INDIANA
MICHIGAN
POWER®
A unit of American Electric Power

Indiana Michigan Power
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
AEP.com

April 28, 2006

AEP:NRC:6541
DPR-58/74 Appendix B 5.4.1

Docket Nos.: 50-315
50-316

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, D.C. 20555-0001

Donald C. Cook Nuclear Plant Units 1 and 2
ANNUAL ENVIRONMENTAL OPERATING REPORT

Enclosed is the Donald C. Cook Nuclear Plant Annual Environmental Operating Report. This report covers the period from January 1, 2005, through December 31, 2005, and was prepared in accordance with the requirements of Environmental Technical Specification 5.4.1.

There are no new commitments in this submittal. Should you have any questions, please contact Mr. Michael K. Scarpello, Supervisor of Nuclear Licensing, at (269) 466-2649.

Sincerely,

Joseph N. Jensen
Site Vice President

DB/jen

Attachment

c: J. L. Caldwell, NRC Region III
K. D. Curry, Ft. Wayne AEP, w/o attachment
J. T. King, MPSC, w/o attachment
MDEQ – WHMD/RPMWS
D. Minnaar, MDEQ
NRC Resident Inspector
P. S. Tam, NRC Washington, DC

IE25

ATTACHMENT TO AEP:NRC:6541

ANNUAL ENVIRONMENTAL OPERATING REPORT

Donald C. Cook Nuclear Plant Units 1 & 2

Annual Environmental Operating Report

January 1 through December 31, 2005

Indiana Michigan Power Company
Bridgman, Michigan

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

TABLE OF CONTENTS

		Page
I.	Introduction	1
II.	Changes to Environmental Technical Specifications	1
III.	Non-Radiological Environmental Operating Report	1
	A. Non-Routine Reports	1
	B. Environmental Protection Plan	1
	C. Plant Design and Operation	1
	D. Environmental Monitoring – Herbicide Application	1
	E. Mollusc Biofouling Monitoring Program	2
	F. NPDES Applications	2
	G. Special Reports	2

LIST OF APPENDICES

Appendix	Title
I.	Non-Routine Reports - 2005
II.	Herbicide Application Report - 2005
III.	Mollusc Biofouling Monitoring Program Report – 2005
IV.	NPDES Applications – 2005
V.	Special Reports – 2005

I. INTRODUCTION

Technical Specifications Appendix B, Part 2, Section 5.4.1, requires that an Annual Environmental Operating Report be produced and include summaries and analyses of the results of the environmental protection activities required by Section 4.2 of the Environmental Protection Plan for the report period. The Annual Environmental Operating Report shall include a comparison with preoperational studies, operational controls (as appropriate), previous non-radiological environmental monitoring reports, and an assessment of the observed impacts of the plant operation on the environment.

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 (CNP) for the operating period from January 1 through December 31, 2005.

The following table summarizes the pertinent data concerning the Plant's operation during the period from January 1 to December 31, 2005.

Parameter	Unit 1	Unit 2
Gross Electrical Generation (megawatt hours)	8,336,729	9,720,540
Unit Service Factor (%)	90.7	98.2
Unit Capacity Factor – Maximum Dependable Capacity Net (%)	92.0	101.4

II. CHANGES TO THE ENVIRONMENTAL TECHNICAL SPECIFICATIONS

There were no changes to Environmental Technical Specifications in 2005.

III. NON-RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

A. Non-Routine Reports

A summary of the 2005 non-routine events is located in Appendix I of this Report. No long-term, adverse environmental effects were noted.

B. Environmental Protection Plan

There were no instances of Environmental Protection Plan noncompliance in 2005.

C. Plant Design and Operation

During 2005, there were no changes in station design, operations, tests, or experiments that involved a potentially significant unreviewed environmental issue. There were no environmental evaluations performed during the reporting period.

D. Environmental Monitoring – Herbicide Application

Herbicide applications are the activities monitored in accordance with Technical Specification Appendix B Section 4.2. There were no preoperational herbicide studies to which comparisons could be made. Herbicide applications are managed by plant procedure PMP-2160-HER-001, Guidelines for the Application of Approved Herbicides.

A summary of the 2005 herbicide application is contained in Appendix II 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 to Environmental Protection Agency and State requirements for the approved use of herbicide.

E. Mollusc Biofouling Monitoring Program

Macrofouling monitoring and control activities during 2005 are discussed in Appendix III of this report.

F. NPDES Applications

On March 1, 2005, CNP made application to the Michigan Department of Environmental Quality (MDEQ) to renew its Groundwater Discharge Permit M00988. In response to MDEQ requests for additional information regarding the permit application, the plant made two additional submittals in letters to the MDEQ dated July 25, 2005, and August 11, 2005. The initial application and two additional submittals are contained in Appendix IV of this report.

G. Special Reports

In 2005, CNP contracted with two consultants, Alden Research Laboratory, Inc. and Great Lakes Environmental Center (GLEC), to determine (1) the dilution ratio that could be used to determine the concentration of the biocide Mexel A-432, proposed for zebra mussel control at the edge of the mixing zone and (2) to prepare a mixing zone evaluation report using the resultant dilution ratio to determine whether a mixing zone is acceptable and protective of the designated uses and water quality of the receiving water (Lake Michigan). The MDEQ Water Quality Standards rule defines the edge of the mixing zone as the point where discharge-induced mixing ceases to occur. The consultants' reports are summarized below and are contained in Appendix V of this report.

Alden Research Laboratory, Inc. conducted a computational fluid dynamics (CFD) simulation of the plume dilution at CNP. The objective of the simulation was to define the edge of the mixing zone and determine the average dilution ratio. Three plant operating conditions and four ambient lake current conditions were simulated. The most common lake current condition is a south to north long shore current of less than 0.5 ft./sec. For all operating scenarios under this condition, the predicted average dilution ratio is less than 0.42 (2.4). Cases where only one unit is operational or discharges are treated individually when both units are operational results in significantly lower dilution ratios.

GLEC prepared a mixing zone evaluation report using the results from the Alden study to determine whether a mixing zone is acceptable and protective of the designated uses and water quality of the receiving water (Lake Michigan). From the CFD simulation, at an ambient current velocity of 0.5 ft./sec., the dilution ratios were predicted to range from 2.4 to 7.1. The two cooling water discharges do not overlap and the area of the near-field mixing zone for each outfall is relatively small and contained within several hundred square feet. A review of the potential impact on designated uses of Lake

Michigan water concluded that there was no impact on any designated use. Particular attention was paid to the potential impact on Great Lakes fisheries, aquatic life and wildlife, and public water supplies. A review of the Michigan water quality standards specific to the toxicity requirements was completed, which also supported the determination of no impact.

APPENDIX I

NON-ROUTINE REPORTS

2005

2005 Non-Routine Reports

January 20, 2005 – On November 4, 2003, a fiberglass underground storage tank at the Bridgman Materials Center (formerly Gast Manufacturing Co.) was removed. Lab samples taken for tank closure noted detectable results for diesel range organics but were below site clean-up standards. The contamination was thought to have occurred during the tank removal process or was pre-existing at the time I&M started leasing the property.

Indiana Michigan Power (I&M) commenced leasing the property formerly owned by Gast on April 26, 2002 from Banker's Leasing Corporation (BLC – a unit of Citi Corp). It was soon realized that the UST on site was filling with stormwater and needed to be pumped on a regular basis. The decision was made to remove the tank. The tank was removed on November 4, 2003, with Mike Vinitski from the MDEQ present during the removal. I&M filed a "Notice of Aesthetic Disclosure" to be filed with the deed and submitted it to the Berrien County Register of Deeds on December 16, 2004.

January 21, 2005 (Also Submitted in 2004 Report) – Beginning on December 22, 2004, wild ducks were entrained into the intake cribs of the Donald C. Cook Plant. The species are believed to be primarily lesser scaup, with some bufflehead, common goldeneye, and common merganser. Plant personnel observations have determined that approximately 100 to 1,000 ducks have been rafting in the proximity of the plant intake cribs. It is believed that these ducks have congregated in the area due to the open water and abundant food supply of zebra mussels on the limestone riprap covering our intake pipes. In past years, cleaning zebra mussels from the intake cribs each fall had proven effective for minimizing wild duck entrainment. The intake cribs were cleaned of zebra mussels in the fall of 2004. A spring 2005 underwater camera inspection of the intake cribs is planned to determine if any other factors may have contributed to the entrainment of these animals.

Plant employees worked with the U. S. Department of Agriculture-Wildlife Service and the U. S Fish and Wildlife Service in January of 2005 to test laser equipment to attempt to reduce the number of ducks rafting in the vicinity of the plant intake structures. The results of the testing showed that the effects were only temporary in scaring the ducks away during periods of low light and was not effective during daylight hours.

March 14, 2005 – Notice was made to the MDEQ that recent intake pipe inspections indicated that the chemical feed pipeline on the center intake structure was damaged over the winter. Although the damage did not affect the plant's ability to control treatment systems or its ability to comply with effluent limits, the event was believed to warrant reporting. Remote camera inspections revealed that the chemical feed pipeline had been damaged to the point where it would have to be removed.

April 25, 2005 – Early on April 17, 2005 at about 0143 hrs., the plant reported a potential NPDES exceedance or "upset" noncompliance in Outfall 001A involving sodium hypochlorite to federal, state, and local agencies. This was done as a precautionary measure as it was not yet known the amount of sodium hypochlorite that had been discharged, or if its Reportable Quantity (RQ) was exceeded. Later that morning at 0310 hrs., it was determined that the 100 pound RQ for sodium hypochlorite was not exceeded, and only 1.96 pounds were released and the notification was retracted to all of the agencies contacted. This event was treated as if the plant was chlorinating on an intermittent basis.

April 29, 2005 – On April 27, 2005 at 0012 hrs. a routine visual observation of Internal Outfall 00A Unit 1 Steam Generator Blowdown indicated a very slight turbidity from suspended solids or "unsatisfactory" condition. This was the first "unsatisfactory" condition since the plant switched from total suspended solids to visual observation for steam generator blowdown samples in the new permit. This was determined to be an expected condition as the plant was being returned to service from a refueling outage where water within the steam generators had been stagnant for a period of time. Another sample taken at 0330 hrs. the same day, resulted in a satisfactory visual test. Visual observations of both the plant's external outfalls 001 and 002 for April 27, 2005 were satisfactory.

May 31, 2005 – A duck entrainment update letter was sent to the US Fish and Wildlife Service. The total number of animals entrained during 2004 was 83 and the total to date in 2005 was 265. The species were believed to be primarily lesser scaup, bufflehead, common goldeneye, black scoter, and common merganser. Ducks were reported rafting in the immediate area in numbers from 0 to 116.

An underwater inspection of the intake structures indicated that the bar racks were clear of visible mussel growth. On February 24, 2005, the plant divers found a 4' X 4' hole in the velocity cap on top of the south intake structure. All collapsible bar racks were in their upright positions on the south intake structure. The same day a temporary grating was placed over the 4' X 4' hole in the velocity cap on top of the south intake structure. Further repairs of the hole were planned under Job Order #05055044 to be completed by 10/8/05. On February 25, 2005, it was discovered that 1 collapsible bar rack (1C) was down on the north intake crib. The center crib was being used as a discharge, thus no waterfowl would be entrained into this structure over the winter.

Interviews with the divers revealed that only the perimeter of the velocity cap tops were cleaned in the fall of 2004 since there was no visible zebra mussel growth at that time. However, the spring's underwater camera inspection indicated that many zebra mussels and algae were growing on the velocity cap and may have attracted the water fowl to the intakes to feed during the past winter. The plant intends to have the entire velocity caps and bar racks cleaned in the fall of 2005. The hole in the south is scheduled to be completely repaired and all bar racks on all cribs in their upright positions prior to the winter de-ice operation. It was also intended to use some type of noise making device to send over the intakes to scare the birds away if entrainment occurred in the coming winter of 2005-2006.

June 28, 2005 – A letter was written to the Michigan Department of Community Health in response to their request for additional information on the April 17, 2005 release of sodium hypochlorite. In the letter the plant responded that it was determined that no release occurred, and that the initial notification was retracted.

June 30, 2005 – The USEPA issued to AEP's attorney, Kevin Mack, a Consent Agreement and Final Order (CAFO) in resolution of a civil penalty under Section 109 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and Section 325 of the Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA). The Complainant (Region 5 USEPA) alleged that the Respondent (IMP/AEP Cook Nuclear Plant) failed to make immediate notifications to the National Response Center, Michigan State Emergency Response Commission (SERC) and Berrien County Local Emergency Planning Committee (LEPC) and failed to provide a written follow-up emergency notice to the Michigan SERC and the Berrien County LEPC as soon as practicable after the release occurred. The release involved a sodium hypochlorite spill on November 16, 2002 at the Cook Nuclear Plant. A civil penalty of $2,953.80 was paid for the CERCLA violation and a civil penalty of $11,815.20 was paid for the EPCRA violation. The parties agreed that settling this action without further litigation, upon terms in this CAFO, was in the public interest. As part of the agreement, a permanent sodium hypochlorite system was installed in 2005.

July 8, 2005 – Revised reporting for Outfall 00A for the Month of May 2005. The Federal form (EPA 3320-1) NPDES Discharge Monitoring Report dated May 2005, Outfall 00A 1 "visual Observation No. of exceedences" incorrectly reported a value of "1" where a "0" should have been entered. There was no exceedence for this outfall for the month of May. The corrected form was included in the letter to the MDEQ.

July 18, 2005 – Groundwater monitoring for dissolved iron exceeded the limit of 300 ug/l in monitoring wells #12, #13, and #19. The dissolved iron concentrations in Wells #12, #13, and #19 were 350 ug/l, 5,580 ug/l, and 2,270 ug/l respectively. In a letter dated April 11, 2001 to Mr. Tim Unseld, the high concentrations of iron were suspected to be the result of natural, mineral reactions and have no correlation with the discharge from Cook Nuclear Plant. It was also indicated that the plant was working with the MDEQ to revise its groundwater permit to resolve this issue. The iron limits have been removed from the pending groundwater permit due to be issued in 2006.

September 23, 2005 – On September 15, 2005 at 1355 hrs., a hydraulic hose failed on a dump truck. Approximately 15 gallons of hydraulic oil leaked on a plant roadway approximately 1800 yards long. A front end loader scraped the gravel and oil from the roadway for proper disposal. The spill posed no threat to the environment, public health, or safety. A hydraulic hose coupling failed, which caused the oil to leak out during operation. The hose coupling was repaired and the truck's hydraulic system inspected to verify that it was in good condition to prevent further spills.

October 21, 2005 – A review of past Discharge Monitoring Reports revealed some discrepancies with Total Residual Oxidant (TRO) reporting levels due to transposition errors. On December 19, 2002 and June 13, 2003, the continuous TRO values were incorrectly reported as <1 ug/l when they should have been reported as 1 ug/l. On June 20, 2003, the intermittent TRO value was omitted from the report, however the correct value was 173 ug/l. The corrected forms were included in the letter to the MDEQ.

October 26, 2005 - A duck entrainment update letter was sent to the US Fish and Wildlife Service. In February 2005, plant divers found a 4' X 4' hole in the velocity cap on top of the south intake structure and two collapsible bar racks down, one on the north structure and one on the south structure. In August, a heavy duty grating was fastened over the hole in the velocity cap. A hazard assessment for placing the collapsible racks back in the upright position was completed in July. Up-righting the collapsible bar racks required divers to enter the intake structures. Due to high velocities in the area of the downed racks causing significant diver safety concerns, the plant divers were unable to up-right the bar racks while at power. The uprighting of the downed bar racks was scheduled for spring 2006 refueling outage for the south intake structure and for the fall 2006 refueling outage for the north intake structure when the associated units could be taken off line. The collapsible bar rack pin inspections and replacements were completed in July for all the upright bar racks. A cable modification was installed on the upright collapsible bar racks that would only allow them to fall inward approximately 50 degrees or less from their vertical position. This would allow diver replacement without having to venture into a flow stream that could be a risk to diver safety.

At the end of September 2005, the divers completed the external zebra mussel cleaning of all external surfaces of the three intake structures. The external surface of the velocity caps were completely cleaned as well. It is believed that by cleaning the external surface of the intake structures, placing the grating over the hole in the south structure velocity cap, and returning the downed bar racks to their upright positions as soon as it is safe to do so, the water fowl will not feed on our intake cribs but will instead feed on the rip-rap bottom, and thus not be entrained into the plant.

APPENDIX II

HERBICIDE APPLICATION REPORT

2005

INDIANA MICHIGAN POWER
A unit of American Electric Power

Date	April 5, 2006
Subject	**2005 Herbicide Spray Report - Cook Nuclear Plant**
From	Craig Wohlgamuth
To	John Carlson, Environmental Manager

The following herbicides were applied per manufacturers' direction by certified Michigan licensed applicators on Cook Nuclear Plant property during 2005:

Via Contractor	Via AEP Personnel
Oust/SFM 75, Du Pont/Vegetation Mgmt.	Round–Up Pro
Diuron, Dow	
Glyphosate, Du Pont	
Vet 720, Riverdale	

DeAngelo Brothers Applications:
DeAngelo Brothers; a Michigan licensed herbicide applicator on contract to the AEP Energy Delivery and Customer Relations performed the applications (Bill Rahm and Joe Ramilla).

On the dates of May 9, 10, and 16 of 2005 a mixture of Diuron, Oust, and Glyphosate was used for total plant control in the 69 KV, 345 KV and 765 KV switch yards, around the Fire Protection Tanks, Kelly Buildings, Steam Generator Mausoleum, Mechanics Garage, Sewage Plant, Dumpster Yard, Fire Training and Laydown Area, CESA Yard, W-Yard, railroad right-of-ways, and in/around the plant's Protected Area. A total of 164.6 pounds of Diuron 80, 53.1 ounces of Oust/SFM 75, and 35.6 quarts of Glyphosate were used for the application and spread over 23.0 acres in accordance with the manufacturers' labels.

On July 20, a mixture of Diuron, Glyphosate, and Vet 720 was applied to the Railroad "Right-of-Way" across Red Arrow Highway. A total of 50.0 pounds of Diuron, 16.0 quarts of Glyphosate, and 16.0 quarts of Vet 720 were used for the application and spread over 4.0 acres in accordance with the manufacturers' labels.

JFNew Application:
JFNew, a Michigan licensed herbicide applicator on contract to AEP DC Cook Plant, performed the following applications to all grassy areas around the Visitor's Center (Jen Lemler and Ryan Postema).

On September 23, 10 quarts of Glyphosate was applied to 1.0 acre. A re-spray on October 13 of 1.25 quarts of Glyphosate was applied to 0.5 acre. Both applications were in accordance with the manufacturer's label. No overspray conditions were noted.

The following table details the application rates used compared to the allowable application rates.

Product Name	Quantity Used		Quantity Used/Acre		Quantity Allowed/Acre	
Diuron	214.6	lbs	7.9	lbs	60.0	lbs
Oust	53.1	oz	2.3	oz	8.0	oz
Glyphosate	62.9	qt	2.2	qt	6.4	qt
Veteran 720	4.0	gal	1.0	gal	2.0	gal

Maintenance Building and Grounds:
Round-Up Pro mixed with water in a backpack sprayer was applied to Owner Controlled Areas by licensed applicators from the Maintenance ANR Buildings and Grounds crew (Andrew Wesner and Rennard Williams).

Weeds were spot-sprayed at the Visitor's Center, Radioactive Material Building, Training Center, Main Plant Roadway, Sewage Pond Area, Protected Area, Unit 1 RWST Yard and the Unit 2 RWST Yard. A total of 114 ounces of Round-Up Pro were used for spot spraying in 2005. According to the product label, spot spraying should contain a 5 - 10% solution.

The following table details the application rates used for weed control in the grass and garden beds compared to the allowable application rates.

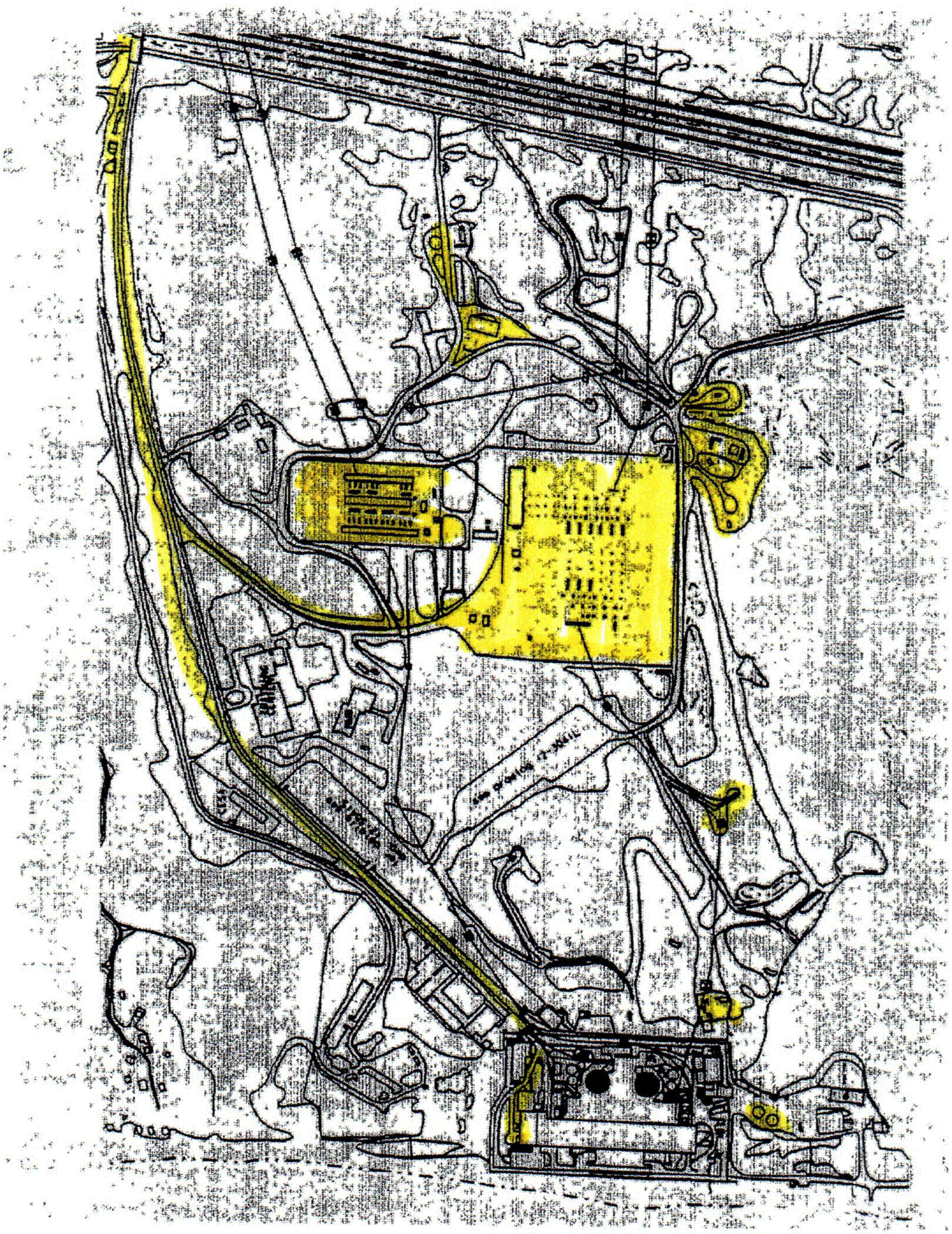
Product Name	Quantity Used	Concentration Used	Concentration Allowed
Round-Up Pro	114 oz	2 – 4% solution	5 – 10 % solution

Mortality Inspection:
On November 1 and 8, 2005, the mortality of these herbicide applications was assessed to be approximately 90% by environmental technicians Dean Warlin and Viren Shah. There were no instances of overspray or spills. As a result of the inspection, the following area requires further applications in 2006, as 2005's application was not fully effective:

- gravel area around the South Security Portal.

Summary:
In summary, based upon our review of the application records, manufacturer specifications, material safety data sheets (MSDSs) and observations of the treated areas, the herbicides were applied according to the manufacturer's labeled instructions and/or according to Federal and State requirements. As required by the State of Michigan, all personnel performing herbicide applications were licensed. A map has been included with this report indicating areas of herbicide application. Detailed maps and application records are filed in PMP-2160-HER-001, Guidelines for the Application of Approved Herbicides. No signs of over spray or spillage were observed. No adverse environmental effects occurred.

Information	PMP-2160-HER-001	Rev. 1	Page 9 of 14
Guidelines for the Application of Approved Herbicides			
Figure 1	Map 1		Page: 9



C01A

APPENDIX III

MOLLUSC BIOFOULING MONITORING PROGRAM REPORT

2005

Mollusc Biofouling Monitoring Program 2005

Performed at Donald C. Cook Nuclear Plant

Performed and Submitted
By
Cook Plant Environmental

Prepared for:

American Electric Power
Donald C. Cook Nuclear Plant
One Cook Place
Bridgman, Michigan

MOLLUSC BIOFOULING MONITORING PROGRAM 2005

March 2006

Cook Nuclear Plant
Environmental Section

Table of Contents

	Page #
List of Tables and Figures	i
Executive Summary	1
Chapter 1 – Introduction	3
1.1 Past History	3
1.2 Objectives	4
Chapter 2 – Methods	5
2.1 Whole-Water Sampling	5
2.2 Artificial Substrates	7
2.2.1 Intake Forebay	7
2.2.2 Service Water Systems	8
2.2.3 Artificial Substrate Cumulative Sample Analysis	9
Chapter 3 – Results and Discussion	10
3.1 Whole-Water Sampling	10
3.2 Artificial Substrate Sampling, Biocide Treatment, and Mechanical Cleaning	14
3.2.1 Circulating Water System Artificial Substrate Sampling	14
3.2.2 Service Water Systems and Miscellaneous Sealing and Cooling Water System Artificial Substrate Sampling	14
3.2.3 Biocide Treatment	18
3.2.4 Mechanical Cleaning	18
Chapter 4 Summary and Recommendations	21
4.1 Summary	21
4.2 Recommendations	22
References	24
Appendix Table 1 Chlorination Values for 2005 Zebra Mussel Monitoring Program	26

List of Tables and Figures

Table #	Title	Page #
2-1	Sampling Schedule for Zebra Mussel Monitoring at the D.C. Cook Nuclear Plant in 2005	6
3-1	Whole-Water Sampling Program Number of Zebra Mussel Veligers Per Cubic Meter, Veliger Size Range, and Mean Veliger Size (*u*m) Collected in the D.C. Cook Nuclear Plant Forebay in 2005	11
3-2	Density, Average Size, and Size Range of Settled Zebra Mussel Postveligers Collected on Cumulative Artificial Substrates Placed in the Forebay, in the Service Water Systems and the Miscellaneous Sealing and Cooling Water System in the D. C. Cook Nuclear Plant in 2005	16

Figure #		
3-1	2005 D.C. Cook Plant-Whole-Water Zebra Mussel Veliger Density and Water Column Temperature in Intake Forebay	12
3-2	2005 D.C. Cook Plant-Whole-Water Zebra Mussel Veliger Density and Zebra Mussel Postveliger Cumulative Settlement in the Service Water Systems	17
3-3	Screenhouse Intake Forebay	20

Executive Summary

Biofouling studies have been conducted at the Donald C. Cook Nuclear Plant since 1983. In 1991, monitoring of zebra mussels in the circulating water, essential service water (ESW), and nonessential service water (NESW) systems was added to the program. The objectives of this monitoring program are to detect the presence and determine the density of zebra mussel veligers in the Circulating Water System and postveliger settlement and growth rate in the forebay and service water systems, and to determine the effectiveness of oxidizing and non-oxidizing biocides in the plant systems by comparing densities and sizes of settled zebra mussels when applicable.

Veligers were present in the forebay from 28 April through 8 December 2005. Peak densities occurred on 23 June and 29 September with the major peak occurring on 29 September (455,000 veligers per cubic meter). Past years' studies have determined that zebra mussel density is independent of the volume of water entering the plant, as the concentration of veligers in the water remains the same regardless of the flow rate through the plant. The past fifteen years data suggest that the zebra mussel population is highly variable and future populations of zebra mussels are difficult to accurately predict.

Cumulative settlement was monitored in the forebay using a six-inch PVC pipe. As opposed to previous years of collection (June to June), the time period of collection was changed to more accurately coincide with the annual fall intake crib cleaning to estimate the size and density of mussels the divers might encounter at the time of cleaning. The PVC pipe was deployed on 5 January 2005 and was retrieved on 15 September 2005. The settlement density and average size of postveligers for the 8-month (approx.)

period was 213,125 individuals/m^2 and 2431u (2.4 mm). Despite its deployment for an 8 month period vs.12 months in 2004, the mussel density on the PVC sampler pulled in September 2005 was slightly higher than the sampler pulled in June 2004 (206,925 ind./m^2) but the average individual size was about ¾ the size than those of the 2004 sampler (3.3 mm). This is the first data set collected for this evaluation, thus a valid comparison could not be made with previous years' results which were 12-months in duration and collected each June.

Service Water Systems and Miscellaneous Sealing and Cooling Water

The return sides (after systems' use) of the ESW and NESW systems and the MSCW system were monitored in the 2005 Mollusc Biofouling Monitoring Program. The results indicate that the chlorination system was effective in preventing growth and prolonged settlement of postveligers in the service water systems. Settlement on bio-box artificial substrates was elevated in June through mid-July as the temporary chlorination system was removed from service to make it a permanent installation under 12-MOD-50719. Settlement remained in control throughout the remainder of the 2005 monitoring season under the permanent chlorination system. The results showed that even when the system was taken out of service for short periods of time for system maintenance, or that system TRC residuals fell below their target band of 0.2-0.5 ppm, settlement control was quickly re-established.

Biocide Treatment

There were no biocide treatments in 2005.

Chapter 1

Introduction

1.1 Past History

American Electric Power Company (AEP) has been conducting zebra mussel monitoring studies at the Donald C. Cook Nuclear Plant since 1991. The purpose of these studies is to monitor zebra mussel veliger and postveliger settlement densities in the Circulating Water, Essential Service Water (ESW), Nonessential Service Water (NESW), and Miscellaneous Sealing and Cooling Water (MSCW) systems to help determine the effectiveness of the zebra mussel control program.

Since 1999, Grand Analysis conducted the monitoring program, designed to detect the timing of spawning and settling of zebra mussels at the Cook Nuclear Plant. In 2004 the program was taken "in house" by the Plant's Environmental staff. The program also determines densities for: 1) whole water samples for planktonic veligers; and 2) artificial substrates set within the ESW, NESW, and MSCW systems for cumulative postveliger settlement. In the Circulating Water System, a section of PVC piping was used to determine the cumulative settlement in the intake forebay.

There were no biocide treatments performed in 2005.

1.2 Objectives

Specific objectives for the 2005 Mollusc Biofouling Monitoring Program were as follows:

- Conduct whole-water sampling of the Circulating Water System weekly (July-September), bimonthly (May, June, October & November), and monthly (April and December) to determine the presence and density of larval zebra mussels.

- Deploy artificial substrates (microscope slides in test tube racks) in the service water systems to determine cumulative settlement of postveligers. Collect samples monthly from May through December.

- Deploy a PVC piping section, also as an artificial substrate, in the intake forebay to determine cumulative settlement for approximately eight months.

Chapter 2

Methods

2.1 Whole-Water Sampling

Whole-water sampling of the Circulating Water System was conducted from 28 April to 8 December 2005 (Table 2-1). Samples were collected from mid-depth in the intake forebay by pumping lake water through an in-line flowmeter into a plankton net. The sampling location was consistent with that of previous studies. Two replicates (2,000 liters each) were collected during each sampling date.

A Myers Model 2JF-51-8 pump or equivalent was connected to an in-line flowmeter assembly (Signet Model #P58640) and pumped water into a plankton net for approximately one hour. To minimize organism abrasion, measured flow was directed into a No. 20 plankton net that was suspended in a partially filled 55-gallon plastic barrel.

Samples were gently washed into the cod-end bucket of the plankton net using filtered Circulating Water System water and then transferred to a one-liter plastic container. Filtered water was added to the container to ensure that a full liter was analyzed. The two samples were analyzed immediately in an on-site laboratory.

Samples were initially mixed thoroughly for three minutes using a magnetic stir plate. Then, using a calibrated Pasteur pipette, a 1-milliliter aliquot of mixed sample was placed into a Sedgewick-Rafter cell for counting. An Olympus SZ-1145 binocular microscope (18-110x) equipped with cross-polarizing filters was used. Ten aliquots

TABLE 2-1

SAMPLING SCHEDULE FOR ZEBRA MUSSEL MONITORING AT THE D.C. COOK NUCLEAR PLANT IN 2005			
Date		**Whole Water**	**Artificial Substrates**
April	28	X(1)	
May	12	X	
	26	X	X
June	9	X	
	23	X	X
July	7	X	
	14	X	
	21	X	X
	28	X	
August	4	X	
	11	X	
	18	X	X
	25	X	
September	1	X	
	8	X	
	15	X	X (2)
	22	X	
	29	X	
October	13	X	X
	27	X	
November	10	X	X
	23	X	
December	8	X	X

1. Deploy slide racks.
2. Retrieve PVC pipe section. Read, clean & re-deploy.

were counted and the average was extrapolated to determine the number of individuals per cubic meter. The density was calculated as follows:

Density (#/m3)=(average #*DF)/0.001L*1L/2000L*1000L/m3

DF- Dilution Factor

This process was repeated for the second replicate and the mean of the two values was calculated to yield a final density value. Size measurements were recorded for up to 50 organisms from each sample. Veliger size was measured using an ocular micrometer that was calibrated to a stage micrometer.

2.2 Artificial Substrates

To determine zebra mussel settlement in the Circulating Water, a PVC section was deployed in the intake forebay, upstream of the trash racks. Bio-box side-stream samplers were installed on the return sides of both service water systems and on the Miscellaneous Sealing and Cooling Water System to determine settlement in these systems. The side-stream samplers consisted of modified test-tube racks designed to hold microscope slides and placed in bio-boxes for cumulative sampling.

2.2.1 Intake Forebay

On 15 September 2005, a PVC pipe section was analyzed that was placed in the forebay on 5 January 2005. The PVC section measured 6 inches long and had an inside diameter of 3.5 inches. It had been cut in half lengthwise, rejoined using hose clamps, attached to a rope weighted by a concrete block, and suspended at mid-depth in the intake forebay. The PVC sampler was analyzed for densities and shell sizes by analyzing scrapings from two separate one-inch square sections of the PVC sampler. The PVC sampler was designed to provide information on zebra mussel accumulated infestation and sizes occurring over an approximate 8-month period from January to September of 2005.

When the PVC sampler was retrieved from the forebay on 15 September 2005, about 1/3 of the concrete block used as a weight was found missing. (CR 05259060) On 16 December, another PVC sampler was deployed in the intake forebay with a more robust weight made of stainless steel pipe.

2.2.2 Service Water Systems

Side-stream bio-boxes were placed on the return side of the service water systems (1 ESW, 2 ESW, NESW) and the Miscellaneous Sealing and Cooling (MSCW) Water System. Each bio-box contained two modified test tube racks containing a total of 80 microscope slides. The racks held the slides above the bio-box base that allowed silt and sediment to fall out before they could affect the slide settlement. The bio-boxes were covered with a plant-approved fireproof fabric to limit light exposure. Plant personnel checked the bio-boxes periodically to ensure that adequate flow was available, and flow was adjusted as necessary. Ten slides from each location were retrieved monthly and immediately analyzed for densities and shell size.

2.2.3 Artificial Substrate Cumulative Sample Analysis

An Olympus SZ-1145 binocular microscope (18-110x) equipped with cross polarizing filters was used for analyzing samples. After one side of the slide was scraped clean, the slide was placed on the microscope stage so that the attached postveligers could be counted. When slides became heavily infested, a sub-sampling technique was followed:

- The slides were sub-sampled using a straight edge that permitted either half or a quarter of the slide to be counted. Counts were then proportionally extrapolated to one square meter.

Settlement rates were computed by taking the average number of mussels from the ten slides and multiplying this value by 533.33 to obtain the density of zebra mussels per square meter. (One postveliger/microscope slide equals 533.33 postveligers per square meter.)

Shell diameters were measured for up to 50 random individuals to obtain maximum, minimum and mean sizes. Diameters were measured using an ocular micrometer calibrated to a stage micrometer.

Chapter 3

Results and Discussion

The zebra mussel monitoring system performed up to expectations in 2005. The whole-water sampling for free-swimming veligers coupled with monitoring postveliger settlement on artificial substrates provided sample results that could be compared with previous years' data.

Appendix Table 1 shows the chlorination values for the ESW and NESW systems. A 0.2-0.5 ppm total residual chlorine (TRC) was the target band for the control of zebra mussel settlement. Total residual chlorine values for the ESW and NESW systems were taken periodically. The MSCW system, which was cross-connected to the NESW system, was chlorinated on all of the dates that the NESW system was chlorinated.

3.1 Whole-Water Sampling

Sampling of planktonic veligers in the circulating water system was initiated 28 April and was completed on 8 December. Results are presented in Table 3-1 and in Figure 3-1. Veligers were present in all samples throughout the monitoring season.

Heaviest spawning activity occurred during late June through mid-July and again in late September. The major peak density occurred on 29 September (455,000 ind./m^3). This major peak occurred three weeks later than 2004's, and is consistent in timing with the major peak in 1995 that occurred during the last week of September but the 1995 peak was much lower at 5,150 ind./m^3. Overall, 2005's Whole-Water results were 2X higher

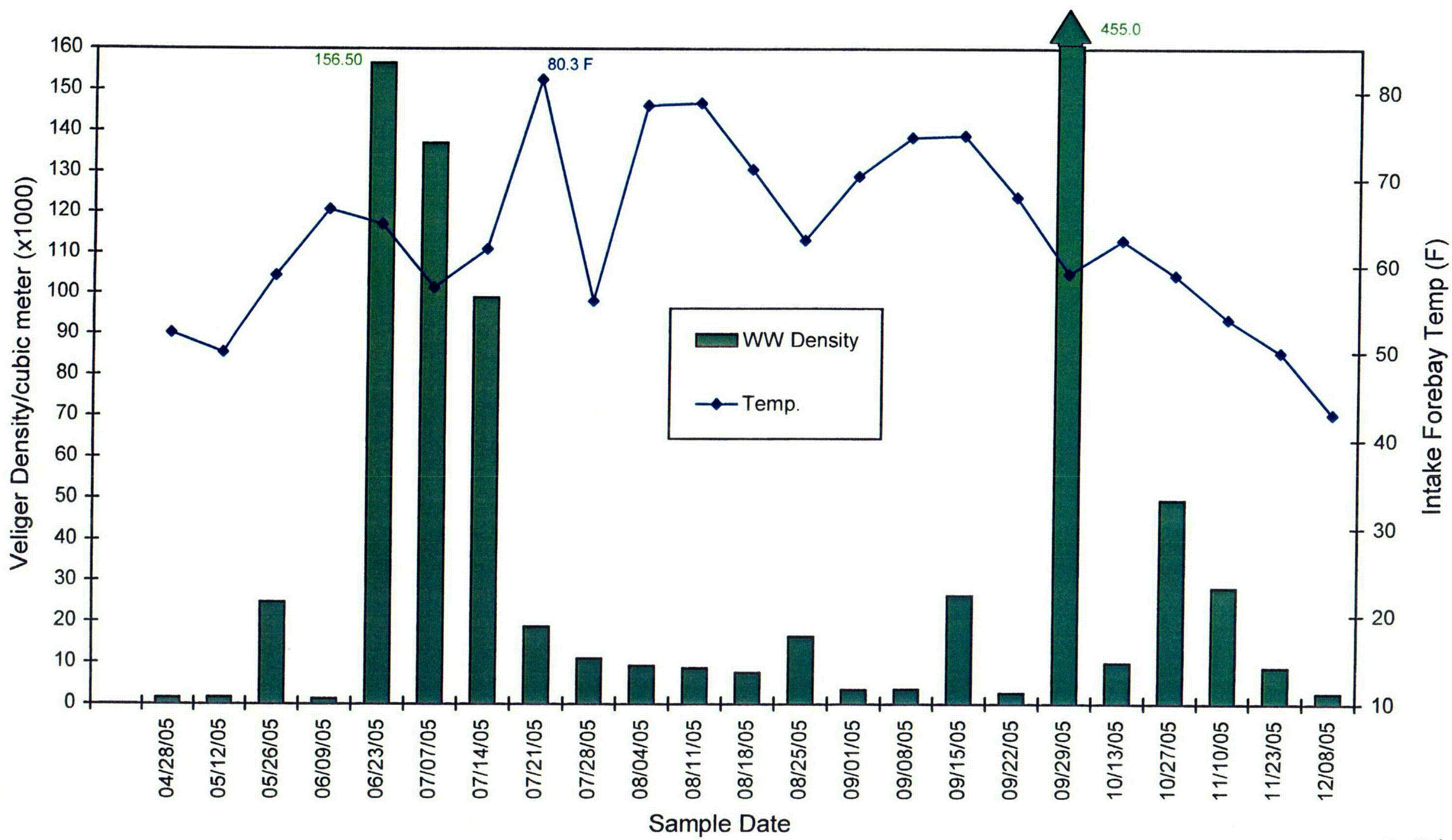
TABLE 3-1

Whole-Water Sampling Program Number of Zebra Mussel Veligers Per Cubic Meter, Veliger Size Range, and Mean Veliger Size (*u*m) Collected in The D.C. Cook Nuclear Plant Forebay in 2005

Date	Density (No./m3)	Size Range (*u*m)	Mean Size (*u*m)
4/28/05	1400	83-266	121
5/12/05	1523	50-400	160
5/26/05	24700	100-167	132
6/9/05	1225	117-216	166
6/23/05	156500	100-300	167
7/7/05	137000	83-283	133
7/14/05	99000	100-283	193
7/21/05	18625	117-300	169
7/28/05	11025	100-433	192
8/4/05	9200	100-366	158
8/11/05	8550	100-400	161
8/18/05	7475	117-250	174
8/25/05	16325	117-466	191
9/1/05	3350	117-366	180
9/8/05	3475	100-266	154
9/15/05	26425	117-250	159
9/22/05	2600	117-533	193
9/29/05	455000	83-350	136
10/13/05	9925	100-316	166
10/27/05	49500	100-266	150
11/10/05	28175	67-250	121
11/23/05	8675	100-300	179
12/8/05	2425	100-250	157

FIGURE 3-1

2005 D.C. Cook Plant- Whole-Water Zebra Mussel Veliger Density and Water Column Temperature in Intake Forebay



C01B

than the recorded peak density for 2004 (212,500 ind./m^3) and consistent with 2003 (450,000 ind./m^3). A secondary peak was recorded in 2005 on 23 June. (156,500 ind./m^3)

Whole water veliger densities trended lower after their peak on 29 September with falling lake temperatures after mid-October. A small blip was noted on 27 October (49,500 ind./m^3) as densities continued their downward trend into December. The whole-water densities show that there are substantial numbers of veligers in the forebay, indicating the need for effective chlorination in the service water systems.

The 2003 report concluded that yearly results in peak abundances make it difficult to predict when the peak abundance will occur each season other than estimating some time between July and October. Continued whole-water monitoring during the veliger spawning season will detect when these peak abundances occur.

Whole-water densities recorded during 1993 through 1995 for the November and December sampling periods were less than 1,000 ind. /m^3 for sampling conducted after 3 November. During the 1996 through 2000 as well as 2002 through 2005 sampling seasons, whole-water densities recorded in November were about five times greater than those of the 1993 through 1995 period, showing that spawning occurred into the late fall due to warm fall weather. In 2001, warm fall weather was not experienced as in the previous five years, as whole-water densities observed in November 2001 were less than 2,000 ind. /m^3. Because of the late fall spawning in recent years, there is a need for chlorination to continue into the late fall months to prevent zebra mussel settlement and growth in plant systems.

In summary, zebra mussel veligers were present in the water column on all sampling dates from 28 April through 8 December. Spawning commenced in late April and continued through the end of the sampling program. Peak veliger densities occurred on 23 June and 29 September.

3.2 Artificial Substrate Sampling, Biocide Treatment, and Mechanical Cleaning

3.2.1 Circulating Water System Artificial Substrate Sampling

Cumulative settlement was monitored in the intake forebay using a six-inch PVC pipe with a 3.5 inch inside diameter. The PVC pipe was set in the forebay on 5 January 2005 and examined on 15 September 2005 to determine the average density and size range for approximately 8 months. The density on the substrate was 213,125 ind./m^2. Individuals ranged from 290*u*-7,342*u* (.29mm – 7mm) and the mean size of fifty randomly selected individuals was 2,431*u* (2.4mm). As opposed to previous years of collection (June to June), the time period of collection was changed to more accurately coincide with the annual fall intake crib cleaning to estimate the size and density of mussels the divers might encounter at the time of cleaning. This is the first data set collected for this evaluation, thus a valid comparison could not be made with previous years' results which were 12-months in duration and collected each June.

3.2.2 Service Water Systems and Miscellaneous Sealing and Cooling Water System Artificial Substrate Sampling

The return sides (after systems' use) of the ESW and NESW systems and the MSCW system were monitored in the 2005 Mollusc Biofouling Monitoring Program. Chlorine is injected beneath each ESW pump suction. The ESW trains are typically cross-tied downstream of the chlorine injection point so that both ESW trains are served. A separate chlorine injection point, which is in the suction header, serves the NESW system and subsequently the MSCW system.

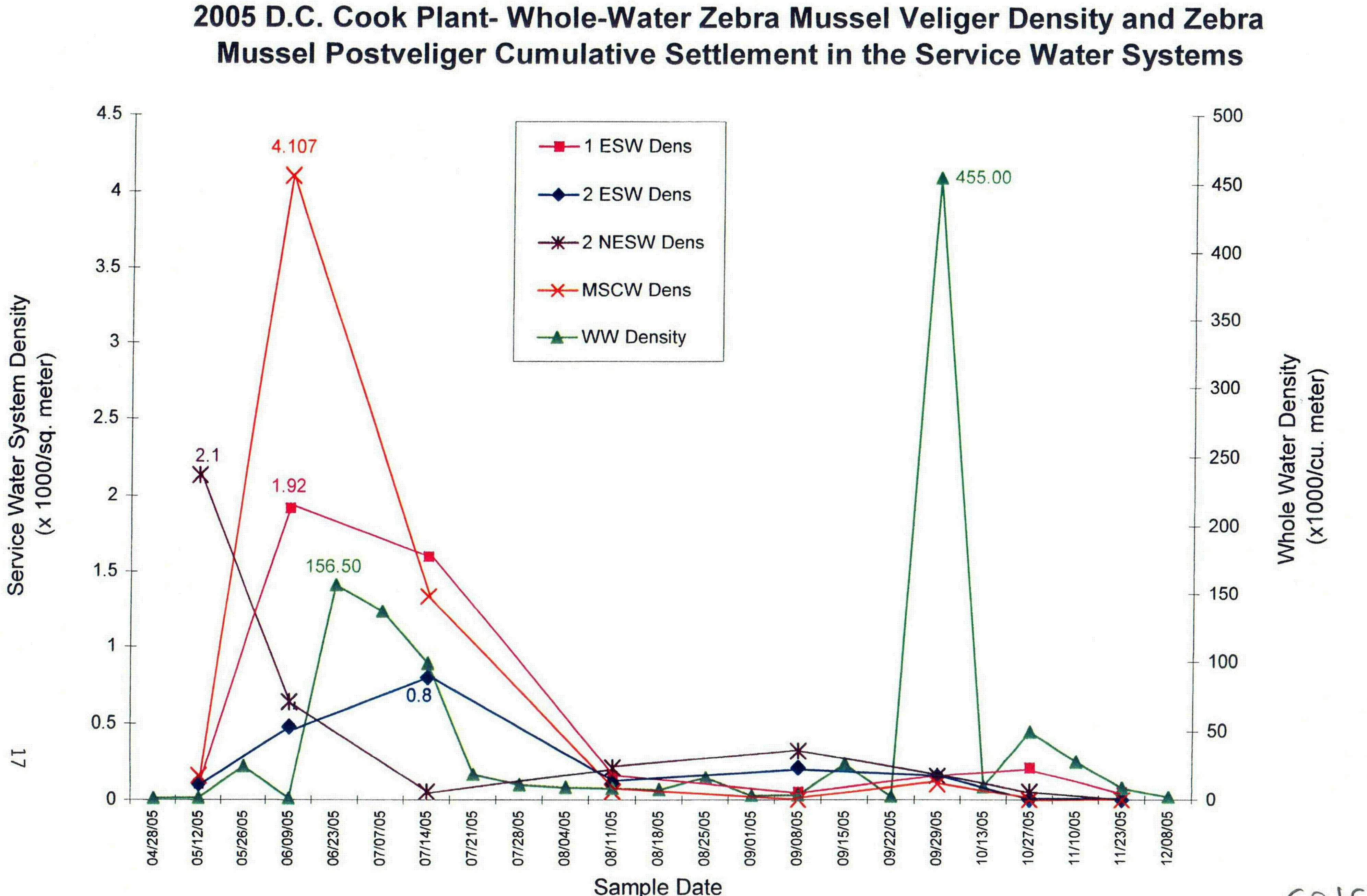
Cumulative settlement sampling and analysis was performed on a monthly basis in 2005. Artificial substrate slides were installed on 28 April and ten slides per month were examined and not replaced. Results are shown in Table 3-2 and Figure 3-2. The chlorine residual and postveliger settlement data indicate that the existing temporary chlorination system performed inconsistently during the period from 26 May through 14 July when the system was being made permanent under 12-MOD-50719. When the new permanent chlorination system came on line on 18 July, postveliger settlement densities in the service water and MSCW systems were reduced and showed good control through the end of the study period. The new chlorination system proved its efficacy when control was maintained in all systems under the peak whole-water density that was measured on 29 September of 455,000 ind./m^3 .

TABLE 3-2

Density, Average Size, and Size Range of Settled Zebra Mussel Postveligers Collected on Cumulative Artificial Substrates Placed in the Forebay, in the Service Water Systems and Miscellaneous Sealing and Cooling Water System in the D.C. Cook Nuclear Plant in 2005.

Cumulative Samples															
	Forebay			NESW			MS&CW			1 ESW			2 ESW		
Date	Density (no/m2)	Avg. Size (um)	Range (um)	Density (no/m2)	Avg. Size (um)	Range (um)	Density (no/m2)	Avg. Size (um)	Range (um)	Density (no/m2)	Avg. Size (um)	Range (um)	Density (no/m2)	Avg. Size (um)	Range (um)
5/26/2005	-	-	-	2133	106	78-137	160	111	78-137	107	88	78-107	107	106	98-107
6/23/2005	-	-	-	640	175	98-274	4107	115	78-235	1920	265	118-333	480	261	118-353
7/21/2005	-	-	-	53	274	274-274	1333	156	78-470	1600	231	98-314	800	345	98-2117
8/18/2005	-	-	-	213	255	118-451	53	137	137-137	160	235	216-274	107	137	137-137
9/15/2005	213,125	2431	290-7342	320	125	97-145	0	0	0	53	290	290-290	213	260	145-314
10/13/2005	-	-	-	160	153	121-217	107	193	121-266	160	250	242-266	160	169	97-290
11/10/2005	-	-	-	53	97	97-97	0	0	0	213	326	290-411	0	0	0
12/8/2005	-	-	-	0	0	0	0	0	0	53	193	193-193	0	0	0

FIGURE 3-2



C01C

In summary, postveliger data collected during 2005 in the service water systems and in the Miscellaneous Sealing and Cooling Water system sampling locations indicate low settlement from mid-August through early December. Even when the chlorine residuals were low of their target band (0.2-0.5 ppm TRC) or the system was taken out of service for maintenance for short periods of time, zebra mussel settlement control was maintained. Furthermore, reports of visual inspections of heat exchangers performed during the Unit 1 C20 Refueling Outage showed no live zebra mussel colonies residing in systems that were chlorinated.

3.2.3 Biocide Treatment

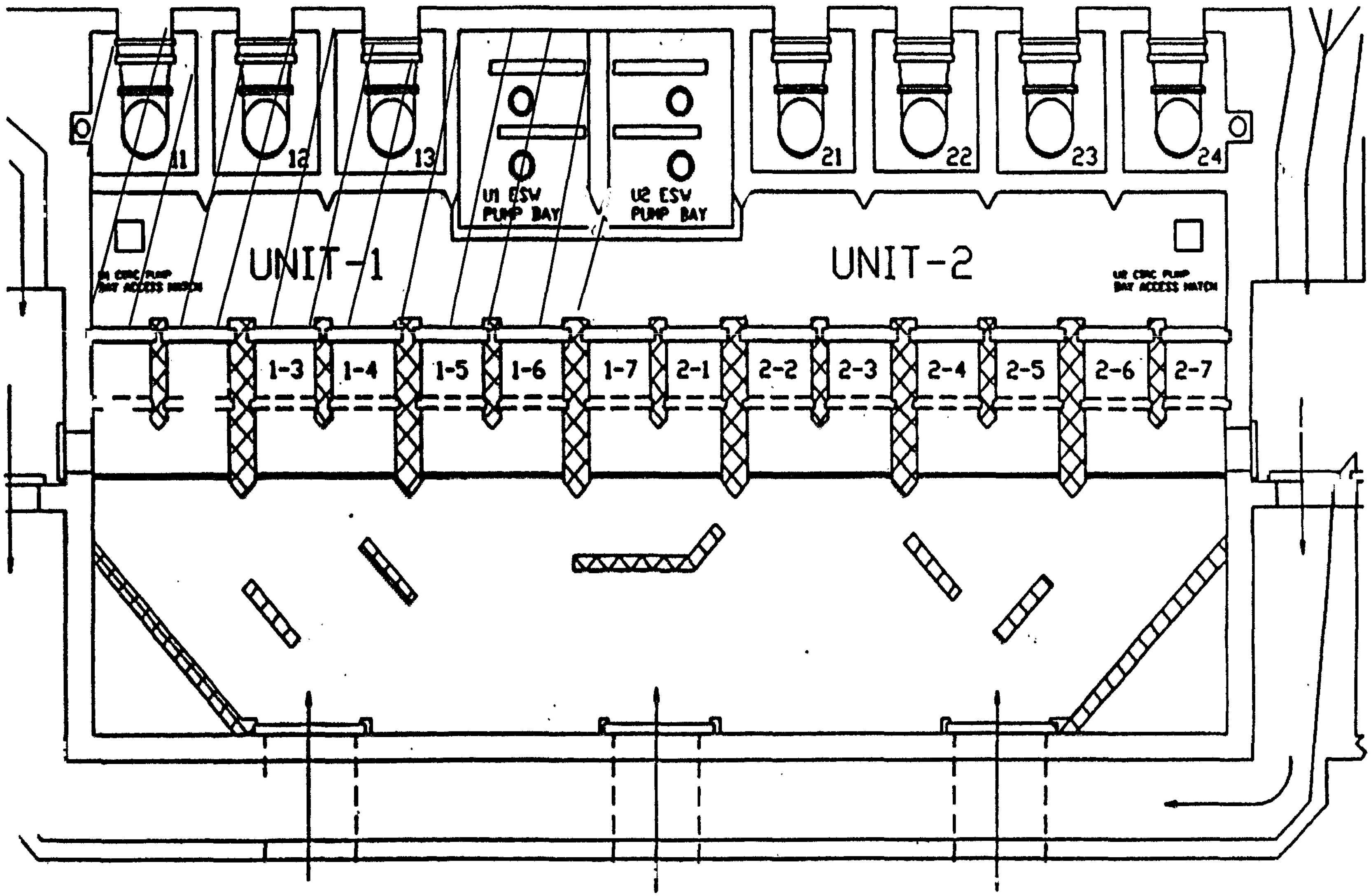
There were no biocide treatments in 2005.

3.2.4 Mechanical Cleaning

During the Unit 1C20 Refueling Outage in March-April of 2005, divers were employed to mechanically clean sand, zebra mussels, and debris from the walls and floors of the Unit 1 Circulating Water Intake Forebay and Unit 1 Condenser Inlet Tunnel. The Unit 1 Condenser Inlet Tunnel was cleaned in its entirety. The Unit 1 Intake Forebay was cleaned on the east (plant) side of the traveling screens (Figure 3-3). This included areas of the Unit 1 Circulating Water Pump and Unit 1 ESW Pump bays. The bays on the west (lake side) of the traveling screens to the trash racks, and further west of the trash racks extending to the west wall of the intake forebay were not cleaned. These areas were eliminated from the cleaning schedule due to diver safety and flow restraints and also with the expectation that the new robust multi-disk screens would be able to handle the zebra mussel sloughage from the walls and surfaces, and sand and mussel debris accumulation on the floor upstream.

In the Fall of 2005, the divers cleaned the intake crib velocity caps, ice guards, and trash racks of zebra mussels to remove the food source that attracts wild ducks to the intake cribs.

Figure 3-3
Screenhouse Intake Forebay



Note: Lined out area was cleaned during the U1C20 refueling outage.

Chapter 4

Summary and Recommendations

4.1 Summary

The 2005 Mollusc Biofouling Monitoring Program was initiated on 28 April and continued to 8 December. The major spawning peak occurred on 29 September. Spawning was relatively light during most of the year with the exception of a sharp spike occurring on 29 September and a moderate period from 9 June through 21 July.

The intake forebay PVC sampler zebra mussel density was 213,125 ind./m^2. Individuals ranged from 290*u*-7,342*u* (.29mm – 7mm) and the mean size of fifty randomly selected individuals was 2,431*u* (2.4mm). As opposed to previous years of collection (June to June), the time period of collection was changed to more accurately coincide with the annual fall intake crib cleaning to estimate the size and density of mussels the divers might encounter at the time of cleaning. This is the first data set collected for this evaluation, thus a valid comparison could not be made with previous years' results which were 12-months in duration and collected each June.

The data indicates that the chlorination system was effective in preventing growth and prolonged settlement of postveligers in the service water systems. Postveliger data collected during 2005 in the service water systems and in the Miscellaneous Sealing and Cooling Water system sampling locations indicate low settlement from mid-August through early December. Even when the chlorine residuals were low of their target band (0.2-0.5 ppm TRC) or the system was taken out of service for maintenance for short periods of time, zebra mussel settlement control was maintained.

Reports of visual inspections of heat exchangers performed during the Unit 1C20 Refueling Outage showed no live zebra mussel colonies residing in systems that were chlorinated.

4.2 Recommendations

Based on observations made during the course of this program, the following recommendations are being made:

- Whole-Water sampling should continue to be initiated in April to determine the presence of veligers in the water column, as currently implemented. The whole-water sampling frequency in 2005 was reduced from weekly to twice monthly in the months of June, October, and November to lessen the sampling burden and better target sampling based on previous years' spawning data. This sampling frequency reduction proved to be effective in 2005 as the major spawning peaks were still able to be captured, but with less sampling and analysis effort. This reduced sampling schedule should be continued as currently implemented.
- Studies of cumulative postveliger settlement should continue to be conducted from May through December, as currently implemented.
- Chlorination should continue to run throughout the spawning season, as currently implemented. As of Rev. 15 to 12-THP-6020-CHM-313, Chlorination effective 6 February 2006, Chemistry has expanded their chlorination target band from 0.2-0.5 ppm to the range of 0.08-0.5 ppm TRC to provide more flexibility to reduce chlorine concentrations in times when bio-fouling is not a

concern. Zebra mussel sampling and analysis in 2006 will confirm the efficacy of this target band change.

- Maintain daily bio-box flow checks to ensure bio-box conditions are representative of system conditions.
- Chlorination data from all water systems (ESW, NESW, and MSCW) and temperature data should continue to be made available to allow meaningful interpretation of results.

References

Lawler, Matusky, & Skelly Engineers LLP. 1995. Mollusc biofouling monitoring during 1994, Donald C. Cook Nuclear Plant: Final Report.

Great Lakes Environmental Center. 1996. A Zebra Mussel (Dreissena) Monitoring Survey for the Donald C. Cook Plant April-December 1995: Final Report

Lawler, Matusky,& Skelly Engineers LLP. 1997. Mollusc biofouling monitoring during 1996, Donald C. Cook Nuclear Plant: Final Report.

Lawler, Matusky, & Skelly Engineers LLP. 1999. Mollusc biofouling monitoring during 1998, Donald C. Cook Nuclear Plant: Final Report.

Grand Analysis. 1999. Zebra Mussel Monitoring Project for 1999. Performed at Donald C. Cook Nuclear Plant. Final Report.

Grand Analysis. 2000. Mollusc Biofouling Monitoring Project for 2000. Performed at Donald C. Cook Nuclear Plant. Final Report.

Grand Analysis. 2001. Mollusc Biofouling Monitoring Program for 2001. Performed at Donald C. Cook Nuclear Plant. Final Report.

Grand Analysis. 2002. Mollusc Biofouling Monitoring Program for 2002. Performed at Donald C. Cook Nuclear Plant. Final Report.

Grand Analysis. 2003. Mollusc Biofouling Monitoring Program for 2003. Performed at Donald C. Cook Nuclear Plant. Final Report.

Cook Nuclear Plant Environmental. 2004. Mollusc Biofouling Monitoring Program for 2004. Performed at Donald C. Cook Nuclear Plant. Final Report.

Appendix Table 1

Chlorination Values for 2005 Zebra Mussel Monitoring Program

	1 ESW		2 ESW		1 NESW	2 NESW
Date	East Hdr (ppm)	West Hdr (ppm)	East Hdr (ppm)	West Hdr (ppm)	(ppm)	(ppm)
5/5/2005	0.91		psc		0.77	0.17
5/6/2005	0.6		0.88		0.77	0.22
5/6/2005	0.61		0.55		0.64	0.16
5/6/2005					0.43	0.16
5/7/2005	0.28		0.33		0.73	0.17
5/8/2005					0.66	0.2
5/9/2005	1.21		1.27		0.26	0.37
5/9/2005	0.21		0.27			
5/24/2005					0.22	1.17
5/25/2005	< 0.08		< 0.08		< 0.08	0.61
5/27/2005	0.14				0.77	
5/27/2005	< 0.08				0.59	0.22
5/28/2005	0.21				0.38	0.33
5/30/2005					0.46	0.21
6/1/2005	< 0.08		< 0.08			
6/3/2005	0.3		0.49		psc	psc
6/6/2005					psc	psc
6/6/2005	0.56		0.56			
6/8/2005	0.12		0.12		0.59	
6/8/2005						0.16
6/10/2005	0.33		0.19		0.29	0.11
6/10/2005			2.7		0.11	
6/10/2005			0.16			
6/11/2005			0.91		0.5	0.11
6/11/2005			0.31			
6/12/2005					0.45	0.23
6/13/2005					< 0.08	< 0.08
6/13/2005	0.47					
6/17/2005	0.1		< 0.08		0.45	0.31
6/20/2005					0.87	0.16
6/20/2005	0.1		0.1		0.45	0.22
6/22/2005	0.14		0.38		0.49	0.13
6/22/2005	0.27				0.61	0.18
6/24/2005	< 0.08		0.62		0.46	0.2
6/24/2005	0.18		0.08			
6/27/2005	0.15		0.11		0.34	0.24

Appendix Table 1

Chlorination Values for 2005 Zebra Mussel Monitoring Program

	1 ESW		2 ESW		1 NESW	2 NESW
Date	East Hdr (ppm)	West Hdr (ppm)	East Hdr (ppm)	West Hdr (ppm)	(ppm)	(ppm)
6/29/2005	0.17		0.17		psc	psc
7/1/2005	< 0.08		0.17		secured	secured
7/4/2005	off		secured		secured	secured
7/6/2005	secured		secured		secured	secured
7/8/2005	secured		secured		secured	secured
7/11/2005	psc		psc		secured	secured
7/13/2005	psc		psc		secured	secured
7/15/2005	psc		psc		psc	psc
7/19/2005	0.18		0.23		0.41	0.5
7/19/2005	0.38					
7/20/2005	0.4		0.34		0.41	0.5
7/22/2005	0.5		0.27		0.34	0.36
7/25/2005	0.44		1.25			0.44
7/26/2005	< 0.08		0.12		0.34	0.44
7/27/2005	0.13		0.21		0.39	0.46
7/28/2005	0.3		0.26			
7/29/2005	0.25		0.17		0.4	0.56
7/30/2005	0.25		0.12		0.36	0.38
8/1/2005	0.12		0.19		0.31	0.38
8/2/2005	0.1		0.17			
8/3/2005	0.22		0.24		0.32	0.39
8/5/2005	0.28		0.49		0.44	0.48
8/8/2005	< 0.08		0.14		0.41	0.55
8/8/2005	0.21		0.24			0.46
8/10/2005	< 0.08		0.11		0.41	0.42
8/12/2005	0.17		0.35		0.5	0.22
8/13/2005	< 0.08					
8/14/2005	0.26		0.08		0.58	0.25
8/14/2005	< 0.08					
8/15/2005	0.32		0.65		0.42	0.2
8/18/2005	0.18		0.34		0.44	0.26
8/19/2005	0.21		0.29		0.49	0.23
8/22/2005	0.16		0.19		0.34	0.19
8/23/2005	0.24		0.31		0.48	0.49
8/24/2005	0.39		0.29		0.31	0.49

Appendix Table 1

Chlorination Values for 2005 Zebra Mussel Monitoring Program

Date	1 ESW East Hdr (ppm)	1 ESW West Hdr (ppm)	2 ESW East Hdr (ppm)	2 ESW West Hdr (ppm)	1 NESW (ppm)	2 NESW (ppm)
8/25/2005	0.23		0.31		0.46	0.53
8/25/2005	0.11		0.2			0.43
8/26/2005	0.27		0.2		0.48	0.33
8/29/2005	0.1		0.2		0.46	0.44
8/31/2005	0.1		< 0.08		0.4	0.38
9/2/2005			< 0.08		0.51	0.56
9/2/2005	< 0.08					
9/5/2005	0.21		0.26		0.25	0.3
9/7/2005	0.1		0.14		0.36	0.34
9/9/2005	< 0.08		1.73		0.4	0.4
9/9/2005	< 0.08		0.83			
9/10/2005	< 0.08		< 0.08			
9/11/2005	< 0.08		< 0.08			
9/12/2005	< 0.08		< 0.08		0.38	0.38
9/14/2005	0.08		< 0.08		0.39	0.33
9/16/2005	< 0.08		< 0.08		0.41	0.37
9/22/2005	0.12		0.18		0.39	0.33
9/23/2005	< 0.08		< 0.08		0.31	0.44
9/24/2005	see U-2		0.76			
9/24/2005			0.68			
9/24/2005			0.29			
9/24/2005			0.24			
9/26/2005	see u-2		0.47		0.37	0.49
9/26/2005			0.49			
9/28/2005	0.55		0.58		0.24	0.32
9/28/2005	0.41		0.42			
9/28/2005	0.58		0.61			
9/30/2005	0.86		0.23		0.45	0.58
10/1/2005	0.44		2.1			0.39
10/1/2005			0.1			
10/1/2005			0.39			
10/1/2005			0.59			
10/3/2005	see u2		0.25			
10/3/2005			0.16		0.26	0.25
10/3/2005			0.29			

Appendix Table 1

Chlorination Values for 2005 Zebra Mussel Monitoring Program

	1 ESW		2 ESW		1 NESW	2 NESW
	East Hdr	West Hdr	East Hdr	West Hdr		
Date	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
10/3/2005			0.45			
10/5/2005	0.49		0.82		0.35	0.3
10/6/2005			0.22			
10/7/2005	0.16		0.21		0.36	0.46
10/10/2005	0.31		0.33		0.32	0.46
10/12/2005	0.36		0.27		0.19	0.26
10/12/2005	0.23		0.46			
10/14/2005	0.29		0.29		0.33	0.36
10/17/2005	see u-2		0.41		0.42	0.43
10/17/2005			0.39			
10/19/2005	see u2		0.34		0.25	0.25
10/19/2005			0.21			
10/21/2005	0.14		0.16		0.62	0.4
10/22/2005	0.08		0.18		0.4	
10/22/2005	< 0.08					
10/23/2005	0.09		0.28			
10/24/2005	< 0.08				0.37	0.44
10/24/2005	0.24	0.13	< 0.08			
10/24/2005			0.13	0.22		
10/26/2005	< 0.08	< 0.08	< 0.08	< 0.08	0.37	0.39
10/26/2005	< 0.08	< 0.08	< 0.08	< 0.08		
10/28/2005	0.11	< 0.08	< 0.08	0.12	0.32	0.38
10/29/2005	0.09	0.13	0.27	0.08		
10/30/2005	0.17	0.35	0.39	0.24		
10/31/2005	0.1	0.1	0.32	0.15	0.52	0.58
11/1/2005	0.17	0.15	0.2	0.18	0.32	0.43
11/2/2005	0.15	0.11	0.24	0.17	0.18	0.25
11/3/2005	0.16	0.13	0.19	0.14	0.24	0.48
11/4/2005	0.48	0.49	0.45	0.37	0.29	0.45
11/7/2005	0.08	0.08	0.17	0.16	0.15	0.3
11/8/2005	0.3	0.31	0.24	0.28	0.41	0.49
11/9/2005	0.08	0.09	0.32	0.33	0.35	0.46
11/11/2005	0.14	0.25	0.24	0.22	0.28	0.55
11/11/2005				secured		
11/14/2005	1.19	0.23	0.32	1.21	0.46	0.48
11/16/2005	0.72	0.13	0.21	0.69	0.4	0.53

Appendix Table 1

Chlorination Values for 2005 Zebra Mussel Monitoring Program

	1 ESW		2 ESW		1 NESW	2 NESW
Date	East Hdr (ppm)	West Hdr (ppm)	East Hdr (ppm)	West Hdr (ppm)	(ppm)	(ppm)
11/18/2005	0.25	0.15	0.11	0.23	0.51	0.43
11/19/2005	0.35	0.34	0.24	0.32	0.45	0.37
11/21/2005	0.46	0.49	0.47	0.46	0.37	0.47
11/23/2005	0.39	0.16	< 0.08	0.22	0.36	0.36
11/24/2005	0.22	0.2	0.21	0.3		
11/25/2005	0.43	0.22	0.14	< 0.08	0.28	0.18
11/26/2005	0.33	0.68	1.85	0.36	0.28	0.2
11/26/2005	0.53	1.39	1.54	0.52	0.53	0.59
11/27/2005	0.12	0.15	0.18	0.18	0.24	0.19
11/28/2005	0.31	0.13	0.11	0.37	0.21	0.18
11/28/2005		0.28	0.17			0.4
11/30/2005	0.85	0.37	0.35	0.85	0.41	0.49
12/2/2005	0.42	0.33	0.23	0.46	0.38	0.53
12/3/2005					0.39	0.47
12/5/2005	0.33	< 0.08	0.1	0.38	0.35	0.5
12/7/2005	0.3	0.72	0.83	0.38	0.31	0.51
12/9/2005	0.29	0.63	1.04	0.42	0.33	0.32
12/12/2005	de-ice	de-ice	de-ice	de-ice	psc	psc
12/14/2005	psc	psc	psc	psc	psc	psc

APPENDIX IV

NPDES APPLICATIONS

2005

CC2005- 149

INDIANA MICHIGAN POWER

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

CERTIFIED MAIL #7004 2510 0003 5264 6070

Permits Section
Groundwater Discharge Unit
Water Bureau
Michigan Department of Environmental Quality
PO Box 30273
Lansing, MI 48909

March 1, 2005

Gentlemen:

Subject: Donald C. Cook Nuclear Plant
Permit No. M00988

Enclosed is the Groundwater Discharge Authorization Application for the disposal of wastewater to the ground or groundwater for renewal of the Donald C. Cook Nuclear Plant Groundwater Discharge Permit M00988. This application is being submitted 180 days prior to the expiration of the present permit.

Should you have any questions regarding this renewal application, please contact me at (616) 465-5901, ext. 1153.

Sincerely,

John P. Carlson
Environmental Manager

Attachment

bc: J. F. Butcher
J. P. Carlson
M. J. Finissi
C. E. Hawk
J. N. Jensen
W. H. Schalk
B. W. Watson
T. K. Woods
B. K. Zordell
MDEQ File w/o attachments
NRC - per Environmental T/S
Annual Operating Report
NDM (Control # 2005-149), Mail Zone 1

TAB 1

STATE OF MICHIGAN

GROUNDWATER DISCHARGE AUTHORIZATION APPLICATION

for
the disposal of wastewater
to the ground or groundwater

Permits Section
Groundwater Discharge Unit
Water Bureau
Michigan Department of Environmental Quality

Jennifer M. Granholm, Governor

Steven E. Chester, Director

4

PREFACE

This document contains a set of instructions and the application form necessary to apply for a groundwater discharge authorization. The instructions are organized to allow you to determine what type of authorization is required and how to obtain it.

The **instructions** first list several types of groundwater discharges that are prohibited, then several types of discharges that are automatically authorized, referred to as exemptions. If the discharge you are proposing is on either of these lists, you will not need to submit an application form. All other discharge authorization requests are required to file an application form. The instructions go on to list several other specific types of discharges that can be authorized short of a full permit. If the discharge is not included among those listed, then you must apply for a permit under Rule 2218.

The **application form** has two parts. The first is general information, which must be filled out by all applicants. The general information section is found on Pages 14-17 of the application. The second half of the application is divided into sections that are specific to the type of authorization being sought. Authorizations issued under Rules 2211, 2213 and 2216 are for very specific discharges, and are listed in the instructions. All remaining discharges are authorized under Rule 2218. Once you have determined what type of authorization you require and filled out the general information section, you should locate the portion of the application specific to your discharge and fill out the appropriate information. Page 18 of this document contains a detailed index listing the specific pages to be filled out for each specific discharge.

Please note: The Rules require that the applicant must provide all information necessary to make a permit decision. Applications that do not contain all necessary information will be returned as incomplete.

TABLE OF CONTENTS

Part I, Instructions

Page

A. GENERAL INFORMATION

1. Who must apply for a permit? 4
2. Purpose 4
3. Information requirements for all dischargers 4
4. Requirements for all dischargers 4
5. Discharge prohibitions 4
6. Isolation distances 5
7. Changes to an existing discharge 5
8. Equivalency demonstration 5

B. IDENTIFICATION OF THE TYPES OF AUTHORIZATIONS

1. Exemptions 5
2. Discharge specific exemptions 7
3. Permit authorizations 8

C. RULE 2218

1. Information requirements 8
2. Rule 2219 – Feasibility of Alternatives 9
3. Rule 2218(2) – Basis of Design 10
4. Rule 2223 – Discharge Monitoring 10

D. APPLICATION PROCESS

1. When do I have to apply? 12
2. How is the application form organized? 12
3. Who must sign the application form? 12
4. Additional reference materials 13
5. Who should I call if I have questions? 13
6. Where should the application form be sent? 13
7. Operational Requirements 13
8. Penalties 13

Part II, PERMIT APPLICATION, EQP 5305

General information 14-17
Detailed Rule Index 18
Rule 2211 Authorization 19
Rule 2213 Authorization 23
Rule 2215 Authorization 27
Rule 2216 Authorization 32
Rule 2218 Authorization 36
Rule 2210(y) Authorization 40
Appendix A – Treatment Method Classification 41-44
Appendix B – Operational Requirements 45-46

A. GENERAL INFORMATION

1. WHO MUST APPLY FOR A PERMIT?

Section 3112(1) of Part 31, Water Resources Protection, of the Michigan Natural Resources and Environmental Protection Act of 1994, PA 451 as amended (Act 451) states that any person discharging any waste or waste effluent into the waters of this state must be in possession of a valid authorization to discharge from the Michigan Department of Environmental Quality (department).

A "person" is defined as an individual, partnership, corporation, association, governmental entity, or other legal entity.

2. PURPOSE

The purpose of the Part 22 Rules is to preserve the quality of groundwater for all of its protected uses, both current and potential future uses. Section 3109(1) of Act 451 prohibits the direct or indirect discharge into any waters of the state any substance that is or may become injurious to any protected uses of those waters. The department enforces this prohibition through the "Part 22" Administrative Rules, contained at M.A.C. R323.2201 through 2240. These rules are referenced in this document as Rule 2201 through 2240. The protected uses include public health, safety, and welfare; domestic, commercial, industrial, agricultural, recreational or other uses that may be made of such waters; the value or utility of riparian lands; and the use of the water by livestock, wild animals, birds, fish, aquatic life, or plants or the growth or propagation of those entities.

3. INFORMATION REQUIREMENTS FOR ALL DISCHARGERS

Rules 2206 and 2217 require that you must provide all information for the Department to make a decision regarding an application for a groundwater discharge authorization. If the information is not provided, the application will be returned as incomplete.

4. REQUIREMENTS FOR ALL DISCHARGERS

Rule 2204 establishes certain requirements for all dischargers. These are:

1. The discharge must not become injurious.
2. The discharge must not cause runoff to, ponding of, or flooding of adjacent property.
3. The discharge must not cause erosion.
4. The discharge must not cause nuisance conditions.
5. The discharge must be located not less than 100 feet inside the boundary of the property where the discharge occurs, unless authorized by Rule 2210, 2211, 2213 or a lesser distance is approved by the department.
6. The discharge must be isolated from water supply wells as indicated in Rule 2204(2)(d).
7. The discharge must not create a facility under Part 201 of Act 451.

There are certain operational requirements for each type of discharge that must be met after an authorization is issued. Those requirements are found in Appendix B, Pages 45-46 of the application form.

5. DISCHARGE PROHIBITIONS

Rule 2205 prohibits:

1. A discharge without an authorization under Rule 2204.
2. A discharge from a general-purpose floor drain unless authorized under Rule 2210(v), Rule 2215 or 2218.
3. A discharge of wastewater originating from a structure within 200 feet of an available public sanitary sewer system, except for a discharge of non-contact cooling water or a discharge from a groundwater remediation activity. For sanitary sewage, an available public sanitary sewer system is defined by section 12751(a) of Act 368 of the Public Acts of 1978, as amended, being 333.12751(a) of the Michigan Compiled Laws. For any other discharge, the department must make a determination of availability based on the ability of the public sanitary sewer system to treat the wastewater and the costs associated with providing the treatment.

7

6. WHAT SETBACK REQUIREMENTS MUST I MEET FOR MY DISCHARGE?

If the discharge is authorized under Rules 2216 or 2218, the point of discharge must be at least 100 feet within the property boundary, unless an alternate distance is required or allowed by the department. Also, there are requirements under Rule 2204(2)(d) for isolation distances from existing water supply wells. The following table lists those isolation requirements.

Well Type	Permit Authorization – 2218, 2216(3)	All Other Authorizations
I, IIa	2000 feet	200 feet
IIb, III	800 feet	75 feet
Domestic	300 feet	50 feet

7. WHAT IF I HAVE AN EXISTING PERMIT, AND THERE IS A CHANGE IN MY DISCHARGE?

If you anticipate there will be a change in either the quantity or quality of your discharge, you must notify the department prior to making the change. Within 30 calendar days of receiving the notice of modification, the department will notify you whether the modification is considered minor or significant. If the department determines the change is **minor**, you can make the changes you have identified, and the existing permit will be modified to reflect those changes. The department will send you a copy of the amended permit. If the changes are determined to be **significant**, then you must reapply for a permit by completing the application form and submitting it to the department for review and approval.

8. HOW DO I DEMONSTRATE EQUIVALENCY?

In many instances, the Part 22 rules allow you to provide equivalent information or alternative ways of meeting the conditions of the Rules. To demonstrate equivalency, you should provide both a narrative description and technical data to show that the alternative proposed meets the intent and achieve the same purpose as the Rule in question. For example, there are specific requirements for source water for Fruit & Vegetable washwater, Rule 2211(c), including municipal water, a water source meeting state or federal criteria, or water meeting standards of Rule 2222. An alternative water source not specified is surface water. If you wish to use surface water, you need to describe and demonstrate, possibly through water quality testing, how the surface water meets the intent of the Rule and provides equivalent environmental protection to the sources specified in the Rule.

B. IDENTIFYING THE TYPE OF AUTHORIZATION REQUIRED

This section lists all of the specific discharges identified in the Part 22 Rules. You should review the list and determine if your discharge is listed, and then follow the directions for how that particular discharge receives authorization.

1. EXEMPTIONS

Pursuant to Rule 2210 the activities listed below are automatically authorized and are exempt from obtaining a further authorization from the department, provided the requirements of Rule 2204 are met. You do not need to submit an application form.

(a) **Sanitary sewage** in either of the following circumstances if the sanitary sewage is not mixed with other waste:

(i) **The discharge is less than 1,000 gallons per day** and the disposal system is approved by the county, district, or city health department that has jurisdiction in accordance with either the requirements of the local sanitary code or the provisions of the publication entitled "Michigan Criteria for Subsurface Sewage Disposal," April 1994. Copies of the publication may be obtained without charge at the time of adoption of these Rules from the Michigan Department of Environmental Quality, Water Division, P.O. Box 30630, Lansing, Michigan 48909.

(ii) **The discharge is less than 6,000 gallons per day**, the disposal system is designed and constructed in accordance with the provisions of the publication entitled "Michigan Criteria for Subsurface Sewage Disposal," April 1994, and the system is approved by the county, district, or city health department that has jurisdiction. Copies of the publication may be obtained without charge at the time of adoption of these Rules from the Michigan Department of Environmental Quality, Water Division, P.O. Box 30630, Lansing, Michigan 48909.

8

(b) **Controlled application of any of the following:**
  (i) An authorized substance to suppress dust. The following are authorized substances:
    (A) Water.
    (B) Calcium chloride.
    (C) Lignosulfate products.
    (D) Emulsified asphalt or resin stabilizers.
    (E) Vegetable by-products.
  (ii) A deicing substance.
  (iii) A substance for a natural resource or right-of-way maintenance program.
  (iv) A substance for a domestic activity.
  (v) A commercially manufactured pesticide or fertilizer for its intended use.

(c) **Stormwater**, other than from a secondary containment facility, when discharged through surface infiltration.

(d) **Stormwater** from a secondary containment facility that does not contain leaks or spills if the stormwater is inspected to ensure it meets the standards established in Rule 2222.

(e) **Water from a well used temporarily for dewatering at a construction site** if the water pumped does not create a site of environmental contamination under part 201.

(f) **A discharge from an animal feeding operation** that has less than 5,000 animal units if the discharge is determined by the director of the department of agriculture or his or her designated representative, to be in accordance with generally accepted agricultural and management practices, as defined in Act No. 93 of the Public Acts of 1981, as amended, being 286.471 to 286.474 of the Michigan Compiled Laws, and known as the Michigan right to farm act. For purposes of this Rule, 5,000 animal units is equal to 5,000 head of slaughter or feeder cattle, 3,500 mature dairy cattle, 12,500 swine weighing more than 25 kilograms or approximately 55 pounds, 50,000 sheep or lambs, 2,500 horses, 275,000 turkeys, 150,000 laying hens or broilers, or 25,000 ducks. An animal feeding operation is a lot or facility, or series of lots or facilities under one ownership which are adjacent to one another or which use a common area or system for the disposal of wastes, that meets both of the following conditions:
  (i) Animals, other than aquatic animals, have been, are, or will be stabled or confined and fed or maintained for a total of 45 calendar days or more in any 12-month period.
  (ii) Crops, vegetation, forage growth, or postharvest residues are not sustained in the normal growing season over the portion of the lot or facility where animals are confined.

(g) Less than 50 gallons of wastewater per day from a **commercial animal care facility.**

(h) **Observation or monitoring well development or evacuation water.**

(i) **Potable water used for a domestic or domestic equivalent activities** other than sanitary sewage disposal.

(j) **Step test or pump test water** from any of the following:
  (i) A potable well or well used to develop a potable water supply.
  (ii) A well producing water that meets state or federal criteria for use as potable water.
  (iii) A test well where the quality of the test well discharge water is equal to or better than the background groundwater quality of the aquifer receiving the discharge.

(k) **Exfiltration from sanitary sewer collection systems.**

(l) **Wastewater from a heat pump** that has a heat exchange capacity of 300,000 Btu per hour or less if there is no chemical additive to the system.

(m) **Wastewater from a portable power washer** when used in either of the following circumstances:
  (i) By the occupant of a household for washing buildings, vehicles, or other surfaces associated with the domestic occupation of the household.
  (ii) By a commercial operator or in a commercial or industrial setting to remove nonpolluting substances from vehicles or surfaces when no additives are used and the washing process does not add significant pollutants to the water.

(n) **Swimming pool drainage and backwash water** discharged in accordance with sections 12521 to 12534 of Act No. 368 of the Public Acts of 1978, as amended, being 333.12521 to 333.12534 of the Michigan Compiled Laws.

(o) **Water treatment filter backwash water** if disposal is in accordance with plans and specifications approved by the department under Act No. 399 of the Public Acts of 1976, as amended, being 325.1001 et seq. of the Michigan Compiled Laws, and known as the safe drinking water act.

9

(p) **Carpet cleaning wastewater** discharged by a noncommercial operator or by a commercial operator at a site receiving wastewater from not more than one location where carpet cleaning has occurred.

(q) **Less than 10,000 gallons per day of noncontact cooling water** that does not contain additives if the source of the cooling water is any of the following:
   (i) A municipal water supply.
   (ii) A water supply meeting state or federal criteria for use as potable water.
   (iii) Another source of water meeting the standards of Rule 2222.
   (iv) Another source approved by the department.

(r) **Land application of process sludge from a wastewater treatment facility** treating sanitary sewage when applied in accordance with applicable state and federal law.

(s) **Land application of process sludge from an industrial or commercial wastewater treatment facility** when authorized under R 299.4101 to R 299.4922, the administrative Rules implementing Part 115.

(t) **Placement of other solid waste on the ground when authorized under Part 115.** This provision does not apply to the disposal of wastewater generated through the operation of a facility licensed under Part 115.

(u) **Wastewater associated with an environmental response activity** described in any of the following paragraphs if the discharge is to the plume of groundwater contamination, including an area 100 feet hydraulically upgradient of the edge of the plume, and any additive used in the treatment process that is not part of the contamination plume meets the standards of Rule 2222:
   (i) A pump test discharge that does not change the physical dimensions of the plume in groundwater or, if the dimensions are changed, the changes are accounted for in the design of the final groundwater remediation plan.
   (ii) A remedial investigation, feasibility study, or remedial action discharge that is at or below the residential criteria authorized by section 20101a(1)(a) of the act, if applicable, or section 21304(a) of the act, if applicable.
   (iii) A discharge for a remedial investigation, feasibility study, or remedial action above the residential criteria authorized by section 20101a(1)(a) of the act, if applicable, or section 21304(a) of the act, if applicable, if a remediation investigation, feasibility study, or remediation plan has been approved by the department division that has compliance oversight. The remediation plan must indicate that the treatment system is designed and will be operated so that contaminated groundwater will eventually meet the appropriate land use-based cleanup criteria authorized by section 20120a(1)(a) to (d) of the act, if applicable, or section 21304(a) of the act, if applicable.

(v) **Precipitation and snow melt drainage off vehicles** discharged through a general-purpose floor drain in a parking structure in which maintenance activities do not occur.

(w) A discharge that has been specifically authorized by the department under a permit if the permit was not issued under this part.

(x) A discharge that occurs as the result of **placing waste materials on the ground in compliance with a designation of inertness issued under part 115** or **leaving contaminated materials in place in compliance with part 201 or 213.**

2. OTHER DISCHARGE SPECIFIC EXEMPTIONS.

Rule 2210 (y) allows discharges other than those listed above to be exempted from permitting on a case by case basis, if the department determines the discharge has an insignificant potential to be injurious based on volume and constituents.

To apply for an exemption according to Rule 2210(y), you should fill out pages 14-17 of the application, which contain general information about the facility. You should also provide the information required on Page 40 of the application. The department will notify you whether your application qualifies for an exemption under Rule 2210(y), or whether you must apply for a different authorization. You are not authorized to discharge until you receive approval from the department.

3. IF I DON'T QUALIFY FOR AN EXEMPTION, WHAT SORT OF AUTHORIZATION DO I NEED?

The following chart lists **specific** discharges for which you must submit an application prior to authorization. The chart also contains the Rule that describes the authorization and the **page numbers in the application** that relate to that specific authorization. Please note that there are specific qualifications that must be met for each of the authorizations listed which are contained in the Part 22 rules.

Discharge Type	Volume Limitation	Rule	Authorization	Page #
Commercial Animal Care	>50 gpd but <1,000 gpd	2211(h)	Notification	19, 22
Contact Cooling Water	< 5,000 gpd	2213(4)	Notification w/Certification	23, 25
Egg Washing	< 10,000 gpd	2213(3)	Notification w/Certification	23, 24
Fruit & Vegetable Washing	< 50,000 gpd	2211(d)	Notification	19, 20
Gravel, sand, limestone, dolomite mining		2215(4)	General Permit	27, 30
Hydrostatic Pipe Testing, Flushing	None	2211(g)	Notification	19, 21
Laundromat	< 500 gpd	2211(b)	Notification	19, 20
Laundromat	< 20,000 gpd	2216(4)	Permit, specific discharge	32, 35
Non-contact Cooling Water, w/additives	< 10,000 gpd	2213(2)	Notification w/Certification	23, 24
Non-contact Cooling Water, no additives	> 10,000 gpd	2211(c)	Notification	19, 20
Oil Field Brine		2215(5)	General Permit	27, 30
Portable Power Wash	1,000 gal/mo/acre	2211(e)	Notification	19, 21
Sanitary Sewage	6,000-10,000 gpd	2211(a)	Notification	19, 20
Sanitary Sewage, above ground treatment	I<10,000 gpd	2215(1)	General Permit	27, 28
Sanitary Sewage, Construct Wetland	< 20,000 gpd	2216(2)	Permit, specific discharge	32, 33
Sanitary Sewage, Specific Treatment	< 50,000 gpd	2216(3)	Permit, specific discharge	32, 34
Slaughterhouse	< 2,000 gpd	2215(3)	General Permit	27, 29
Groundwater Remediation:				
Pump Test Outside Plume	None	2211(f)	Notification	19, 21
Remediation, Outside Plume	None	2213(5)	Notification w/Certification	23, 26
Vehicle Wash, not open to public	< 2,000 gpd	2215(2)	General Permit	27, 28
Vehicle Wash, open to the public	< 3,000 gpd	2215(6)	General Permit	27, 31

gpd	= gallons per day
gal/mo/acre	= gallons per month per acre
<	= less than
>	= greater than

4. WHAT IF MY DISCHARGE TYPE DOES NOT APPEAR ON ANY OF THESE LISTS?

If your discharge does not appear on any of the previous lists, either as an exemption or a specific discharge permit, you must apply for a discharge authorization under Rule 2218. The section of the application that must be filled out specific to Rule 2218 begins on Page 36.

C. Rule 2218

1. IF I HAVE TO APPLY FOR AN AUTHORIZATION UNDER RULE 2218, WHAT TYPE OF INFORMATION MUST I PROVIDE?

Facilities that are authorized under Rule 2218 must provide the following types of information as part of the application:

a) An evaluation of the feasibility of alternatives to discharge to the groundwater in accordance with Rule 2219.
b) The basis of design as required by Rule 2218(2).
c) The hydrogeological report as required by Rule 2221.
d) The wastewater characterization as required by Rule 2220.
e) If a standard applicable to the discharge is to be determined under Rule 2222(5), the information necessary to determine that standard, including whether a substance is a hazardous substance under part 201.
f) The groundwater, or other media, sampling and analysis plan as specified by Rule 2223.
g) A description of the discharge methods and information that demonstrate that the land treatment requirements of Rule 2233 will be met.
h) If a lagoon is included in the treatment process, information that demonstrates that the requirements of Rule 2237 will be met.

Technical guidance documents have been drafted for items c,d,e,g and h above. They are identified in Part I, Section D.4 as additional reference materials. Sections C.2, C.3 and C.4 of these instructions provide guidance for the other information requirements of Rule 2218.

You are also responsible for meeting the groundwater quality standards contained in Rule 2222. You must meet the standards either in the discharge, or in the groundwater if treatment that takes place after discharging the wastewater to the ground. The standards themselves are complex, and it is strongly recommended that you schedule a pre-application meeting to discuss them with program staff. The process for requesting a meeting is found on Page 12, Section D.1 of these instructions. If you wish to investigate the standards on your own, the Part 22 Rules, including Rule 2222, are available on the Internet at the following location, **http://www.deq.state.mi.us/wmd/GWP/index.html**. You may also contact staff at the address or phone number found on Page 13 of these instructions for printed copies of the rules.

2. RULE 2219 - EVALUATION OF FEASIBILITY OF ALTERNATIVES TO DISCHARGE TO GROUNDWATER

Prior to applying for a Rule 2218 authorization, you must conduct an evaluation of the feasibility of alternatives to discharging to the groundwater and submit that as part of the application. The analysis should contain, at a minimum, the items listed below. Feasibility includes the practical ability to implement the alternative and a comparison of the cost of the alternative to its benefits.

At a minimum, alternatives to the discharge that must be considered are:

- (a) minimizing the volume and toxicity of the wastewater.
- (b) recycling wastewater.
- (c) connecting to a municipal sanitary sewer system.
- (d) discharging to surface water.

Alternatives for minimizing the volume and toxicity of wastewater include pollution prevention opportunities, including the following:

- (a) Equipment or technology modifications.
- (b) Process or procedure modifications.
- (c) Reformulation or redesign of products.
- (d) Substitution of raw materials.
- (e) Improvements in housekeeping, maintenance, training, or inventory control.

The following treatment systems must be considered for substances determined to be in the discharge by the characterization required by Rule 2220:

- (a) For a metal, the following:
  - (i) Flocculation.
  - (ii) Settling.
  - (iii) Oxidation.
  - (iv) Filtration.
  - (v) Ion exchange
  - (vi) Reverse osmosis.
  - (vii) Electrolytic recovery.
- (b) For a volatile substance, the following:
  - (i) Carbon adsorption.
  - (ii) Air stripping.
  - (iii) Aeration.
- (c) For a nonvolatile substance, the following:
  - (i) Sorption.
  - (ii) Settling.
  - (iii) Filtration.

For a substance that degrades biologically, biological treatment in a lagoon, tank, or biological reactor or through controlled land treatment.

3. RULE 2218(2), BASIS OF DESIGN

At the time of application, you must submit a basis of design for the treatment system. The basis of design should include all of the following information:

(a) The volume of wastewater to be treated per unit of time.
(b) An analysis of the influent, or a description of the anticipated influent, including the substances to be treated to meet the requirements of Rule 2222 and the concentrations of the substances.
(c) A description of the existing or proposed treatment, or both, including, where applicable, the following:
  (i) The treatment methods before discharge.
  (ii) To the extent applicable, engineering plans depicting all of the following:
    (A) A schematic flow diagram.
    (B) Information on unit processes.
    (C) Flow rates.
    (D) Design hydraulic capacity.
    (E) Pollutant loading.
    (F) Detention times.
    (G) Sizing of treatment units.
    (H) Design calculations for major treatment units.
    (I) A description of sludge management.
  (iii) A discharge management plan that includes, where applicable, all of the following information:
    (A) Maximum daily and annual discharge volumes.
    (B) The total discharge area.
    (C) Scheduled maintenance.
    (D) Vegetative cover control and removal.
    (E) Load and rest cycles.
    (F) Application rates.
    (G) Means for even distribution of waste or wastewater.
    (H) Strategies for periods of adverse weather.
    (I) Monitoring procedures.
    (J) Other pertinent information.
(d) For a discharge of sanitary sewage, unless the Rules provide otherwise, the treatment system must be consistent with the standards in chapter 10 of the publication entitled "Engineering Reports and Facility Plans of the Recommended Standards for Wastewater Facilities" 1997 edition. The standards in chapter 10 are adopted by reference in the Rules. The standards may be purchased from Health Education Services, P.O. Box 7126, Albany, New York 12224, or from the Michigan Department of Environmental Quality, Water Division, P.O. Box 30630, Lansing, Michigan 48909, at a cost at the time of adoption of these Rules of $12.00, plus shipping and handling.

4. RULE 2223 - DISCHARGE MONITORING.

You are required to monitor your discharge in a manner, at a frequency, and for a substance(s) the department specifies are necessary to assess compliance with these Rules. The components of a monitoring program are:

(1) Monitoring of an indicator parameter may be used in monitoring if the technique accurately reflects the effect of the discharge. An indicator parameter must be representative of the environmental fate of a substance or substances in the discharge and must be one of the following:
  (a) A substance in the discharge.
  (b) A decomposition material of a substance.
  (c) A sampling parameter that can be directly correlated to the concentration of another substance in the discharge.
(2) Groundwater monitoring must include the collection of water quality and water level data from a well or group of wells that are specifically designed to adequately assess the impact of the discharge on groundwater. The design of the groundwater monitoring system must be based on all of the following:
  (a) The hydrogeologic report.
  (b) Considerations of the local geology.
  (c) Groundwater conditions specific to each site.
  (d) The type of discharge.

(3) At the time of application for a permit under Rule 2218, an applicant must propose, for department approval, a groundwater sampling and analysis plan that establishes criteria for collecting representative samples of groundwater. The plan must contain all of the following information:
   (a) The number and location of wells to be included in the groundwater monitoring system.
   (b) For each well, the depth and screened interval for each monitor well. The screened interval must be referenced to United States geological survey data.
   (c) Well construction materials and installation techniques.
   (d) Sampling frequency.
   (e) A list of substances to be sampled.
   (f) Sampling procedure, including all of the following:
      (i) The method and volume of water removed from each well during sampling.
      (ii) Steps taken to prevent cross contamination between wells.
      (iii) Sample handling and preservation methods.
      (iv) Laboratory analysis method.
      (v) Laboratory method detection level.
      (vi) Quality assurance and quality control program.
   (g) A description of the techniques used to present and evaluate groundwater quality monitoring data.
   (h) A description of the method used to collect static water levels and present groundwater flow data. Static water level precision must be to 0.01 foot.

(4) A discharger must design, construct, and abandon a monitoring well as follows:
   (a) A monitoring well must be located at a depth where the screened interval will intercept the path of any discharge from the site in the groundwater.
   (b) If the thickness of the aquifer receiving the discharge is more than 20 feet, then at least one hydraulically downgradient monitor well location must contain a cluster well. The separation and length of the screens must be such that discrete groundwater potentiometric surface data can be collected to determine vertical gradients within the aquifer.
   (c) Monitor well construction and sampling equipment materials must not influence the sampling results for the substances sampled.
   (d) A monitor well must be designed to collect an adequate volume of water to allow analysis for the complete set of substances indicative of the discharge.
   (e) Annular space between the borehole and the well must be grouted from the ground surface to two feet above the well screen to prevent vertical leakage of the fluids between the casing and the drill hole. When drilling through confining layers, a discharger must install double-cased wells to prevent the hydraulic connection of fluids between formations above and below the confining layer.
   (f) A well must be protected against the introduction of contaminants by means of a locking device or by another method approved by the department.
   (g) A well must be vented so that accurate static water levels may be collected, or well caps must be removed a sufficient amount of time before measurement so that representative static water levels can be measured. Care must be taken to prevent the introduction of contaminants through vents.
   (h) The well casing must be adequately marked and protected against accidental damage.
   (i) A well must be labeled so that the discharger s name, address and the well number can be determined through the life of the permit.
   (j) If a monitoring well is to be permanently abandoned, a discharger must follow the plugging procedures in part 127 of Act No. 368 of the Public Acts of 1978, as amended, being 323.12701 to 323.12715 of the Michigan Compiled Laws.
   (k) A discharger must receive department approval before installing, replacing, redeveloping, or abandoning a monitoring well that is part of the discharge-monitoring program.

(5) If necessary to measure compliance with a standard established under Rule 2222, the department may specify the monitoring of media in addition to groundwater.

(6) A monitoring program under this Rule must be evaluated by the department on the basis of the threat the discharge poses to protected uses given all of the following factors:
   (a) The substances in the discharge.
   (b) The volume of the discharge.
   (c) The amount of information related to predicting the impacts of a discharge developed through the hydrogeological report prepared under Rule 2221.

D. APPLICATION PROCESS

At this point, you should be aware of the type of authorization that you will need from the department. This section describes the process of filing an application form with the department, formally requesting the authorization.

1. WHEN DO I HAVE TO APPLY?

For **new discharges or significant changes to an existing discharge,** you must submit the application at least 180 days in advance of the proposed date of discharge or significant change (Rule 2106). Permits are generally issued for five years, at which time an updated application must be submitted. For **reissuance** of an existing permit, you must submit the completed application form and the necessary attachments **180 days prior to the expiration date** of your current permit (Rule 2151(1)).

It is strongly recommended, especially prior to submitting an initial application or an application for a Rule 2218 authorization, that you request a pre-application meeting with staff of the Groundwater Section, Water Division. Technical staff will be available to discuss the proposed discharge, and can answer questions and provide information to you regarding such items as treatment alternatives, hydrogeologic studies, waste characterization, etc. It is recommended that you and/or your consultant be prepared to describe, at least in general terms, the basis of design for the proposed or existing wastewater treatment and disposal facilities.

To arrange a pre-application meeting, please contact:

Groundwater Discharge Unit Chief
Permits Section
Water Bureau
PO Box 30273
Lansing, MI 48909
Telephone: 517-373-8148
Fax: 517-241-1328

2. HOW IS THE FORM ORGANIZED?

The application form is divided into two sections. Section I, pages 14-17, consists of general information that must be filled out by all applicants. (Occasionally, especially for general permits, not every item in Section I will be required, so please only fill out the applicable portions. For example, if you are applying for a General Permit under Rule 2215 for brine spreading, you would not fill out Item 7 which requests a CMR address). Section II contains information that must be filled out for specific discharges. An index appears after the general information section of the application, Page 18, which lists all of the specific discharges, Rules 2213 through 2216, and other discharges, covered under Rule 2218, and directs you to the appropriate pages for each particular discharge. Many of the discharges require supporting documentation of one kind or another. There are guidesheets available, listed on Page 13 as available reference materials, which provide guidance on how to gather and report the information in a manner that is acceptable to the Department. This does not preclude you from using alternative methods. It only means that if the guidance is followed very carefully, the methodology for collecting and reporting the information will be acceptable.

3. WHO MUST SIGN THE FORM?

The Part 21 Rules have very specific requirements for who must sign an application form. For a **corporation,** the form must be signed by a principal executive officer of at least the level of vice president, or his/her designated representative, if the representative is responsible for the overall operation of the facility from which the discharge described in the permit application (appropriate documentation must be provided to demonstrate the position and responsibility of the designated representative). For a **partnership**, the form must be signed by a general partner, for a sole proprietorship, by the proprietor. For **municipal, state or other public facility,** the form must be singed by either a principal executive officer, the mayor, village president, city or village manager or other duly authorized employee. All signatures submitted to the department must be **original signatures,** or the application will be returned to you. The details of these requirements are found in Rule 2114.

4. WHAT ADDITIONAL REFERENCE MATERIALS ARE AVAILABLE?

The following are a list of the acts, rules, forms and other items that can be obtained from the Groundwater Program Section to assist an applicant in filling out an application form and providing information necessary to obtain a groundwater discharge permit or permit exemption:

1. Part 31 Water Resources Protection of Act 451
2. Part 41 Sewerage Systems of Act 451
3. Part 21 Wastewater Discharge Permits - Rules of Part 31 of Act 451
4. Part 22 Groundwater Quality - Rules of Part 31 of Act 451
5. Communities Participating in the Michigan Wellhead Protection Plan
6. Guidesheet I Guidance document for hydrogeologic studies
7. Guidesheet II Guidance document for irrigation management plans
8. Guidesheet III Guidance document for waste characterization
9. Guidesheet IV Guidance document for wastewater treatment and storage lagoons
10. Guidesheet V Guidance document for development of toxicology information
11. Guidesheet VI Guidance document for the Operation and Maintenance Manual

Requests for any of the above items should be made to:

Permits Section
Groundwater Discharge Unit
Water Bureau
Michigan Department of Environmental Quality
P. O. Box 30273
Lansing, Michigan 48909
Telephone: 517-373-8148
FAX: 517-241-1328

There is a charge of 5 cents per page to cover handling costs.

This information is also available electronically on the Internet at the following address:
http://www.michigan.gov/deq/0,1607,7-135-3313_4117---,00.html

5. WHAT IF I HAVE QUESTIONS?

If you have questions about the form or process, please call or fax your questions to the following numbers:

Telephone: 517-373-8148
FAX: 517-241-1328

6. WHERE SHOULD I SEND THE COMPLETED FORM?

Please provide **two copies, including the signed original,** of the application form and all pertinent attachments, to the following address:

Permits Section
Groundwater Discharge Unit
Water Bureau
Michigan Department of Environmental Quality
P. O. Box 30273
Lansing, Michigan 48909

7. DO THE RULES SPECIFY OPERATIONAL REQUIREMENTS?

Appendix B, Pages 45-46, provides an outline of the operational requirements that are mandated by the Part 22 Rules for each particular authorization. Please refer to the specific rule for detailed requirements.

8. PENALTIES

It is against the law to knowingly discharge wastewater into the groundwater without a permit or in violation of an existing permit. It is also against the law to intentionally make false statements in a permit application. A person who commits these offenses is guilty of a felony and substantial fines, and perhaps imprisonment, are the consequences. Section 3115(2) of Act 451 contains the details of the penalties associated with violating Part 31.

Groundwater Discharge Permit Application

REFERENCES IN THIS DOCUMENT TO "RULES" ARE TO ADMINISTRATIVE RULES IMPLEMENTING PART 31 OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451, AS AMENDED, BEING R 323.2101 TO 2192 AND R 323.2201 TO 2240.

GENERAL INFORMATION

Please type or print clearly

1. DISCHARGE FACILITY NAME

2. FACILITY OWNER NAME AND MAILING ADDRESS
   Name
   Street Address or P.O. Box
   City, State and Zip Code
   Telephone No.
   Fax No.

3. CONTACT PERSON
   Name and Title
   Street Address or P.O. Box
   City, State and Zip Code
   Telephone No. Fax No.

4. DISCHARGE LOCATION
   Street Address
   City State Zip Code
   County Township
   Township Range Section Number
   First Quarter Section Second Quarter Section Additional Quarter Sections
   Latitude Longitude

5. FACILITY TYPE
   Municipal (Sanitary Only) _____ Municipal (w/ Sanitary and Industrial Wastewater Inputs) _____
   Industrial _____ Commercial _____
   If Municipal, population served _______________

6. CERTIFIED OPERATOR (NOT REQUIRED FOR 2211(c), (d), (e), (g), (h), or 2213 (2), (3), (4))
   A Certified Operator is required by Section 3110 (1) of Part 31 of Act 451.
   Name Certification Number
   Street Address
   City State Zip Code
   Telephone No.

17

7. FOR RULE **2215, 2216 AND 2218** AUTHORIZATIONS ONLY:

PLEASE INDICATE WHERE THE COMPLIANCE MONITORING REPORT FORMS SHOULD BE SENT

NAME		
STREET ADDRESS		
CITY	STATE	ZIP CODE

8. AUTHORIZATION REQUESTED:

____Rule 2210(y), Site Specific Exemption	____NEW USE	____REISSUANCE
____Rule 2211, Notification	____NEW USE	____REISSUANCE
____Rule 2213, Notification with Certification	____NEW USE	____REISSUANCE
____Rule 2215, General Permit, Certificate of Coverage	____NEW USE	____REISSUANCE
____Rule 2216, Specific Discharges	____NEW USE	____REISSUANCE
____Rule 2218, Discharge Permit	____NEW USE	____REISSUANCE

IF REQUESTING A REISSUANCE OR AN AUTHORIZATION DIFFERENT THAN THE CURRENT AUTHORIZATION, PLEASE INCLUDE THE PERMIT/EXEMPTION NUMBER OF THE CURRENT AUTHORIZATION:

If the current authorization is a permit, Rules 2216 or 2218, or was issued prior to August 26, 1999, the number is: M__________

If the current authorization is a General Permit, Rule 2215, the number is: MG__________

If the current authorization is a site specific exemption, Rule 2210(y), or was issued prior to August 26, 1999, the number is: GWE-_______

If the current authorization is a notification, Rule 2211, the number is: GWN-_______

If the current authorization is a notification/certification, Rule 2213, the number is: GWC-_______

9. FACILITY STANDARD INDUSTRIAL CLASSIFICATION (SIC) CODE. ________________
This information is available through the US Department of Labor, Office of Safety and Heath Administration, at the following web address: **www.osha.gov/oshstats/sicser.html**

10. SITE MAPS

Provide two black and white 8 1/2" X 11" maps drawn to scale that show the following:

SITE MAP 1

a) Discharge location in relation to property boundaries on a topographic map.
b) Township and county name.
c) North arrow orientation.

SITE MAP 2 - All sites must include item a, include items b-e as necessary.

a. Current and proposed treatment units and discharge areas and distance to property lines.
b. Monitoring wells on site and on adjacent properties.
c. Potable wells on site and on adjacent properties.
d. Surface waters, including wetlands, lakes, rivers, streams, and drains on the property.
e. Distance between multiple disposal sites.

ATTACH SITE MAP TO THIS APPLICATION FORM

11. WATER USAGE DIAGRAM

Please attach an 8 ½ x 11 diagram showing water usage at the facility, from supply to discharge. Include all flows such as sanitary, process water, etc. Please also indicate where in the system additives or other substances are added to the waste stream for which this authorization is being sought. The water balance should show daily average flow rates at influent, intake and discharge points and daily flow rates between treatment units. Please use actual measurements whenever possible.

12. OWNERSHIP OF TREATMENT SYSTEM AND DISPOSAL AREA

Are all parts of the treatment system and discharge areas (e.g. treatment plant, underground piping or irrigation fields) located on property owned by the applicant? Yes ________ No _________

IF NO, ATTACH THE NAME AND ADDRESS OF THE PROPERTY OWNER WHERE THE DISCHARGE WILL OCCUR, AND A COPY OF THE WRITTEN PERMISSION TO DISCHARGE ON PROPERTY NOT OWNED BY THE DISCHARGER.

13. PROXIMITY OF TREATMENT SYSTEM TO A KNOWN SOURCE OF GROUNDWATER CONTAMINATION

Are there any known groundwater contamination sites within 1/4 mile of your disposal site?

Yes _______ No _______ Unknown _______

IF YES, ATTACH TO THE APPLICATION FORM A DESCRIPTION OF THE LOCATION AND CONTAMINANTS BEING REMEDIATED AT THE SITE.

14. ISOLATION DISTANCE

The following are isolation distances required from the discharge to adjacent water supply wells. What is the distance from your discharge to the nearest water supply well?

WELL TYPE	PERMIT AUTHORIZATION: 2218, 2216(3)	ALL OTHER AUTHORIZATIONS
I, IIa	2000	200
IIb, III	800	75
Domestic	300	50

Distance to nearest **Type I, IIa** water supply well ____________
Distance to nearest **Type IIb, III** water supply well ____________
Distance to nearest **Domestic** water supply well ____________

15. ADJACENT PROPERTY OWNERS

List the names and addresses of all property owners adjacent to the facility, treatment systems and discharge locations. Include properties across roadways.

ATTACH ANY ADDITIONAL NAMES AND ADDRESSES TO THE APPLICATION FORM.

NAME COMPLETE MAILING ADDRESS

16. WELLHEAD PROTECTION

Is your facility located in a designated wellhead protection area? Yes _____ No _____
If yes, please identify the community* ____________________

- Approved wellhead protection areas can be reviewed at the following web address: **http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695-59280--,00.html**

17. SIGNATORY REQUIREMENT

Pursuant to Rule 2114 of the Part 21 Rules, this application must have an original signature, and be signed by

19

the appropriate representative(s) as follows:

A. For a corporation, the form must be signed by a principal executive officer of at least the level of Vice-president, or his/her designated representative, if the representative is responsible for the overall operation of the facility from which the discharge described in the permit application (appropriate documentation must be provided to demonstrate the position and responsibility of the designated representative).
B. For a partnership, the form must be signed by a general partner.
C. For a sole proprietorship, the form must be signed by the proprietor.
D. For municipal, state or other public facility, the form must be signed by either a principal executive officer, the mayor, village president, city or village manager or other duly authorized employee.

All signatures submitted to the department must be original signatures, or the application will be returned as incomplete. The details of these requirements are found in Rule 2114.

The department reserves the right to request information in addition to that supplied with this application if necessary to verify statements made by the applicant or for the department to make a determination required by Part 31, Water Resources Protection, Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451) and/or the Part 22 Rules associated with Part 31.

I certify, under penalty of law, that I have personally examined and am familiar with the information submitted in this document and all attachments. The information being submitted was collected and analyzed in accordance with the Part 22 Rules of Part 31 of Act 451, as amended. Based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Print Name ______________________________ Title ______________________________

Representing ____

Signature ______________________________ Date ______________________________

If the application is for the discharge of treated sanitary wastewater from a privately owned treatment system serving a mobile home park, campground, apartment complex, condominium, nursing home, prison, or other commercial or residential facility, a principal executive officer or ranking elected official from the local unit of government must sign the permit application in the space provided. The signature is only a certification that the local unit of government is aware of its responsibilities as set forth in Section 3109(2) of Act 451. The refusal of the local unit of government to sign the application does not reduce its liability under the statute.

This is to certify that I am aware of and recognize the responsibilities of the municipality as set forth in Section 3109 of Act 451.

Print Name ______________________________ Title ______________________________

Representing ____

Signature ____ Date ____________________

THE FOLLOWING INDEX SHOWS WHERE EACH OF THE DISCHARGE SPECIFIC PAGES ARE LOCATED. PLEASE FILL OUT THE APPROPRIATE PAGES FOR THE SPECIFIC DISCHARGE PROPOSED AND ATTACH ALL SUPPORTING DOCUMENTATION.

PERMIT INDEX, AUTHORIZATION SPECIFIC INFORMATION

RULE 2211 AUTHORIZATION: WASTEWATER TYPE	DAILY MAXIMUM DISCHARGE, GALLONS	RULE SPECIFIC PAGES TO BE FILLED OUT
(a) Sanitary Sewage	6,000 – 10,000	19, 20
(b) Laundromat	< 500	19, 20
(c) Non-contact Cooling Water	>10, 000	19, 20
(d) Fruit & Vegetable Washwater	< 50,000	19, 20
(e) Portable Power Washer		19, 21
(f) Pump test Water		19, 21
(g) Hydrostatic Test Water		19, 21
(h) Commercial Animal Care	50 - 1,000	19, 22

RULE 2213 AUTHORIZATION: WASTEWATER TYPE		
(2) Non-contact cooling water, with additives	< 10,000	23, 24
(3) Egg washing wastewater	< 10,000	23, 24
(4) Cooling water	< 5,000	23, 25
(5) Groundwater remediation, outside plume		23, 26

RULE 2215 AUTHORIZATION WASTEWATER TYPE		
00-1 Sanitary Sewage, above ground	< 10,000	27, 28
00-2 Vehicle wash, not open to public	< 2,000	27, 28
01-3 Slaughterhouse	< 2,000	27, 29
00-4 Gravel, sand, limestone, dolomite mining		27, 30
00-5 Oil Field Brine		27, 30
01-6 Vehicle wash, open to the public	<3,000	27, 31

RULE 2216 AUTHORIZATION: ** WASTEWATER TYPE		
(2) Sanitary Sewage, Constructed Wetland	< 20,000	32, 33
(3) Sanitary Sewage, Specific 2216 Design	< 50,000	32, 34
(4) Laundromat wastewater	< 20,000	32, 35

RULE 2218 AUTHORIZATION, WHICH COVERS DISCHARGES NOT OTHERWISE LISTED	
New Permits	36, 37
Reissuance Permit, No Modifications	36, 38
Reissuance Permits, With Significant Modifications	36, 39

RULE 2210(y) AUTHORIZATION, SITE SPECIFIC EXEMPTION 40

\> = GREATER THAN
< = LESS THAN

**RULE 2216 LISTS SPECIFIC DESIGN CRITERIA THAT MUST BE MET TO IN ORDER TO QUALIFY FOR THAT AUTHORIZATION. DISCHARGERS THAT MEET THE FLOW AND WASTEWATER CRITERIA, BUT DO NOT MEET THE DESIGN CRITERIA, MUST EITHER DEMONSTRATE EQUIVALENCY WITH THE RULE 2216 CRITERIA, OR APPLY FOR A PERMIT UNDER RULE 2218.

PERMIT BY RULE; NOTIFICATION

RULE 2211

A facility is authorized to discharge at the time a complete application is received by the department. The permittee will receive an acknowledgement letter from the department, indicating that the application was considered complete or is deficient, in which case the discharge would not be authorized.

1. RULE 2211 AUTHORIZATION REQUESTED:

	Wastewater Type	Daily Maximum Discharge, Gallons,
_____	(a) Sanitary Sewage	6,000 – 10,000
_____	(b) Laundromat	< 500
_____	(c) Non-contact Cooling Water, w/o additives	>10, 000
_____	(d) Fruit & Vegetable Washwater	<50,000
_____	(e) Portable Power Washer	
_____	(f) Pump Test Water	
_____	(g) Hydrostatic Test Water	
_____	(h) Commercial Animal Care	50 - 1,000

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: ____________________ gallons per day

Cumulative annual discharge: ____________________ gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period _________ through __________

3. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
_____Other - Please describe:			

a. **Sanitary Sewage, Rule 2211(a), 6,000-10,000 gallons per day.** Please check all system characteristics that apply to this specific discharge:

_____ Discharge is between 6,000 and 10,000 gallons per day.
_____ Sanitary sewage is not mixed with other waste.
_____ System is, or is to be, designed in accordance with "Michigan Criteria for Subsurface Sewage Disposal."
_____ The system has been approved by the county, district or city health department having jurisdiction.
_____ If the facility was constructed or expanded after August 26, 1999, the flow is monitored by a meter.

b. **Laundromat Wastewater, Rule 2211(b), less than 500 gallons per day.** Please check all system characteristics that apply to this specific discharge:

_____ Discharge is less than 500 gallons per day.
_____ The treatment system consists of at least two 1,000 gallon septic tanks, followed by disposal to a tile field.
_____ There is an operational lint filter on the wastewater discharge line.
_____ The tile field is designed and constructed in accordance with "Michigan Criteria for Subsurface Sewage Disposal."
_____ The sanitary sewage is routed to the same septic tank or tanks as the laundry wastewater.

c. **Non-contact cooling water, Rule 2211(c), more than 10,000 gallons per day, no additives.** Please check all system characteristics that apply to this specific discharge:

_____ The discharge is greater than 10,000 gallons per day.
_____ The non-contact cooling water contains no additives.

Please check which **one** of the following applies:
_____ The source water is from a municipal supply.
_____ The water source meets state or federal criteria for use as potable water.
_____ The water source meets the standards of Rule 2222.
_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

d. **Fruit & Vegetable washwater, Rule 2211(d), less than 50,000 gallons per day.** Please check all system characteristics that apply to this specific discharge:

_____ The discharge is less than 50,000 gallons per day.
_____ There are no additives in the discharge.
_____ There are additives in the discharge which will not cause the groundwater to exceed the standards of Rule 2222.

Please check which **one** of the following applies:
_____ The source water is from a municipal supply.
_____ The water source meets state or federal criteria for use as potable water.
_____ The water source meets the standards of Rule 323.2222.
_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

Please list all additives in the discharge, and the concentration of the additive in the effluent. The concentration can be submitted as an analysis of the wastewater, or as a mass balance calculation. Wastewater characterization, including the use of mass balance calculations, should follow the guidance found in Guidesheet III.

ADDITIVE	ANNUAL USE RATE	CONCENTRATION (Indicate how determined, A for analysis, M for mass balance. Please remember to include units of measurement.)

e. **Portable Power Washer, Rule 2211(e).** Please check all system characteristics that apply to this specific discharge:

_____ Only household soap or detergent readily available to consumers are used for cleaning.

_____ Additives other than soap and detergent are used only for their intended purpose and according to manufacturers directions.

_____ A log of all locations where discharges occur will be maintained after receiving authorization to discharge, including date, address, additive(s) used, and item(s) washed.

_____ Washing will be limited to removal of dirt and grime from the exterior of a vehicle, equipment, or a stationary source. It will not include the undercarriage of a vehicle, or the portion of a vehicle used to contained or transported substances as a product.

_____ Discharge will be limited to less than 1000 gallons of washwater per month per acre where discharge occurs.

Please check which **one** of the following applies:

_____ The source water is from a municipal supply.

_____ The water source meets state or federal criteria for use as potable water.

_____ The water source meets the standards of Rule 323.2222.

_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

f. Pump test water associated with environmental remediation, Rule 2211(f), discharge outside plume. Please check all system characteristics that apply for this specific discharge:

_____ Discharge meets the standards of Rule 2222.

TREATMENT CODES

Select and enter the appropriate treatment codes to describe treatment units, i.e., A1b, B2b (See APPENDIX A, Pages 41-44).

Treatment Unit A _____ _____ _____
Treatment Unit B _____ _____ _____
Treatment Unit C _____ _____ _____
Treatment Unit D _____ _____ _____

TREATMENT SYSTEM

Please describe how the current treatment system is/will meet the standards of Rule 2222 and the number of years it has been in operation.

g. Hydrostatic testing or flushing water, Rule 2211(g). Please check all system characteristics that apply to this specific discharge:

_____ There are no additives in the discharge.

_____ The testing is for new pipelines or tanks.

Please check which **one** of the following applies:

_____ The source water is from a municipal supply.

_____ The water source meets state or federal criteria for use as potable water.

_____ The water source meets the standards of Rule 2222.

_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

h. Commercial animal care, Rule 2211(h), between 50 and 1000 gallons per day. Please check all system characteristics that apply to this specific discharge:

_____ The discharge is between 50 and 1,000 gallons per day.
_____ There are no additives in the discharge.
_____ There are additives in the discharge which will not cause the groundwater to exceed the standards of Rule 2222.
_____ The distance to the nearest surface water body is greater than 200 feet.

Please check which **one** of the following applies:
_____ The source water is from a municipal supply.
_____ The water source meets state or federal criteria for use as potable water.
_____ The water source meets the standards of Rule 323.2222.
_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

Please list the name of all products used at the facility, and list all of the active ingredients for each of those products:

PRODUCT NAME	MANUFACTURER'S NAME	ACTIVE INGREDIENTS

25

PERMIT BY RULE, NOTIFICATION WITH DEPARTMENT CERTIFICATION

RULE 2213

A facility is authorized to discharge when it receives a certification from the department that verifies the discharge is authorized under this part. Within 60 calendar days of receiving a complete notification form required by this Rule, the department will issue a certification or indicate why the discharger is not authorized to discharge under this Rule.

1. RULE 2213 AUTHORIZATION REQUESTED:

	Wastewater Type	Daily Maximum Discharge, Gallons
_____	(2) Non-contact cooling water, with additives	< 10,000
_____	(3) Egg washing wastewater	< 10,000
_____	(4) Cooling water	< 5,000
_____	(5) Groundwater remediation, outside plume	

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: ____________________ gallons per day

Cumulative annual discharge: ____________________ gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period _________ through __________

IRRIGATION SYSTEMS AND SEEPAGE BEDS UTILIZING SOILS FOR TREATMENT SHOULD INLCUDE THE FOLLOWING:

Effluent application rate:

Inches per hour _____ Inches per day _____ Inches per week _____ Inches per year _____

3. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
_____Other - Please describe:			

2. **Non-contact cooling water with additives, Rule 2213(2), < 10,000 gallons per day.** Please check all system characteristics that apply to this specific discharge:

_____ The discharge is less than 10,000 gallons per day
_____ The additive(s) will not cause groundwater to exceed the standards of Rule 323.2222.

Please list the name and concentration of all additives in the discharge. The concentration can be submitted as an analysis of the wastewater, or as a mass balance calculation. Wastewater characterization, including the use of mass balance calculations, should follow the guidance found in Guidesheet III.

ADDITIVE	ANNUAL USE RATE	CONCENTRATION (Indicate how determined, A for analysis, M for mass balance. Please remember to include units of measurement)

3. **Egg Washing wastewater, Rule 2213(3), less than 10,000 gallons per day.** Please check all system characteristics that apply to this specific discharge:

_____ The discharge is less than 10,000 gallons per day.
_____ The additive(s) will not cause groundwater to exceed the standards of Rule 323.2222. For each additive, please fill out the additive information listed below.

Please check which **one** of the following applies:
_____ The source water is from a municipal supply.
_____ The water source meets state or federal criteria for use as potable water.
_____ The water source meets the standards of Rule 323.2222.
_____ The water source is an alternative to the above, approved by the Department.

Please list the name and concentration of all additives in the discharge. The concentration can be submitted as an analysis of the wastewater, or as a mass balance calculation. Wastewater characterization, including the use of mass balance calculations, should follow the guidance found in Guidesheet III.

ADDITIVE	ANNUAL USE RATE	CONCENTRATION (Indicate how determined, A for analysis, M for mass balance. Please remember to include units of measurement)

4. **Cooling water, Rule 2213(4), <5,000 gallons per day.** Please check all system characteristics that apply to this specific discharge:

_____ The discharge is less than 5,000 gallons per day.

_____ The discharge contains no additives.

_____ The discharge contains an additive, and it will not cause the groundwater to exceed the standards contained in Rule 2222.

_____ Wastewater has been characterized according to Rule 2220 and is listed below. Wastewater characterization, including the use of mass balance calculations, should follow the guidance found in Guidesheet III.

_____ If seeking a renewal of a previous authorization, the wastewater has been characterized annually and records are attached.

_____ If seeking a renewal of a previous authorization, the material cooled does not vary substantially from that used in seeking the original authorization.

Please list all additives in the discharge, and the concentration of the additive in the effluent. The concentration can be submitted as an analysis of the wastewater, or as a mass balance calculation. Wastewater characterization, including the use of mass balance calculations, should follow the guidance found in Guidesheet III.
NOTE: The discharger must characterize the wastewater annually, and submit the records of the annual characterization at the time of reissuance.

ADDITIVE	ANNUAL USE RATE	CONCENTRATION (Indicate how determined, A for analysis, M for mass balance. Please remember to include units of measurement)

5. **Groundwater remediation activities, clean up, discharge outside the plume, 2213(5).** Please check all system characteristics that apply to this specific discharge:

_____ The remedial action includes a groundwater extraction system designed and operated to prevent any portion of the plume above approved cleanup criteria from migrating beyond the zone of influence approved by the department division that has compliance oversight. The division having compliance oversight is:

- _____ Remediation and Redevelopment Division
- _____ Geological and Land Management Division
- _____ Waste and Hazardous Materials Division
- _____ Water Division
- _____ Other, please identify

_____ A memorandum from the chief, or his/her designated representative, of the department division responsible for compliance oversight of the remediation is included which certifies that the discharge meets the requirements of part 31, 111, 115, 201, 213, or 615, as applicable.

_____ A performance-monitoring plan was included in the remediation plan submitted to the department division responsible for compliance oversight. The plan included the following:

- _____ Groundwater monitoring wells have been installed within 150 feet of the discharge to verify that the standards of Rule 2222 are being met in groundwater.
- _____ Effluent and groundwater sampling to verify compliance with Rule 2213(5)(f).

_____ The frequency of sampling meets the requirements of Rule 2213(5)(e)(ii).

_____ Site map 1, required in Rule 2212(3)(m), should include the location of drinking water wells adequate to identify each water supply formation within ½ mile of the discharge. A copy of the well logs for each drinking water well identified on the map should be included.

_____ Site map 2, required in Rule 2212(3)(m) should include all of the following information:

- _____ Groundwater flow direction.
- _____ Extent of contamination plume.
- _____ Calculated capture zone.
- _____ Location of the groundwater extraction and interception system.
- _____ Location of all observation and monitoring wells.

TREATMENT CODES

Select and enter the appropriate treatment codes to describe treatment units, i.e., A1b, B2b (see APPENDIX A, Pages 41-44)

Treatment Unit A	_____	_____	_____
Treatment Unit B	_____	_____	_____
Treatment Unit C	_____	_____	_____
Treatment Unit D	_____	_____	_____

Please provide a description of the treatment system indicating how it will produce an effluent that will meet the standards of Rule 2222.

29

GENERAL PERMIT
RULE 2215

A facility is not authorized to discharge until it receives a Certificate of Coverage from the department that verifies the discharge is authorized under this part.

1. RULE 2215 AUTHORIZATION REQUESTED:

	Wastewater Type	Daily Maximum Discharge, Gallons
_____	00-1 Above ground sewage disposal	< 10,000 (annual average)
_____	00-2 Vehicle wash, not open to the public	< 2,000
_____	01-3 Slaughterhouse	< 2,000 (annual average)
_____	00-4 Gravel, sand, limestone, or dolomite mining	
_____	00-5 Application of oil field brine	
_____	01-6 Vehicle wash, open to public	< 3,000

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: ____________________ gallons per day

Cumulative annual discharge: ____________________ gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period _________ through __________

IRRIGATION SYSTEMS AND SEEPAGE BEDS UTILIZING SOILS FOR TREATMENT SHOULD INLCUDE THE FOLLOWING:

Effluent application rate:

Inches per hour _____ Inches per day ______ Inches per week _____ Inches per year _____

3. CERTIFICATION OF DISCHARGE MINIMIZATION

Please attach the steps identified and considered to avoid or minimize the use and discharge of pollutants according to Rule 2215(3).

4. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
_____Other - Please describe:			

00-1. **Above Ground Sewage Disposal Systems, less than 10,000 gallons per day (annual average), Rule 2215.** Please check all system characteristics that apply to this specific discharge and fill appropriate blanks:

_____ Discharge is less than 10,000 gallons per day, calculated as an annual average.

_____ A log will be maintained on site by the discharger of the daily discharge volume of sanitary sewage. The log shall be retained for a minimum of three years, and made available upon request by the Department.

Property Ownership:

_____ Discharge occurs on property owned by the applicant

_____ Discharge occurs on property not owned by the applicant. Please attach written authorization to discharge on that property from the property owner.

Lagoon/Irrigation System:

_____ Anticipated date when plans and specifications for the treatment system will be submitted to the Department.

NOTE: Applicant cannot commence discharge until the Department notifies the discharger that the treatment system will meet the requirements of Rule 2204.

_____ The lagoon system is fenced and perimeter warning signs placed around the perimeter of the lagoon.

_____ Irrigation occurs between May 1 and October 15.

_____ If irrigating crops for human consumption, crops will be processed prior to consumption.

_____ Dairy animals will not be allowed to graze on fields until 30 days after the land application of wastewater.

Isolation Distance:

_____ Effluent will not be applied within 100 feet of the property line

_____ The Department has authorized a discharge less than 100 feet from the property line. The documentation for the lesser distance is included with this application, and is found in Attachment _____.

00-2. **Vehicle Wash Not Open to the Public, less than 2000 gallons per day, Rule 2215.** Please check all system characteristics that apply to this specific discharge:

_____ Discharge is less than 2000 gallons per day.

_____ The discharge consists of washwater with additives designed to remove non-polluting, inert substances from the exterior of vehicles, which excludes the washing of undercarriages or any portion of the vehicle that has come in contact with waste or products.

_____ Soaps, detergents and additives are used according to manufacturers directions, and do not include volatile organic compounds, such as degreasers.

_____ A log will be maintained on site by the discharger of the daily discharge volume of washwater with additives. The log shall be retained for a minimum of three years, and made available upon request by the Department.

Isolation Distance:

_____ Effluent will not be applied within 100 feet of the property line.

_____ The Department has authorized a discharge less than 100 feet from the property line. The documentation for the lesser distance is included with this application, and is found in Attachment _____.

Please check which one of the following applies:

_____ The source water is from a municipal supply.

_____ The water source meets state or federal criteria for use as potable water.

_____ The water source meets the standards of Rule 2222.

_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

01-3. **Slaughterhouse Washwater with Additives, less than 2,000 gallons per day (annual average), Rule 2215.** Please check all system characteristics that apply to this specific discharge:

_____ The discharge is less than 2,000 gallons per day calculated as an annual average.
_____ The washwater shall only contain additives resulting from cleaning operations.
_____ Soaps, detergents and additives are used according to manufacturers directions, and do not include volatile organic compounds, such as degreasers.
_____ The discharger has taken steps to minimize the discharge of blood, fat, paunch and other solids.
_____ The wastewater is transported to the discharge location in enclosed containers.
_____ A log will be maintained on site by the discharger of the daily discharge volume of washwater with additives. The log shall be retained for a minimum of three years, and made available upon request by the Department.

Please check which **one** of the following applies to the facility water source:

_____ The source water is from a municipal supply.
_____ The water source meets state or federal criteria for use as potable water.
_____ The water source meets the standards of Rule 2222.
_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

Location:

_____ The facility is located in the Upper Peninsula.
_____ The facility is located in the Lower Peninsula.

Property Ownership:

_____ Discharge occurs on property owned by the applicant
_____ Discharge occurs on property not owned by the applicant. Please attach written authorization to discharge on that property from the property owner.

Lagoon/Irrigation System:

_____ Anticipated date when plans and specifications for the treatment system will be submitted to the Department.
NOTE: Applicant cannot commence discharge until the Department notifies the discharger that the treatment system will meet the requirements of Rule 2204.
_____ The lagoon system is fenced and perimeter warning signs placed around the perimeter of the lagoon.
_____ If irrigating crops for human consumption, crops will be processed prior to consumption.

Growing Season:

_____ Irrigation occurs between May 1 and November 15 in the Lower Peninsula, between May 1 and October 15 in the Upper Peninsula.
_____ The discharge is less than 4,000 gallons per acre per day.
_____ The irrigation area is vegetated to prevent erosion and provide adequate nutrient uptake.
_____ Effluent will not be applied within 100 feet of the property line.
_____ The Department has authorized a discharge less than 100 feet from the property line. The documentation for the lesser distance is included with this application, and is found in Attachment _____.

Winter Season:

_____ Irrigation occurs between November 16 and April 30 in the Lower Peninsula, between October 16 and April 30 in the Upper Peninsula.
_____ The discharge is less than 2,000 gallons per acre per week.
_____ The maximum total winter seasonal discharge is 10,000 gallons per acre.
_____ The irrigation area is vegetated to prevent erosion and provide adequate nutrient uptake.
_____ The irrigation area will be vegetated to prevent erosion and provide adequate nutrient uptake immediately after snow melt.
_____ The slope of the discharge area does not exceed two per cent.
_____ Effluent will not be applied within 400 feet of the property line, homes, buildings or surface water.
_____ The Department has authorized a discharge less than 400 feet from the property line. The documentation for the lesser distance is included with this application, and is found in Attachment _____.

00-4. **Gravel, sand, limestone, or dolomite mining, Rule 2215**. Please check all system characteristics that apply to this specific discharge:

_____ The discharge consists of washwater without additives, used for the purpose of washing and sorting uncontaminated gravel, sand, limestone or dolomite.

_____ A log will be maintained on site by the discharger of the daily discharge volume of washwater without additives. The log shall be retained for a minimum of three years, and made available upon request by the Department.

Property Ownership:

_____ Discharge occurs on property owned by the applicant

_____ Discharge occurs on property not owned by the applicant. Please attach written authorization to discharge on that property from the property owner.

Isolation Distance:

_____ Effluent will not be applied within 100 feet of the property line

_____ The Department has authorized a discharge less than 100 feet from the property line. The documentation for the lesser distance is included with this application, and is found in Attachment _____.

Please check which **one** of the following applies:

_____ The source water is from a municipal supply.

_____ The water source meets state or federal criteria for use as potable water.

_____ The water source meets the standards of Rule 323.2222.

_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

00-5. **Application of Oil Field Brine, Rule 2215.** Please check all system characteristics that apply to this specific discharge:

_____ The brine meets the requirements of R 324.705(3) of Part 615, Supervisor of Wells, 1994, PA 451, as amended.

_____ The brine is being used for ice or dust control or soil stabilization on land.

_____ Vehicular equipment used for the spreading of approved oil field brine is dedicated for that use or hauling fresh water.

_____ Brine will not be applied at a site of environmental contamination for chlorides as defined under Part 201 of Act 451.

_____ A brine application log will be maintained in the application vehicle for the previous two weeks applications of brine use that includes the information required in Section A.9 of the General Permit, and made available upon request by the Department or a peace officer.

_____ A brine application log will be maintained by the discharger for a minimum of three years of brine use which shall include the information required in Section A.9 of the General Permit, and made available upon request by the Department or a peace officer.

Dust Control/Soil Stabilization:

_____ The number of brine applications per year will be in accordance with Condition A.4.a. and Condition A.4.b. of the General Permit.

_____ Brine will be applied to roads and parking areas with a spreader bar delivering the brine over an eight to ten foot area.

_____ Brine will be applied at a maximum rate of 1500 gallons per lane mile of road or 1250 gallons per acre of land.

_____ Brine will be applied in a manner to prevent runoff.

Ice Control:

_____ Brine will be applied only to paved roads or paved parking lots.

_____ Brine will be applied at a maximum rate of 500 gallons per lane mile or 400 gallons per acre of land.

_____ Brine will be applied only when the air temperature is above 20 degrees Fahrenheit.

_____ Brine will be applied with equipment designed to direct the discharge to the center of the pavement or high sides of curves.

_____ Brine application equipment will be equipped with measuring devices to ensure brine applications meet the requirements of the General Permit.

01-6. Vehicle Wash, open to the public, **Rule 2215**. Please check all system characteristics that apply to this specific discharge.

_____ The facility was in operation as of April 1, 2001.
_____ The discharge is less than 3,000 gallons per day.
_____ The soaps, detergents, and other cleaning chemicals do not contain volatile organic compounds, such as degreasers.
_____ There are o repair or maintenance activities taking place in the wash areas.
_____ Detergents, surfactants and other additives are only used in accordance with manufacturers specifications.
_____ Groundwater will be sampled twice per year and analyzed for the substances listed in Tables I, II and III of this General Permit.

Isolation Distance:
_____ Effluent will not be applied within 100 feet of the property line
_____ The Department has authorized a discharge less than 100 feet from the property line. The documentation for the lesser distance is included with this application, and is found in Attachment _____.

Monitor Wells:
_____ Monitor wells have been installed in accordance with Attachment II of this General Permit. A map showing the location of the wells in relation to the discharge, well logs, elevations (referenced to USGS datum) for top of casing, ground, and well screen interval, are found in Attachment _____.

Please check which **one** of the following applies:
_____ The source water is from a municipal supply.
_____ The water source meets state or federal criteria for use as potable water.
_____ The water source meets the standards of Rule 323.2222.
_____ The water source is an alternative to the above. Department approval is required, and supporting documentation is attached.

RULE 323.2216

PERMITS FOR SPECIFIC DISCHARGES

A DISCHARGE OF THE TYPE AND VOLUME SPECIFIED IN RULE 2216 THAT DOES NOT MEET THE SPECIFIC CRITERIA OF THIS RULE MUST APPLY FOR A PERMIT UNDER RULE 2218.

1. RULE 2216 AUTHORIZATION REQUESTED

	WASTEWATER TYPE	DAILY MAXIMUM DISCHARGE, GALLONS
_____	(2a) Sanitary Sewage, Constructed Wetland	less than 20,000
_____	(2b) Alternative Treatment System	
_____	(3) Sanitary Sewage, Rule 2216 Design	less than 50,000
_____	(4) Laundromat Wastewater	less than 20,000

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: ____________________ gallons per day

Cumulative annual discharge: ____________________ gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period _________ through __________

IRRIGATION SYSTEMS AND SEEPAGE BEDS UTILIZING SOILS FOR TREATMENT SHOULD INLCUDE THE FOLLOWING:

Effluent application rate:

Inches per hour _____ Inches per day ______ Inches per week _____ Inches per year _____

3. PUBLIC NOTICE

Please attach a copy of the public notice, containing information required by Rule 2217(2)(b).

4. CERTIFICATION OF DISCHARGE MINIMIZATION

Please attach the steps identified and considered to avoid or minimize the use and discharge of pollutants according to Rule 2217(2)(c)

5. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
_____Other - Please describe:			

6a. **Sanitary Sewage, Constructed Wetland, Rule 2216(2), less than 20,000 gallons per day.** Please check all system characteristics that apply for this specific discharge, either already in place or are part of the proposed design of the treatment system:

_____ The discharge is less than 20,000 gallons per day.
_____ A minimum of 2 septic tanks are installed in series preceding the constructed wetland.
_____ The septic tanks have a combined volume of at least 2 times the daily design flow.
_____ The outfall to the constructed wetland is equipped with a septic tank effluent filter.
_____ There is a system to enhance nitrification prior to discharge to the constructed wetland.
_____ The discharge has been treated to remove oil and grease, if applicable.
_____ The system has at least 2 wetland cells.
_____ Each wetland cell has a length to width ratio of between 2:1 and 4:1.
_____ The constructed wetland treatment cells have a composite bottom liner in compliance with Rule 2237. See Guidesheet IV for lagoon construction guidance
_____ The bottom of the lagoon cell has been constructed to be level.
_____ The wetland cell filter media consists of 1/2-inch to 1-inch washed gravel with 100% passing the 1.0-inch sieve and a maximum of 3% passing the 1/2-inch sieve.
_____ The filter media is between 18 inches and 30 inches in depth.
_____ The constructed wetland is insulated with at least 6 inches of mulch or other comparable substitute.
_____ The filter surface area hydraulic loading rate is not more than 1.2 gallons per square foot per day.
_____ The design retention time is not less than 7 calendar days.
_____ Indigenous or sterile wetland vegetation has been planted on a 1-foot grid across each wetland cell.
_____ The system has the capability to recirculate effluent back into the influent end of the system.
_____ The wetland cell discharges to a tile field designed and constructed in accordance with the provisions of the publication entitled "Michigan Criteria for Subsurface Sewage Disposal," April 1994.
The tile field has been approved by:
_____ The county, district, or city health department that has jurisdiction.
_____ The department.

6b. **Sanitary Sewage, Rule 2216(2)(b), less than 20,000 gallons per day,** alternative treatment system.

_____ Alternative treatment system. If you are applying for an authorization for a alternative treatment system equivalent to a constructed wetland, please attach documentation that the proposed system produces an effluent of similar quality to that of the constructed wetland.

7. Sanitary sewage, specific design, Rule 2216(3), less than 50,000 gallons per day.

Please check the treatment systems being proposed under this Rule:

_____ Lagoon w/land treatment
_____ Sequencing batch reactor
_____ Activated sludge w/denitrification
_____ Oxidation ditch
_____ Other If other, please describe:

Please check all system characteristics that apply for this specific discharge:

_____ The discharge is less than 50,000 gallons per day.
_____ The sanitary sewage is not mixed with any other type of wastewater.
_____ The treatment system has sufficient hydraulic capacity to treat organic or inorganic loading so that the discharge receives physical, chemical, biological treatment or a combination of treatments to meet the standards of Rule 2222.
_____ The facility is under the supervision of a certified operator.
_____ Land application is in accordance with Rule 2233, requirements common to all land application.
_____ Land application is in accordance with the specific requirements of the following Rule:
  _____ Rule 2234, Slow rate land treatment
  _____ Rule 2235, Overland flow treatment
  _____ Rule 2236, Rapid Infiltration

7a. Lagoon with land treatment

_____ The lagoon liner meets the requirements of Rule 2237. See Guidesheet IV for lagoon construction guidance.
_____ The lagoon system has at least 2 cells.
_____ The lagoon storage volume is at a minimum 1/2 of the annual influent flow.
_____ The lagoon has security fencing and warning signs.
_____ Wastewater disposal is by means of land application to a suitable crop in accordance with Rule 2233. See Guidesheet II for guidance regarding land application of wastewater.
_____ The discharge occurs only from a cell(s) which have not received untreated wastewater for at least 30 calendar days prior to the discharge.

Lagoons without aeration

  _____Cell 1 does not exceed a maximum depth of 6 feet.
  _____Cell 2 does not exceed a maximum depth of 8 feet.
  _____All additional cells do not exceed a maximum depth of 10 feet.

Lagoons with aeration

  _____A minimum of 2 mg/l of dissolved oxygen is maintained in the primary cell.
  _____The maximum depth of secondary cells does not exceed 10 feet.

7b. Sequencing batch reactor

_____ The discharge meets the requirements of Rule 2222 in the effluent.
_____ The facility has a contingency plan to deal with periods of upset, mechanical malfunctions, and routine maintenance while maintaining compliance with this part.
_____ The sequencing batch reactor system has at least 2 treatment tanks.

7c. All other treatment systems which do not involve land treatment

_____ The treatment system has a minimum storage volume of 1/2 the annual influent flow.
_____ The treatment system does not have a minimum storage volume of 1/2 the annual influent flow, the discharge meets the requirements of Rule 2222 in the effluent, and the facility has a contingency plan to deal with periods of upset, mechanical malfunctions, and routine maintenance while maintaining compliance with these rules.

8. **Laundromat Wastewater, Rule 2216(4), less than 20,000 gallons per day.** Please check all system characteristics that apply for this specific discharge:

_____ The discharge is less than 20,000 gallons per day.
_____ The laundromat does not have any dry cleaning operations.
_____ The lagoon liner meets the requirements of Rule 2237. See Guidesheet IV for lagoon construction guidance.
_____ The storage volume of the lagoon is at a minimum 1/2 of the annual influent flow.
_____ The lagoon system has at least 2 cells.
_____ The discharge shall occur only from cells that have not received untreated wastewater for at least 30 days.
_____ The lagoons have security fencing and warning signs.
_____ Discharge of treated wastewater is by means of low-rate application in accordance with Rule 2233. See Guidesheet II for guidance regarding land application of wastewater.
_____ The spray irrigation system is under pressure to enhance volatilization of organic constituents.

If aeration is not included as part of the lagoon treatment system, the following apply:
_____ Cell 1 does not exceed a maximum depth of 6 feet.
_____ Cell 2 does not exceed a maximum depth of 8 feet.
_____ Additional cells do not exceed a maximum depth of 10 feet.

If aeration is included as part of the lagoon treatment system, the following apply:
_____ The maximum depth of secondary cells does not exceed 10 feet.
_____ A minimum of 2 mg/l of dissolved oxygen will be maintained in the primary cell.

RULE 323.2218

DISCHARGE PERMITS

1. TYPE OF TREATED WASTEWATER FOR WHICH THE AUTHORIZATION IS REQUESTED. PLEASE CHECK ALL THAT APPLY

_____ Sanitary sewage
_____ Process wastewater
_____ Cooling water, greater than 5,000 gallons per day
_____ Non-contact cooling without additives, greater than 10,000 gallons per day, source water not approved by department.
_____ Non-contact cooling water with additives, greater than 10,000 gallons per day.
_____ Other, please describe:

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: ____________________ gallons per day

Cumulative annual discharge: ____________________ gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period _________ through __________

IRRIGATION SYSTEMS AND SEEPAGE BEDS UTILIZING SOILS FOR TREATMENT SHOULD INLCUDE THE FOLLOWING:

Effluent application rate:

Inches per hour _____ Inches per day ______ Inches per week _____ Inches per year _____

3. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
_____Other - Please describe:			

4. TREATMENT CODES

Select and enter the appropriate treatment codes to describe treatment units, i.e., A1b, B2b (see APPENDIX A, Pages 41-44)

Treatment Unit A _____ _____ _____
Treatment Unit B _____ _____ _____
Treatment Unit C _____ _____ _____
Treatment Unit D _____ _____ _____

Please provide a description of the treatment system indicating how it will produce an effluent that will meet the standards of Rule 2222.

4a. **New Permits – Rule 2218(3)(a)**

The following information must be included in the application for a new permit. Refer directly to Rule 2218 for specific information requirements. Please indicate where the necessary information is included in this application. Please indicate NA for those that do not apply to your discharge:

_____ An evaluation of the feasibility of alternatives to discharge to the groundwater in accordance with Rule 2219. See instructions, Page 9. This item is found _______________.

_____ The basis of design as required by 323.2218(2). See instructions, Page 10. This item is found _______________.

_____ The hydrogeological report as required by Rule 2221. See Guidesheet I. This item is found _______________.

_____ The wastewater characterization as required by Rule 2220. See Guidesheet III. This item is found _______________.

_____ If a standard applicable to the discharge is to be determined under Rule 2222(5), the information necessary to determine that standard, including whether a substance is a hazardous substance under Part 201. See Guidesheet V. This item is found _______________.

_____ The groundwater, or other media, sampling and analysis plan specified by Rule 2223. See instructions, Page 10 This item is found _______________.

_____ Information is attached that demonstrates the land treatment requirements of Rule 2233 will be met. See Guidesheet II. This item is found _______________.

_____ If a lagoon is included in the treatment process, information that demonstrates that the requirements of Rule 2237 will be met. See Guidesheet IV. This item is found _______________.

4b. **Reissuance of current permit, no modifications, Rule 2218(3)(c).** The following information must be included in the application for the reissuance of your current permit. Please check that all items have been included:

_____ The discharge consists of the same quantity, effluent characterization, and treatment process as previously permitted.

_____ A narrative description of the history of facility compliance with effluent and groundwater permit limits and sampling frequency is included. This item is found _______________.

_____ An updated site map is included. This item is found _______________.

_____ The most recent static water levels and groundwater elevations from all wells on site. This item is found _______________.

_____ A current groundwater contour map is included, with a narrative evaluation of whether changes to the existing groundwater monitoring system are warranted and the rationale for any proposed change. This item is found _______________.

_____ The most recent groundwater quality results are included from all wells on site. This item is found _______________.

_____ The most recent effluent quality results are included. This item is found _______________.

Please check that all of the following that apply are included:

_____ If permit limits were exceeded, the steps taken to bring the facility into compliance. This item is found _______________.

_____ An evaluation of whether there are general trends in the effluent or groundwater sampling data indicating that the discharge is approaching permit limits. This item is found _______________.

_____ The discharger has provided the department, within 30 calendar days of completion of construction of the treatment facilities, a certification by an engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, that a quality control and quality assurance program was utilized and that the facilities were built consistent with standard construction practices to comply with the permit and this part.

4c. **Reissuance of current permit, with significant modifications Rule 2218(3)(b).** The following information must be included in the application for the reissuance of your current permit. Please check that all items have been included:

_____ An evaluation of the feasibility of alternatives to discharge to the groundwater in accordance with Rule 2219 is included. See Page 9. This item is found _______________.

_____ The basis of design required by 323.2218(2) is included. See Page 10. This item is found _______________.

_____ The hydrogeological report required by Rule 2221 is included. See Guidesheet I. This item is found _______________.

_____ The wastewater characterization required by Rule 2220 is included. See Guidesheet III. This item is found _______________.

_____ If a standard applicable to the discharge is to be determined under Rule 2222(5), the information necessary to determine that standard, including whether a substance is a hazardous substance under Part 201. See Guidesheet V. This item is found _______________.

_____ The monitoring plan as specified by Rule 2223 is included. See Page 10. This item is found _______________.

_____ Information that demonstrates the land treatment requirements of Rule 2233 will be met is included. See Guidesheet II. This item is found _______________.

_____ If a lagoon is included in the treatment process, information that demonstrates that the requirements of Rule 2237 will be met is included. See Guidesheet IV. This item is found _______________.

_____ A narrative description of the history of facility compliance with effluent and groundwater permit limits and sampling frequency is included. This item is found _______________.

_____ An updated site map is included. This item is found _______________.

_____ The most recent static water levels and groundwater elevations from all wells on site are included. This item is found _______________.

_____ A current groundwater contour map and a narrative evaluation of whether changes to the existing groundwater monitoring system are warranted and the rationale for any proposed change are included. This item is found _______________.

_____ The most recent groundwater quality results from all wells on site are included. This item is found _______________.

_____ The most recent effluent quality results are included. This item is found _______________.

Please check that all of the following that apply are included:

_____ If permit limits were exceeded, a description of the steps taken to bring the facility into compliance. This item is found _______________.

_____ An evaluation of whether there are general trends in the effluent or groundwater sampling data indicating that the discharge is approaching permit limits. This item is found _______________.

_____ The discharger has provided the department, within 30 calendar days of completion of construction of the treatment facilities, a certification by an engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, that a quality control and quality assurance program was utilized and that the facilities were built consistent with standard construction practices to comply with the permit and this part.

SITE SPECIFIC EXEMPTION

RULE 2210(Y)

A facility is authorized to discharge after it receives approval from the department that states the discharge is authorized under this part.

1. Please attach a narrative description of the discharge, indicating how the volume and/or constituents in the discharge present an insignificant potential to be injurious to the groundwater.

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: ____________________ gallons per day

Cumulative annual discharge: ____________________ gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period _________ through __________

3. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
_____Other - Please describe:			

To apply for an exemption according to Rule 2210(y), you should fill out pages 14-17 of this application, which contain general information about the facility. You should also provide the above information. The department will notify you whether your application qualifies for an exemption under Rule 2210(y), or whether you must apply for a different authorization. You are not authorized to discharge until you receive approval from the department.

APPENDIX A

TREATMENT METHOD CLASSIFICATION

The Treatment Method Classification is a three digit alphanumeric code to describe the treatment system and a guide for operator certification. The first entry is a letter designation to indicate **physical (A), chemical (B), or biological (C)** treatment. The second entry describes the appropriate **sub-classification**, and the last entry is a letter **correlating to the specific type of treatment.**

1. PHYSICAL

A-1a Special Classification - Minor discharges with no treatment and limited monitoring requirements. This classification applies only to discharges where no other classification applies. (Note: Proper application for certification is necessary, however no additional examination is required.)

Examples:
Hydrostatic testing of pipes and tanks
Discharge of storm water from secondary containment

A-1b Plain Clarification - Solids removal by gravity separation in a mechanical clarifier with no provision for the addition of chemical coagulant. (Note: Does not include basins intended to provide biological or chemical treatment.)

Examples:
Clarifiers with no provision for addition of coagulant
Settling Tanks with tube or plate settlers with no provision for addition of coagulant

A-1d Impoundment – A tank, basin, or reservoir intended to hold wastewater to allow for a controlled discharge; may or may not provide settling of solids. (Note: Does not include basins intended to provide biological or chemical treatment.)

Examples:
Discharge flow equalization
Mine tailing ponds
Gravel pits used to remove solids from wastewater

A-1f Land Surface Disposal – Disposal of wastewater by means of application to the surface of the land with percolation into the ground i.e.) No Underdrain

Examples:
Spray Irrigation
Ridge and Furrow
Rapid Infiltration Basin
Seepage Pond

A-1g Sub-surface Disposal – Tile field system used for discharge of wastewater with percolation into the ground. Does not include under-drain systems used to collect wastewater for further treatment and/or discharge.

Examples:
Septic tank – tile field system

A-1h Non-contact Cooling Water – Flow measurement, visual observation, sampling, and minor testing of non-contact cooling water discharges regulated by permit. Discharge of cooling water that has mixed with untreated wastewater is excluded. Proper application for certification is required; the written examination consists of a take-home questionnaire.

Examples:
Discharge from Heat Exchangers
Compressor Condensate
Cooling Tower Discharge

A-2b Filtration of Wastewater – Filtration of wastewater for the purpose of removing particulate materials. Specifically for Rapid Sand Filters, but may also include such processes as pressure filters, micro-screens, and bag filters.

A-2c Air Flotation – A wastewater treatment process for separation in which fine air bubbles are utilized to raise suspended materials to the surface where they are collected.

Note: Does not include sludge thickening processes

A-2d Air Stripping (Note Name Change from Gas Stripping) – Air stripping of volatile substances from wastewater or groundwater.

Note: Does not include off-gas treatment for odor control

A-2e Centrifuging – A wastewater treatment process in which a centrifuge is used to apply centripetal force to accelerate the separation of substances.

Examples:
Removal of solids from wastewater by centrifuging
Separation of oil from wastewater by centrifuging

Note: Does not include thickening of sludge by centrifuging

A-2g Deep Well Injection – Pressure injection of wastewater into a sub-surface formation.

B. CHEMICAL

B-1b Neutralization – A chemical treatment process whereby a wastewater is neutralized (pH adjustment) to achieve a pH level required for discharge.

Examples:
Addition of acid or base to meet limit in discharge permit
Does not include pH adjustment intended for such purposes as precipitation, nitrification, or to enhance biological treatment.

B-2a Chemical Clarification - Coagulation and/or Precipitation for solids removal from wastewater.

Chemical coagulation – The removal of suspended solids from wastewater through the addition of polymer, ferric chloride, alum, or other coagulants added to wastewater just prior to clarification.

Chemical precipitation – The removal of dissolved solids from wastewater by precipitation through the addition of a base, ferric chloride, alum or other chemical agent just prior to clarification.

Examples:
Precipitation of metals from wastewater
Precipitation of phosphorus from wastewater

B-2b Ion Exchange – A wastewater treatment process in which undesirable ionic materials in wastewater are exchanged for other ions on a resin material.

Note: Does not include softening of process water or boiler make-up water

B-2c Oil – Water Separation – Separation of oil from water with or without chemical addition.

Examples:
Grease Traps
Gravity Oil Water Separators
Chemical Emulsion Breaking
Oil Skimming

B-2d Ultraviolet Oxidation – A wastewater treatment process in which ultraviolet radiation is used to oxidize organic contaminants (Note: Does not include UV disinfection)

B-3b Carbon Adsorption – Removal of organic compounds from wastewater by adsorption on activated carbon.

Examples:
Includes systems in which wastewater passes through a carbon bed (liquid phase adsorption)
Does not include systems in which organics are removed from the wastewater by air stripping and then from the air by carbon adsorption (vapor phase adsorption).
Does not include carbon canisters used for odor control systems.

B-3c Reduction of Hexavalent Chromium – A wastewater treatment process in which hexavalent chromium is chemically reduced to trivalent chromium.

B-3d Oxidation of Cyanide – The removal of cyanide from wastewater through the process of alkaline chlorination.

C. BIOLOGICAL

C-1b Aerated Lagoons – A man-made pond or lagoon with mechanical or diffused aeration intended to provide aerobic biological treatment.

Note: Includes wastewater treatment systems with a combination of aerated and non-aerated cells

C-1c Stabilization Ponds – A man-made pond or lagoon intended to provide natural biological treatment without the addition of supplemental aeration.

C-2a Disinfection – The chemical or ultraviolet radiation disinfection process to destroy pathogenic organisms in wastewater just prior to discharge.

C-2b Trickling Filters – An attached growth wastewater treatment process in which wastewater is distributed over a media (usually rock or plastic) which supports the biological system and is designed to convert colloidal and dissolved organic compounds into settleable sludge.

C-2c Biological Sand Filters - Sand filtration systems intended to provide biological treatment of wastewater as well as physical filtration.

Examples:
Intermittent Sand Filters
Recirculating Sand Filters

C-2d Rotating Biological Contactors – An attached growth wastewater treatment process utilizing rotating plastic media designed to convert colloidal and dissolved organic compounds into settleable sludge.

C-2e Package Plant – (Note: Exam no longer offered. All new package plants will be classified C-3a or C-3b)

C-2f Constructed Wetlands - A man-made complex that simulates natural wetlands, intended to treat wastewater through microbial utilization and plant uptake of nutrients.

C-3a Activated Sludge – A suspended growth, biological treatment system designed to convert colloidal and dissolved organic compounds in wastewater into settleable sludge.

Examples:
Conventional Activated Sludge
Oxidation Ditch
Package Plants

C-3b Sequencing Batch Reactor – A modification of the activated sludge process in which treatment occurs in batch mode and the reactor also serves as the secondary clarifier. The treatment sequence is largely computer controlled.

APPENDIX B

OPERATIONAL REQUIREMENTS

In addition to information necessary to make a permit decision, the Part 22 Rules contain a series of operational requirements that must be followed after the discharge begins. The following is a brief overview of those requirements. The discharger should refer to the specific rule authorization for detailed requirements.

<u>Rule 2211</u>
(b) **Laundromat, less than 500 gallons per day**
(i) Septic tanks must be pumped when the sludge level reaches 25% of the tank volume.
(ii) Septic tanks must be equipped with an effluent filter.

(e) **Portable power washer**
(i) The discharge must not cause runoff of wastewater or deposition of waste materials onto adjacent properties.

<u>Rule 2213</u>
(3)Egg washing, less than 10,000 gallons per day
(a) The discharger must minimize the discharge of proteinaceous matter, such as egg yolks, to control odor and prevent nuisance conditions.

(4)Department approved groundwater remediation
(a) The discharger shall maintain all treatment works in good working order at all times.

<u>Rule 2216</u>
(2) Constructed wetland, less than 20,000 gallons per day
(a) Wetland vegetation shall be cultivated to maximize the rooted depth throughout the gravel filter media.

(3) Sanitary sewage, less than 50,000 gallons per day
(a) Sludge resulting from the wastewater treatment process must be disposed of in accordance with part 115 or land applied in accordance with applicable state and federal law.
(b) The discharger shall maintain all treatment or control facilities or systems in good working order and operate the facilities or systems as efficiently as possible.
(c) A discharger shall have an operation and maintenance manual for the wastewater treatment facility. The manual shall include all of the following information:
(i) Function, start-up, shutdown, and periodic maintenance procedures for each unit process and item of mechanical and electrical equipment.
(ii) The appropriate response or facility adjustment to minimize the impact of an emergency situation.
(iii) A monitoring program to monitor process efficiency.
(iv) Details of how inspections will be conducted and a schedule for the inspection of collection system and pump stations, where applicable.
(v) Periodic maintenance procedures for the collection system and pump stations, where applicable.
(vi) Procedures for the routine maintenance and inspection of lagoons and equipment used for irrigation, where applicable.
(d) Effluent may be discharged from May 1 through October 15, unless the department approves alternative dates.

(e) The discharger shall inspect the lagoon facilities weekly and maintain an inspection log unless otherwise authorized by the department.

(f) When drawing down a cell for transfer or discharge, the discharger shall meet all of the following requirements unless otherwise authorized by the department:

(i) Water discharged or transferred shall be removed from the surface 2 feet of the cell at a rate of less than 1 foot per day.

(ii) A discharger shall maintain a minimum of 2 feet of freeboard in all cells at all times.

(iii) A discharger shall maintain a minimum of 2 feet of water in all cells at all times.

(g) The discharger shall implement a facility maintenance program that incorporates all of the following management practices, unless otherwise authorized by the department:

(i) Vegetation shall be maintained at a height not more than 6 inches above the ground on lagoon dikes.

(ii) Not more than 10% of the water surface shall be covered by floating vegetation and not more than 10% of the water perimeter may have emergent rooted aquatic plants.

(iii) Dikes shall be inspected for evidence of erosion and animal burrowing. Damage due to erosion or animal burrowing shall be corrected immediately and steps taken to prevent occurrences in the future.

(iv) The occurrence of any of the following shall be minimized and immediate steps shall be taken to eliminate each occurrence:

(A) Scum.
(B) Floating sludge.
(C) Offensive odors.
(D) Insect infestations.
(E) Septic conditions.

(4) **Laundromats, less than 20,000 gallons per day**

(a) Effluent may be discharged from May 1 through October 15, unless alternative dates are approved by the department.

(b) The discharger shall inspect the lagoon facilities weekly and maintain an inspection log unless otherwise authorized by the department.

(c) When drawing down a cell for transfer or discharge, the discharger shall meet all of the following requirements unless otherwise authorized by the department:

(i) Water discharged or transferred shall be removed from the surface 2 feet of the cell at a rate of less than 1 foot per day.

(ii) A discharger shall maintain a minimum of 2 feet of freeboard in all cells at all times.

(iii) A discharger shall maintain a minimum of 2 feet of water in all cells at all times.

(d) The discharger shall implement a facility maintenance program that incorporates all of the following management practices, unless otherwise authorized by the department:

(i) Vegetation shall be maintained at a height not more than 6 inches above the ground on lagoon dikes.

(ii) Not more than 10% of the water surface shall be covered by floating vegetation and not more than 10% of the water perimeter may have emergent rooted aquatic plants.

(iii) Dikes shall be inspected for evidence of erosion and animal burrowing. Damage due to erosion or animal burrowing shall be corrected immediately and steps taken to prevent occurrences in the future.

(iv) The occurrence of any of the following shall be minimized and immediate steps shall be taken to eliminate each occurrence:

(A) Scum.
(B) Floating sludge.
(C) Offensive odors.
(D) Insect infestations.
(E) Septic conditions.

TAB 2

Groundwater Discharge Permit Application

REFERENCES IN THIS DOCUMENT TO "RULES" ARE TO ADMINISTRATIVE RULES IMPLEMENTING PART 31 OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451, AS AMENDED, BEING R 323.2101 TO 2192 AND R 323.2201 TO 2240.

GENERAL INFORMATION

Please type or print clearly

1. DISCHARGE FACILITY NAME Donald C. Cook Nuclear Plant

2. FACILITY OWNER NAME AND MAILING ADDRESS
   Name Indiana Michigan Power - A fully owned subsidiary of American Electric Power
   Street Address or P.O. Box 1 Cook Place, Mail Zone 5A
   City, State and Zip Code Bridgman, MI 49106
   Telephone No. 269-465-5901 ext. 1153
   Fax No. 269-466-2550

3. CONTACT PERSON
   Name and Title John P. Carlson - Environmental Manager
   Street Address or P.O. Box 1 Cook Place, Mail Zone 5A
   City, State and Zip Code Bridgman, MI 49106
   Telephone No. 269-465-5901 ext. 1153 Fax No. 269-466-2550

4. DISCHARGE LOCATION
   Street Address 1 Cook Place
   City Bridgman State MI Zip Code 49106
   County Berrien Township Lake
   Township 06S Range 19W Section Number 6
   First Quarter Section SW Second Quarter Section SE Additional Quarter Sections
   Latitude 41 58'30" Longitude 86 34'30"

5. FACILITY TYPE
   Municipal (Sanitary Only) _____ Municipal (w/ Sanitary and Industrial Wastewater Inputs) _____
   Industrial X Commercial _____
   If Municipal, population served ____________

6. CERTIFIED OPERATOR (NOT REQUIRED FOR 2211(c), (d), (e), (g), (h), or 2213 (2), (3), (4))
   A Certified Operator is required by Section 3110 (1) of Part 31 of Act 451.
   Name Blair K. Zordell Certification Number 4537
   Street Address 1 Cook Place, Mail Zone 5A
   City Bridgman State MI Zip Code 49106
   Telephone No. 269-465-5901 ext. 2006

51

7. FOR RULE **2215, 2216 AND 2218** AUTHORIZATIONS ONLY:

PLEASE INDICATE WHERE THE COMPLIANCE MONITORING REPORT FORMS SHOULD BE SENT

NAME Donald C. Cook Plant - Attention John Carlson, Mail Zone 5A

STREET ADDRESS 1 Cook Place

CITY Bridgman STATE MI ZIP CODE 49106

8. AUTHORIZATION REQUESTED:

____Rule 2210(y), Site Specific Exemption	____NEW USE	____REISSUANCE
____Rule 2211, Notification	____NEW USE	____REISSUANCE
____Rule 2213, Notification with Certification	____NEW USE	____REISSUANCE
____Rule 2215, General Permit, Certificate of Coverage	____NEW USE	____REISSUANCE
____Rule 2216, Specific Discharges	____NEW USE	____REISSUANCE
____Rule 2218, Discharge Permit	____NEW USE	_X_REISSUANCE

IF REQUESTING A REISSUANCE OR AN AUTHORIZATION DIFFERENT THAN THE CURRENT AUTHORIZATION, PLEASE INCLUDE THE PERMIT/EXEMPTION NUMBER OF THE CURRENT AUTHORIZATION:

If the current authorization is a permit, Rules 2216 or 2218, or was issued prior to August 26, 1999, the number is:	M_00988_
If the current authorization is a General Permit, Rule 2215, the number is:	MG________
If the current authorization is a site specific exemption, Rule 2210(y), or was issued prior to August 26, 1999, the number is:	GWE-______
If the current authorization is a notification, Rule 2211, the number is:	GWN-______
If the current authorization is a notification/certification, Rule 2213, the number is:	GWC-______

9. FACILITY STANDARD INDUSTRIAL CLASSIFICATION (SIC) CODE. _4911_

This information is available through the US Department of Labor, Office of Safety and Heath Administration, at the following web address: **www.osha.gov/oshstats/sicser.html**

10. SITE MAPS

Provide two black and white 8 1/2" X 11" maps drawn to scale that show the following:

SITE MAP 1

a) Discharge location in relation to property boundaries on a topographic map.
b) Township and county name.
c) North arrow orientation.

SITE MAP 2 - All sites must include item a, include items b-e as necessary.

a. Current and proposed treatment units and discharge areas and distance to property lines.
b. Monitoring wells on site and on adjacent properties.
c. Potable wells on site and on adjacent properties.
d. Surface waters, including wetlands, lakes, rivers, streams, and drains on the property.
e. Distance between multiple disposal sites.

ATTACH SITE MAP TO THIS APPLICATION FORM

11. WATER USAGE DIAGRAM

Please attach an 8 ½ x 11 diagram showing water usage at the facility, from supply to discharge. Include all flows such as sanitary, process water, etc. Please also indicate where in the system additives or other substances are added to the waste stream for which this authorization is being sought. The water balance should show daily average flow rates at influent, intake and discharge points and daily flow rates between treatment units. Please use actual measurements whenever possible.

12. OWNERSHIP OF TREATMENT SYSTEM AND DISPOSAL AREA

Are all parts of the treatment system and discharge areas (e.g. treatment plant, underground piping or irrigation fields) located on property owned by the applicant? Yes __X__ No _____

IF NO, ATTACH THE NAME AND ADDRESS OF THE PROPERTY OWNER WHERE THE DISCHARGE WILL OCCUR, AND A COPY OF THE WRITTEN PERMISSION TO DISCHARGE ON PROPERTY NOT OWNED BY THE DISCHARGER.

13. PROXIMITY OF TREATMENT SYSTEM TO A KNOWN SOURCE OF GROUNDWATER CONTAMINATION

Are there any known groundwater contamination sites within 1/4 mile of your disposal site?

Yes __X__ No _____ Unknown _____

IF YES, ATTACH TO THE APPLICATION FORM A DESCRIPTION OF THE LOCATION AND CONTAMINANTS BEING REMEDIATED AT THE SITE. On Site Map #2

14. ISOLATION DISTANCE

The following are isolation distances required from the discharge to adjacent water supply wells. What is the distance from your discharge to the nearest water supply well?

WELL TYPE	PERMIT AUTHORIZATION: 2218, 2216(3)	ALL OTHER AUTHORIZATIONS
I, IIa	2000	200
IIb, III	800	75
Domestic	300	50

Distance to nearest **Type I, IIa** water supply well 6 miles - Outdoor Kitchen

Distance to nearest **Type IIb, III** water supply well 3 miles - Grand Mere State Park

Distance to nearest **Domestic** water supply well 1 mile

15. ADJACENT PROPERTY OWNERS

List the names and addresses of all property owners adjacent to the facility, treatment systems and discharge locations. Include properties across roadways.

ATTACH ANY ADDITIONAL NAMES AND ADDRESSES TO THE APPLICATION FORM.

NAME COMPLETE MAILING ADDRESS

16. WELLHEAD PROTECTION

Is your facility located in a designated wellhead protection area? Yes _____ No __X__

If yes, please identify the community* __________

- Approved wellhead protection areas can be reviewed at the following web address: **http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695-59280--,00.html**

17. SIGNATORY REQUIREMENT

Pursuant to Rule 2114 of the Part 21 Rules, this application must have an original signature, and be signed by the appropriate representative(s) as follows:

A. For a corporation, the form must be signed by a principal executive officer of at least the level of Vice-president, or his/her designated representative, if the representative is responsible for the overall operation of the facility from which the discharge described in the permit application (appropriate documentation must be provided to demonstrate the position and responsibility of the designated representative).
B. For a partnership, the form must be signed by a general partner.
C. For a sole proprietorship, the form must be signed by the proprietor.
D. For municipal, state or other public facility, the form must be signed by either a principal executive officer, the mayor, village president, city or village manager or other duly authorized employee.

All signatures submitted to the department must be original signatures, or the application will be returned as incomplete. The details of these requirements are found in Rule 2114.

The department reserves the right to request information in addition to that supplied with this application if necessary to verify statements made by the applicant or for the department to make a determination required by Part 31, Water Resources Protection, Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451) and/or the Part 22 Rules associated with Part 31.

I certify, under penalty of law, that I have personally examined and am familiar with the information submitted in this document and all attachments. The information being submitted was collected and analyzed in accordance with the Part 22 Rules of Part 31 of Act 451, as amended. Based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Print Name John P. Carlson Title Environmental Manager

Representing Indiana Michigan Power - A fully owned Subsidiary of American Electric Power

Signature [signature] Date 2-23-05

If the application is for the discharge of treated sanitary wastewater from a privately owned treatment system serving a mobile home park, campground, apartment complex, condominium, nursing home, prison, or other commercial or residential facility, a principal executive officer or ranking elected official from the local unit of government must sign the permit application in the space provided. The signature is only a certification that the local unit of government is aware of its responsibilities as set forth in Section 3109(2) of Act 451. The refusal of the local unit of government to sign the application does not reduce its liability under the statute.

This is to certify that I am aware of and recognize the responsibilities of the municipality as set forth in Section 3109 of Act 451.

Print Name Section not applicable Title __________

Representing __________

Signature __________ Date __________

RULE 323.2218

DISCHARGE PERMITS

1. TYPE OF TREATED WASTEWATER FOR WHICH THE AUTHORIZATION IS REQUESTED. PLEASE CHECK ALL THAT APPLY

__X__ Sanitary sewage
__X__ Process wastewater
_____ Cooling water, greater than 5,000 gallons per day
_____ Non-contact cooling without additives, greater than 10,000 gallons per day, source water not approved by department.
_____ Non-contact cooling water with additives, greater than 10,000 gallons per day.
_____ Other, please describe:

2. DISCHARGE VOLUME
ALL DISCHARGES:
Maximum daily discharge: ____________________ gallons per day

Cumulative annual discharge: ____________________ gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:
Discharge period __________ through __________

IRRIGATION SYSTEMS AND SEEPAGE BEDS UTILIZING SOILS FOR TREATMENT SHOULD INLCUDE THE FOLLOWING:
Effluent application rate:
Inches per hour _____ Inches per day _____ Inches per week _____ Inches per year _____

3. DISCHARGE METHOD
Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4

Seepage Beds:
_____Slow/Medium Rate A1f4
_____Rapid Rate A1f5
__X__Other - Please describe: Infiltration pond

4. TREATMENT CODES
Select and enter the appropriate treatment codes to describe treatment units, i.e., A1b, B2b (see APPENDIX A, Pages 41-44)

Treatment Unit A	TRS	A-1h	B-1b	A-1f	
Treatment Unit B	SBR	A-2b	C-3a	C3b	A-1f
Treatment Unit C		_____	_____	_____	
Treatment Unit D		_____	_____	_____	

Please provide a description of the treatment system indicating how it will produce an effluent that will meet the standards of Rule 2222.

4b. **Reissuance of current permit, no modifications, Rule 2218(3)(c).** The following information must be included in the application for the reissuance of your current permit. Please check that all items have been included:

__X__ The discharge consists of the same quantity, effluent characterization, and treatment process as previously permitted.

__X__ A narrative description of the history of facility compliance with effluent and groundwater permit limits and sampling frequency is included. This item is found Tab 9.

__X__ An updated site map is included. This item is found Tab 3 & 4.

__X__ The most recent static water levels and groundwater elevations from all wells on site. This item is found Tab 10.

__X__ A current groundwater contour map is included, with a narrative evaluation of whether changes to the existing groundwater monitoring system are warranted and the rationale for any proposed change. This item is found Tab 11.

__X__ The most recent groundwater quality results are included from all wells on site. This item is found Tab 12.

__X__ The most recent effluent quality results are included. This item is found Tab 12.

Please check that all of the following that apply are included:

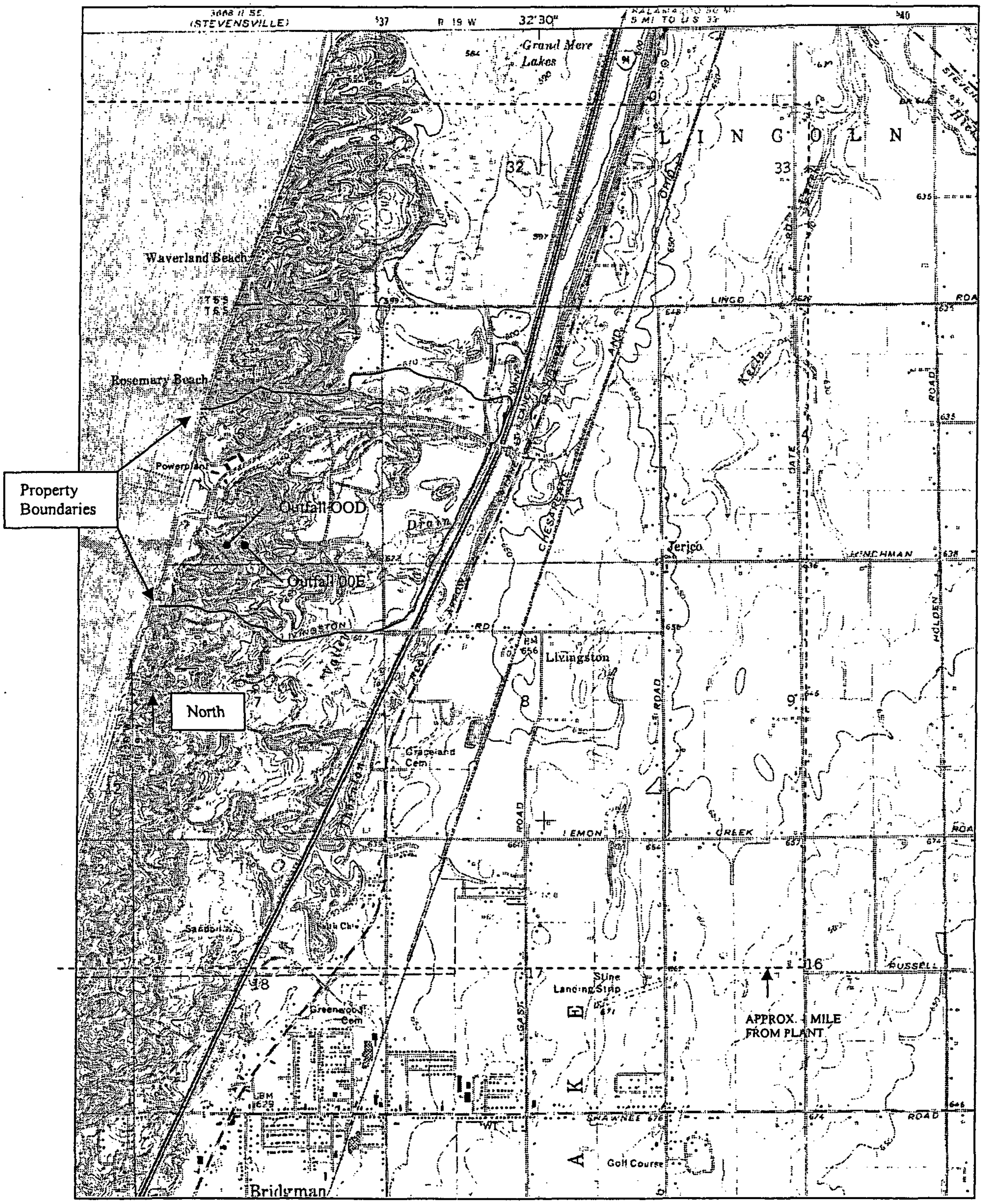
__X__ If permit limits were exceeded, the steps taken to bring the facility into compliance. This item is found N/A - iron limits - nothing due to naturally occurring

__X__ An evaluation of whether there are general trends in the effluent or groundwater sampling data indicating that the discharge is approaching permit limits. This item is found _______________.

__N/A__ The discharger has provided the department, within 30 calendar days of completion of construction of the treatment facilities, a certification by an engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, that a quality control and quality assurance program was utilized and that the facilities were built consistent with standard construction practices to comply with the permit and this part.

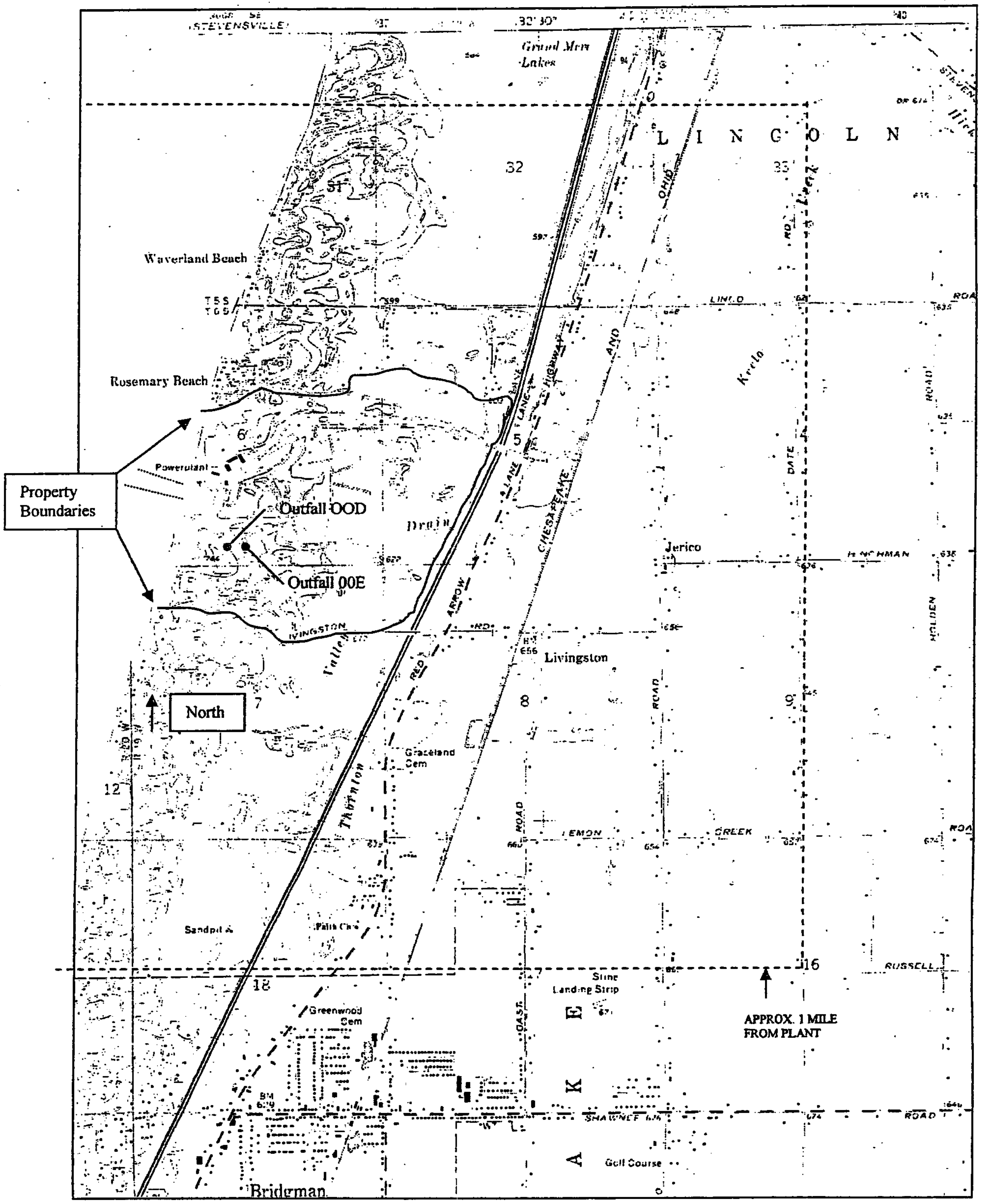
TAB 3

Donald C. Cook Nuclear Plant M00988
Part 10, Site Map 1



Donald C. Cook Nuclear Plant.
Bridgman Michigan
Lake Township
Berrien County
1" = 0.5 mile

Donald C. Cook Nuclear Plant M00988
Part 10, Site Map 1

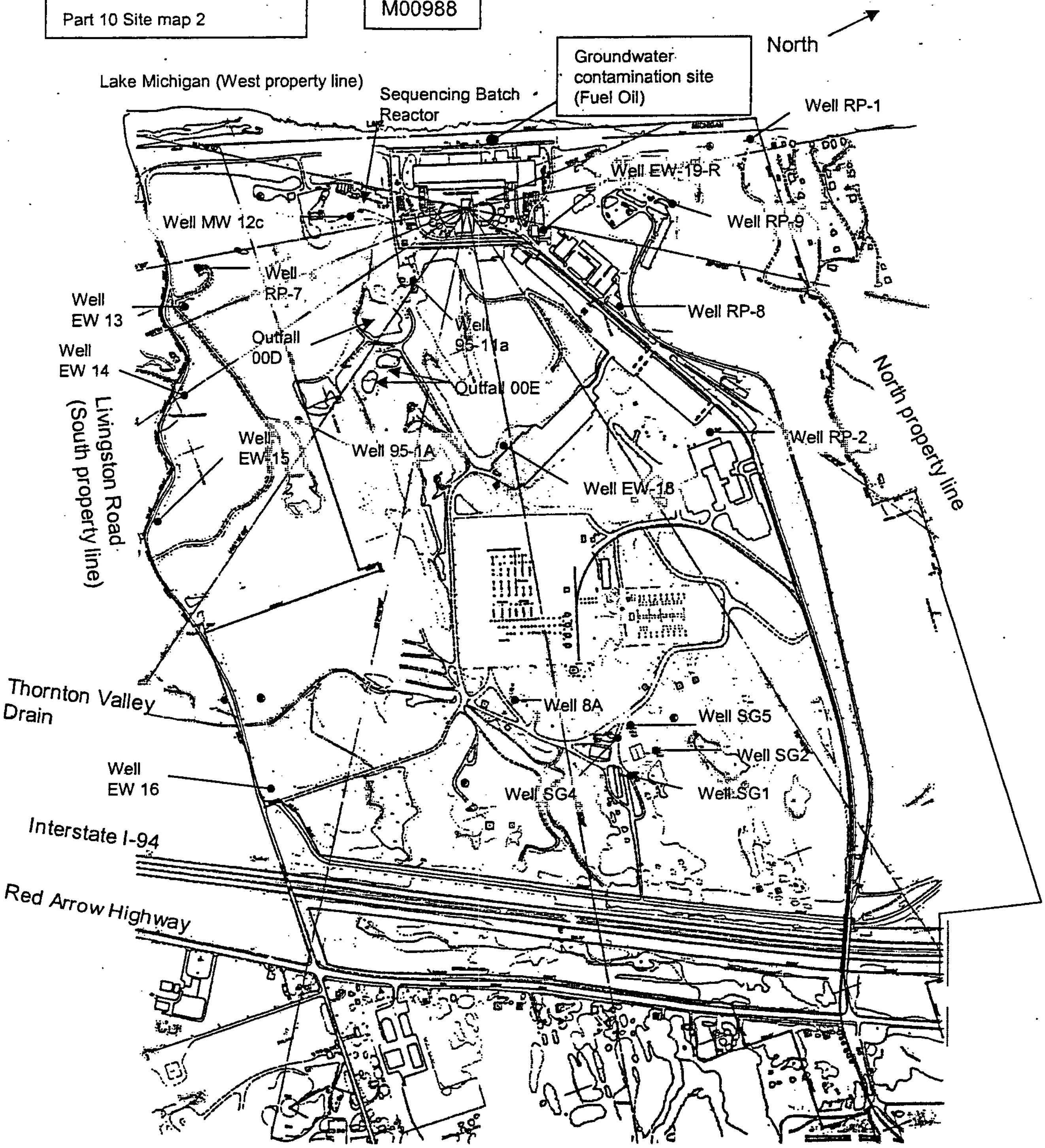


Donald C. Cook Nuclear Plant.
Bridgman Michigan
Lake Township
Berrien County
1" = 0.5 mile

TAB 4

Donald C. Cook Nuclear Plant
Part 10 Site map 2

M00988



Distance from discharge 00D	Distance from discharge 00E
South property line: 1200'	South property line: 1300'
Lake Michigan: 1000'	Lake Michigan: 1500'
East property line: 3600'	East property line: 3400'
North property line: 2600'	North property line: 2600'

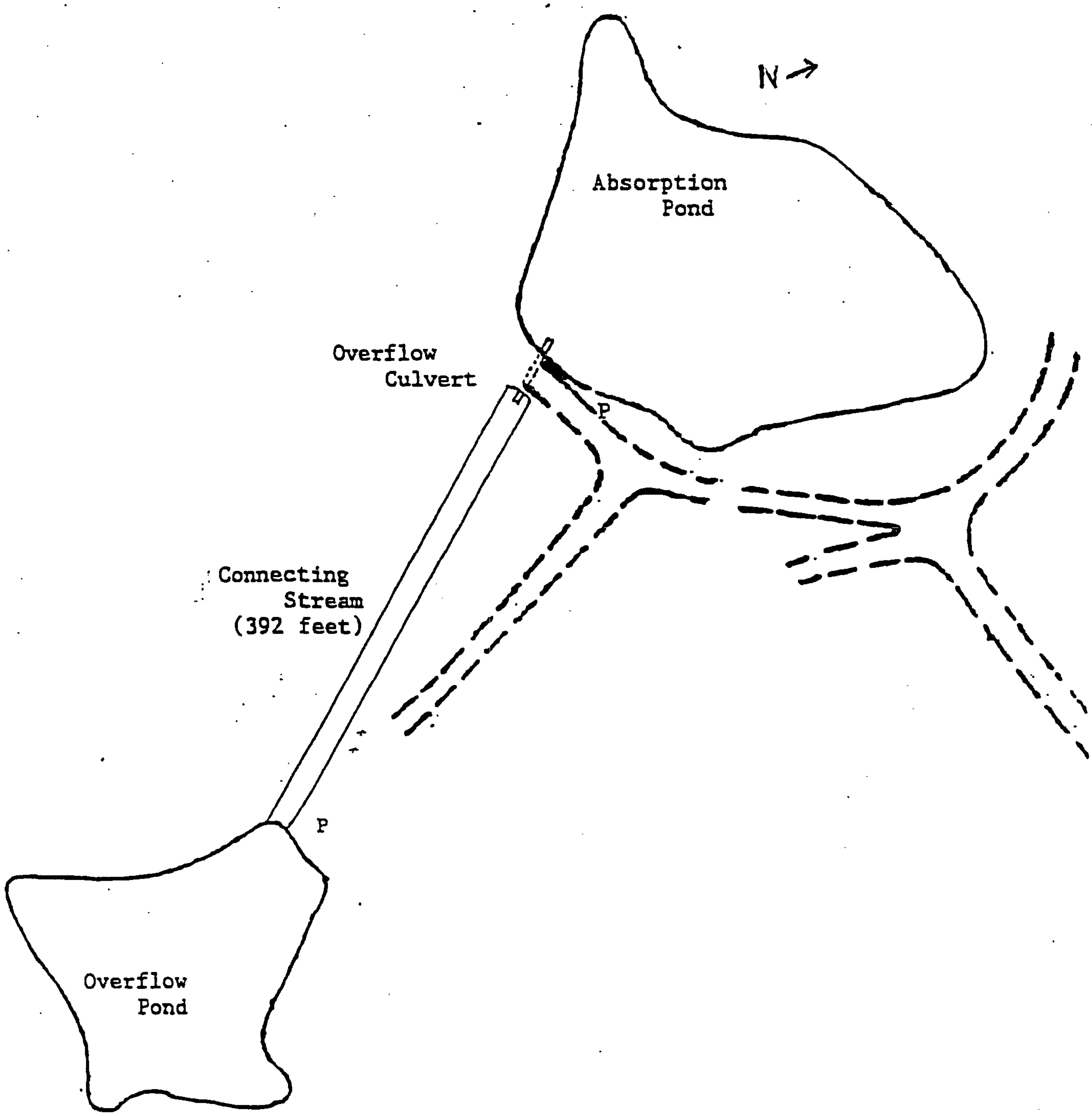
Cook Nuclear Plant
Berrien County
Lake Township
Scale: 1" = 1000'

Cook Nuclear Plant
Berrien County
Lake Township
Scale: 1" = 1000'

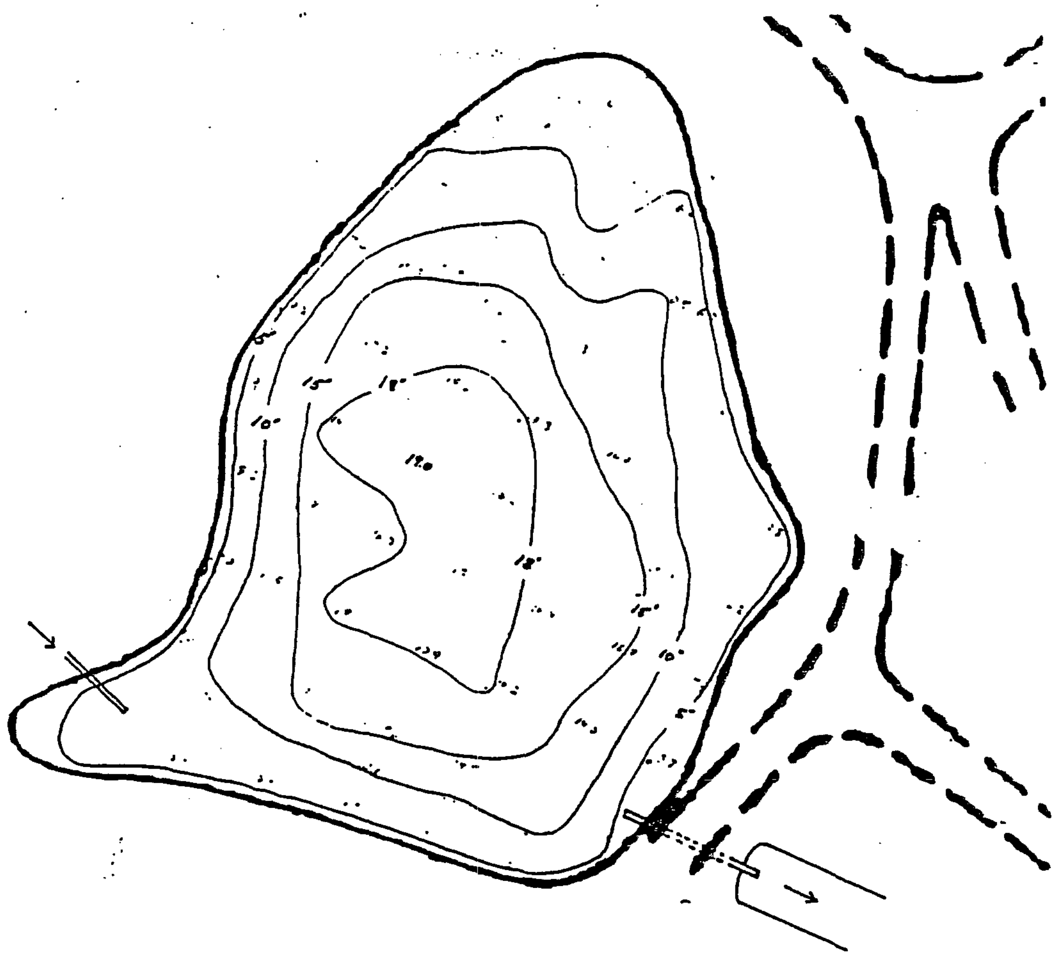
Cook Nuclear Plant
Berrien County
Lake Township
Scale: 1" = 1000'

Cook Nuclear Plant, Absorption Pond Complex and Topography

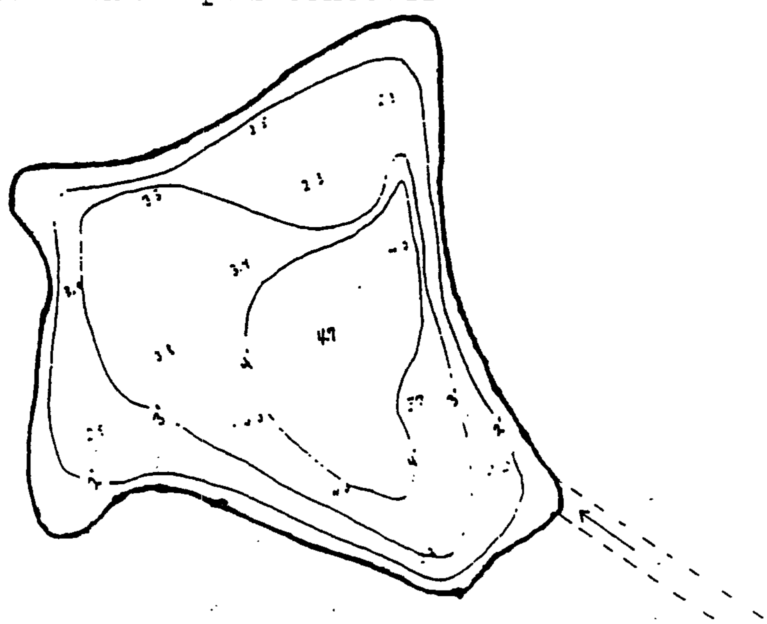
Absorption Pond and Overflow Pond



Absorption Pond Depth Contours



Overflow Pond Depth Contours



TAB 5

Michigan Department of Environmental Quality-Surface Water Quality Division

Groundwater Discharge Permit Application

General Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT OR COC NUMBER
..nald C. Cook Nuclear Plant	M00988

15) List adjacent property owners

List the names and addresses of all property owners adjacent to the facility, treatment systems, and discharge locations. List this information in the space provided below or include the information as an attachment on 8 1/2" x 11" paper. If additional space is necessary, copy this blank page and attach this information to this application.

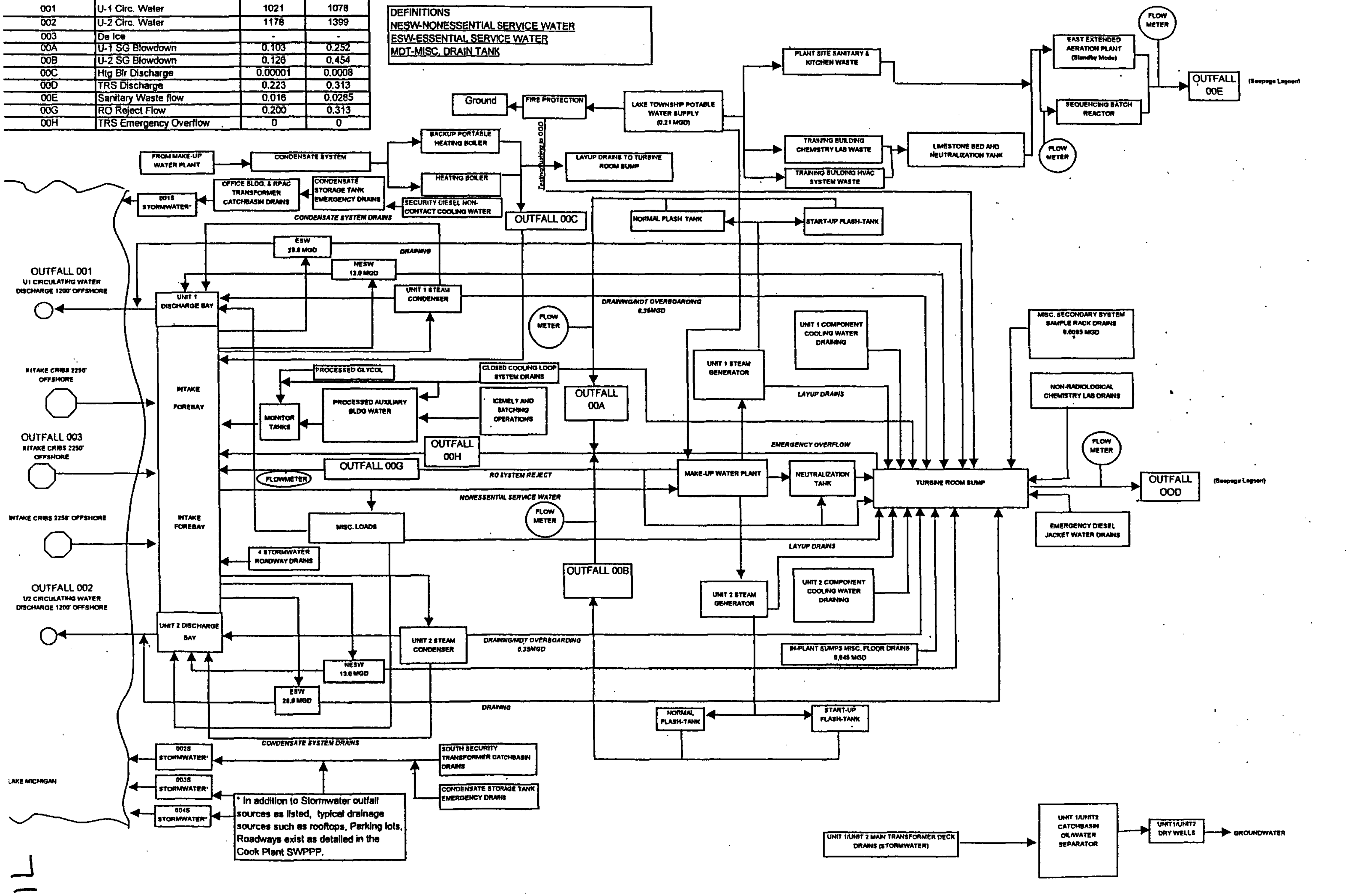
Location	Property Number	Name	Address
NORTH			
Rosemary Beach	11-11-6800 0038-00-5	Tengerstrom, Eric H.	7470 Rosemary Stevensville MI 49127
	11-11-6800-0037-02-5	Tengerstrom Eric H.	7470 Rosemary Stevensville MI 49127
	11-11-6800-0037-01-7	Gielniewski, Michael Z. & Teresa B.	1113 Independence Rd Bartlett IL 60103
	11-11-6800-0037-00-9	Vesely, Alan Kobler, Rich +Matthews, Larry.	527 S Oak Park Ave. Oak Park IL 60304
	11-11-6800-0036-00-2	Lewis, James G. Jr.	4183 Lake Ct. Stevensville, MI 49127
	11-11-6800-0033-00-3	Gilpin, Clark and Nancy	714 Dearborn #8 Chicago IL 60605
	11-11-6800-0032-01-5	Giese Marie E.	4291 Lake Road Stevensville MI 49127
	11-11-6800-0030-02-1	Gottschall, Bruce A. & Susan M.	5760 S. Blackstone Chicago, IL 60637
	11-11-6800-0028-01-8	Balka, Ronald A. & Janet M.	3334 Louise Dr. Lansing, IL 60438
	11-11-0006-0002-03-1	Michigan Department of Natural Resources	PO Box 30735 Lansing, MI 48909
	11-11-0006-0004-00-9	Franklin Real Estate	c/o Indiana Michigan Power Co. PO Box 16428 Columbus OH 43216
	11-11-0006-0004-04-1	Temmel, Edward P.	9617 E. Shore Dr. Oak Lawn IL 60453
	11-11-0006-0004-01-7	Caparo, William E. & Oyler, Kathryn E.	122 S. Ellsworth Pl. South Bend, IN 46635
	11-11-0006-0004-02-5	Rosemary Beach Corp.	C/O Secretary 3415 S. 59 St. Cicero IL 60650
	11-11-0007-0013-00-6	Lake Charter Twp.	Shawnee Rd. Bridgman, MI 49106
	11-11-0007-0013-01-4	Lake Charter Twp.	Shawnee Rd. Bridgman, MI 49106
	11-11-0007-0006-01-8	Indiana Michigan Power Company	PO Box 16428 Columbus OH 43216
	11-11-0007-0001-01-6	Lake Charter Twp.	Shawnee Rd. Bridgman, MI 49106
	11-11-0007-0004-01-5	Lake Charter Twp.	Shawnee Rd. Bridgman, MI 49106
	11-11-0005-0029-00-3	Technisand, Inc.	PO Box 177 Wedron, IL 50557
	11-11-0005-0036-01-8	Ruff, Timothy W.	7500 Thorton Dr. Stevensville, MI 49127

Location	Property Number	Name	Address
	11-11-0005-0027-00-1	Technisand, Inc.	PO Box 177 Wedron, IL 50557
	11-11-0005-0036-06-9	Emery, Martin; Hopkins, Elwood J. & Mable N.;	7499 Thorton Dr. Stevensville, MI 49127
	11-11-0005-0036-02-6	Indiana Michigan Power Company	PO Box 16428 Columbus OH 43216
	11-11-0005-0002-01-6	Blue Jay Assoc.	PO Box 24400 Canton OH 44701
	11-11-0008-0041-00-8	Michigan Dept. of Transportation	Lansing MI 48900
	11-11-0008-0009-00-7	Franklin Real Estate	c/o Indiana Michigan Power Co. PO Box 60 Ft. Wayne, IN 46801.
EAST		Interstate I-94	Michigan Dept of State Highways
SOUTH		Lake Township	Township Supervisor 1410 Shawnee Road Bridgman, MI 49106
WEST		Lake Michigan	State of Michigan and United States of America

TAB 6

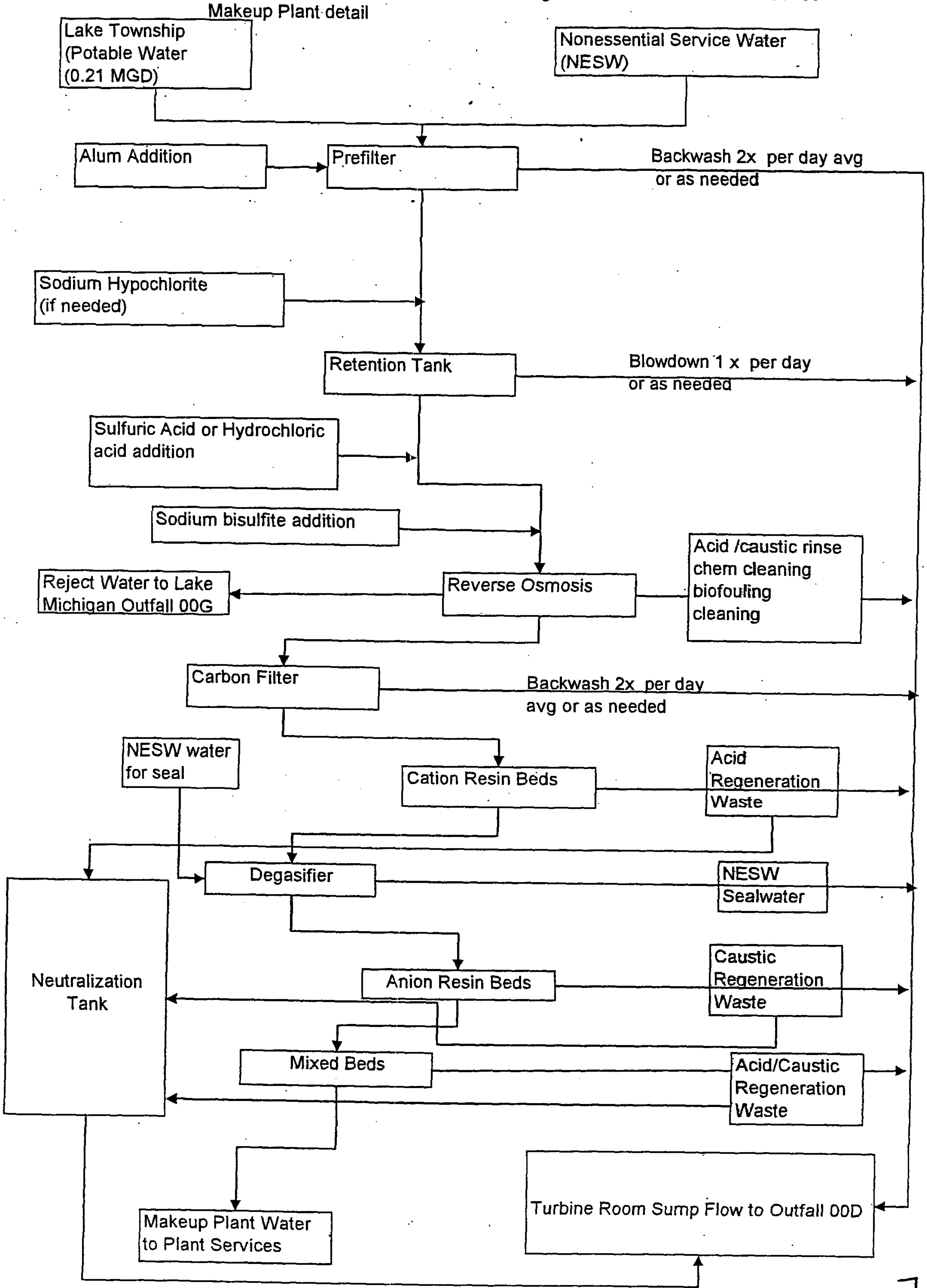
WASTEWATER FLOW DIAGRAM
DONALD C. COOK NUCLEAR PLANT

Outfall	Description	AVG Flow in MGD	MAX Flow in MGD
001	U-1 Circ. Water	1021	1078
002	U-2 Circ. Water	1178	1399
003	De Ice	-	-
00A	U-1 SG Blowdown	0.103	0.252
00B	U-2 SG Blowdown	0.126	0.454
00C	Htg Blr Discharge	0.00001	0.0008
00D	TRS Discharge	0.223	0.313
00E	Sanitary Waste flow	0.016	0.0285
00G	RO Reject Flow	0.200	0.313
00H	TRS Emergency Overflow	0	0



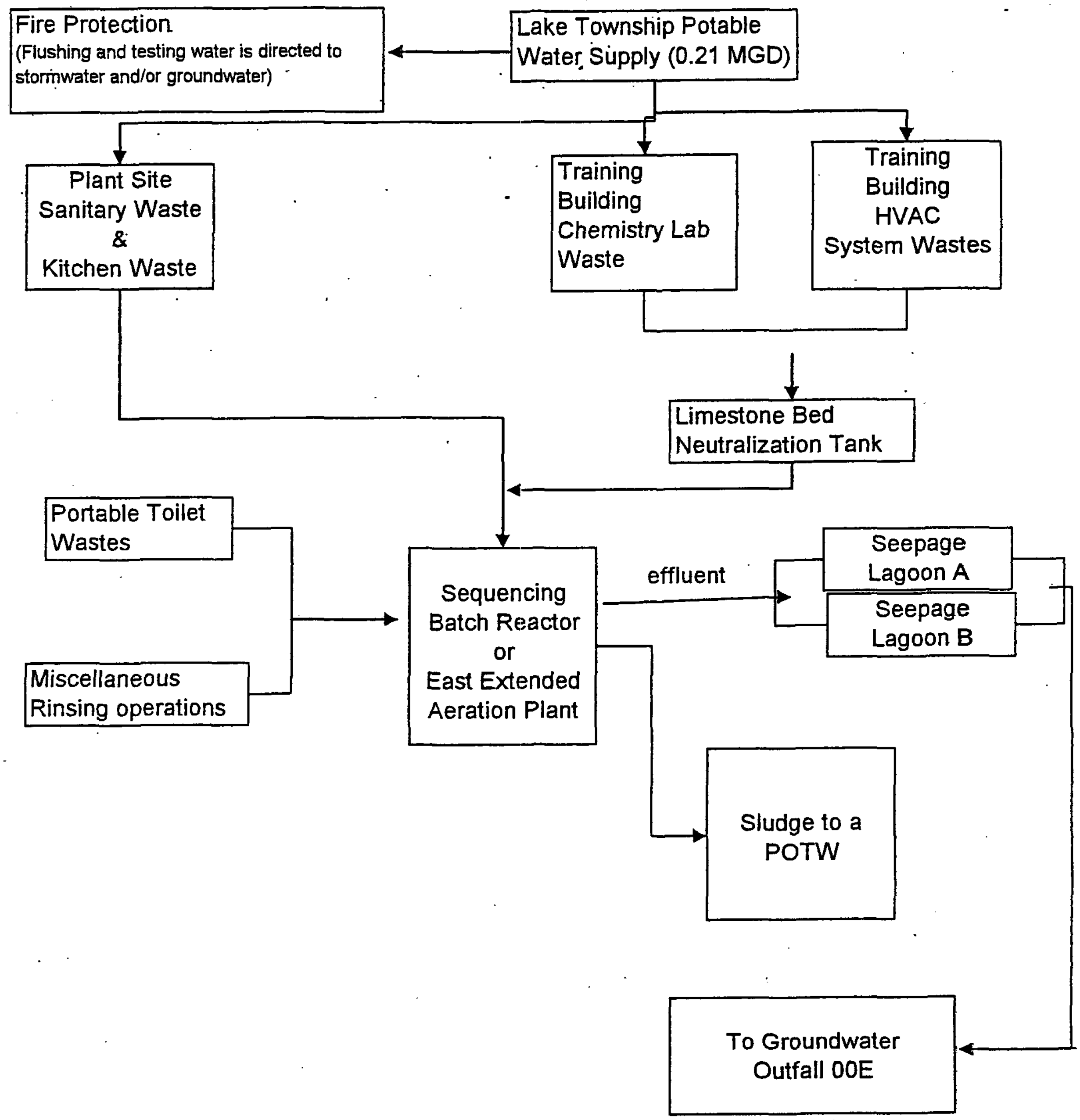
Cook Nuclear Plant Wastewater Flow Diagram
Makeup Plant detail

M00988



Cook Nuclear Plant Wastewater flow diagram
Sewage treatment plant detail

M00988



TAB 7

General Information, ITEM 11 Cont'd

Groundwater and Surface Water Waste Stream Narrative

This narrative describes all outfalls discharging to Lake Michigan under NPDES Permit MI0005827, and for Outfalls 00D and 00E discharges permitted under Permit M00988 "Authorization to Discharge." Flows are based on a review of previous NPDES applications, Plant system descriptions, or previously submitted Discharge Monitoring Reports (DMR). The chemical additives described below may include a manufacturer's name as an example of the type of product used in a specific system. Indiana Michigan Power may substitute vendors of chemical additives provided that the chemical ingredients are similar. Surface water discharge values are based on maximum release rates and volumes, dilution rates are based on a minimum number of pumps running.

OUTFALL 001 - Unit 1 Circulating Water Discharge

Outfall 001 is a non-contact cooling water discharge. The majority of non-contact cooling water (Circulating Water System, ~690,000 GPM) is used to condense the steam exhausting from steam driven turbines. Non-contact cooling water is drawn from Lake Michigan approximately one-half mile from shore through three 16 ft. diameter tunnels. Water enters the tunnels via intake cribs at an approximate velocity of 1.3 feet per second. The water enters to a forebay where it is screened to remove large debris that may be entrained in the water. It is routed through the Unit 1 condensers and then discharged to Lake Michigan through a 16 foot diameter tunnel. The water exits the tunnels through high velocity discharges at a rate of approximately 13 feet per second approximately 1/4 mile from shore. Outfall 001 also includes internal Outfalls (as designated by the Michigan Department of Environmental Quality) steam generator Blowdown (00A, 00B), Plant Heating Boiler (00C), Reverse Osmosis Unit (00G), and the Turbine Room Sump Emergency Overflow (00H) described in detail later in this document.

Outfall 001 also may contain the effluent flow from both Units' Essential Service Water (ESW) systems, both Units' Non-Essential Service Water (NESW) system, and monitor tank releases. ESW (~40,000 GPM) is Lake Michigan water taken from the forebay that is used to provide cooling to safety-related equipment. NESW (~18,000 GPM) is also Lake Michigan water taken from the forebay used for non-contact cooling for various plant systems including oil coolers, a source of water for the demineralized makeup system (MUP), and a water supply for non-safety related equipment. Monitor tank releases (~15,000 to 20,000 gallons per event) are regulated by the NRC and consist of wastewater from various system and equipment leakage that may be generated within the auxiliary building area. Minor leakage from systems containing lube oil, hydrazine, carbohydrazide, ethanolamine or closed-loop cooling systems containing a maximum concentration of gluteraldehyde (100 ppm), methyl (bis) thiocyanate (10 ppm), tolyltriazole (60 ppm), Molybdate (1000 ppm), and nitrite (1200 ppm), may be discharged via monitor tank releases.

The non-contact cooling water for the Circulating Water, the ESW and the NESW, and Miscellaneous Sealing and Cooling Water Systems is treated for biological control using sodium hypochlorite. This same water is periodically treated using a non-oxidizing biocide to eradicate zebra mussels from the cooling systems. The biocides (Betz Spectrus CT-1300, Betz CT-4, Calgon H-130M, Calgon EVAC and NALCO Macro-Trol 9380) are all polyquats, and are used as required to protect plant systems while meeting water quality based effluent limits. The treatments can be directed to various critical plant systems from the intake structures through the entire plant cooling system, including the Circulating Water System, ESW and NESW systems and other non-contact cooling water. The biocide may be added to the systems via a chemical injection pipeline through a ring header located inside the intake crib, or directly applied at a specific system. A chemical injection pipeline is installed inside the intake piping and is designed to feed chemicals from inside the plant. The intake chemical injection header may be stored with chemical inside the pipe to prevent zebra mussel infestation. The header may also be leak checked using approved dyes such as fluorescein, or other indicators such as Nalco Trasar 23299. Non-contact cooling systems biocide treatments are dependent upon zebra mussel infestation. Concentrations and chemical feed points are chosen to minimize the amount of biocide required and to maximize the efficacy on zebra mussels. Bentonite clay may be added to detoxify the biocide prior to discharge. The plant non-contact cooling water systems may be treated concurrently or individually to allow more efficient use of chemicals. Plant systems are treated to assure safe operation of the nuclear generating units.

The piping used to apply chemicals is regularly cleaned of calcium carbonate scale buildup. A small amount of weak acid cleaner such as Betz FerroQuest FQ LP 7200 may be used to remove accumulated carbonate scale deposits. The accumulated deposits will be discharged via Outfalls 001/003. Circulating water will dilute the weak acid prior to discharge to Lake Michigan.

Condensate flushes are performed periodically to purge the plant's secondary water system from layup chemistry specifications during shutdown conditions to startup chemistry specifications prior to startup of the unit. Water containing up to 4 ppm hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H], 10 ppm carbohydrazide (NALCO 1250 plus, or equivalent), 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001), is overboarded to Outfall 001 as required to remove contaminants to meet desired startup secondary Chemistry specifications. This flowrate averages 70 GPM, but may reach 600 GPM for short periods of time. The flowrate is dependent on chemistry specification parameters and makeup water availability. The maximum output from the MUP is approximately 600 GPM or 864,000 GPD. (See Outfalls 00A, 00B for further description.)

Monitor tanks receive treated water from the auxiliary building radioactive waste removal system and other sources such as ice production and removal processes from the ice condenser systems and other radioactively contaminated wastes generated at the facility. This system handles wastes generated from the reactor coolant pump seal leakoffs, the refueling cavity water, equipment leaks, floor drains, valve stem leakoffs, system sampling, and waste sample solutions. It also handles laboratory wastes from the radiochemistry analysis in the hot chemical laboratory, system equipment drains, non-contact cooling water, ice production/removal and decontamination processes and any contaminated liquid waste generated in the auxiliary building area. The wastes are collected in one of several tanks and are treated when enough water is collected. The treatment utilizes a demineralizer system to minimize radioactive contaminants. A small amount of wastewater may bypass the treatment because it cannot be processed by resin.

Other special drains of non-radioactive process water systems such as Component Cooling Water system flushes with biocides such as gluteraldehyde (100 ppm), methyl (bis) thiocyanate (10 ppm), tolyltriazole (60 ppm), Molybdate (1000 ppm) and nitrite (1200 ppm), and borated icemaking/ice removal operations, can be routed directly to the plant's monitor tanks without treatment. For maintenance purposes to prevent microbial growth, Component Cooling Water flushes are performed generating approximately 281,000 gallons per year of flushwater to the monitor tanks.

Borated icemaking/ice removal operations occur for maintenance of the plant's ice condenser systems. This process produces a solution of sodium tetraborate (approximately 2200 ppm as boron) that can be drained to the monitor tanks. This process takes place approximately every 18 months and may produce up to 30,000 gallons of sodium tetraborate solution.

Both the treated wastewater and the special drains are accumulated in the monitor tanks and sampled to ensure the waste meets the radiological requirements prior to being discharged into the Circulating Water System.

Periodically, due to equipment leaks and/or system upsets, a waste stream is generated that contains radioactively contaminated ethylene glycol and water. Incidental amounts of ethylene glycol generated from equipment leaks may be drained directly to the monitor tanks or treated by the radwaste processing system. Small amounts of ethylene glycol may be discharged to outfalls 001, 002, or 003.

Sulfur hexafluoride gas (SF6) is utilized in the non-contact cooling water systems at the plant to detect leaks in various components such as the condensers. The gas is injected in the cooling water stream and discharged to outfalls 001, 002 or 003 at less than 54 ul/l.

Aryl sulfate liquid (NALCO Trasar 23299) is utilized in the non-contact cooling water systems at the plant to determine flow through various parts of the system. The liquid is injected into the service water system to reach a target concentration of approximately 2 mg/l. The service water is discharged to Outfalls 001, 002, or 003, which would, in turn, discharge at less than 0.15 mg/l. The liquid is also injected into the circulating water system to reach a target concentration of approximately 2 mg/l.

Control Room Air Conditioning (CRAC) testing: Approximately 1440 gallons/yr. of CRAC water may mix with ESW and then be discharged to the forebay during a monthly test of the system. CRAC water is demineralized water, and may contain up to: 2000 ppm nitrite [Calgon LCS 60, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203, or equivalent], 100 ppm gluteraldehyde [from Betz Biotrol 107 (Spectrus NX 1105), Calgon H-300, or equivalent], 60 ppm tolyltriazole [from Calgon LCS-60, Betz Copper-Trol Cu-1, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203, or equivalent], 10 ppm methyl (bis) thiocyanate (from Betz 3610), 1000 ppm molybdate from Betz Corrshield MD 4103 and 25 ppm aryl sulfate (from NALCO 22199).

Three roadway storm drains route small amounts of stormwater from a small section of roadway that traverses over the Circulating Water Forebay. The three storm drains are designed to route accumulated stormwater from this small roadway to the forebay below. A small amount of de-icing compound used on this section of road could potentially enter these small (Approximately 8") gratings. Screened material collected from the plant's intakes is also stored in this area in designated trash dumpsters. Fish exudiates are now drained to the forebay as recommended by the MDEQ stormwater and NPDES inspection team (M. Fields and J. Molloy 1997).

During upset conditions it is possible to overflow the contents of the Turbine Room Sump (See Outfall 00H) to Outfalls 001, 002 and/or 003 if the flow path to the on-site absorption pond cannot be used.

OUTFALL 002 - Unit 2 Circulating Water Discharge

Outfall 002 is a non-contact cooling water discharge. The majority of non-contact cooling water (Circulating Water System, ~920,00 GPM) is used to condense the steam exhausting from steam driven turbines. Non-contact cooling water is drawn from Lake Michigan approximately one-half mile from shore through three 16 ft. diameter tunnels. Water enters the tunnels via intake cribs at an approximate velocity of 1.3 feet per second. The water enters to a forebay where it is screened to remove large debris that may be entrained in the water. It is routed through the Unit 2 condensers and then discharged to Lake Michigan through an 18 foot diameter tunnel. The water exits the tunnels through high velocity discharges at a rate of approximately 13 feet per second approximately 1/4 mile from shore. Outfall 002 also includes internal Outfalls (as designated by the Michigan Department of Environmental Quality) steam generator Blowdown (00A, 00B), Plant Heating Boiler (00C), Reverse Osmosis Unit (00G), and the Turbine Room Sump Emergency Overflow (00H) described in detail later in this document.

Outfall 002 also may contain the effluent flow from both Units' Essential Service Water (ESW) systems, both Units' Non-Essential Service Water (NESW) system, and monitor tank releases. ESW (~40,000 GPM) is Lake Michigan water taken from the forebay that is used to provide cooling to safety-related equipment. NESW (~18,000 GPM) is also Lake Michigan water taken from the forebay used for non-contact cooling for various plant systems including oil coolers, a source of water for the demineralized makeup system (MUP), and a water supply for non-safety related equipment. Monitor tank releases (~15,000 to 20,000 gallons per event) are regulated by the NRC and consist of wastewater from various system and equipment leakage that may be generated within the auxiliary building area. Minor leakage from systems containing lube oil, hydrazine, carbohydrazide, ethanolamine or closed-loop cooling systems containing a maximum concentration of gluteraldehyde (100 ppm), methyl (bis) thiocyanate (10 ppm), tolyltriazole (60 ppm), Molybdate (1000 ppm), and nitrite (1200 ppm), may be discharged via monitor tank releases.

The non-contact cooling water for the Circulating Water, the ESW and the NESW, and Miscellaneous Sealing and Cooling Water Systems is treated for biological control using sodium hypochlorite. This same water is periodically treated using a non-oxidizing biocide to eradicate zebra mussels from the cooling systems. The biocides (Betz Spectrus CT-1300, Betz CT-4, Calgon H-130M, Calgon EVAC and NALCO Macro-Trol 9380) are all polyquats, and are used as required to protect plant systems while meeting water quality based effluent limits. The treatments can be directed to various critical plant systems from the intake structures through the entire plant cooling system, including the Circulating Water System, ESW and NESW systems and other non-contact cooling water. The biocide may be added to the systems via a chemical injection pipeline through a ring header located inside the intake crib, or directly applied at a specific system. A chemical injection pipeline is installed inside the intake piping and is designed to feed chemicals from inside the plant. The intake chemical injection header may be stored with chemical inside the pipe to prevent zebra mussel infestation. The header may also be leak checked using approved dyes such as fluorescein, or other indicators such as Nalco Trasar 23299. Non-contact cooling systems biocide treatments are dependent upon zebra mussel infestation. Concentrations and chemical feed points are chosen to minimize the amount of biocide required and to maximize the efficacy on zebra mussels. Bentonite clay may be added to detoxify the biocide prior to discharge. The plant non contact cooling water systems may be treated at the concurrently or individually to allow more efficient use of chemicals. Plant systems are treated to assure safe operation of the nuclear generating units.

The piping used to apply chemicals is regularly cleaned of calcium carbonate scale buildup. A small amount of weak acid cleaner such as Betz FerroQuest FQ LP 7200 may be used to remove accumulated carbonate scale deposits. The accumulated deposits will be discharged via Outfalls 002/003. Circulating water will dilute the weak acid prior to discharge to Lake Michigan.

Condensate flushes are performed periodically to purge the plant's secondary water system from layup chemistry specifications during shutdown conditions to startup chemistry specifications prior to startup of the unit. Water containing up to 4 ppm hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H], 10 ppm carbohydrazide (NALCO 1250 plus, or equivalent), 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001), is overboarded to Outfall 002 as required to remove contaminants to meet desired startup secondary Chemistry specifications. This flowrate averages 70 GPM, but may reach 600 GPM for short periods of time. The flowrate is dependent on chemistry specification parameters and makeup water availability. The maximum output from the MUP is approximately 600 GPM or 864,000 GPD. (See Outfalls 00A, 00B for further description.)

Monitor tanks receive treated water from the auxiliary building radioactive waste removal system and other sources such as ice production and removal processes from the ice condenser systems and other radioactively contaminated wastes generated at the facility. This system handles wastes generated from the reactor coolant pump seal leakoffs, the refueling cavity water, equipment leaks, floor drains, valve stem leakoffs, system sampling, and waste sample solutions. It also handles laboratory wastes from the radiochemistry analysis in the hot chemical laboratory, system equipment drains, non-contact cooling water, ice production/removal and decontamination processes and any contaminated liquid waste generated in the auxiliary building area. The wastes are collected in one of several tanks and are treated when enough water is collected. The treatment utilizes a demineralizer system to minimize radioactive contaminants. A small amount of wastewater may bypass the treatment because it cannot be processed by resin.

Other special drains of non-radioactive process water systems such as Component Cooling Water system flushes with biocides such as gluteraldehyde (100 ppm), methyl (bis) thiocyanate (10 ppm), tolyltriazole (60 ppm), Molybdate (1000 ppm) and nitrite (1200 ppm), and borated icemaking/ice removal operations, can be routed directly to the plant's monitor tanks without treatment. For maintenance purposes to prevent microbial growth, Component Cooling Water flushes are performed generating approximately 281,000 gallons per year of flushwater to the monitor tanks.

Borated icemaking/ice removal operations occur for maintenance of the plant's ice condenser systems. This process produces a solution of sodium tetraborate (approximately 2200 ppm as boron) that can be drained to the monitor tanks. This process takes place approximately every 18 months and may produce up to 30,000 gallons of sodium tetraborate solution.

Both the treated wastewater and the special drains are accumulated in the monitor tanks and sampled to ensure the waste meets the radiological requirements prior to being discharged into the Circulating Water System.

Periodically, due to equipment leaks and/or system upsets, a waste stream is generated that contains radioactively contaminated ethylene glycol and water. Incidental amounts of ethylene glycol generated from equipment leaks may be drained directly to the monitor tanks or treated by the radwaste processing system. Small amounts of ethylene glycol may be discharged to outfalls 001, 002, or 003.

Sulfur hexafluoride gas (SF6) is utilized in the non-contact cooling water systems at the plant to detect leaks in various components such as the condensers. The gas is injected in the cooling water stream and discharged to outfalls 001, 002 or 003 at less than 54 ul/l.

Aryl sulfate liquid (NALCO Trasar 23299) is utilized in the non-contact cooling water systems at the plant to determine flow through various parts of the system. The liquid is injected into the service water system to reach a target concentration of approximately 2 mg/l. The service water is discharged to Outfalls 001, 002, or 003, which would, in turn, discharge at less than 0.15 mg/l. The liquid is also injected into the circulating water system to reach a target concentration of approximately 2 mg/l.

Control Room Air Conditioning (CRAC) testing: Approximately 1440 gallons/yr. of CRAC water may mix with ESW and then be discharged to the forebay during a monthly test of the system. CRAC water is demineralized water, and may contain up to: 2000 ppm nitrite [Calgon LCS 60, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203, or equivalent], 100 ppm gluteraldehyde [from Betz Biotrol 107 (Spectrus NX 1105), Calgon H-300, or equivalent], 60 ppm tolyltriazole [from Calgon LCS-60, Betz Copper-Trol Cu-1, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203, or equivalent], 10 ppm methyl (bis) thiocyanate (from Betz 3610), 1000 ppm molybdate from Betz Corrshield MD 4103 and 25 ppm aryl sulfate (from NALCO 22199).

Three roadway storm drains route small amounts of stormwater from a small section of roadway that traverses over the Circulating Water Forebay. The three storm drains are designed to route accumulated stormwater from this small roadway to the forebay below. A small amount of de-icing compound used on this section of road could potentially enter these small (Approximately 8") gratings. Screened material collected from the plant's intakes is also stored in this area in designated trash dumpsters. Fish exudiates are now drained to the forebay as recommended by the MDEQ stormwater and NPDES inspection team (M. Fields and J. Molloy 1997).

During upset conditions it is possible to overflow the contents of the Turbine Room Sump (See Outfall 00H) to Outfalls 001, 002 and/or 003 if the flow path to the on-site absorption pond cannot be used.

OUTFALL 003 - Deicing Discharge

Outfall 003 is a deicing discharge which is used when water temperatures approach freezing temperatures. A portion of the flow from Outfall 001 and /or Outfall 002 is directed through the center intake tunnel to temper the intake water and prevent ice buildup on the intake structures which could restrict intake flow. The velocity at the other two intake structures during de-icing mode increases to approximately 1.9 feet per second. Discharge velocity will be less that 13 feet per second since a portion of the discharge is routed out the center intake tunnel.

The Essential and Non-Essential Service Water System (ESW and NESW) may be recirculated with a combination of Circulating Water Pumps in service to raise the forebay temperature to prevent frazil ice formation during cold weather periods. During shutdown conditions when normal operating heat addition is not available, portable heat addition units may be placed in the forebay to prevent frazil ice formations that may prevent flow to safety systems in the plant.

OUTFALL 00A - Unit 1 Steam Generator Blowdown

The steam generators (part of the secondary water system) require ultra high purity water for operation. Makeup water used in the steam generators is withdrawn from the intake forebay (or from Lake Township water supply or a blending of both sources) and treated so most natural impurities are removed through sedimentation, filtration, reverse osmosis, and demineralization. Impurities concentrate in the steam generators as the water is turned to steam and must be removed to protect the steam turbines and heat transfer surfaces of the steam generators. The impurities are removed by continuously draining a portion of the water from the steam generators in a process called "blowdown".

In the steam generator, steam is separated from the water, further heated, and then routed to the turbines. When the steam separates from the water, the impurities remain in the water, concentrating in the steam generator. Blowdown consists of two forms, a liquid portion (700 gpm max) and a wet steam portion, which is exhausted to the atmosphere. The liquid portion of the steam generator blowdown is discharged to the screenhouse forebay either directly (Normal Flash Tank), or after processing through mixed bed demineralizers. Impurities in this discharge may consist of small quantities of insoluble iron and copper or impurities from the Circulating Water System used to cool the condensers should condenser tube leaks occur. Steam generator additives consist of ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for pH adjustment, hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] and/or carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging.

When the units are not operating, the steam generators are placed in wet layup conditions to protect against corrosion during storage. Layup water is periodically discharged through the outfall to the Circulating Water Forebay. The layup water contains a maximum concentration of 400 ppm hydrazine [Betz Powerline Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] and/or 40 ppm carbohydrazide (NALCO 1250 plus, or equivalent), and /or 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001). The waste strength of this discharge is reduced through mixing with Outfalls 001, 002, or 003.

During the **Sludge Lancing Process**, demineralized water or secondary water is used to pressure clean the steam generators during outage periods. The water is recirculated through temporary filters to remove entrained solids. The major constituent of the solids is iron oxide from the steam generators. The water is then returned to the steam generators and can be drained to Outfalls 00A, 00B, to Outfall 001, 002, 003, 00D or 00H. The suspended solids are analyzed for radioactivity prior to disposal.

<u>OUTFALL 00B - Unit 2 Steam Generator Blowdown</u>

The steam generators (part of the secondary water system) require ultra high purity water for operation. Makeup water used in the steam generators is withdrawn from the intake forebay (or from Lake Township water supply or a blending of both sources) and treated so most natural impurities are removed through sedimentation, filtration, reverse osmosis, and demineralization. Impurities concentrate in the steam generators as the water is turned to steam and must be removed to protect the steam turbines and heat transfer surfaces of the steam generators. The impurities are removed by continuously draining a portion of the water from the steam generators in a process called "blowdown".

In the steam generator, steam is separated from the water, further heated, and then routed to the turbines. When the steam separates from the water, the impurities remain in the water, concentrating in the steam generator. Blowdown consists of two forms, a liquid portion (700 gpm max) and a wet steam portion, which is exhausted to the atmosphere. The liquid portion of the steam generator blowdown is discharged to the screenhouse forebay either directly (Normal Flash Tank), or after processing through mixed bed demineralizers. Impurities in this discharge may consist of small quantities of insoluble iron and copper or impurities from the Circulating Water System used to cool the condensers should condenser tube leaks occur. Steam generator additives consist of ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for pH adjustment, hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] and/or carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging.

When the units are not operating, the steam generators are placed in wet layup conditions to protect against corrosion during storage. Layup water is periodically discharged through the outfall to the Circulating Water Forebay. The layup water contains a maximum concentration of 400 ppm hydrazine [Betz Powerline Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] and/or 40 ppm carbohydrazide (NALCO 1250 plus, or equivalent), and /or 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001). The waste strength of this discharge is reduced through mixing with Outfalls 001, 002, or 003.

During the **Sludge Lancing Process**, demineralized water or secondary water is used to pressure clean the steam generators during outage periods. The water is recirculated through temporary filters to remove entrained solids. The major constituent of the solids is iron oxide from the steam generators. The water is then returned to the steam generators and can be drained to Outfalls 00A, 00B, to Outfall 001, 002, 003, 00D or 00H. The suspended solids are analyzed for radioactivity prior to disposal.

OUTFALL 00C - Plant Heating Boiler

A heating boiler (150,000 lb/hr capacity) operates to supply plant heating and auxiliary steam when Unit 1 and/or Unit 2 are out of service. The boiler is also fired periodically for testing purposes to ensure its availability.

During periods when not in operation, the **heating boiler** may be stored full of treated boiler water containing up to 400 ppm hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] or 40 ppm carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging and or 50 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for corrosion protection. Prior to use, this "wet lay-up" water is drained to Outfall 00C via blowdown, which discharges to the intake forebay. The volume drained is approximately 600 gallons. This boiler may also be occasionally drained for maintenance activities, approximately 6,000 gallons of treated boiler water would be directed to Outfall 00C or 00D/00H for such purposes.

Impurities from the boiler water consisting primarily of insoluble iron and copper are discharged via blowdown (30 GPM) to the intake forebay during operation as needed for Chemistry control. Boiler water treatment additives consist of up to 15 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for pH adjustment, up to 150 ppb hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] and/or 150 ppb carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging and 25 ppm aryl sulfate (from NALCO 22199) for flow testing purposes.

Just after boiler shutdown, the boiler may be placed in dry layup. The boiler contents (up to 6,000 gallons) are drained via blowdown to the intake forebay. Boiler water treatment additives consist of up to 3 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for pH adjustment and up to 150 ppb hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] and/or 150 ppb carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging. The boiler is then dried out and stored empty. This process saves on chemicals and prevents unnecessary discharge of wet layup chemicals.

A smaller boiler may be installed to provide back-up heat if the permanent heating boiler was out of service. This back-up boiler may be located outdoors on the West Side of the turbine building. The blowdown line is directed to the Unit One forebay, near the same discharge point as the permanently installed heating boiler.

The same boiler treatment chemistry will be maintained in the back-up boiler as is used in the permanent heating boiler. The back-up boiler treatment additives consist of ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for pH adjustment, and hydrazine [Betz Powerline Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] and/or carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging. This boiler may be occasionally drained for maintenance activities, approximately 6,000 gallons of treated boiler water would be directed to Outfall 00C for such purposes. Impurities from the boiler water consisting primarily of insoluble iron and copper are discharged via blowdown (30 GPM maximum) to the intake forebay during operation as needed for Chemistry control.

OUTFALL 00G - Reverse Osmosis System

The Reverse Osmosis System (RO) is used to assist in the removal of dissolved solids from the lake water prior to demineralization. Reject water flow is directed to the forebay, which leads to Outfalls 001, 002, and 003. Reject water flow rates may reach up to 0.360 MGD. The RO system must maintain very clean membranes to assure efficient operation and purity of water. Several methods are used to maintain this level of cleanliness from scale and biofouling. Hydrochloric acid or sulfuric acid is fed at approximately 1.3 GPH continually when the RO is in service to lower the pH to reduce the scaling tendencies of the water. The reject water from the RO unit consists of concentrated Lake Michigan water and a small amount of acid that inhibits scale buildup in the membranes.

Approximately once per month, a flush is performed using approximately 1,000 gallons of a nominal 0.05% hydrochloric acid solution. This is followed with approximately 1,000 gallons of a nominal 0.1% sodium hydroxide solution. This flush will dissolve any scale that deposits on the membranes. The total amount of flushing solution will average approximately 5,000 gallons per event. Sodium bisulfite is used to preserve the membranes during long-term shutdown periods. Approximately 15 lbs. of sodium bisulfite per year is used in this manner.

The chemical cleaning involves several steps and may contain citric acid, hydrochloric acid, phosphoric acid, sodium hydroxide, and a neutral pH detergent. The periodic cleaning process averages approximately 10,000 gallons per event, diverted either to the Turbine Room Sump (Outfall 00H/00D), through the

Neutralization Tank to the Turbine Room Sump (Outfall 00H/00D), or to the Circulating Water Forebay (Outfall 001, 002, or 003).

OUTFALL 00H - Turbine Room Sump Emergency Overflow

Utility wastewater from within the plant is discharged via the turbine room sump (TRS) into an on-site absorption pond (Outfall 00D). The normal disposition of these wastewaters is to an on-site absorption pond, which eventually vents via groundwater to Lake Michigan. In the unlikely event that the normal flow path to the absorption pond is not available, the overflow line (Outfall 00H) will direct the TRS flow to the plant's intake forebay. The wastewaters associated with this Outfall include:

Wastes from the makeup water treatment system.

- **NESW**: (144,000 GPD) The main contributor to this waste stream is the degassifier pump seal water. Non-Essential Service Water (NESW) from Lake Michigan supplies the vacuum degassifier pumps which utilize up to 100 GPM to remove non-condensable gases (primarily carbon dioxide and oxygen) from the makeup plant water and exhausts them to the atmosphere.

- **Pre-filter backwash**: (Estimated 98,000 GPD) Six pre-filters are backwashed with Lake Michigan water to remove the suspended matter captured on the filter media. Alum solution (aluminum sulfate 0.5 lb. per gallon) is added to the pre-filter influent as a flocculent. The alum is added via a coagulant feed pump. Approximately 50 lb./day of alum is used in this process. The alum contained in the backwash is discharged in the form of insoluble aluminum hydroxide.

- **Carbon filter backwash**: (Estimated 42,000 GPD) Carbon filters are periodically backwashed with Lake Michigan water to the TRS. These filters primarily remove organics, chlorine and small amounts of iron.

- **Demineralizer regeneration:** (Estimated 50,000 gallons per regeneration) occurs 2-4 times per month when the RO is in service and more often when it is not in service. Dilute sulfuric acid and sodium hydroxide used by the system to regenerate the resin. Dilute sulfuric acid, sodium hydroxide, and contaminates from the demineralization process is discharged to the neutralization tank or TRS. The pH is then adjusted to between 5.5 and 9.0 with sulfuric acid, or sodium hydroxide prior to discharge.

- **MUP Neutralization Tank** provides a place for demineralization regeneration wastes, and Reverse Osmosis Unit cleaning flushes to be neutralized prior to being discharged to the TRS and ultimately the absorption pond. When the MUP resin beds are regenerated, up to 50,000 gallons of regeneration chemicals, and backwash waters are processed in the neutralization tank. The Reverse Osmosis cleaning flushes average approximately 5,000 gallons per event. When the water is neutralized, it is pumped to the TRS via a 2,000 GPM neutralization waste pump.

- The **Retention Tank** is periodically blown down, discharging small volumes of solid material removed by settling. The retention tank contains a mixture of Lake Township water and filtered Lake Michigan water waiting further processing by the Makeup Plant.

- **The Reverse Osmosis System (RO) Cleaning.** Normal reject water flow is to Lake Michigan via Outfall 00G. The RO system must maintain very clean membranes to assure efficient operation and purity of water. Several methods are used to maintain this level of cleanliness from scale and biofouling. Hydrochloric acid or sulfuric acid is fed at approximately 1.3 GPH continually when the RO is in service to lower the pH to reduce the scaling tendencies of the water. The reject water from the RO unit consists of concentrated Lake Michigan water and a small amount of acid that inhibits scale buildup in the membranes.

  Approximately once per month, a flush is performed using approximately 1,000 gallons of a nominal 0.05% hydrochloric acid solution. This is followed with approximately 1,000 gallons of a nominal 0.1% sodium hydroxide solution. This flush will dissolve any scale that deposits on the membranes. The total amount of flushing solution will average approximately 5,000 gallons per event. Sodium bisulfite is used to preserve the membranes during long-term shutdown periods. Approximately 15 lbs. of sodium bisulfite per year is used in this manner.

  The chemical cleaning involves several steps and may contain citric acid, hydrochloric acid, phosphoric acid, sodium hydroxide, and a neutral pH detergent. The periodic cleaning process averages approximately 10,000 gallons per event, diverted either to the Turbine Room Sump (Outfall 00H), through the Neutralization Tank to the Turbine Room Sump (Outfall 00H), or to the Circulating Water Forebay (Outfall 001, 002, or 003).

Waste from miscellaneous processes.

- During periods when not in operation, the **heating boiler** may be stored full of treated boiler water containing at most 400 ppm hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] or 40 ppm carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging and/or 50 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for corrosion protection. Prior to use, this "wet lay-up" water is drained to the TRS. The volume drained is approximately 600 gallons.

- The Circulating Water System cooling water contained in the **condensers** during shutdowns are periodically drained to the TRS. (Six condenser halves and 2 feedpump condensers, approximately 37,000 gallons of lake water per half).

- The **Component Cooling Water system** (CCW) is periodically drained to allow for equipment inspection, maintenance or repair. This system uses demineralized water from the makeup plant as its source of makeup water along with a maximum of: 1200 ppm nitrite [from Calgon LCS 60, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203, or equivalent], 100 ppm gluteraldehyde [from Betz Spectrus NX 1105, Calgon H-300, or equivalent], methyl (bis) thiocyanate (10 ppm) [from Betz 3610 or equivalent], 60 ppm tolyltriazole (from Betz Copper-Trol Cu-1, Calgon LCS-60, or equivalent)), 1000 ppm molybdate from Betz Corrshield MD 4103, and 25 ppm aryl sulfate (from NALCO 22199). The infrequent drainings release approximately 60,000 gallons of treated water to the TRS per year.

- There are four Emergency Diesel Generators that are each cooled by an **Emergency Diesel Generator cooling jacket water system** (DJW), which employs chemical control for corrosion with a maximum of 2000 ppm nitrite [Calgon LCS 60 or Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203 or equivalent], 100 ppm gluteraldehyde [Betz Spectrus NX 1105, Calgon H-300, or equivalent], methyl (bis) thiocyanate (10 ppm) [from Betz 3610 or equivalent], 60 ppm tolyltriazole [Betz Copper-Trol Cu-1, Calgon LCS-60, or equivalent]), 1000 ppm molybdate from Betz Corrshield MD 4103, and 25 ppm aryl sulfate [from NALCO 22199].

  This system is drained through the floor drains to the TRS when maintenance is performed. Each system volume is approximately 1000 gallons. Any system leaks would also be directed to the floor drain during normal operations.

- **Control Room Air Conditioning (CRAC)** drains: Approximately 1440 gallons/yr. of CRAC water is drained to the TRS. CRAC Water is demineralized water, and may contain up to: 2000 ppm nitrite [Calgon LCS 60, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203 or equivalent], 100 ppm gluteraldehyde [Betz Spectrus NX 1105, Calgon H-300, or equivalent], methyl (bis) thiocyanate (10 ppm) [from Betz 3610 or equivalent], 60 ppm tolyltriazole (Calgon LCS-60, Betz Copper-Trol Cu-1, or equivalent)), 1000 ppm molybdate from Betz Corrshield MD 4103, and 25 ppm aryl sulfate (NALCO 22199). The system may be flushed with demineralized water, and when completed, corrosion control chemicals will be added back to the system. No additions of corrosion controlling chemicals are done during the demineralized water flush.

- The **Essential Service Water systems** (ESW) and **Non-Essential Service Water systems** (NESW) are also periodically drained to allow for equipment inspection, maintenance, or repair. These drains may discharge Lake Michigan water used for non-contact cooling into the TRS. This water may be chlorinated for zebra mussel control. During some special treatment periods, this water may contain zebra mussel biocides, used as a molluscicide for zebra mussel control. Periodically, components of the ESW or NESW systems may be chemically cleaned to remove iron deposits using vendor supplied cleaning solution such as EDTA (ethylenediaminetetraacetic acid) or ascorbic acid, acetic acid and ammonia. These wastes could either be drained to the TRS or Lake Michigan via Outfall 001, 002, or 003.

- During wet lay-up, the **steam generators** are stored full of water with up to 400 ppm of hydrazine from Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H or 40 ppm carbohydrazide (NALCO 1250 plus, or equivalent) and 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) are added for corrosion control. The water may also contain up to 20 ppm boron. This water is normally drained to surface water via NPDES Outfalls 00A or 00B, but may be drained to the TRS in some instances. Drain volume will be approximately 32,000 gallons for each of the unit's four steam generators.

- The **Miscellaneous Drain Tanks** can be aligned to discharge to the TRS. As much as 350,000 gallons per day per unit may be directed to the TRS to control the chemistry limitations on the secondary water systems. Water chemistry is primarily the same as in the steam generators. This type of batch drain occurs in concert with condensate flushing activities, or it may occur during normal operation to adjust

91

system chemistry. The overboarded water is normal secondary water. It may contain a mixture of ethanolamine, hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H], or carbohydrazide (NALCO 1250 plus, or equivalent). Maximum flows may approach 240 GPM as makeup plant water supplies can deliver.

- **Condensate flushes** are performed periodically to clean up the plant's secondary system prior to startup, and can be discharged to the TRS. Water containing up to 4 ppm hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H], 10 ppm carbohydrazide (NALCO 1250 plus, or equivalent), 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001), is overboard to the TRS as required to remove contaminants. This flow rate averages 70 GPM, but may reach 600 GPM for short periods of time. The flow rate is dependent on water demands in the plant. Maximum output from the MUP is approximately 600 GPM.

- Around the plant, **miscellaneous sumps** collect an estimated 45,000 GPD of water from various equipment drains (ESW pipe tunnel sump). **Water and condensate leaks from valves and pumps** (Circulating Water condenser pit sumps, ESW pipe tunnel sump, heater drain pump room sump, screen wash pump room sump, acid and caustic room sumps, elevator pit sumps, screenhouse electrical equipment enclosure sump) will also be drained to the TRS. **Steam jet air ejector drains** also are directed to the heater drain pump room sump prior to pumping to the TRS. Betz FerroQuest FQ LP 7200 may be added to this sump to prevent scale buildup.

- **Miscellaneous floor drains** are located throughout the plant to provide a safe working environment by routing spilled or leaked water to the TRS. The major chemical influx into these drains is from general floor cleaning products used to maintain the floors. Also routed to the TRS through the floor drains are fire protection water, chlorinated Lake Township water, drinking water, cooling water (ESW/NESW), and drains from bioboxes used to monitor the zebra mussel control measures and other chemical control monitors. The bioboxes will discharge chlorine and zebra mussel biocides during periods when the Service Water Systems are treated with previously mention biological control agents.

- **Chemical feed tank drains** (drains are limited to emergencies only). There are eight chemical feed tanks that are approximately 200 gallons each that contain hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] at approximately 2%, ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001), at approximately 5%, carbohydrazide (NALCO 1250 plus, or equivalent), approximately 2%. Normal process will be to collect these tank volumes to be reused whenever possible.

- **Chemical cleaning tank drains:** During refueling and maintenance outages, the chemical cleaning tank, and or temporary tanks may be used to mix borax (sodium tetraborate @ approximately 2000 ppm as boron) solutions for ice making operations. Small portions of the system may be drained to the TRS. In the unlikely event that a full tank is drained, approximately 3500 gallons will be directed to the TRS.

- **Non-radiological chemical lab** sink and floor drains are routed to the TRS for disposal. The drains carry water and the wastes generated while performing analyses and preparing laboratory standard including those on the attached list. Also discharged will be glassware cleaning and normal laboratory cleaning wastes. The average volume directed to the TRS is estimated to be 500 -1000 GPD.

- **Secondary sample water** from continuous analyzers are routed to drains which discharge to the TRS and/or the miscellaneous drain tank. The analyzers are on the cycles that may contain as much as 150 ppb hydrazine from either a direct feed or (as a breakdown product of carbohydrazide, and 2.5 ppm ethanolamine. The analyzers measure corrosion transport at an average flow of 1440 gallons per day when in operation.

- **Miscellaneous sealing and cooling water (MSCW)** supplies cooling and sealing water to the TRS pumps, Condensate Booster Pumps, Circulating Water Pumps, Vacuum Priming Pumps, Drain Seal Reservoir Tanks, MSCW pump sealing water, screen wash pumps sealing water, and Drain Sample Coolers. The flow per day may reach approximately 576,000 gallons; this water is filtered and chlorinated Lake Michigan water .

- Non-essential service water supplies approximately 53,000 GPD of non-contact cooling water to various **sample coolers** throughout the plant's turbine building.

- Chemical spills that enter the TRS may be neutralized within the sump to prevent a discharge to the environment. The potential for spills to the TRS exists for the following chemicals with the proposed neutralizers listed:

Chemical	Associated Neutralizer
Sulfuric acid	Sodium hydroxide
Sodium hydroxide	Sulfuric acid
Sodium hypochlorite	Sodium thiosulfate
Hydrazine/Carbohydrazide	NESW (lake water), Hydrogen peroxide, sodium hypochlorite.
Ethanolamine	Sodium Hypochlorite, Hydrogen Peroxide, or ozone.
Ethylene glycol	Hydrogen peroxide

Reduction of hydrazine/carbohydrazide and ETA prior to discharge to the absorption pond may include additions of chemicals such as sodium hypochlorite, hydrogen peroxide, or ozone to the Turbine Room Sump in batches, or to the discharge piping as continuous treatment. A downstream treatment system provided by a vendor may be used to break down the hydrazine/carbohydrazide and ETA.

ADDITIONAL CHEMICAL LAB ANALYSES

Additional Information
General Section
Item 11
Donald C. Cook Nuclear Plant
Groundwater Permit Application

Plant Chemistry Lab (To Outfall 00H/00D)

Laboratory sink drains from the 633' Turbine lab are directed to the 90,000 gallon Turbine Room Sump. The sump contents are normally directed to the groundwater discharge (outfall 00D). Occasionally the Emergency by-pass may be utilized and the sump's contents will be discharged to the surface water discharge (outfall 00H). The following analyses are performed in the lab. Laboratory wastes from the analyses are discarded in the sink.

Parameter	Analysis Method
Nitrite	HACH DR-2000 Method 373, HACH DR 2010 Method 373
Hydrazine	ASTM D-1385 -88
Oil and Grease	EPA-600-4-79-020 Method 413.1
pH	Standard Methods for the examination of Water and Wastewater, ASTM-1293
Total Phosphorus	EPA-600-4-79-020 Method 365.3
Sulfate	EPA-600-4-79-020 Method 375.4
Total Residual Chlorine	EPA-600-4-79-020 Method 330.5
Ethanolamine (ETA)	Betz Standard Operating Procedure. 9Betz proprietary Method adapted from HACH Dr-2000 1,2- Naphthoquinone-4-sulfonic acid Method.
ICP Metals	Standard Methods for Examination of water and wastewater - 17th ed. 1989, 3120B.
Tolyltriazole	HACH DR-2000 Method 730
Carbohydrazide	HACH DR-2000 Method 732 HACH DR-2010 Method 182
N,N Diethylhyroxylamine (DEHA)	HACH DR-2010 Method 182
Silica	ASTM D 859-88

GROUNDWATER DISCHARGES

OUTFALL 00D - Turbine Room Sump

Utility wastewater from within the plant is discharged via the turbine room sump (TRS) into an on-site absorption pond (Outfall 00D). The normal disposition of these wastewaters is to an on-site absorption pond, which eventually vents via groundwater to Lake Michigan. In the unlikely event that the normal flow path to the absorption pond is not available, the overflow line (Outfall 00H) will direct the TRS flow to the plant's intake forebay. The wastewaters associated with this Outfall include:

Wastes from the makeup water treatment system.

- **NESW:** (144,000 GPD) The main contributor to this waste stream is the degassifier pump seal water. Non-Essential Service Water (NESW) from Lake Michigan supplies the vacuum degassifier pumps which utilize up to 100 GPM to remove non-condensable gases (primarily carbon dioxide and oxygen) from the makeup plant water and exhausts them to the atmosphere.

- **Pre-filter backwash:** (Estimated 98,000 GPD) Six pre-filters are backwashed with Lake Michigan water to remove the suspended matter captured on the filter media. Alum solution (aluminum sulfate 0.5 lb. per gallon) is added to the pre-filter influent as a flocculent. The alum is added via a coagulant feed pump. Approximately 50 lb./day of alum is used in this process. The alum contained in the backwash is discharged in the form of insoluble aluminum hydroxide.

- **Carbon filter backwash:** (Estimated 42,000 GPD) Carbon filters are periodically backwashed with Lake Michigan water to the TRS. These filters primarily remove organics, chlorine and small amounts of iron.

- **Demineralizer regeneration:** (Estimated 50,000 gallons per regeneration) occurs 2-4 times per month when the RO is in service and more often when it is not in service. Dilute sulfuric acid and sodium hydroxide used by the system to regenerate the resin. Dilute sulfuric acid, sodium hydroxide, and contaminates from the demineralization process is discharged to the neutralization tank or TRS. The pH is then adjusted to between 5.5 and 9.0 with sulfuric acid, or sodium hydroxide prior to discharge.

- **MUP Neutralization Tank** provides a place for demineralization regeneration wastes, and Reverse Osmosis Unit cleaning flushes to be neutralized prior to being discharged to the TRS and ultimately the absorption pond. When the MUP resin beds are regenerated, up to 50,000 gallons of regeneration chemicals, and backwash waters are processed in the neutralization tank. The Reverse Osmosis cleaning flushes average approximately 5,000 gallons per event. When the water is neutralized, it is pumped to the TRS via a 2,000 GPM neutralization waste pump.

- The **Retention Tank** is periodically blown down, discharging small volumes of solid material removed by settling. The retention tank contains a mixture of Lake Township water and filtered Lake Michigan water waiting further processing by the Makeup Plant.

- **The Reverse Osmosis System (RO) Cleaning.** Normal reject water flow is to Lake Michigan via Outfall 00G. The RO system must maintain very clean membranes to assure efficient operation and purity of water. Several methods are used to maintain this level of cleanliness from scale and biofouling. Hydrochloric acid or sulfuric acid is fed at approximately 1.3 GPH continually when the RO is in service to lower the pH to reduce the scaling tendencies of the water. The reject water from the RO unit consists of concentrated Lake Michigan water and a small amount of acid that inhibits scale buildup in the membranes.

Approximately once per month, a flush is performed using approximately 1,000 gallons of a nominal 0.05% hydrochloric acid solution. This is followed with approximately 1,000 gallons of a nominal 0.1% sodium hydroxide solution. This flush will dissolve any scale that deposits on the membranes. The total amount of flushing solution will average approximately 5,000 gallons per event. Sodium bisulfite is used to preserve the membranes during long-term shutdown periods. Approximately 15 lbs. of sodium bisulfite per year is used in this manner.

The chemical cleaning involves several steps and may contain citric acid, hydrochloric acid, phosphoric acid, sodium hydroxide, and a neutral pH detergent. The periodic cleaning process averages approximately 10,000 gallons per event, diverted either to the Turbine Room Sump (Outfall 00H), through the Neutralization Tank to the Turbine Room Sump (Outfall 00H), or to the Circulating Water Forebay (Outfall 001, 002, or 003).

Waste from miscellaneous processes.

- During periods when not in operation, the **heating boiler** may be stored full of treated boiler water containing at most 400 ppm hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] or 40 ppm carbohydrazide (NALCO 1250 plus, or equivalent) for oxygen scavenging and/or 50 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) for corrosion protection. Prior to use, this "wet lay-up" water is drained to the TRS. The volume drained is approximately 600 gallons.

- The Circulating Water System cooling water contained in the **condensers** during shutdowns are periodically drained to the TRS. (Six condenser halves and 2 feedpump condensers, approximately 37,000 gallons of lake water per half).

- The **Component Cooling Water system** (CCW) is periodically drained to allow for equipment inspection, maintenance or repair. This system uses demineralized water from the makeup plant as its source of makeup water along with a maximum of: 1200 ppm nitrite [from Calgon LCS 60, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203, or equivalent], 100 ppm gluteraldehyde [from Betz Spectrus NX 1105, Calgon H-300, or equivalent], methyl (bis) thiocyanate (10 ppm) [from Betz 3610 or equivalent], 60 ppm tolyltriazole (from Betz Copper-Trol Cu-1, Calgon LCS-60, or equivalent)), 1000 ppm molybdate from Betz Corrshield MD 4103, and 25 ppm aryl sulfate (from NALCO 22199). The infrequent drainings release approximately 60,000 gallons of treated water to the TRS per year.

- There are four Emergency Diesel Generators that are each cooled by an **Emergency Diesel Generator cooling jacket water system** (DJW), which employs chemical control for corrosion with a maximum of 2000 ppm nitrite [Calgon LCS 60 or Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203 or equivalent], 100 ppm gluteraldehyde [Betz Spectrus NX 1105, Calgon H-300, or equivalent], methyl (bis) thiocyanate (10 ppm) [from Betz 3610 or equivalent], 60 ppm tolyltriazole [Betz Copper-Trol Cu-1, Calgon LCS-60, or equivalent]), 1000 ppm molybdate from Betz Corrshield MD 4103, and 25 ppm aryl sulfate [from NALCO 22199].

This system is drained through the floor drains to the TRS when maintenance is performed. Each system volume is approximately 1000 gallons. Any system leaks would also be directed to the floor drain during normal operations.

- **Control Room Air Conditioning (CRAC)** drains: Approximately 1440 gallons/yr. of CRAC water is drained to the TRS. CRAC Water is demineralized water, and may contain up to: 2000 ppm nitrite [Calgon LCS 60, Betz Corrshield NT 4205, BETZ CORRSHIED NT 4201, Betz Corrshield NT 4203 or equivalent], 100 ppm gluteraldehyde [Betz Spectrus NX 1105, Calgon H-300, or equivalent], methyl (bis) thiocyanate (10 ppm) [from Betz 3610 or equivalent], 60 ppm tolyltriazole (Calgon LCS-60, Betz Copper-Trol Cu-1, or equivalent)), 1000 ppm molybdate from Betz Corrshield MD 4103, and 25 ppm aryl sulfate (NALCO 22199). The system may be flushed with demineralized water, and when completed, corrosion control chemicals will be added back to the system. No additions of corrosion controlling chemicals are done during the demineralized water flush.

- The **Essential Service Water systems** (ESW) and **Non-Essential Service Water systems** (NESW) are also periodically drained to allow for equipment inspection, maintenance, or repair. These drains may discharge Lake Michigan water used for non-contact cooling into the TRS. This water may be chlorinated for zebra mussel control. During some special treatment periods, this water may contain zebra mussel biocides, used as a molluscicide for zebra mussel control. Periodically, components of the ESW or NESW systems may be chemically cleaned to remove iron deposits using vendor supplied cleaning solution such as EDTA (ethylenediaminetetraacetic acid) or ascorbic acid, acetic acid and ammonia. These wastes could either be drained to the TRS or Lake Michigan via Outfall 001, 002, or 003.

- During wet lay-up, the **steam generators** are stored full of water with up to 400 ppm of hydrazine from Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H or 40 ppm carbohydrazide (NALCO 1250 plus, or equivalent) and 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001) are added for corrosion control. The water may also contain up to 20 ppm boron. This water is normally drained to surface water via NPDES Outfalls 00A or 00B, but may be drained to the TRS in some instances. Drain volume will be approximately 32,000 gallons for each of the unit's four steam generators.

- The **Miscellaneous Drain Tanks** can be aligned to discharge to the TRS. As much as 350,000 gallons per day per unit may be directed to the TRS to control the chemistry limitations on the secondary water systems. Water chemistry is primarily the same as in the steam generators. This type of batch drain occurs in concert with condensate flushing activities, or it may occur during normal operation to adjust system chemistry. The overboarded water is normal secondary water. It may contain a mixture of ethanolamine, hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H], or carbohydrazide (NALCO 1250 plus, or equivalent). Maximum flows may approach 240 GPM as makeup plant water supplies can deliver.

- **Condensate flushes** are performed periodically to clean up the plant's secondary system prior to startup, and can be discharged to the TRS. Water containing up to 4 ppm hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H], 10 ppm carbohydrazide (NALCO 1250 plus, or equivalent), 100 ppm ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001), is overboard to the TRS as required to remove contaminants. This flow rate averages 70 GPM, but may reach 600 GPM for short periods of time. The flow rate is dependent on water demands in the plant. Maximum output from the MUP is approximately 600 GPM.

- Around the plant, **miscellaneous sumps** collect an estimated 45,000 GPD of water from various equipment drains (ESW pipe tunnel sump). **Water and condensate leaks from valves and pumps** (Circulating Water condenser pit sumps, ESW pipe tunnel sump, heater drain pump room sump, screen wash pump room sump, acid and caustic room sumps, elevator pit sumps, screenhouse electrical equipment enclosure sump) will also be drained to the TRS. **Steam jet air ejector drains** also are directed to the heater drain pump room sump prior to pumping to the TRS. Betz FerroQuest FQ LP 7200 may be added to this sump to prevent scale buildup.

- **Miscellaneous floor drains** are located throughout the plant to provide a safe working environment by routing spilled or leaked water to the TRS. The major chemical influx into these drains is from general floor cleaning products used to maintain the floors. Also routed to the TRS through the floor drains are fire protection water, chlorinated Lake Township water, drinking water, cooling water (ESW/NESW), and drains from bioboxes used to monitor the zebra mussel control measures and other chemical control monitors. The bioboxes will discharge chlorine and zebra mussel biocides during periods when the Service Water Systems are treated with previously mention biological control agents.

- **Chemical feed tank drains** (drains are limited to emergencies only). There are eight chemical feed tanks that are approximately 200 gallons each that contain hydrazine [Betz Cortrol OS5035, Betz Cortrol OS5010, NALCO 19H] at approximately 2%, ethanolamine (Betz Powerline 1440, Betz Powerline 1480, NALCO 92UM001), at approximately 5%, carbohydrazide (NALCO 1250 plus, or equivalent), approximately 2%. Normal process will be to collect these tank volumes to be reused whenever possible.

- **Chemical cleaning tank drains:** During refueling and maintenance outages, the chemical cleaning tank, and or temporary tanks may be used to mix borax (sodium tetraborate @ approximately 2000 ppm as boron) solutions for ice making operations. Small portions of the system may be drained to the TRS. In the unlikely event that a full tank is drained, approximately 3500 gallons will be directed to the TRS.

- **Non-radiological chemical lab** sink and floor drains are routed to the TRS for disposal. The drains carry water and the wastes generated while performing analyses and preparing laboratory standard including those on the attached list. Also discharged will be glassware cleaning and normal laboratory cleaning wastes. The average volume directed to the TRS is estimated to be 500 -1000 GPD.

- **Secondary sample water** from continuous analyzers are routed to drains which discharge to the TRS and/or the miscellaneous drain tank. The analyzers are on the cycles that may contain as much as 150 ppb hydrazine from either a direct feed or (as a breakdown product of carbohydrazide, and 2.5 ppm ethanolamine. The analyzers measure corrosion transport at an average flow of 1440 gallons per day when in operation.

- **Miscellaneous sealing and cooling water (MSCW)** supplies cooling and sealing water to the TRS pumps, Condensate Booster Pumps, Circulating Water Pumps, Vacuum Priming Pumps, Drain Seal Reservoir Tanks, MSCW pump sealing water, screen wash pumps sealing water, and Drain Sample Coolers. The flow per day may reach approximately 576,000 gallons; this water is filtered and chlorinated Lake Michigan water .

- Non-essential service water supplies approximately 53,000 GPD of non-contact cooling water to various sample coolers throughout the plant's turbine building.

- Chemical spills that enter the TRS may be neutralized within the sump to prevent a discharge to the environment. The potential for spills to the TRS exists for the following chemicals with the proposed neutralizers listed:

Chemical	Associated Neutralizer
Sulfuric acid	Sodium hydroxide
Sodium hydroxide	Sulfuric acid
Sodium hypochlorite	Sodium thiosulfate
Hydrazine/carbohydrazide	NESW (lake water), Hydrogen peroxide, sodium hypochlorite.
Ethanolamine	Sodium Hypochlorite, Hydrogen Peroxide, or ozone.
Ethylene glycol	Hydrogen peroxide

Reduction of hydrazine/carbohydrazide and ETA prior to discharge to the absorption pond may include additions of chemicals such as sodium hypochlorite, hydrogen peroxide, or ozone to the Turbine Room Sump in batches, or to the discharge piping as continuous treatment. A downstream treatment system provided by a vendor may be used to break down the hydrazine/carbohydrazide and ETA.

102

ADDITIONAL CHEMICAL LAB ANALYSES

Additional Information
General Information
Item 11
Donald C. Cook Nuclear Plant
Groundwater Discharge Permit Application

Plant Chemistry Lab (To Outfall 00H/00D)

Laboratory sink drains from the 633' Turbine lab are directed to the 90,000 gallon Turbine Room Sump. The sump contents are normally directed to the groundwater discharge (outfall 00D). Occasionally the Emergency by-pass may be utilized and the sump's contents will be discharged to the surface water discharge (outfall 00H). The following analyses are performed in the lab. Laboratory wastes from the analyses are discarded in the sink.

Parameter	Analysis Method
Nitrite	HACH DR-2000 Method 373, HACH DR 2010 Method 373
Hydrazine	ASTM D-1385 -88
Oil and Grease	EPA-600-4-79-020 Method 413.1
pH	Standard Methods for the examination of Water and Wastewater, ASTM-1293
Total Phosphorus	EPA-600-4-79-020 Method 365.3
Sulfate	EPA-600-4-79-020 Method 375.4
Total Residual Chlorine	EPA-600-4-79-020 Method 330.5
Ethanolamine (ETA)	Betz Standard Operating Procedure. 9Betz proprietary Method adapted from HACH Dr-2000 1,2- Naphthoquinone-4-sulfonic acid Method.
ICP Metals	Standard Methods for Examination of water and wastewater - 17th ed. 1989, 3120B.
Tolyltriazole	HACH DR-2000 Method 730
Carbohydrazide	HACH DR-2000 Method 732 HACH DR-2010 Method 182
N,N Diethylhyroxylamine (DEHA)	HACH DR-2010 Method 182
Silica	ASTM D 859-88

OUTFALL 00E – Sanitary Waste Discharges

The system operates at a designed flow of 50,000 GPD with a maximum flow capacity of 60,000 GPD. The Sequencing Batch Reactor (SBR) system treats the wastewater and discharges to an effluent tank where it can be filtered prior to discharge to one of two seepage lagoons. The lagoons discharge into the groundwater with the ultimate disposition venting to Lake Michigan. The sludge removed from the digester tank basins is taken to a local POTW (public owned treatment works) for disposal or dewatered and disposed of as low level radioactive waste.

To aid in the settling process, flocculents such as ferric chloride, pH controllers such as magnesium hydroxide, or polymers (such as Axchem AF4500) are added to the process. To selectively enhance biosolids, bioaugmentation nutrients (such as Bioprime Dosfolat) are added to the process. This is a nutrient that encourages the growth of beneficial microbes in the activated sludge. Sodium hypochlorite is added in small amounts to the process to control filamentous bacteria growth if needed. Sodium hypochlorite and detergent are also added to the sand filters to clean them periodically. These are then backwashed into the equalization basin to be reprocessed by the SBR treatment process.

Plant sanitary waste consists of shower and rest room facilities, and janitor washbasins located throughout the Plant's non-radiological property. Kitchen wastes are generated from the plant cafeteria, the Cook Energy Information Center and Training buildings.

The chemistry training laboratory discharges to the sewage treatment plants through a limestone bed neutralization tank. The chemistry lab is used to train technicians on analyses performed in the plant. The discharge from the lab carries water and wastes generated while performing analyses and preparing laboratory standards including those on the attached list. The training building HVAC system also drains through the limestone bed.

The wastewater treatment plant laboratory discharges to the sewage treatment plants. The discharge from the lab carries water and wastes generated from performing analyses and preparing laboratory standards used for compliance monitoring of the sewage treatment plant under groundwater discharge permit M00988.

Portable toilet wastes on the plant site may be collected and discharged to the sewage treatment plants. A biodegradable deodorant is used in the portable toilets. Sludge effluent waste may also be recycled through the plants to decrease the amount of sludge for processing when possible.

Miscellaneous rinsing of waste receptacles and possible cleaning operations waste, utilizing various detergents, may be rinsed to the sewage treatment plants.

TAB 8

Rule 323.2218
Discharge permits
Part 4 Treatment Codes

Turbine Room Sump Outfall 00D

The Turbine Room Sump (TRS) provides commingling wastes for neutralization and discharge to Outfall 00D. An on-line pH controller and isolation valve ensures that the effluent discharge is within permit limits for pH (B1b). Dilute acid or caustic is added to the wastewater to achieve a pH level required for discharge. The effluent is discharged to an on-site absorption pond, where it percolates into the ground (A-1f). Non contact cooling water, air compressor condensate also discharges to the TRS. Flow measurement, visual observation and sampling is required under the current permit.

- **MUP Neutralization Tank** provides a place for demineralization regeneration wastes, and Reverse Osmosis Unit cleaning flushes to be neutralized prior to being discharged to the TRS and ultimately the absorption pond. When the MUP resin beds are regenerated, up to 50,000 gallons of regeneration chemicals, and backwash waters are processed in the neutralization tank. The Reverse Osmosis cleaning flushes average approximately 5,000 gallons per event. When the water is neutralized, it is pumped to the TRS via a 2,000 GPM neutralization waste pump.
- **Demineralizer regeneration:** (Estimated 50,000 gallons per regeneration) occurs 2-4 times per month when the RO is in service and more often when it is not in service. Dilute sulfuric acid and sodium hydroxide are used by the system to regenerate the resin. Dilute sulfuric acid, sodium hydroxide, and contaminates from the demineralization process are discharged to the neutralization tank or TRS. The pH is then adjusted to between 5.5 and 9.0 with sulfuric acid, or sodium hydroxide prior to discharge.
- Chemical spills that enter the TRS may be neutralized within the sump to prevent a discharge to the environment. The potential for spills to the TRS exists for the following chemicals with the proposed neutralizers listed:

Chemical	Associated Neutralizer
Sulfuric acid	Sodium hydroxide
Sodium hydroxide	Sulfuric acid
Sodium hypochlorite	Sodium thiosulfate
Hydrazine/Carbohydrazide	NESW (lake water), Hydrogen peroxide, sodium hypochlorite.
Ethanolamine	Sodium Hypochlorite, Hydrogen Peroxide, or ozone.
Ethylene glycol	Hydrogen peroxide

Reduction of hydrazine and ETA prior to discharge to the absorption pond may include additions of chemicals such as sodium hypochlorite, hydrogen peroxide, or ozone to the Turbine Room Sump in batches, or to the discharge piping as continuous treatment. A downstream treatment system provided by a vendor may be used to break down the hydrazine and ETA.

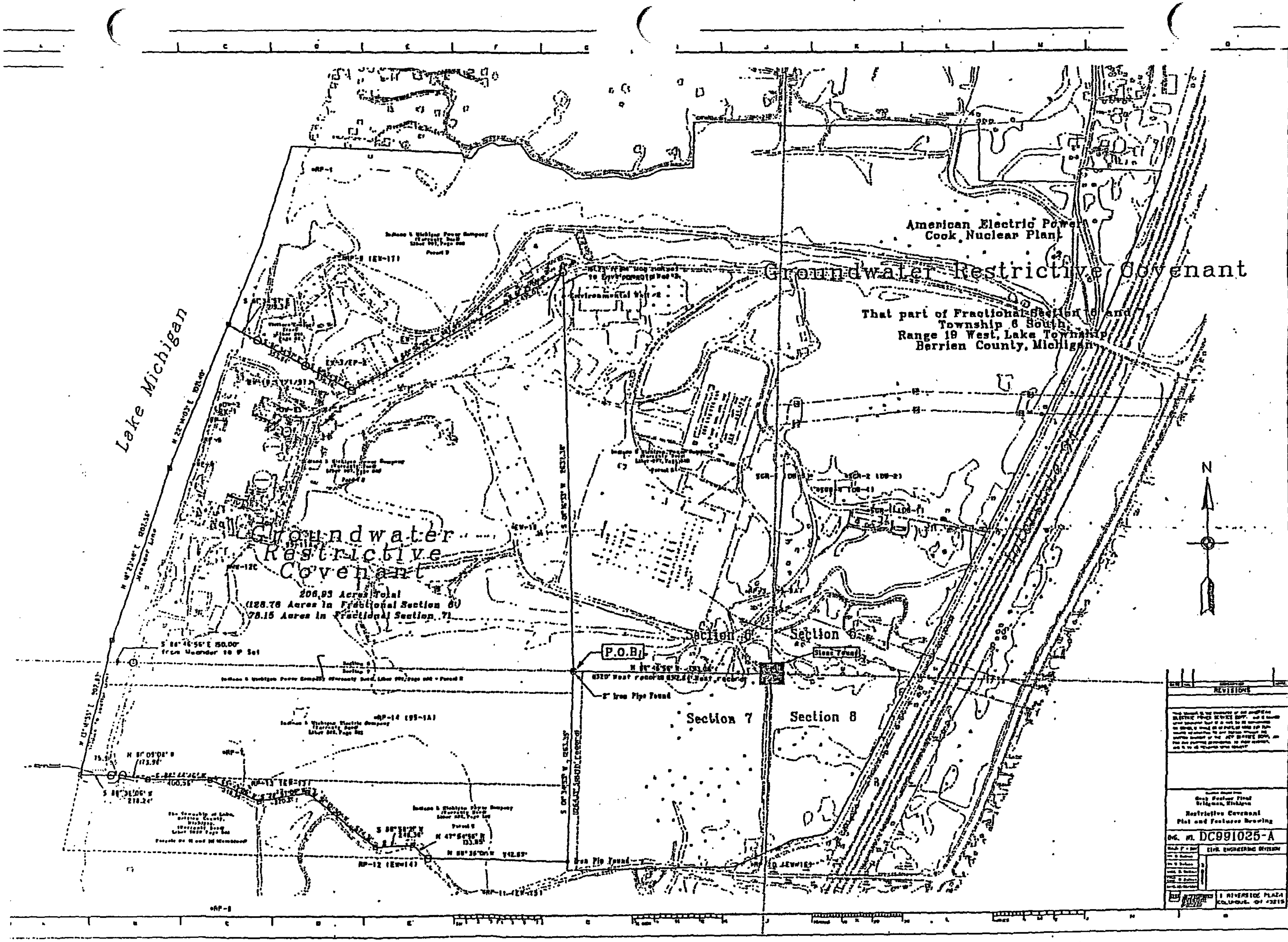
OUTFALL 00E – Sanitary Waste Discharges

The sequencing batch reactor is maintained by licensed operators under contract to Indiana Michigan Power. The contract manager is also a licensed wastewater operator. The system operates at a designed flow of 50,000 GPD with a maximum flow capacity of 60,000 GPD. The Sequencing Batch Reactor (SBR) system treats the wastewater using the activated sludge process (C-3a and C-3b). The treated effluent discharges to an effluent tank where it can be filtered (A-2b) prior to discharge to one of two seepage lagoons (A-1f). The lagoons discharge into the groundwater with the ultimate disposition venting to Lake Michigan. The sludge removed from the digester tank basins is taken to a local POTW (public owned treatment works) for disposal or dewatered and disposed as low level radioactive waste.

To aid in the settling process, flocculents such as ferric chloride, pH controllers such as magnesium hydroxide, or polymers (such as Axchem AF4500) are added to the process. To selectively enhance biosolids, bioaugmentation nutrients (such as Bioprime Dosfolat) are added to the process. This is a nutrient that encourages the growth of beneficial microbes in the activated sludge. Sodium hypochlorite is added in small amounts to the process to control filamentous bacteria growth if needed. Sodium hypochlorite and detergent are also added to the sand filters to clean them periodically. These are then backwashed into the equalization basin to be reprocessed by the SBR treatment process.

Compliance with rule 2222:

These plant discharges meet the requirement of R323.2222.2.ii by complying with the effluent standards of part 2222, groundwater standards of part 2222, or both. A single exception exists for iron concentration in monitoring well EW13 where iron fouling bacteria are naturally present in the groundwater. Plant effluent is in compliance with the groundwater standard for iron, but naturally occurring iron bacteria shows up in one of the monitoring wells. Upgradient monitoring well EW-8 monitoring history shows Mercury levels at 0.0035 ug/l. The remaining monitoring wells are below the 0.0013 ug/l limit. This is not a permit exceedence since there are no limits on upgradient wells.



Lake Michigan
American Electric Power
Cook Nuclear Plant
Groundwater Restrictive Covenant
That part of Fractional Section 6 and
Township 6 South,
Range 19 West, Lake Township
Berrien County, Michigan
Groundwater
Restrictive
Covenant
206.93 Acres Total
(128.78 Acres in Fractional Section 6)
78.15 Acres in Fractional Section 7)
P.O.B.
Section 6
Section 6
Section 7
Section 8
N
REVISIONS
Restrictive Covenant
Plat and Features Drawing
DC991025-A
1 RIVERSIDE PLAZA

TAB 9

History of CNPs Compliance with Effluent and Groundwater Permit Limits and Sampling Frequency.

Cook Nuclear Plant's groundwater discharges are in compliance with the effluent limits established in the Groundwater Permit M00988. There were a few problems dealing with sample contamination in Method 1631 (low level mercury) in the first round of monitoring which resulted in high levels of mercury being detected but these problems did not repeat in subsequent sampling. Iron fouling bacteria has influenced several wells including the background well. However, in general, concentrations of pollutants in the groundwater are far below the effluent limits and there is no indication that the concentrations of pollutants are trending upward. In fact, there are only four parameters that have concentrations near the groundwater effluent limits (iron, mercury, selenium, and silver). The background well EW-8 shows a similar trend for these four parameters, indicating that the natural groundwater has a potential for exceeding the effluent limits and influencing the monitoring wells.

The history of Cook Nuclear Plants groundwater compliance is discussed in greater detail in the following sections:

1. Process Wastewater/Turbine Room Sump Discharge (Outfall 00D)........ 1
2. Sanitary Wastewater (Sequencing Batch Reactor) Discharge (Outfall 00E)........ 2
3. Groundwater Monitoring (Wells EW-1A, EW-12, EW-13, EW-19, and Background Well EW-8)........ 3

The observations made are based on a review of the monitoring data for the years 2002 through 2004. Monitoring data determined to be less than the Method Detection Limit (MDL) were treated as ½ the MDL for statistical calculations. (ref USEPA SW846)

1. Process Wastewater/Turbine Room Sump Discharge (Outfall 00D).

The Turbine Room Sump discharge is regulated by Part I.A.2. of the permit as follows:

Part I.A.2. Process Wastewater, STP, Lagoons and Seepage Beds					
Outfall	Parameter	Limit	Units	Measurement Frequency	Sample Type
00D EF-1 EQ-1	Flow	2,400,000	gpd	Daily	Total
	Sodium (dissolved)		mg/l	Weekly	**
	pH	5.5 to 9.0	SU	Continuous	Grab
	Sulfate	250	mg/l	Weekly	**
	Carbohydrazide/Hydrazine	NA		Weekly	Grab
	Ethanolamine	NA		Weekly	Grab
	Oil	NA		Daily	Visual Observation

** = 24 hour composite samples.

Monitoring data for the Turbine Room Sump Discharge are summarized in Tables 1 & 2.

Flow is typically less than 500,000 gpd with an average of 0.284 MGD.

Sodium in the discharge ranged from 2.3 to 691 mg/l and averaged 23.7 mg/l. The sodium discharge is the result of regenerating ion exchange resins. Both cation and anion resins are regenerated and the spent regeneration solutions neutralize each other in the turbine room sump, or pumped to the neutralization tank where they are neutralized. The treated effluent is controlled by an in line pH monitor that prevents discharges less than pH 6.3, and greater than pH 8.2 values.

As discussed above, the pH of the turbine room sump discharge is dependent upon the regeneration of the ion exchange resins. The cation resin is regenerated with sulfuric acid and the anion resin is

110

regenerated with sodium hydroxide. The pH of the resultant mixture of spent regeneration solutions in the turbine room sump generally ranges from 6.3 to 8.2 S.U. Sulfuric acid and sodium hydroxide to adjust pH prior to pump to TRS or absorption pond.

Sulfate in the discharge ranged from 17 to 840 mg/l and averaged 67 mg/l. As discussed above, the sulfate discharge is the result of regenerating ion exchange resins. The sulfate concentration exceeded 250 mg/l in 8 of 163 observations. 95% of all the observations are below the 250 mg/l effluent limit.

Carbohydrazide is used as a replacement for hydrazine for safe handling reasons. The carbohydrazide converts to Hydrazine, carbon dioxide and nitrogen in the plant's steam cycle. Hydrazine in the effluent ranged from 2 to 18,700 ug/l. The average discharge concentration was 389 ug/l and 90% of all the observations are less than 164 ug/l.

Ethanolamine in the effluent ranged from 0.4 to 81.3 mg/l. The average discharge concentration was 2.9 mg/l and 95% of all the observations are less than 7 mg/l.

There is no indication that the concentrations of pollutants are trending upward at GW well 12.

The TRS is designed with the discharge piping outlets/pumps at the bottom of the tank. This configuration will allow spilled oil to remain in the TRS to be recovered instead of being discharged to the environment. The sump has a working capacity of approximately 82,855 gallons.

The absorption pond receives the effluent from the TRS. A solar powered mixing pump recirculates the pond's contents to ensure proper mixing and additional biological treatment.

2. Sanitary Wastewater (Sequencing Batch Reactor) Discharge (Outfall 00E).

The sanitary wastewater discharge is regulated by Part I.A.2. of the permit as follows:

Part I.A.2. Process Wastewater, STP, Lagoons and Seepage Beds					
00E Effluent EQ-2	Flow	60,000	gpd	Daily	Total
	BOD5	35	mg/l	Weekly	Grab
	TIN (max)	85	mg/l	Weekly	Calculation
	TIN (monthly avg)	50	mg/l	Weekly	Calculation
	Ammonia (N)		mg/l	Weekly	**
	Nitrite (N)		mg/l	Weekly	**
	Nitrate (N)		mg/l	Weekly	**
	Phosphorus, Total	15	mg/l	Weekly	**
	pH	5.5 to 9.0	S.U.	Weekly	Grab
	Total Dissolved Solids		mg/l	Weekly	**

** = 24 hour composite samples.

Monitoring data for the sanitary wastewater discharge are summarized in Tables 3 & 4.

The maximum flow through the sewage treatment plant was 45,680 gpd which is below the design flow of 60,000 gpd.

The sequencing batch reactors reduce the BOD_5 concentration by about 98% (far better than the 85% reduction requirement). The maximum concentration of BOD_5 in the discharge was 13.8 mg/l and the highest monthly average concentration was 6.9 mg/l.

The maximum concentration of Total Inorganic Nitrogen (TIN) was 51.0 mg/l compared to the effluent limit of 85 mg/l. The highest monthly average concentration of TIN was 45.6 mg/l compared to the effluent limit of 50 mg/l. There is no upward trend.

The limitation for ammonia nitrogen is an 85% reduction from the influent level. Based on the maximum amount of ammonia, the percent reduction is 87.3%. Based on the monthly average amount of ammonia, the percent reduction is 95.9%.

Total phosphorus is consistently below the 15 mg/l effluent limit. The maximum concentration of phosphorus in the discharge was 9.3 mg/l and the monthly average concentration was 4.8 mg/l.

pH in the sewage treatment plant ranged from 6.9 to 8.8 S. U. No pH adjustments to the effluent are required.

The maximum concentration of Total Suspended Solids (TSS) in the discharge was 46.0 mg/l and the highest monthly average concentration was 8.6 mg/l. The limitation for TSS is an 85% reduction from the influent level. Based on the maximum amount of TSS, the percent reduction is 92.6%. Based on the monthly average amount of TSS, the percent reduction is 98.1%.

3. Groundwater Monitoring (Wells EW-1A, EW-12, EW-13, EW-19, and Background Well EW-8).

The groundwater is regulated by Part I.B.2. of the permit as follows (limitations are for Wells EW-1A, EW-12, EW-13, EW-19):

PARAMETERS	CONCENTRATION LIMITATIONS	FREQUENCY OF ANALYSIS	SAMPLE TYPE
Static Water Elevation	USGS-F	Quarterly	Measurement
pH	S.U.	Quarterly	Grab
Chloride	250 mg/l	Quarterly	Grab
Specific Conductance	umhos/cm	Quarterly	Grab
Total Inorganic Nitrogen*	5 mg/l	Quarterly	Grab
Ammonia Nitrogen	mg/l	Quarterly	Calculation
Nitrite Nitrogen	mg/l	Quarterly	Grab
Nitrate Nitrogen	mg/l	Quarterly	Grab
Total Phosphorus	1 mg/l	Quarterly	Grab
Sulfate	**	Quarterly	Grab
Dissolved Sodium	**	Quarterly	Grab
Total Dissolved Solids	**	Quarterly	Grab
Total Alkalinity	mg/l	Annually	Grab
Bicarbonate	mg/l	Annually	Grab
Dissolved Aluminum	150 ug/l	Annually	Grab
Dissolved Barium	440 ug/l	Annually	Grab
Dissolved Boron	1900 ug/l	Annually	Grab
Dissolved Cadmium	2.2 ug/l	Annually	Grab
Dissolved Calcium	mg/l	Annually	Grab
Dissolved Chromium	11 ug/l	Annually	Grab
Dissolved Copper	9 ug/l	Annually	Grab
Dissolved Iron	30.0 ug/l	Annually	Grab

112

PARAMETERS	CONCENTRATION LIMITATIONS	FREQUENCY OF ANALYSIS	SAMPLE TYPE
Dissolved Lead	10 ug/l	Annually	Grab
Dissolved Manganese	530 ug/l	Annually	Grab
Dissolved Magnesium	200 mg/l	Annually	Grab
Dissolved Inorganic Mercury	0.0013 ug/l	Annually	Grab
Dissolved Nickel	52 ug/l	Annually	Grab
Dissolved Potassium	mg/l	Annually	Grab
Dissolved Selenium	5 ug/l	Annually	Grab
Dissolved Silver	0.2 ug/l	Annually	Grab
Dissolved Zinc	120 ug/l	Annually	Grab
Total Organic Carbon (TOC)	mg/l	Annually	Grab
Phenols	mg/l	Annually	Grab
Hydrazine	10 ug/l	Quarterly	Grab
Ethanolamine	2 mg/l	Quarterly	Grab

The groundwater monitoring data is summarized in Tables 5 through 9.

In general, the concentration of chemical constituents in the groundwater are far below the groundwater limitations (in many cases by more than one order of magnitude). Therefore, only the exceptions are discussed.

Total Inorganic Nitrogen (TIN)

The maximum TIN concentration at Well EW-1A is 4.87 mg/l compared to the effluent limit of 5.0 mg/l. However, the average maximum concentration is 2.49 mg/l. Well EW-1A is the only well with a high concentration of TIN. The well with the next highest concentration is the background well EW-8. There is no upward trend in the data for any of the wells.

Iron

Wells EW-13 and EW-19 show high concentrations of iron due to iron fouling bacteria. The highest concentration of iron detected in Well EW-13 was 5.79 mg/l. The highest concentration of iron detected in Well EW-19 was 1.73 mg/l. Both Wells EW-13 and EW-19 are off-gradient wells near the extremities of the plant property. Well EW-8, the background well, also shows a high concentration of iron, although much lower than that of Wells EW-13 and EW-19. The maximum concentration of iron at Well EW-8 is 0.11 mg/l. The natural groundwater appeared to have a tendency to support iron fouling bacteria which has a potential influence on the Cook Nuclear Plant monitoring wells.

Mercury

The mercury effluent limit (0.0013 ug/l) was exceeded once at Well EW-1A and once at Well EW-12. Each of these exceedences was during the first sampling event and may have been due to contamination during sampling. Sampling was performed using a new low level mercury procedure, Method 1631. Resampling and subsequent sampling at these wells showed that mercury is in compliance with the mercury groundwater effluent limit. In contrast, all samples taken at the background well EW-8 exceed the groundwater standard.

Selenium

Selenium is generally less that the method detection limit (MDL). However, since the MDL is very close to the groundwater standard, results of the statistical analysis indicate a potential to exceed the standard. However, because selenium is generally less than detectable and there is no upward trend, selenium should not be a concern. Again, the greatest concentrations were found in the background well EW-8.

Silver

Silver was always less that the method detection limit (MDL). Since the MDL is very close to the groundwater standard, results of the statistical analysis indicate a potential to exceed the standard. However, because silver is always less than detectable and there is no upward trend, silver should not be a concern.

Table 1. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Roon Sump Discharge)

Date	Sample Location	EF-1	EQ -1		EQ -1	EQ -1	EQ -1	EQ -1	EQ -1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					7.0	43	<3	<0.7	Sat
					7.6	34	<3	<0.7	Sat
					8.0	38	<3	<0.7	Sat
					9.9	25	206	2.9	Sat
Jan-02		0.289	6.3	8.2	6.7	34	14	1.2	Sat
					6.8	27	14	<0.7	Sat
					7.6	26	9	1.0	Sat
					8.3	35	<3	1.4	Sat
Feb-02		0.284	6.3	8.2	11.0	34	35	2.6	Sat
					9.3	28	<3	0.7	Sat
					7.8	47	<3	<0.7	Sat
					7.6	36	<3	0.9	Sat
Mar-02		0.306	6.3	8.2	5.7	40	15	2.0	Sat
					5.4	44	4	3.1	Sat
					6.2	28	<3	<0.7	Sat
					7.4	23	<3	<0.7	Sat
					6.6	23	<3	<0.7	Sat
Apr-02		0.281	6.3	8.2		38	<3	<0.7	Sat
					6.7				Sat
					5.8	33	8,100	23.6	Sat
					5.1	31	5	1.0	Sat
					210.0	80	<3	<0.7	Sat
May-02		0.369	6.3	8.2	5.3	27	14,040	33.4	Sat
					3.6	23	159	1.6	Sat
					494.0	92	186	1.9	Sat
					4.5	39	35	1.8	Sat
Jun-02		0.391	6.3	8.2	7.1	47	<3	<0.7	Sat
					5.8	38	<3	<0.7	Sat
					5.5	53	<3	<0.7	Sat
					6.1	48	<3	<0.7	Sat
					3.7	35	3	2.2	Sat
Jul-02		0.311	6.3	8.2	3.8	20	4,640	15.1	Sat
					6.5	29	<3	<0.7	Sat
					6.2	49	<3	1.3	Sat
					7.4	57	<3	1.5	Sat
Aug-02		0.291	6.3	8.2	5.7	49	<3	1.2	Sat
					5.8	53	<3	2.3	Sat
					5.1	42	11	3.8	Sat
					5.1	41	22	3.6	Sat
					5.5	52	8	<0.7	Sat
Sep-02		0.288	6.3	8.4			<3	1.8	Sat
					5.8	410	<10	<1	Sat
					6.5	35	14.4	1.14	Sat
					5.7	40	<10	1.31	Sat
					5.8	35	<10	1.22	Sat
						40	<10	<1	Sat
						34			Sat
Oct-02		0.232	6.3	8.2		840			Sat
					6.1	39	<10	<1	Sat
					6.1	35	<10	<1	Sat
					6.9	38	361	3.05	Sat
					193.0	18	<10	<1	Sat
Nov-02		0.278	6.1	8.2	4.5	38			Sat
					4.6	43	445	14.8	Sat
					4.1	840	37.9	2.6	Sat
					5.7	58	48	3.8	Sat

Table 1. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Roon Sump Discharge)

Date	Sample Location	EF-1	EQ -1		EQ -1	EQ -1	EQ -1	EQ -1	EQ -1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					4.7	28	<10	<1	Sat
					6.2	35			Sat
						42			Sat
Dec-02		0.379	2.4	8.2		45.6			Sat
					85.6	53	<3	2.7	Sat
					6.6	48	<3	3.8	Sat
					8.1	250	735	5.0	Sat
					5.3	27	240	2.6	Sat
Jan-03		0.0398	6.3	8.2	3.0				Sat
					5.3	23	<3	2.3	Sat
					3.4	39	20	3.8	Sat
					5.0	76	<3	4.4	Sat
Feb-03		0.388	6.3	8.2	4.7	39	<3	3.7	Sat
					4.9	45	<3	2.4	Sat
					6.8	43	<3	<0.7	Sat
					45.5	129	<3	0.81	Sat
					33.5	62	<3	1.4	Sat
Mar-03		0.2999	6.2	8.9			<3	<0.7	Sat
					6.2	56	<3	0.9	Sat
					7.6	53	<3	2.9	Sat
					5.4	49	<3	3.1	Sat
					6.3	45	146	4.7	Sat
Apr-03		0.288	6.3	8.2	4.3	49			Sat
					4.2	18	<3	<0.7	Sat
					6.6	26	7.5	2.5	Sat
					5.9	31	51.3	1.7	Sat
					3.5	34	<3	81.3	Sat
May-03		0.347	6.3	8.2			18,700		Sat
					5.3	21	<3	<0.7	Sat
					5.5	33	1,930	10.6	Sat
					3.6	18	128	1.1	Sat
Jun-03		0.305	6.3	8.2	4.3	27	6.8	0.8	Sat
					6.5	25	<3	1.2	Sat
					26.8	48	<3	1.3	Sat
					57.2	142	<3	1.0	Sat
					7.0	32	<3	0.8	Sat
Jul-03		0.287	6.3	8.2	7.4	40	<3	<0.7	Sat
					9.8	45	7.9	4.0	Sat
					6.1	59	<3	1.2	Sat
					3.3	23	2,620	4.2	Sat
Aug-03		0.334	6.3	8.2	3.3	31	49.9	<0.7	Sat
					4.4	50	<3	<0.7	Sat
					691.0	72	<3	1.3	Sat
					4.9	54	<3	1.1	Sat
					8.2	270	<3	1.4	Sat
Sep-03		0.28	6.3	8.2	7.0		8.1	<0.7	Sat
					5.6	52	<3	1.2	Sat
					8.2	58	<3	1.7	Sat
					14.8	50	140	1.4	Sat
					5.8	44	<3	1.2	Sat
Oct-03		0.298	6.3	8.2		47			Sat
					20.0	48	630	4.1	Sat
					5.5	46	5	3.0	Sat
					5.5	41	<3	1.4	Sat
Nov-03		0.322	6.3	8.2	3.7	42	107	4.7	Sat
					8.2	262	<3	<0.7	Sat
					6.6	42	<3	2.2	Sat

Table 1. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Roon Sump Discharge)

Date	Sample Location	EF-1	EQ -1		EQ -1	EQ -1	EQ -1	EQ -1	EQ -1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					6.4	52	7	2.1	Sat
					5.6	42	16	3.7	Sat
Dec-03		0.279	6.3	8.2	5.4	48	5	2.6	Sat
					7.2	46	1,233	6.4	Sat
					6.3	41	2,376	11.5	Sat
					8.9	49	8	1.6	Sat
Jan-04		0.2831	6.3	8.2	7.1	54	<3	1.2	Sat
					6.5	340	9	<0.7	Sat
					6.4	46	<3	1.3	Sat
					7.4	47	<3	<0.7	Sat
Feb-04		0.258	6.3	8.2	6.8	66	<3	0.8	Sat
					5.3	47	10	1.3	Sat
					69.9	45	<3	2.8	Sat
					7.0	205	9	2.9	Sat
					5.3	55	<3	1.1	Sat
					6.7	49	<3	1.6	Sat
Mar-04		0.262	6.3	8.2		46			Sat
					3.5	280	85	3.7	Sat
					4.5	39	119	2.2	Sat
					134.0	250	<3	0.8	Sat
					81.9	60	<3	<0.7	Sat
Apr-04		0.321	6.3	8.2	6.8				Sat
					5.6	56	7.2	1.2	Sat
					5.9	55	<3	1.3	Sat
					6.5	39	<3	1.0	Sat
					4.7	54	5.8	1.2	Sat
May-04		0.223	6.3	8.2			12.8	1.6	Sat
					308.0	44	<3	2.74	Sat
					5.2	45	<3	2.62	Sat
					5.1	52	<3	1.19	Sat
					5.8	39	4.3	2.46	Sat
Jun-04			6.3	8.2	4.7	48			Sat
					5.4	38	<3	1.8	Sat
					4.9	43	<3	2.6	Sat
					56.4	48	<3	1.8	Sat
Jul-04		0.243	6.3	8.2	6.1	54	<3	1.4	Sat
					4.6	63	3.8	2.3	Sat
					4.1	52	<3	2.3	Sat
					5.8	59	<3	0.9	Sat
					5.1	48	<3	<0.7	Sat
Aug-04		0.236	6.3	8.2		44	<3	2.5	Sat
					4.7	53	<3	<0.7	Sat
					5.1	50	<3	1.3	Sat
					4.6	48	<3	2.0	Sat
					4.4	56	<3	1.3	Sat
Sep-04		0.229	6.3	8.8	5.0				Sat
					5.4	17	13	1.6	Sat
					3.8	23	3,660	15.1	Sat
					5.4	340	<3	<0.7	Sat
					4.3	20	<3	1.7	Sat
Oct-04		0.233	6.3	8.2			<3	1.4	Sat
					4.4	21	6	1.3	Sat
					3.7	17	60	1.3	Sat
					4.4	28	17	1.8	Sat
					2.3	35	<3	<0.7	Sat
Nov-04		0.269	6.3	8.2	11.9	27	6.5	1.1	Sat
					5.5	47	14	5.5	Sat

117

Table 1. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Roon Sump Discharge)

Date	Sample Location	EF-1	EQ -1		EQ -1	EQ -1	EQ -1	EQ -1	EQ -1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					6.4	46	<3	1.7	Sat
					5.1	34	<3	2.5	Sat
Dec-04		0.224	6.3	8.2	423.0	125	<3	1.6	Sat
	No. Observations				159	163	159	158	Sat
	Minimum			2.4	2.3	17	2	0.4	Sat
	Average	0.284			23.7	67	389	2.9	Sat
	Maximum			8.9	691.0	840	18,700	81.3	Sat
	90th Percentile				16	75	164	4	
Summary	95th Percentile				82.3	250.0	1302.7	7.0	

Table 2. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Room Sump)

Date	Sample Location	EF-1	EQ -1		EQ -1	EQ -1	EQ -1	EQ -1	EQ -1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					7.0	43	2	0.4	Sat
					7.6	34	2	0.4	Sat
					8.0	38	2	0.4	Sat
					9.9	25	206	2.9	Sat
Jan-02		0.289	6.3	8.2	6.7	34	14	1.2	Sat
					6.8	27	14	0.4	Sat
					7.6	26	9	1.0	Sat
					8.3	35	2	1.4	Sat
Feb-02		0.284	6.3	8.2	11.0	34	35	2.6	Sat
					9.3	28	2	0.7	Sat
					7.8	47	2	0.4	Sat
					7.6	36	2	0.9	Sat
Mar-02		0.306	6.3	8.2	5.7	40	15	2.0	Sat
					5.4	44	4	3.1	Sat
					6.2	28	2	0.4	Sat
					7.4	23	2	0.4	Sat
					6.6	23	2	0.4	Sat
Apr-02		0.281	6.3	8.2		38	2	0.4	Sat
					6.7				Sat
					5.8	33	8,100	23.6	Sat
					5.1	31	5	1.0	Sat
					210.0	80	2	0.4	Sat
May-02		0.369	6.3	8.2	5.3	27	14,040	33.4	Sat
					3.6	23	159	1.6	Sat
					494.0	92	186	1.9	Sat
					4.5	39	35	1.8	Sat
Jun-02		0.391	6.3	8.2	7.1	47	2	0.4	Sat
					5.8	38	2	0.4	Sat
					5.5	53	2	0.4	Sat
					6.1	48	2	0.4	Sat
					3.7	35	3	2.2	Sat
Jul-02		0.311	6.3	8.2	3.8	20	4,640	15.1	Sat
					6.5	29	2	0.4	Sat
					6.2	49	2	1.3	Sat
					7.4	57	2	1.5	Sat
Aug-02		0.291	6.3	8.2	5.7	49	2	1.2	Sat
					5.8	53	2	2.3	Sat
					5.1	42	11	3.8	Sat
					5.1	41	22	3.6	Sat
					5.5	52	8	0.4	Sat
Sep-02		0.288	6.3	8.4			2	1.8	Sat
					5.8	410	5	1	Sat
					6.5	35	14.4	1.14	Sat
					5.7	40	5	1.31	Sat
					5.8	35	5	1.22	Sat
						40	5	1	Sat
						34			Sat
Oct-02		0.232	6.3	8.2		840			Sat
					6.1	39	5	1	Sat
					6.1	35	5	1	Sat
					6.9	38	361	3.05	Sat
					193.0	18	5	1	Sat
Nov-02		0.278	6.1	8.2	4.5	38			Sat
					4.6	43	445	14.8	Sat
					4.1	840	37.9	2.6	Sat
					5.7	58	48	3.8	Sat

Table 2. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Room Sump)

Date	Sample Location	EF-1	EQ-1		EQ-1	EQ-1	EQ-1	EQ-1	EQ-1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					4.7	28	5	1	Sat
					6.2	35			Sat
						42			Sat
Dec-02		0.379	2.4	8.2		45.6			Sat
					85.6	53	2	2.7	Sat
					6.6	48	2	3.8	Sat
					8.1	250	735	5.0	Sat
					5.3	27	240	2.6	Sat
Jan-03		0.0398	6.3	8.2	3.0				Sat
					5.3	23	2	2.3	Sat
					3.4	39	20	3.8	Sat
					5.0	76	2	4.4	Sat
Feb-03		0.388	6.3	8.2	4.7	39	2	3.7	Sat
					4.9	45	2	2.4	Sat
					6.8	43	2	0.4	Sat
					45.5	129	2	0.81	Sat
					33.5	62	2	1.4	Sat
Mar-03		0.2999	6.2	8.9			2	0.4	Sat
					6.2	56	2	0.9	Sat
					7.6	53	2	2.9	Sat
					5.4	49	2	3.1	Sat
					6.3	45	146	4.7	Sat
Apr-03		0.288	6.3	8.2	4.3	49			Sat
					4.2	18	2	0.4	Sat
					6.6	26	7.5	2.5	Sat
					5.9	31	51.3	1.7	Sat
					3.5	34	2	81.3	Sat
May-03		0.347	6.3	8.2			18,700		Sat
					5.3	21	2	0.4	Sat
					5.5	33	1,930	10.6	Sat
					3.6	18	128	1.1	Sat
Jun-03		0.305	6.3	8.2	4.3	27	6.8	0.8	Sat
					6.5	25	2	1.2	Sat
					26.8	48	2	1.3	Sat
					57.2	142	2	1.0	Sat
					7.0	32	2	0.8	Sat
Jul-03		0.287	6.3	8.2	7.4	40	2	0.4	Sat
					9.8	45	7.9	4.0	Sat
					6.1	59	2	1.2	Sat
					3.3	23	2,620	4.2	Sat
Aug-03		0.334	6.3	8.2	3.3	31	49.9	0.4	Sat
					4.4	50	2	0.4	Sat
					691.0	72	2	1.3	Sat
					4.9	54	2	1.1	Sat
					8.2	270	2	1.4	Sat
Sep-03		0.28	6.3	8.2	7.0		8.1	0.4	Sat
					5.6	52	2	1.2	Sat
					8.2	58	2	1.7	Sat
					14.8	50	140	1.4	Sat
					5.8	44	2	1.2	Sat
Oct-03		0.298	6.3	8.2		47			Sat
					20.0	48	630	4.1	Sat
					5.5	46	5	3.0	Sat
					5.5	41	2	1.4	Sat
Nov-03		0.322	6.3	8.2	3.7	42	107	4.7	Sat
					8.2	262	2	0.4	Sat
					6.6	42	2	2.2	Sat

120

Table 2. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Room Sump)

Date	Sample Location	EF-1	EQ-1		EQ-1	EQ-1	EQ-1	EQ-1	EQ-1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					6.4	52	7	2.1	Sat
					5.6	42	16	3.7	Sat
Dec-03		0.279	6.3	8.2	5.4	48	5	2.6	Sat
					7.2	46	1,233	6.4	Sat
					6.3	41	2,376	11.5	Sat
					8.9	49	8	1.6	Sat
Jan-04		0.2831	6.3	8.2	7.1	54	2	1.2	Sat
					6.5	340	9	0.4	Sat
					6.4	46	2	1.3	Sat
					7.4	47	2	0.4	Sat
Feb-04		0.258	6.3	8.2	6.8	66	2	0.8	Sat
					5.3	47	10	1.3	Sat
					69.9	45	2	2.8	Sat
					7.0	205	9	2.9	Sat
					5.3	55	2	1.1	Sat
					6.7	49	2	1.6	Sat
Mar-04		0.262	6.3	8.2		46			Sat
					3.5	280	85	3.7	Sat
					4.5	39	119	2.2	Sat
					134.0	250	2	0.8	Sat
					81.9	60	2	0.4	Sat
Apr-04		0.321	6.3	8.2	6.8				Sat
					5.6	56	7.2	1.2	Sat
					5.9	55	2	1.3	Sat
					6.5	39	2	1.0	Sat
					4.7	54	5.8	1.2	Sat
May-04		0.223	6.3	8.2			12.8	1.6	Sat
					308.0	44	2	2.74	Sat
					5.2	45	2	2.62	Sat
					5.1	52	2	1.19	Sat
					5.8	39	4.3	2.46	Sat
Jun-04					4.7	48			Sat
					5.4	38	2	1.8	Sat
					4.9	43	2	2.6	Sat
					56.4	48	2	1.8	Sat
Jul-04		0.243	6.3	8.2	6.1	54	2	1.4	Sat
					4.6	63	3.8	2.3	Sat
					4.1	52	2	2.3	Sat
					5.8	59	2	0.9	Sat
					5.1	48	2	0.4	Sat
Aug-04		0.236	6.3	8.2		44	2	2.5	Sat
					4.7	53	2	0.4	Sat
					5.1	50	2	1.3	Sat
					4.6	48	2	2.0	Sat
					4.4	56	2	1.3	Sat
Sep-04		0.229	6.3	8.8	5.0				Sat
					5.4	17	13	1.6	Sat
					3.8	23	3,660	15.1	Sat
					5.4	340	2	0.4	Sat
					4.3	20	2	1.7	Sat
Oct-04		0.233	6.3	8.2			2	1.4	Sat
					4.4	21	6	1.3	Sat
					3.7	17	60	1.3	Sat
					4.4	28	17	1.8	Sat
					2.3	35	2	0.4	Sat
Nov-04		0.269	6.3	8.2	11.9	27	6.5	1.1	Sat
					5.5	47	14	5.5	Sat

Table 2. Cook Nuclear Plant
Compliance with Effluent Limits (Turbine Room Sump)

Date	Sample Location	EF-1	EQ -1		EQ -1	EQ -1	EQ -1	EQ -1	EQ -1
	PARAMETER	Flow	pH		Dissolved Sodium	Sulfate	Hydrazine	Ethanolamine	Oil Sheen
	LIMITS	2.4	5.5 - 9.0			250 (AVG)			
	UNITS	MGD	Low	High	mg/l	mg/l	ug/l	mg/l	Sat/Unsat
					6.4	46	2	1.7	Sat
					5.1	34	2	2.5	Sat
Dec-04		0.224	6.3	8.2	423.0	125	2	1.6	Sat
	No. Observations				159	163	159	158	Sat
	Minimum		2.4		2.3	17.0	1.5	0.4	Sat
	Average	0.284			23.7	67.0	388.7	2.9	Sat
	Maximum			8.9	691.0	840.0	18,700.0	81.3	Sat
	90th Percentile				16	75	164	4	
Summary	95th Percentile				82.3	250.0	1302.7	7.0	

Tε (ok Nuclear Plant
Compliance with STP Limits

	Maximum						Monthly Average Flow					
Sample Location	EF-2	IQ-2	IQ-2	IQ-2	IQ-2	IQ-2	EF-2	IQ-2	IQ-2	IQ-2	IQ-2	IQ-2
Parameter	Daily Maximum Flow	BOD5	Ammonia(N)	T. Phosphorus	pH	TSS	Monthly Average Flow	BOD5	Ammonia(N)	T. Phosphorus	pH	TSS
Units	gpd	mg/l	mg/l	mg/l	S.U.	mg/l	gpd	mg/l	mg/l	mg/l	S.U.	mg/l
Date												
Jan-02	45,680	294	95.1	22.5	8.2 to 8.8	405	29,328	185	83.1	20.3	NA	164
Feb-02	36,420	611	107.0	12.3	7.2 to 8.6	534	29,921	314	81.3	9.5	NA	271
Mar-02	34,830	339	90.8	16.5	7.9 to 8.5	297	25,866	253	52.6	7.0	NA	175
Apr-02	37,600	350	88.0	10.5	7.7 to 8.6	413	27,449	205	55.1	7.3	NA	222
May-02	40,320	563	117.0	11.8	8.3 to 8.7	562	34,263	406	92.0	11.3	NA	380
Jun-02	27,450	567	83.9	10.3	8.1 to 8.6	456	19,740	443	61.2	7.7	NA	350
Jul-02	33,050	540	78.2	11.3	8.0 to 8.6	410	17,711	324	51.4	9.0	NA	269
Aug-02	26,350	357	139.0	11.3	8.0 to 8.6	381	17,525	288	65.0	9.7	NA	311
Sep-02	22,810	391	66.4	37.5	8.3 to 8.7	332	15,602	297	53.5	14.0	NA	274
Oct-02	25,240	435	67.0	10.3	8.2 to 8.6	341	18,670	268	56.2	7.9	NA	222
Nov-02	28,270	217	93.7	13.5	8.4 to 8.7	277	18,970	188	64.1	9.2	NA	163
Dec-02	28,780	316	88.1	26.3	8.4 to 8.7	365	18,766	275	61.7	12.5	NA	279
Jan-03	27,180	344	83.6	9.5	8.2 to 8.6	492	17,890	279	70.0	7.5	NA	334
Feb-03	38,030	367	97.7	11.0	8.5 to 8.8	369	17,075	280	69.3	8.6	NA	275
Mar-03	20,180	437	80.0	8.0	8.3 to 8.7	358	13,366	382	71.7	7.2	NA	270
Apr-03	28,830	480	83.4	9.8	8.5 to 8.8	529	17,180	444	71.3	8.5	NA	408
May-03	33,990	516	113.0	10.5	8.4 to 8.7	619	27,285	430	103.9	9.5	NA	443
Jun-03	30,730	410	117.0	10.0	8.5 to 8.6	495	19,577	336	75.5	8.8	NA	425
Jul-03	21,900	438	76.7	9.0	8.2 to 8.5	523	14,932	326	66.3	7.6	NA	325
Aug-03	27,600	322	72.3	8.8	8.3 to 8.6	359	17,635	289	68.3	7.9	NA	278
Sep-03	27,810	373	77.3	9.1	8.4 to 8.6	265	16,119	347	63.3	7.8	NA	226
Oct-03	35,370	348	121.0	9.3	8.3 to 8.6	439	20,520	283	96.6	7.3	NA	344
Nov-03	35,690	357	138.0	9.5	8.4 to 8.5	431	24,260	292	111.9	7.8	NA	308
Dec-03	22,290	446	77.4	14.0	8.2 to 8.5	378	14,640	224	66.2	9.4	NA	298
Jan-04	20,510	304	83.1	9.0	8.4 to 8.5	314	14,814	298	68.9	7.1	NA	282
Feb-04	30,860	315	86.9	9.8	8.2 to 8.4	321	17,961	275	71.8	7.8	NA	246
Mar-04	24,290	319	80.4	9.0	8.4 to 8.7	350	16,018	273	68.2	7.9	NA	264
Apr-04	23,090	298	75.2	10.3	8.2 to 8.4	326	16,253	263	69.9	8.7	NA	279
May-04	36,180	295	76.8	8.5	8.2 to 8.6	301	16,255	238	68.0	7.6	NA	250
Jun-04	28,570	281	105.0	11.5	8.2 to 8.5	293	16,143	260	80.6	8.2	NA	240
Jul-04	24,980	328	66.3	13.3	8.2 to 8.6	335	17,445	265	59.9	11.5	NA	261
Aug-04	31,540	427	55.5	13.9	8.3 to 8.5	409	21,973	343	44.3	9.7	NA	314
Sep-04	35,230	410	126.1	9.3	8.2 to 8.8	350	20,854	345	84.6	8.5	NA	237
Oct-04	38,140	344	110.0	11.0	8.1 to 8.5	242	28,493	289	92.4	9.7	NA	217
Nov-04	31,410	273	81.3	9.0	8.4 to 8.7	441	17,973	255	68.8	7.8	NA	282
Dec-04	28,500	319	73.8	45.0	6.9 to 8.8	258	15,525	243	67.8	29.6	NA	202
No. Observations	36	36	36.0	36.0		36	36	36	36.0	36.0		36
Minimum	20,180	217	55.5	8.0	6.9	242	13,366	185	44.3	7.0		163
Average	30,269	381	90.9	13.1		388	19,833	297	71.0	9.7		280
Maximum	45,680	611	139.0	45.0	8.8	619	34,263	444	111.9	29.6		443
90th Percentile	37,815	528	119.0	19.5		526	27,971	394	92.2	12.0		365
95th Percentile	38,685	564	129.1	29.1		541	29,476	433	98.4	15.6		412

123

Maximum

Sample Location	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2
Parameter	BOD5	Total Inorganic Nitrogen, Max	Total Inorganic Nitrogen, Mo. Avg	Ammonia(N)	Nitrite (N)	Nitrate (N)	T. Phosphorus	pH	TSS
Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	S.U.	mg/l
Date									
Jan-02	11.1	51.0	NA	8.2	1.65	46.6	8.8	6.7 to 8.2	46.0
Feb-02	9.9	30.6	NA	11.5	2.88	29.9	9.3	7.2 to 8.3	7.3
Mar-02	7.9	22.0	NA	3.7	5.58	21.5	6.0	6.8 to 7.8	6.8
Apr-02	9.0	28.7	NA	2.8	3.28	27.7	7.6	7.4 to 8.1	3.7
May-02	13.8	26.7	NA	6.5	2.15	21.7	5.9	6.7 to 7.7	8.6
Jun-02	5.8	16.4	NA	0.8	0.25	16.3	1.1	6.9 to 7.8	2.8
Jul-02	7.4	24.7	NA	1.2	1.26	23.5	1.4	7.2 to 7.7	3.0
Aug-02	4.7	16.8	NA	6.9	0.12	16.7	3.5	6.9 to 7.8	4.2
Sep-02	3.4	11.5	NA	0.7	0.08	11.5	6.3	7.3 to 8.0	1.2
Oct-02	2.7	23.2	NA	3.9	0.19	23.2	4.0	7.4 to 8.0	0.8
Nov-02	3.6	26.9	NA	3.3	0.14	26.9	1.5	7.5 to 8.0	2.2
Dec-02	2.1	43.6	NA	0.2	0.01	43.8	1.5	6.8 to 8.0	1.0
Jan-03	6.1	46.3	NA	0.2	0.10	46.3	2.3	7.5 to 8.0	3.6
Feb-03	3.5	48.6	NA	0.5	0.01	48.6	1.1	7.2 to 7.9	2.8
Mar-03	7.9	47.8	NA	2.3	0.06	47.8	0.8	7.0 to 7.7	2.0
Apr-03	6.3	33.0	NA	1.0	0.09	33.0	2.5	7.0 to 8.3	1.7
May-03	11.6	24.3	NA	5.4	0.36	24.3	1.3	7.3 to 7.5	4.8
Jun-03	8.2	29.3	NA	3.1	0.90	26.1	0.8	7.0 to 7.5	7.0
Jul-03	4.4	27.8	NA	2.4	0.41	25.3	1.1	6.9 to 8.0	1.4
Aug-03	5.3	20.4	NA	0.1	0.06	20.4	1.5	7.1 to 7.3	1.0
Sep-03	6.2	12.5	NA	0.1	0.01	12.4	1.4	7.1 to 7.4	0.6
Oct-03	6.6	25.1	NA	2.3	0.31	25.0	1.0	7.1 to 7.6	3.0
Nov-03	4.2	24.3	NA	3.1	0.51	20.6	1.4	7.1 to 7.6	3.8
Dec-03	4.4	46.5	NA	2.4	0.37	46.1	3.6	6.9 to 7.3	2.1
Jan-04	3.1	46.8	NA	2.0	0.68	46.7	1.5	7.2 to 7.4	3.6
Feb-04	3.0	21.4	NA	2.3	0.31	20.1	2.8	7.0 to 7.4	2.4
Mar-04	3.1	33.4	NA	3.1	0.62	30.9	1.1	7.1 to 7.5	7.6
Apr-04	3.6	8.7	NA	7.0	0.40	7.3	0.9	7.2 to 7.3	2.8
May-04	3.6	9.3	NA	3.5	0.20	5.6	1.6	7.1 to 7.8	3.4
Jun-04	3.1	17.2	NA	2.1	0.20	14.8	2.3	7.0 to 7.4	4.2
Jul-04	3.0	22.1	NA	4.1	0.60	21.2	1.5	6.8 to 7.2	3.2
Aug-04	3.1	15.1	NA	2.2	0.60	14.9	2.4	7.0 to 7.3	4.0
Sep-04	5.6	25.1	NA	8.6	0.80	26.6	1.4	7.1 to 7.5	2.8
Oct-04	6.3	17.9	NA	5.6	0.66	12.4	1.9	6.9 to 7.1	3.7
Nov-04	3.3	41.2	NA	17.6	0.48	23.4	3.8	7.1 to 7.6	3.8
Dec-04	4.5	43.0	NA	0.1	0.01	43.0	8.3	6.4 to 8.1	2.3
No. Observations	36	36		36	36	36	36		36
Minimum	2.1	8.7		0.1	0.01	5.6	0.8	6.4	0.6
Average	5.7	28.1		3.6	0.74	26.5	2.9		4.6
Maximum	13.8	51.0		17.6	5.58	48.6	9.3	8.3	46.0
90th Percentile	9.5	47.3		7.6	2.00	46.7	7.0		7.2
95th Percentile	11.2	48.4		9.3	2.98	47.9	8.4		7.9

Monthly Average Flow

Sample Location	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2	EQ-2
Parameter	BOD5	Total Inorganic Nitrogen, Max	Total Inorganic Nitrogen, Mo. Avg	Ammonia(N)	Nitrite (N)	Nitrate (N)	T. Phosphorus	pH	TSS
Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	S.U.	mg/l
Date									
Jan-02	5.7	NA	30.5	3.0	0.59	27.7	3.2	NA	6.6
Feb-02	6.9	NA	20.8	2.4	1.35	19.7	3.4	NA	4.2
Mar-02	5.3	NA	19.9	1.3	1.69	19.5	2.2	NA	1.6
Apr-02	4.8	NA	16.6	0.8	1.42	15.6	1.6	NA	1.3
May-02	6.7	NA	22.6	3.1	0.92	18.4	3.3	NA	2.9
Jun-02	3.7	NA	8.0	0.2	0.08	7.8	0.7	NA	1.5
Jul-02	4.6	NA	15.2	0.4	0.20	14.5	0.7	NA	1.3
Aug-02	2.9	NA	11.7	0.8	0.03	9.8	1.2	NA	1.2
Sep-02	2.3	NA	8.9	0.1	0.02	8.9	1.8	NA	0.6
Oct-02	1.7	NA	18.1	0.5	0.03	17.7	1.5	NA	0.3
Nov-02	2.4	NA	17.8	1.0	0.04	16.4	1.1	NA	0.9
Dec-02	1.7	NA	28.3	0.1	0.01	28.2	1.1	NA	0.6
Jan-03	2.8	NA	41.8	0.1	0.04	41.7	0.9	NA	1.8
Feb-03	2.3	NA	45.6	0.1	0.01	45.6	0.1	NA	1.2
Mar-03	3.9	NA	40.6	0.3	0.02	40.0	0.5	NA	1.1
Apr-03	3.8	NA	20.2	0.3	0.03	19.9	1.0	NA	1.0
May-03	6.6	NA	15.9	2.7	0.21	13.9	0.8	NA	2.0
Jun-03	5.1	NA	21.6	1.4	0.36	19.5	0.6	NA	3.0
Jul-03	3.2	NA	21.3	0.64	0.10	20.7	0.8	NA	0.9
Aug-03	4.1	NA	14.5	0.05	0.03	14.5	1.1	NA	0.7
Sep-03	4.7	NA	9.6	0.03	0.01	9.6	1.0	NA	0.3
Oct-03	3.0	NA	16.2	1.00	0.15	15.0	0.7	NA	1.6
Nov-03	2.9	NA	16.8	1.80	0.30	14.6	1.0	NA	1.4
Dec-03	3.0	NA	35.7	1.60	0.17	34.0	1.8	NA	0.6
Jan-04	2.9	NA	39.0	1.00	0.26	37.8	1.2	NA	1.7
Feb-04	2.2	NA	17.4	1.50	0.19	15.7	2.2	NA	1.5
Mar-04	2.5	NA	26.3	1.50	0.27	24.5	0.9	NA	2.8
Apr-04	2.8	NA	6.6	3.00	0.20	3.4	0.7	NA	1.8
May-04	3.2	NA	6.1	3.00	0.10	3.0	1.2	NA	2.1
Jun-04	3.0	NA	11.8	1.60	0.20	10.0	1.4	NA	2.3
Jul-04	2.4	NA	13.8	2.40	0.40	11.0	0.9	NA	2.3
Aug-04	2.3	NA	9.2	1.10	0.30	7.8	1.4	NA	2.3
Sep-04	2.5	NA	16.3	3.50	0.40	15.1	1.0	NA	2.1
Oct-04	2.5	NA	11.9	4.60	0.40	7.0	1.5	NA	2.2
Nov-04	2.9	NA	24.7	4.40	0.25	18.9	1.7	NA	1.8
Dec-04	2.9	NA	36.0	0.10	0.01	35.9	4.8	NA	1.4
No. Observations	36		36	36	36	36	36		36
Minimum	1.7		6.1	0.03	0.01	3.0	0.1		0.3
Average	3.5		20.5	1.43	0.30	19.0	1.4		1.8
Maximum	6.9		45.6	4.60	1.69	45.6	4.8		8.6
90th Percentile	5.5		37.5	3.05	0.76	36.9	2.7		2.9
95th Percentile	6.6		40.9	3.73	1.37	40.4	3.3		3.3

Table 5. Cook Nuclear Plant
Compliance with Groundwater Limits Well 1A

Date	Static Water Elevation	pH	Chloride	Specific Conductance	Total Inorganic Nitrogen*	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Phosphorus	Sulfate	Dissolved Sodium	Total Dissolved Solids	Total Alkalinity	Bicarbonate	Dissolved Aluminum	Dissolved Barium	Dissolved Boron	Dissolved Cadmium
	Feet*	S.U	mg/l	umhos/cm	mg/l	mg/l	mg/l	mg/l	mg/l				mg/l	mg/l	ug/l	ug/l	ug/l	ug/l
			250		5.00				1.00						150	440	1900	2.2
Jan-02	604.51	7.1	10	467	1.70	<0.01	0.24	1.46	0.01	134	47.0	285						
Apr-02	604.95	7.0	12	474	2.94	<0.01	0.05	2.89	<0.01	121	56.2	289						
Jul-02	606.14	7.2	12	399	3.19	0.40	0.02	2.77	<0.01	91	37.3	218	79	79	<50	10	50	<0.5
Aug-02																		
Oct-02	604.67	7.0	11	450	0.39	0.06	0.03	0.30	0.06	136	43.9	267						
Jan-03	604.84	6.6	16	448	1.11	0.07	0.15	0.89	<0.01	110	30.8	255						
Apr-03	604.14	6.9	4	512	3.76	0.40	0.02	3.34	<0.01	141	62.2	288						
Jul-03	604.37	6.6	16	385	2.38	0.32	0.01	2.05	<0.01	86	33.2	279	78	78	<50	16	40	<0.5
Oct-03	603.64	6.5	4	231	1.05	0.52	<0.01	0.53	0.14	30	16.5	131						
Jan-04	603.14	6.5	8	566	2.48	0.70	<0.01	1.78	<0.01	158	47.4	322						
Apr-04	604.54	7.3	8	436	3.45	0.19	<0.01	3.26	<0.01	114	39.6	274						
Jul-04	603.89	6.8	11	452	4.87	<0.01	0.04	4.83	<0.01	96	40.5	327	78	78	<50	17	<40	<0.5
Oct-04	603.13	6.8	11	546	2.61	0.06	0.04	2.51	<0.01	137	57.4	287						
No. Observations		12	12	12	12	9	9	12	3	12	12	12	3	3	0	3	2	0
Minimum		6.5	4	231	0.39	0.06	0.01	0.30	0.01	30	16.5	131.0	78	78	0.0	10	40	0.0
Average		6.9	10	447	2.49	0.30	0.07	2.22	0.07	113	42.7	268.5	78	78	#DIV/0!	14	45	#DIV/0!
Maximum		7.3	16	566	4.87	0.70	0.24	4.83	0.14	158	62.2	327.0	79	79	0.0	17	50	0.0
90th Percentile		7.2	16	543	3.73	0.56	0.17	3.33	0.12	141	57.3	318.7	79	79	#NUM!	17	49	#NUM!
95th Percentile		7.2	16	555	4.26	0.63	0.20	4.01	0.13	149	59.6	324.3	79	79	#NUM!	17	50	#NUM!

Date	Dissolved Calcium	Dissolved Chromium	Dissolved Copper	Dissolved Iron	Dissolved Lead	Dissolved Manganese	Dissolved Magnesium	Dissolved Inorganic Mercury	Dissolved Nickel	Dissolved Potassium	Dissolved Selenium	Dissolved Silver	Dissolved Zinc	Total Organic Carbon (TOC)	Phenols	Hydrazine	Ethanolamine	Fluoride
	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l	ug/l	mg/l	mg/l
		11	9	30	10	530	200	0.0013	52		5	0.2	120			10	2	NA
Jan-02																<3	<0.7	
Apr-02																<3	<0.7	0.3
Jul-02	27.8	<2	<1	<10	3	<5	10.2	0.0081	<2	1.2	4	<0.2	<4	3	0.001	<3	<0.7	
Aug-02								0.0012										
Oct-02																<3	<0.7	<0.1
Jan-03																<3	<0.7	
Apr-03																<3	<0.7	
Jul-03	28.2	<2	<1	<10	<1	10	9.9	<0.0005	<2	1.5	<1	<0.2	<4	2	<0.001	<3	<0.7	
Oct-03																<3	<0.7	
Jan-04																<3	<0.7	
Apr-04																<3	<0.7	
Jul-04	32.3	<2	<1	<10	<1	<10	12.6	<0.0005	<2	0.7	<5	<0.2	<4	1	<0.001	<3	<0.7	
Oct-04																<3	<0.7	
No. Observations	3	0	0	0	1	1	3	2	0	3	1	0	0	3	1	0	0	1
Minimum	27.8	0.0	0.0	0.0	3	10	9.9	0.0012	0.0	0.7	4.0	0.0	0.0	1.0	0.0	0.0	0.0	0.3
Average	29.4	#DIV/0!	#DIV/0!	#DIV/0!	3	10	10.9	0.0047	#DIV/0!	1.1	4.0	#DIV/0!	#DIV/0!	2.0	0.0	#DIV/0!	#DIV/0!	0.3
Maximum	32.3	0.0	0.0	0.0	3	10	12.6	0.0081	0.0	1.5	4.0	0.0	0.0	3.0	0.0	0.0	0.0	0.3
90th Percentile	31.5	#NUM!	#NUM!	#NUM!	3	10	12.1	0.0074	#NUM!	1.4	4.0	#NUM!	#NUM!	2.8	0.0	#NUM!	#NUM!	0.3
95th Percentile	31.9	#NUM!	#NUM!	#NUM!	3	10	12.4	0.0078	#NUM!	1.5	4.0	#NUM!	#NUM!	2.9	0.0	#NUM!	#NUM!	0.3

	Static Water Elevation	pH	Chloride	Specific Conductance	Total Inorganic Nitrogen*	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Phosphorus	Sulfate	Dissolved Sodium	Total Dissolved Solids	Total Alkalinity	Bicarbonate	Dissolved Aluminum	Dissolved Barium	Dissolved Boron	Dissolved Cadmium
No. Observations		12.0	12	12	12.00	12.00	12.00	12.00	12.00	12	12.0	12	3	3	3	3	3	3
Minimum		6.5	4	231	0.39	0.01	0.01	0.30	0.01	30	16.5	131	78	78	25	10	20	0.25
Average		6.86	10.25	447.17	2.49	0.23	0.05	2.22	0.02	112.83	42.67	268.50	78.33	78.33	25.00	14.33	36.67	0.25
Maximum		7.3	16	566	4.87	0.70	0.24	4.83	0.14	158	62.2	327	79	79	25	17	50	0.25
90th Percentile		7.2	15.6	542.6	3.73	0.51	0.14	3.33	0.06	140.6	57.3	318.7	78.8	78.8	25	16.8	48	0.25
95th Percentile		7.2	16	555	4.26	0.60	0.19	4.01	0.10	148.65	59.6	324.25	78.9	78.9	25	16.9	49	0.25

	Dissolved Calcium	Dissolved Chromium	Dissolved Copper	Dissolved Iron	Dissolved Lead	Dissolved Manganese	Dissolved Magnesium	Dissolved Inorganic Mercury	Dissolved Nickel	Dissolved Potassium	Dissolved Selenium	Dissolved Silver	Dissolved Zinc	Total Organic Carbon (TOC)	Phenols	Hydrazine	Ethanolamine	Fluoride
No. Observations	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	12	12	2
Minimum	27.8	1	0.5	5	0.5	2.5	9.8	0.00025	1	0.7	0.5	0.1	2	1	0.0005	1.5	0.35	0.05
Average	29.43	1.00	0.50	5.00	1.33	5.83	10.90	0.00	1.00	1.13	2.33	0.10	2.00	2.00	0.00	1.50	0.35	0.18
Maximum	32.3	1	0.5	5	3	10	12.6	0.0081	1	1.5	4	0.1	2	3	0.001	1.5	0.35	0.3
90th Percentile	31.48	1	0.5	5	2.5	9	12.12	0.00603	1	1.44	3.7	0.1	2	2.8	0.0009	1.5	0.35	0.275
95th Percentile	31.89	1	0.5	5	2.75	9.5	12.36	0.007065	1	1.47	3.85	0.1	2	2.9	0.00095	1.5	0.35	0.2875

Table 6. Cook Nuclear Plant
Compliance with Groundwater Limits Well 12

Date	Static Water Elevation Feet	pH S.U.	Chloride mg/l	Specific Conductance umhos/cm	Total Inorganic Nitrogen* mg/l	Ammonia Nitrogen mg/l	Nitrite Nitrogen mg/l	Nitrate Nitrogen mg/l	Total Phosphorus mg/l	Sulfate	Dissolved Sodium	Total Dissolved Solids	Total Alkalinity mg/l	Bicarbonate mg/l	Dissolved Aluminum ug/l	Dissolved Barium ug/l
			250		5.00				1.00						150	440
Jan-02	592.26	7.4	12	376	0.25	0.25	<0.01	<0.01	0.08	67	31.6	214				
Apr-02	592.75	7.4	10	508	0.27	0.27	<0.01	<0.01	<0.01	128	37.0	264				
Jul-02	593.26	8.0	13	545	0.26	0.26	<0.01	<0.01	0.01	146	55.3	324	109	108	<50	15
Aug-02																
Oct-02	592.69	8.0	11	591	0.28	0.28	<0.01	<0.01	0.08	156	60.9	352				
Jan-03	592.30	8.0	16	520	0.27	0.27	<0.01	<0.01	0.03	134	58.1	315				
Apr-03	592.44	7.8	10	543	0.26	0.25	0.01	<0.01	<0.01	137	56.7	285				
Jul-03	592.91	7.8	12	490	0.30	0.23	<0.01	0.07	<0.01	120	53.0	351	108	108	<50	15
Oct-03	592.35	7.2	4	465	0.28	0.24	<0.01	0.04	0.10	114	41.8	289				
Jan-04	592.37	7.4	10	550	0.23	0.23	<0.01	<0.01	0.03	119	46.5	301				
Apr-04	592.38	7.4	8	520	0.24	0.24	<0.01	<0.01	0.03	141	47.8	320				
Jul-04	592.65	7.9	7	468	0.24	0.20	<0.01	0.04	0.03	115	51.7	309	105	104	<50	15
Oct-04	592.23	7.6	9	460	0.21	0.18	<0.01	0.03	0.01	95	43.2	238				
No. Observations		12	12	12	12	12	12	12	12	12	12	12	3	3	0	3
Minimum		7.2	4.0	376.0	0.2	0.2	0.0	0.0	0.0	67.0	31.6	214.0	105.0	104.0	0.0	15.0
Average		7.7	10.2	503.0	0.3	0.2	0.0	0.0	0.0	122.7	48.6	296.8	107.3	106.7	#DIV/0!	15.0
Maximum		8.0	16.0	591.0	0.3	0.3	0.0	0.1	0.1	156.0	60.9	352.0	109.0	108.0	0.0	15.0
90th Percentile		8.0	12.9	549.5	0.3	0.3	0.0	0.1	0.1	145.5	58.0	348.3	108.8	108.0	#NUM!	15.0
95th Percentile		8.0	14.4	568.5	0.3	0.3	0.0	0.1	0.1	150.5	59.4	351.5	108.9	108.0	#NUM!	15.0

Date	Dissolved Boron ug/l	Dissolved Cadmium ug/l	Dissolved Calcium mg/l	Dissolved Chromium ug/l	Dissolved Copper ug/l	Dissolved Iron ug/l	Dissolved Lead ug/l	Dissolved Manganese ug/l	Dissolved Magnesium mg/l	Dissolved Inorganic Mercury ug/l	Dissolved Nickel ug/l	Dissolved Potassium, mg/l	Dissolved Selenium ug/l	Dissolved Silver ug/l	Dissolved Zinc ug/l	Total Organic Carbon (TOC) mg/l	Phenols mg/l	Hydrazine ug/l	Ethanolamine mg/l	Fluoride mg/l
	1900	2.2		11	9	30	10	530	200	0.0013	52		5	0.2	120			10	2	NA
Jan-02																		<3	<0.7	
Apr-02																		<3	<0.7	0.1
Jul-02	90	<0.5	39.9	<2	<1	280	2	96	12.6	0.0136	<2	1.1	2	<0.2	<4	3	<0.001	<3	<0.7	
Aug-02										0.0006										
Oct-02																		<3	<0.7	<0.1
Jan-03																		<3	<0.7	
Apr-03																		<3	<0.7	
Jul-03	70	<0.5	33.4	<2	<1	260	1	83	10.7	<0.0005	<2	1	<1	<0.2	<4	2	<0.001	<3	<0.7	
Oct-03																		<3	<0.7	
Jan-04																		<3	<0.7	
Apr-04																		<3	<0.7	
Jul-04	70	<0.5	32	<2	<1	260	<1	80	9.8	<0.0005	<2	0.9	<5	<0.2	<4	2	<0.001	<3	<0.7	
Oct-04																		<3	<0.7	
No. Observations	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2
Minimum	70.0	0.0	32.0	0.0	0.0	260.0	1.0	80.0	9.8	0.0	0.0	0.9	2.0	0.0	0.0	2.0	0.0	0.0	0.0	0.1
Average	76.7	#DIV/0!	35.1	#DIV/0!	#DIV/0!	266.7	1.5	86.3	11.0	0.0	#DIV/0!	1.0	2.0	#DIV/0!	#DIV/0!	2.3	#DIV/0!	#DIV/0!	#DIV/0!	0.1
Maximum	90.0	0.0	39.9	0.0	0.0	280.0	2.0	96.0	12.6	0.0	0.0	1.1	2.0	0.0	0.0	3.0	0.0	0.0	0.0	0.1
90th Percentile	86.0	#NUM!	38.6	#NUM!	#NUM!	276.0	1.9	93.4	12.2	0.0	#NUM!	1.1	2.0	#NUM!	#NUM!	2.8	#NUM!	#NUM!	#NUM!	0.1
95th Percentile	88.0	#NUM!	39.3	#NUM!	#NUM!	278.0	2.0	94.7	12.4	0.0	#NUM!	1.1	2.0	#NUM!	#NUM!	2.9	#NUM!	#NUM!	#NUM!	0.1

	Static Water Elevation	pH	Chloride	Specific Conductance	Total Inorganic Nitrogen*	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Phosphorus	Sulfate	Dissolved Sodium	Total Dissolved Solids	Total Alkalinity	Bicarbonate	Dissolved Aluminum	Dissolved Barium
No. Observations		12.0	12	12	12.00	12.00	12.00	12.00	12.00	12	12.0	12	3	3	3	3
Minimum		7.2	4	376	0.21	0.18	0.01	0.01	0.01	67	31.6	214	105	104	25	15
Average		7.66	10.17	503.00	0.26	0.24	0.01	0.02	0.03	122.67	48.63	296.83	107.33	106.67	25.00	15.00
Maximum		8.0	16	591	0.30	0.28	0.01	0.07	0.10	156	60.9	352	109	108	25	15
90th Percentile		8.0	12.9	549.5	0.28	0.27	0.01	0.04	0.08	145.5	58.0	348.3	108.8	108	25	15
95th Percentile		8.0	14.35	568.45	0.29	0.27	0.01	0.05	0.09	150.5	59.4	351.45	108.9	108	25	15

	Dissolved Boron	Dissolved Cadmium	Dissolved Calcium	Dissolved Chromium	Dissolved Copper	Dissolved Iron	Dissolved Lead	Dissolved Manganese	Dissolved Magnesium	Dissolved Inorganic Mercury	Dissolved Nickel	Dissolved Potassium,	Dissolved Selenium	Dissolved Silver	Dissolved Zinc	Total Organic Carbon (TOC)	Phenols	Hydrazine	Ethanolamine	Fluoride
No. Observations	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	12	12	2
Minimum	70	0.25	32	1	0.5	260	0.5	80	9.8	0.00025	1	0.9	0.5	0.1	2	2	0.0005	1.5	0.35	0.05
Average	76.67	0.25	35.10	1.00	0.50	266.67	1.17	86.33	11.03	0.00	1.00	1.00	1.67	0.10	2.00	2.33	0.00	1.50	0.35	0.08
Maximum	90	0.25	39.8	1	0.5	280	2	96	12.6	0.0136	1	1.1	2.5	0.1	2	3	0.0005	1.5	0.35	0.1
90th Percentile	86	0.25	38.6	1	0.5	276	1.8	93.4	12.22	0.0097	1	1.08	2.4	0.1	2	2.8	0.0005	1.5	0.35	0.095
95th Percentile	88	0.25	39.25	1	0.5	278	1.9	94.7	12.41	0.01165	1	1.09	2.45	0.1	2	2.9	0.0005	1.5	0.35	0.0975

Table 7. Cook Nuclear Plant
Compliance with Groundwater Limits Well 13

Date	Static Water Elevation	pH	Chloride	Specific Conductance	Total Inorganic Nitrogen*	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Phosphorus	Sulfate	Dissolved Sodium	Total Dissolved Solids
	Feet	S.U.	mg/l	umhos/cm	mg/l	mg/l	mg/l	mg/l	mg/l			
			250		5.00				1.00			
Jan-02	598.75	7.2	58	600	0.21	0.21	<0.01	<0.01	0.01	35	29.8	348
Apr-02	600.35	6.9	41	558	0.18	0.18	<0.01	<0.01	<0.01	26	25.4	309
Jul-02	599.76	6.9	52	599	0.23	0.23	<0.01	<0.01	<0.01	36	31.4	337
Aug-02												
Oct-02	598.80	7.0	81	734	0.25	0.25	<0.01	<0.01	0.03	44	37.7	398
Jan-03	598.30	7.2	45	601	0.20	0.20	<0.01	<0.01	<0.01	55	34.0	343
Apr-03	598.47	6.6	52	665	0.19	0.19	<0.01	<0.01	<0.01	51	33.2	399
Jul-03	599.10	6.9	57	646	0.33	0.24	<0.01	0.09	<0.01	128	42.8	366
Oct-03	598.25	6.7	85	693	0.30	0.25	<0.01	0.05	0.04	47	34.7	406
Jan-04	598.23	7.1	66	695	0.22	0.22	<0.01	<0.01	<0.01	43	39.9	371
Jan-04												
Apr-04	598.60	7.1	51	598	0.21	0.21	<0.01	<0.01	0.02	45	27.8	375
Jul-04	598.75	7.0	59	645	0.28	0.24	<0.01	0.04	<0.01	59	38.7	435
Oct-04	598.04	7.1	61	735	0.31	0.31	<0.01	<0.01	<0.01	199	33.8	376
No. Observations		12	12	12	12	12	0	3	4	12	12	12
Minimum		6.6	41.0	558.0	0.2	0.2	0.0	0.0	0.0	26.0	25.4	309.0
Average		7.0	59.0	647.4	0.2	0.2	#DIV/0!	0.1	0.0	64.0	34.1	371.9
Maximum		7.2	85.0	735.0	0.3	0.3	0.0	0.1	0.0	199.0	42.8	435.0
90th Percentile		7.2	79.5	730.1	0.3	0.3	#NUM!	0.1	0.0	121.1	39.8	405.3
95th Percentile		7.2	82.8	734.5	0.3	0.3	#NUM!	0.1	0.0	160.0	41.2	419.1

Date	Total Alkalinity	Bicarbonate	Dissolved Aluminum	Dissolved Barium	Dissolved Boron	Dissolved Cadmium	Dissolved Calcium	Dissolved Chromium	Dissolved Copper	Dissolved Iron	Dissolved Lead	Dissolved Manganese
	mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l
			150	440	1900	2.2		11	9	30	10	530
Jan-02												
Apr-02												
Jul-02	188	188	<50	37	40	<0.5	64.4	<2	<1	5790	1	153
Aug-02												
Oct-02												
Jan-03												
Apr-03												
Jul-03	182	182	<50	40	90	<0.5	63.5	<2	<1	5480	<1	136
Oct-03												
Jan-04												
Jan-04												
Apr-04												
Jul-04	201	201	<50	37	70	<0.5	68.8	<2	<1	4900	<1	120
Oct-04												
No. Observations	3	3	0	3	3	0	3	0	0	3	1	3
Minimum	182.0	182.0	0.0	37.0	40.0	0.0	63.5	0.0	0.0	4900.0	1.0	120.0
Average	190.3	190.3	#DIV/0!	38.0	66.7	#DIV/0!	65.6	#DIV/0!	#DIV/0!	5390.0	1.0	136.3
Maximum	201.0	201.0	0.0	40.0	90.0	0.0	68.8	0.0	0.0	5790.0	1.0	153.0
90th Percentile	198.4	198.4	#NUM!	39.4	86.0	#NUM!	67.9	#NUM!	#NUM!	5728.0	1.0	149.6
95th Percentile	199.7	199.7	#NUM!	39.7	88.0	#NUM!	68.4	#NUM!	#NUM!	5759.0	1.0	151.3

Date	Dissolved Magnesium	Dissolved Inorganic Mercury	Dissolved Nickel	Dissolved Potassium	Dissolved Selenium	Dissolved Silver	Dissolved Zinc	Total Organic Carbon (TOC)	Phenols	Hydrazine	Ethanolamine	Fluoride
	mg/l	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l	ug/l	mg/l	mg/l
	200	0.0013	52		5	0.2	120			10	2	NA
Jan-02										<3	<0.7	
Apr-02										<3	<0.7	<0.1
Jul-02	17.8	0.0021	<2	2.3	3	<0.2	<4	10	<0.001	<3	<0.7	
Aug-02		0.0009										
Oct-02										<3	<0.7	<0.1
Jan-03										<3	<0.7	
Apr-03										<3	1.7	
Jul-03	18.1	0.00067	<2	2.4	<1	<0.2	<4	5	<0.001	<3	<0.7	
Oct-03										<3	<0.7	
Jan-04										3	<0.7	
Jan-04										<3		
Apr-04										3.2	<0.7	
Jul-04	19.5	0.00124	<2	2.4	<5	<0.2	<4	4	<0.001	<3	<0.7	
Oct-04										<3	<0.7	
No. Observations	3	4	0	3	1	0	0	3	0	2	1	0
Minimum	17.8	0.0	0.0	2.3	3.0	0.0	0.0	4.0	0.0	3.0	1.7	0.0
Average	18.5	0.0	#DIV/0!	2.4	3.0	#DIV/0!	#DIV/0!	6.3	#DIV/0!	3.1	1.7	#DIV/0!
Maximum	19.5	0.0	0.0	2.4	3.0	0.0	0.0	10.0	0.0	3.2	1.7	0.0
90th Percentile	19.2	0.0	#NUM!	2.4	3.0	#NUM!	#NUM!	9.0	#NUM!	3.2	1.7	#NUM!
95th Percentile	19.4	0.0	#NUM!	2.4	3.0	#NUM!	#NUM!	9.5	#NUM!	3.2	1.7	#NUM!

		pH	Chloride	Specific Conductance	Total Inorganic Nitrogen*	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Phosphorus	Sulfate	Dissolved Sodium	Total Dissolved Solids
No. Observations		12.0	12	12	12.00	12.00	12.00	12.00	12.00	12	12.0	12
Minimum		6.6	41	558	0.18	0.18	0.01	0.01	0.01	26	25.4	309
Average		6.98	59.00	647.42	0.24	0.23	0.01	0.02	0.01	64.00	34.10	371.92
Maximum		7.2	85	735	0.33	0.31	0.01	0.09	0.04	199	42.8	435
90th Percentile		7.2	79.5	730.1	0.31	0.25	0.01	0.05	0.03	121.1	39.8	405.3
95th Percentile		7.2	82.8	734.45	0.32	0.28	0.01	0.07	0.03	159.95	41.2	419.05

	Total Alkalinity	Bicarbonate	Dissolved Aluminum	Dissolved Barium	Dissolved Boron	Dissolved Cadmium	Dissolved Calcium	Dissolved Chromium	Dissolved Copper	Dissolved Iron	Dissolved Lead	Dissolved Manganese
No. Observations	3	3	3	3	3	3	3	3	3	3	3	3
Minimum	182	182	25	37	40	0.25	63.5	1	0.5	4900	0.5	120
Average	190.33	190.33	25.00	38.00	66.67	0.25	65.57	1.00	0.50	5390.00	0.67	136.33
Maximum	201	201	25	40	90	0.25	68.8	1	0.5	5790	1	153
90th Percentile	198.4	198.4	25	39.4	86	0.25	67.92	1	0.5	5728	0.9	149.6
95th Percentile	199.7	199.7	25	39.7	88	0.25	68.36	1	0.5	5759	0.95	151.3

	Dissolved Magnesium	Dissolved Inorganic Mercury	Dissolved Nickel	Dissolved Potassium	Dissolved Selenium	Dissolved Silver	Dissolved Zinc	Total Organic Carbon (TOC)	Phenols	Hydrazine	Ethanolamine	Fluoride
No. Observations	3	4	3	3	3	3	3	3	3	13	12	2
Minimum	17.8	0.00067	1	2.3	0.5	0.1	2	4	0.0005	1.5	0.35	0.05
Average	18.47	0.00	1.00	2.37	2.00	0.10	2.00	6.33	0.00	1.75	0.46	0.05
Maximum	19.5	0.0021	1	2.4	3	0.1	2	10	0.0005	3.2	1.7	0.05
90th Percentile	19.22	0.001842	1	2.4	2.9	0.1	2	9	0.0005	2.7	0.35	0.05
95th Percentile	19.36	0.001971	1	2.4	2.95	0.1	2	9.5	0.0005	3.08	0.9575	0.05

Table 8. Cook Nuclear Plant
Compliance with Groundwater Limits Well 19

Date	Static Water Elevation	pH	Chloride	Specific Conductance	Total Inorganic Nitrogen*	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Phosphorus	Sulfate	Dissolved Sodium	Total Dissolved Solids	Total Alkalinity	Bicarbonate	Dissolved Aluminum	Dissolved Barium	Dissolved Boron	Dissolved Cadmium
	Feet	S.U.	mg/l	umhos/cm	mg/l	mg/l	mg/l	mg/l	mg/l				mg/l	mg/l	ug/l	ug/l	ug/l	ug/l
			250		5.00				1.00						150	440	1900	2.2
Jan-02	590.96	7.6	26	554	0.36	0.36	<0.01	<0.01	0.02	70	40.9	327						
Apr-02	591.31	7.2	27	524	0.35	0.35	<0.01	<0.01	<0.01	53	35.0	304						
Jul-02	592.1	7.6	29	547	0.35	0.35	<0.01	<0.01	<0.01	58	37.0	309	176	175	<50	19	80	<0.5
Aug-02																		
Oct-02	591.6	7.2	29	548	0.35	0.35	<0.01	<0.01	<0.01	43	34.7	306						
Jan-03	590.4	7.6	32	533	0.35	0.35	<0.01	<0.01	<0.01	43	31.0	306						
Apr-03	590.78	7.7	35	542	0.35	0.34	0.01	<0.01	<0.01	43	32.3	329						
Jul-03	591.38	7.5	30	572	0.41	0.33	<0.01	0.08	<0.01	61	33.8	380	193	193	<50	26	110	<0.5
Oct-03	590.93	7.2	25	556	0.37	0.32	<0.01	0.05	0.02	64	33.5	341						
Jan-04	590.65	6.9	29	569	0.33	0.32	<0.01	0.01	<0.01	60	27.4	321						
Jan-04																		
Apr-04	590.68	7.0	30	518	0.34	0.34	<0.01	<0.01	<0.01	56	32.2	313						
Jul-04	591.38	7.5	28	544	0.35	0.31	<0.01	0.04	<0.01	66	32.5	335	172	171	<50	23	100	<0.5
Oct-04	591.18	7.0	30	594	0.37	0.35	<0.01	0.02	<0.01	55	26.6	300						
No. Observations		12	12	12	12	12	1	5	2	12	12	12	3	3	0	3	3	0
Minimum		6.9	25.0	518.0	0.3	0.3	0.0	0.0	0.0	43.0	26.6	300.0	172.0	171.0	0.0	19.0	80.0	0.0
Average		7.3	29.2	550.1	0.4	0.3	0.0	0.0	0.0	56.0	33.1	322.6	180.3	179.7	#DIV/0!	22.7	96.7	#DIV/0!
Maximum		7.7	35.0	594.0	0.4	0.4	0.0	0.1	0.0	70.0	40.9	380.0	193.0	193.0	0.0	26.0	110.0	0.0
90th Percentile		7.6	31.8	571.7	0.4	0.4	0.0	0.1	0.0	65.8	36.8	340.4	189.6	189.4	#NUM!	25.4	108.0	#NUM!
95th Percentile		7.6	33.4	581.9	0.4	0.4	0.0	0.1	0.0	67.8	38.8	358.6	191.3	191.2	#NUM!	25.7	109.0	#NUM!

Date	Dissolved Calcium	Dissolved Chromium	Dissolved Copper	Dissolved Iron	Dissolved Lead	Dissolved Manganese	Dissolved Magnesium	Dissolved Inorganic Mercury	Dissolved Nickel	Dissolved Potassium	Dissolved Selenium	Dissolved Silver	Dissolved Zinc	Total Organic Carbon (TOC)	Phenols	Hydrazine	Ethanolamine	Fluoride
	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l	ug/l	mg/l	mg/l
		11	9	30	10	530	200	0.0013	52		5	0.2	120			10	2	NA
Jan-02																<3	<0.7	
Apr-02																<3	<0.7	<0.1
Jul-02	54.5	<2	<1	1530	<1	69	15.1	0.0026	<2	1.6	<1	<0.2	<4	6	<0.001	<3	<0.7	
Aug-02								0.0007										
Oct-02																<3	<0.7	<0.1
Jan-03																<3	<0.7	
Apr-03																<3	<0.7	
Jul-03	60.5	<2	<1	1730	<1	74	16.6	<0.0005	<2	1.7	<1	<0.2	<4	4	<0.001	<3	<0.7	
Oct-03																<3	<0.7	
Jan-04																<3	0.82	
Jan-04																	<0.7	
Apr-04																<3	<0.7	
Jul-04	55.2	<2	<1	1710	<1	70	15.9	0.00107	<2	1.7	<5	<0.2	<4	4	<0.001	<3	<0.7	
Oct-04																<3	<0.7	
No. Observations	3	0	0	3	0	3	3	3	0	3	0	0	0	3	0	0	1	0
Minimum	54.5	0.0	0.0	1530.0	0.0	69.0	15.1	0.0	0.0	1.6	0.0	0.0	0.0	4.0	0.0	0.0	0.8	0.0
Average	56.7	#DIV/0!	#DIV/0!	1656.7	#DIV/0!	71.0	15.9	0.0	#DIV/0!	1.7	#DIV/0!	#DIV/0!	#DIV/0!	4.7	#DIV/0!	#DIV/0!	0.8	#DIV/0!
Maximum	60.5	0.0	0.0	1730.0	0.0	74.0	16.6	0.0	0.0	1.7	0.0	0.0	0.0	6.0	0.0	0.0	0.8	0.0
90th Percentile	59.4	#NUM!	#NUM!	1726.0	#NUM!	73.2	16.5	0.0	#NUM!	1.7	#NUM!	#NUM!	#NUM!	5.6	#NUM!	#NUM!	0.8	#NUM!
95th Percentile	60.0	#NUM!	#NUM!	1728.0	#NUM!	73.6	16.5	0.0	#NUM!	1.7	#NUM!	#NUM!	#NUM!	5.8	#NUM!	#NUM!	0.8	#NUM!

No. Observations		12.0	12	12	12.00	12.00	12.00	12.00	12.00	12	12.0	12	3	3	3	3	3	3
Minimum		6.9	25	518	0.33	0.31	0.01	0.01	0.01	43	26.6	300	172	171	25	19	80	0.25
Average		7.33	29.17	550.08	0.36	0.34	0.01	0.02	0.01	56.00	33.08	322.58	180.33	179.67	25.00	22.67	96.67	0.25
Maximum		7.7	35	594	0.41	0.36	0.01	0.08	0.02	70	40.9	380	193	193	25	26	110	0.25
90th Percentile		7.6	31.8	571.7	0.37	0.35	0.01	0.05	0.02	65.8	36.8	340.4	189.6	189.4	25	25.4	108	0.25
95th Percentile		7.6	33.35	581.9	0.39	0.35	0.01	0.06	0.02	67.8	38.8	358.55	191.3	191.2	25	25.7	109	0.25

No. Observations	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	12	13	2
Minimum	54.5	1	0.5	1530	0.5	69	15.1	0.00025	1	1.6	0.5	0.1	2	4	0.0005	1.5	0.35	0.05
Average	56.73	1.00	0.50	1656.67	0.50	71.00	15.87	0.00	1.00	1.67	1.17	0.10	2.00	4.67	0.00	1.50	0.39	0.05
Maximum	60.5	1	0.5	1730	0.5	74	16.6	0.0026	1	1.7	2.5	0.1	2	6	0.0005	1.5	0.82	0.05
90th Percentile	59.44	1	0.5	1726	0.5	73.2	16.46	0.002141	1	1.7	2.1	0.1	2	5.6	0.0005	1.5	0.35	0.05
95th Percentile	59.97	1	0.5	1728	0.5	73.6	16.53	0.0023705	1	1.7	2.3	0.1	2	5.8	0.0005	1.5	0.538	0.05

Table 9. Cook Nuclear Plant
Compliance with Groundwater Limits, Background Well 8

Date	Static Water Elevation	pH	Chloride	Specific Conductance	Total Inorganic Nitrogen*	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Phosphorus	Sulfate	Dissolved Sodium	Total Dissolved Solids
	Feet	S.U.	mg/l	umhos/cm	mg/l	mg/l	mg/l	mg/l	mg/l			
			250		5.00				1.00			
Jan-02	604.29	7.0	65	625	0.02	0.02	<0.01	<0.01	<0.01	44	34.4	364
Apr-02	604.58	6.4	33	410	<0.01	<0.01	<0.01	<0.01	<0.01	27	13.5	247
Jul-02	603.97	7.1	33	498	1.16	0.04	<0.01	1.12	<0.01	28	18.9	289
Aug-02												
Oct-02	602.85	6.7	46	520	0.03	0.03	<0.01	<0.01	0.05	31	31.2	293
Jan-03	602.67	7.0	64	665	0.02	0.02	<0.01	<0.01	<0.01	57	38.4	386
Apr-03	608.03	6.5	49	603	0.02	0.02	<0.01	<0.01	<0.01	34	33.1	344
Jul-03	608.29	6.8	61	547	0.16	0.01	0.01	0.14	<0.01	30	33.7	319
Oct-03	607.09	6.4	32	437	0.13	0.07	<0.01	0.06	0.08	38	17.3	282
Jan-04	607.81	6.6	49	573	0.03	0.03	<0.01	<0.01	<0.01	29	26.8	333
Jan-04												
Apr-04	607.96	6.6	41	436	<0.01	<0.01	<0.01	<0.01	<0.01	28	18.1	289
Jul-04	607.86	6.9	38	473	0.30	0.01	<0.01	0.29	<0.01	33	19.8	318
Oct-04	609.74	6.6	40	537	1.02	<0.01	<0.01	1.02	<0.01	33	23.6	272
No. Observations		12	12	12	10	9	1	5	2	12	12	12
Minimum		6.4	32.0	410.0	0.0	0.0	0.0	0.1	0.1	27.0	13.5	247.0
Average		6.7	45.9	527.0	0.3	0.0	0.0	0.5	0.1	34.3	25.7	311.3
Maximum		7.1	65.0	665.0	1.2	0.1	0.0	1.1	0.1	57.0	38.4	386.0
90th Percentile		7.0	63.7	622.8	1.0	0.0	0.0	1.1	0.1	43.4	34.3	362.0
95th Percentile		7.0	64.5	643.0	1.1	0.1	0.0	1.1	0.1	49.9	36.2	373.9
No. Observations		12.0	12	12	12.00	12.00	12.00	12.00	12.00	12	12	12
Minimum		6.4	32	410	0.01	0.01	0.01	0.01	0.01	27	13.5	247
Average		6.72	45.92	527.00	0.24	0.02	0.01	0.22	0.02	34.33	25.73	311.33
Maximum		7.1	65	665	1.16	0.07	0.01	1.12	0.08	57	38.4	386
90th Percentile		7.0	63.7	622.8	0.95	0.04	0.01	0.95	0.05	43.4	34.33	362
95th Percentile		7.0	64.45	643	1.08	0.05	0.01	1.07	0.06	49.85	36.2	373.9

Date	Total Alkalinity	Bicarbonate	Dissolved Aluminum	Dissolved Barium	Dissolved Boron	Dissolved Cadmium	Dissolved Calcium	Dissolved Chromium	Dissolved Copper	Dissolved Iron	Dissolved Lead	Dissolved Manganese
	mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l
			150	440	1900	2.2		11	9	30	10	530
Jan-02												
Apr-02												
Jul-02	175	175	<50	16	30	<0 5	60.1	<2	1	110	2	60
Aug-02												
Oct-02												
Jan-03												
Apr-03												
Jul-03	151	151	<50	25	50	<0.5	54.2	<2	<1	90	2	51
Oct-03												
Jan-04												
Jan-04												
Apr-04												
Jul-04	143	143	<50	21	50	<0.5	51	<2	1	90	<1	50
Oct-04												
No. Observations	3	3	0	3	3	0	3	0	2	3	2	3
Minimum	143.0	143.0	0.0	16.0	30.0	0.0	51.0	0.0	1.0	90.0	2.0	50.0
Average	156.3	156.3	#DIV/0!	20.7	43.3	#DIV/0!	55.1	#DIV/0!	1.0	96.7	2.0	53.7
Maximum	175.0	175.0	0.0	25.0	50.0	0.0	60.1	0.0	1.0	110.0	2.0	60.0
90th Percentile	170.2	170.2	#NUM!	24.2	50.0	#NUM!	58.8	#NUM!	1.0	106.0	2.0	58.2
95th Percentile	172.6	172.6	#NUM!	24.6	50.0	#NUM!	59.5	#NUM!	1.0	108.0	2.0	59.1
No. Observations	3	3	3	3	3	3	3	3	3	3	3	3
Minimum	143	143	25	16	30	0.25	51	1	0.5	90	0.5	50
Average	156.33	156.33	25.00	20.67	43.33	0.25	55.10	1.00	0.83	96.67	1.50	53.67
Maximum	175	175	25	25	50	0.25	60.1	1	1	110	2	60
90th Percentile	170.2	170.2	25	24.2	50	0.25	58.92	1	1	106	2	58.2
95th Percentile	172.6	172.6	25	24.6	50	0.25	59.51	1	1	108	2	59.1

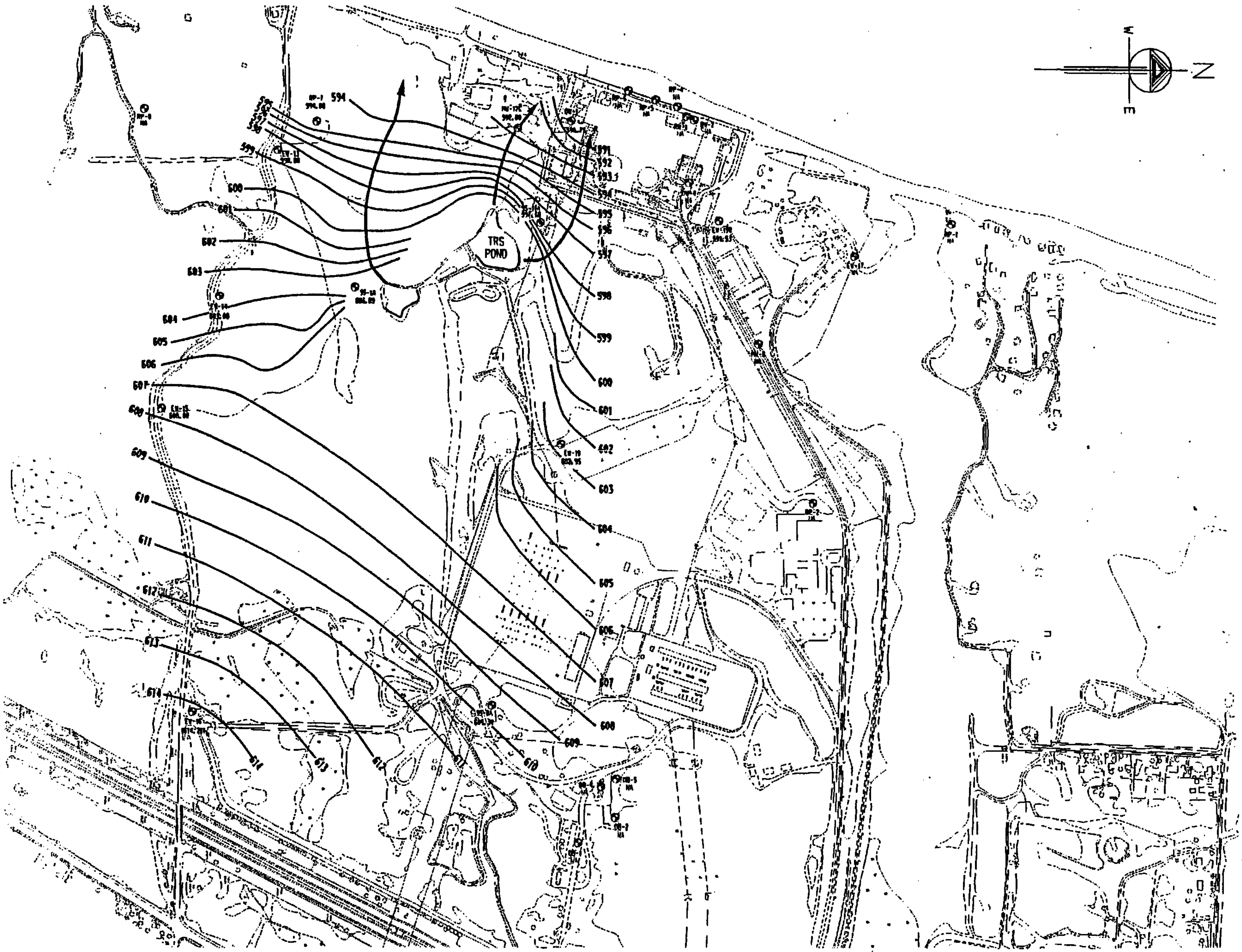
Date	Dissolved Magnesium	Dissolved Inorganic Mercury	Dissolved Nickel	Dissolved Potassium	Dissolved Selenium	Dissolved Silver	Dissolved Zinc	Total Organic Carbon (TOC)	Phenols	Hydrazine	Ethanolamine	Fluoride
	mg/l	ug/l	ug/l	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l	ug/l	mg/l	mg/l
	200	0.0013	52		5	0.2	120			10	2	NA
Jan-02										<3	<0.7	
Apr-02										<3	<0.7	0.1
Jul-02	15.7	0.0072	<2	3.7	7	<0.2	<4	7	<0.001	<3	<0.7	
Aug-02		0.0025			<1.0							
Oct-02										<3	<0.7	<0.1
Jan-03										<3	<0.7	
Apr-03										<3	<0.7	
Jul-03	15.9	0.0035	<2	3.3	2	<0.2	<4	6	<0.001	<3	<0.7	
Oct-03										<3	<0.7	
Jan-04										3	<0.7	
Jan-04										<3		
Apr-04										<3	<0.7	
Jul-04	14.3	0.00134	<2	2.3	<5	<0.2	<4	7	<0.001	<3	<0.7	
Oct-04										<3	<0.7	
No. Observations	3	4	0	3	2	0	0	3	0	1	0	1
Minimum	14.3	0.0	0.0	2.3	2.0	0.0	0.0	6.0	0.0	3.0	0.0	0.1
Average	15.3	0.0	#DIV/0!	3.1	4.5	#DIV/0!	#DIV/0!	6.7	#DIV/0!	3.0	#DIV/0!	0.1
Maximum	15.9	0.0	0.0	3.7	7.0	0.0	0.0	7.0	0.0	3.0	0.0	0.1
90th Percentile	15.9	0.0	#NUM!	3.6	6.5	#NUM!	#NUM!	7.0	#NUM!	3.0	#NUM!	0.1
95th Percentile	15.9	0.0	#NUM!	3.7	6.8	#NUM!	#NUM!	7.0	#NUM!	3.0	#NUM!	0.1
No. Observations	3	4	3	3	4	3	3	3	3	13	12	12
Minimum	14.3	0.00134	1	2.3	0.5	0.1	2	6	0.0005	1.5	0.35	0.35
Average	15.30	0.00	1.00	3.10	3.00	0.10	2.00	6.67	0.00	1.62	0.35	0.35
Maximum	15.9	0.0072	1	3.7	7	0.1	2	7	0.0005	3	0.35	0.35
90th Percentile	15.86	0.00609	1	3.62	5.65	0.1	2	7	0.0005	1.5	0.35	0.35
95th Percentile	15.88	0.006645	1	3.66	6.325	0.1	2	7	0.0005	2.1	0.35	0.35

TAB 10

Well Elevations					
Data taken 1/24/2005					
Well Number	Coordinates		Top of riser/pipe	Water level in ft. from top of pipe	Groundwater level (ft above sea level)
95-1A (RP-14)	N 179,676.6	E 1,393,844.6	660.99	57.3	603.69
95-8A (RP-3)	N 180,510.5	E 1,396,322.4	616.26	6.92	609.34
95-11A	N 180,811.1	E 1,393,446.8	609.4	11.8	597.6
MW-12C	N 180,678.0	E 1,392,881.9	610.9	18.1	592.8
EW-13 (RP-13)	N 179,215.26	E 1,393,019.93	641.75	42.95	598.8
EW#14 (RP-12)	N 178,857.96	E 1,393,902.49	620.08	17	603.08
EW-15 (RP-11)	N 178,512.86	E 1,394,569.77	614.38	6.3	608.08
EW#16 (RP-10)	N 178,689.61	E 1,396,361.82	630.83	16.62	614.21
EW-18	N 180,935.058	E 1,394,772.889	631.15	28.2	602.95
EW-19R (7/1/97)	N 181,888.72	E 1,393,435.52	612.48	20.95	591.53
OW-1	N 180,939.3	E 1,393,109.0	608.35	17.6	590.75
RP-7	N 179,447.797	E 1,392,848.135	675.104	80.5	594.604

131

s:\stru\cook\u12\EXHIBIT 1.dgn Feb. 04, 2005 08:03:48



STATIC WATER ELEVATIONS
MEASURED ON 1/24/2005

LEGEND

MONITORING WELL

600 POTENTIOMETRIC CONTOUR

DIRECTION OF GROUNDWATER FLOW

DONALD C. COOK
NUCLEAR PLANT
POTENTIOMETRIC MAP
EXHIBIT 1

132

Tab 12 Page 38 Part 4b Groundwater and effluent data set. Approved quarterly monitoring reports.

Additional data set (2002 – 2004) are available under Tab 9 "Facility Compliance history"

Michigan Department of Environmental Quality Waste Management Division

COMPLIANCE MONITORING REPORT FORM

Required by Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA)

Facility Name I American Electric Power Company	**Facility Name 2** D.C. Cook Nuclear Plant
Facility ID Number GWIII600	**Authorization Number** M00988
Jurisdiction: X WMD	**DWRPD** **CIS**
District: Kalamazoo	
Quarter: 3rd **Year:** 2004	

CERTIFICATION STATEMENT:

I certify, under penalty of law, that I have personally examined and am familiar with the information submitted in this document and all attachments. The information being submitted was collected and analyzed according to the approved methods specified in the groundwater discharge permit for this facility. Based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment

CERTIFIED OPERATOR (PRINT): **Blair K. Zordell**	CERTIFICATION NUMBER: **4537**
CERTIFIED OPERATOR (SIGNATURE): Blair Zordell	DATE: 10-14-04
PRINCIPAL EXECUTIVE OFFICER (PRINT): John Carlson	10-14-04
PRINCIPAL EXECUTIVE OFFICER (SIGNATURE):	DATE: 10-14-04

134

EQP
10/99

D.C. Cook Nuclear Plant
1 Cook Place
Bridgman , MI
49106
Permit # M 00988
Part II.A.8

Outfall Description	Description of the circumstances	Cause of noncompliance	Period of non compliance	Steps to prevent recurrance
Groundwater Monitoring Wells #13 and #19 remain outside of permit limitations for dissolved iron.	Groundwater monitoring for dissolved iron exceeded the limit of 300 ug/l. (6 month background water quality study.) Sample date is July 19, 2004.	Natural GW occurrence.	1/14/01 - 7/19/04 (ongoing)	Letter submitted on April 11, 2001 requesting revision to the existing groundwater permit limits.

135

FLOW MONITORING

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

INFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences

EFFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences
EF-1	Daily	2,400,000 gpd	359,600	243,800	56,006,400	0
EF-2	Daily	60,000 gpd	24,980	17,445	3,493,246	0

136

FLOW MONITORING

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

SEEPAGE BEDS

Sample Location	Sampling Frequency	Dike Inspection-Visual	Freeboard -2 Feet Min.			
LA-1	Weekly	SAT	10.0			
LA-2	Weekly	Not in service	10.0			

137

INFLUENT QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit	Maximum Concentration	Monthly Average	Number of Limit Exceedences
IQ-2	Weekly	BOD5	mg/l		328	265	0
IQ-2	Weekly	Ammonia Nitrogen	mg/l		66.3	59.9	0
IQ-2	Weekly	Tot. Phosphorus	mg/l		13.3	11.5	0
IQ-2	Weekly	pH	s.u.		Min 8.2 Max 8.6	-	0
IQ-2	Weekly	Tot. Suspended Solids	mg/l		335	261	0

138

EFFLUENT QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit: Rule 2227	Limit: Rule 2228	Maximum Concentration	Monthly Average	Number of Limit Exceedences
EQ-1	Weekly	Diss. Sodium	mg/l			56.4	18.2	0
EQ-1	Continuous	pH	s.u.	5.5 - 9.0		Min 6.3 Max 8.2	-	0
EQ-1	Weekly	Sulfate	mg/l	250 Mon. ave.		54	46	0
EQ-1	Weekly	Hydrazine	ug/l			<3	<3	0
EQ-1	Weekly	Ethanolamine	ug/l			2550	1890	0
EQ-1	Daily	Oil Sheen-absorption Pond	visual			-	SAT	0
EQ-2	Weekly	BOD5	mg/l	35		3.0	2.4	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	85 max		22.1	-	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	50 Mon. ave.		-	13.8	0
EQ-2	Weekly	Ammonia Nitrogen	mg/l			4.1	2.4	0
EQ-2	Weekly	Nitrite Nitrogen	mg/l			0.6	0.4	0
EQ-2	Weekly	Nitrate Nitrogen	mg/l			21.2	11.0	0
EQ-2	Weekly	Tot. Phosphorus	mg/l	15		1.5	0.9	0
EQ-2	Weekly	pH	s.u.	5.5 - 9.0		Min 6.8 Max 7.2	-	0
EQ-2	Weekly	Tot. Susp. Solids	mg/l			3.2	2.3	0

139

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-1A Compliance	EW-12 Compliance	EW-13 Compliance	EW-19 Compliance		
Static Water Elevation	Ft.	Quarterly			603.89	592.65	598.75	591.38		
pH	s.u.	Quarterly			6.8	7.9	7.0	7.5		
Chloride	mg/l	Quarterly	250		11	7	59	28		
Specific Conductivity	umho/cm	Quarterly			452	468	645	544		
Tot. Inorganic Nitrogen	mg/l	Quarterly	5		4.87	0.24	0.28	0.35		
Ammonia Nitrogen	mg/l	Quarterly			<0.01	0.20	0.24	0.31		
Nitrite Nitrogen	mg/l	Quarterly			0.04	<0.01	<0.01	<0.01		
Nitrate Nitrogen	mg/l	Quarterly			4.83	0.04	0.04	0.04		
Tot. Phosphorus	mg/l	Quarterly	1		<0.01	0.03	<0.01	<0.01		
Sulfate	mg/l	Quarterly			96	115	59	66		
Diss. Sodium	mg/l	Quarterly			40.5	51.7	38.7	32.5		
Tot. Diss. Solids	mg/l	Quarterly			327	309	435	335		
Tot. Alkalinity	mg/l	Annual			78	105	201	172		
Bicarbonate	mg/l	Annual			78	104	201	171		
Diss. Aluminum	ug/l	Annual	150		<50	<50	<50	<50		
Volume Purged	gallon	Quarterly			48	30	45	32		

EQP
10/00

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-1A Compliance	EW-12 Compliance	EW-13 Compliance	EW-19 Compliance		
Diss. Barium	ug/l	Annual	440		17	15	37	23		
Diss. Boron	ug/l	Annual	1900		<40	70	70	100		
Diss. Cadmium	ug/l	Annual	2.2		<0.5	<0.5	<0.5	<0.5		
Diss. Calcium	mg/l	Annual			32.3	32.0	68.8	55.2		
Diss.Chromium	ug/l	Annual	11		<2	<2	<2	<2		
Diss. Copper	ug/l	Annual	9		<1	<1	<1	<1		
Diss. Iron	ug/l	Annual	300		<10	260	4900	1710		
Diss. Lead	ug/l	Annual	10		<1	<1	<1	<1		
Diss. Managanese	ug/l	Annual	530		<10	80	120	70		
Diss. Magnesium	mg/l	Annual	200		12.6	9.8	19.5	15.9		
Diss. Inorganic Mercury	ug/l	Annual	0.0013		<0.0005	<0.0005	0.00124	0.00107		
Diss. Nickel	ug/l	Annual	52		<2	<2	<2	<2		
Diss. Potassium	mg/l	Annual			0.7	0.9	2.4	1.7		
Diss. Selenium	ug/l	Annual	5		<5	<5	<5	<5		
Diss. Silver	ug/l	Annual	0.2		<0.2	<0.2	<0.2	<0.2		

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-1A Compliance	EW-12 Compliance	EW-13 Compliance	EW-19 Compliance		
Diss. Zinc	ug/l	Annual	120		<4	<4	<4	<4		
Tot. Organic Carbon (TOC)	mg/l	Annual			1	2	4	4		
Phenols	mg/l	Annual			<0.001	<0.001	<0.001	<0.001		
Hydrazine	ug/l	Quarterly	10		<3	<3	<3	<3		
Ethanolamine	mg/l	Quarterly	2		<0.7	<0.7	<0.7	<0.7		

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-8 Upgradient					
Static Water Elevation	Ft.	Quarterly			607.86					
pH	s.u.	Quarterly			6.9					
Chloride	mg/l	Quarterly			38					
Specific Conductivity	umho/cm	Quarterly			473					
Tot. Inorganic Nitrogen	mg/l	Quarterly			0.30					
Ammonia Nitrogen	mg/l	Quarterly			0.01					
Nitrite Nitrogen	mg/l	Quarterly			<0.01					
Nitrate Nitrogen	mg/l	Quarterly			0.29					
Tot. Phosphorus	mg/l	Quarterly			<0.01					
Sulfate	mg/l	Quarterly			33					
Diss. Sodium	mg/l	Quarterly			19.8					
Tot. Diss. Solids	mg/l	Quarterly			318					
Tot. Alkalinity	mg/l	Annual			143					
Bicarbonate	mg/l	Annual			143					
Diss. Aluminum	ug/l	Annual			<50					
Volume Purged	Gallons	Quarterly			53					

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-8 Upgradient					
Diss. Barium	ug/l	Annual			21					
Diss. Boron	ug/l	Annual			50					
Diss. Cadmium	ug/l	Annual			<0.5					
Diss. Calcium	mg/l	Annual			51.0					
Diss.Chromium	ug/l	Annual			<2					
Diss. Copper	ug/l	Annual			1					
Diss. Iron	ug/l	Annual			90					
Diss. Lead	ug/l	Annual			<1					
Diss. Managanese	ug/l	Annual			50					
Diss. Magnesium	mg/l	Annual			14.3					
Diss. Inorganic Mercury	ug/l	Annual			0.00134					
Diss. Nickel	ug/l	Annual			<2					
Diss. Potassium	mg/l	Annual			2.3					
Diss. Selenium	ug/l	Annual			<5					
Diss. Silver	ug/l	Annual			<0.2					

144

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Jul-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-8 Upgradient					
Diss. Zinc	ug/l	Annual			<4					
Tot. Organic Carbon (TOC)	mg/l	Annual			7					
Phenols	mg/l	Annual			<0.001					
Hydrazine	ug/l	Quarterly			<3					
Ethanolamine	mg/l	Quarterly			<0.7					

145

FLOW MONITORING

American Electric Power Company
Facility Name 1

Aug-04
Date

GW111600
ID Number

INFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences

EFFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences
EF-1	Daily	2,400,000 gpd	372,300	233,000	63,229,900	0
EF-2	Daily	60,000 gpd	31,540	21,973	4,174,406	0

146

FLOW MONITORING

American Electric Power Company
Facility Name 1

Aug-04
Date

GW111600
ID Number

SEEPAGE BEDS

Sample Location	Sampling Frequency	Dike Inspection-Visual	Freeboard -2 Feet Min.			
LA-1	Weekly	SAT	10			
LA-2	Weekly	NOT IN SERVICE	10			

INFLUENT QUALITY

American Electric Power Company
Facility Name 1

Aug-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit	Maximum Concentration	Monthly Average	Number of Limit Exceedences
IQ-2	Weekly	BOD5	mg/l		427	343	0
IQ-2	Weekly	Ammonia Nitrogen	mg/l		55.5	44.3	0
IQ-2	Weekly	Tot. Phosphorus	mg/l		13.9	9.7	0
IQ-2	Weekly	pH	s.u.		Min 8.3 Max 8.5	-	0
IQ-2	Weekly	Tot. Suspended Solids	mg/l		409	314	0

148

EFFLUENT QUALITY

American Electric Power Company
Facility Name 1

Aug-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit: Rule 2227	Limit: Rule 2228	Maximum Concentration	Monthly Average	Number of Limit Exceedences
EQ-1	Weekly	Diss. Sodium	mg/l			5.8	4.9	0
EQ-1	Continuous	pH	s.u.	5.5 - 9.0		Min 6.3 Max 8.2	-	0
EQ-1	Weekly	Sulfate	mg/l	250 Mon. ave.		63	53	0
EQ-1	Weekly	Hydrazine	ug/l			4	<3	0
EQ-1	Weekly	Ethanolamine	ug/l			2,500	1,600	0
EQ-1	Daily	Oil Sheen-absorption Pond	visual			-	SAT	0
EQ-2	Weekly	BOD5	mg/l	35		3.1	2.3	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	85 max		15.1	-	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	50 Mon. ave.		-	9.2	0
EQ-2	Weekly	Ammonia Nitrogen	mg/l			2.2	1.1	0
EQ-2	Weekly	Nitrite Nitrogen	mg/l			0.6	0.3	0
EQ-2	Weekly	Nitrate Nitrogen	mg/l			14.9	7.8	0
EQ-2	Weekly	Tot. Phosphorus	mg/l	15		2.4	1.4	0
EQ-2	Weekly	pH	s.u.	5.5 - 9.0		Min 7.0 Max 7.3	-	0
EQ-2	Weekly	Tot. Susp. Solids	mg/l			4.0	2.3	0

149

FLOW MONITORING

American Electric Power Company
Facility Name 1

Sep-04
Date

GW111600
ID Number

INFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences

EFFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences
EF-1	Daily	2,400,000 gpd	292,400	228,600	70,089,200	0
EF-2	Daily	60,000 gpd	35,230	20,854	4,800,036	0

150

FLOW MONITORING

American Electric Power Company
Facility Name 1

Sep-04
Date

GW111600
ID Number

SEEPAGE BEDS

Sample Location	Sampling Frequency	Dike Inspection-Visual	Freeboard -2 Feet Min.			
LA-1	Weekly	SAT	9.5			
LA-2	Weekly	SAT	10.0			

151

EQP

INFLUENT QUALITY

American Electric Power Company
Facility Name 1

Sep-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit	Maximum Concentration	Monthly Average	Number of Limit Exceedences
IQ-2	Weekly	BOD5	mg/l		410	345	0
IQ-2	Weekly	Ammonia Nitrogen	mg/l		126.1	84.6	0
IQ-2	Weekly	Tot. Phosphorus	mg/l		9.3	8.5	0
IQ-2	Weekly	pH	s.u.		Min 8.2 Max 8.8	-	0
IQ-2	Weekly	Tot. Suspended Solids	mg/l		350	237	0

EFFLUENT QUALITY

American Electric Power Company
Facility Name 1

Sep-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit: Rule 2227	Limit: Rule 2228	Maximum Concentration	Monthly Average	Number of Limit Exceedences
EQ-1	Weekly	Diss. Sodium	mg/l			5.1	4.8	0
EQ-1	Continuous	pH	s.u.	5.5 - 9.0		Min 6.3 Max 8.8	-	0
EQ-1	Weekly	Sulfate	mg/l	250 Mon. ave.		56	52	0
EQ-1	Weekly	Hydrazine	ug/l			<3	<3	0
EQ-1	Weekly	Ethanolamine	ug/l			2000	1200	0
EQ-1	Daily	Oil Sheen-absorption Pond	visual			-	SAT	0
EQ-2	Weekly	BOD5	mg/l	35		5.6	2.5	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	85 max		25.1	-	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	50 Mon. ave.		-	16.3	0
EQ-2	Weekly	Ammonia Nitrogen	mg/l			8.6	3.5	0
EQ-2	Weekly	Nitrite Nitrogen	mg/l			0.8	0.4	0
EQ-2	Weekly	Nitrate Nitrogen	mg/l			26.6	15.1	0
EQ-2	Weekly	Tot. Phosphorus	mg/l	15		1.4	1.0	0
EQ-2	Weekly	pH	s.u.	5.5 - 9.0		Min 7.1 Max 7.5	-	0
EQ-2	Weekly	Tot. Susp. Solids	mg/l			2.8	2.1	0

153

Michigan Department of Environmental Quality Waste Management Division

COMPLIANCE MONITORING REPORT FORM

Required by Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA)

Facility Name I American Electric Power Company	**Facility Name 2** D.C. Cook Nuclear Plant
Facility ID Number GWIII600	**Authorization Number** M00988
Jurisdiction: X **WMD**	**DWRPD** **CIS**
District: Kalamazoo	
Quarter: 4th **Year:** 2004	

ERTIFICATION STATEMENT:

I certify, under penalty of law, that I have personally examined and am familiar with the information submitted in this document and all attachments. The information being submitted was collected and analyzed according to the approved methods specified in the groundwater discharge permit for this facility. Based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment

CERTIFIED OPERATOR (PRINT): **Blair K. Zordell**	CERTIFICATION NUMBER: **4537**
CERTIFIED OPERATOR (SIGNATURE):	DATE: 1-14-05
PRINCIPAL EXECUTIVE OFFICER (PRINT): **John P. Carlson**	
PRINCIPAL EXECUTIVE OFFICER (SIGNATURE):	DATE: 1-14-05

FLOW MONITORING

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

INFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences

EFFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences
EF-1	Daily	2,400,000 gpd	377,000	233,242	77,319,700	0
EF-2	Daily	60,000 gpd	38,140	28,493	5,683,306	0

155

FLOW MONITORING

American Electric Power Company
Facility Name 1

Nov-04
Date

GW111600
ID Number

INFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences

EFFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences
EF-1	Daily	2,400,000 gpd	472,200	268,590	85,377,400	0
EF-2	Daily	60,000 gpd	31,410	17,973	6,222,486	0

156

FLOW MONITORING

American Electric Power Company
Facility Name 1

Dec-04
Date

GW111600
ID Number

INFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences

EFFLUENT FLOW

Sample Location	Sampling Frequency	Limit (gallons)	Daily Maximum Flow	Monthly Average Flow	Cumulative Year to Date Flow	Number of Limit Exceedences
EF-1	Daily	2,400,000 gpd	313,400	223,748	92,313,600	0
EF-2	Daily	60,000 gpd	28,500	15,525	6,703,756	0

157

FLOW MONITORING

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

SEEPAGE BEDS

Sample Location	Sampling Frequency	Dike Inspection-Visual	Freeboard -2 Feet Min.			
LA-1	Weekly	SAT	10.0			
LA-2	Weekly	SAT	9.3			

158

FLOW MONITORING

American Electric Power Company
Facility Name 1

Nov-04
Date

GW111600
ID Number

SEEPAGE BEDS

Sample Location	Sampling Frequency	Dike Inspection-Visual	Freeboard -2 Feet Min.			
LA-1	Weekly	SAT	10.0			
LA-2	Weekly	SAT	10.0			

159

FLOW MONITORING

American Electric Power Company
Facility Name 1

Dec-04
Date

GW111600
ID Number

SEEPAGE BEDS

Sample Location	Sampling Frequency	Dike Inspection-Visual	Freeboard -2 Feet Min.			
LA-1	Weekly	SAT	9.0			
LA-2	Weekly	NOT IN SERVICE				

160

INFLUENT QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit	Maximum Concentration	Monthly Average	Number of Limit Exceedences
IQ-2	Weekly	BOD5	mg/l		344	289	0
IQ-2	Weekly	Ammonia Nitrogen	mg/l		110.0	92.4	0
IQ-2	Weekly	Tot. Phosphorus	mg/l		11.0	9.7	0
IQ-2	Weekly	pH	s.u.		Min 8.1 Max 8.5	-	0
IQ-2	Weekly	Tot. Suspended Solids	mg/l		242	217	0

INFLUENT QUALITY

American Electric Power Company
Facility Name 1

Nov-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit	Maximum Concentration	Monthly Average	Number of Limit Exceedences
IQ-2	Weekly	BOD5	mg/l		273	255	0
IQ-2	Weekly	Ammonia Nitrogen	mg/l		81.3	68.8	0
IQ-2	Weekly	Tot. Phosphorus	mg/l		9.0	7.8	0
IQ-2	Weekly	pH	s.u.		Min 8.4 Max 8.6	-	0
IQ-2	Weekly	Tot. Suspended Solids	mg/l		441	282	0

179

INFLUENT QUALITY

American Electric Power Company
Facility Name 1

Dec-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit	Maximum Concentration	Monthly Average	Number of Limit Exceedences
IQ-2	Weekly	BOD5	mg/l		319	243	0
IQ-2	Weekly	Ammonia Nitrogen	mg/l		73.8	67.8	0
IQ-2	Weekly	Tot. Phosphorus	mg/l		45.0	29.6	0
IQ-2	Weekly	pH	s.u.		Min 6.9 Max 8.8	-	0
IQ-2	Weekly	Tot. Suspended Solids	mg/l		258	202	0

163

EFFLUENT QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit: Rule 2227	Limit: Rule 2228	Maximum Concentration	Monthly Average	Number of Limit Exceedences
EQ-1	Weekly	Diss. Sodium	mg/l			5.4	4.7	0
EQ-1	Continuous	pH	s.u.	5.5 - 9.0		Min 6.3 Max 8.2	-	0
EQ-1	Weekly	Sulfate	mg/l	250 Mon. ave.		340	100	0
EQ-1	Weekly	Hydrazine	ug/l			3660	735	0
EQ-1	Weekly	Ethanolamine	ug/l			15100	4000	0
EQ-1	Daily	Oil Sheen-absorption Pond	visual			-	SAT	0
EQ-2	Weekly	BOD5	mg/l	35		6.3	4.7	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	85 max		17.9	-	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	50 Mon. ave.		-	11.9	0
EQ-2	Weekly	Ammonia Nitrogen	mg/l			5.6	4.6	0
EQ-2	Weekly	Nitrite Nitrogen	mg/l			0.66	0.40	0
EQ-2	Weekly	Nitrate Nitrogen	mg/l			12.4	7.0	0
EQ-2	Weekly	Tot. Phosphorus	mg/l	15		1.9	1.5	0
EQ-2	Weekly	pH	s.u.	5.5 - 9.0		Min 6.9 Max 7.1	-	0
EQ-2	Weekly	Tot. Susp. Solids	mg/l			3.7	2.2	0

1164

EFFLUENT QUALITY

American Electric Power Company
Facility Name 1

Nov-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit: Rule 2227	Limit: Rule 2228	Maximum Concentration	Monthly Average	Number of Limit Exceedences
EQ-1	Weekly	Diss. Sodium	mg/l			11.9	5.3	0
EQ-1	Continuous	pH	s.u.	5.5 - 9.0		Min 6.3 Max 8.2	-	0
EQ-1	Weekly	Sulfate	mg/l	250 Mon. ave.		35	26	0
EQ-1	Weekly	Hydrazine	ug/l			60	18	0
EQ-1	Weekly	Ethanolamine	ug/l			1800	1100	0
EQ-1	Daily	Oil Sheen-absorption Pond	visual			-	SAT	0
EQ-2	Weekly	BOD5	mg/l	35		3.3	2.9	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	85 max		41.2	-	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	50 Mon. ave.		-	24.7	0
EQ-2	Weekly	Ammonia Nitrogen	mg/l			17.6	4.4	0
EQ-2	Weekly	Nitrite Nitrogen	mg/l			0.48	0.25	0
EQ-2	Weekly	Nitrate Nitrogen	mg/l			23.4	19.0	0
EQ-2	Weekly	Tot. Phosphorus	mg/l	15		3.8	1.7	0
EQ-2	Weekly	pH	s.u.	5.5 - 9.0		Min 7.1 Max 7.6	-	0
EQ-2	Weekly	Tot. Susp. Solids	mg/l			3.8	1.8	0

EFFLUENT QUALITY

American Electric Power Company
Facility Name 1

Dec-04
Date

GW111600
ID Number

Sample Location	Sampling Frequency	Parameter	Units	Limit: Rule 2227	Limit: Rule 2228	Maximum Concentration	Monthly Average	Number of Limit Exceedences
EQ-1	Weekly	Diss. Sodium	mg/l			423	110	0
EQ-1	Continuous	pH	s.u.	5.5 - 9.0		Min 6.3 Max 8.2	-	0
EQ-1	Weekly	Sulfate	mg/l	250 Mon. ave.		125	63	0
EQ-1	Weekly	Hydrazine	ug/l			14	4	0
EQ-1	Weekly	Ethanolamine	ug/l			5500	2800	0
EQ-1	Daily	Oil Sheen-absorption Pond	visual			-	SAT	0
EQ-2	Weekly	BOD5	mg/l	35		4.5	2.9	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	85 max		43.0	-	0
EQ-2	Weekly	Tot. Inorganic Nitrogen	mg/l	50 Mon. ave.		-	36.0	0
EQ-2	Weekly	Ammonia Nitrogen	mg/l			0.1	0.1	0
EQ-2	Weekly	Nitrite Nitrogen	mg/l			0.01	0.01	0
EQ-2	Weekly	Nitrate Nitrogen	mg/l			43.0	35.9	0
EQ-2	Weekly	Tot. Phosphorus	mg/l	15		8.3	4.8	0
EQ-2	Weekly	pH	s.u.	5.5 - 9.0		Min 6.4 Max 8.1	-	0
EQ-2	Weekly	Tot. Susp. Solids	mg/l			2.3	1.4	0

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-1A Compliance	EW-12 Compliance	EW-13 Compliance	EW-19 Compliance		
Static Water Elevation	Ft.	Quarterly			603.13	592.23	598.04	591.18		
pH	s.u.	Quarterly			6.8	7.6	7.1	7.0		
Chloride	mg/l	Quarterly	250		11	9	61	30		
Specific Conductivity	umho/cm	Quarterly			546	460	735	594		
Tot. Inorganic Nitrogen	mg/l	Quarterly	5		2.61	0.21	0.31	0.37		
Ammonia Nitrogen	mg/l	Quarterly			0.06	0.18	0.31	0.35		
Nitrite Nitrogen	mg/l	Quarterly			0.04	<0.01	<0.01	<0.01		
Nitrate Nitrogen	mg/l	Quarterly			2.51	0.03	<0.01	0.02		
Tot. Phosphorus	mg/l	Quarterly	1		<0.01	0.01	<0.01	<0.01		
Sulfate	mg/l	Quarterly			137	95	199	55		
Diss. Sodium	mg/l	Quarterly			57.4	43.2	33.8	26.6		
Tot. Diss. Solids	mg/l	Quarterly			287	238	376	300		
Tot. Alkalinity	mg/l	Annual								
Bicarbonate	mg/l	Annual								
Diss. Aluminum	ug/l	Annual	150							
Volume Purged	gallon	Quarterly			33	25	26	33		

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-1A Compliance	EW-12 Compliance	EW-13 Compliance	EW-19 Compliance		
Diss. Barium	ug/l	Annual	440							
Diss. Boron	ug/l	Annual	1900							
Diss. Cadmium	ug/l	Annual	2.2							
Diss. Calcium	mg/l	Annual								
Diss.Chromium	ug/l	Annual	11							
Diss. Copper	ug/l	Annual	9							
Diss. Iron	ug/l	Annual	300							
Diss. Lead	ug/l	Annual	10							
Diss. Managanese	ug/l	Annual	530							
Diss. Magnesium	mg/l	Annual	200							
Diss. Inorganic Mercury	ug/l	Annual	0.0013							
Diss. Nickel	ug/l	Annual	52							
Diss. Potassium	mg/l	Annual								
Diss. Selenium	ug/l	Annual	5							
Diss. Silver	ug/l	Annual	0.2							

68

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-1A Compliance	EW-12 Compliance	EW-13 Compliance	EW-19 Compliance		
Diss. Zinc	ug/l	Annual	120							
Tot. Organic Carbon (TOC)	mg/l	Annual								
Phenols	mg/l	Annual								
Hydrazine	ug/l	Quarterly	10		<3	<3	<3	<3		
Ethanolamine	mg/l	Quarterly	2		<0.7	<0.7	<0.7	<0.7		

169

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-8 Upgradient					
Static Water Elevation	Ft.	Quarterly			609.74					
pH	s.u.	Quarterly			6.6					
Chloride	mg/l	Quarterly			40					
Specific Conductivity	umho/cm	Quarterly			537					
Tot. Inorganic Nitrogen	mg/l	Quarterly			1.02					
Ammonia Nitrogen	mg/l	Quarterly			<0.01					
Nitrite Nitrogen	mg/l	Quarterly			<0.01					
Nitrate Nitrogen	mg/l	Quarterly			1.02					
Tot. Phosphorus	mg/l	Quarterly			<0.01					
Sulfate	mg/l	Quarterly			33					
Diss. Sodium	mg/l	Quarterly			23.6					
Tot. Diss. Solids	mg/l	Quarterly			272					
Tot. Alkalinity	mg/l	Annual								
Bicarbonate	mg/l	Annual								
Diss. Aluminum	ug/l	Annual								
Volume Purged	Gallons	Quarterly			30					

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-8 Upgradient					
Diss. Barium	ug/l	Annual								
Diss. Boron	ug/l	Annual								
Diss. Cadmium	ug/l	Annual								
Diss. Calcium	mg/l	Annual								
Diss.Chromium	ug/l	Annual								
Diss. Copper	ug/l	Annual								
Diss. Iron	ug/l	Annual								
Diss. Lead	ug/l	Annual								
Diss. Managanese	ug/l	Annual								
Diss. Magnesium	mg/l	Annual								
Diss. Inorganic Mercury	ug/l	Annual								
Diss. Nickel	ug/l	Annual								
Diss. Potassium	mg/l	Annual								
Diss. Selenium	ug/l	Annual								
Diss. Silver	ug/l	Annual								

GROUNDWATER QUALITY

American Electric Power Company
Facility Name 1

Oct-04
Date

GW111600
ID Number

Parameter	Units	Sampling Frequency	Limit: Rule 2227	Limit: Rule 2228	EW-8 Upgradient					
Diss. Zinc	ug/l	Annual								
Tot. Organic Carbon (TOC)	mg/l	Annual								
Phenols	mg/l	Annual								
Hydrazine	ug/l	Quarterly			<3					
Ethanolamine	mg/l	Quarterly			<0.7					

D.C. Cook Nuclear Plant
1 Cook Place
Bridgman , MI
49106
Permit # M 00988
Part II.A.8

Outfall Description	Description of the circumstances	Cause of noncompliance	Period of non compliance	Steps to prevent recurrance
No exceedences				

173

EQP
10/99

INDIANA MICHIGAN POWER

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

Ms. Jeanette Bailey
Michigan Department of Environmental Quality
Groundwater Permits Unit
P.O. Box 30273
Lansing Michigan 48909-7773

July 25, 2005

Dear Ms. Bailey:

Subject: Donald C. Cook Nuclear Plant
Groundwater Permit M00988

The following is a response to your request of June 14, 2005 for more information for our groundwater permit application submitted to your office on March 3, 2005. The attached pages include a legible map listed in item #1, a copy of a letter designating signatory authority listed in item #2, a new page 36 that includes discharge volumes for the outfalls requested in item #3, and an irrigation management plan requested in item #4. In addition, we have included a clean copy of the wastewater flow diagram with updated outfall flows.

Should you have any questions regarding this response, please contact me at (269) 465-5901, ext. 1153.

Sincerely,

John P. Carlson
Environmental Manager

Enclosure

2005-661

I certify under penalty of law that I have personally examined and am familiar with the information submitted on this and all attached documents, and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

John P. Carlson
Environmental Manager

2005-661

bc: J. P. Carlson
M. J. Finissi
C. E. Hawk
J. N. Jensen
J. S. Miller
W. H. Schalk
R. J. Sieber
B. W. Watson
T. K. Woods
B. K. Zordell
MDEQ File
NDM (2005-661)

1. TYPE OF TREATED WASTEWATER FOR WHICH THE AUTHORIZATION IS REQUESTED. PLEASE CHECK ALL THAT APPLY

__X__ Sanitary sewage
__X__ Process wastewater
_____ Cooling water, greater than 5,000 gallons per day
_____ Non-contact cooling without additives, greater than 10,000 gallons per day, source water not approved by department.
_____ Non-contact cooling water with additives, greater than 10,000 gallons per day.
_____ Other, please describe:

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: 669,340 gallons per day

Cumulative annual discharge: 99,017,356 gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period __NA__ through __NA__

IRRIGATION SYSTEMS AND SEEPAGE BEDS UTILIZING SOILS FOR TREATMENT SHOULD INLCUDE THE FOLLOWING:

Effluent application rate:

Inches per hour __NA__ Inches per day __NA__ Inches per week __NA__ Inches per year __NA__

3. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
__X__Other - Please describe: Infiltration pond			

4. TREATMENT CODES

Select and enter the appropriate treatment codes to describe treatment units, i.e., A1b, B2b (see APPENDIX A, Pages 41-44)

Treatment Unit A	TRS	A-1h	B-1b	A-1f	
Treatment Unit B	SBR	A-2b	C-3a	C3b	A-1f
Treatment Unit C		_____	_____	_____	
Treatment Unit D		_____	_____	_____	

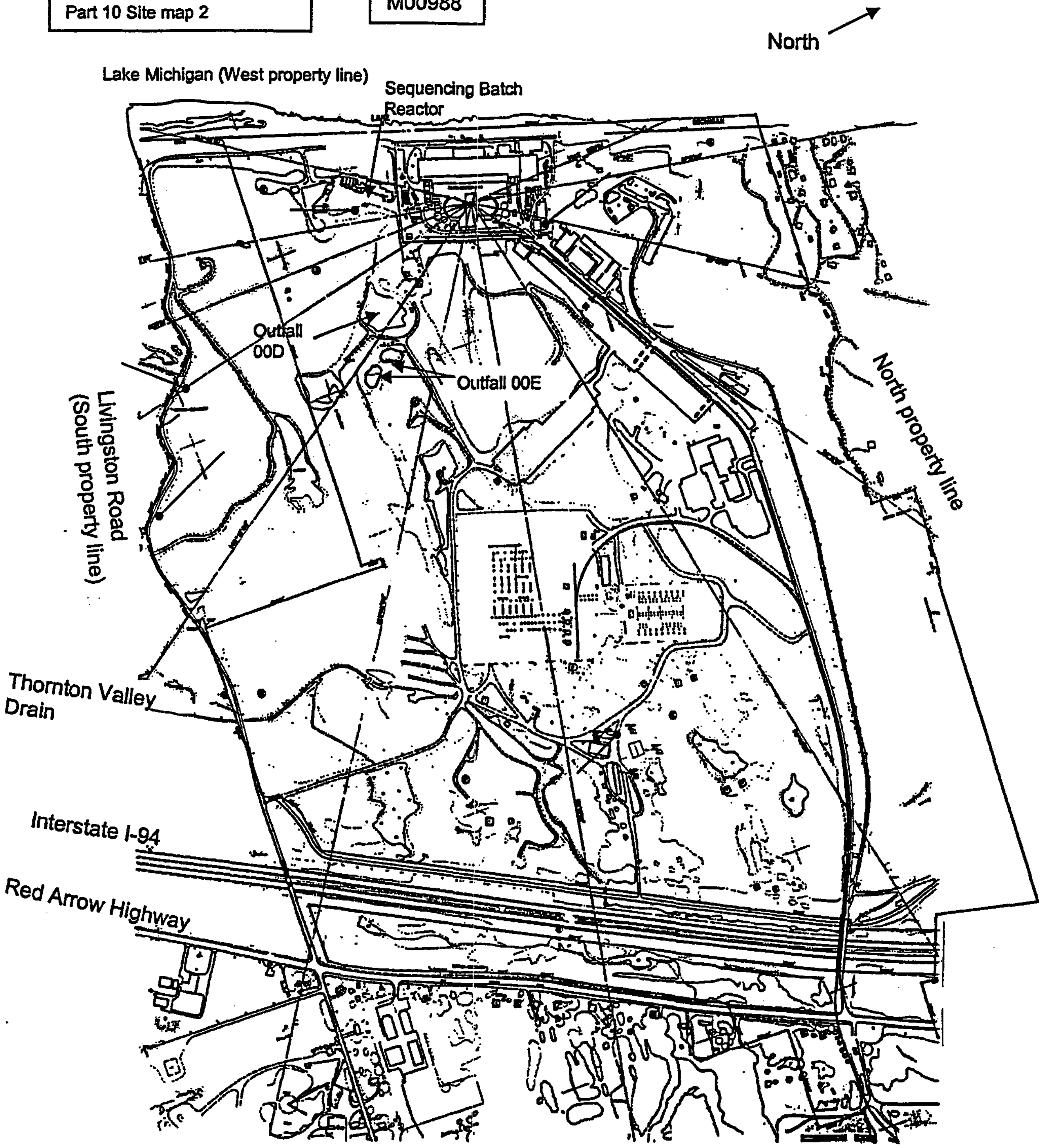
Please provide a description of the treatment system indicating how it will produce an effluent that will meet the standards of Rule 2222.

Cook Nuclear Plant
Berrien County
Lake Township
Scale: 1" = 1250'

5

Donald C. Cook Nuclear Plant
Part 10 Site map 2

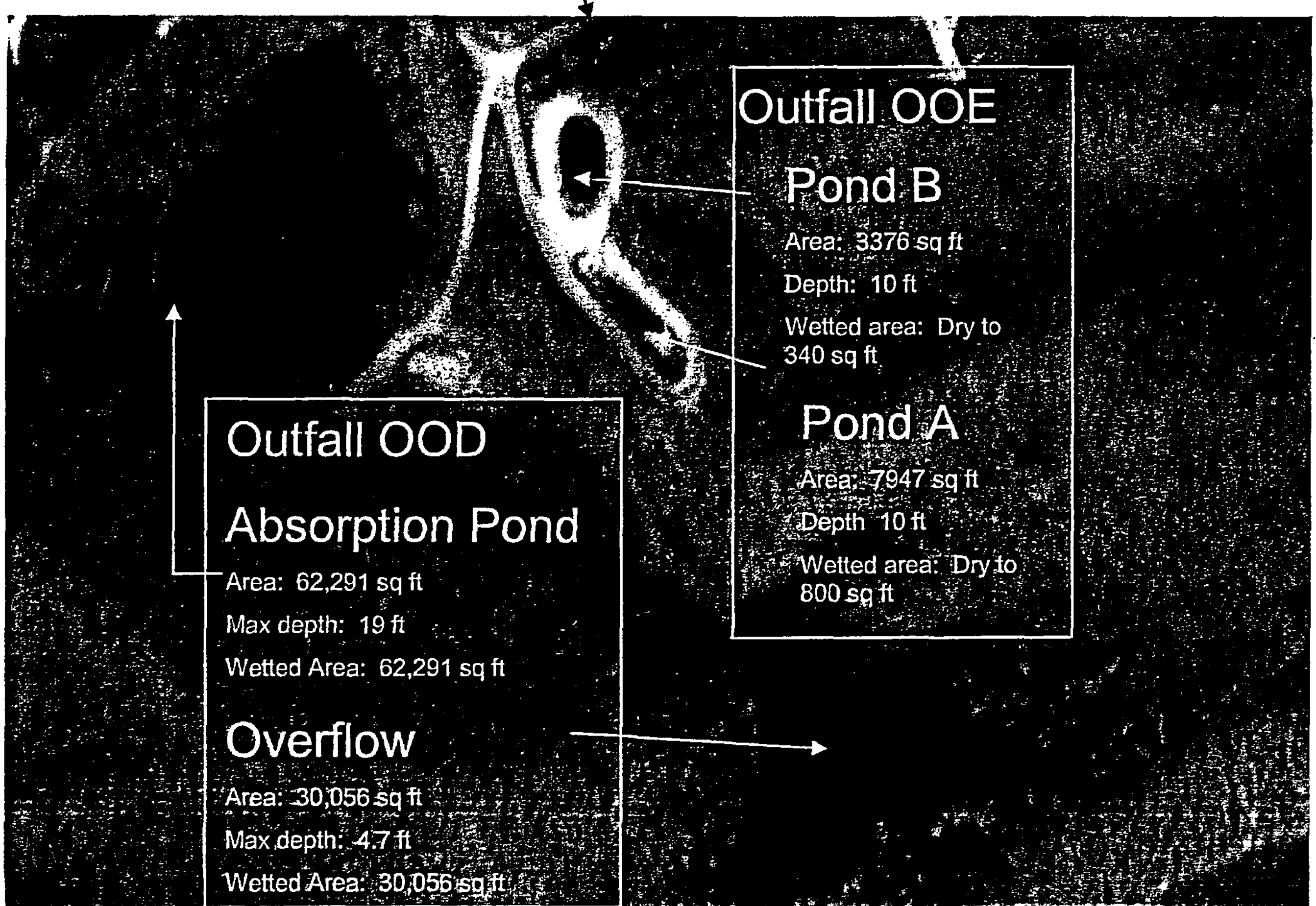
M00988



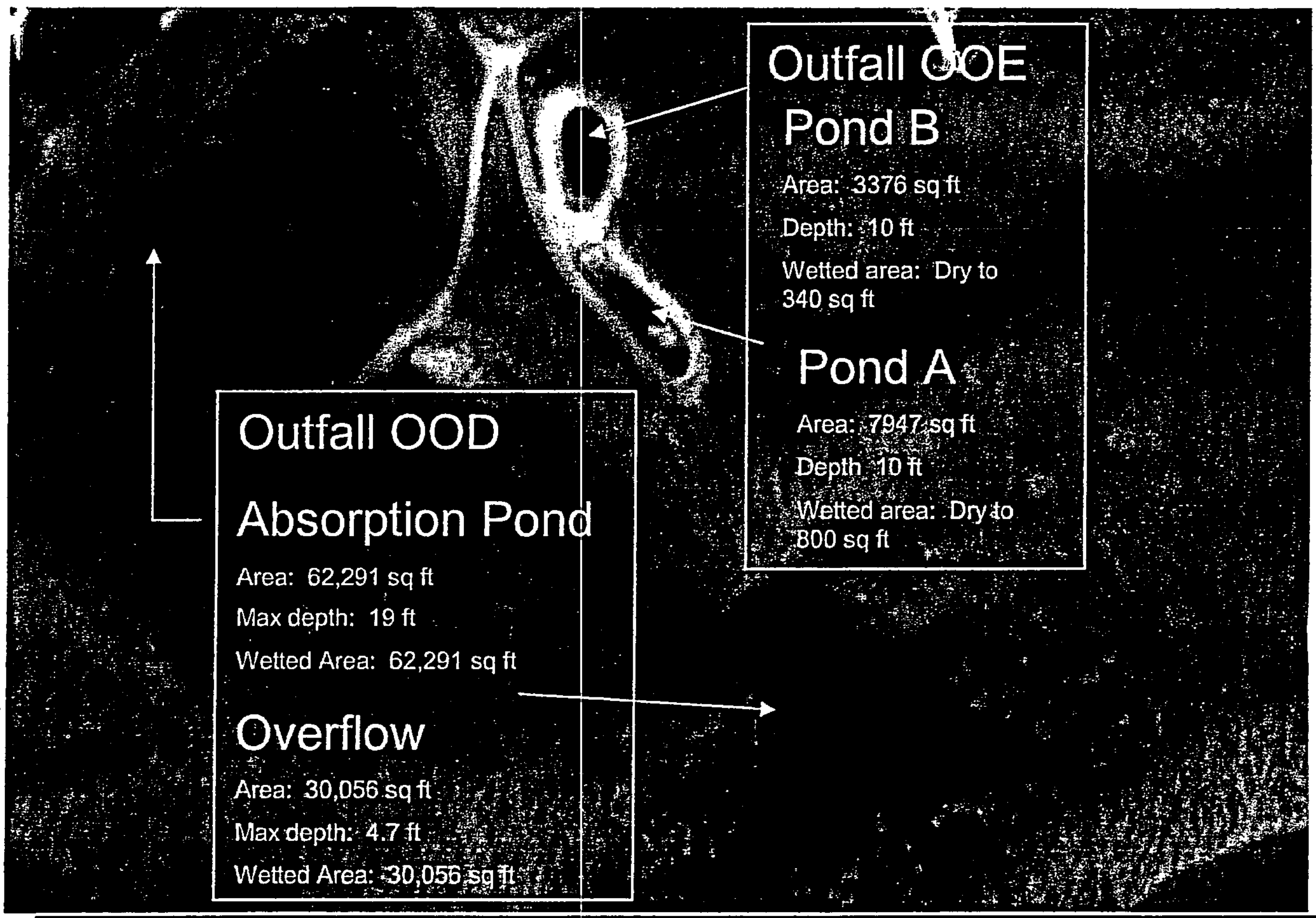
Distance from discharge 00D	Distance from discharge 00E
South property line: 1200'	South property line: 1300'
Lake Michigan: 1000'	Lake Michigan: 1500'
East property line: 3600'	East property line: 3400'
North property line: 2600'	North property line: 2600'

Cook Nuclear Plant
Berrien County
Lake Township
Scale: 1" = 1000'

6



Cook Nuclear Plant GW application. Response to June 14, 2005 request for more information.



Cook Nuclear Plant GW application. Response to June 14, 2005 request for more information.

Groundwater Discharge Management Plan

American Electric Power Company
Donald C. Cook Nuclear Plant
Bridgman, Michigan
Permit Number M 00988

July 18, 2005

Revision 0

9

Table of Contents

1. Introduction 1
   Outfall 00D - Turbine Room Sump 1
   Outfall 00E – Sanitary Waste Discharges 1
2. Discharge Information 2
3. Infiltration Area Information 2
4. Hydraulic Loading Cycle 3
   4.1 Permeability Data 3
   4.2 Dosing Cycle 3
      Outfall 00D - Turbine Room Sump 3
      Outfall 00E – Sanitary Waste Discharges 3
Attachment 1 Solar Bee Specifications 5
Attachment 2 Permeability Data 6

10

1. Introduction

There are two groundwater discharges at the Cook Nuclear Plant; the Turbine Room Sump and Sanitary Waste Discharges. Both of these discharges have been authorized since July 10, 1974 although there have been revisions to both the quantity and location of the discharges. Both effluents are treated to meet water quality standards prior to discharge to the respective ponds. Therefore, the sole purpose of the ponds is to transport the effluent to Lake Michigan by rapid infiltration into the groundwater (no treatment is required by the soil).

Outfall 00D - Turbine Room Sump

Utility wastewater from within CNP is discharged via the turbine room sump (TRS) into an on-site absorption pond (Outfall 00D). The ultimate disposition of these wastewaters is to Lake Michigan since the groundwater in the vicinity naturally vents to Lake Michigan. The wastewaters associated with this Outfall include: wastes from the makeup water treatment system which is comprised of the NESW (filtered and treated with sodium hypochlorite Lake Michigan Water), pre-filter backwash, carbon filter backwash, demineralizer regeneration, MUP Neutralization Tank, the Retention Tank, and the Reverse Osmosis System (RO) Cleaning. There are also wastes from miscellaneous processes.

The only treatment required is pH neutralization. The pH is continuously monitored in the discharge to the absorption pond.

The turbine room sump absorption pond consists of two rapid infiltration areas; the main area (Area A) and an overflow area (Area B). The discharge is made to Area A. Area B is only used if Area A cannot process the discharge flow.

Outfall 00E – Sanitary Waste Discharges

The system operates at a designed flow of 50,000 GPD with a maximum flow capacity of 60,000 GPD. The Sequencing Batch Reactors (SBRs) treat the wastewater and discharge to an effluent tank where the wastewater is filtered prior to discharge to one of two "seepage lagoons". Although known as "seepage lagoons" by plant personnel, the very clean effluent from the SBRs rapidly infiltrates into the groundwater which vents to Lake Michigan. Sludge removed from the digester tanks is taken to a local POTW (public owned treatment works) for disposal or dewatered and stored as low level radioactive waste, as appropriate.

To aid in the settling process, flocculants such as ferric chloride, pH controllers such as magnesium hydroxide, or Polymers (such as Axchem AF4500) are added to the process. To selectively enhance biosolids, bioaugmentation nutrients (such as Bioprime Dosfolat) are added. Bioprime Dosfolat is a nutrient that encourages the growth of beneficial microbes in the activated sludge. Sodium hypochlorite is added in small amounts to control filamentous bacteria growth if needed. Sodium hypochlorite and detergent are also added to the sand filters to clean them periodically. These are then backwashed into the equalization basin to be reprocessed by the SBRs.

Plant sanitary waste consists of shower and rest room facilities, and janitor washbasins located throughout the Plant's non-radiological property. Kitchen wastes are generated from the plant cafeteria, the Cook Energy Information Center and Training buildings.

The chemistry training laboratory discharges to the SBRs through a limestone bed neutralization tank. The chemistry training lab is used to train technicians on analyses performed in the plant. The discharge from the lab carries water and wastes generated while performing analyses and preparing laboratory standards. The training building HVAC system also drains to the limestone bed.

All portable toilet wastes on the plant site are collected and may be discharged to the sequencing batch reactor, or trucked to the POTW. A biodegradable deodorant is used in the portable toilets. Sludge effluent waste may also be recycled through the plants to decrease the amount of sludge for processing when possible.

Waste water from miscellaneous rinsing of waste receptacles and possible cleaning operations utilizing detergents, may be directed to the sewage treatment plants.

2. Discharge Information

The following Table shows the maximum annual and daily average volume of discharge expected to the sanitary seepage lagoons and to the non-contact cooling discharge. This information was determined for the period January 2004 through December 2004.

Discharge	Volume, gpd
EF-1 Turbine Room Sump daily average flow	252,000
EF-1 Turbine Room Sump maximum annual flow	631,000
EF-2 Sanitary Wastewater daily average flow	18,000
EF-2 Sanitary Wastewater maximum annual flow	38,300

3. Infiltration Area Information

The following Tables provide information regarding the infiltration areas.

EF-1 Turbine Room Sump Discharge	
How many infiltration areas?	2
Size of each bed/seepage lagoon (area and depth)?	Area A surface area = 62,291 ft^2 Area A depth = 19 ft Overflow Area B surface area = 30,056 ft^2 Overflow Area A depth = 4.7 ft
Wetted area of each?	Area A wetted area = 62,291 ft^2 Overflow Area B wetted area = 30,056 ft^2
How constructed to prevent surface runoff?	The area is at the bottom of a swale among the sand dunes and is isolated from other area runoff.
How constructed to provide even distribution of wastewater?	Area A is continuously stirred using a Solar Bee (see Attachment 1). Area B receives the fully mixed effluent from Area A.
How often they are inspected?	The ponds are inspected daily in accordance with permit M 00988.
Can one bed can be taken out of service for repair and/or maintenance without disruption of the use of the other cell?	The ponds were not designed for this but it could be done, if necessary.

EF-2 Sanitary Wastewater Discharge	
How many infiltration areas?	2
Size of each bed/seepage lagoon (area and depth)?	Area A surface area = 7,947 ft^2 Area A depth = 10 ft Area B surface area = 3,376 ft^2 Area A depth = 10 ft
Wetted area of each?	Area A wetted area = 800 ft^2 Overflow Area B wetted area = 340 ft^2
How constructed to prevent surface runoff?	Constructed on the pinnacle of a sand dune.
How constructed to provide even distribution of wastewater?	There is a concrete splash plate. However, the effluent is so clean that it is instantly absorbed into the sand.
How often they are inspected?	At least weekly in accordance with permit M 00988.
Can one bed can be taken out of service for repair and/or maintenance without disruption of the use of the other cell?	Yes.

4. Hydraulic Loading Cycle

4.1 Permeability Data

Short duration pumping tests were performed to determine values of permeability across the site. These pumping tests indicate that permeability values could range from 115 to 196 ft/day (4.06×10^{-2} to 6.91×10^{-2} cm/sec) assuming an aquifer thickness of 30 feet. This pump test data is shown in Attachment 2.

4.2 Dosing Cycle

Following is a thorough explanation of the dosing cycle to the beds, including # of days of dosing, draining, and resting before next dosing.

Outfall 00D - Turbine Room Sump

International Hydronics Corporation only designed one pond for the turbine room sump discharge since this waste stream is relatively free from suspended matter and dissolved organic material which would lead to the development of biological sludge. It was expected that this pond would not require extensive cleaning to maintain infiltration rates. This has proved to be the case. The pond has only been cleaned once in 1982.

Outfall 00E – Sanitary Waste Discharges

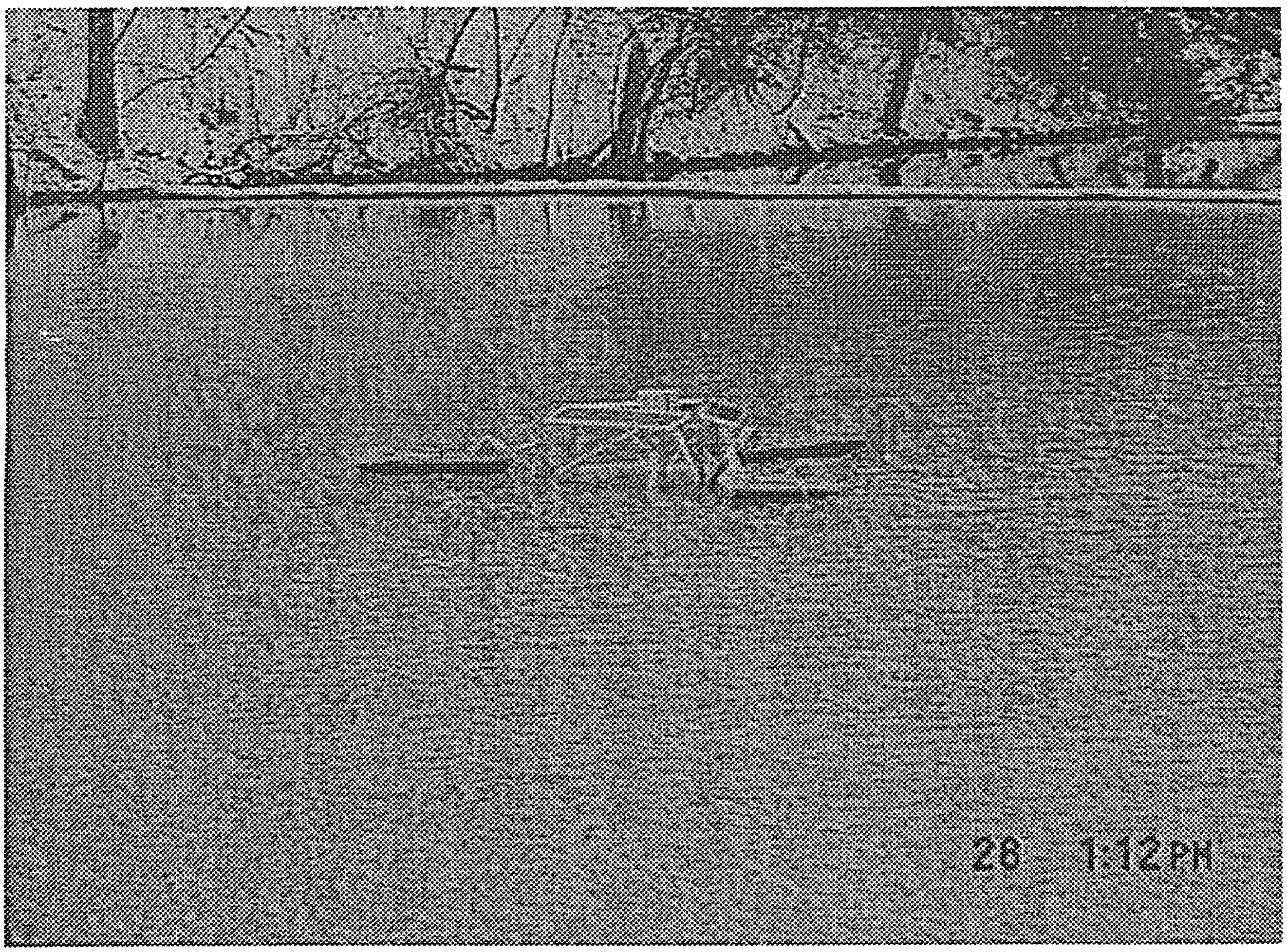
The current sanitary waste discharge ponds were constructed on the top of sand dune above the turbine room sump pond at the same time the turbine room sump pond was cleaned in 1982. Before that time, the sanitary waste discharge ponds were located in the dune swale adjacent to the turbine room sump pond. The change was made to assure that all biological sludge was separate from the turbine room sump discharge.

In 1995, the extended aeration sewage treatment plants were replaced with two sequencing batch reactors (SBRs). The final effluent from the SBRs is so clean, that there is no sludge observed in the sanitary waste discharge ponds and the discharge instantly disappears into the sand. However, the ponds are still rotated approximately every six weeks . Therefore, the dosing cycle is:

# Days Dosing	42
# Days Draining	0
# Days Resting	42

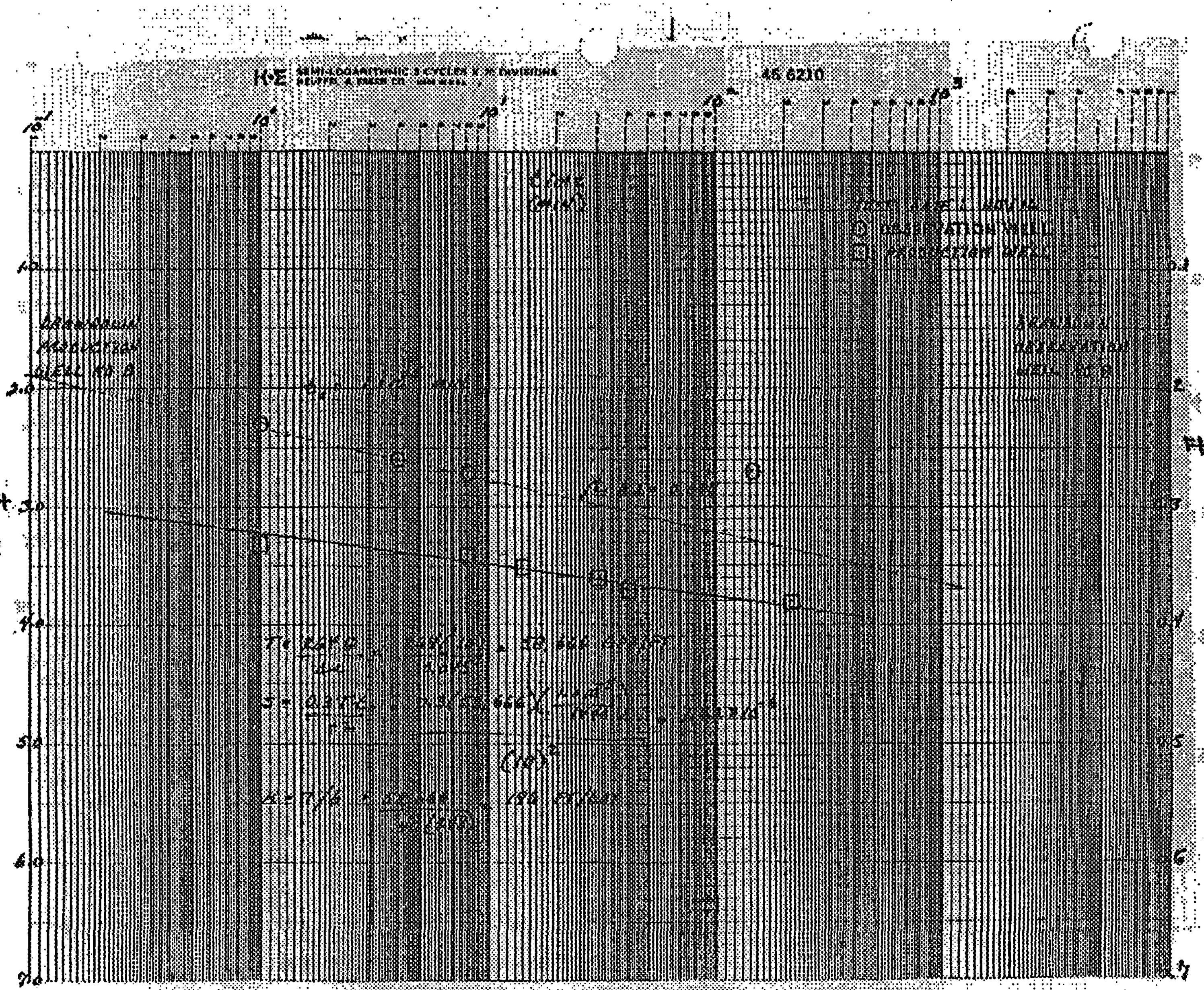
Attachment 1 Solar Bee Specifications

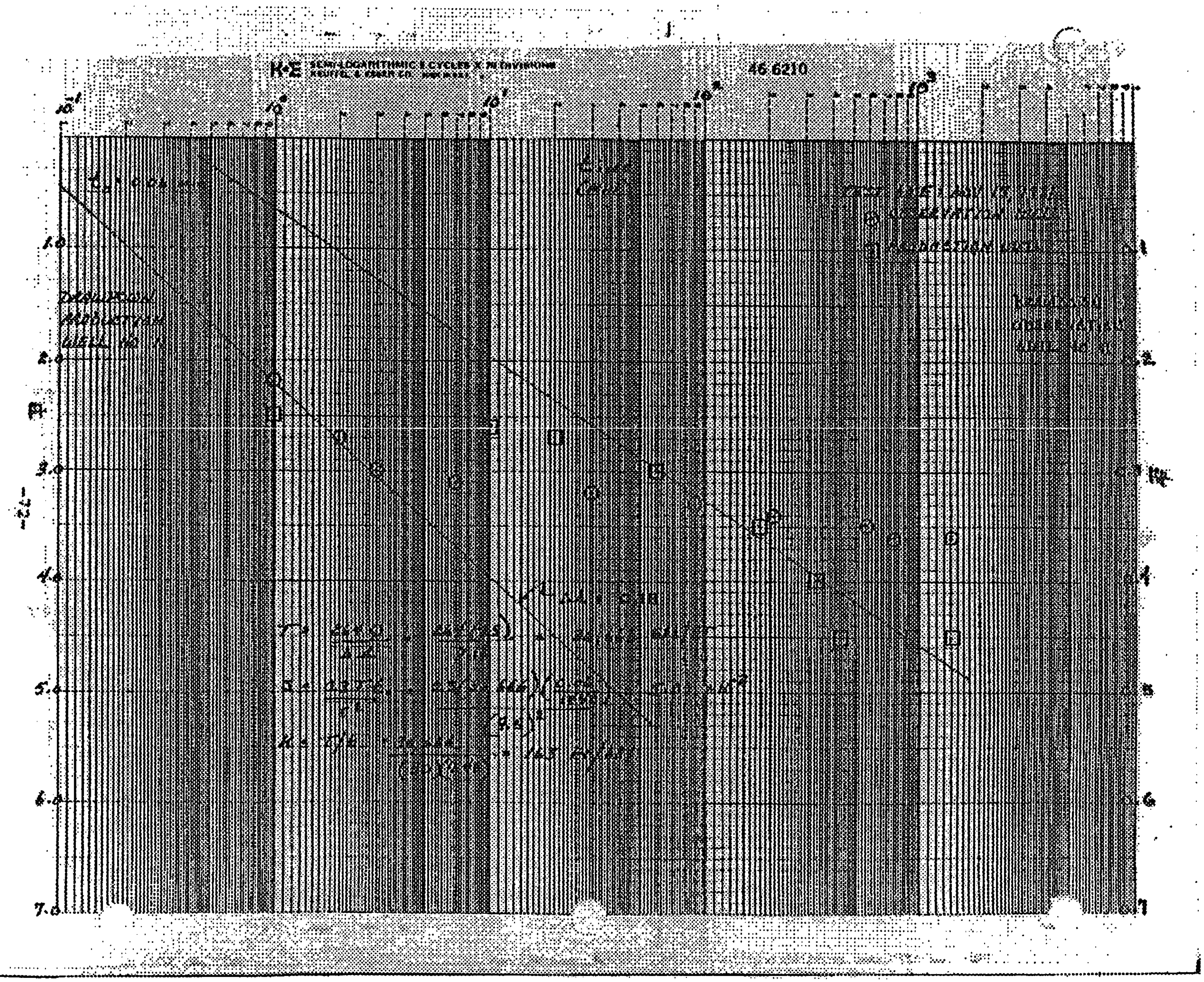
Solar-Energy-Powered Pump. The total flow leaving the SolarBee can be described as: Primary flow + Induced Flow = Total Flow = Surface Renewal Flow. In full sunlight, the SolarBee pumps 500 gallons per minute (gpm) of primary flow which, in turn, causes an additional 2000 gpm of induced flow to come up from the lower depths of the pond under the machine, for a total flow of 2500 gpm that renews the surface of the pond.



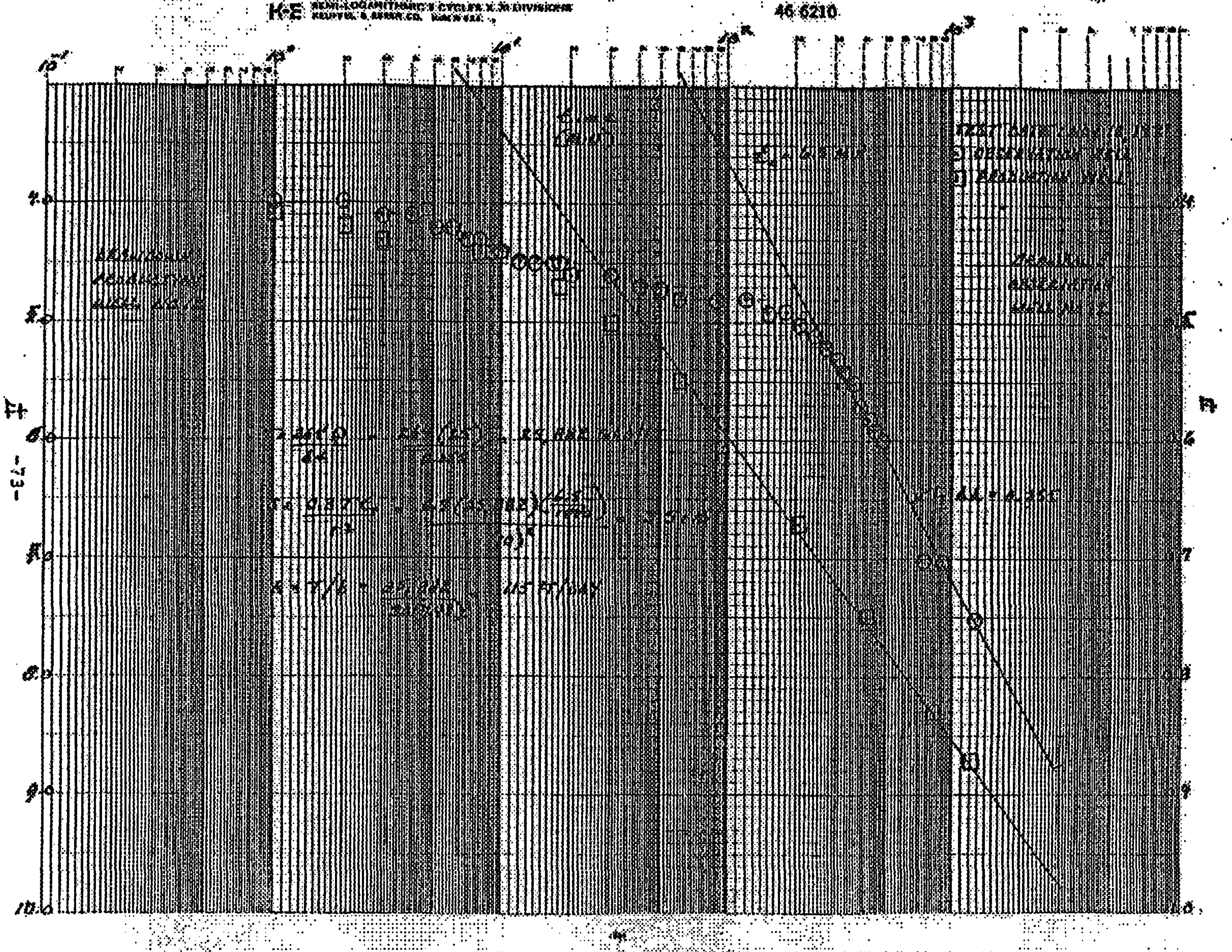
Attachment 2 Permeability Data

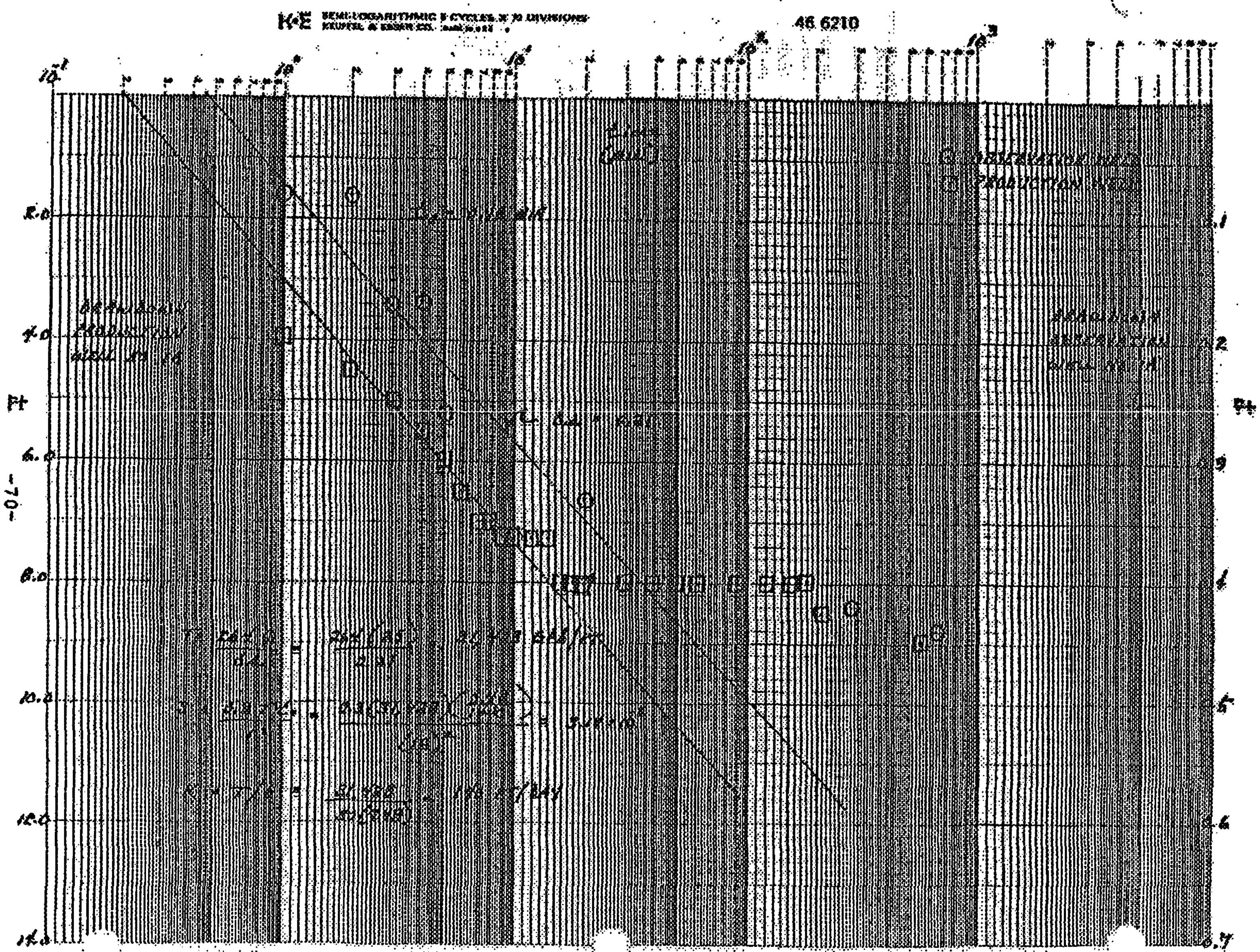
Summary of Aquifer Pump Test Data						
Observation Well No.	Q, gpd	r, ft	T, gpd/ft	k, ft/day	S	Analytical Method
8	10	10	58,666	196	1.22×10^{-6}	Jacob
1 A	25	10	31,428	140	3.14×10^{-7}	Jacob
11	25	9.5	36,666	163	5.07×10^{-3}	Jacob
12	25	10	25,882	115	3.50×10^{-1}	Jacob
Average			38,160	153.5		
Notes:	1. The drawdown for each production well is plotted on semi-logarithmic paper for comparison with the drawdown observed in the respective observation well.					
	2. The permeability is derived from the transmissivity (T) divided by the aquifer thickness. The aquifer thickness at observation well No. 8 is estimated to be 40 ft and 30 ft for the remaining wells.					
	3. Data Source is Donald C. Cook Nuclear Plant, Annual Environmental Operating Report, 1981.					


K·E SEMI-LOGARITHMIC 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO.
46 6210
OBSERVATION WELL
PRODUCTION WELL
1.0
2.0
3.0
4.0
5.0
6.0
7.0
ft



K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO.
46 6210


46 6210


46 6210

INDIANA MICHIGAN POWER

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

Ms. Jeanette Makries
Michigan Department of Environmental Quality
Groundwater Permits Unit
Constitution Hall-North Tower 2nd Floor
P.O. Box 30630
Lansing, MI 48900-8130

August 11, 2005

Dear Ms. Makries:

Subject: Donald C. Cook Nuclear Plant
Groundwater Permit M00988

The enclosed is a revision to page 36 of our Groundwater Permit application submitted to your office on March 3, 2005. In our revised submittal dated July 25, 2005, we assumed that the data submitted in Section 2 of page 36 was actual data collected from submitted reports. We now understand after a phone conversation with you that this Section is used as a request for potential discharges. We are requesting the same discharge volumes that were included in the September 29, 2000 authorization.

Outfall 00D	2,400,000 gpd max
Outfall 00E	60,000 gpd max
Outfall 00D	876,000,000 gpy cumulative
Outfall 00E	21,900,000 gpy cumulative

Should you have any questions regarding this response, please contact me at (269) 465-5901, ext. 1153.

Sincerely,

John P. Carlson
Environmental Manager

Enclosure

2005-756

I certify under penalty of law that I have personally examined and am familiar with the information submitted on this and all attached documents, and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

John P. Carlson
Environmental Manager

bc: J. P. Carlson
C. E. Hawk
J. N. Jensen
J. S. Miller
M. K. Scarpello
W. H. Schalk
R. J. Sieber
B. W. Watson
L. J. Weber
B. K. Zordell
MDEQ File
NDM (2005-756)

RULE 323.2218

DISCHARGE PERMITS

1. TYPE OF TREATED WASTEWATER FOR WHICH THE AUTHORIZATION IS REQUESTED. PLEASE CHECK ALL THAT APPLY

__x__ Sanitary sewage
__x__ Process wastewater
_____ Cooling water, greater than 5,000 gallons per day
_____ Non-contact cooling without additives, greater than 10,000 gallons per day, source water not approved by department.
_____ Non-contact cooling water with additives, greater than 10,000 gallons per day.
_____ Other, please describe:

2. DISCHARGE VOLUME

ALL DISCHARGES:

Maximum daily discharge: 00D: 2,400,000 gpd 00E: 60,000 gpd gallons per day

Cumulative annual discharge: 00D: 876,000,000 00E: 21,900,000 gallons per year

SEASONAL DISCHARGES SHOULD INCLUDE THE FOLLOWING:

Discharge period __NA__ through __NA__

IRRIGATION SYSTEMS AND SEEPAGE BEDS UTILIZING SOILS FOR TREATMENT SHOULD INLCUDE THE FOLLOWING:

Effluent application rate:

Inches per hour __NA__ Inches per day __NA__ Inches per week __NA__ Inches per year __NA__

3. DISCHARGE METHOD

Please check the discharge method used:

LAND SURFACE DISPOSAL	DISPOSAL CODE	SUBSURFACE DISPOSAL	DISPOSAL CODE
_____Spray Irrigation	A1f1	_____Tile Field	A1g1
_____Ridge and Furrow	A1f2	_____Injection well	A1g2
_____Flood/Sheet Irrigation	A1f3	_____Trench	A1g3
		_____ Drywell	A1g4
Seepage Beds:			
_____Slow/Medium Rate	A1f4		
_____Rapid Rate	A1f5		
__x__Other - Please describe:	Infiltration Pond		

4. TREATMENT CODES

Select and enter the appropriate treatment codes to describe treatment units, i.e., A1b, B2b (see APPENDIX A, Pages 41-44)

Treatment Unit A	A-1h	B-1b	A-1f	
Treatment Unit B	A-2b	C-3a	c-3b	A-1f
Treatment Unit C	____	____	____	
Treatment Unit D	____	____	____	

Please provide a description of the treatment system indicating how it will produce an effluent that will meet the standards of Rule 2222.

APPENDIX V

SPECIAL REPORTS

2005

FINAL REPORT

Mixing Zone Evaluation for the Donald C. Cook Nuclear Plant Discharge Plume in Lake Michigan

Prepared for:

AEP Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106

Prepared by:

Great Lakes Environmental Center

Great Lakes Environmental Center
739 Hastings Street
Traverse City, MI 49686
Phone: 231-941-2230
Facsimile: 231-941-2240

Principal Contact Persons:

Dennis J. McCauley
dmccauley@glec.com

Doug Endicott
dendicott@glec.com

April 20, 2006

EXECUTIVE SUMMARY

The Indiana Michigan Power Company's Donald C. Cook Nuclear Plant located on the southeastern shore of Lake Michigan is seeking to modify its NPDES Permit to allow the use of the proprietary molluscicide, Mexel 432, to control the settlement and growth of zebra mussels and quagga mussels on the intake tunnels of the circulating water system.

The Michigan Department of Environmental Quality has calculated a water quality criterion for Mexel. If this criterion is applied to the Cook Nuclear Plant as an end-of-pipe limit, the limit will be exceeded. The objective of the mixing zone evaluation was to summarize the existing data in a report to the Michigan Department of Environmental Quality (MDEQ) to determine whether a mixing zone is acceptable and protective of the designated uses and water quality of the receiving water (Lake Michigan). Ultimately, the goal of the demonstration is to achieve compliance for future Cook Nuclear NPDES discharges with Rule 51 of the Michigan Water Quality Standards, specifically, Rule 323.1082 (Rule 82, Mixing zones); Sub-rule 7.

The State of Michigan water quality standard allows dischargers to meet water quality criteria at the edge of a mixing zone. Michigan's regulation defines mixing zone as, "that portion of a water body allocated by the department where a point source or venting groundwater discharge is mixed with the surface waters of the state." (Water Quality Standards Part 4, R 323.1082(1)) Indiana Michigan Power Company was asked by the MDEQ to determine the dilution ratio of the Mexel discharge concentration with Lake Michigan water. Michigan Surface Water Quality Standards rule defines the edge of the mixing zone as the point where discharge-induced mixing ceases to occur.

A computational fluid dynamics model (FLUENT v6.2) was used to determine the dilution ratio of Mexel in the discharge from Cook Nuclear Plant, at the edge of a mixing zone, using Michigan water quality standards definitions and procedures.

The modeling results demonstrated that the dilution factor at the edge of the near-field mixing zone will be approximately 3.0 at the 2 ft. /sec. (fps) isopleth. The modeling results also demonstrated that the two cooling water discharges do not overlap and that the area of the near-field mixing zone for each outfall is relatively small and contained within several hundred square feet.

A review of the potential impact on designated uses of Lake Michigan water concluded that there was no impact on any designated use. Of particular concern, will be the impact of the application of a molluscide Mexel A-432 to the cooling water discharge on Great Lakes fisheries and aquatic life. Cook Nuclear had previously developed a Tier I water quality criterion of 0.1 mg/L (100 μg/L) for Mexel. No other water quality criterion is of concern at this time. The expected maximum concentration of Mexel A-432 at the edge of the near-field mixing zone, with one unit treated at a time is approximately 0.1 mg/L. The expected maximum concentration of Mexel A-432 at the edge of the near-field mixing zone, with two units treated simultaneously is approximately 0.2 mg/L.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i

Introduction 1

Description of the Study Area and Intake and Discharge Configuration 2
- Lake Bathymetry and Water Currents 2
- Intake Configuration Discharge Configuration 2
- Discharge Configuration 3

Review of Previous Mixing Zone Studies 4

Modeling Objectives 5
- Mixing Zone Definition 5
- FLUENT Model 6
- Model Boundary Conditions 6

FLUENT Model Results 6

Impact on Designated Uses 12

Great Lakes Fishery, Aquatic Life and Wildlife 12
- Review of Water Quality Standards and Toxicity Test Data 13

Public Water Supply 16

SUMMARY AND CONCLUSIONS 21

REFERENCES 23

FIGURES

Figure 1. Plan View of D.C. Cook Condenser Cooling Water System

Figure 2. Two fps Isopleth.

Figure 3. Three fps Isopleth.

Figure 4. Visualization of effluent dilution within the discharge-induced mixing zone (plan view). FLUENT model prediction of ambient lake water fraction (i.e., 1/DR) on 2 fps plume surface velocity isopleth for zero ambient velocity, 2 discharge units operating and treating simultaneously.

Figure 5. Visualization of effluent dilution within the discharge-induced mixing zone (plan view). FLUENT model prediction of ambient lake water fraction (i.e., 1/DR) on 3 fps plume surface velocity isopleth for 1 fps ambient velocity, 2 discharge units operating and treating simultaneously.

Figure 6. Visualization of stream paths for particles injected into the plume at the discharge point(s)

Figure 7. Map Indicating Location of Lake Township Public Water Supply Intake and CNP Discharge Structures in Lake Michigan. The distance between these points was measured as 3,220 feet using survey methods and GPS controls.

TABLES

Table 1. Predicted Average Dilution Ratios (DRs) For Different Ambient Current Velocities, Plume Boundary Velocities, and Operating/Treatment Conditions.

Table 2. Summary of the Designated Uses and the Impact of Cooling Water Discharge on Lake Michigan Offshore of the DC Cook Cooling Water Discharge

Table 3. Summary of Acceptable @Mexel Toxicity Test Data (December 2004)

Table 4. Mexel A-432 Median Lethal Toxicant Concentrations (Lc50) Based on Daily Intermittent Exposures of 20 Minutes Each Day

APPENDIX

Appendix A. Current Meter Data from NOAA/GLERL EEGLE Project. Data Measured at Station C4, Moored in 11 Meters of Water Offshore of the D.C. Cook Nuclear Power Plant.

Introduction

The Indiana Michigan Power Company's Donald C. Cook Nuclear Plant located on the southeastern shore of Lake Michigan is seeking to modify its NPDES Permit to allow the use of the proprietary molluscicide, Mexel 432, to control the settlement and growth of zebra mussels and quagga mussels on the intake tunnels of the circulating water system. Plant operators plan to inject Mexel into the circulating water system at the intake structures out in the lake. The Mexel would be circulated through the plant cooling system and discharged back out into the lake through the cooling water discharge structures.

The objective of this mixing zone evaluation is to summarize the existing data in a report to the Michigan Department of Environmental Quality (MDEQ) to determine whether a mixing zone is acceptable and protective of the designated uses and water quality of the receiving water (Lake Michigan). Ultimately, the goal of the demonstration is to achieve compliance for future Cook Nuclear NPDES discharges with Rule 51 of the Michigan Water Quality Standards, specifically, Rule 323.1082 (Rule 82, Mixing zones); Sub-rule 7.

The MDEQ has calculated a water quality criterion for Mexel. If this criterion is applied to the Cook Nuclear Plant as an end-of-pipe limit, the limit will be exceeded. For the treatments to be effective, Mexel will need to be injected in the intake at concentrations that will not be degraded and diluted to a concentration less than or equal to the water quality criterion by the time the cooling water is discharged to Lake Michigan. In other words, the dosage of Mexel 432 required to control zebra and quagga mussels will result in the discharge of cooling water to Lake Michigan that exceeds the water quality criterion.

The State of Michigan water quality standard allows dischargers to meet water quality criteria at the edge of a mixing zone. Michigan's regulation defines mixing zone as, "that portion of a water body allocated by the department where a point source or venting groundwater discharge is mixed with the surface waters of the state." (Water Quality Standards Part 4, R 323.1082(1)) Indiana Michigan Power Company was asked by the MDEQ to determine the dilution ratio of the Mexel discharge concentration with Lake Michigan water. Michigan Surface Water Quality Standards rule defines the edge of the mixing zone as the point where discharge-induced mixing ceases to occur. According to General Rule, Part 4 R 323.1043 Definitions; A to L:

> "Discharge-induced mixing" means the mixing of a discharge and receiving water that occurs due to discharge momentum and buoyancy up to the point where mixing is controlled by ambient turbulence."

A computational fluid dynamics model (FLUENT v6.2) was used to determine the dilution ratio of Mexel in the discharge from Cook Nuclear Plant, at the edge of a mixing zone, using Michigan water quality standards definitions and procedures. The dilution ratio was applied to the expected maximum end of pipe concentration of Mexel A-432 to determine the expected maximum concentration of Mexel A-432 in Lake Michigan under varying operational scenarios. That concentration was compared to the calculated Michigan Tier I water quality criterion for Mexel A-432.

Description of the Study Area and Intake and Discharge Configuration

Lake Bathymetry and Water Currents

The bottom of Lake Michigan off shore of the Cook Nuclear Plant is fairly smooth and featureless. The bottom slopes gradually at a uniform angle from the shoreline out to a depth of 50 feet at approximately one mile off shore. At that point, the slope of the decent decreases and the depth increases only 10 feet, from 50 feet to 60 feet, over the next half-mile off shore. From there the slope becomes shallower and the depth increases only 15 feet, from 60 to 75 feet, over the next two miles off shore.

The major surface water currents in the southern basin of Lake Michigan are generally in a counterclockwise direction, giving the prevailing current past the Cook Nuclear Plant a south to north direction. North to south currents occurs infrequently depending upon the wind pattern. Acoustic current meter data from the National Oceanic and Atmospheric Administration (NOAA)/Great Lakes Environmental Research Laboratory (GLERL) Episodic Events in the Great Lakes Experiment (EEGLE) Project was acquired to characterize current velocities in the vicinity of the plant outfall structures. Water velocities measured in the fall of 1998 at Station C4, moored in 11 meters of water offshore of the power plant outfalls, are presented as an appendix to this report. Positive u-components of velocity (the second line on the data graphs, counting from the top) correspond to south-to-north longshore currents. Examination of this time series shows that current velocities are usually smaller than 10-20 cm/s (0.3-0.6 fps). Current velocities exceeded 40 cm/s (1.3 fps) twice during this period; these high velocities persisted for several hours to about one day. Given that the November-January time period is particularly energetic in terms of wind, waves, and currents in the Great Lakes, ambient current velocities near the power plant outfalls will tend to be smaller in other seasons.

Intake Configuration

The design intake flow is 1,645,000 gallons per minute (gpm) for the condenser cooling water flow, 16,000 gpm for the essential service water, and 9,000 gpm for the nonessential service water system, for a total intake of approximately 1.67 million gallons per minute. All cooling water and service water is drawn into the plant through three intake tunnels that extend about 2,250 feet offshore. Each tunnel begins with an octagonal-shaped steel structure and velocity cap crib that protects the upturned elbow that is connected to the intake tunnel. Each intake tunnel is 16 feet in diameter and the tunnel carries the water from the offshore location into the screen house. The intake cribs are located in 24 feet of water at 579 ft MSL water elevation. Water flows into the cribs through an 8 x 8 inch mesh grid work that is intended to keep large objects out of the intakes. The water velocity through the 8 x 8-in. grid is 1.27 fps and the water velocity through the tunnels is about 6 fps.

Each intake tunnel is 16 feet in diameter and the tunnel carries the water from the offshore location into the screen house. Inside the screen house the water enters a common forebay (common to both units). The water passes through steel trash racks composed of two designs. The original trash racks are composed of $^3/_8$-in thick by 4-in deep bars on 3-in centers, giving an opening of 2 $^5/_8$-in. These are being replaced over time with trash racks made of bars set on edge to allow a 3 $^3/_{16}$-in clear space between bars (bars are 3 $^9/_{16}$-in. on center and the bar material is $^3/_8$-in thick). From the trash racks, the water flows to optionally installed supplemental trash rack removable inserts placed in the traveling screen stop log slots directly in front of the traveling screens. These inserts are made of $^3/_{16}$-in thick by 2-in deep horizontal bars spaced on 1 $^3/_{16}$-in centers and vertical $^3/_{16}$-in rods on 4-in centers leaving an effective rectangular clear space between the bars and rods of 1-in x 3 $^{13}/_{16}$-in. From there the water flows through the traveling water screens. The original screens were chain belt with $^3/_8$-in mesh screens. The original screens have been replaced with single entry single exit screens (with $^3/_8$-in mesh and $^5/_{16}$-in. mesh screen material) manufactured by Geiger International, Inc.

Discharge Configuration

The cooling water is discharged back to the lake through two tunnels buried beneath Lake Michigan. The discharge structures are located 1,200 feet offshore in 18 feet of water. The total cooling water transit time from intake to discharge is about ten minutes. The Unit 1 discharge tunnel is 16 feet in diameter and the Unit 2 tunnel is 18 feet in diameter. Both tunnels terminate with a 90° elbow that turns the water flow from horizontal to vertical. The water enters the discharge structures from the elbows and is passed horizontally through slots in the discharge structures. The Unit 1 discharge structure has two slot openings, with an overall length of 27 ft. 10 1/8 in. and a height of 2 ft., providing a cross-sectional area of 111.36 ft.^{2}. At a cooling water flow rate of 719,850 gpm (1603.94 ft.^{3}/sec), the discharge velocity from Unit 1 is 14.4 fps. The Unit 2 discharge structure has three slot openings, with an overall length of 19 ft. 7/8 in. and a height of 2 ft. 9 in., providing a cross-sectional area of 157.33 ft.^{2}. At a cooling water flow rate of 950,150 gpm (2117.09 ft.^{3}/sec), the discharge velocity from Unit 2 is 13.5 fps. A conceptual diagram of the cooling water system, including the intake and discharge structures, is provided in Figure 1.

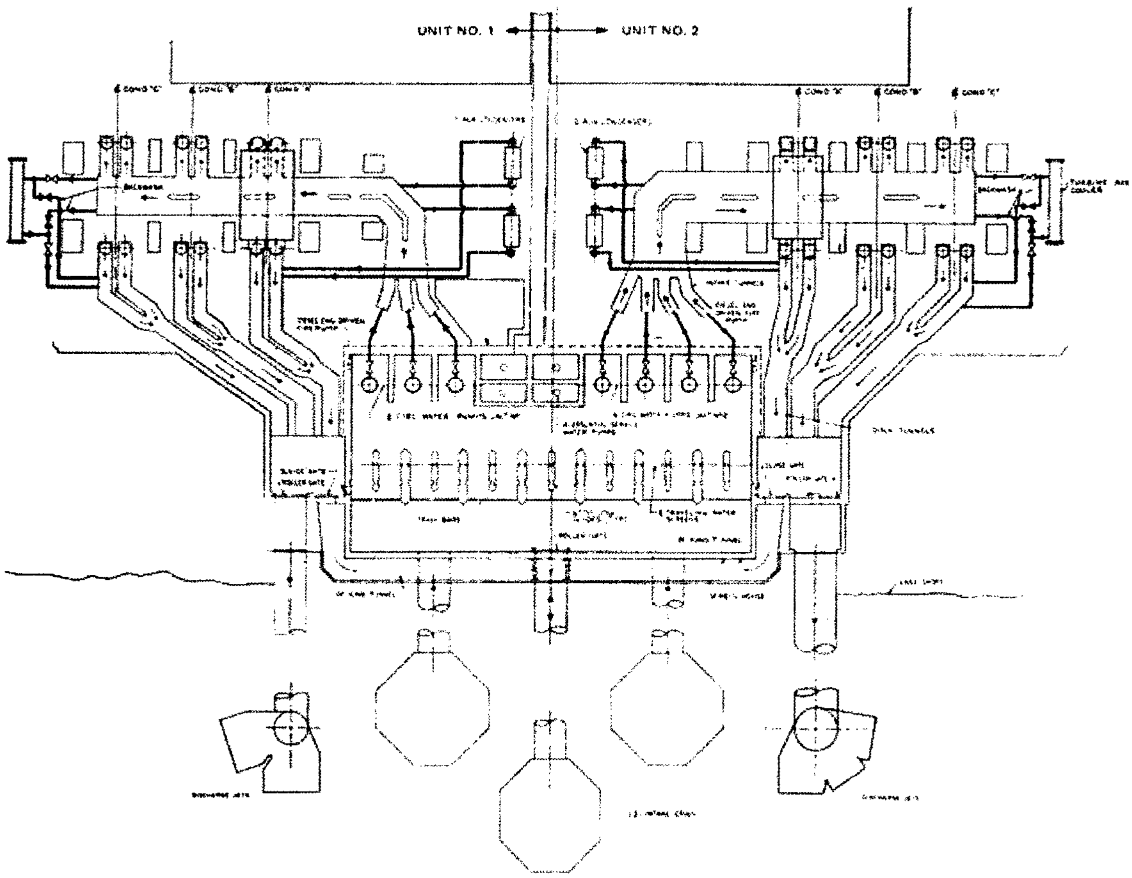


Figure 1. Plan View of D.C. Cook Condenser Cooling Water System

Review of Previous Mixing Zone Studies

LTI conducted a modeling study of the thermal discharge from the D.C. Cook Nuclear Power Plant in 2000 (*Cook Plant Thermal Plume Study*; May 16, 2000). The emphasis of that work was to simulate far-field characteristics of the discharge plume, well beyond the limits of discharge-induced mixing of interest here. However, as part of the LTI study the CORMIX mixing zone model (Jirka et al., 1996) was applied to capture the details of the strong mixing that occurs near the high velocity discharge structures. CORMIX was applied assuming both effluent discharge units were operating, and a long-shore ambient current velocity of 0.03 m/s was used. The CORMIX predictions indicated that (1) the plumes from the two discharge units did not interact with each other (i.e., overlap) in the near-field, (2) the thermal plumes would each reach the lake surface at a distance of 4.85 meters from the respective diffuser structure, and (3) a dilution ratio of 2.2 would be achieved at this distance. The authors of the LTI report did not present the plume velocities predicted by CORMIX, so it is difficult to relate these results to the mixing zone definition being used by the State of Michigan. However, the CORMIX model results can be compared qualitatively to the model predictions made for this mixing zone evaluation.

Modeling Objectives

The object of the numeric modeling was to determine the dilution ratio at the edge of the mixing zone. Michigan Surface Water Quality Standards rule defines the edge of the mixing zone as the point where discharge induced mixing ceases to occur. Theoretically this definition of edge of the mixing zone is reasonable, however, in practice can be difficult to define. A jet discharging into an ambient fluid entrains the ambient fluid. The entrainment is the result of a momentum exchange between the jet and the ambient fluid. Near the source of the jet, the entrainment rate is high, the rate decreases as the jet penetrates the ambient fluid and the jet loses its momentum to the ambient fluid. When the momentum of the jet has been lost to the ambient, further mixing is the result of ambient turbulent mixing and diffusion. Ambient turbulence and diffusion causes mixing at the edge of the plume similar to jet induced mixing but at a much slower rate since there is no relative motion between the jet and the ambient fluid (Davis 1998). The transition from jet induced mixing to ambient mixing is gradual.

<u>Mixing Zone Definition</u>

For the purpose of the DC Cook dilution modeling, the edge of the mixing zone is defined by considering the 3-dimensional velocity distribution for the discharge plumes, predicted by a computational fluid dynamics model. Isopleths (constant velocity surfaces) were constructed and visualized for velocities of 2, 3, 4, and 5 fps. For each iso-surface it was determined if a coherent jet structure was visible. For ambient lake currents of 2 fps it is reasonable to assume that a coherent jet structure is not visible on a 2 fps iso-surface (see Figure 2). Under the same conditions, an iso-surface of 3 fps clearly shows the jet structure (Figure 3). In each figure, the iso-surface has been colored by the inverse of the dilution ratio (i.e., 1/DR). A 100 x 100 ft background grid is shown in each picture. Selecting the appropriate jet surface velocity for defining the edge of discharge induced mixing was somewhat subjective. For this reason, results are provided for a range of velocities.

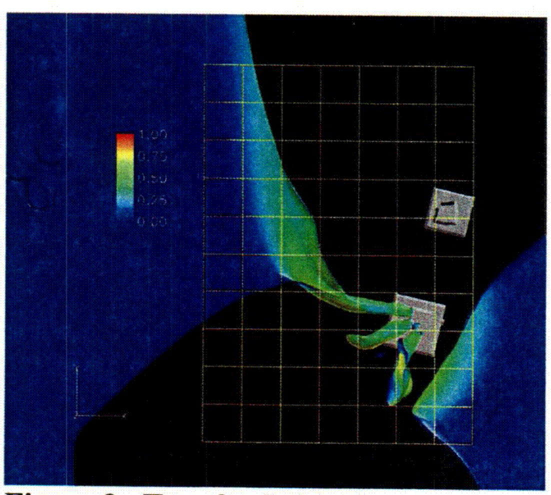


Figure 2. Two fps Isopleth.

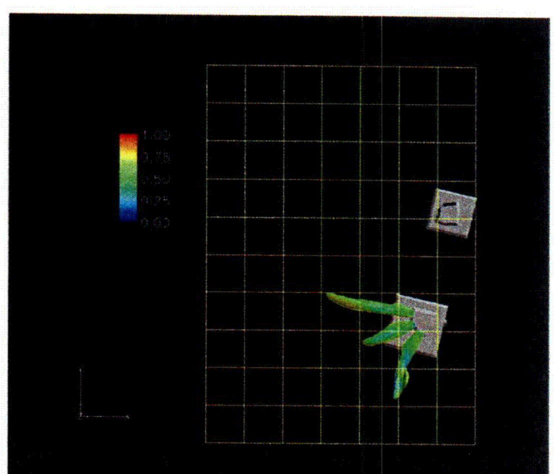


Figure 3. Three fps Isopleth.

C01D

FLUENT Model

The commercially available software FLUENT was used for all the simulations. FLUENT is a fully three dimensional computational fluid dynamics (CFD) solving the Navier-Stokes equations on a boundary fitted mesh. A finite volume formulation of the governing equations is solved in FLUENT. Turbulence closure was achieved using the RNG k-epsilon turbulence model (Yakhot and Orszag, 1986). The energy equation was solved in the simulation to account for the difference in the plume temperature and the ambient temperature.

Model Boundary Conditions

Three plant operating conditions were considered; Unit 1 discharge only, Unit 2 discharge only and discharge through Units 1 and 2. Each operating condition was simulated for four lake current conditions; a no current condition, and currents of 0.5, 1, and 2 fps. As illustrated by current meter data (see Appendix A: lake bathymetry and water currents), 2 fps is a relatively extreme high ambient velocity. The lake current was assumed to be from south to north and the nominal current is the depth averaged value. When units 1 and 2 are in operation, the dilution ratio varies considerably if both units are treated simultaneously or individually. Results are given for both conditions in Table 1. The unit 1 discharge in the simulations is 719,850 gpm and unit 2 discharge is 950,150 gpm.

FLUENT Model Results

Michigan DEQ surface water quality standards rule defines the edge of the mixing zone as the point where discharge induced mixing ceases to occur. For the purpose of this study, dilution ratios are reported on surfaces of constant velocity ("isopleths") ranging from 2 to 5 fps in 1 fps intervals. A visual evaluation of the surface was used to estimate if discharge induced mixing occurred at a specific velocity. For ambient lake currents of 0 to 0.5 fps, discharge induced mixing ceases at a plume surface velocity of 1 to 1.5 fps, depending upon the operating and treatment conditions. For an ambient lake current of 1 fps, discharge induced mixing ceases at a plume surface velocity of 1.5 to 3 fps, while at the highest ambient lake current (2 fps), discharge induced mixing ceases at a plume surface velocity of 3 fps.

Visualizations of effluent dilution predicted within the discharge-induced mixing zones are displayed in Figures 4 and 5. Both discharge units are operating in the simulations shown in these figures. In Figure 4, the ambient current velocity is 0 while, in Figure 5, the current velocity is 1 fps. Comparison of Figures 4 and 5 shows that increasing the ambient velocity tends to shrink the extent of the discharge plumes, as well as the entrainment of lake water within the discharge-induced mixing zone. The yellow grid lines in the visualizations are spaced 100 feet apart, to indicate the size of the plumes. The color scale shows the percentage of water from the discharge. Warm colors (red-yellow) indicate less mixing with lake water and cool colors (blue) indicate more mixing with lake water. The discharge plumes from the two units do not overlap or interact within the discharge-induced mixing region.

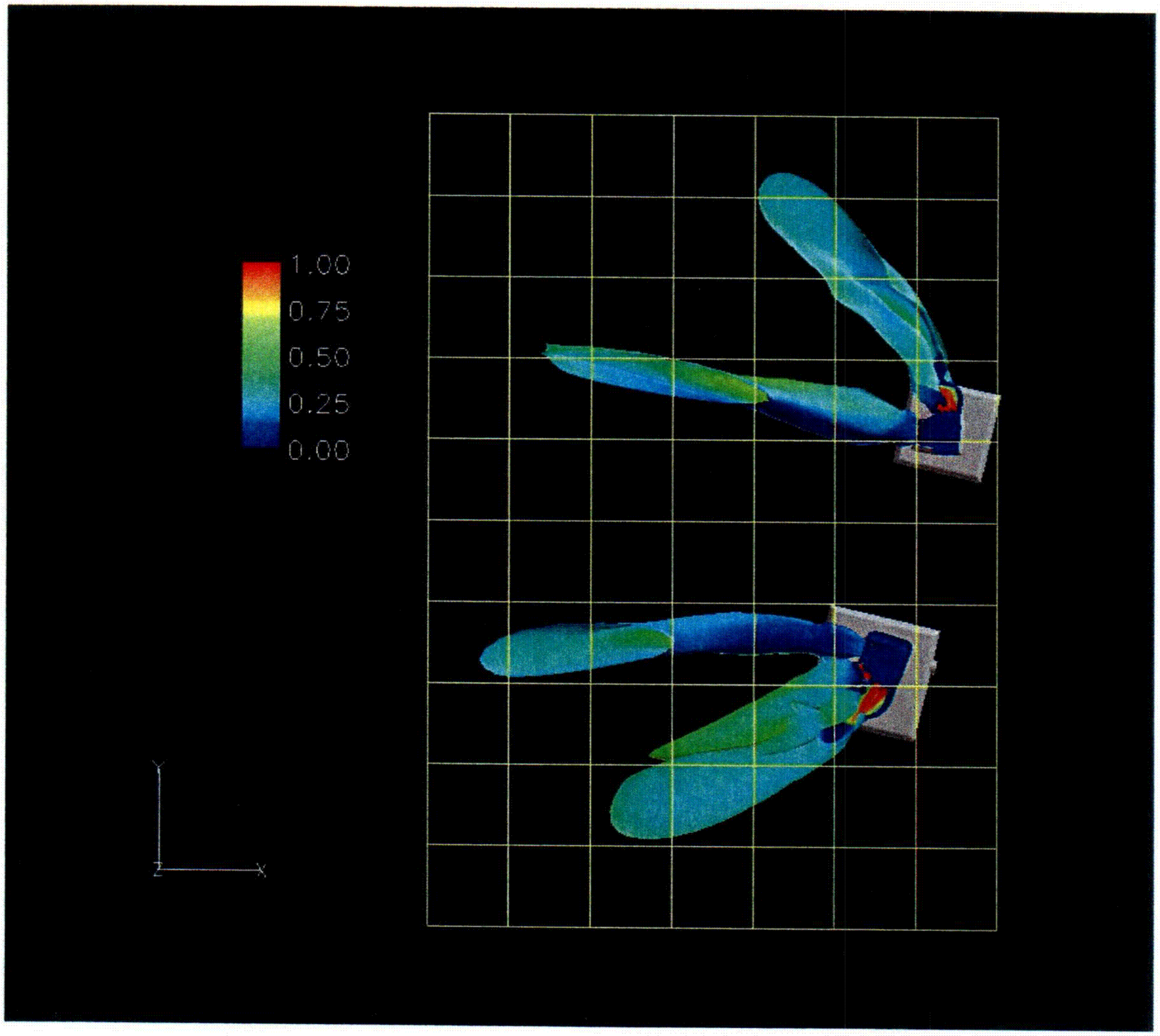


Figure 4. Visualization of effluent dilution within the discharge-induced mixing zone (plan view). FLUENT model prediction of ambient lake water fraction (i.e., 1/DR) on 2 fps plume surface velocity isopleth for zero ambient velocity, 2 discharge units operating and treating simultaneously.

C02

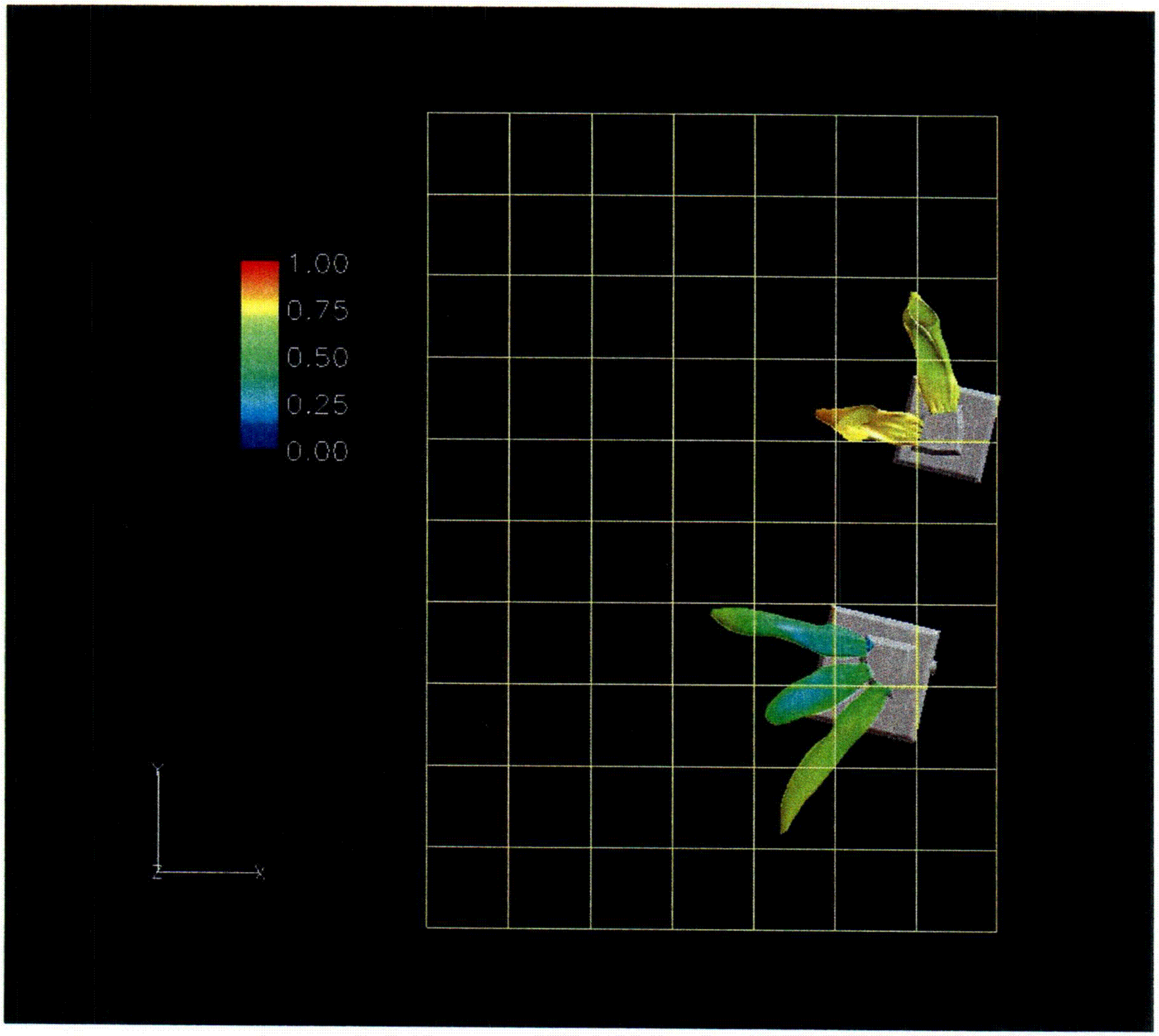


Figure 5. Visualization of effluent dilution within the discharge-induced mixing zone (plan view). FLUENT model prediction of ambient lake water fraction (i.e., 1/DR) on 3 fps plume surface velocity isopleth for 1 fps ambient velocity, 2 discharge units operating and treating simultaneously.

C03

Table 1. Predicted Average Dilution Ratios (DRs) For Different Ambient Current Velocities, Plume Boundary Velocities, and Operating/Treatment Conditions.

discharge units operating	1 & 2	1	2	1 & 2	1 & 2
discharge units being treated	1 & 2	1	2	1	2
ambient current velocity (fps): 0					
average DR at 1 fps jet velocity		4.17	7.14	5.88	5.00
average DR at 1.5 fps jet velocity	4.17				
average DR at 2 fps jet velocity	3.23	3.13	3.85	3.23	3.03
average DR at 3 fps jet velocity	2.56	2.50	3.13	2.63	2.50
average DR at 4 fps jet velocity	2.22	2.13	2.56	2.22	2.22
average DR at 5 fps jet velocity	2.00	1.92	2.22	2.00	2.00
ambient current velocity (fps): 0.5					
average DR at 1 fps jet velocity		7.14		4.00	
average DR at 1.5 fps jet velocity			3.13		
average DR at 2 fps jet velocity	2.38	3.03	2.70	2.86	2.38
average DR at 3 fps jet velocity	2.04	2.44	2.13	2.27	2.08
average DR at 4 fps jet velocity	1.85	2.17	1.96	2.00	1.89
average DR at 5 fps jet velocity	1.69	1.96	1.79	1.85	1.67
ambient current velocity (fps): 1.0					
average DR at 1.5 fps jet velocity		4.76			
average DR at 2 fps jet velocity		3.33	2.08		
average DR at 3 fps jet velocity	1.59	2.50	1.92	1.61	1.89
average DR at 4 fps jet velocity	1.47	2.22	1.82	1.47	1.72
average DR at 5 fps jet velocity	1.37	2.00	1.69	1.39	1.59
ambient current velocity (fps): 2.0					
average DR at 3 fps jet velocity	1.72	2.78	1.85	1.64	2.22
average DR at 4 fps jet velocity	1.64	2.44	1.67	1.56	1.92
average DR at 5 fps jet velocity	1.56	2.17	1.52	1.49	1.72

At zero ambient (lake) velocity, all operating/treatment conditions achieve an average dilution factor of greater than 3 (from 3.03 to 7.14) at the 2 fps velocity boundary used to define the plume limits for discharge-induced mixing (Table 1). As ambient velocity is increased, the discharge plume shapes and volumes change in somewhat complex ways that also become more dependent on the operating and treatment conditions. In addition, it becomes more difficult to identify the discharge-induced mixing boundary. Although average dilution ratios in the plume generally decrease (in some cases down to 1.5 to 2.0) as ambient velocity increases, there are instances where the opposite is observed in the modeling results. For example, when discharge unit 1 is being operated and treated, the maximum predicted dilution ratio increases from 4.17 to 7.14 as the ambient velocity is increased from zero to 0.5 fps, but then declines to 4.77 as the ambient velocity is further increased to 1 fps.

Since the ambient velocity in Lake Michigan is usually less than 0.3-0.6 fps, we believe that the model predictions based on an ambient velocity of 0 or 0.5 fps are the most representative for mixing zone determinations. At these ambient velocities, the 1, 1.5 or 2 fps (depending on operating/treatment conditions) discharge plume isopleths can be used to define the discharge induced mixing zone. As indicated in Table 1, dilution ratios are greater than 3.0 for all operating and treatment conditions modeled at zero ambient velocity. At an ambient velocity of 0.5 fps, DRs were predicted to range from 2.4 to 7.1, depending on operating and treatment conditions. Based on these results, we are confident that a dilution ratio of 3.0 will be maintained within the discharge-induced mixing zone under most conditions. Conservatively, a dilution ratio of 2.4 could be selected. However, we believe that using a DR lower than 3.0 is inappropriately conservative because many other safety factors are built into the mixing zone evaluation (see review of Water Quality Standards section).

The model results can also be used to calculate the maximum contact time for a drifting organism that enters the discharge plume. Figure 6 is a visualization of stream paths for particles injected into the plume at the discharge point(s). The color of the stream paths reflects the time of travel as the particles move from the points of discharge to the plume boundaries. As can be seen from this figure, the average contact time of a particle (i.e., a drifting organism) in the plume is about 1 minute, with a maximum contact time of about 2 ½ minutes. The significance of this visualization is the consideration of the potential contact time for aquatic species exposed to the cooling water discharge within the near-field mixing zone and the corresponding water quality criterion concentration.

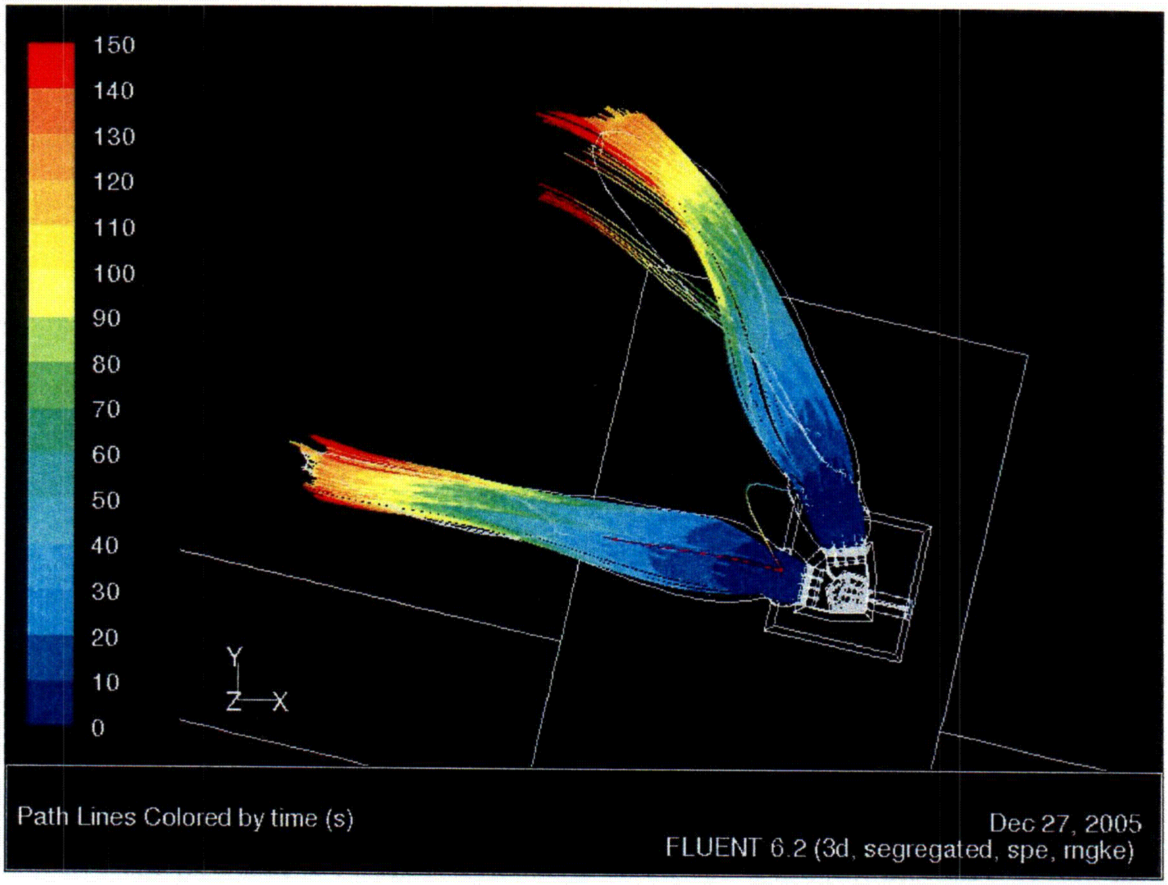


Figure 6. Visualization of stream paths for particles injected into the plume at the discharge point(s)

C04

Impact on Designated Uses

The impact of the cooling water discharge on the designated uses of southern Lake Michigan was evaluated by comparing the observations and results of this study to the seven designated uses of the water body. The designated uses of Lake Michigan, which we evaluated, were:

1. Agriculture
2. Navigation
3. Industrial water supply
4. Public water supply
5. Great Lakes fishery
6. Other indigenous aquatic life and wildlife, and
7. Partial body contact recreation

Of the seven designated uses outlined for this study, the potential impact to the Great Lakes fishery and other indigenous aquatic life and wildlife may be of greatest concern in this instance. We determined that there was no impact to any designated use in Lake Michigan due to the cooling water discharge. A summary of each use designation, likely impacts and rationale are outlined in Table 2. Additional discussion of the potential impact of the cooling water discharge on Great lakes fisheries, aquatic life and wildlife, and public water supply are discussed below.

Great Lakes Fishery, Aquatic Life and Wildlife

The cooling water discharge at the DC Cook Nuclear Plant is authorized by the State of Michigan via a National Pollutant Discharge Elimination System (NPDES) permit. The conditions of that permit require that Cook routinely monitor the concentration of various water quality constituents and compare those to established water quality based standards that are specifically designed to protect aquatic life and wildlife in the Great Lakes. The DC Cook Nuclear Plant is in complete compliance with their NPDES permit. Consequently, it is reasonable to conclude that the State of Michigan, through the extensive NPDES monitoring, has determined that there is no impact to the Great Lakes fishery, aquatic life and wildlife.

Of particular concern, will be the impact of the application of a molluscide Mexel A-432 to the cooling water discharge. Cook Nuclear Plant is required by their NPDES permit to provide prior notification for the use of any water treatment chemical or change in discharge pursuant to Cook Nuclear Plant's NPDES Permit No. MI0005827, Part I, Section A.6, Request for "Discharge of Water Treatment Additives" and Part II, Section C.10 "Notification of Change in Discharge". Cook Nuclear Plant will be requesting the approval of an intermittent discharge resulting from a daily application of Mexel A-432 to the three circulating water intake tunnels to prevent zebra mussel settlement.

Review of Water Quality Standards and Toxicity Test Data

One principal objective for the DC Cook Nuclear Plant Mixing Zone Evaluation was to evaluate the mixing of the cooling water discharge with Lake Michigan water in the context of the application of the molluscide Mexel A-432 to the cooling water to control zebra mussels. Cook Nuclear had previously developed a Tier I water quality criterion for Mexel. No other water quality criterion is of concern at this time.

We reviewed the water quality information that is specific to Cook Nuclear to determine compliance with State Water Quality Standards, including the toxicity requirements of R323.1057 and R323.1082 of the Michigan Water Quality Standards.

Cook Nuclear Plant's (CNP) intention is to use Mexel 432/0 in an intermittent discharge resulting from a daily application of Mexel 432/0 as A-432 to the three circulating water intake tunnels to prevent zebra mussel settlement. Specifically, CNP's proposal is to treat for up to one 30-minute period per day of discharge of A-432 at a daily average concentration not to exceed the established Final Acute Value (FAV) for Mexel A-432 (0.1 mg/L), with no one sample exceeding a maximum concentration of 1.5 mg/L for each outfall (NPDES Outfalls 001 and/or 002) as measured at each outfall's nearshore sample point during the treatment period and adjusted for the expected concentration at the end of the pipe and mixing zone. CNP in collaboration with Mexel and Great Lakes Environmental Center developed a Tier I FAV for Mexel A-432 following the Michigan DEQ Rule 57 guidelines.

The aquatic toxicity test data generated by CNP and Mexel satisfies the MDEQ Rule 57 requirements for a Tier I FAV calculation (Table 3), and provides intermittent dosage aquatic toxicity test data that demonstrates the reduced toxicity of Mexel A-432 when applied intermittently (Table 4). Table 3 lists the FAV as 0.092 mg/L, which was rounded up to 0.1 mg/L for the purposes of this evaluation.

CNP has used various biocides over the years for shock treatments to the intake tunnels. These treatments have proven to be a very efficient means of removing zebra mussels. An efficacy rate of greater than 95% has been realized by applying a biocide for 12 hours as a shock treatment to the intake tunnels. However, uncontrolled sloughage of shell debris creates a heavy load on the traveling screens and pump strainers downstream from the intake tunnels. The sloughage of shells could possibly overwhelm and block flow in the safety systems required by the NRC at all times for safe operation. In addition, biocides previously used require detoxification with bentonite clay. This process is a potential source of silt intrusion that may clog vital heat exchangers required for safe shutdown of the units.

The CNP proposal to use a daily 30-minute treatment of A-432, targeted at the zebra mussel post-veliger stage will eliminate the uncontrolled release of adult shell debris that potentially affects the safe operation of the plant. A-432 would be applied simultaneously to the tunnels each day during the seasons when zebra mussel veligers and post-veligers are the most abundant (April through November) to remove existing mussel colonies and to prevent further settlement. Mexel A-432 is an aqueous dispersion of linear aliphatic amines. It is in the general category of filming amines, differing from other water treatment products in that it treats the wetted surfaces of the system without having to treat the water column. Mexel A-432 functions as a corrosion inhibitor, dispersant, and control agent for cooling system-fouling species such as mussels and hydroids.

The recommended dosage is 4 ppm for 30 minutes per day to strive for an effective concentration in the tunnel. Our calculations for determining effluent concentrations are outlined below. When all three tunnels are dosed at one time, the injected concentration of 4 ppm will be decreased by 1) the demand factor of 0.38 at the tunnel inlet, 2) by a mixing zone factor of 3.0, and 3) by a 0.38 demand factor in the mixing zone. This treatment will result in an expected maximum effluent concentration of 0.51 ppm during the 30 minute treatment period in the effluent (4 ppm x 0.62 x 0.62/3.0).

When one tunnel is dosed at one time, the effluent concentration will depend upon *which* tunnel is dosed, because baffles in the plant intake forebay prevent complete mixing between lake water drawn through the three intake tunnels. The average concentration reductions in each tunnel, based upon measurements (Mallen, 2004), are 9, 61 and 15% for the north, center and south tunnels, respectively. So for Mexel injected into the north intake tunnel, the injected concentration of 4 ppm will be decreased by 1) a demand factor of 0.38 at the tunnel inlet, 2) a concentration reduction of 9% due to forebay dilution, and 3) a demand factor of 38% in the forebay. The mixing zone dilution ratio is 3.0, and there is another 38% demand factor in the mixing zone. For this case, the mixing zone concentration is calculated to be 0.29 ppm [4 ppm × (1-0.38) × (1-0.09) × (1-0.38) × (1-0.38)/3.0 = 0.29 ppm]. For injection into the center intake tunnel, the mixing zone concentration is calculated to be 0.12 ppm [4 ppm × (1-0.38) × (1-0.61) × (1-0.38) × (1-0.38)/3.0 = 0.12 ppm]. And, for injection into the south intake tunnel, the mixing zone concentration is calculated to be 0.27 ppm [4 ppm × (1-0.38) × (1-0.15) × (1-0.38) × (1-0.38)/3.0 = 0.12 ppm]. Once CNP begins dosing, they will be able to corroborate these projections by actual measurement. Measured demands at other locations agreed with these projections.

However, it is important to emphasize that this is a very conservative estimate of the maximum expected concentration during a thirty-minute interval once a day. The final concentration will be much lower because, 1) our degradation estimates are based solely on the water demand and dilution, 2) the demand calculation does not include allowances for surface adsorption or for the demand due to biodegradation, 3) Mexel A-432 is a filming amine, part of the chemical concentration will be lost due to the formation of the film, and 4) our calculations also exclude the demand at the edge of the mixing zone and in the condenser water boxes within the plant due to turbulence. Consequently, we are confident that the actual measured maximum concentration will be much lower than our projections. Once CNP begins dosing, they will be able to corroborate these projections by actual measurement. The final average daily concentration will be far less than the FAV because of the daily intermittent application of the chemical (30 minutes). Mexel's experience with measured demands at other plants has agreed with the projections, and we are confident that they will be able to do the same at Cook.

Consequently, the final average daily concentration that will enter Lake Michigan at the edge of the demonstrated mixing zone as a result of this report will be protective of aquatic life. Our basis for this is that:

1) The maximum expected concentration of Mexel A-432 at the edge of the near-field mixing zone will be equal to or less than the calculated water quality criterion.

2) The expected contact time of a drifting organism potentially drawn into the discharge plume is less than two minutes, whereas the calculated water quality criterion is based on exposures measured in days.

3) Mexel A-432 rapidly biodegrades in water. Its half-life in still water is less than 22 hours, and the half-life can be further reduced to six hours with agitation and aeration.

4) Its toxicity to aquatic life has been well demonstrated (See attached toxicity test information), and the proposed intermittent use and short duration of the dosages further reduce the impact on the environment. In fact, this application provides data that demonstrates that the toxicity of Mexel A-432 is significantly reduced when aquatic organisms are exposed to the chemical on an intermittent daily dosage pattern similar to the typical field application of the product.

5) The degradation products of A-432 consist of water, carbon dioxide, and nitrogen. Product that has not degraded or adhered to the walls of the cooling system will be discharged with the cooling water from the plant.

CNP has also developed intermittent dosage toxicity test data for Mexel A-432 that demonstrates that the toxicity of this substance is less during intermittent exposures than with continuous exposures. That data demonstrates that the median lethal concentration of Mexel A-432 applied as an intermittent dose is more than 44 times less than the demonstrated lethal concentration in continuous exposures (based on a *D. magna* GMAV of 0.197 mg/L and an intermittent dosage LC50 of 8.7 mg/L). This is an important site-specific characteristic because even though we do not expect that the final end of pipe concentration will exceed the FAV, MDEQ can be confident that the final discharge concentration will be much lower than the known toxicity of this compound when it is applied intermittently. Aquatic life toxicity test data using fathead minnow, *Daphnia magna* and rainbow trout in intermittent daily dosage experiments are summarized in Table 4. The fathead minnow and *Daphnia magna* intermittent toxicity test data were generated by the Lake Superior Research Institute at the University of Wisconsin-Superior and the rainbow trout intermittent dose toxicity test data was recently generated at the Great Lakes Environmental Center in Traverse City, Michigan.

Based on the above consideration of the data, it is reasonable to conclude that the application of Mexel A-432 to control zebra mussels will have no impact on Great Lakes fisheries, aquatic life or wildlife.

Public Water Supply

The intake for the Lake Township public water supply (PWS) is located 3,220 ft. southwest of the CNP discharge structure in Lake Michigan (D.C. Cook Condition Report, 1998). The PWS intake and CNP discharge structure are located on a map in Figure 7. As noted in Table 2, the PWS is located well beyond the study area. Fluent model predictions indicate that the maximum extent (length) of the discharge plume is about 2,500 ft from the CNP discharge structures. Thus, under no condition is the cooling water discharge plume predicted to reach the location of the PWS intake. In addition, Mexel does not bioaccumulate or otherwise pose a human health risk at the maximum concentration at the edge of the mixing zone. Based on these considerations, it is reasonable to conclude that the application of Mexel A-432 to control zebra mussels will have no impact on any public water supply.

Table 2. Summary of the Designated Uses and the Impact of Cooling Water Discharge on Lake Michigan Offshore of the DC Cook Cooling Water Discharge

Designated Use	Perceived Impact (if any)	Rationale
Agriculture	None	There is no evidence of irrigation water removal.
Navigation	None	The CNP cooling water discharge does not cause any obstructions to recreational navigation in Lake Michigan. The diffuser structure is 18 feet below the surface
Industrial Water Supply	None	There are no other industrial water intakes within the study area.
Public Water Supply	Lake Township public water supply intake is located 3,220 ft southwest of CNP discharge structures in Lake Michigan	This public water supply is located beyond the study area; model predictions indicate that the maximum extent of the discharge plume is about 2,500 ft from the CNP discharge structures. Mexel does not bioaccumulate or pose a human health risk at the maximum concentration at the edge of the mixing zone.
Great Lakes Fishery	None	The expected maximum concentration for Mexel in Lake Michigan at the edge of the mixing zone is similar to the measured criteria for Mexel. The most sensitive species used in the criteria calculation are excluded from the edge of the mixing zone due to discharge velocity. Expected contact time within the mixing plume is less than two minutes for drifting organisms.
Other Aquatic Life and Wildlife	None	The expected maximum concentration for Mexel in Lake Michigan at the edge of the mixing zone is similar to the measured criteria for Mexel The cooling water is neither acutely or chronically toxic to aquatic organisms. The most sensitive species used in the criteria calculation are excluded from the mixing zone due to discharge velocity. Expected contact time within the mixing plume is less than two minutes for drifting organisms.
Recreational Partial Body Contact	None	The water quality of the cooling water discharge would not be detrimental to human health

Table 3. Summary of Acceptable [@]Mexel Toxicity Test Data (December 2004)

Species	Investigator	LC_{50} (mg/L)	GMAV	FAV
Bluegill Sunfish	GLEC, 2004[1]	**1.71***		
Planaria	GLEC, 2004	2.03		
Hyalella azteca	GLEC, 2004	1.99		
Chironomus tentans	GLEC, 2004	8.82		
Rainbow Trout	GLEC, 2004	0.450		
	Brooke et al, 1997[2]	0.730	**0.5731***	
Lumbriculus	GLEC, 2004	1.86		
Fathead minnow	GLEC, 2004	0.450		
	Brooke et al, 1997	0.360		
	Brooke et al, 1997	0.660	**0.4746***	
Daphnia magna	GLEC, 2004	0.200		
	Brooke et al, 1997	0.121		
	Brooke et al, 1997	0.216		
	Brooke et al, 1997	0.199		
	Brooke et al, 1997	0.178		
	Brooke et al, 1997	0.120		
	Brooke et al, 1997	0.168		
	Brooke et al, 1997	0.198		
	Brooke et al, 1997	0.198		
	Brooke et al, 1997	0.595	**0.197***	
		N = 8 (SMAV)		**0.092 mg/L**

* LC50s used in the Final Acute Value (FAV) calculation.

@ Fathead minnow, *D. magna* and rainbow trout data completed by Brooke, et al was identified as acceptable by MDEQ from the Mexel toxicity data base.

1 Tests conducted by Great Lakes Environmental Center, 2004.

2 Brooke et al. 1997. Tests conducted by the Lake Superior Research Institute.

Table 4. Mexel A-432 Median Lethal Toxicant Concentrations (Lc50) Based on Daily Intermittent Exposures of 20 Minutes Each Day

Species	Water Type	**Daily Exposure Duration** (min. per 24 hrs)	Test Duration	LC_{50} (mg/L)
Fathead minnow (larval) (*Pimephales promelas*)	Lake Superior (USA)	20	96	6.2[1]
Daphnia magna (neonates)	Lake Superior (USA)	20	48	8.7[1]
Rainbow Trout (*Onchorhynchus mykiss*)	Lake Michigan (USA)	20	96	3.2[2]

1 Ghillebaert, F. and L.T. Brooke. 1997. Mexel 432 toxicity to cladorceran and fathead minnow during continuous and daily intermittent exposures. Lake Superior Research Institute, University of Wisconsin-Superior, Groupe d'Embryotoxicologie des Poissons, Universite Paris 7, 12pp.

2 Great Lakes Environmental Center. 2004. LC50 Determination for Mexel A-432 Using Rainbow Trout (*Onchorhynchus mykiss*). Final Report to RTK Technologies, Inc. Baton Rouge, LA. April 23, 2004.

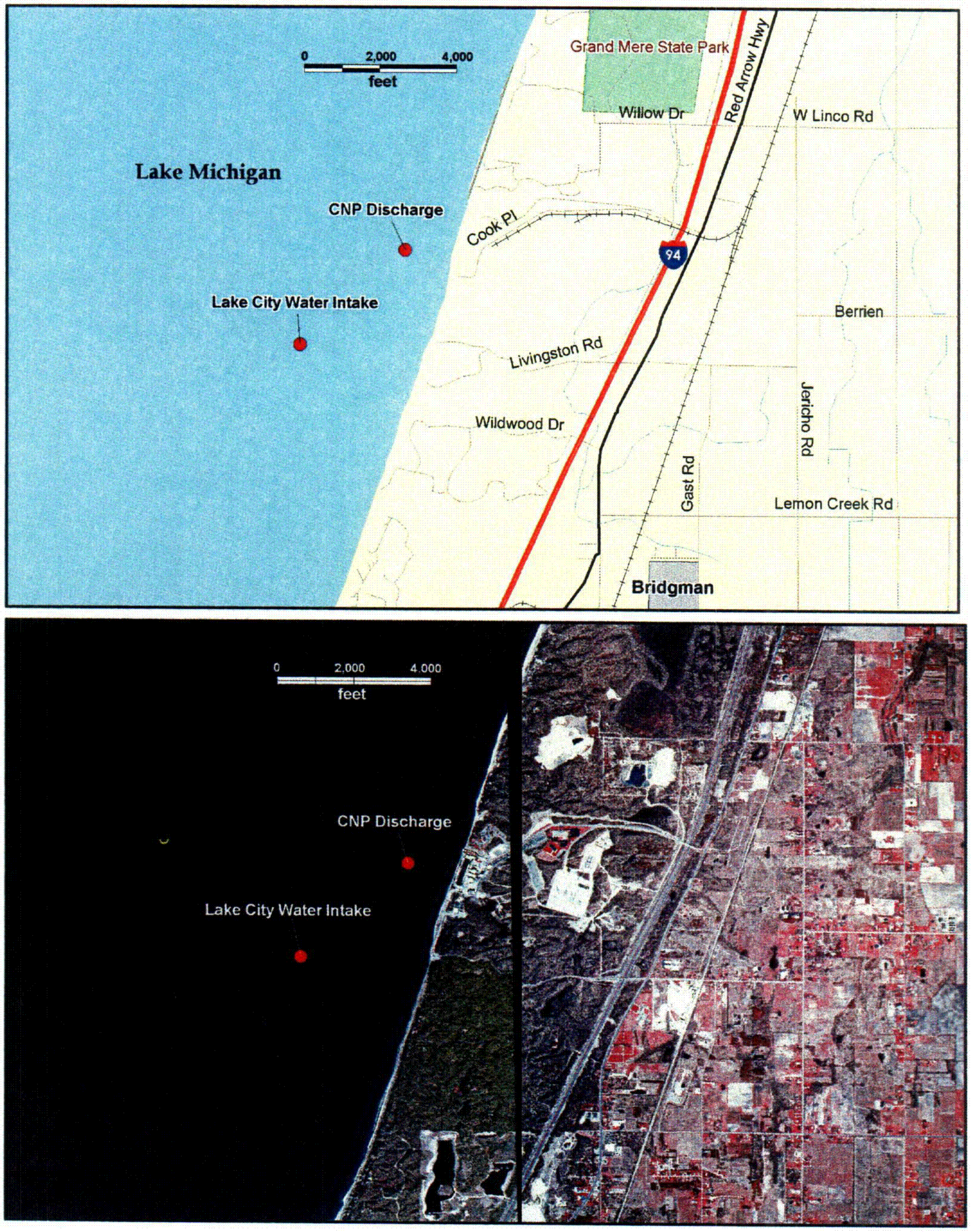


Figure 7. **Map Indicating Location of Lake Township Public Water Supply Intake and CNP Discharge Structures in Lake Michigan. The distance between these points was measured as 3,220 feet using survey methods and GPS controls.**

C05

SUMMARY AND CONCLUSIONS

The AEP DC Cook Nuclear Plant conducted a mixing zone evaluation to determine the dilution ratio of the plant cooling water with Lake Michigan water at varying velocities and distances. The mixing zone evaluation included a plume modeling study by Alden Laboratories that provided a computational and visual basis for the mixing zone. The mixing zone evaluation also addressed the impact of the cooling water discharge on the designated uses of Lake Michigan and reviewed water quality standards, specifically the toxicity requirements of R323.1057 and R323.1082 of the Michigan Water Quality Standards.

The modeling results demonstrated that the dilution factor at the edge of the near-field mixing zone is approximately 3.0 at the 2 fps isopleth. Conservatively, the dilution factor would increase at ambient currents less than or equal to 0.5 fps. At an ambient velocity of 0.5 fps, DRs were predicted to range from 2.4 to 7.1. The modeling results also demonstrated that the two cooling water discharges do not overlap and that the area of the near-field mixing zone for each outfall is relatively small and contained within several hundred square feet.

A review of the potential impact on designated uses of Lake Michigan water concluded that there was no impact on any designated use. Particular attention was paid to the potential impact on Great Lakes fisheries, aquatic life and wildlife, and public water supplies. A review of Michigan water quality standards, specifically the toxicity requirements of R323.1057 and R323.1082 of the Michigan Water Quality Standards was completed, which also supported the determination of no impact.

Of particular concern, will be the impact of the application of a molluscide Mexel A-432 to the cooling water discharge. One objective for the DC Cook Nuclear Plant Mixing Zone Evaluation was to evaluate the mixing of the cooling water discharge with Lake Michigan water in the context of the application of the molluscide Mexel A-432 to the cooling water to control zebra mussels. Cook Nuclear provided sufficient data to the MDEQ to develop a Tier I water quality criterion for Mexel. No other water quality criterion is of concern at this time. The calculated Tier I water quality criterion for Mexel A-432 is 0.092 mg/L (rounded up to 0.100 mg/L or 100 µg/L for this evaluation). The expected maximum concentration of Mexel A-432 at the edge of the near-field mixing zone, with one unit treated at one time is approximately 0.1 mg/L. The expected maximum concentration of Mexel A-432 at the edge of the near-field mixing zone, with two units treated at one time is approximately 0.5 mg/L.

The assumptions used for the evaluation of the toxicity of Mexel A-432 within the near-field mixing zone are:

1. The recommended dosage will be 4 ppm (mg/L) for 30 minutes per day to strive for an effective concentration in the tunnel.

2. When all three tunnels are dosed at one time, the injected concentration of 4 ppm will be decreased by: 1) a demand factor of 0.38 at the tunnel inlet, 2) by the mixing zone factor of 3.0, and 3) and by a 0.38 demand factor in the mixing zone. This treatment will result in an expected maximum effluent concentration of 0.51 ppm during the 30 minute treatment period in the effluent [4 ppm × (1-0.38) × (1-0.38)/3.0 = 0.51 ppm].

3. When one tunnel is dosed at one time, the effluent concentration will depend upon *which* tunnel is dosed, because baffles in the plant intake forebay prevent complete mixing between lake water drawn through the three intake tunnels. This is discussed on Page 16 (Review of Water Quality Standards and Toxicity Test Data). The mixing zone concentrations are calculated to be 0.29 ppm, 0.12 ppm, and 0.12 ppm for dosing of the north, center and south intake tunnels, respectively.

Based on the above consideration of the data, it is reasonable to conclude that the proposed application of Mexel A-432 to control zebra mussels will have no impact on Great Lakes fisheries, aquatic life or wildlife, or any other designated use of the Great Lakes.

REFERENCES

Alden Research Laboratories. 2005. Cook Nuclear Plant Plume Modeling Study (DRAFT).

Davis, L.R., (1998). "Fundamentals of Environmental Discharge Modeling". CRC Press, pp. 352.

D.C. Cook Condition Report. 1998. Condition Report P-98-04943.

Ghillebaert, F. and L.T. Brooke. 1997. Mexel 432 toxicity to cladorceran and fathead minnow during continuous and daily intermittent exposures. Lake Superior Research Institute, University of Wisconsin-Superior, Groupe d'Embryotoxicologie des Poissons, Universite Paris 7, 12pp.

Great Lakes Environmental Center. 2004. LC50 Determination for Mexel A-432 Using Rainbow Trout (*Onchorhynchus mykiss*). Final Report to RTK Technologies, Inc. Baton Rouge, LA. April 23, 2004.

Jirka, G. H., Doneker, R.L., and S.W. Hinton, 1996. "User's Manual for CORMIX: A Hydro-Dynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters", EPA#: 823/B-97-006.
LTI. 2000. *Cook Plant Thermal Plume Study*; May 16, 2000

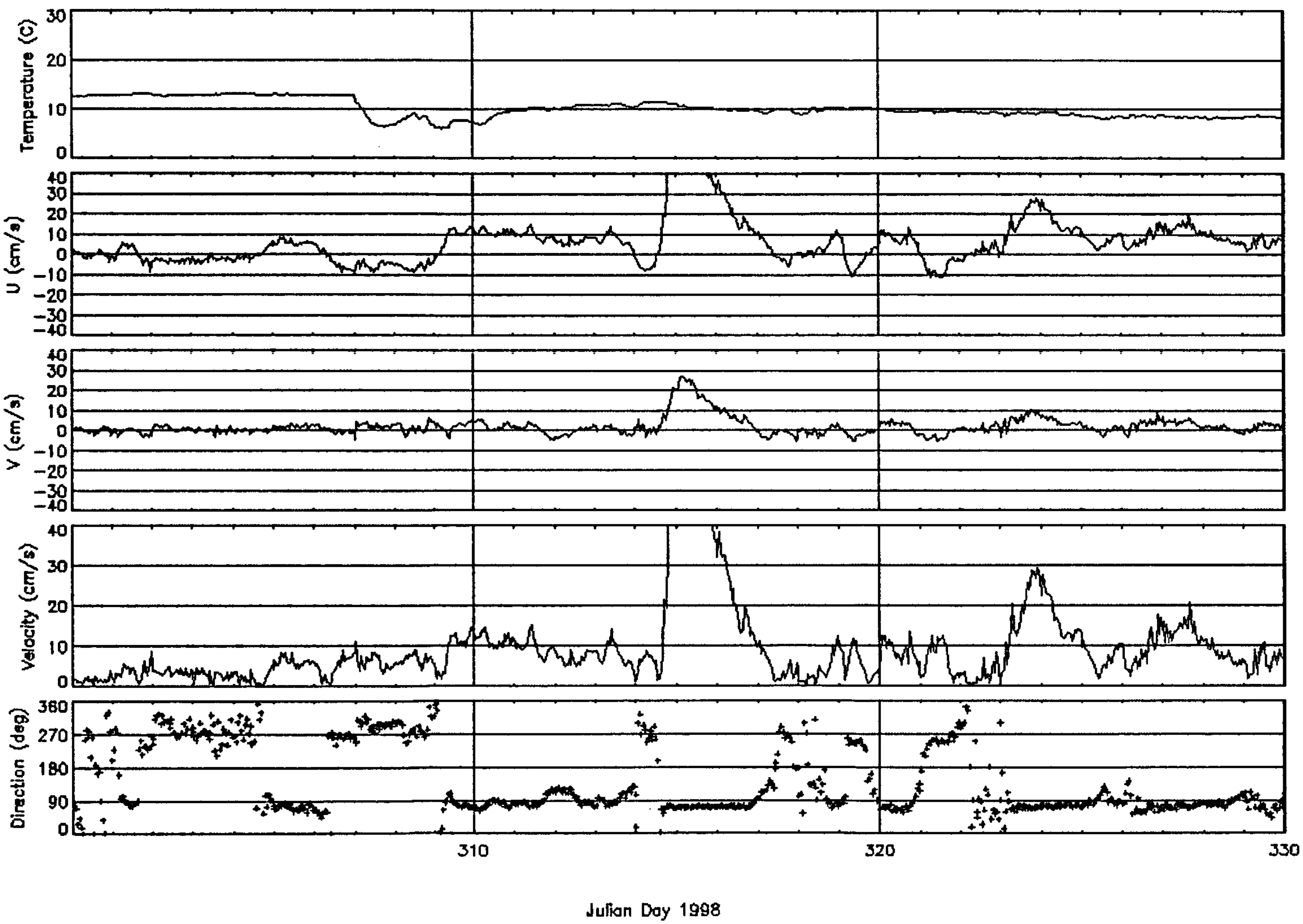
Mallen, E. 2004. Mussel Monitoring and Control Program. Assessment Number: SA-2003-REA-003-QH. Assessment Dates: 12/15/03 to 01/25/04. Condition Report: CR-03344013.

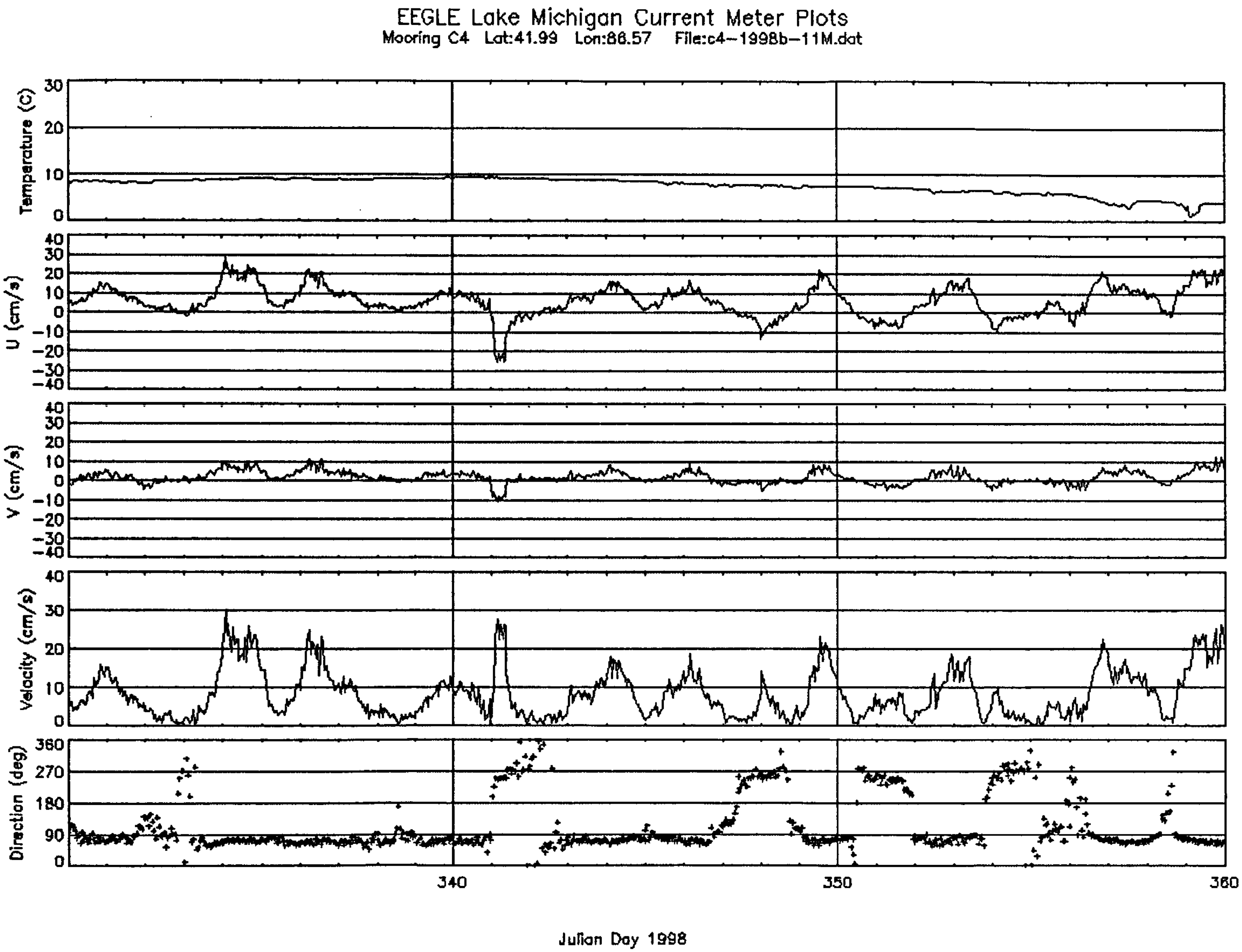
Michigan Department of Environmental Quality. 1999. Michigan Water Quality Standards. Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451 as Amended.

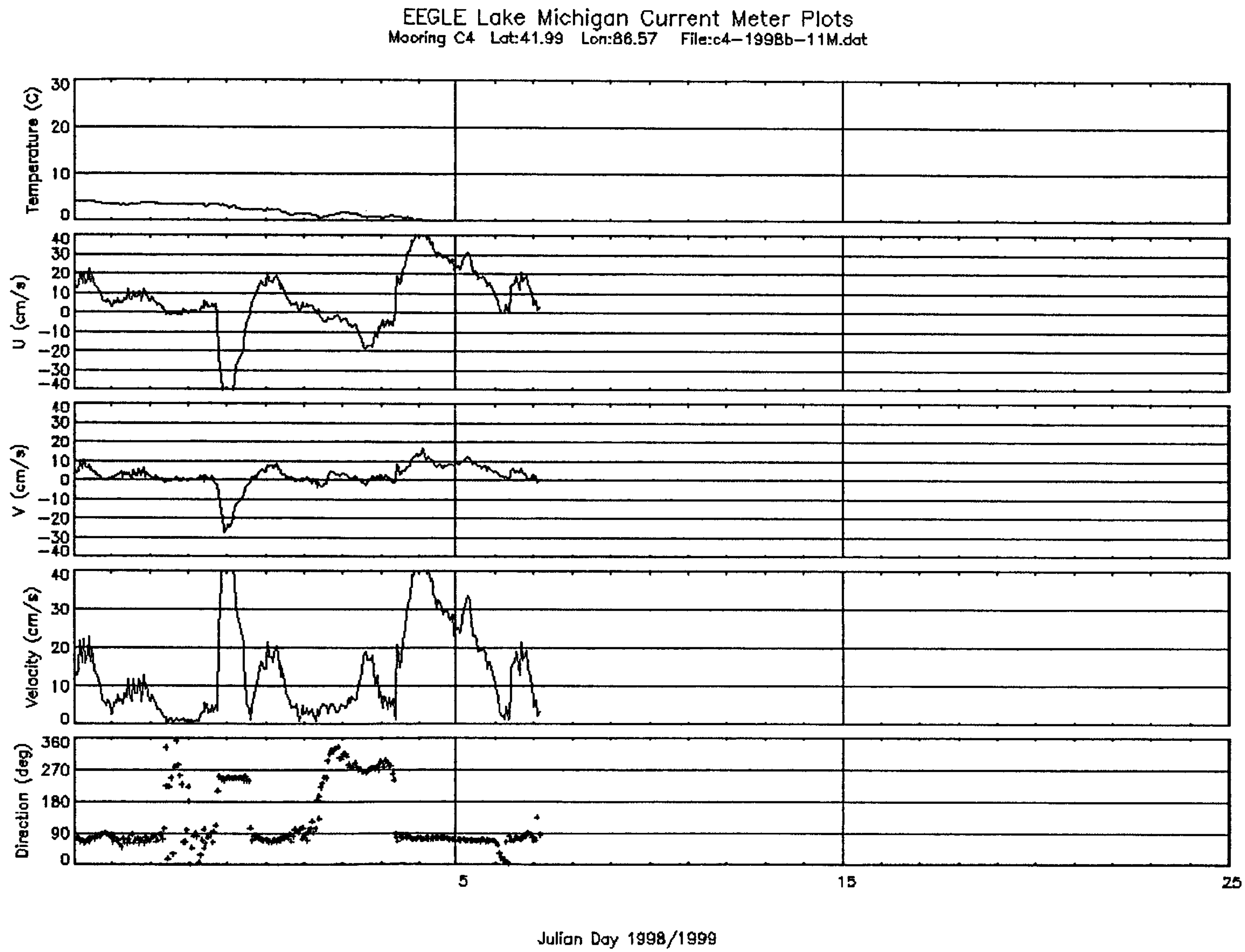
Yakhot, V., Orszag, S.A., (1986). "Renormalized Group Analysis of Turbulence: I. Basic Theory". Journal of Scientific Computing, 1(1) pp 1-51.

Appendix A. Current Meter Data from NOAA/GLERL EEGLE Project. Data Measured at Station C4, Moored in 11 Meters of Water Offshore of the D.C. Cook Nuclear Power Plant.

EEGLE Lake Michigan Current Meter Plots
Mooring C4 Lat:41.99 Lon:86.57 File:c4-1998b-11M.dat




EEGLE Lake Michigan Current Meter Plots
Mooring C4 Lat:41.99 Lon:86.57 File:c4-1998b-11M.dat
Temperature (C)
30
20
10
0
U (cm/s)
40
30
20
10
0
-10
-20
-30
-40
V (cm/s)
40
30
20
10
0
-10
-20
-30
-40
Velocity (cm/s)
40
30
20
10
0
Direction (deg)
360
270
180
90
0
340
350
360
Julian Day 1998


EEGLE Lake Michigan Current Meter Plots
Mooring C4 Lat:41.99 Lon:86.57 File:c4-1998b-11M.dat
Temperature (C)
U (cm/s)
V (cm/s)
Velocity (cm/s)
Direction (deg)
Julian Day 1998/1999

CFD SIMULATIONS FOR DETERMINING DILUTION RATIO OF D.C. COOK NUCLEAR PLANT DISCHARGE PLUME

By

Daniel Gessler, Ph.D., P.E.

Submitted to

AMERICAN ELECTRIC POWER

2006-97_N178C

April 2006

CFD SIMULATIONS FOR DETERMINING
DILUTION RATIO OF D.C. COOK NUCLEAR PLANT DISCHARGE PLUME

By

Daniel Gessler, Ph.D., P.E.

Submitted to

AMERICAN ELECTRIC POWER

April 2006

ALDEN RESEARCH LABORATORY, INC.

30 Shrewsbury Street

Holden, MA 01520

2006-97_N178C - Final Report

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
INTRODUCTION .... - 1 -
BACKGROUND .... - 2 -
MODEL DESCRIPTION .... - 2 -
BOUNDARY CONDITIONS .... - 6 -
MODELS .... - 9 -
SIMULATIONS AND POST PROCESSING .... - 9 -
RESULTS AND CONCLUSIONS .... - 24 -
REFERENCES .... - 25 -
APPENDIX A:
ALL ISO-SURFACE PLOTS FOR ALL OPERATING CONDITIONS .... - 26 -
APPENDIX B:
AVERAGE DILUTION RATIO TABLES FOR
ALL ISO-SURFACES CONSIDERED .... - 27 -
APPENDIX C:
DILUTION RATIO VARIABILITY TABLES .... - 32 -

LIST OF FIGURES

Figure 1: Zero current condition, 2 ft/s iso-surface, Units 1 and 2 discharging. ....- 3 -
Figure 2: Plan view of computational domain and grid..- 5 -
Figure 3: Overview of the Unit 2 discharge structure..- 8 -
Figure 4: Over view of the three intake structures..- 8 -
Figure 5: Zero current condition, Unit 1, 1 ft/s iso-surface. ....- 11 -
Figure 6: 0.5 ft/s current condition, Unit 1, 1 ft/s iso-surface..- 12 -
Figure 7: 1 ft/s current condition, Unit 1, 1.5 ft/s iso-surface..- 13 -
Figure 8: 2 ft/s current condition, Unit 1, 3 ft/s iso-surface...- 14 -
Figure 9: Zero current condition, Unit 2, 1 ft/s iso-surface. ....- 15 -
Figure 10: 0.5 ft/s current condition, Unit 2, 1.5 ft/s iso-surface..- 16 -
Figure 11: 1 ft/s current condition, Unit 2, 2 ft/s iso-surface...- 17 -
Figure 12: 2 ft/s current condition, Unit 2, 3 ft/s iso-surface...- 18 -
Figure 13: Zero current condition, Unit 1&2, 1.5 ft/s iso-surface. ....- 19 -
Figure 14: 0.5 ft/s current condition, Unit 1&2, 2 ft/s iso-surface...- 20 -
Figure 15: 1 ft/s current condition, Unit 1&2, 3 ft/s iso-surface...- 21 -
Figure 16: 2 ft/s current condition, Unit 1&2, 3 ft/s iso-surface...- 22 -

LIST OF TABLES

Table 1: Dilution Ratio at Mixing Zone Edge ....- 23 -
Table 2: Dilution Ratio Variability ....- 24 -

EXECUTIVE SUMMARY

D.C. Cook Nuclear Generating Station is considering the use of the molluscicide, Mexel 432, to control the settlement and growth of zebra mussels and quagga mussels on the intake tunnels of the circulating water system. The Mexel would be injected near the upstream end of the intake tunnels, circulate through the tunnels and the plant and discharge back out into the lake through the cooling water discharge structures. End of pipe discharge concentrations of the Mexel will exceed the Michigan Department of Environmental Quality (MDEQ) standards. State water quality standards also permit compliance at the edge of the mixing zone, defined as the point where discharge induced mixing ceases to occur.

Alden Research Laboratory, Inc. (Alden) conducted a Computational Fluid Dynamics (CFD) simulation of the plume dilution at the D.C. Cook Nuclear Generating Station. The objective of the simulations was to define the edge of the mixing zone and determine the average dilution ratio. In addition to three plant operating conditions, four lake current conditions were simulated. Each simulation was evaluated to determine the edge of the mixing zone.

The most common current condition is a south to north long shore current of less than 0.5 ft/s. For all operating scenarios under this condition, the predicted average dilution ratio is less than 0.42. Cases where only one unit is operational or discharges are treated individually when both units are operational result in significantly lower dilution ratios. Complete results for the 12 scenarios, 3 operating conditions and 4 lake current conditions are given in the report.

CFD SIMULATIONS FOR DETERMINING
DILUTION RATIO OF D.C. COOK NUCLEAR PLANT DISCHARGE PLUME

INTRODUCTION

The Indiana Michigan Power Company's Donald C. Cook Nuclear Plant, located on the southeastern shore of Lake Michigan is seeking to modify its NPDES permit to allow the use of the molluscicide, Mexel 432, to control the settlement and growth of zebra mussels and quagga mussels on the intake tunnels of the circulating water system. The Mexel would be injected near the upstream end of the intake tunnels, circulate through the tunnels and the plant and discharge back out into the lake through the cooling water discharge structures.

The Michigan Department of Environmental Quality (MDEQ) has calculated a water quality criterion for Mexel. If the criterion is applied to the end of the Cook Nuclear Plant discharge pipe, the criterion will be exceeded. Mexel will be injected at the intake in concentrations that exceed the water quality criteria and will not degrade or dilute by the time the water reaches the end of the discharge pipe.

The state water quality standard allows dischargers to meet the water quality criterion at the edge of the mixing zone. The MDEQ regulations define the mixing zone as "that portion of a water body allocated by the department where a point source or venting groundwater discharge is mixed with the surface waters of the state" (Water Quality Standards Part 4, R323.1082(1)). Michigan Surface Water Quality Standards define the edge of the mixing zone as the point where discharge induced mixing ceases to occur.

> "(y) "Discharge Induced Mixing" means the mixing of a discharge and receiving water that occurs due to discharge momentum and buoyancy up to the point where mixing is controlled by ambient turbulence." (General Rule, Part 4 323.1043 Definitions; A to L)

A Computational Fluid Dynamics (CFD) model was developed to determine the edge of the mixing zone as defined in the MDEQ regulations. The model was also used to determine the dilution ratio of the plant discharge at the edge of the mixing zone. The commercially available software Fluent was used for the modeling.

BACKGROUND

The MDEQ definition of the edge of the mixing zone is precise in theory but difficult to define in practice. A jet discharged into an ambient fluid entrains the ambient fluid due to viscous and turbulent shear. As the jet penetrates the ambient, the jet momentum decreases as does the rate of entrainment of ambient fluid. Gradually, a transition occurs where the dominant mode of mixing changes from jet induced entrainment of ambient fluid to ambient turbulent mixing and diffusion. Because the transition is gradual, the end of jet induced mixing is a subjective location.

For the purpose of this study, the edge of the mixing zone is defined as a surface of constant velocity (iso-surface) where an obvious penetrating jet still exists. The Unit 1 and Unit 2 discharge velocities are 14.4 and 13.46 ft/sec, respectively. Iso-surfaces of the plumes were created at a range of velocities between 0.5 and 5 ft/s. Figure 1 shows a 2 ft/s iso-surface into an ambient water body with zero current, Units 1 and 2 are discharging.

The ambient lake current varies from 0 to 2 ft/s, with the most common current being 0.5 ft/s or less. The modeling considered 4 current conditions: zero current and currents of 0.5, 1, and 2 ft/s. The current was always along the shore from south to north. For each current condition, three plant operating conditions were simulated: Unit 1 only, Unit 2 only, and Units 1 and 2. In each case, it was assumed that plant intake was equal to the discharge and that it was uniformly distributed among the three intake tunnels.

MODEL DESCRIPTION

The commercially available computational fluid dynamics software Fluent was used for the simulations. Fluent has been widely used in the aerospace and automotive industry for simulating a wide range of flow fields including jet induced mixing problems. Many common mixing jet problems are related to combustion where a combustible fluid is injected and mixed

CFD SIMULATIONS FOR DETERMINING DILUTION RATIO OF D.C. COOK NUCLEAR PLANT DISCHARGE PLUME

By

Daniel Gessler, Ph.D., P.E.

Submitted to

AMERICAN ELECTRIC POWER

2006-97_N178C

April 2006

CFD SIMULATIONS FOR DETERMINING
DILUTION RATIO OF D.C. COOK NUCLEAR PLANT DISCHARGE PLUME

By

Daniel Gessler, Ph.D., P.E.

Submitted to

AMERICAN ELECTRIC POWER

April 2006

ALDEN RESEARCH LABORATORY, INC.

30 Shrewsbury Street

Holden, MA 01520

2006-97_N178C - Final Report

TABLE OF CONTENTS

EXECUTIVE SUMMARY i

INTRODUCTION .... - 1 -

BACKGROUND .... - 2 -

MODEL DESCRIPTION .... - 2 -

BOUNDARY CONDITIONS .... - 6 -

MODELS .... - 9 -

SIMULATIONS AND POST PROCESSING .... - 9 -

RESULTS AND CONCLUSIONS .... - 24 -

REFERENCES .... - 25 -

APPENDIX A:

ALL ISO-SURFACE PLOTS FOR ALL OPERATING CONDITIONS .... - 26 -

APPENDIX B:

AVERAGE DILUTION RATIO TABLES FOR
ALL ISO-SURFACES CONSIDERED .... - 27 -

APPENDIX C:

DILUTION RATIO VARIABILITY TABLES .... - 32 -

LIST OF FIGURES

Figure 1: Zero current condition, 2 ft/s iso-surface, Units 1 and 2 discharging. .... - 3 -

Figure 2: Plan view of computational domain and grid.. - 5 -

Figure 3: Overview of the Unit 2 discharge structure... - 8 -

Figure 4: Over view of the three intake structures.. - 8 -

Figure 5: Zero current condition, Unit 1, 1 ft/s iso-surface. .... - 11 -

Figure 6: 0.5 ft/s current condition, Unit 1, 1 ft/s iso-surface.. - 12 -

Figure 7: 1 ft/s current condition, Unit 1, 1.5 ft/s iso-surface.. - 13 -

Figure 8: 2 ft/s current condition, Unit 1, 3 ft/s iso-surface... - 14 -

Figure 9: Zero current condition, Unit 2, 1 ft/s iso-surface. .... - 15 -

Figure 10: 0.5 ft/s current condition, Unit 2, 1.5 ft/s iso-surface.. - 16 -

Figure 11: 1 ft/s current condition, Unit 2, 2 ft/s iso-surface... - 17 -

Figure 12: 2 ft/s current condition, Unit 2, 3 ft/s iso-surface... - 18 -

Figure 13: Zero current condition, Unit 1&2, 1.5 ft/s iso-surface. .... - 19 -

Figure 14: 0.5 ft/s current condition, Unit 1&2, 2 ft/s iso-surface... - 20 -

Figure 15: 1 ft/s current condition, Unit 1&2, 3 ft/s iso-surface.. - 21 -

Figure 16: 2 ft/s current condition, Unit 1&2, 3 ft/s iso-surface.. - 22 -

LIST OF TABLES

Table 1: Dilution Ratio at Mixing Zone Edge .... - 23 -

Table 2: Dilution Ratio Variability .... - 24 -

EXECUTIVE SUMMARY

D.C. Cook Nuclear Generating Station is considering the use of the molluscicide, Mexel 432, to control the settlement and growth of zebra mussels and quagga mussels on the intake tunnels of the circulating water system. The Mexel would be injected near the upstream end of the intake tunnels, circulate through the tunnels and the plant and discharge back out into the lake through the cooling water discharge structures. End of pipe discharge concentrations of the Mexel will exceed the Michigan Department of Environmental Quality (MDEQ) standards. State water quality standards also permit compliance at the edge of the mixing zone, defined as the point where discharge induced mixing ceases to occur.

Alden Research Laboratory, Inc. (Alden) conducted a Computational Fluid Dynamics (CFD) simulation of the plume dilution at the D.C. Cook Nuclear Generating Station. The objective of the simulations was to define the edge of the mixing zone and determine the average dilution ratio. In addition to three plant operating conditions, four lake current conditions were simulated. Each simulation was evaluated to determine the edge of the mixing zone.

The most common current condition is a south to north long shore current of less than 0.5 ft/s. For all operating scenarios under this condition, the predicted average dilution ratio is less than 0.42. Cases where only one unit is operational or discharges are treated individually when both units are operational result in significantly lower dilution ratios. Complete results for the 12 scenarios, 3 operating conditions and 4 lake current conditions are given in the report.

CFD SIMULATIONS FOR DETERMINING
DILUTION RATIO OF D.C. COOK NUCLEAR PLANT DISCHARGE PLUME

INTRODUCTION

The Indiana Michigan Power Company's Donald C. Cook Nuclear Plant, located on the southeastern shore of Lake Michigan is seeking to modify its NPDES permit to allow the use of the molluscicide, Mexel 432, to control the settlement and growth of zebra mussels and quagga mussels on the intake tunnels of the circulating water system. The Mexel would be injected near the upstream end of the intake tunnels, circulate through the tunnels and the plant and discharge back out into the lake through the cooling water discharge structures.

The Michigan Department of Environmental Quality (MDEQ) has calculated a water quality criterion for Mexel. If the criterion is applied to the end of the Cook Nuclear Plant discharge pipe, the criterion will be exceeded. Mexel will be injected at the intake in concentrations that exceed the water quality criteria and will not degrade or dilute by the time the water reaches the end of the discharge pipe.

The state water quality standard allows dischargers to meet the water quality criterion at the edge of the mixing zone. The MDEQ regulations define the mixing zone as "that portion of a water body allocated by the department where a point source or venting groundwater discharge is mixed with the surface waters of the state" (Water Quality Standards Part 4, R323.1082(1)). Michigan Surface Water Quality Standards define the edge of the mixing zone as the point where discharge induced mixing ceases to occur.

> "(y) "Discharge Induced Mixing" means the mixing of a discharge and receiving water that occurs due to discharge momentum and buoyancy up to the point where mixing is controlled by ambient turbulence." (General Rule, Part 4 323.1043 Definitions; A to L)

A Computational Fluid Dynamics (CFD) model was developed to determine the edge of the mixing zone as defined in the MDEQ regulations. The model was also used to determine the dilution ratio of the plant discharge at the edge of the mixing zone. The commercially available software Fluent was used for the modeling.

BACKGROUND

The MDEQ definition of the edge of the mixing zone is precise in theory but difficult to define in practice. A jet discharged into an ambient fluid entrains the ambient fluid due to viscous and turbulent shear. As the jet penetrates the ambient, the jet momentum decreases as does the rate of entrainment of ambient fluid. Gradually, a transition occurs where the dominant mode of mixing changes from jet induced entrainment of ambient fluid to ambient turbulent mixing and diffusion. Because the transition is gradual, the end of jet induced mixing is a subjective location.

For the purpose of this study, the edge of the mixing zone is defined as a surface of constant velocity (iso-surface) where an obvious penetrating jet still exists. The Unit 1 and Unit 2 discharge velocities are 14.4 and 13.46 ft/sec, respectively. Iso-surfaces of the plumes were created at a range of velocities between 0.5 and 5 ft/s. Figure 1 shows a 2 ft/s iso-surface into an ambient water body with zero current, Units 1 and 2 are discharging.

The ambient lake current varies from 0 to 2 ft/s, with the most common current being 0.5 ft/s or less. The modeling considered 4 current conditions: zero current and currents of 0.5, 1, and 2 ft/s. The current was always along the shore from south to north. For each current condition, three plant operating conditions were simulated: Unit 1 only, Unit 2 only, and Units 1 and 2. In each case, it was assumed that plant intake was equal to the discharge and that it was uniformly distributed among the three intake tunnels.

MODEL DESCRIPTION

The commercially available computational fluid dynamics software Fluent was used for the simulations. Fluent has been widely used in the aerospace and automotive industry for simulating a wide range of flow fields including jet induced mixing problems. Many common mixing jet problems are related to combustion where a combustible fluid is injected and mixed with ambient air. Validation for the mixing of gasses can be found on the fluent website at www.fluent.com. In principal the mixing of a liquid jet with ambient liquid is no different than the mixing of gasses, making the use of fluent a reasonable choice.

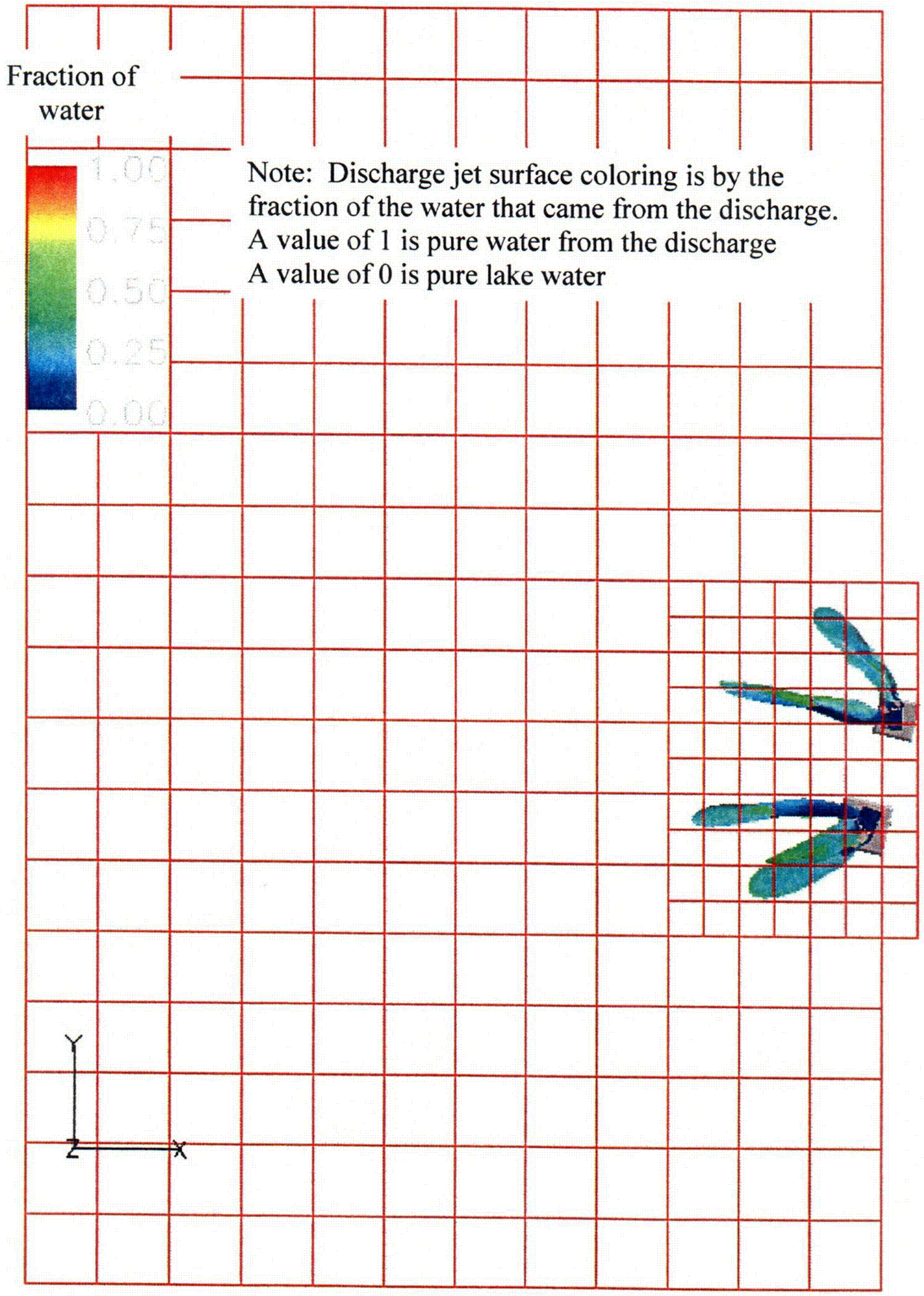


Figure 1: Zero current condition, 2 ft/s iso-surface, Units 1 and 2 discharging.

C06

Fluent solves the Reynolds averaged Navier-Stokes equations on a boundary fitted grid. The total number of grid cells is approximately 1,200,000. Cell size varies spatially with the highest cell density and smallest cell size existing at the discharge structures. In the vicinity of the discharge structures, a cell size of approximately 0.7 x 0.7 ft in the horizontal direction and 0.2 ft in the vertical direction is used. The far field grid size is approximately 100 feet in the horizontal direction and 2 feet in the vertical direction. Several turbulence models have been incorporated in Fluent for computing the creation, transport and dissipation of turbulent kinetic energy. The RNG k-epsilon turbulence model is used for this application (Choudhury, 1993).

The discharge plumes are warmer than the ambient lake water. Units 1 and 2 have approximate temperature differentials of 23 F° and 18 F°, respectively. The ambient lake temperature is assumed to be 60 °F. The lake temperature can vary significantly throughout the year, however, the temperature and density differential remain fairly constant. To simulate the buoyant effects of the discharge plume, the model included the calculation of energy terms. The plume temperature decreases and density increases as heat is exchanged with the surrounding water body. The Boussinesq approximation is used for simulating the variable density fluids: When using the Boussinesq approximation, variations in density only affect the buoyancy terms in the equations of motion, density is assumed constant for all other terms.

The computational domain is approximately square, extending 5,500 feet from the shore outward into the lake and 7,200 feet parallel to the shoreline. Figure 2 shows a plan view of the computational domain. The discharge structures are located approximately 1,200 feet from the shore.

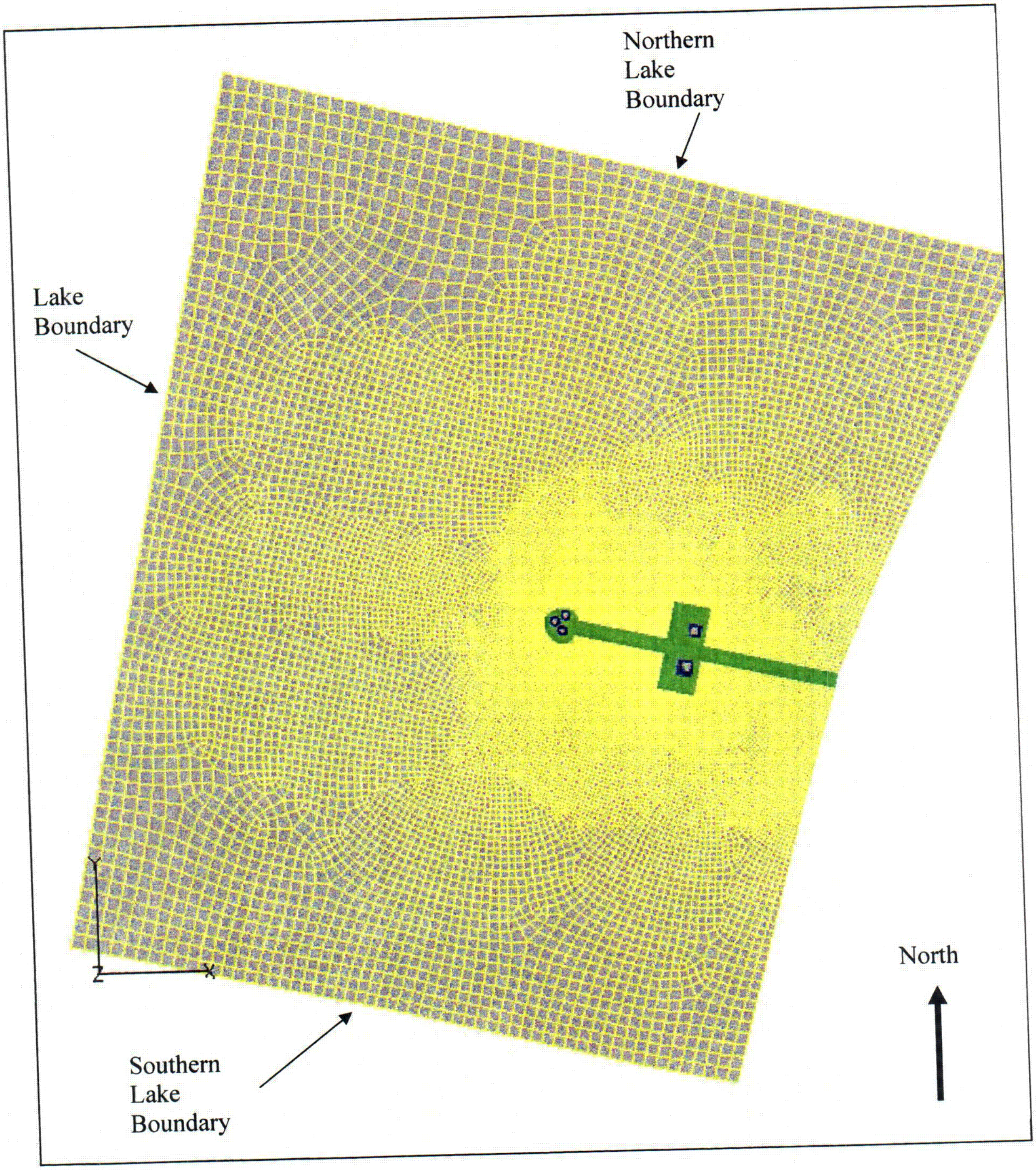


Figure 2: Plan view of computational domain and grid.

C07

BOUNDARY CONDITIONS

Locations where water can enter or exit the model are model boundaries. In addition, all solid surfaces in the model are considered model boundaries. Definition of boundary conditions is a significant aspect of each model and affects the results of the computations.

Wall Boundaries

All walls and solid surfaces in the model including the lake bed are assumed to be hydraulically smooth. The approximation is reasonable for a concrete surface. The lake bed was also assumed to be smooth because any surface irregularities are minor compared to the overall water depth. All walls are assumed to have no-slip boundaries, i.e., a velocity of zero. Standard wall functions (Launder and Spalding, 1974) are used to compute the tangential water velocity in the first cell adjacent to a wall.

Lake Boundaries

Three lake boundaries exist in the model and are indicated in Figure 2. For zero current conditions, each boundary is modeled as pressure boundary where flow is allowed to enter and exit the computational domain based on the local flow conditions in the model. Flow across a specific pressure boundary does not necessarily have to be in the same direction over the entire boundary.

For the simulations where a long shore current exists, the southern boundary is modeled as a velocity inlet where the current direction and magnitude can be specified. The northern boundary is simulated as a pressure boundary, allowing flow to exit the model. The lake boundary parallel to the shore is simulated as a symmetry plane such that it does not contribute to the flow field. All flow passing into the model from a lake boundary has a temperature of 60 °F.

Free Surface

The water level within the computational domain is assumed to vary by insignificant amounts relative to the total depth at the discharge structures. Consistent with this assumption, a 'rigid lid' simulation is performed. In a rigid lid simulation, the free surface elevation is fixed; however, the lid is modeled as a symmetry plane and provides no resistance to the flow. Local wind effects are neglected and no surface shear stress is applied.

Discharge Boundary

The discharge structures, including the internal geometry are simulated in the model. A short portion of the horizontal piping and the entire diffuser structure is included for each discharge; Figure 3 shows an overview of the Unit 2 discharge. The internal geometry is based on the drawings and notes provided by AEP. Each discharge structure is modeled such that the flow through the multiple slot diffusers varied appropriately and in response to the lake currents. The Unit 1 discharge is 719,850 gpm, while the Unit 2 discharge is 950,150 gpm (information provided by AEP). The discharge temperature of Unit 1 is 83 °F and Unit 2 is 78 °F with an ambient lake temperature of 60 °F. The Unit 1 discharge tunnel is 16 feet in diameter and the Unit 2 discharge tunnel is 18 feet in diameter, with respective cross-sectional areas of 200.9 and 254.3 square feet. The specified boundary velocities are 7.982 ft/s for Unit 1 and 8.326 ft/s for Unit 2.

Cooling Water Intake Boundary

All cooling water and service water is drawn into the plant through three intake tunnels that extend about 2,250 feet off shore. The three cooling water intake structures are included in the simulation as shown in Figure 4. The intake cribs are located in 24 feet of water at 579 ft MSL water elevation. Water flows into the cribs through an 8 x 8 inch mesh grid that is intended to keep large objects from entering the intake. The water velocity through the mesh is about 1.27 ft/s. Each intake tunnel is 16 feet in diameter. For the purpose of the modeling, it is assumed that inflow through the intakes matches the discharge. It is also assumed that the flow in each intake tunnel is equal, regardless of which units are in operation.

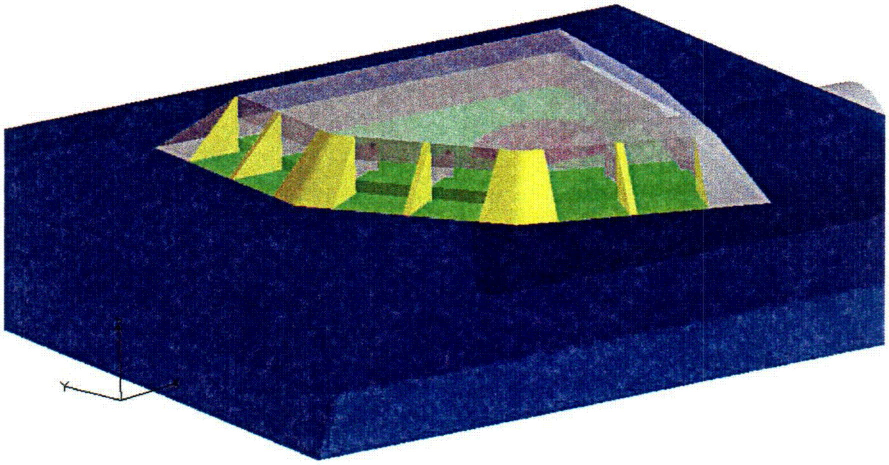


Figure 3: Overview of the Unit 2 discharge structure.

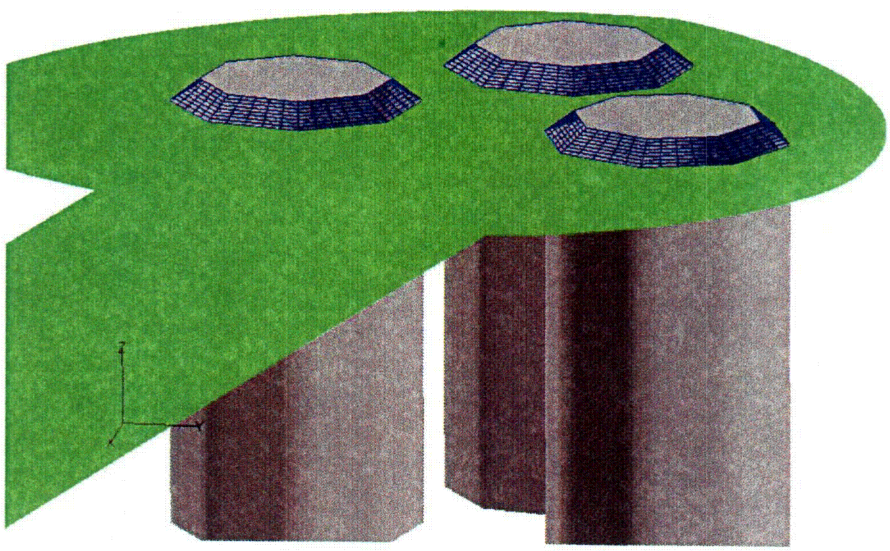


Figure 4: Over view of the three intake structures.

C08

MODELS

In addition to specifying the boundary conditions, it is necessary to select appropriate models and approximations for the simulation. The RNG k-epsilon turbulence model is selected for all the simulations. Fluent documentation indicates that this model is proven to be well suited to simulating jets entering an ambient flow field.

The temperature of the discharge plume is higher than the ambient, consequently, the discharge plume is buoyant. The boussinesq approximation (model) was used for the variable density simulation. Differences in fluid density affect the plume buoyancy, however, density variations are assumed to be negligible for all other calculations (i.e., horizontal momentum, etc.).

A species model is used to determine the mixing between the discharge flow and the ambient. Physical properties of the two fluids, other than density, are assumed to be the same. The species calculation does not affect the flow patterns. Therefore, species calculations are introduced after successful convergence of the flow equations. The amount of Mexel 432 in the discharge is not simulated. The discharge water is treated as a single species for which mixing with the ambient is computed. To determine the amount of Mexel at the edge of the mixing zone, the computed dilution ratio is multiplied by the Mexel concentration at the discharge.

SIMULATIONS AND POST PROCESSING

A total of 12 flow simulations are considered: three operating conditions at four different ambient water body conditions. For each case, it is assumed that all of the intake tunnels are being treated simultaneously and equally. In addition, for the case where both Units 1 and 2 are operational, a scenario is considered where only one of the two discharge tunnels at a time contained treated discharge water.

The edge of the mixing zone is defined in the Michigan Surface Water Quality Standards as the point where discharge induced mixing ceases to occur. The transition from discharge induced mixing to ambient turbulent mixing is gradual; as the penetrating jet looses momentum, the relative importance of ambient turbulent mixing increases. In the analysis of the model results, it is assumed that discharge induced mixing is the dominant cause of mixing to a point where a coherent velocity gradient between the jet and the ambient is no longer present. Discharge induced mixing ceases to occur when a visible jet is no longer present.

At the conclusion of each run, iso-surfaces of constant velocity are created for each simulation at water velocities of 0.5, 1, 1.5, 2, 3, 4, and 5 ft/s. The lowest velocity iso-surface which still retained a clear plume structure is defined as the edge of the mixing zone. Figures 5 through 8 show the minimum velocity iso-surface for the Unit 1 only cases. Figures 9 through 12 show the minimum velocity iso-surface for the Unit 2 only cases. Figures 13 through 16 show the minimum velocity iso-surface for the cases where both units are operational. In each figure, the plume is colored by the volume fraction of discharge water (dilution ratio). Appendix A (on CD-ROM) provides a complete set of the plots showing the iso-surface for velocities from 1 to 5 ft/s for each case considered.

The average dilution ratio is computed for each case shown in Figures 5 through 16. Results are shown in Table 1. In addition, Table 1 indicates the surface velocity and surface area of the plume. The average dilution ratio is also computed for the higher velocity iso-surfaces; Appendix B provides a complete set of tables showing the average dilution ratio for the cases considered. Data is omitted from the tables at the lower jet surface velocities, when a visual inspection of the iso-surface clearly showed that the surface extended beyond the area of discharge induced mixing.

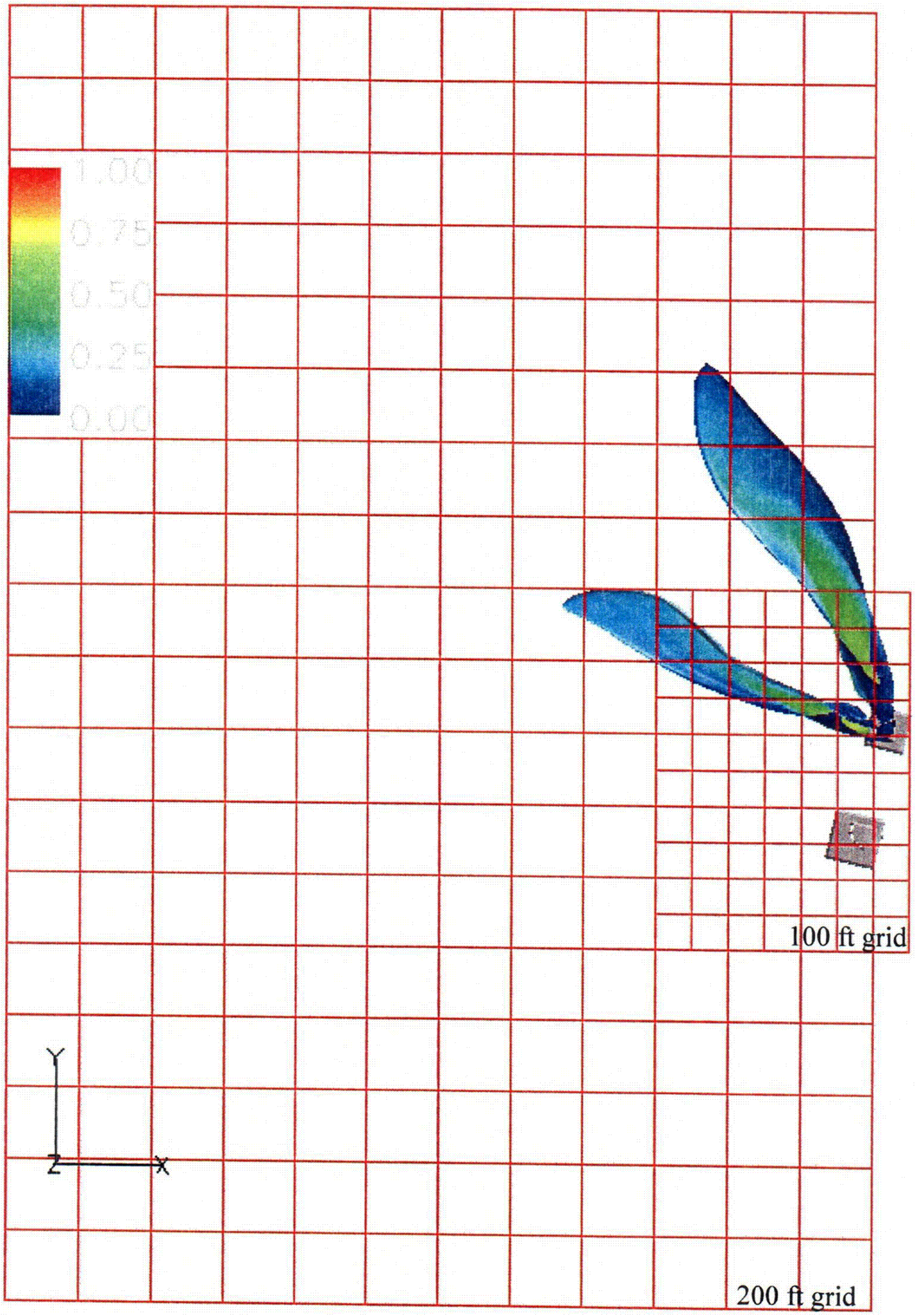


Figure 5: Zero current condition, Unit 1, 1 ft/s iso-surface.

C09

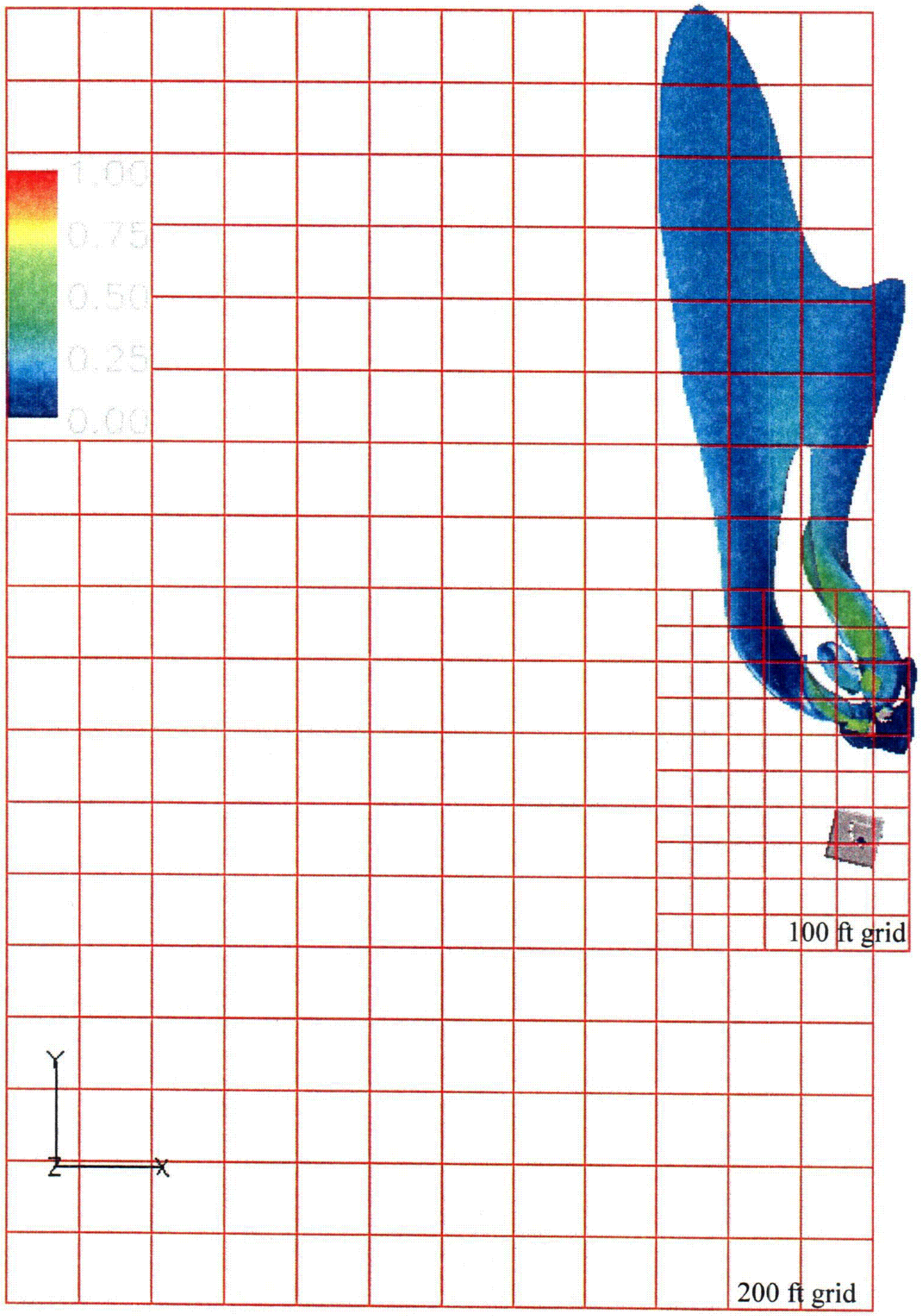


Figure 6: 0.5 ft/s current condition, Unit 1, 1 ft/s iso-surface.

C10

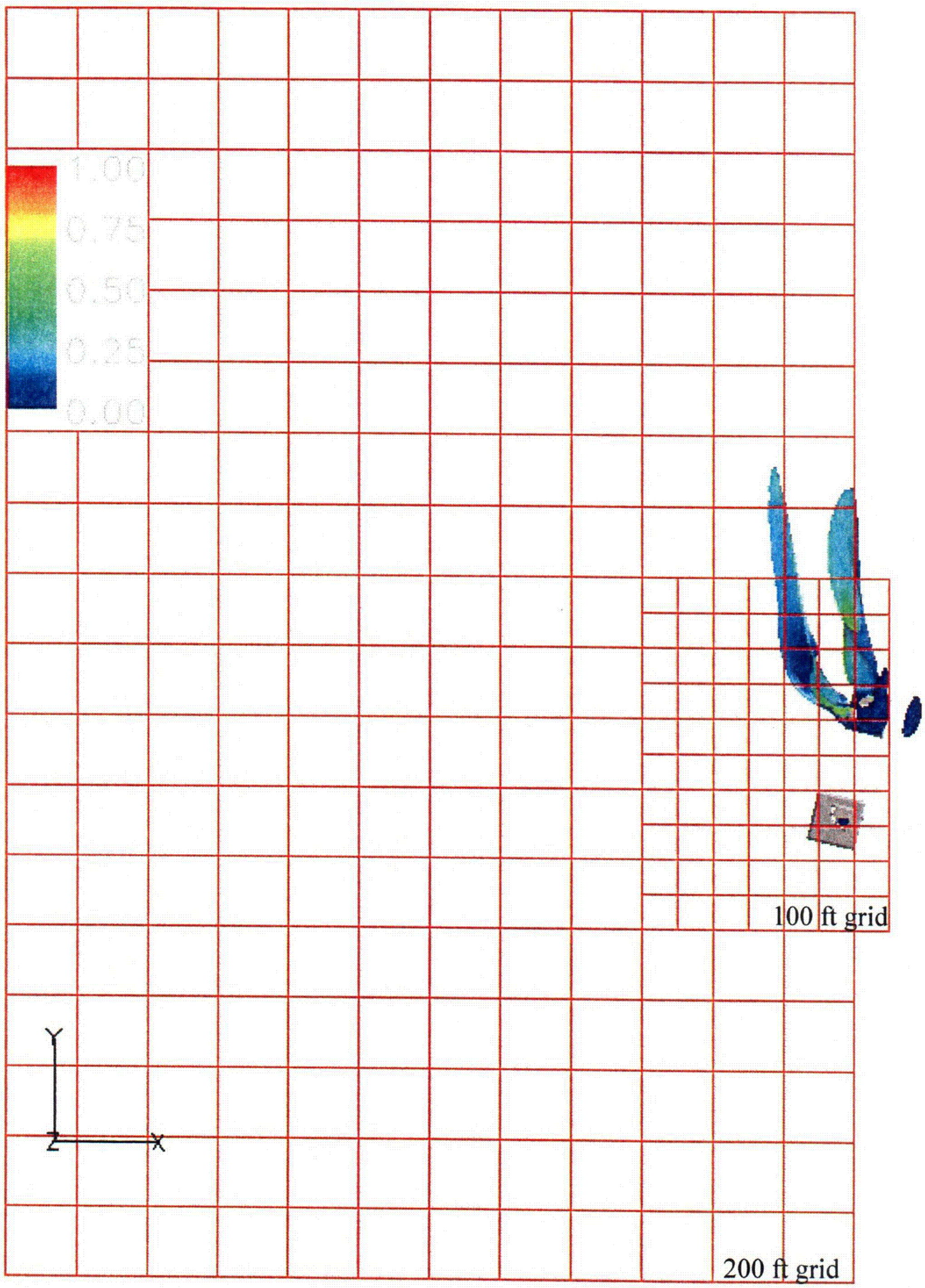


Figure 7: 1 ft/s current condition, Unit 1, 1.5 ft/s iso-surface.

C11

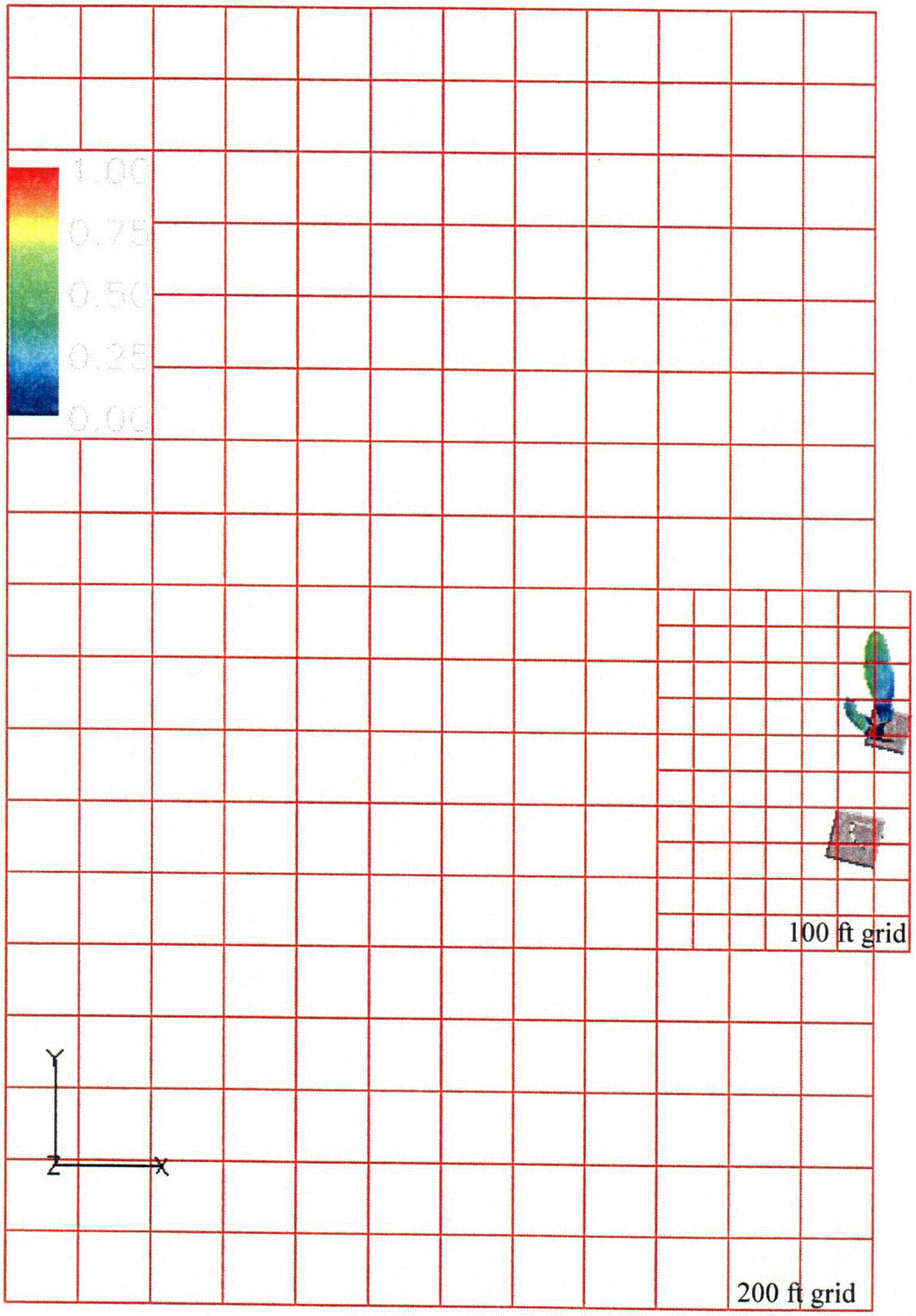


Figure 8: 2 ft/s current condition, Unit 1, 3 ft/s iso-surface.

C12

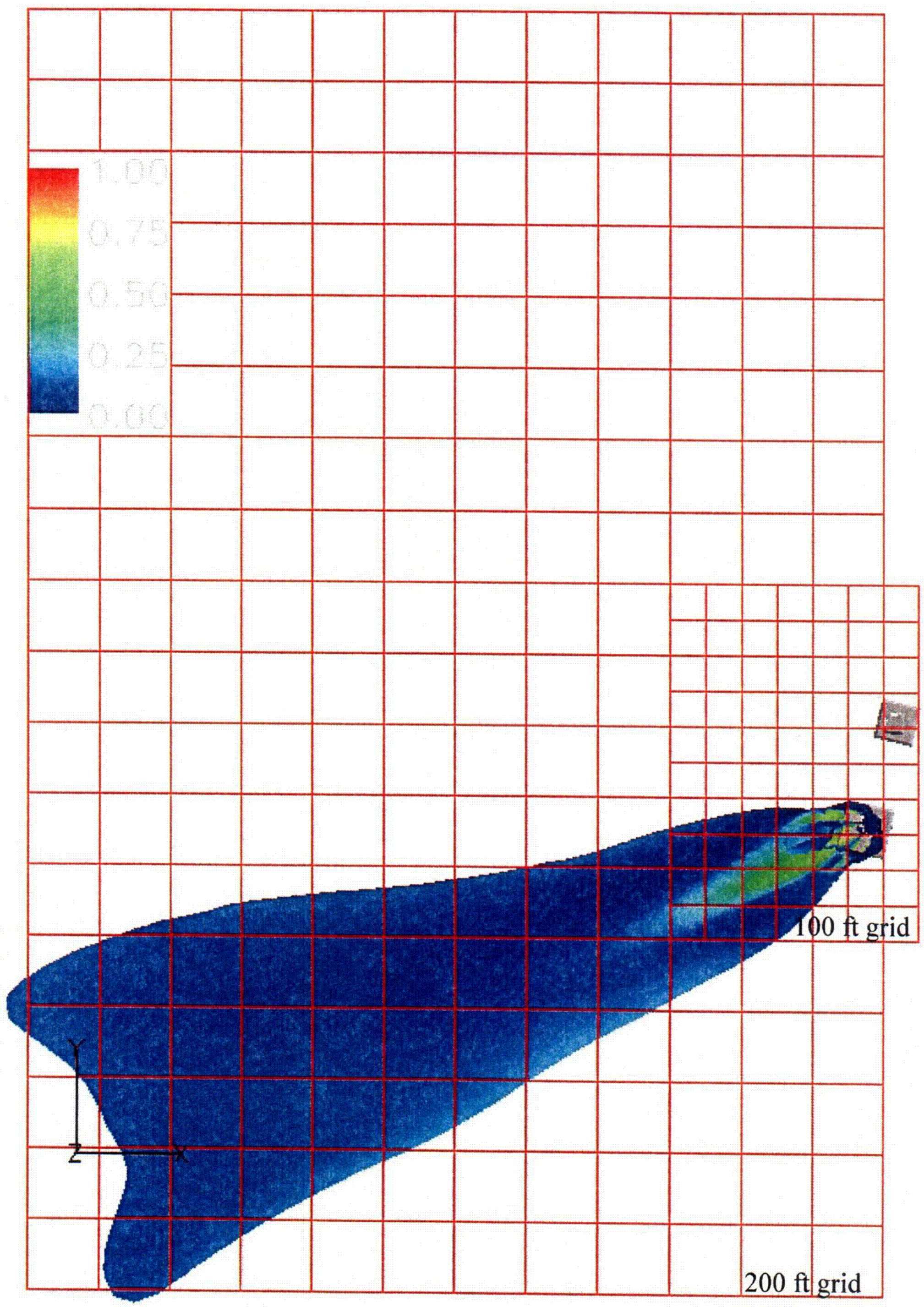


Figure 9: Zero current condition, Unit 2, 1 ft/s iso-surface.

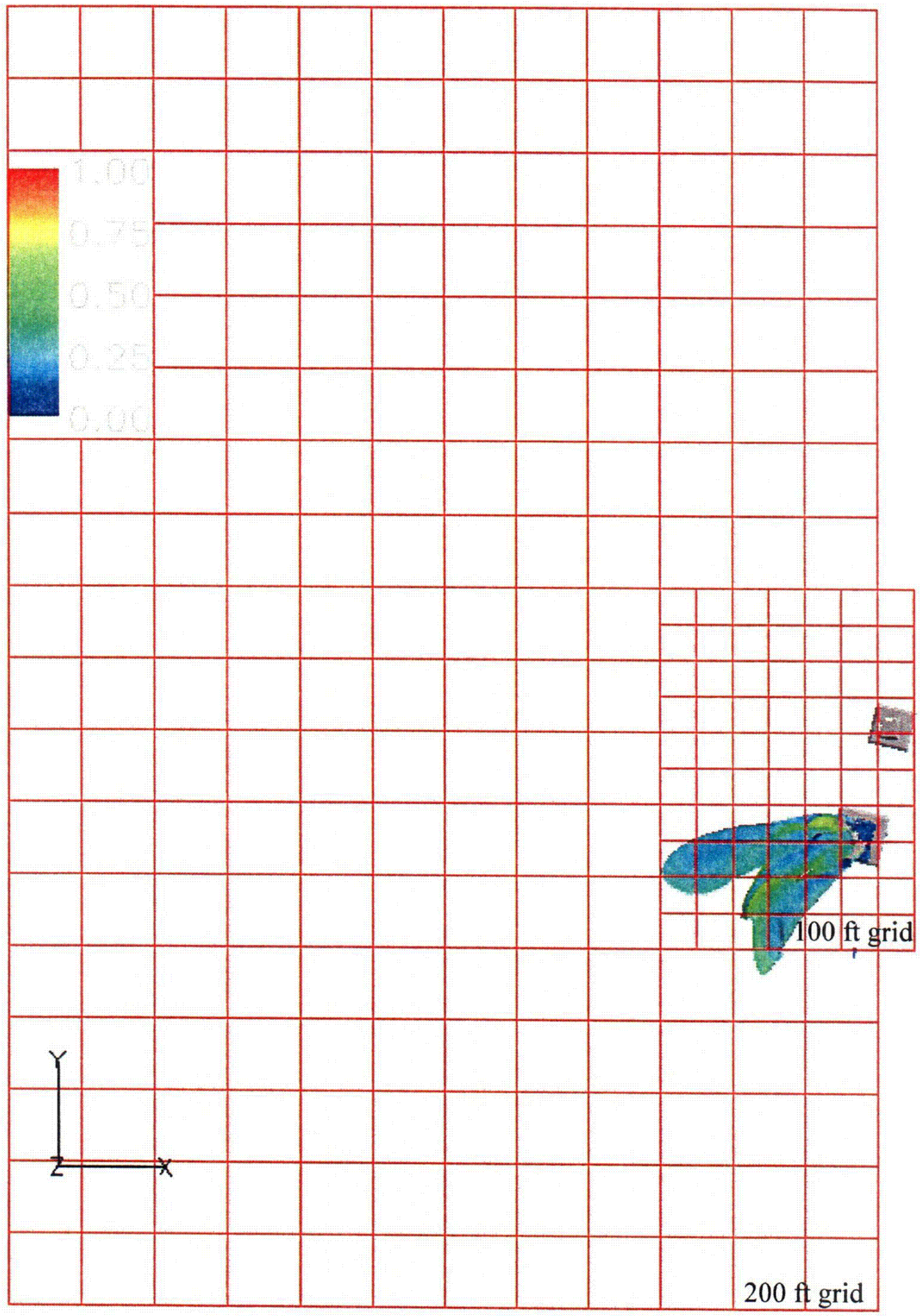


Figure 10: 0.5 ft/s current condition, Unit 2, 1.5 ft/s iso-surface.

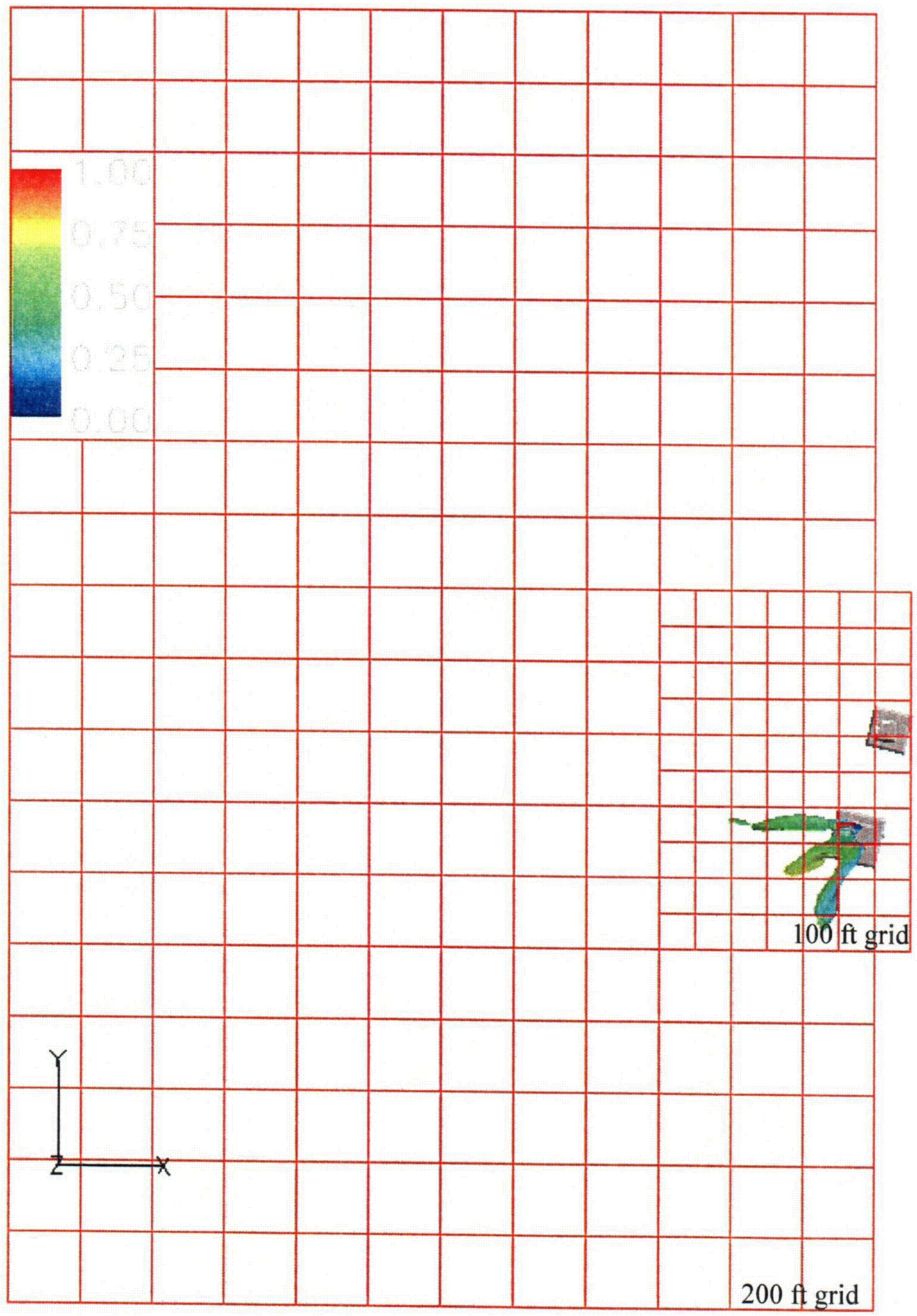


Figure 11: 1 ft/s current condition, Unit 2, 2 ft/s iso-surface.

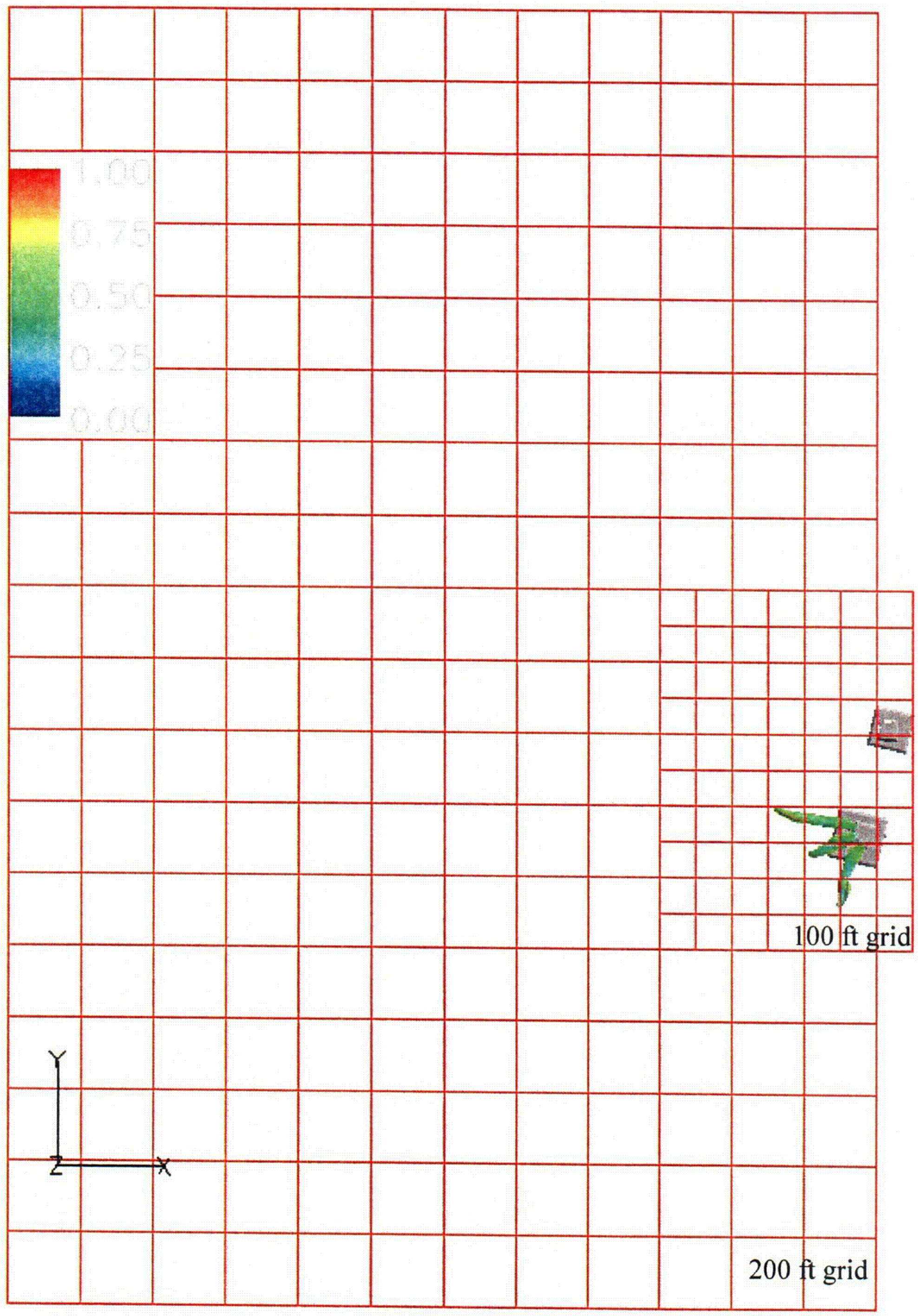


Figure 12: 2 ft/s current condition, Unit 2, 3 ft/s iso-surface.

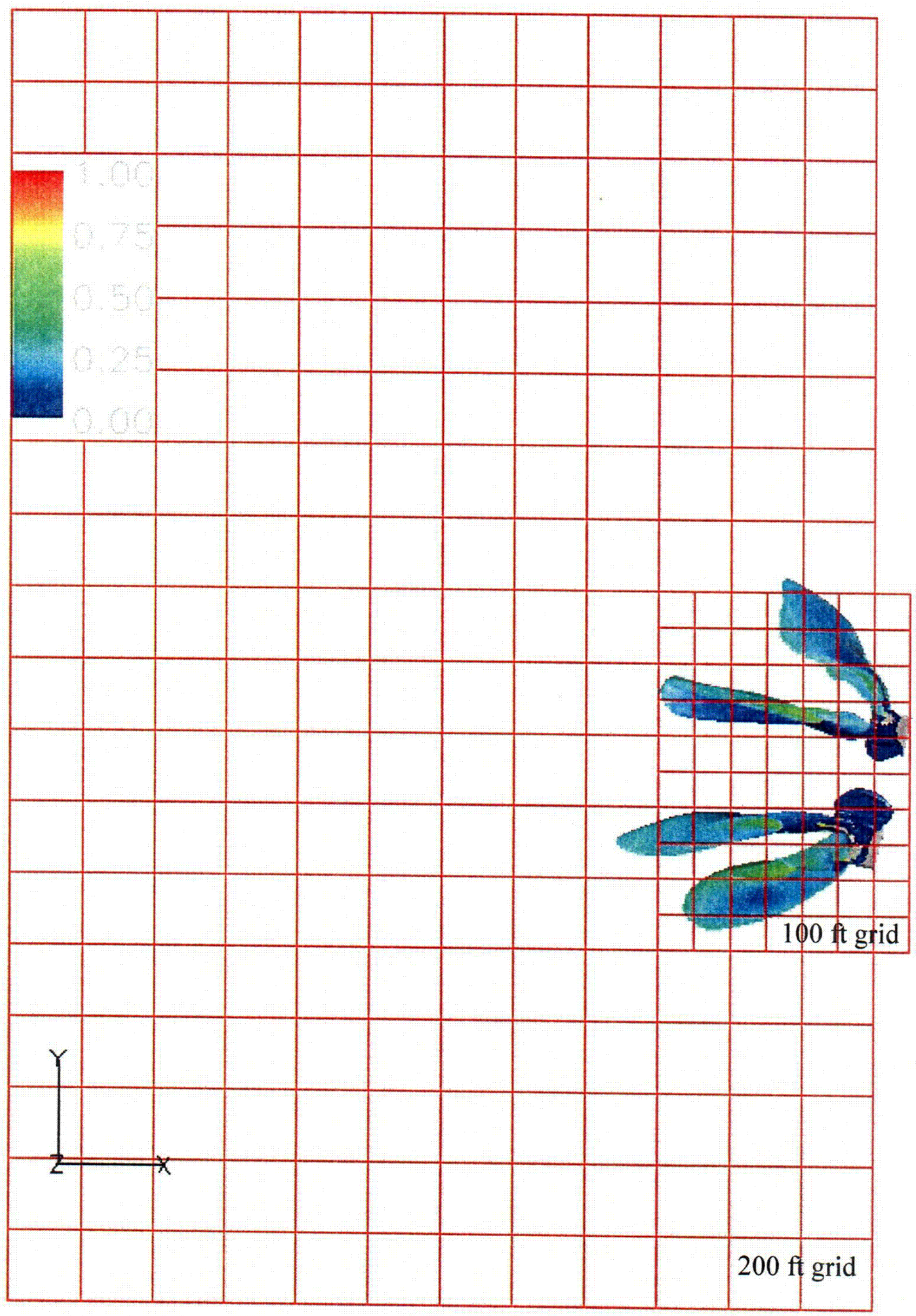


Figure 13: Zero current condition, Units 1&2, 1.5 ft/s iso-surface.

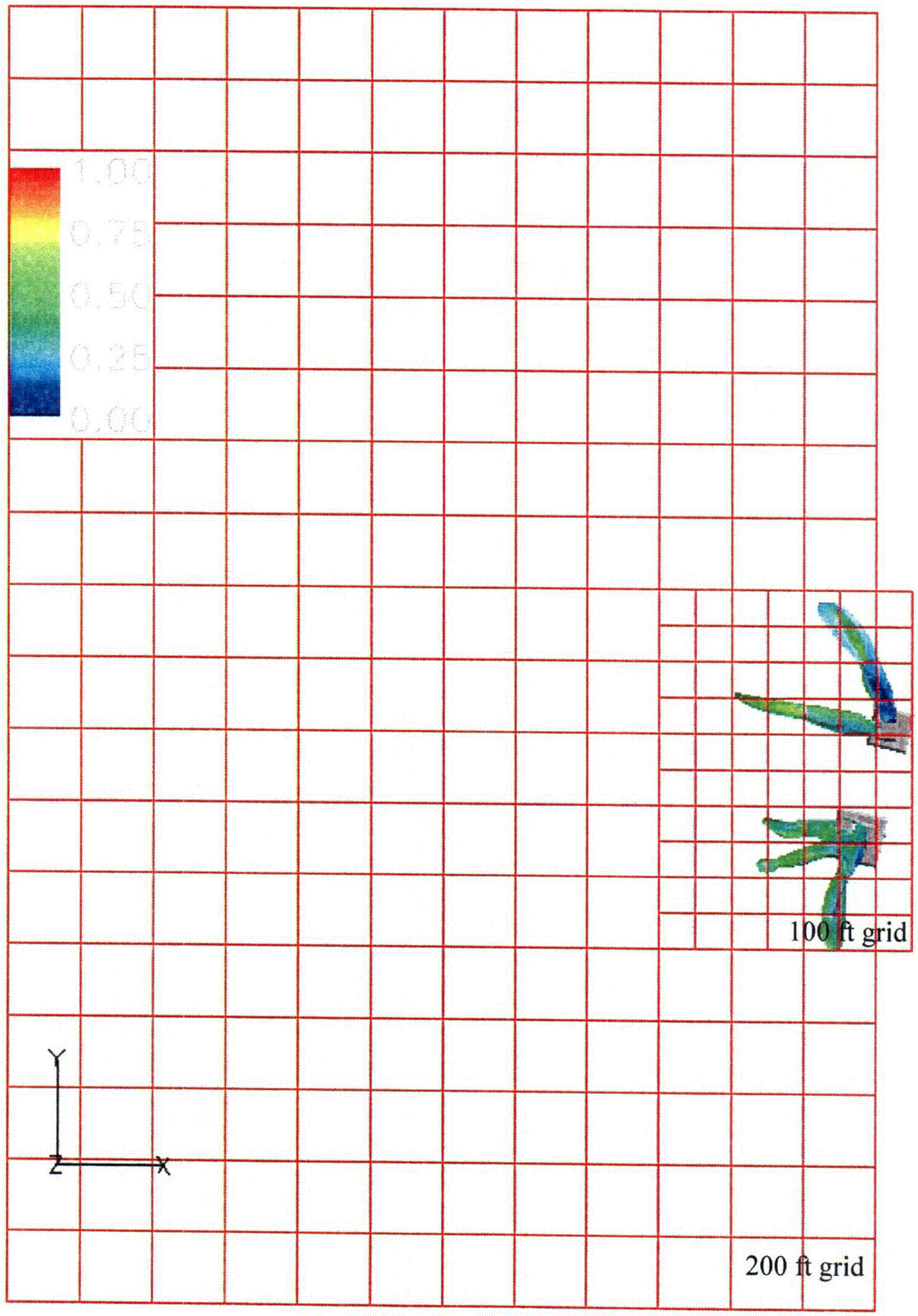


Figure 14: 0.5 ft/s current condition, Units 1&2, 2 ft/s iso-surface.

C18

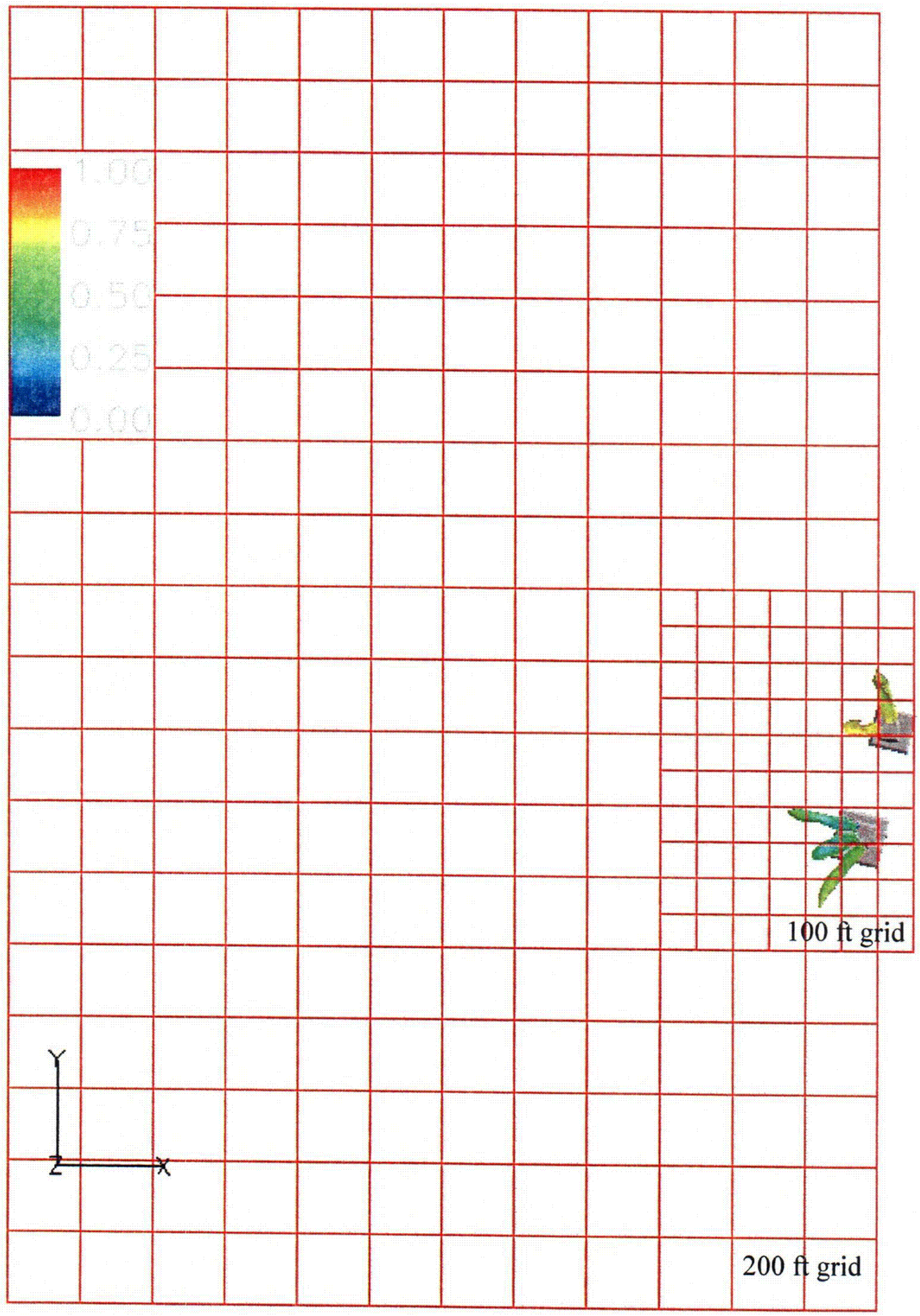


Figure 15: 1 ft/s current condition, Units 1&2, 3 ft/s iso-surface.

C19

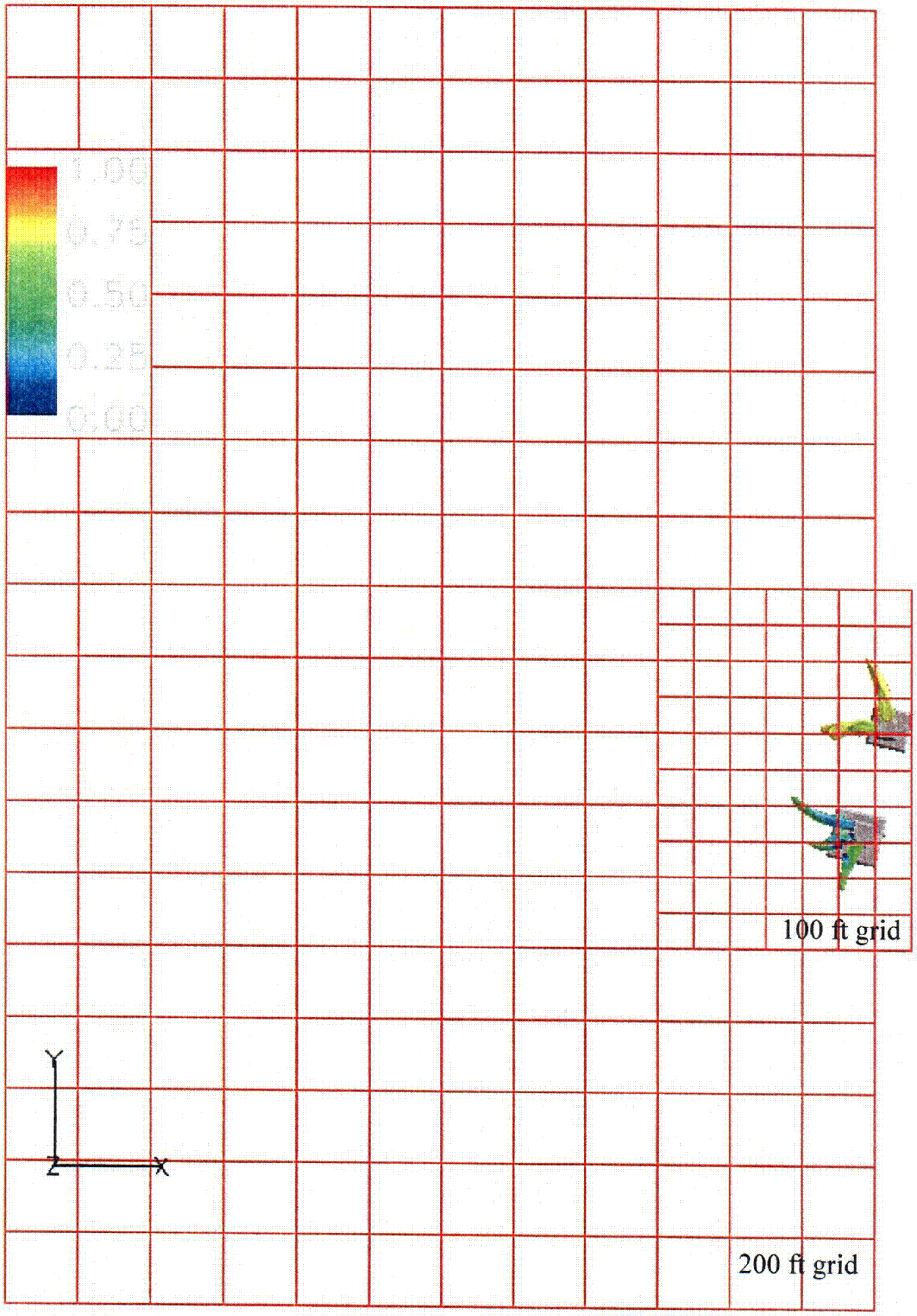


Figure 16: 2 ft/s current condition, Units 1&2, 3 ft/s iso-surface.

C20

The dilution ratio varies across the iso-surface. To quantify the variability of the dilution ratio, the iso-surface is subdivided by dilution ratio intervals of 0.1. The area of each subdivision is determined and reported cumulatively in a set of tables included in Appendix C. Table 2 shows a partial example of the tabular results of dilution ratio variability.

Table 1: Dilution Ratio at Mixing Zone Edge

Units Operational	Ambient Current	Surface Velocity	Surface Area	Dilution Ratio	Discharge Treated
1	0	1	333,200	0.24	1
1	0.5	1	829,600	0.19	1
1	1	1.5	163,100	0.21	1
1	2	3	42,600	0.36	1
2	0	1	1,513,500	0.14	2
2	0.5	1.5	172,700	0.32	2
2	1	2	68,800	0.48	2
2	2	3	32,700	0.54	2
1&2	0	1.5	331,300	0.24	1&2
1&2	0.5	2	158,900	0.42	1&2
1&2	1	3	58,100	0.63	1&2
1&2	2	3	48,000	0.58	1&2
1&2	0	1	220,800	0.17	1
1&2	0.5	1	245,126	0.25	1
1&2	1	3	19,900	0.62	1
1&2	2	3	25,900	0.61	1
1&2	0	1.5	189,900	0.25	2
1&2	0.5	2	76,500	0.42	2
1&2	1	3	35,300	0.53	2
1&2	2	3	28,300	0.45	2

Table 2: Dilution Ratio Variability

	Jet Surface Velocity (ft/s)			
	1		2	
Dilution Ratio	Area (sq-ft)	Area (% of total)	Area (sq-ft)	Area (% of total)
0.1	41,254	12%	10,837	11%
0.2	172,299	52%	34,808	35%
0.3	262,409	79%	54,070	55%
0.4	284,731	85%	65,686	67%
0.5	305,177	92%	75,724	77%
0.6	326,761	98%	92,271	94%
0.7	332,921	100%	98,115	100%
0.8	333,217	100%	98,365	100%

RESULTS AND CONCLUSIONS

A Computational Fluid Dynamics model (Fluent) is used to simulate the plume dilution at the D.C. Cook Nuclear Generating Station. Three operating conditions are considered at four different ambient lake current conditions. For each case, the average dilution ratio is determined at the edge of the mixing zone. The dilution ratio is the ratio of discharge water to lake water; a ratio of 1 indicates pure discharge water while a ratio of zero indicates pure lake water. To determine the Mexel concentration at the edge of the mixing zone, the Mexel concentration at the point of discharge is multiplied by the dilution ratio. For example, from Table 1 it is seen that when only Unit 2 is operating in a zero current condition, the dilution ratio is 0.14. If the Mexel concentration at the point of discharge is 10 percent, the average concentration at the edge of the mixing zone is computed by multiplying 0.14 by 10% to get 1.4 %.

The most common current condition is a south to north long shore current of less than 0.5 ft/s. For this condition:

- The average dilution ratio is less than 0.24 when only unit one is operating.
- The average dilution ratio is less than 0.32 when only unit two is operating.
- When Units 1 and 2 are in operation and all three intake tunnels are treated simultaneously, an average dilution ratio of less than 0.42 is predicted.
- When Units 1 and 2 are in operation and all three intake tunnels are treated, the presence of a 0.5 ft/s south to north current results in a considerably higher dilution ratio (0.42) than when discharging into a zero current condition (0.24).

- Treating the intake tunnels individually while both units are operational yields lower dilution ratios than treating all three intake tunnels simultaneously. Treating only the north intake tunnel (Unit 1 discharge) is predicted to give a dilution ratio of 0.25 or less. Treating only the south intake tunnel (Unit 2 discharge) gives a dilution ratio of less than 0.42.
- The dilution ratio when treating only the center intake tunnel while both units are operational can be determined using the Table 1 dilution ratios where both units are operational and both discharges are treated. The concentration at the edge of the mixing zone is determined by multiplying the dilution ratio with the Mexel concentration at the point of discharge. The Mexel concentration would be lower than when all three intake tunnels are treated from dilution occurring in the plant.

The presence of a south to north current, somewhat counter intuitively, increases the dilution ratio. In general, it is observed that the stronger the current the greater the dilution ratio; recalling that a large dilution ratio indicates less mixing with the ambient water. The dilution ratio increases with increasing current because of the definition of the mixing zone. The edge of the mixing zone is defined as the point where discharge induced mixing ends and ambient turbulent mixing becomes dominant. Therefore, the presence of a current reduces the size of the mixing zone by increasing the velocity at which ambient mixing becomes dominant. This observation is illustrated by the figures in Appendix A.

REFERENCES

D. Choudhury.
Introduction to the Renormalization Group Method and Turbulence Modeling.
Fluent Inc. Technical Memorandum TM-107, 1993.

B.E. Launder and D.B. Spalding.
The Numerical Computation of Turbulent Flows.
Computer Methods in Applied Mechanics and Engineering, 3:269-289, 1974.

Great Lakes Environmental Center.
Mixing Zone Evaluation for the Donald C. Cook Nuclear Plant Discharge Plume in Lake Michigan.
Traverse City, Michigan 49868.

APPENDIX A:

ISO-SURFACE PLOTS FOR ALL OPERATING CONDITIONS

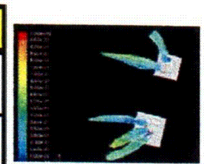
(On CD-ROM only)

APPENDIX B:
AVERAGE DILUTION RATIO TABLES FOR
ALL ISO-SURFACES CONSIDERED

No Ambient Lake Current

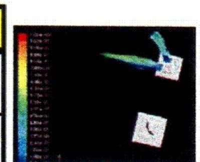
Units 1 and 2 Operation All Intake Tunnels Treated

	Jet Surface Velocity (ft/s)				
	1.5	2	3	4	5
Plume surface area (sq ft)	331,312	182,917	84,714	47,566	28,002
Average dilution ratio	0.24	0.31	0.39	0.45	0.5



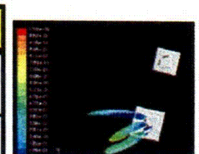
Unit 1 Operating

	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)	333,217	98,365	46,589	26,814	14,893
Average dilution ratio	0.24	0.32	0.4	0.47	0.52



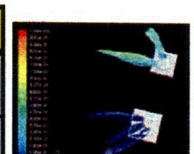
Unit 2 Operating

	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)	1,513,460	127,018	45,166	24,004	14,328
Average dilution ratio	0.14	0.26	0.32	0.39	0.45



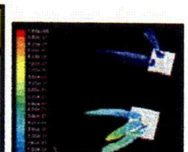
Units 1 and 2 Operating Unit 1 Treated Only

	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)	220,753	77,703	38,994	22,632	12,984
Average dilution ratio	0.17	0.31	0.38	0.45	0.5



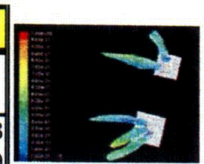
Units 1 and 2 Operating Unit 2 Treated Only

	Jet Surface Velocity (ft/s)				
	1.5	2	3	4	5
Plume surface area (sq ft)	189,861	97,041	45,324	24,929	15,016
Average dilution ratio	0.25	0.33	0.4	0.45	0.5

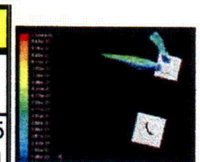


0.5 ft/s Ambient Lake Current

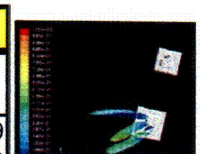
Units 1 and 2 Operation All Intake Tunnels Treated					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)		158,885	79,424	45,454	27,948
Average dilution ratio		0.42	0.49	0.54	0.59



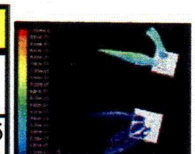
Unit 1 Operating					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)	829,617	80,391	42,187	25,091	13,975
Average dilution ratio	0.19	0.33	0.41	0.46	0.51



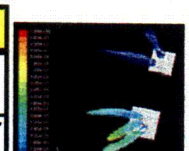
Unit 2 Operating					
	Jet Surface Velocity (ft/s)				
	1.5	2	3	4	5
Plume surface area (sq ft)	172,661	94,576	37,938	20,703	12,919
Average dilution ratio	0.32	0.37	0.47	0.51	0.56



Units 1 and 2 Operating Unit 1 Treated Only					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)	245,126	82,155	42,327	25,491	14,665
Average dilution ratio	0.25	0.35	0.44	0.5	0.54



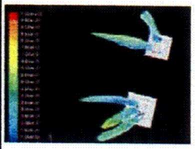
Units 1 and 2 Operating Unit 2 Treated Only					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)		76,496	37,198	20,070	13,487
Average dilution ratio		0.42	0.48	0.53	0.6



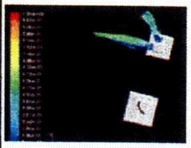
C22

1 ft/s Ambient Lake Current

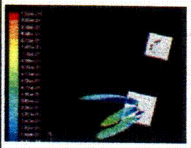
Units 1 and 2 Operation All Intake Tunnels Treated	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			58,092	40,046	28,826
Average dilution ratio			0.63	0.68	0.73



Unit 1 Operating	Jet Surface Velocity (ft/s)				
	1.5	2	3	4	5
Plume surface area (sq ft)	163,084	73,754	35,476	21,745	13,639
Average dilution ratio	0.21	0.3	0.4	0.45	0.5

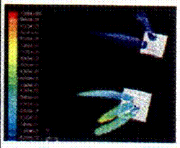


Unit 2 Operating	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)		68,803	37,688	21,646	14,158
Average dilution ratio		0.48	0.52	0.55	0.59



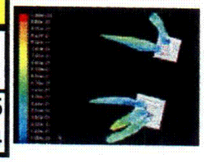
Units 1 and 2 Operating Unit 1 Treated Only	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			19,950	13,580	9,637
Average dilution ratio			0.62	0.68	0.72

Units 1 and 2 Operating Unit 2 Treated Only	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			35,287	23,742	16,192
Average dilution ratio			0.53	0.58	0.63

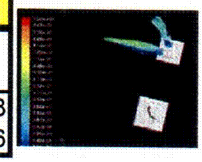


2 ft/s Ambient Lake Current

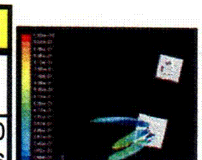
Units 1 and 2 Operation All Intake Tunnels Treated					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			48,016	29,508	20,365
Average dilution ratio			0.58	0.61	0.64



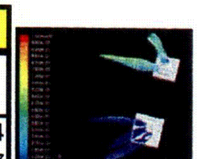
Unit 1 Operating					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			42,560	23,340	13,733
Average dilution ratio			0.36	0.41	0.46



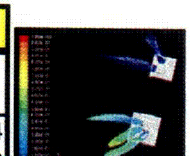
Unit 2 Operating					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			32,675	21,298	13,820
Average dilution ratio			0.54	0.6	0.66



Units 1 and 2 Operating Unit 1 Treated Only					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			25,924	16,545	10,704
Average dilution ratio			0.61	0.64	0.67



Units 1 and 2 Operating Unit 2 Treated Only					
	Jet Surface Velocity (ft/s)				
	1	2	3	4	5
Plume surface area (sq ft)			28,316	18,040	13,444
Average dilution ratio			0.45	0.52	0.58



C24

APPENDIX C:
DILUTION RATIO VARIABILITY TABLES

No Ambient Lake Current

Units 1 and 2 Operating All Intake Tunnels Treated										
	Jet Surface Velocity (ft/s)									
	1.5		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	61,189	18%	17,017	9%	1,162	1%	174	0%	0	0%
0.2	128,904	39%	38,866	21%	8,509	10%	506	1%	6	0%
0.3	248,278	75%	105,411	58%	23,564	28%	7,628	16%	352	1%
0.4	294,976	89%	143,736	79%	51,461	61%	19,179	40%	7,690	27%
0.5	307,775	93%	159,128	87%	62,932	74%	30,905	65%	16,629	59%
0.6	321,567	97%	173,162	95%	75,008	89%	39,506	83%	21,500	77%
0.7	330,387	100%	182,001	99%	83,766	99%	46,473	98%	26,411	94%
0.8	331,312	100%	182,917	100%	84,714	100%	47,566	100%	28,002	100%

Unit 1 Operating										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	41,254	12%	10,837	11%	489	1%	0	0%	0	0%
0.2	172,299	52%	34,808	35%	8,162	18%	36	0%	0	0%
0.3	262,409	79%	54,070	55%	16,454	35%	4,732	18%	31	0%
0.4	284,731	85%	65,686	67%	23,660	51%	10,159	38%	3,788	25%
0.5	305,177	92%	75,724	77%	30,657	66%	15,082	56%	6,888	46%
0.6	326,761	98%	92,271	94%	40,952	88%	21,481	80%	10,408	70%
0.7	332,921	100%	98,115	100%	46,292	99%	26,352	98%	14,274	96%
0.8	333,217	100%	98,365	100%	46,589	100%	26,814	100%	14,893	100%

Unit 2 Operating										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	203,131	13%	16,179	13%	2,776	6%	0	0%	0	0%
0.2	1,439,120	95%	33,038	26%	12,127	27%	1,399	6%	0	0%
0.3	1,477,274	98%	97,315	77%	24,197	54%	8,718	36%	369	3%
0.4	1,494,551	99%	108,178	85%	32,140	71%	14,537	61%	7,113	50%
0.5	1,504,602	99%	118,290	93%	36,750	81%	17,904	75%	10,407	73%
0.6	1,511,500	100%	125,081	98%	43,227	96%	22,083	92%	12,230	85%
0.7	1,512,793	100%	126,360	99%	44,501	99%	23,331	97%	13,646	95%
0.8	1,513,460	100%	127,018	100%	45,166	100%	24,004	100%	14,328	100%

Units 1 and 2 Operating Unit 1 Treated Only										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	78,477	36%	3,379	4%	174	0%	0	0%	0	0%
0.2	136,131	62%	13,932	18%	3,205	8%	74	0%	0	0%
0.3	192,269	87%	45,735	59%	10,823	28%	3,281	14%	110	1%
0.4	208,706	95%	63,947	82%	25,192	65%	9,034	40%	3,559	27%
0.5	212,825	96%	69,561	90%	30,434	78%	14,648	65%	7,801	60%
0.6	218,221	99%	74,986	97%	36,194	93%	19,740	87%	10,117	78%
0.7	220,552	100%	77,490	100%	38,738	99%	22,266	98%	12,401	96%
0.8	220,753	100%	77,703	100%	38,994	100%	22,632	100%	12,984	100%

Units 1 and 2 Operating Unit 2 Treated Only										
	Jet Surface Velocity (ft/s)									
	1.5		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	36,408	19%	5,570	6%	606	1%	173	1%	0	0%
0.2	66,003	35%	16,881	17%	4,935	11%	431	2%	6	0%
0.3	136,185	72%	51,823	53%	12,388	27%	4,362	17%	242	2%
0.4	164,680	87%	71,710	74%	25,929	57%	10,166	41%	4,144	28%
0.5	172,639	91%	81,446	84%	32,141	71%	16,273	65%	8,841	59%
0.6	181,002	95%	90,115	93%	38,495	85%	19,796	79%	11,401	76%
0.7	187,317	99%	96,370	99%	44,644	98%	24,235	97%	14,041	94%
0.8	189,861	100%	97,041	100%	45,324	100%	24,929	100%	15,016	100%

C25

0.5 ft/s Ambient Lake Current

Units 1 and 2 Operating All Intake Tunnels Treated

	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1			374	0%	10	0%	0	0%	0	0%
0.2			9,039	6%	338	0%	19	0%	0	0%
0.3			32,859	21%	7,944	10%	352	1%	2	0%
0.4			73,036	46%	18,872	24%	6,021	13%	625	2%
0.5			117,454	74%	43,136	54%	15,426	34%	5,252	19%
0.6			143,265	90%	63,953	81%	30,551	67%	15,736	56%
0.7			155,287	98%	75,826	95%	41,722	92%	24,474	88%
0.8			158,885	100%	79,424	100%	45,454	100%	27,948	100%

Unit 1 Operating

	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	66,001	8%	3,840	5%	83	0%	7	0%	0	0%
0.2	611,323	74%	11,120	14%	2,540	6%	79	0%	0	0%
0.3	770,708	93%	41,394	51%	11,682	28%	3,130	12%	65	0%
0.4	795,455	96%	56,218	70%	21,622	51%	8,438	34%	3,410	24%
0.5	815,554	98%	66,386	83%	29,221	69%	14,393	57%	6,714	48%
0.6	825,317	99%	76,317	95%	38,368	91%	21,448	85%	10,536	75%
0.7	829,389	100%	80,151	100%	41,937	99%	24,833	99%	13,656	98%
0.8	829,617	100%	80,391	100%	42,187	100%	25,091	100%	13,975	100%

Unit 2 Operating

	Jet Surface Velocity (ft/s)									
	1.5		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	1,866	1%	708	1%	0	0%	0	0%	0	0%
0.2	18,265	11%	7,819	8%	132	0%	11	0%	0	0%
0.3	97,389	56%	28,213	30%	4,775	13%	245	1%	0	0%
0.4	137,078	79%	66,037	70%	11,661	31%	4,113	20%	177	1%
0.5	149,636	87%	77,446	82%	23,815	63%	10,004	48%	4,444	34%
0.6	161,553	94%	84,155	89%	29,887	79%	15,239	74%	9,290	72%
0.7	171,454	99%	93,383	99%	36,407	96%	19,195	93%	11,771	91%
0.8	172,661	100%	94,577	100%	37,938	100%	20,703	100%	12,919	100%

Units 1 and 2 Operating Unit 1 Treated Only

	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	34,144	14%	5,098	6%	40	0%	9	0%	0	0%
0.2	118,837	48%	21,746	26%	4,158	10%	42	0%	0	0%
0.3	178,225	73%	38,235	47%	10,805	26%	3,463	14%	15	0%
0.4	210,336	86%	50,275	61%	18,172	43%	8,046	32%	2,790	19%
0.5	224,631	92%	65,644	80%	25,379	60%	12,148	48%	6,320	43%
0.6	235,744	96%	73,994	90%	34,460	81%	17,861	70%	9,417	64%
0.7	244,239	100%	81,202	99%	41,280	98%	24,352	96%	13,480	92%
0.8	245,126	100%	82,155	100%	42,327	100%	25,491	100%	14,665	100%

Units 1 and 2 Operating Unit 2 Treated Only

	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1			45	0%	0	0%	0	0%	0	0%
0.2			1,090	1%	3	0%	0	0%	0	0%
0.3			7,931	10%	1,282	3%	12	0%	0	0%
0.4			32,410	42%	6,532	18%	1,275	6%	68	1%
0.5			60,181	79%	23,067	62%	6,759	34%	1,428	11%
0.6			73,003	95%	34,083	92%	16,123	80%	8,213	61%
0.7			75,684	99%	36,380	98%	19,182	96%	12,302	91%
0.8			76,496	100%	37,198	100%	20,070	100%	13,487	100%

C26

1 ft/s Ambient Lake Current

Units 1 and 2 Operating All Intake Tunnels Treated										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					0	0%	0	0%	0	0%
0.2					84	0%	0	0%	0	0%
0.3					1,149	2%	1	0%	0	0%
0.4					7,104	12%	1,440	4%	0	0%
0.5					13,031	22%	6,665	17%	1,526	5%
0.6					21,811	38%	11,731	29%	6,385	22%
0.7					35,639	61%	20,431	51%	11,738	41%
0.8					49,213	85%	28,844	72%	18,262	63%

Unit 1 Operating										
	Jet Surface Velocity (ft/s)									
	1.5		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1	36,575	22%	8,945	12%	612	2%	29	0%	0	0%
0.2	79,133	49%	18,279	25%	3,746	11%	262	1%	0	0%
0.3	134,155	82%	43,165	59%	10,396	29%	3,518	16%	243	2%
0.4	145,515	89%	55,428	75%	19,124	54%	8,173	38%	3,445	25%
0.5	151,824	93%	62,076	84%	24,821	70%	12,823	59%	6,866	50%
0.6	157,941	97%	68,762	93%	30,862	87%	18,021	83%	10,672	78%
0.7	162,840	100%	73,520	100%	35,229	99%	21,488	99%	13,373	98%
0.8	163,084	100%	73,754	100%	35,476	100%	21,745	100%	13,637	100%

Unit 2 Operating										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1			19	0%	0	0%	0	0%	0	0%
0.2			1,053	2%	63	0%	0	0%	0	0%
0.3			8,932	13%	1,070	3%	30	0%	0	0%
0.4			18,773	27%	6,937	18%	1,714	8%	64	0%
0.5			39,147	57%	17,461	46%	7,851	36%	2,488	18%
0.6			55,571	81%	27,712	74%	14,115	65%	8,160	58%
0.7			64,106	93%	33,995	90%	19,104	88%	12,169	86%
0.8			68,803	100%	37,688	100%	21,646	100%	14,158	100%

Units 1 and 2 Operating Unit 1 Treated Only										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					0	0%	0	0%	0	0%
0.2					0	0%	0	0%	0	0%
0.3					0	0%	1	0%	0	0%
0.4					0	0%	0	0%	0	0%
0.5					2,709	14%	22	0%	0	0%
0.6					7,248	36%	1,980	15%	21	0%
0.7					16,209	81%	7,581	56%	3,192	33%
0.8					19,950	100%	13,580	100%	9,637	100%

Units 1 and 2 Operating Unit 2 Treated Only										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					0	0%	0	0%	0	0%
0.2					0	0%	0	0%	0	0%
0.3					1,414	4%	1	0%	0	0%
0.4					7,532	21%	2,006	8%	0	0%
0.5					13,213	37%	6,891	29%	1,810	11%
0.6					21,850	62%	12,006	51%	6,490	40%
0.7					32,469	92%	20,499	86%	11,801	73%
0.8					35,287	100%	23,742	100%	16,192	100%

2 ft/s Ambient Lake Current

Units 1 and 2 Operating All Intake Tunnels Treated										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					0	0%	0	0%	0	0%
0.2					1,348	3%	0	0%	0	0%
0.3					4,922	10%	1,201	4%	0	0%
0.4					8,670	18%	4,249	14%	1,070	5%
0.5					13,514	28%	7,118	24%	3,898	19%
0.6					21,041	44%	11,968	41%	6,729	33%
0.7					31,187	65%	17,683	60%	11,399	56%
0.8					48,016	100%	29,508	100%	20,365	100%

Unit 1 Operating										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					3,295	8%	922	4%	96	1%
0.2					8,393	20%	1,907	8%	221	2%
0.3					16,568	39%	6,534	28%	1,046	8%
0.4					24,948	59%	10,913	47%	5,156	38%
0.5					32,075	75%	15,997	69%	8,239	60%
0.6					39,965	94%	20,994	90%	11,669	85%
0.7					42,334	99%	23,102	99%	13,484	98%
0.8					42,560	100%	23,340	100%	13,733	100%

Unit 2 Operating										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					21	0%	0	0%	0	0%
0.2					220	1%	0	0%	0	0%
0.3					1,178	4%	0	0%	0	0%
0.4					5,132	16%	129	1%	1	0%
0.5					12,642	39%	3,205	15%	57	0%
0.6					20,760	64%	11,202	53%	4,120	30%
0.7					29,839	91%	17,948	84%	10,133	73%
0.8					32,675	100%	21,298	100%	13,820	100%

Units 1 and 2 Operating Unit 1 Treated Only										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					0	0%	0	0%	0	0%
0.2					0	0%	0	0%	0	0%
0.3					0	0%	0	0%	0	0%
0.4					248	1%	0	0%	0	0%
0.5					2,488	10%	207	1%	1	0%
0.6					13,077	50%	4,938	30%	1,232	12%
0.7					20,818	80%	11,879	72%	7,101	66%
0.8					25,924	100%	16,545	100%	10,704	100%

Units 1 and 2 Operating Unit 2 Treated Only										
	Jet Surface Velocity (ft/s)									
	1		2		3		4		5	
Dilution Ratio	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)	Area (sq ft)	Area (% of total)
0.1					1,144	4%	0	0%	0	0%
0.2					2,536	9%	0	0%	0	0%
0.3					6,272	22%	1,232	7%	0	0%
0.4					9,854	35%	4,279	24%	1,123	8%
0.5					14,772	52%	7,147	40%	3,915	29%
0.6					22,219	78%	12,040	67%	6,768	50%
0.7					27,150	96%	16,464	91%	11,305	84%
0.8					28,316	100%	18,040	100%	13,444	100%

CZ8