67 ±	0.58	
		Gr-Beta	20.0 ±	5.0	21.00 ±	0.00	
09/27/91	Milk	Sr-89	25.0 ±	5.0	21.00 ±	2.65	
		Sr-90	25.0 ±	5.0	19.00 ±	0.00	(e)
		I-131	108.0 ±	11.0	113.33 ±	5.77	
		Cs-137	30.0 ±	5.0	29.00 ±	3.61	
		K	1740.0 ±	87.0	1503.33 ±	75.06	(f)

See footnotes at end of table.

US EPA INTERLABORATORY COMPARISON PROGRAM 1991
(Environmental)

Collection Date	Media	Nuclide	EPA Result(a)		Teledyne Isotopes Result(b)		
10/04/91	Lab Perf. Water	Co-60	29.0 ±	5.0	30.33 ±	2.08	
		Zn-65	73.0 ±	7.0	72.67 ±	7.09	
		Ru-106	199.0 ±	20.0	197.67 ±	7.51	
		Cs-134	10.0 ±	5.0	10.33 ±	0.58	
		Cs-137	10.0 ±	5.0	11.33 ±	0.58	
		Ba-133	98.0 ±	10.0	97.00 ±	8.72	
10/18/91	Water	H-3	2454.0 ±	353.0	2333.33 ±	57.74	
10/22/91	Lab Perf. Water	Gr-Alpha	82.0 ±	21.0	55.00 ±	4.36	(g)
		Ra-226	22.0 ±	3.3	21.00 ±	2.65	
		Ra-228	22.2 ±	5.6	18.00 ±	1.00	
		Gr-Beta	65.0 ±	10.0	56.00 ±	1.00	
		Sr-89	10.0 ±	5.0	10.67 ±	2.08	
		Sr-90	10.0 ±	5.0	9.33 ±	0.58	
		Co-60	20.0 ±	5.0	19.67 ±	0.58	
		Cs-134	10.0 ±	5.0	10.33 ±	2.08	
		Cs-137	11.0 ±	5.0	13.67 ±	0.58	
11/08/91	Water	Ra-226	6.5 ±	1.0	5.37 ±	0.32	
		Ra-228	8.1 ±	2.0	7.90 ±	1.20	

See footnotes at end of table.

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) The sample presents a different counting geometry. The EPA deposits activity in a 3/4 inch diameter circle, on a plastic disk approximately 3/32 inch thick. A special calibration for EPA filters will be performed. The laboratory has obtained blank filters from the Las Vegas facility, and will simulate their deposits.

(d) The lowest three results out of nine analyses were chosen. Other results in the group were close to the given value. Subsequent EPA analyses were accepted without selection, leading to acceptable results.

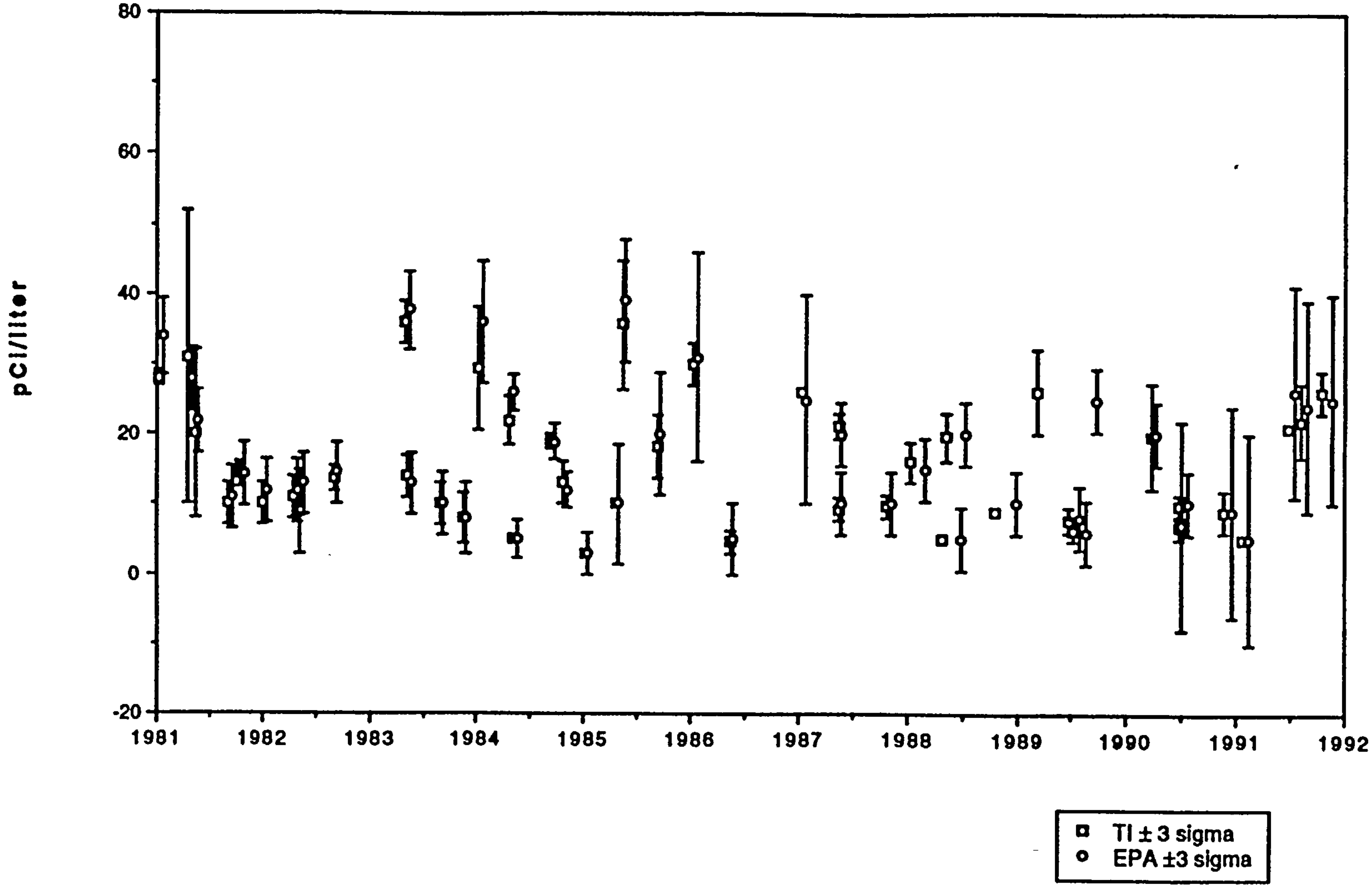
(e) The cause for the deviation is believed to be erroneously high strontium yields, probably caused by incomplete separation of calcium. The laboratory has investigated carrier concentrations and pipeting techniques, and have found them to be correct. Further aspects of analysts' techniques are being tested. The laboratory has received a new strontium extraction material developed at Argonne National Laboratory. Experiments with this method to achieve better separation of calcium were completed and procedure PRO-032-105 was implemented on 2/1/92.

(f) There is no apparent cause for the low K-40 results. Two other isotopes spiked in the sample were in good agreement with EPA values. Unit conversions were reviewed and found to be correctly applied. Possible background errors in geometry were investigated and found to have an insignificant effect.

(g) Probable failure to transfer all sample residue to the counting planchet. Analysts are being tested using in-house and other EPA spikes.

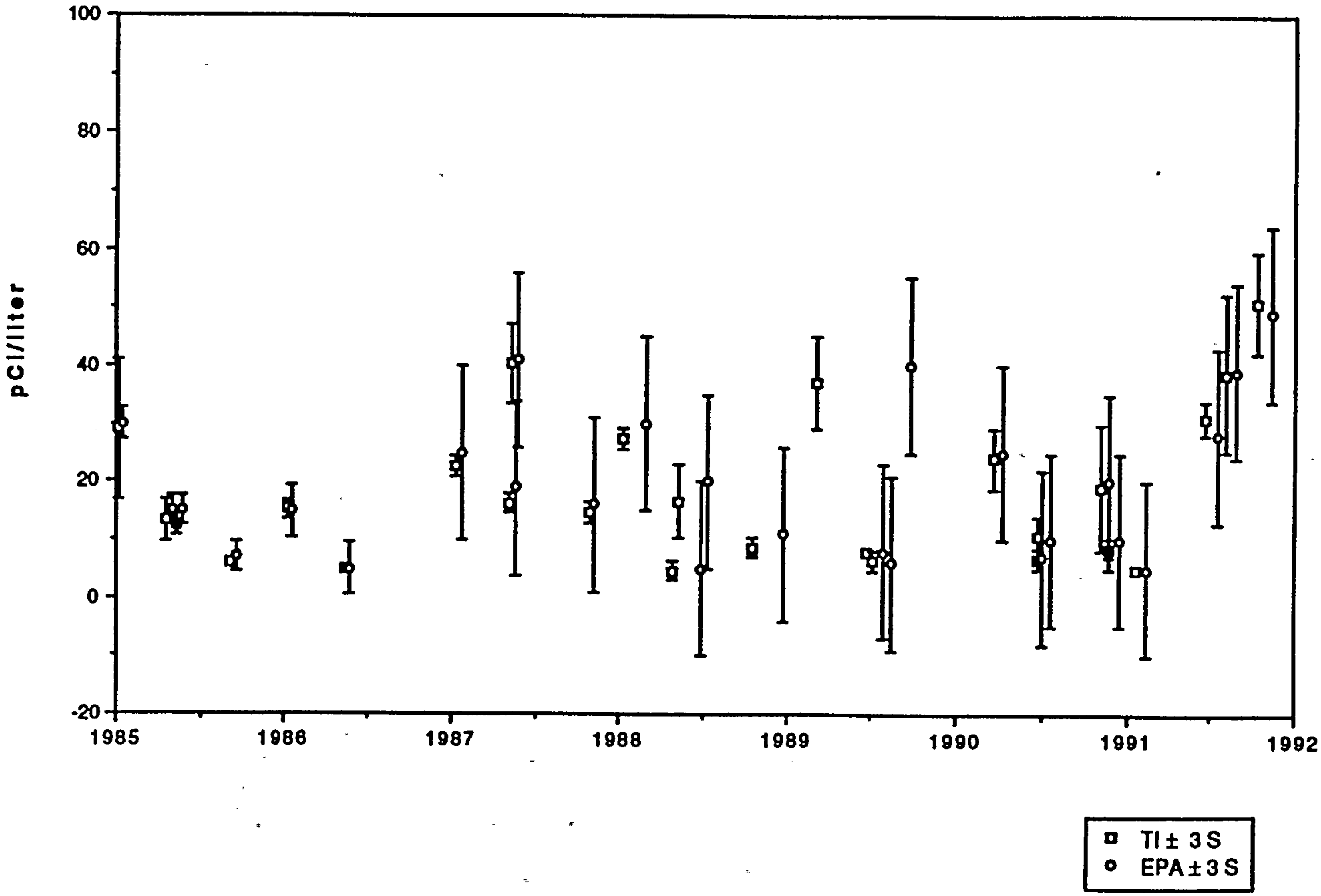
US EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN WATER



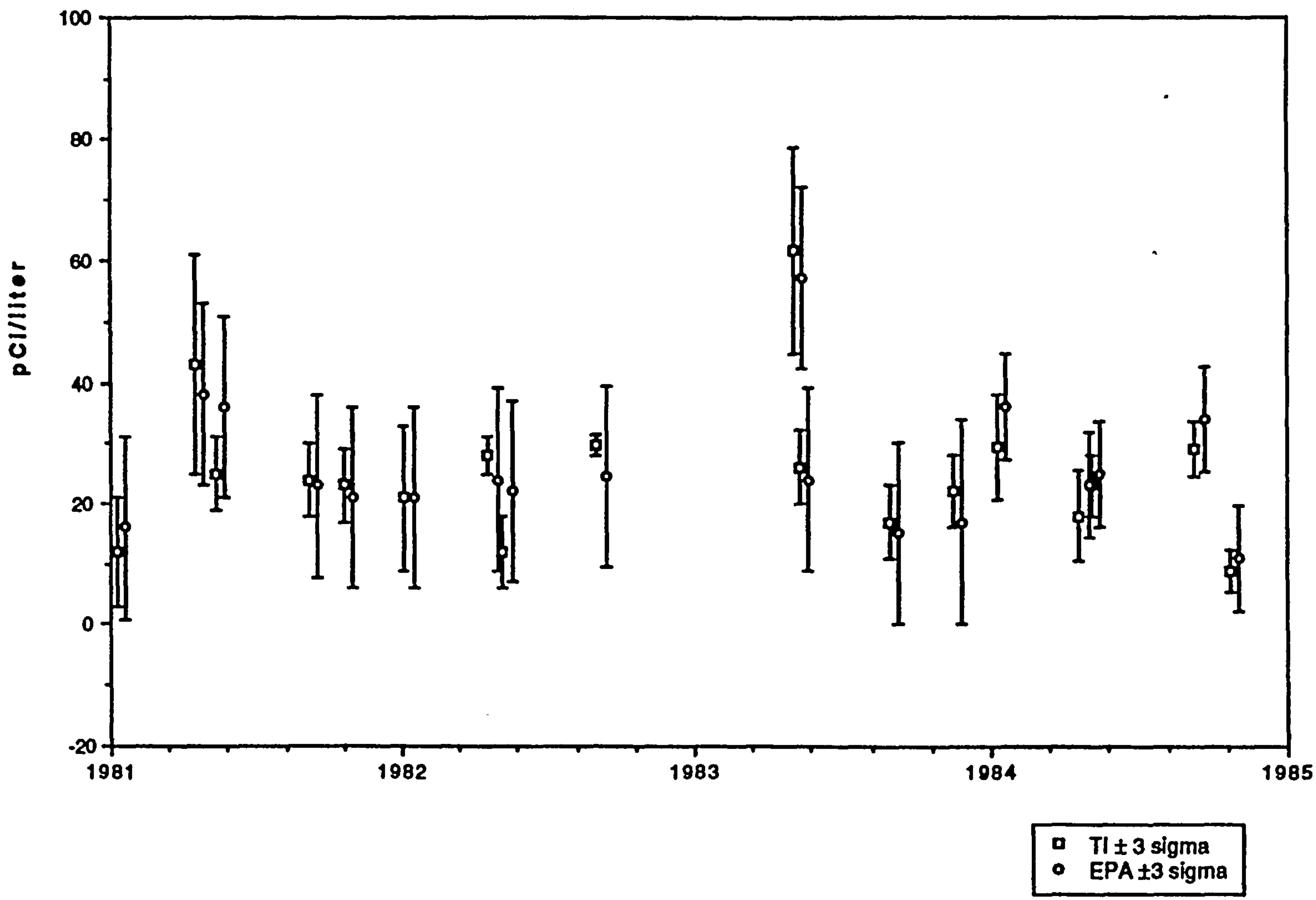
US EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER (Cont.)



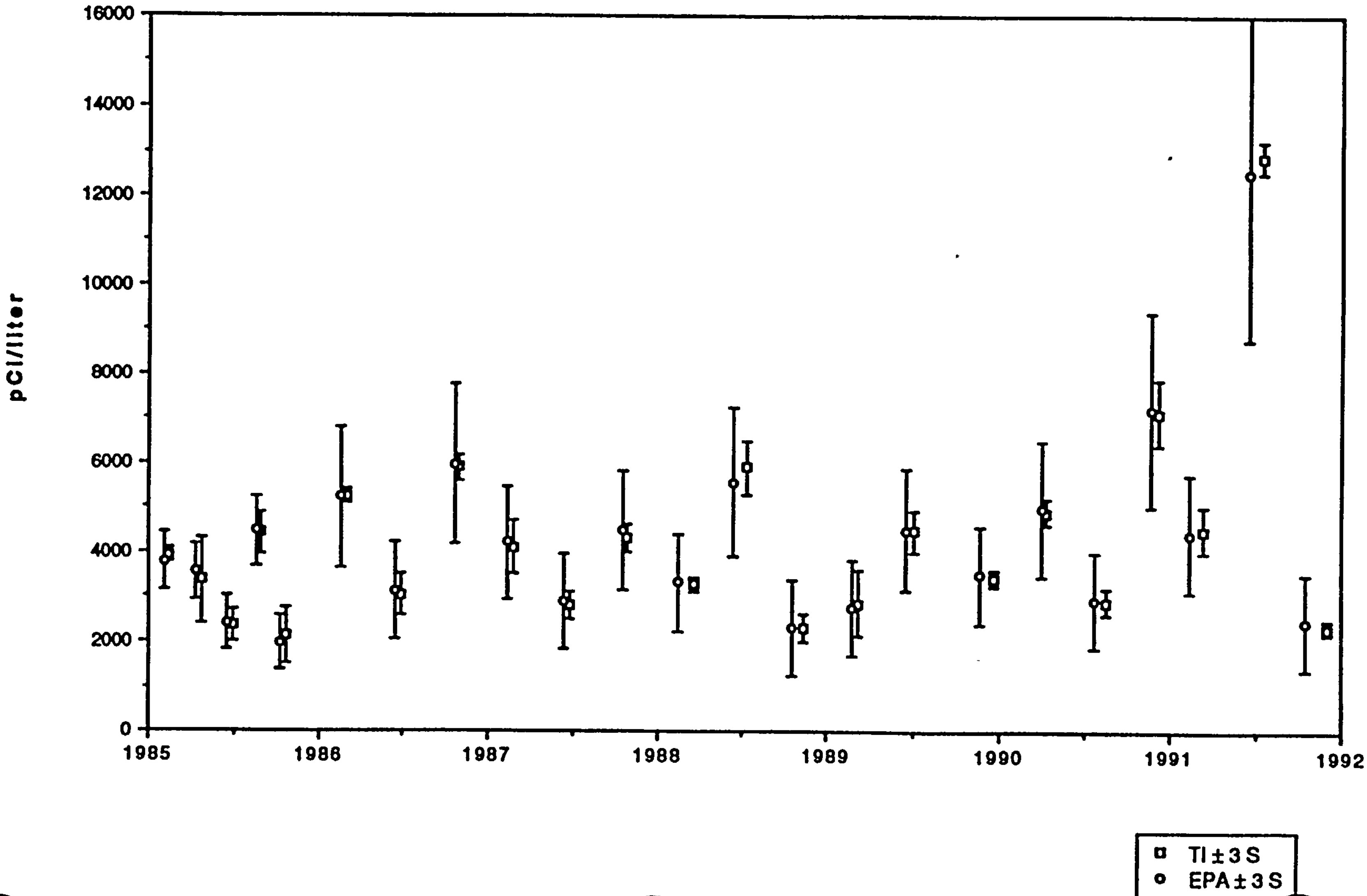
US EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER



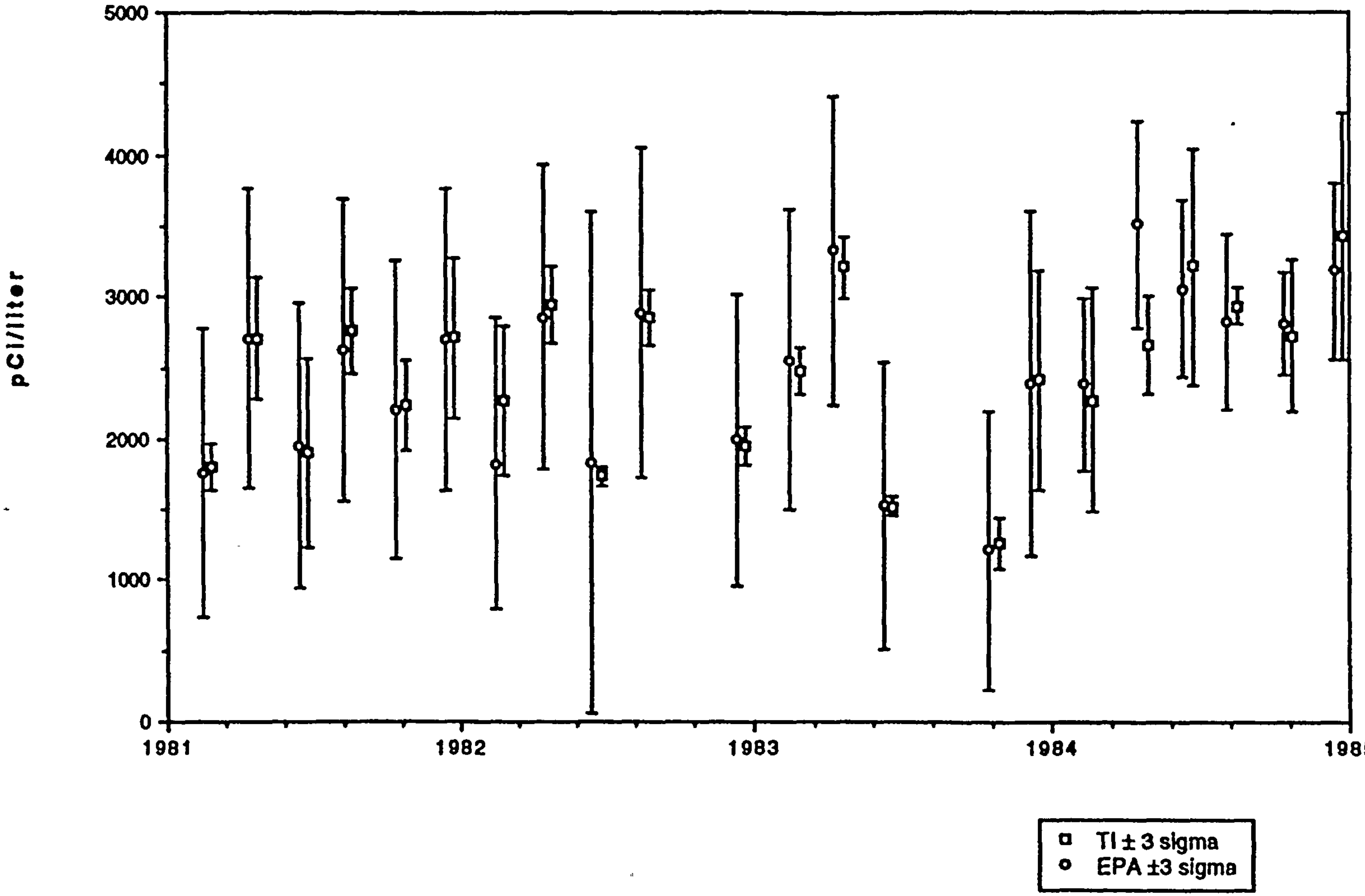
US EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (Cont.)



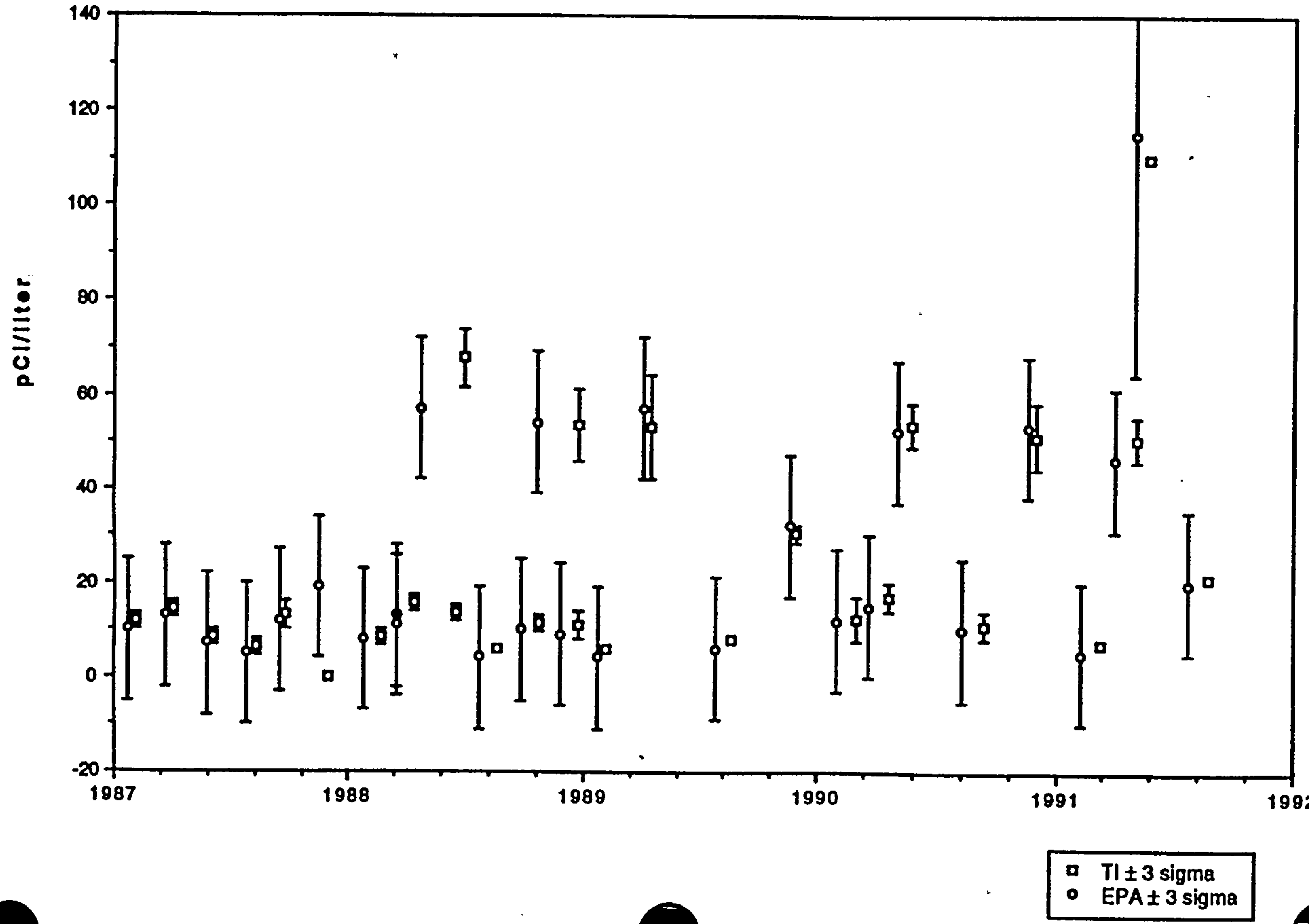
US EPA CROSS CHECK PROGRAM

TRITIUM IN WATER



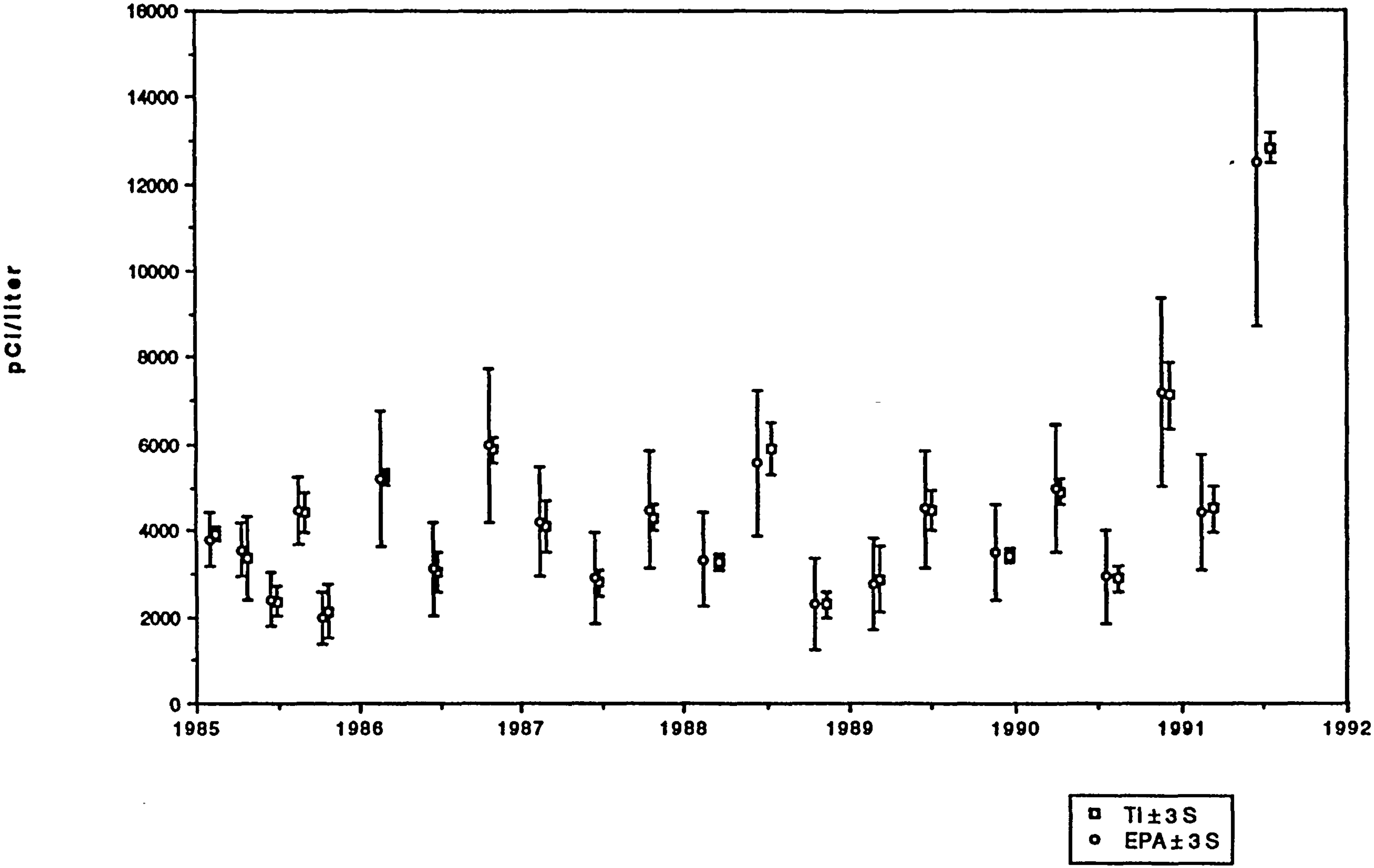
US EPA CROSS CHECK PROGRAM

GROSS BETA IN WATER (Cont.)



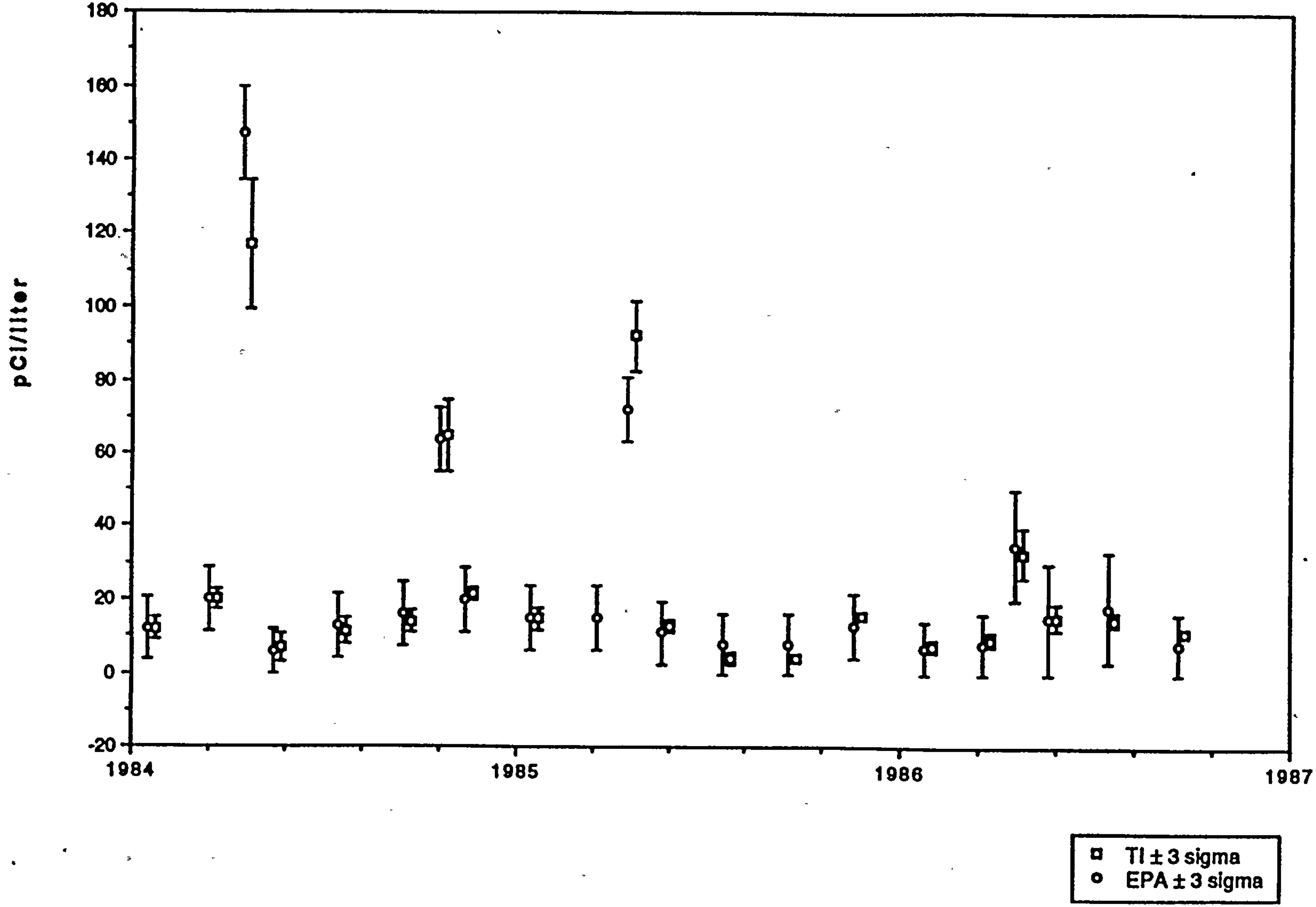
US EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (Cont.)



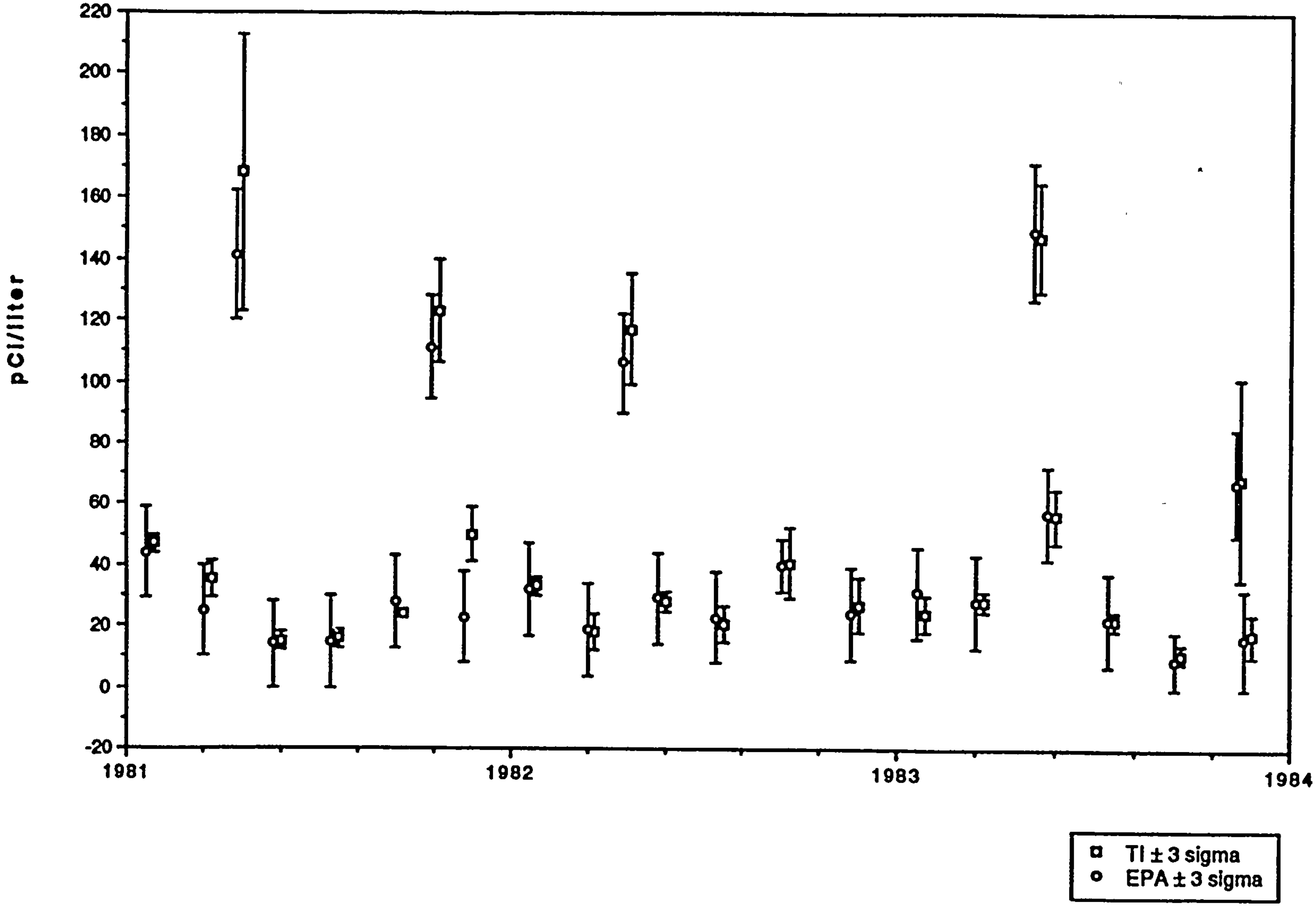
US EPA CROSS CHECK PROGRAM

GROSS BETA IN WATER



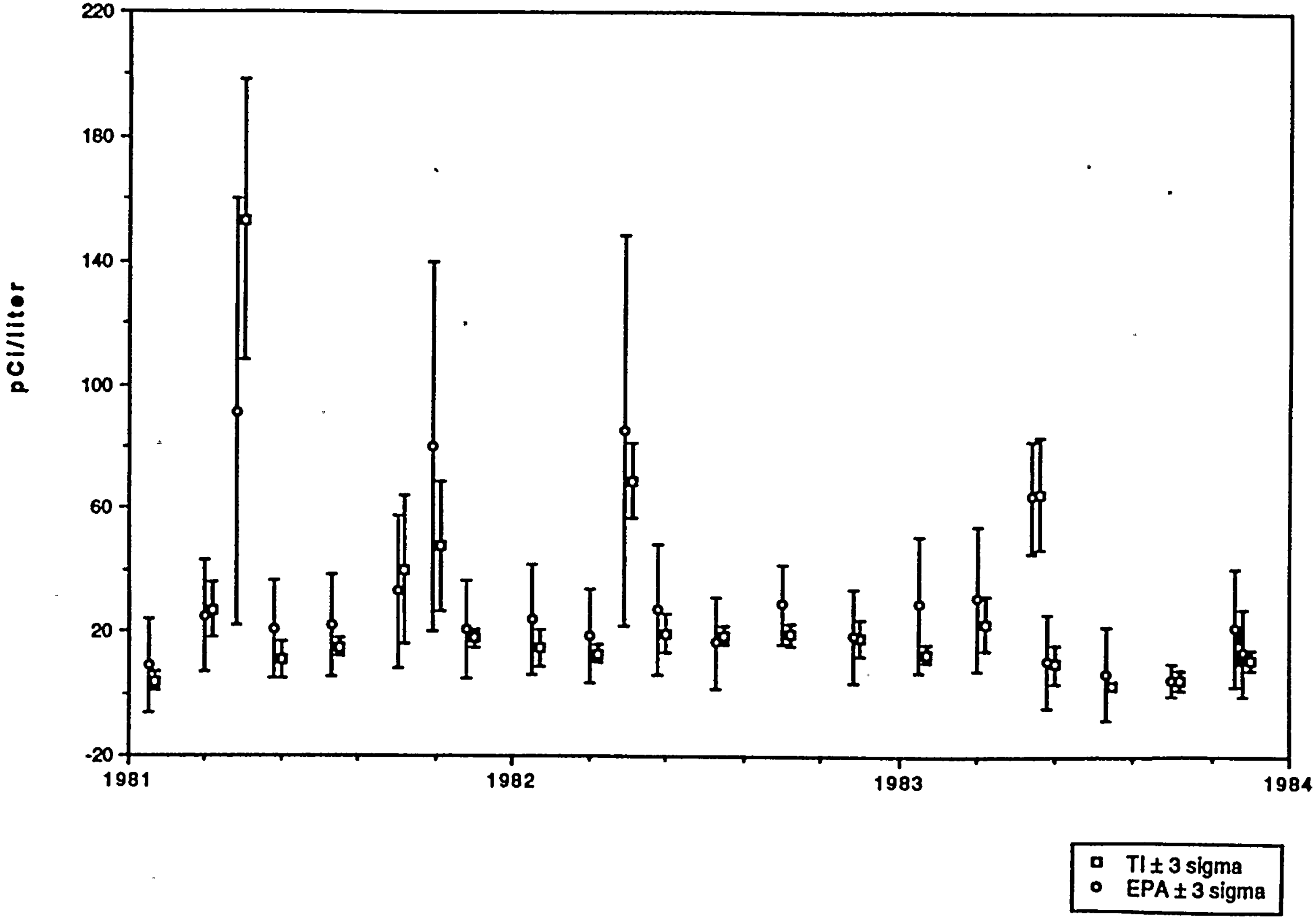
US EPA CROSS CHECK PROGRAM

GROSS BETA IN WATER



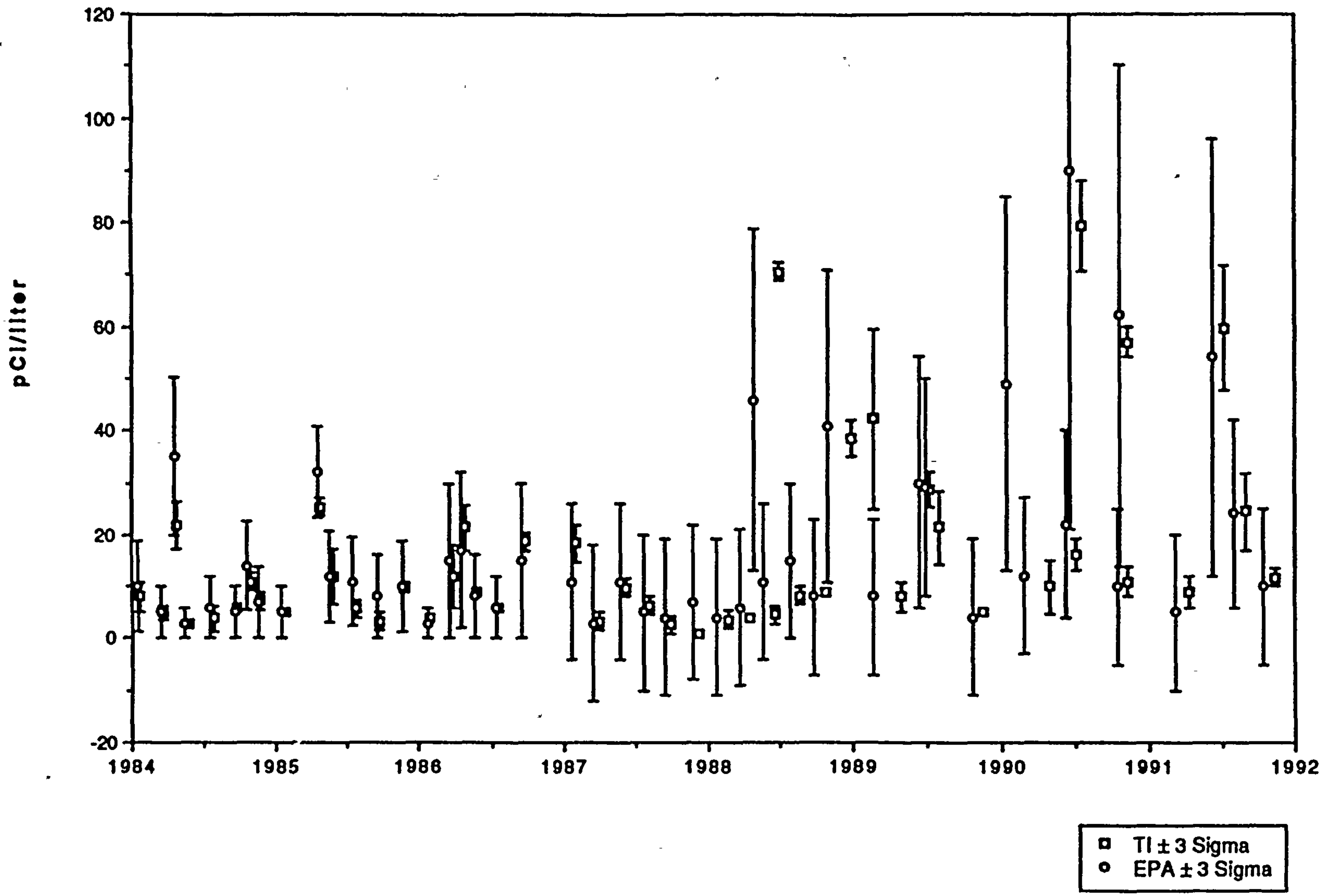
US EPA CROSS CHECK PROGRAM

GROSS ALPHA IN WATER



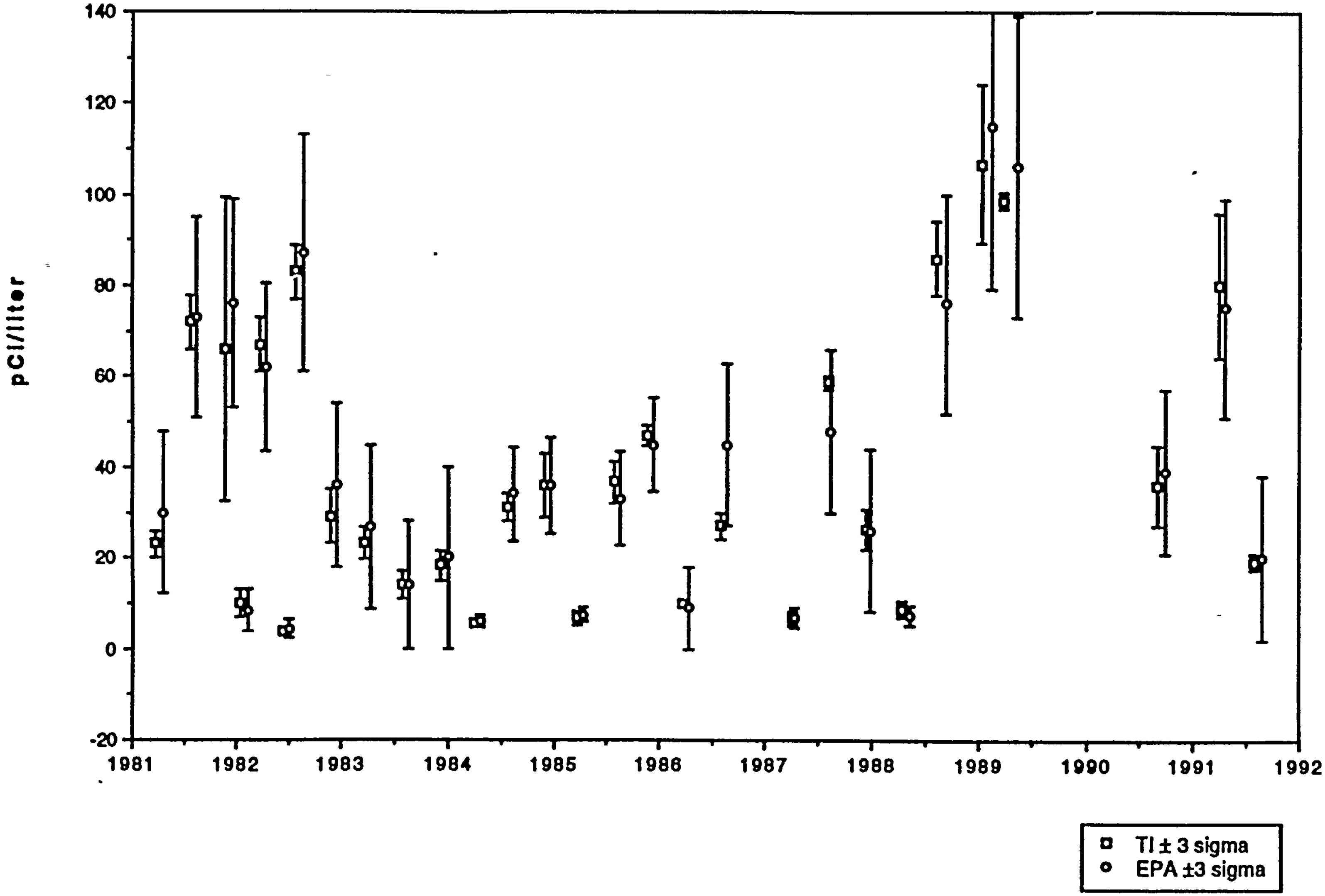
US EPA CROSS CHECK PROGRAM

GROSS ALPHA IN WATER



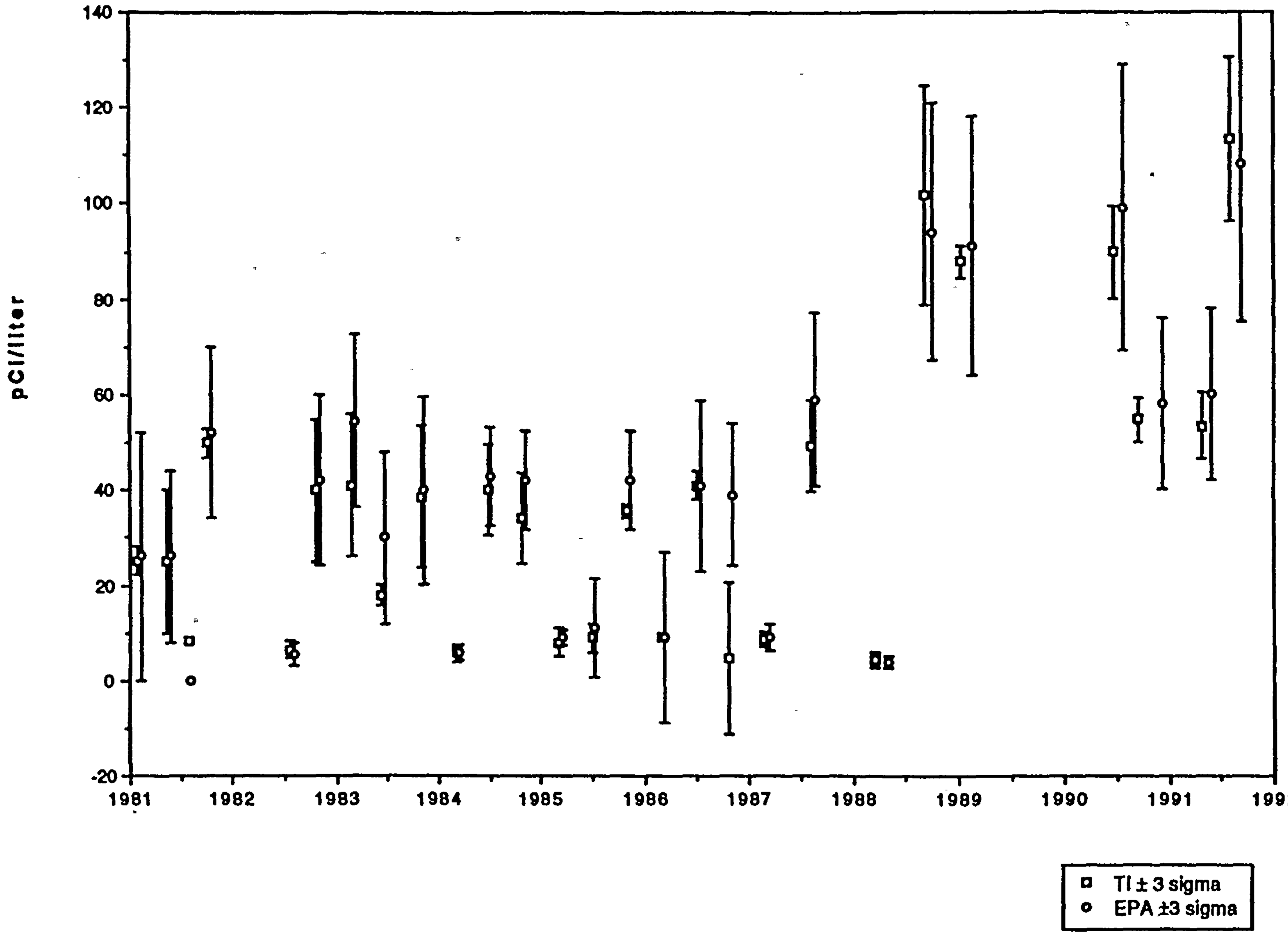
US EPA CROSS CHECK PROGRAM

IODINE-131 IN WATER



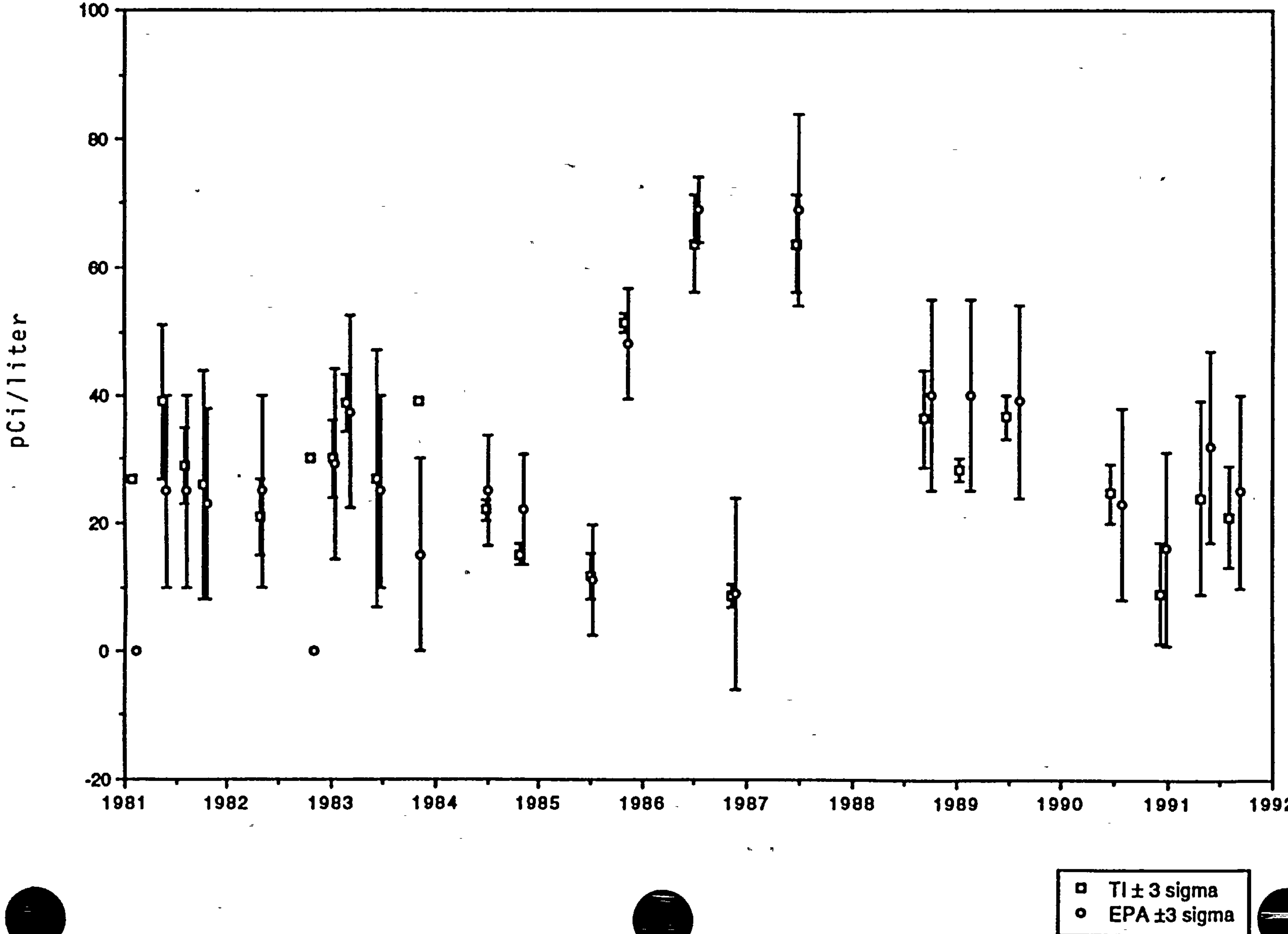
US EPA CROSS CHECK PROGRAM

IODINE-131 IN MILK



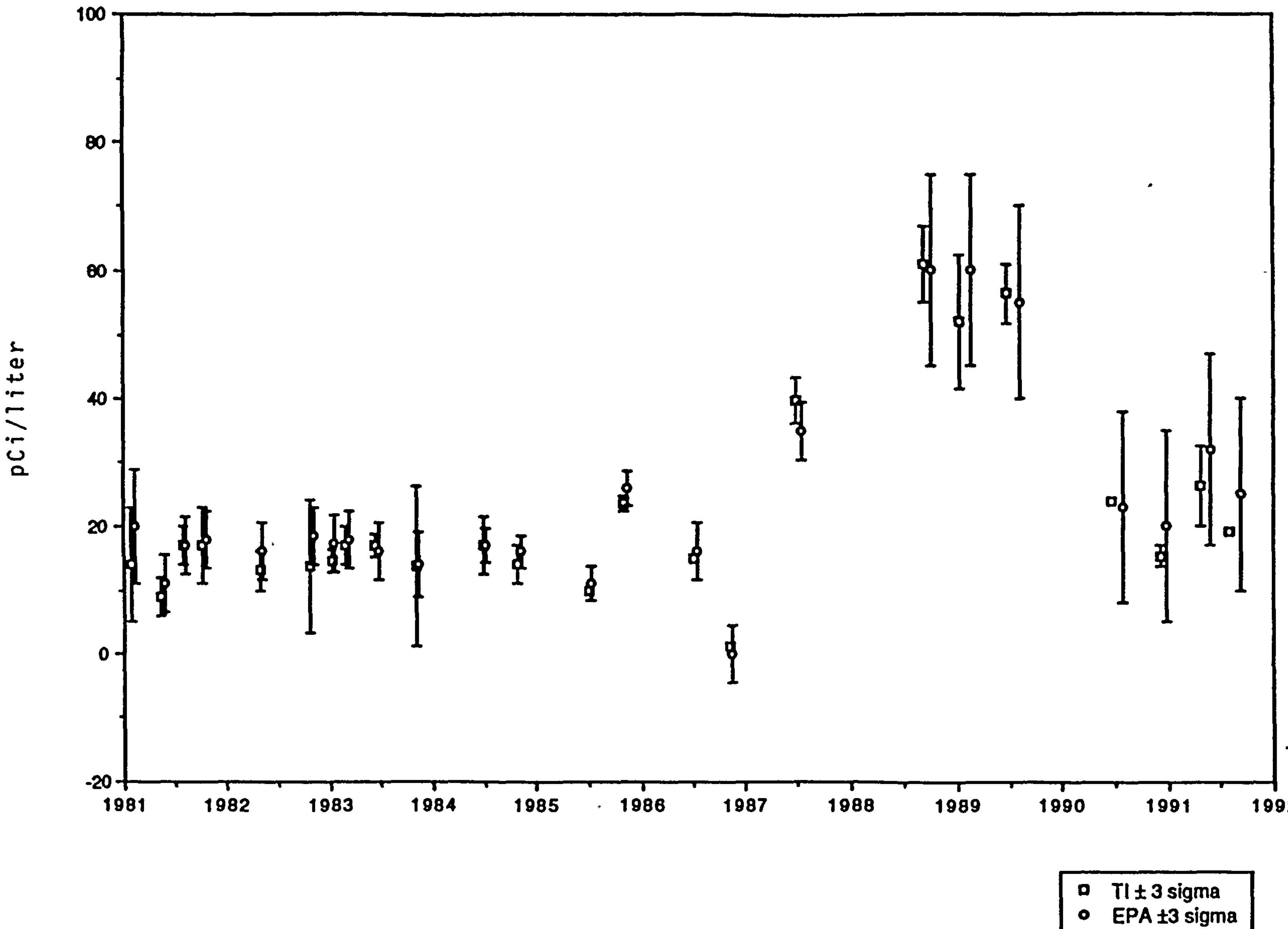
US EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN MILK



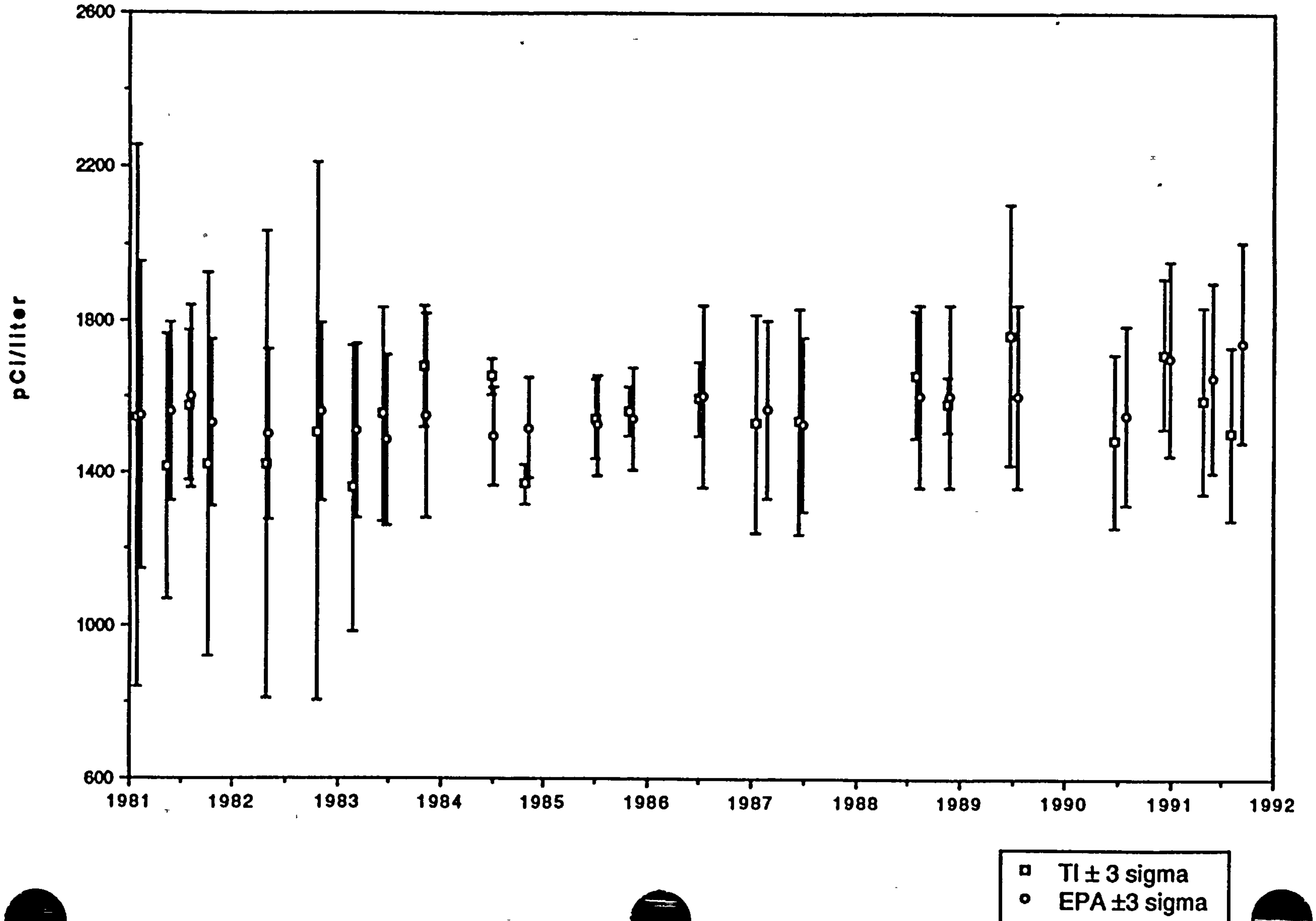
US EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN MILK



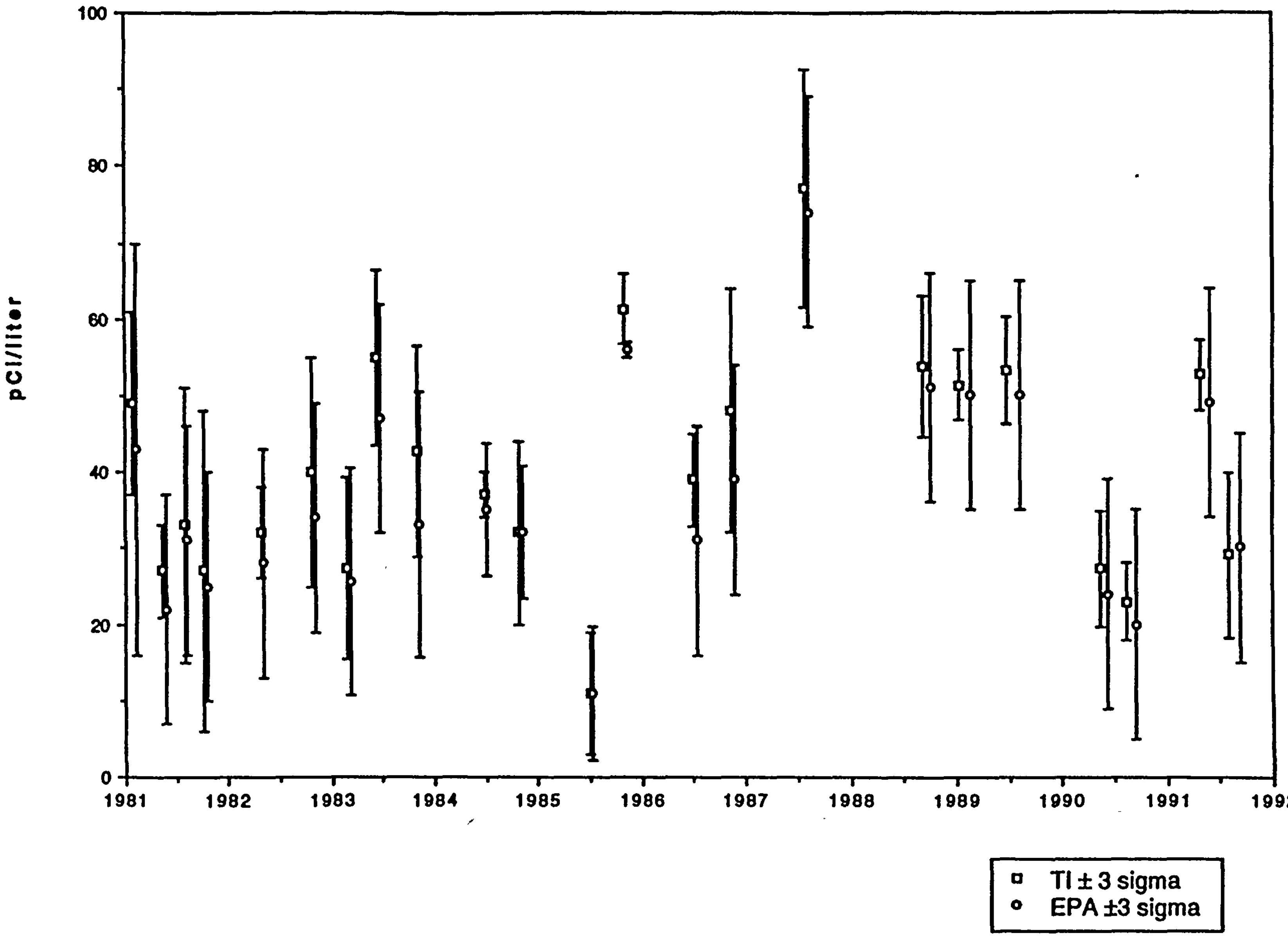
US EPA CROSS CHECK PROGRAM

POTASSIUM-40 IN MILK



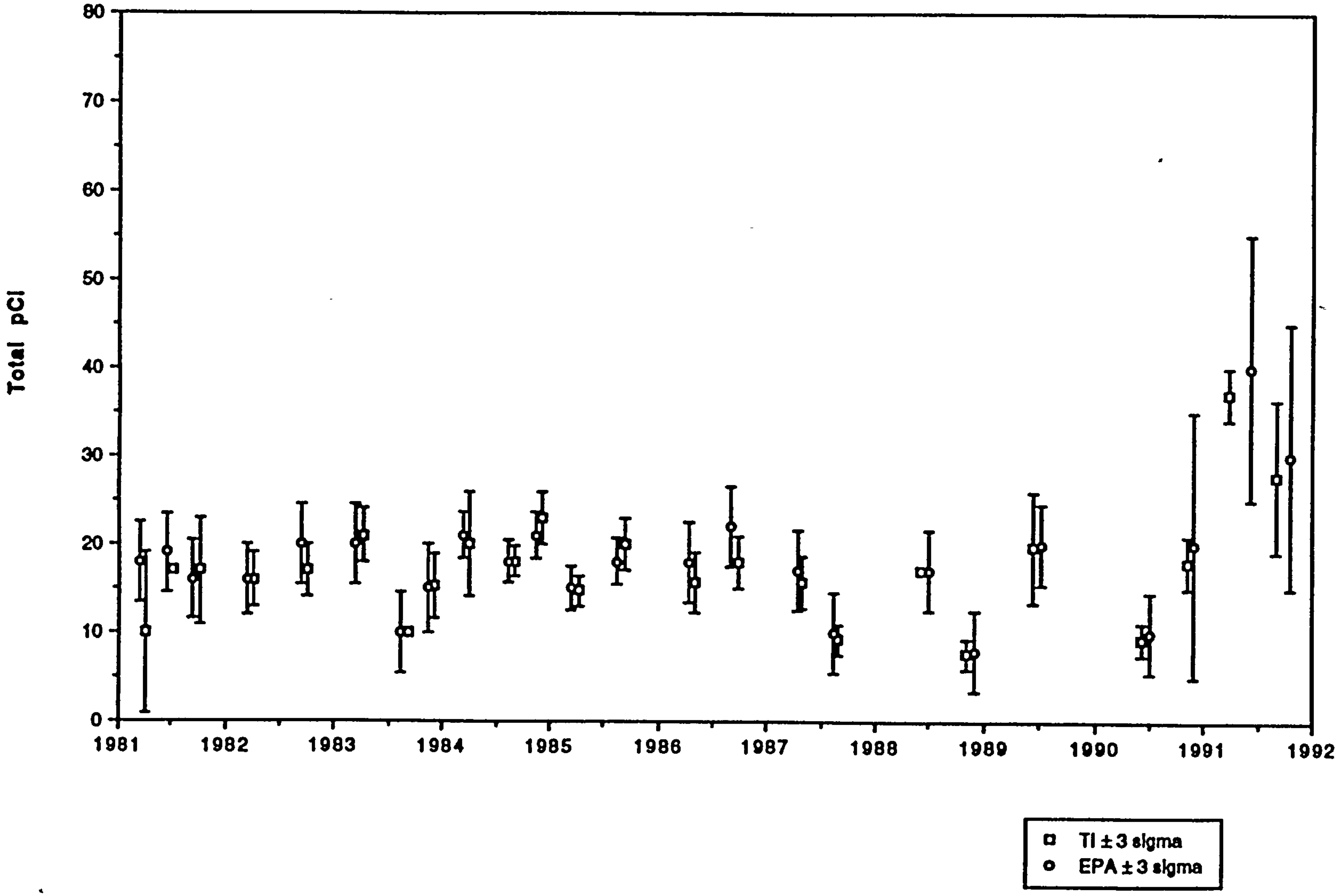
US EPA CROSS CHECK PROGRAM

CESIUM-137 IN MILK



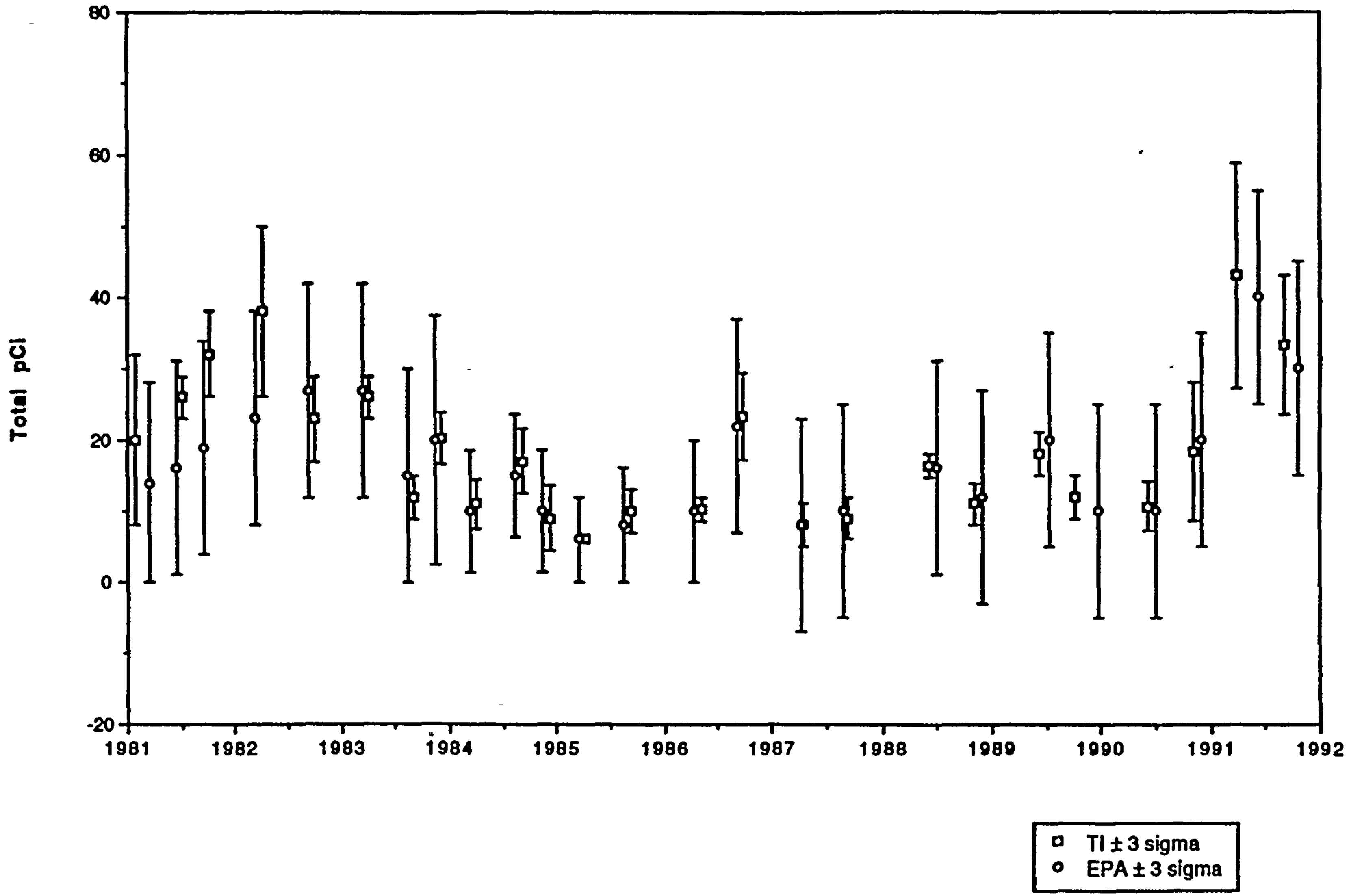
US EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN AIR PARTICULATES



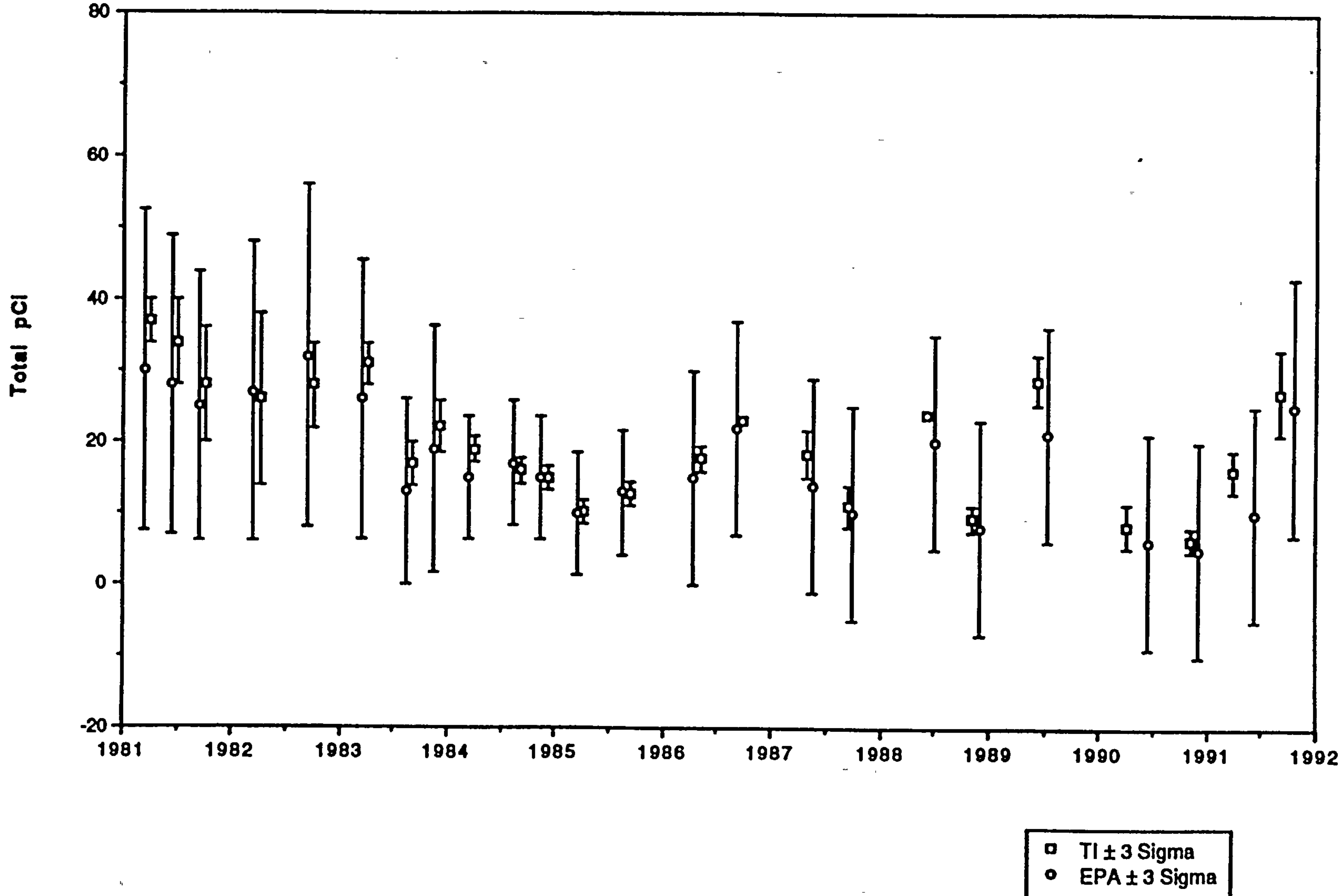
US EPA CR[?]S CHECK PROGRAM

CESIUM-137 IN AIR PARTICULATES



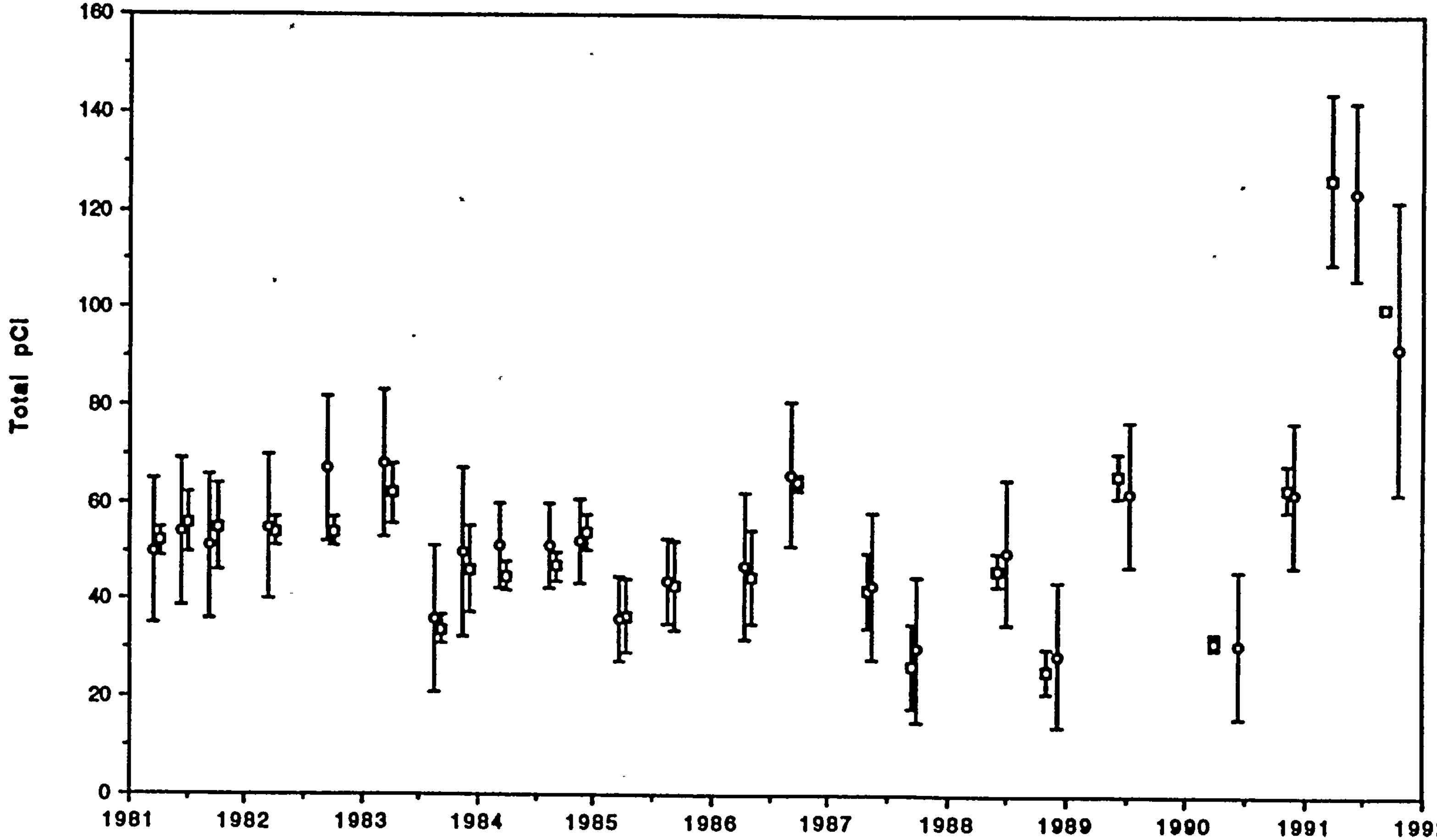
US EPA CROSS CHECK PROGRAM

GROSS ALPHA IN AIR PARTICULATES



US EPA CR[hole-punch]S CHECK PROGRAM

GROSS BETA IN AIR PARTICULATES



* 08/25/89 EPA test invalid.

APPENDIX E
REMP SAMPLING AND ANALYTICAL EXCEPTIONS

PROGRAM EXCEPTIONS

REMP deviations for 1991 are listed at the end of this appendix. Where possible, the causes of the deviations have been corrected to prevent recurrence.

During 1991 the majority of REMP exceptions from the sampling requirements involved periods of inoperability of air samplers. They are listed individually in the following Exceptions table. The frequency of air sampler failures observed during 1991 appears to be fairly typical. In some cases the units were removed, serviced, recalibrated and returned to service. To prevent recurrence, Procedure 12 THP 6010 ENV.051 was revised to include an Environmental Instrument Discrepancy sheet to determine the root causes of failures.

Broadleaf samples were collected in land sector J when in fact sector A had the highest D/Q value. The D/Q Deposition table in the Offsite Dose Calculation Manual, PMP 6010 OSD.001 has been revised to be more "user friendly". The table now clearly identifies the land sector with the highest D/Q value and will prevent any recurrence of this problem.

Several surface water samples could not be collected due to ice on the shoreline. Since harsh and extreme weather conditions seldom impedes environmental sampling no action will be taken at this time.

REMP EXCEPTIONS FOR SCHEDULED SAMPLING AND ANALYSIS DURING 1991

Station	Description	Date of Sampling	Reason(s) for Loss/ Exception
Dowagiac	Air Particulate/ Air Iodine	01/07/91	Timer malfunction.
A-3	Air Particulate/ Air Iodine	03/18/91	Sample inadvertently was not placed.
Dowagiac	Air Particulate/ Air Iodine	03/04/91	Unit serviced.
South Bend	Air Particulate/ Air Iodine	04/15/91	Timer malfunction.
A-5/A-6	Air Particulate/ Air Iodine	05/13/91	Blown fuse; unit found off.
A-5	Air Particulate/ Air Iodine	06/17/91 06/24/91 07/01/91	Timer malfunction.
Dowagiac	Air Particulate/ Air Iodine	07/15/91	Clock disconnected.
A-5	Air Particulate	08/12/91 08/19/91	Elevated result due to low air volume.
L-2/L-3 L-4/L-5	Surface Water	02/07/91 03/07/91	Samples not available due to ice on the shoreline.
Site Boundary	Broadleaf	08/10/91	Collected in land sector J when in fact Sector A had the highest D/Q value.

APPENDIX F
1991 LAND USE CENSUS

APPENDIX F
SUMMARY OF THE 1991 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 1991 Land Use Census. The following is a summary of the 1991 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 August 8, 1991.

In 1991 there were two additions and two 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 2.2 miles from the plant's centerline axis to the closest edge of the animal's pasture. This distance was verified by Wightman & Associates, an independent surveying firm.

Residential Survey

The residential survey is performed to identify the closest residence to the plant in each land sector. The closest residences in each sector were unchanged for 1991. A table identifying each residence is included at the end of this appendix.

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 1991 were <LLD.

Figure 5

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

Milk and Animal Survey - 1991

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
D	(a)	2.2	Sue Dorman	Holden Rd., Stevensville
E	a	10.5	Andrews Univ.	Berrien Springs
	b	10.5	Andrews Univ.	Berrien Springs
F	a	6.8	Lee Nelson	RFD 1, Box 390A, Sno[illegible]. 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	4.8	Norman Zelmer	11701 S. Gast Rd., Bridgman
	b	4.8	Norman Zelmer	11701 S. Gast Rd., Bridgman
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.

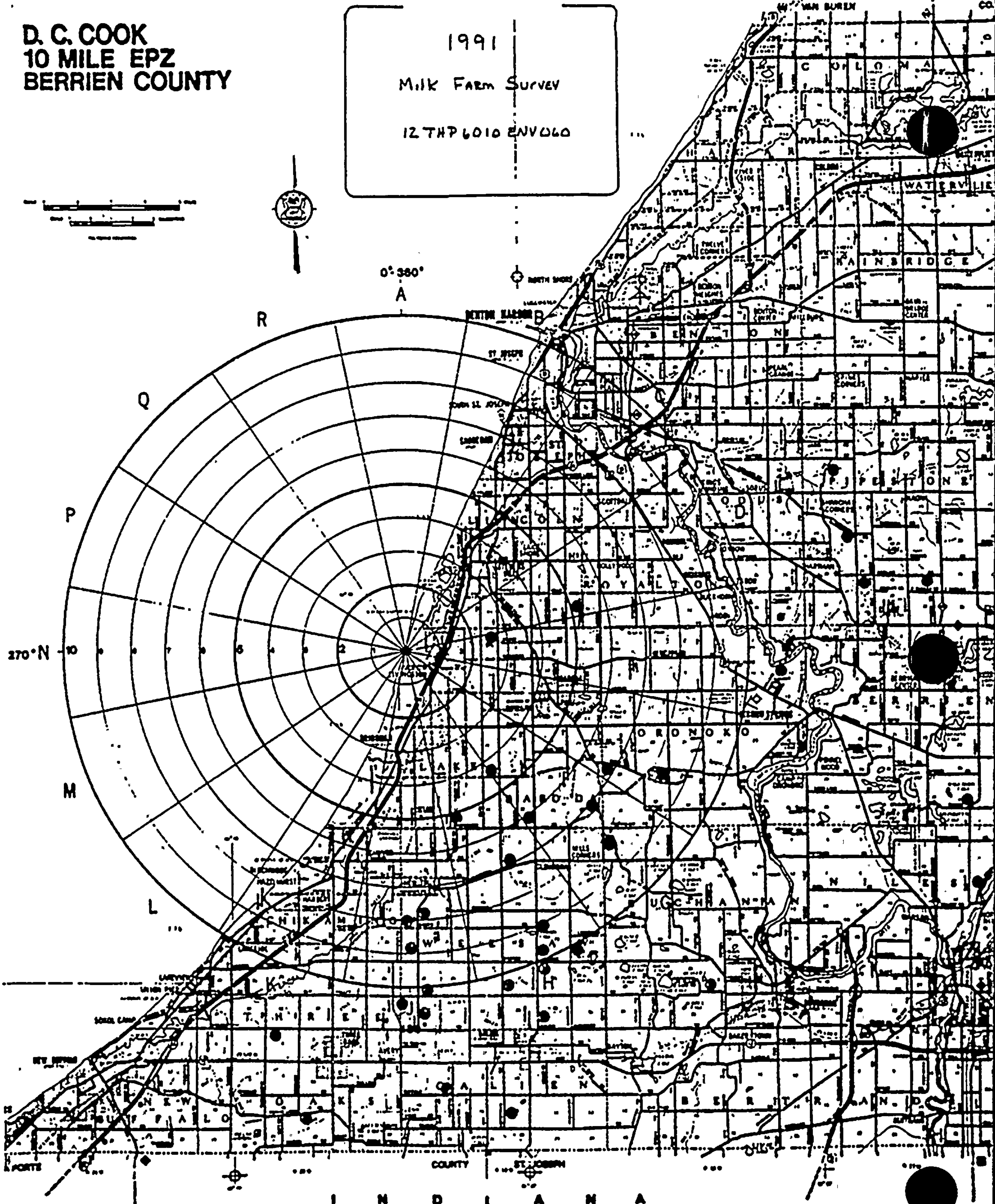
[illegible]e 6

INDIANA MICHIGAN POWER COMPANY - DONALD C. COOK NUCLEAR PLANT

Residential Land Use Survey - 1991

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	6-4.1	Rt. #1, Rosemary Rd.
B	a	2	2165	11-11-0006-0004-09-2	Iler Drive, Rosemary Beach
	b	2	2165	6-4.9	Rt. #1, Rosemary Rd.
C	a	3	3093	11-11-6800-0028-00-0	Lake Road, Rosemary Beach
	b	3	3093	6-28	Rt. #1, Rosemary Rd.
D	a	4	5733	11-11-0005-0036-01-8	7500 Thorton Drive
	b	4	5733	5-36	7500 Thorton Drive
E	a	5	5631	11-11-0005-0009-07-0	7927 Red Arrow Highway
	b	5	5631	5.25.5	7927 Red Arrow Highway
F	a	6	5392	11-11-0008-0015-03-1	8197 Red Arrow Highway
	b	6	5392	8-10.3	3900 Livingston Rd.
G	a	7	3728	11-11-0007-0013-01-4	Livingston Road
	b	7	3728	7-4	4212 Livingston Rd.
H	a	8	4944	11-11-8600-0004-00-1	Wildwood
	b	8	4944	7-7+8	Wildwood Subdivision (8700 Red Arrow Hwy.)
J	a	9	3366	11-11-0007-0010-02-3	Livingston Hills
	b		3366	7-1 0.3	4600 W. Livingston Rd. Livingston Hills Subdivision)
K	a	10	3090	11-11-0007-0010-03-1	Livingston Hills
	b	10	3090	7-10.3	4600 W. Livingston Rd. (Livingston Hills Subdivision)

(1) All other sectors are over water.
(a) Reporting Year
(b) Year prior to reporting year.
* Specific property numbers as listed on the tax rolls were used to identify houses. Previous year's report used lot numbers. The lot numbers remained the same.
** House #6 was incorrectly addressed the previous year. All other address changes are minor modifications reflecting updated address format.


D. C. COOK
10 MILE EPZ
BERRIEN COUNTY
1991
Milk Farm Survey
12THP6010 ENV060
0°-360°
A
B
R
Q
P
270° N
M
L
K
I N D I A N A

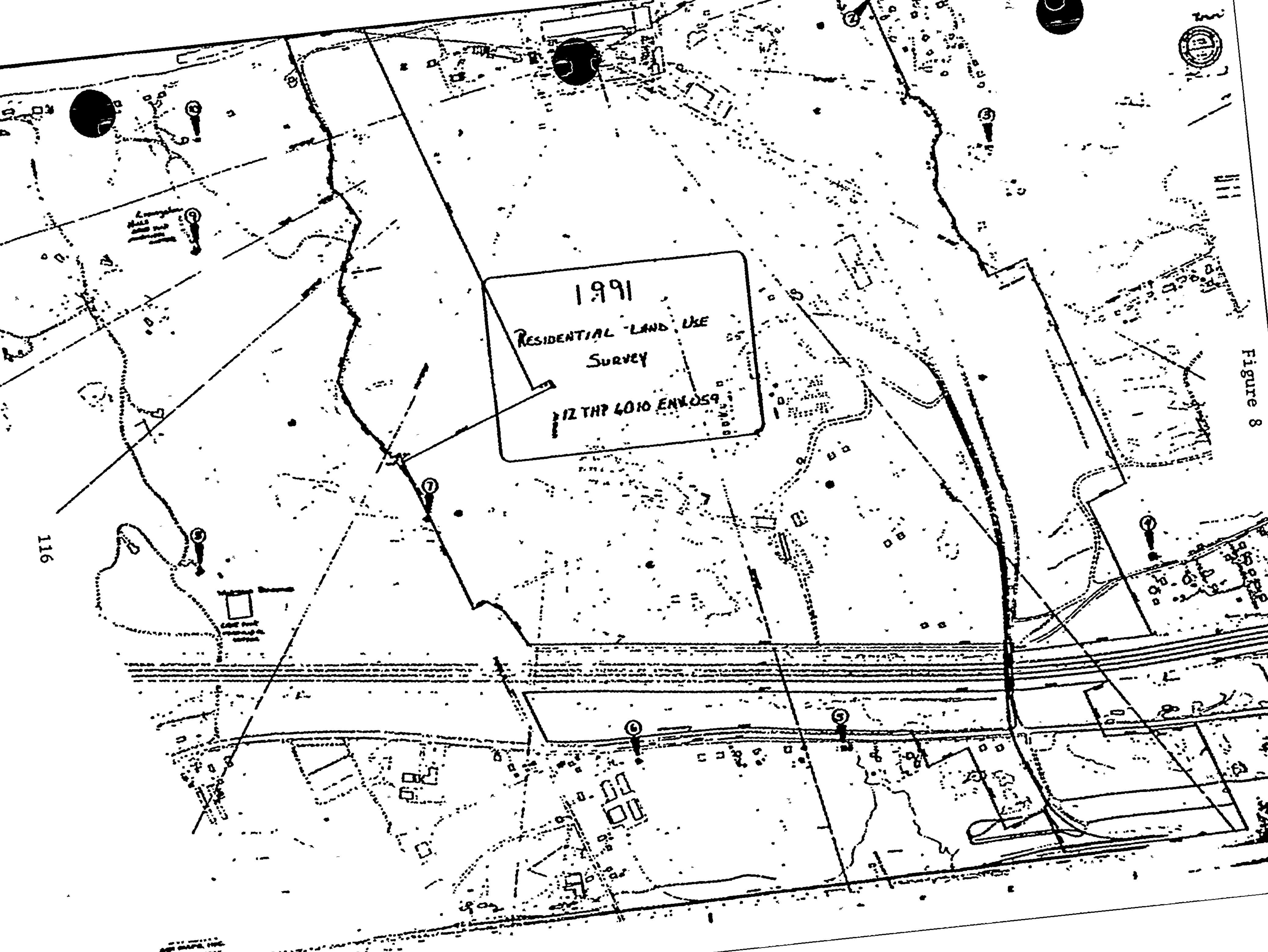


Figure 8

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 1991.

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 1991. Analyses, such as strontium-89 and strontium-90 in milk and air

particulates performed during the preoperational but not required in 1991, 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 BLIND DUPLICATE SAMPLE PROGRAM

SUMMARY OF THE BLIND DUPLICATE SAMPLE PROGRAM

The Plant procedure for implementing the blind duplicate sampling program references Regulatory Guide 4.15. The program utilizes blind, duplicate and spiked samples within four different parameters; gamma isotopic, tritium, iodine and gross beta. The samples are prepared by D.C. Cook's analytical lab, Teledyne Isotopes.

Ten blind, duplicate and spiked analyses were performed during 1991. Eight of the ten samples were within acceptable limits. The first quarter tritium water sample did not meet the acceptable criteria, however it did fall within ± 2 sigma of the control solution.

The second quarter gross beta sample did not meet the acceptance criteria. Teledyne Isotopes conducted an acceptable investigation to determine the root cause. The analysis 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 1991 for the Teledyne Isotopes In-house Quality Assurance Program. Analysis date is analogous to collection date to identify weekly analysis of samples.

Two 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. Techniques in transferring spiked liquids to the counting planchet and analysis methodology are under investigation to determine the cause for a low bias in the gross beta spikes.

Teledyne Isotopes In-House Blanks Sample Results
1991 - Water

GROSS ALPHA

TI #	Analysis Date	Activity (pCi/l)
23844	01/02/91	L. T. 6. E-01
23845	01/09/91	L. T. 4. E-01
23846	01/16/91	L. T. 4. E-01
23847	01/23/91	L. T. 4. E-01
23848	01/30/91	L. T. 4. E-01
27138	02/06/91	L. T. 7. E-01
27139	02/13/91	L. T. 4. E-01
27140	02/20/91	L. T. 4. E-01
27141	02/27/91	L. T. 5. E-01
30065	03/06/91	L. T. 7. E-01
30066	03/13/91	L. T. 4. E-01
30067	03/20/91	L. T. 4. E-01
30068	03/27/91	L. T. 7. E-01
33116	04/03/91	L. T. 5 E-01
33117	04/10/91	L. T. 4. E-01
33118	04/17/91	L. T. 5. E-01
33119	04/24/91	L. T. 4. E-01
36606	05/01/91	L. T. 6. E-01
36607	05/08/91	L. T. 5. E-01
36608	05/15/91	L. T. 6. E-01
36609	05/22/91	L. T. 7. E-01
36610	05/29/91	L. T. 6. E-01
40327	06/05/91	L. T. 6. E-01
40328	06/12/91	L. T. 4. E-01
40329	06/19/91	L. T. 5. E-01
40330	06/26/91	L. T. 6. E-01
43205	07/03/91	L. T. 7. E-01
43206	07/10/91	L. T. 7. E-01
43207	07/17/91	L. T. 5. E-01
43208	07/24/91	L. T. 4. E-01
43209	07/31/91	L. T. 7. E-01
47097	08/07/91	L. T. 7. E-01
47098	08/14/91	L. T. 4. E-01
47099	08/21/91	L. T. 5. E-01
47100	08/28/91	L. T. 8. E-01
49738	09/04/91	L. T. 5. E-01
49739	09/11/91	L. T. 7. E-01
49740	09/18/91	L. T. 7. E-01
49741	09/25/91	L. T. 4. E-01
52791	10/02/91	L. T. 7. E-01
52792	10/09/91	L. T. 5. E-01
52793	10/16/91	L. T. 4. E-01

GROSS ALPHA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
52794	10/23/91	L. T. 6. E-01
52795	10/30/91	L. T. 6. E-01
56540	11/06/91	L. T. 5. E-01
56541	11/13/91	L. T. 8. E-01
56542	11/20/91	L. T. 7. E-01
56542	11/27/91	L. T. 4. E-01
59179	12/04/91	L. T. 7. E-01
59180	12/11/91	L. T. 6. E-01
59181	12/18/91	L. T. 6. E-01
59182	12/26/91	L. T. 4. E-01

GROSS BETA

TI #	Analysis Date	Activity (pCi/l)
23844	01/02/91	L. T. 8. E-01
23845	01/09/91	L. T. 8. E-01
23846	01/16/91	L. T. 7. E-01
23847	01/23/91	L. T. 8. E-01
23848	01/30/91	L. T. 8. E-01
27138	02/06/91	L. T. 7. E-01
27139	02/13/91	L. T. 7. E-01
27140	02/20/91	L. T. 8. E-01
27141	02/27/91	L. T. 8. E-01
30065	03/06/91	L. T. 8. E-01
30066	03/13/91	L. T. 7. E-01
30067	03/20/91	L. T. 7. E-01
30068	03/27/91	L. T. 7. E-01
33116	04/03/91	L. T. 8. E-01
33117	04/10/91	L. T. 9. E-01
33118	04/17/91	L. T. 8. E-01
33119	04/24/91	L. T. 8. E-01
36606	05/01/91	L. T. 9. E-01
36607	05/08/91	L. T. 7. E-01
36608	05/15/91	L. T. 7. E-01
36609	05/22/91	L. T. 7. E-01
36610	05/29/91	L. T. 8. E-01
40327	06/05/91	L. T. 7. E-01
40328	06/12/91	L. T. 9. E-01
40329	06/19/91	L. T. 8. E-01
40330	06/26/91	L. T. 8. E-01
43205	07/03/91	L. T. 7. E-01
43206	07/10/91	L. T. 7. E-01

GROSS BETA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
43207	07/17/91	L. T. 8. E-01
43208	07/24/91	L. T. 8. E-01
43209	07/31/91	L. T. 7. E-01
47097	08/07/91	L. T. 9. E-01
47098	08/14/91	L. T. 8. E-01
47099	08/21/91	L. T. 7. E-01
47100	08/28/91	L. T. 8. E-01
49738	09/04/91	L. T. 7. E-01
49739	09/11/91	L. T. 1. E 00
49740	09/18/91	L. T. 8. E-01
49741	09/25/91	L. T. 7. E-01
52791	10/02/91	L. T. 7. E-01
52792	10/09/91	L. T. 8. E-01
52793	10/16/91	L. T. 8. E-01
52794	10/23/91	L. T. 9. E-01
52795	10/30/91	L. T. 7. E-01
56540	11/06/91	L. T. 8. E-01
56541	11/13/91	L. T. 7. E-01
56542	11/20/91	L. T. 9. E-01
56543	11/27/91	L. T. 7. E-01
59179	12/04/91	L. T. 1. E 00
59180	12/11/91	L. T. 7. E-01
59181	12/18/91	L. T. 7. E-01
59182	12/26/91	L. T. 8. E-01

TRITIUM - (H-3)

TI #	Analysis Date	Activity (pCi/l)
23874	01/02/91	L. T. 2. E 02
23875	01/09/91	L. T. 1. E 02
23876	01/16/91	L. T. 1. E 02
23877	01/23/91	L. T. 1. E 02
23878	01/30/91	L. T. 1. E 02
27162	02/06/91	L. T. 1. E 02
27163	02/13/91	L. T. 1. E 02
27164	02/20/91	L. T. 9. E 01
27165	02/27/91	L. T. 1. E 02
30089	03/06/91	L. T. 1. E 02
30090	03/13/91	L. T. 1. E 02
30091	03/20/91	L. T. 1. E 02
30092	03/27/91	L. T. 1. E 02
33140	04/03/91	L. T. 1. E 02
22141	04/10/91	L. T. 1. E 02
33142	04/17/91	L. T. 1. E 02
33143	04/24/91	L. T. 1. E 02

TRITIUM - (H-3) (Cont.)

36636	05/01/91	L. T. 2. E 02
36637	05/08/91	L. T. 2. E 02
36638	05/15/91	L. T. 2. E 02
36639	05/22/91	L. T. 1. E 02
36640	05/29/91	L. T. 2. E 02
40351	06/05/91	L. T. 1. E 02
40352	06/12/91	L. T. 1. E 02
40353	06/19/91	L. T. 1. E 02
40354	06/26/91	L. T. 1. E 02
43302	07/03/91	L. T. 1. E 02
43303	07/10/91	L. T. 1. E 02
43304	07/17/91	L. T. 1. E 02
43305	07/24/91	L. T. 1. E 02
43306	07/31/91	L. T. 1. E 02
47121	08/07/91	L. T. 1. E 02
47122	08/14/91	L. T. 1. E 02
47123	08/21/91	L. T. 1. E 02
47124	08/28/91	L. T. 1. E 02
49762	09/04/91	L. T. 1. E 02
49763	09/11/91	L. T. 9. E 01
49764	09/18/91	L. T. 1. E 02
49765	09/25/91	L. T. 1. E 02
52821	10/02/91	L. T. 1. E 02
52822	10/09/91	L. T. 1. E 02
52823	10/16/91	L. T. 1. E 02
52824	10/23/91	L. T. 2. E 02
52825	10/30/91	L. T. 1. E 02
56564	11/06/91	L. T. 1. E 02
56565	11/13/91	L. T. 1. E 02
56566	11/20/91	L. T. 9. E 01
56567	11/27/91	L. T. 1. E 02
59203	12/04/91	L. T. 2. E 02
59204	12/11/91	L. T. 2. E 02
59205	12/18/91	L. T. 1. E 02
59206	12/26/91	L. T. 2. E 02

Teledyne Isotopes In-House Spiked Sample Results

1991 - Water

Analysis	Spike Levels (pCi/L)	Acceptable Range (pCi/l)
Gross Alpha	11 ± 5	6 - 16
Gross Beta	21 ± 5	16 - 26
	22.6 ± 5*	17 - 27*
Gamma (Eu-154)	1.4 ± 0.2 E 05	1.2 - 1.6 E 05
H-3 (G)	2.7 ± 0.3 E 03	2.4 - 3.0 E 03
	4.5 ± 0.5 E 03**	4.0 ± 5.0 E 03 **

GROSS ALPHA

TI #	Analysis Date	Activity (pCi/l)
23854	01/02/91	1.3 ± 0.2 E 01
23855	01/09/91	1.2 ± 0.2 E 01
23856	01/16/91	9.7 ± 1.5 E 00
23857	01/23/91	1.1 ± 0.2 E 01
23858	01/30/91	7.0 ± 1.3 E 00
27146	02/06/91	1.1 ± 0.2 E 01
27147	02/13/91	1.1 ± 0.2 E 01
27148	02/20/91	9.4 ± 1.6 E 00
27149	02/27/91	1.1 ± 0.2 E 01
30073	03/06/91	9.2 ± 1.6 E 00
30074	03/13/91	1.2 ± 0.2 E 01
30075	03/20/91	1.6 ± 0.2 E 01
30076	03/27/91	9.8 ± 1.6 E 00
33124	04/03/91	1.4 ± 0.2 E 01
33125	04/10/91	8.0 ± 1.6 E 00
33126	04/17/91	1.1 ± 0.2 E 01
33127	04/24/91	9.6 ± 1.6 E 00
36616	05/01/91	9.8 ± 1.6 E 00
36617	05/08/91	1.1 ± 0.1 E 01
36618	05/15/91	9.2 ± 1.5 E 00
36619	05/22/91	9.6 ± 1.6 E 00
36620	05/29/91	1.2 ± 0.2 E 01
40335	06/05/91	1.3 ± 0.1 E 01
40336	06/12/91	1.1 ± 0.2 E 01
40337	06/19/91	9.9 ± 1.7 E 00
40338	06/26/91	1.4 ± 0.2 E 01
43215	07/03/91	9.4 ± 1.6 E 00
43216	07/10/91	1.3 ± 0.2 E 01
43217	07/17/91	1.1 ± 0.2 E 01

* Beginning 3/1/91
** Beginning 5/1/91

GROSS ALPHA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
43218	07/24/91	1.1 ± 0.2 E 01
43219	07/31/91	1.1 ± 0.2 E 01
47105	08/07/91	1.0 ± 0.2 E 01
47106	08/14/91	1.3 ± 0.2 E 01
47107	08/21/91	1.3 ± 0.2 E 01
47108	08/28/91	1.1 ± 0.2 E 01
49746	09/04/91	1.2 ± 0.2 E 01
49747	09/11/91	9.3 ± 1.5 E 00
49748	09/18/91	9.5 ± 1.6 E 00
49749	09/25/91	1.1 ± 0.2 E 01
52801	10/02/91	8.5 ± 1.5 E 00
52802	10/09/91	1.1 ± 0.2 E 01
52803	10/16/91	1.1 ± 0.2 E 01
52804	10/23/91	9.7 ± 1.7 E 00
52805	10/30/91	9.6 ± 1.5 E 00
56548	11/06/91	1.0 ± 0.2 E 01
56549	11/13/91	1.1 ± 0.2 E 01
56550	11/20/91	1.1 ± 0.2 E 01
56551	11/27/91	1.1 ± 0.2 E 01
59187	12/04/91	1.1 ± 0.2 E 01
59188	12/11/91	9.0 ± 1.5 E 00
59189	12/18/91	1.1 ± 0.2 E 01
59190	12/26/91	8.8 ± 1.5 E 00

GROSS BETA

TI #	Analysis Date	Activity (pCi/l)
23849	01/02/91	1.7 ± 0.1 E 01
23850	01/09/91	1.9 ± 0.1 E 01
23851	01/16/91	1.7 ± 0.1 E 01
23852	01/23/91	1.9 ± 0.1 E 01
23853	01/30/91	1.9 ± 0.1 E 01
27142	02/06/91	1.9 ± 0.1 E 01
27143	02/13/91	2.1 ± 0.1 E 01
27144	02/20/91	1.6 ± 0.1 E 01
27145	02/27/91	1.9 ± 0.1 E 01
30069	03/06/91	2.6 ± 0.2 E 01
30070	03/13/91	2.0 ± 0.1 E 01
30071	03/20/91	2.0 ± 0.1 E 01
30072	03/27/91	2.1 ± 0.1 E 01
33120	04/03/91	1.9 ± 0.1 E 01
33121	04/10/91	2.1 ± 0.2 E 01
33122	04/17/91	2.0 ± 0.1 E 01
33123	04/24/91	2.1 ± 0.2 E 01

GROSS BETA (Cont.)

TI #	Analysis Date	Activity (pCi/l)
36611	05/01/91	1.7 ± 0.1 E 01
36612	05/08/91	2.1 ± 0.2 E 01
36613	05/15/91	1.8 ± 0.1 E 01
36614	05/22/91	2.1 ± 0.1 E 01
36615	05/29/91	2.0 ± 0.2 E 01
40331	06/05/91	1.9 ± 0.1 E 01
40332	06/12/91	1.5 ± 0.1 E 01
40333	06/19/91	2.2 ± 0.2 E 01
40334	06/26/91	1.7 ± 0.1 E 01
43210	07/03/91	2.1 ± 0.2 E 01
43211	07/10/91	1.8 ± 0.1 E 01
43212	07/17/91	2.1 ± 0.2 E 01
43213	07/24/91	1.9 ± 0.1 E 01
43214	07/31/91	2.0 ± 0.1 E 01
47101	08/07/91	1.8 ± 0.1 E 01
47102	08/14/91	2.2 ± 0.2 E 01
47103	08/21/91	1.8 ± 0.1 E 01
47104	08/28/91	2.4 ± 0.2 E 01
49742	09/04/91	1.9 ± 0.1 E 01
49743	09/11/91	2.1 ± 0.2 E 01
49744	09/18/91	2.2 ± 0.2 E 01
49745	09/25/91	1.8 ± 0.1 E 01
52796	10/02/91	1.8 ± 0.1 E 01
52797	10/09/91	2.3 ± 0.2 E 01
52798	10/16/91	2.0 ± 0.1 E 01
52799	10/23/91	2.0 ± 0.2 E 01
52800	10/30/91	2.0 ± 0.1 E 01
56544	11/06/91	1.9 ± 0.1 E 01
56545	11/13/91	1.6 ± 0.1 E 01
56546	11/20/91	1.8 ± 0.1 E 01
56547	11/27/91	1.7 ± 0.1 E 01
59183	12/04/91	2.0 ± 0.1 E 01
59184	12/11/91	2.0 ± 0.1 E 01
59185	12/18/91	1.9 ± 0.2 E 01
59186	12/26/91	2.0 ± 0.1 E 01

GAMMA (Eu-154)

TI #	Analysis Date	Activity (pCi/l)
23879	01/02/91	1.47 ± 0.15 E 05
23880	01/09/91	1.43 ± 0.14 E 05
23881	01/16/91	1.47 ± 0.15 E 05
23882	01/23/91	1.40 ± 0.14 E 05
23883	01/30/91	1.40 ± 0.14 E 05
27166	02/06/91	1.40 ± 0.14 E 05
27167	02/13/91	1.39 ± 0.14 E 05
27168	02/20/91	1.42 ± 0.14 E 05
27169	02/27/91	1.43 ± 0.14 E 05
30093	03/06/91	1.49 ± 0.15 E 05
30094	03/13/91	1.37 ± 0.14 E 05
30095	03/20/91	1.41 ± 0.14 E 05
30096	03/27/91	1.45 ± 0.15 E 05
33144	04/03/91	1.37 ± 0.14 E 05
33145	04/10/91	1.45 ± 0.15 E 05
33146	04/17/91	1.45 ± 0.15 E 05
33147	04/24/91	1.40 ± 0.14 E 05
36641	05/01/91	1.39 ± 0.14 E 05
36642	05/08/91	1.39 ± 0.14 E 05
36643	05/15/91	1.45 ± 0.15 E 05
36644	05/22/91	1.45 ± 0.15 E 05
36645	05/29/91	1.43 ± 0.14 E 05
40355	06/05/91	1.43 ± 0.14 E 05
40356	06/12/91	1.41 ± 0.14 E 05
40357	06/19/91	1.40 ± 0.14 E 05
40358	06/26/91	1.40 ± 0.14 E 05
43307	07/03/91	1.42 ± 0.14 E 05
43308	07/10/91	1.36 ± 0.14 E 05
43309	07/17/91	1.43 ± 0.14 E 05
43310	07/24/91	1.44 ± 0.14 E 05
43311	07/31/91	1.39 ± 0.14 E 05
47125	08/07/91	1.34 ± 0.13 E 05
47126	08/14/91	1.48 ± 0.15 E 05
47127	08/21/91	1.42 ± 0.14 E 05
47128	08/28/91	1.42 ± 0.14 E 05
49766	09/04/91	1.39 ± 0.14 E 05
49767	09/11/91	1.46 ± 0.15 E 05
49768	09/18/91	1.41 ± 0.14 E 05
49769	09/25/91	1.45 ± 0.15 E 05
52826	10/02/91	1.43 ± 0.14 E 05
52827	10/09/91	1.42 ± 0.14 E 05
52828	10/16/91	1.36 ± 0.14 E 05
52829	10/23/91	1.42 ± 0.14 E 05
52830	10/30/91	1.44 ± 0.14 E 05

GAMMA (Eu-154) (Cont.)

TI #	Analysis Date	Activity (pCi/l)
56568	11/06/91	1.40 ± 0.14 E 05
56569	11/13/91	1.45 ± 0.15 E 05
56570	11/20/91	1.40 ± 0.14 E 05
56571	11/27/91	1.47 ± 0.15 E 05
59207	12/04/91	1.38 ± 0.14 E 05
59208	12/11/91	1.43 ± 0.14 E 05
59209	12/18/91	1.41 ± 0.14 E 05
59210	12/26/91	1.37 ± 0.14 E 05

TRITIUM - (H-3)

23864	01/02/91	2.6 ± 0.1 E 03
23865	01/09/91	2.8 ± 0.1 E 03
23866	01/16/91	2.6 ± 0.1 E 03
23867	01/23/91	2.5 ± 0.1 E 03
23868	01/30/91	2.3 ± 0.1 E 03
27154	02/06/91	2.6 ± 0.2 E 03
27155	02/13/91	2.5 ± 0.2 E 03
27156	02/20/91	2.7 ± 0.1 E 03
27157	02/27/91	2.3 ± 0.1 E 03
30081	03/06/91	2.4 ± 0.1 E 03
30082	03/13/91	2.6 ± 0.1 E 03
30083	03/20/91	2.6 ± 0.1 E 03
30084	03/27/91	2.4 ± 0.2 E 03
33132	04/03/91	2.7 ± 0.1 E 03
33133	04/10/91	2.5 ± 0.1 E 03
33134	04/17/91	2.6 ± 0.1 E 03
33135	04/24/91	2.5 ± 0.1 E 03
36626	05/01/91	4.8 ± 0.2 E 03
36627	05/08/91	4.8 ± 0.1 E 03
36628	05/15/91	4.3 ± 0.2 E 03
36629	05/22/91	4.6 ± 0.1 E 03
36630	05/29/91	4.3 ± 0.1 E 03
40343	06/05/91	4.5 ± 0.1 E 03
40344	06/12/91	4.5 ± 0.1 E 03
40345	06/19/91	4.7 ± 0.1 E 03
40346	06/26/91	4.4 ± 0.1 E 03
43225	07/03/91	4.3 ± 0.3 E 03
43226	07/10/91	4.4 ± 0.2 E 03
43227	07/17/91	4.4 ± 0.3 E 03
43228	07/24/91	4.5 ± 0.1 E 03
43229	07/31/91	4.2 ± 0.1 E 03
47113	08/07/91	4.5 ± 0.1 E 03
47114	08/14/91	4.4 ± 0.1 E 03

TRITIUM - (H-3) (Cont.)

47115	08/21/91	4.3 ± 0.4 E 03
47116	08/28/91	4.5 ± 0.3 E 03
49754	09/04/91	4.2 ± 0.3 E 03
49755	09/11/91	4.5 ± 0.1 E 03
49756	09/18/91	4.7 ± 0.1 E 03
49757	09/25/91	4.7 ± 0.1 E 03
52811	10/02/91	4.5 ± 0.1 E 03
52812	10/09/91	4.4 ± 0.2 E 03
52813	10/16/91	4.5 ± 0.1 E 03
52814	10/23/91	4.5 ± 0.1 E 03
52815	10/30/91	4.6 ± 0.1 E 03
56556	11/06/91	4.2 ± 0.1 E 03
56557	11/13/91	4.3 ± 0.2 E 03
56558	11/20/91	4.3 ± 0.2 E 03
56559	11/27/91	4.2 ± 0.1 E 03
59195	12/04/91	4.7 ± 0.1 E 03
59196	12/11/91	4.6 ± 0.1 E 03
59197	12/18/91	4.1 ± 0.1 E 03
59198	12/26/91	4.4 ± 0.2 E 03

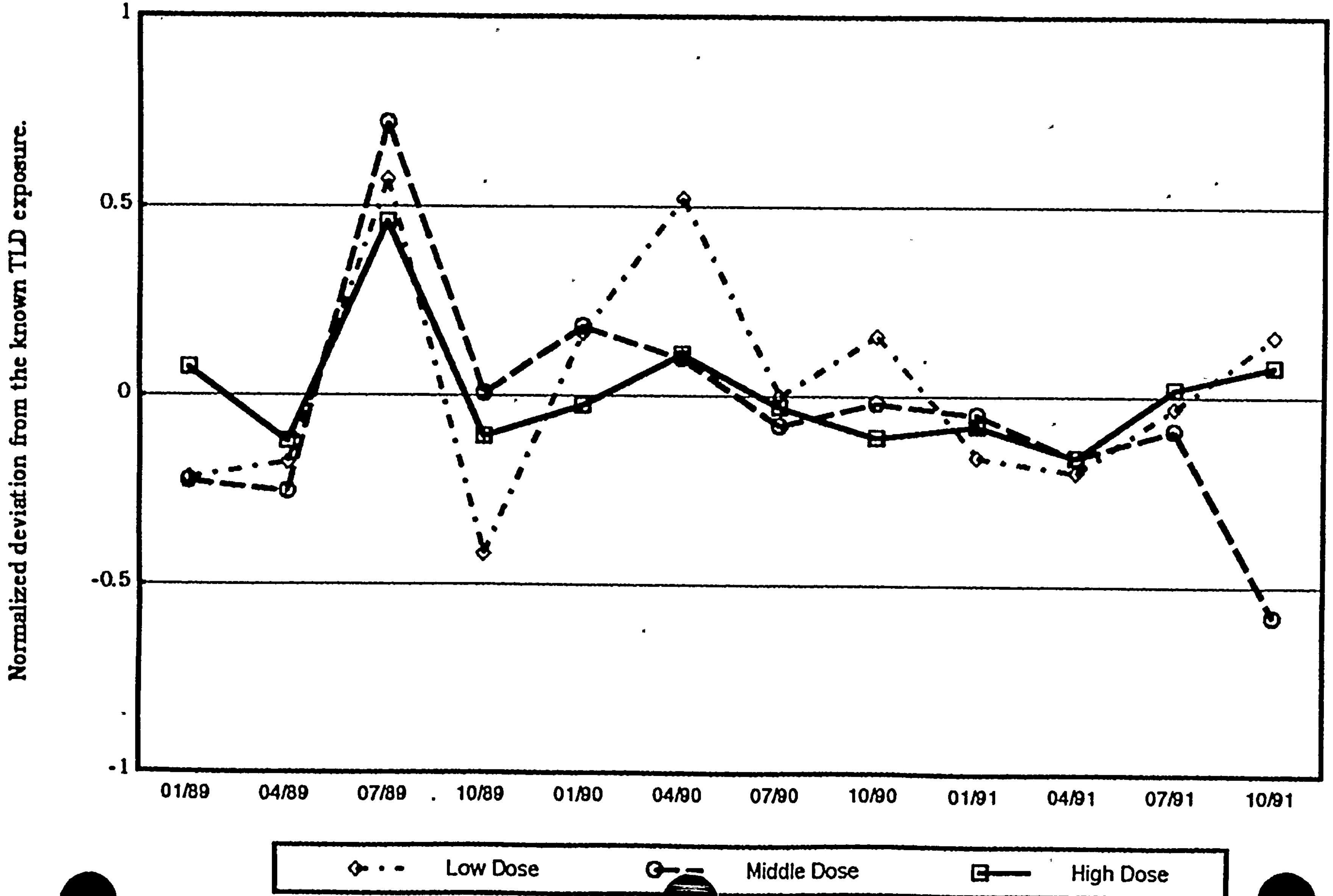
APPENDIX J

TLD QUALITY CONTROL PROGRAM

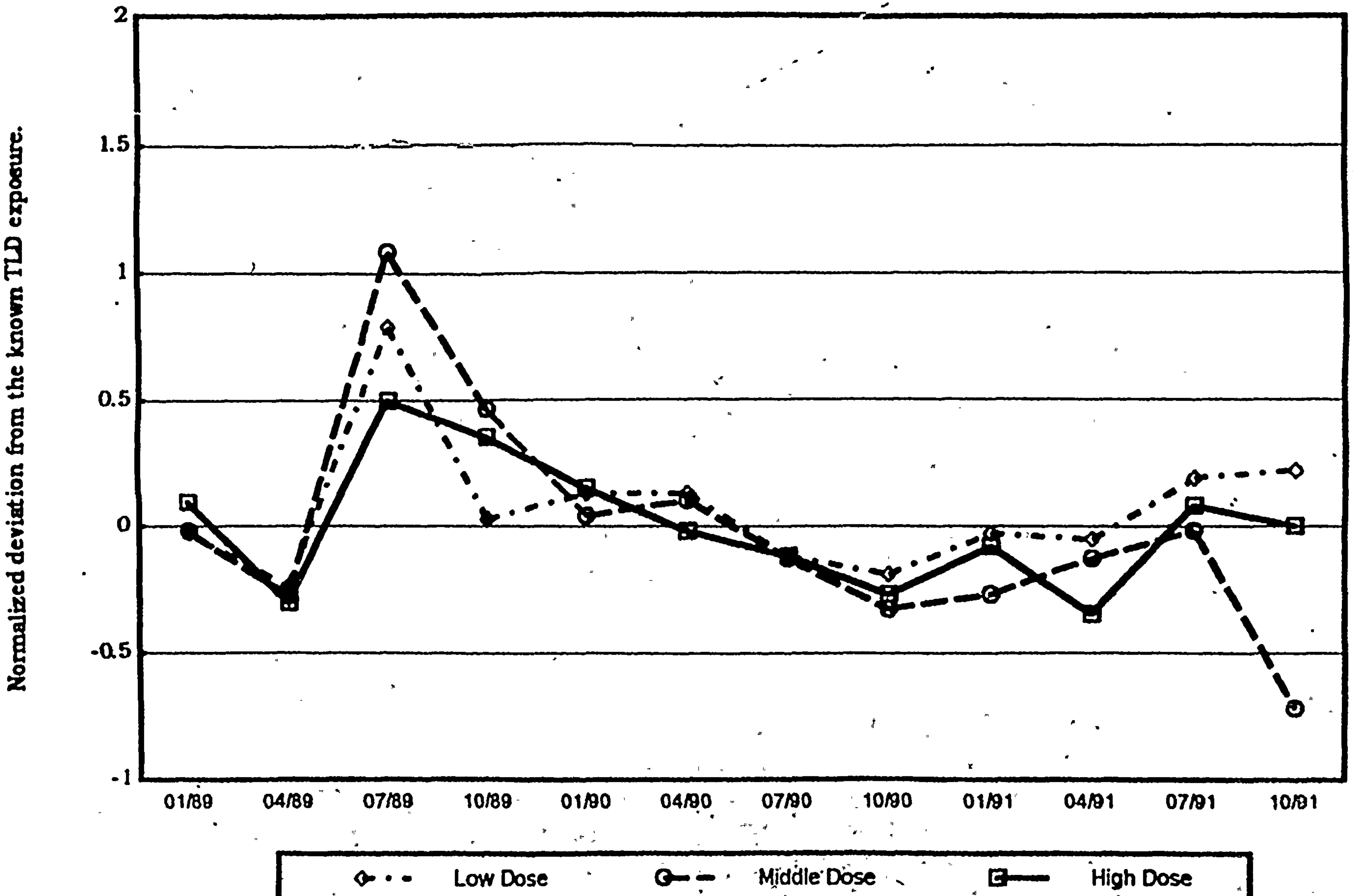
TLD QUALITY CONTROL PROGRAM

Teledyne Isotopes performs an in-house quality assurance testing program for the environmental TLD laboratory. On a quarterly basis the QA manager exposes groups of TLDs to three different doses using a known cesium-137 exposure rate. 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 1991 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.

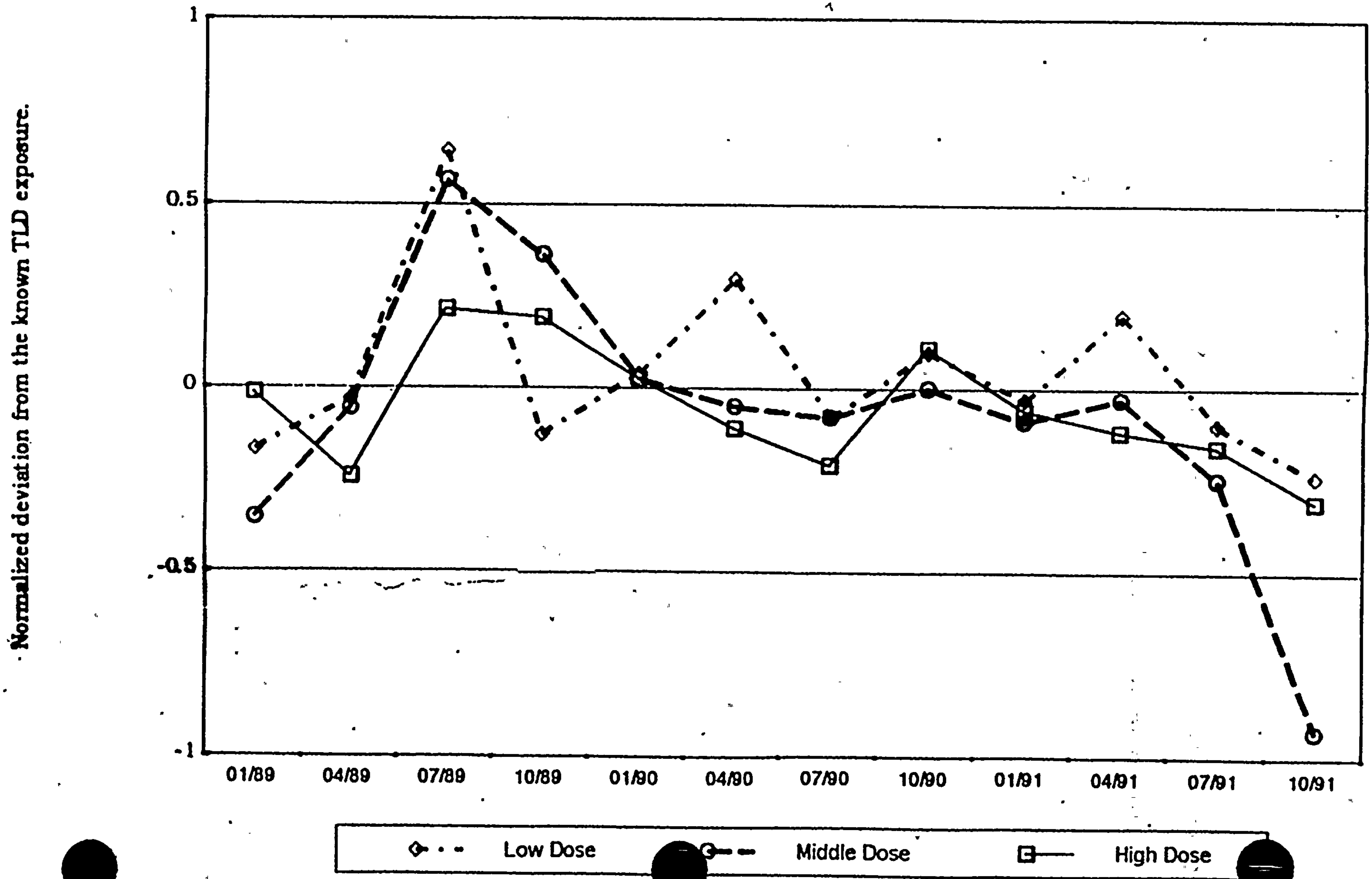
QUALITY CONTROL - TLDS
TLD READER 205



QUALITY CONTROL - TLDS
TLD READER 211



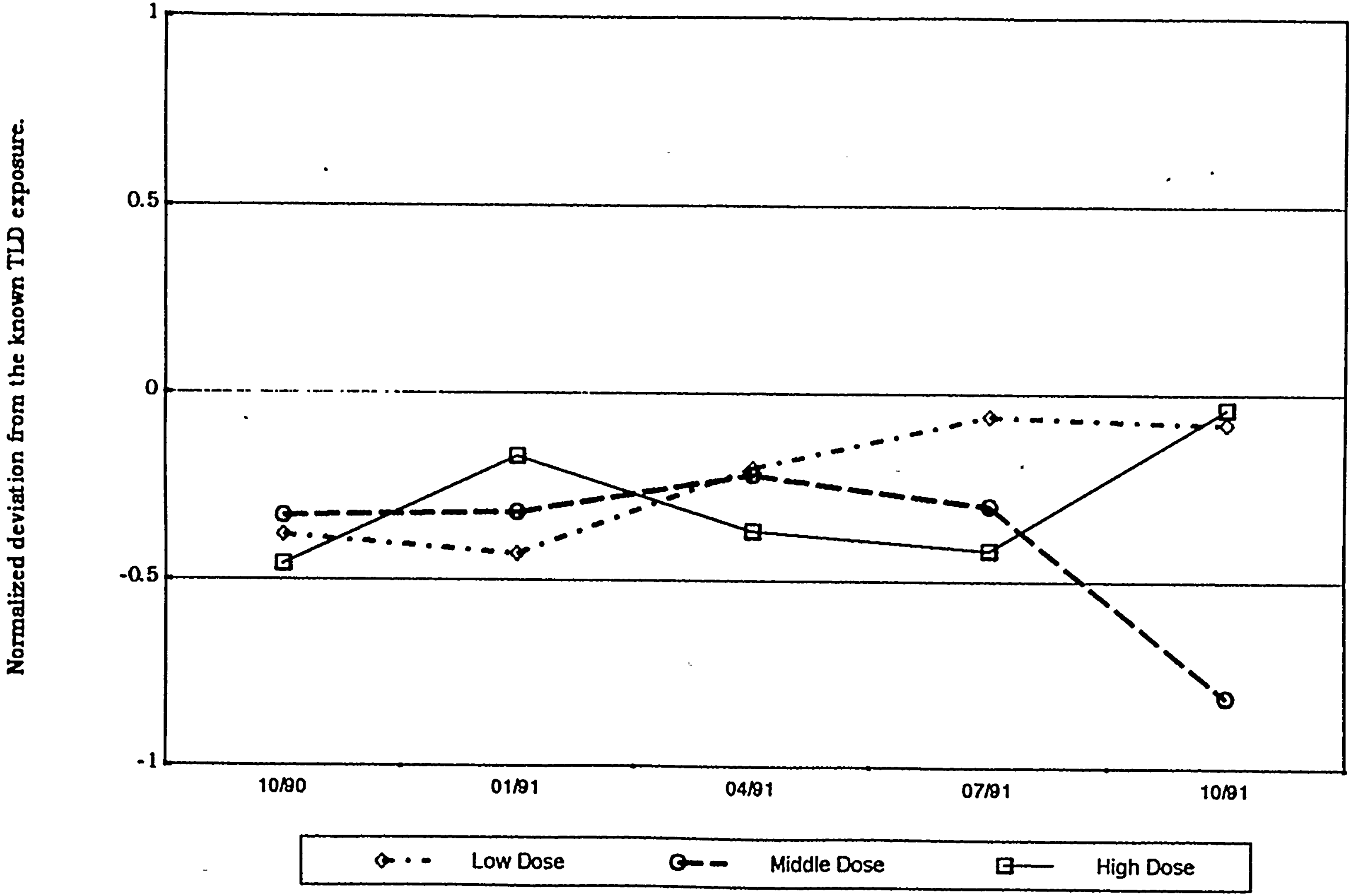
QUALITY CONTROL - TLDS
TLD READER 242



APPENDIX VII

A SUMMARY OF THE EVALUATION OF TRITIUM MIGRATION IN THE AQUIFER OF THE COOK NUCLEAR PLANT AND SURROUNDING COMMUNITIES

QUALITY CONTROL - TLDS
TLD READER 9150



SUMMARY OF THE EVALUATION OF TRITIUM MIGRATION IN THE AQUIFER OF THE COOK NUCLEAR PLANT AND SURROUNDING COMMUNITIES

Groundwater samples obtained from environmental monitoring wells within the Donald C. Cook Nuclear Plant's site boundary have been found to contain levels of tritium greater than preoperational levels. The level of tritium in these samples raised a concern that offsite users of well water from the affected aquifer could be impacted and prompted an evaluation of this potential dose pathway to the offsite population. As part of the evaluation, an investigation to determine the source of the tritium detected in the environmental monitoring well samples was also initiated.

Eight active and two inactive offsite domestic wells were identified for sampling purposes to determine if the wells were subjected to the affected aquifer. All eight active wells and the two inactive wells were sampled and analyzed for tritium, iodine and gamma emitting radionuclides. In all but one case, no detectable radioactivity was found. The sample with detectable activity showed a tritium concentration consistent with documented preoperational groundwater tritium concentrations. The presence of tritium in the onsite environmental monitoring well samples is therefore concluded to have no impact on public health and safety.

The source of tritium in the environmental monitoring well samples was determined to be the onsite Absorption Pond which is upgradient from the wells and receives effluent from the Turbine Room Sump. Having determined the tritium source, the Radiological Environmental Monitoring Program (REMP) was revised to include monitoring of additional wells. The locations of the added monitoring wells are based on a detailed hydrogeologic study of the groundwater system in the vicinity of the plant site and was performed as a part of the evaluation to determine the potential offsite impact.

It was concluded that any offsite impact is minimized and there is no threat to the safety and welfare of the public.

This evaluation was sent to the U.S. Nuclear Regulatory Commission (NRC) on September 24, 1991 (AEP:NRC:1164). An update to the September 24, 1991, report was sent to the NRC on December 23, 1991 (AEP:NRC:1164A).