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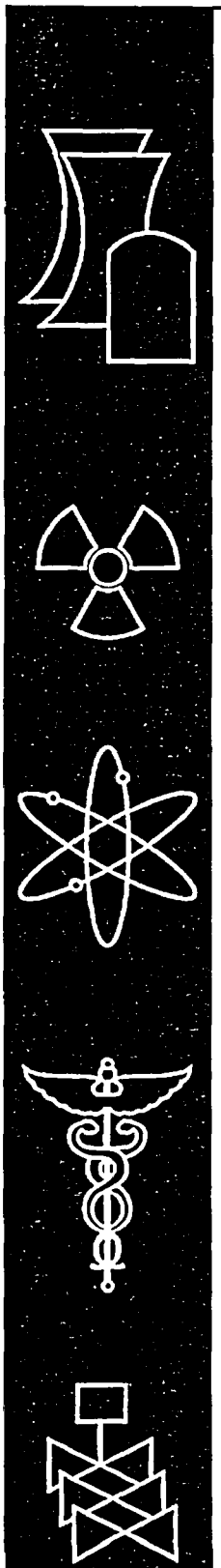

# Generic Environmental Impact Statement for License Renewal of Nuclear Plants

## Supplement 23

**Regarding**
**Point Beach Nuclear Plant Units 1 and 2**

**Final Report**

**U.S. Nuclear Regulatory Commission**
**Office of Nuclear Reactor Regulation**
**Washington, DC 20555-0001**

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NUREG-1437
Supplement 23

# Generic Environmental Impact Statement for License Renewal of Nuclear Plants

# Supplement 23

# Regarding Point Beach Nuclear Plant Units 1 and 2

# Final Report

Manuscript Completed: July 2005
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**Division of Regulatory Improvement Programs**
**Office of Nuclear Reactor Regulation**
**U.S. Nuclear Regulatory Commission**
**Washington, DC 20555-0001**

# Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental impacts of renewing nuclear power plant operating licenses (OLs) for a 20-year period in its *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, and codified the results in Title 10 of the Code of Federal Regulations (CFR) Part 51. In the GEIS (and its Addendum 1), the staff identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 69 of these issues that apply to all plants or to plants with specific design or site characteristics. Additional plant-specific review is required for the remaining 23 issues. These plant-specific reviews are to be included in a supplement to the GEIS.

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by the Nuclear Management Company, LLC (NMC), on behalf of the owner, the Wisconsin Electric Power Company (WEPCO), to renew the OLs for Point Beach Nuclear Plant Units 1 and 2 (PBNP) for an additional 20 years under 10 CFR Part 54. This SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action.

Regarding the 69 issues for which the GEIS reached generic conclusions, neither NMC nor the staff has identified information that is both new and significant for any issue that applies to PBNP. In addition, the staff determined that information provided during the scoping and the draft SEIS comment processes did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the PBNP OLs would not be greater than impacts identified for these issues in the GEIS. For each of these issues, the staff's conclusion in the GEIS is that the impact would be of SMALL[(a)] significance (except for collective offsite radiological impacts from the fuel cycle and high-level waste and spent fuel, which were not assigned a single significance level).

Regarding the remaining 23 issues, those that apply to PBNP are addressed in this SEIS. With the exception of the chronic effects of electromagnetic fields (for which the magnitude of impact is "uncertain"), for each applicable issue, the staff concludes that the significance of the potential environmental impacts of renewal of the OLs would be SMALL. The staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be

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(a) Environmental impacts are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.

warranted. The staff determined that information provided during the public comment period did not identify any new issue that requires site-specific assessment.

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for PBNP would not be so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by NMC; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

# Contents


Abstract ..... iii

Executive Summary ..... xv

Abbreviations/Acronyms ..... xx

1.0 Introduction ..... 1-1

1.1 Report Contents ..... 1-2
1.2 Background ..... 1-3

1.2.1 Generic Environmental Impact Statement ..... 1-3
1.2.2 License Renewal Evaluation Process ..... 1-5

1.3 The Proposed Federal Action ..... 1-7
1.4 The Purpose and Need for the Proposed Action ..... 1-8
1.5 Compliance and Consultations ..... 1-9
1.6 References ..... 1-9

2.0 Description of Nuclear Power Plant and Site and Plant Interaction with the Environment ..... 2-1

2.1 Plant and Site Description and Proposed Plant Operation during the Renewal Term ..... 2-1

2.1.1 External Appearance and Setting ..... 2-1
2.1.2 Reactor Systems ..... 2-4
2.1.3 Cooling and Auxiliary Water Systems ..... 2-4
2.1.4 Radioactive Waste Management Systems and Effluent Control Systems ..... 2-7

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls ..... 2-8
2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls ..... 2-9
2.1.4.3 Solid-Waste Processing ..... 2-10

2.1.5 Nonradioactive Waste Systems ..... 2-11
2.1.6 Plant Operation and Maintenance ..... 2-12
2.1.7 Power Transmission System ..... 2-12

Contents


2.2 Plant Interaction with the Environment ..... 2-15

2.2.1 Land Use ..... 2-16
2.2.2 Water Use ..... 2-17
2.2.3 Water Quality ..... 2-18
2.2.4 Air Quality ..... 2-19
2.2.5 Aquatic Resources ..... 2-22
2.2.6 Terrestrial Resources ..... 2-32
2.2.7 Radiological Impacts ..... 2-35
2.2.8 Socioeconomic Factors ..... 2-36

2.2.8.1 Housing ..... 2-36
2.2.8.2 Public Services ..... 2-37
2.2.8.3 Offsite Land Use ..... 2-39
2.2.8.4 Visual Aesthetics and Noise ..... 2-41
2.2.8.5 Demography ..... 2-42
2.2.8.6 Economy ..... 2-44

2.2.9 Historic and Archaeological Resources ..... 2-47

2.2.9.1 Cultural Background ..... 2-47
2.2.9.2 Historic and Archaeological Resources at PBNP Site ..... 2-53

2.2.10 Related Federal Project Activities and Consultations ..... 2-54

2.3 References ..... 2-55

3.0 Environmental Impacts of Refurbishment ..... 3-1

3.1 References ..... 3-4

4.0 Environmental Impacts of Operation ..... 4-1

4.1 Cooling System ..... 4-2

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages ..... 4-10
4.1.2 Impingement of Fish and Shellfish ..... 4-14
4.1.3 Heat Shock ..... 4-19

4.2 Transmission Lines ..... 4-21

4.2.1 Electromagnetic Fields – Acute Effects ..... 4-25
4.2.2 Electromagnetic Fields – Chronic Effects ..... 4-27

4.3 Radiological Impacts of Normal Operations ..... 4-27
4.4 Socioeconomic Impacts of Plant Operations during the License Renewal Period ..... 4-29

4.4.1 Housing Impacts during Operations ..... 4-31
4.4.2 Public Services: Public Utility Impacts during Operations ..... 4-33
4.4.3 Offsite Land Use during Operations ..... 4-33
4.4.4 Public Services: Transportation Impacts during Operations ..... 4-35
4.4.5 Historic and Archaeological Resources ..... 4-36
4.4.6 Environmental Justice ..... 4-38

4.5 Groundwater Use and Quality ..... 4-43
4.6 Threatened or Endangered Species ..... 4-44

4.6.1 Aquatic Species ..... 4-44
4.6.2 Terrestrial Species ..... 4-45
4.6.3 Conclusions ..... 4-45

4.7 Evaluation of Potential New and Significant Information on Impacts of Operations during the Renewal Term ..... 4-46
4.8 Cumulative Impacts of Operations during the Renewal Term ..... 4-46

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System ..... 4-47
4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines ..... 4-49
4.8.3 Cumulative Radiological Impacts ..... 4-50
4.8.4 Cumulative Socioeconomic Impacts ..... 4-50
4.8.5 Cumulative Impacts on Groundwater Use and Quality ..... 4-52
4.8.6 Conclusions Regarding Cumulative Impacts ..... 4-52

4.9 Summary of Impacts of Operations during the Renewal Term ..... 4-52
4.10 References ..... 4-53

Contents


5.0 Environmental Impacts of Postulated Accidents ..... 5-1

5.1 Postulated Plant Accidents ..... 5-1

5.1.1 Design-Basis Accidents ..... 5-2
5.1.2 Severe Accidents ..... 5-3

5.2 Severe Accident Mitigation Alternatives ..... 5-4

5.2.1 Introduction ..... 5-5
5.2.2 Estimate of Risk ..... 5-5
5.2.3 Potential Plant Improvements ..... 5-7
5.2.4 Evaluation of Risk Reduction and Costs of Improvements ..... 5-8
5.2.5 Cost-Benefit Comparison ..... 5-8
5.2.6 Conclusions ..... 5-9

5.3 References ..... 5-9

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management ..... 6-1

6.1 The Uranium Fuel Cycle ..... 6-2
6.2 References ..... 6-9

7.0 Environmental Impacts of Decommissioning ..... 7-1

7.1 Decommissioning ..... 7-2
7.2 References ..... 7-4

8.0 Environmental Impacts of Alternatives to License Renewal ..... 8-1

8.1 No-Action Alternative ..... 8-1
8.2 Alternative Energy Sources ..... 8-6

8.2.1 Coal-Fired Generation ..... 8-8

8.2.1.1 Closed-Cycle Cooling System ..... 8-9
8.2.1.2 Once-Through Cooling System ..... 8-23

8.2.2 Natural Gas-Fired Generation ..... 8-24

8.2.2.1 Closed-Cycle Cooling System ..... 8-24
8.2.2.2 Once-Through Cooling System ..... 8-33

8.2.3 Nuclear Power Generation ..... 8-34

8.2.3.1 Closed-Cycle Cooling System ..... 8-35
8.2.3.2 Once-Through Cooling System ..... 8-43

8.2.4 Purchased Electrical Power ..... 8-44
8.2.5 Other Alternatives ..... 8-45

8.2.5.1 Wind Power ..... 8-45
8.2.5.2 Solar Power ..... 8-46
8.2.5.3 Hydropower ..... 8-47
8.2.5.4 Geothermal Energy ..... 8-47
8.2.5.5 Wood Waste ..... 8-47
8.2.5.6 Municipal Solid Waste ..... 8-48
8.2.5.7 Other Biomass-Derived Fuels ..... 8-49
8.2.5.8 Fuel Cells ..... 8-49
8.2.5.9 Delayed Retirement ..... 8-50
8.2.5.10 Utility-Sponsored Conservation ..... 8-50

8.2.6 Combination of Alternatives ..... 8-51

8.3 Summary of Alternatives Considered ..... 8-54
8.4 References ..... 8-54

9.0 Summary and Conclusions ..... 9-1

9.1 Environmental Impacts of the Proposed Action – License Renewal ..... 9-4

9.1.1 Unavoidable Adverse Impacts ..... 9-5
9.1.2 Irreversible or Irretrievable Resource Commitments ..... 9-6
9.1.3 Short-Term Use Versus Long-Term Productivity ..... 9-6

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives ..... 9-7
9.3 Staff Conclusions and Recommendations ..... 9-7
9.4 References ..... 9-9

Contents

Appendix A - Comments Received on the Environmental Review ..... A-1

Appendix B - Contributors to the Supplement ..... B-1

Appendix C - Chronology of NRC Staff Environmental Review Correspondence Related to Nuclear Management Company, LLC's Application for License Renewal of Point Beach Nuclear Plant Units 1 and 2 ..... C-1

Appendix D - Organizations Contacted ..... D-1

Appendix E - Nuclear Management Company, LLC's Compliance Status and Consultation Correspondence ..... E-1

Appendix F - GEIS Environmental Issues Not Applicable to Point Beach Nuclear Plant Units 1 and 2 ..... F-1

Appendix G - NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) For Point Beach Nuclear Plant Units 1 and 2, in Support of License Renewal Application ..... G-1

# Figures

2-1 Location of PBNP, 80-km (50-mi) Region ..... 2-2
2-2 Location of PBNP, 10-km (6-mi) Region ..... 2-3
2-3 PBNP Site Layout ..... 2-5
2-4 PBNP Transmission Lines ..... 2-14

4-1 Geographic Distribution of Minority Populations (Shown in Shaded Areas) within 80 km (50 mi) of PBNP Based on Census Block Group Data ..... 4-41
4-2 Geographic Distribution of Low-Income Populations (Shown in Shaded Areas) within 80 km (50 mi) of the PBNP Site Based on Census Block Group Data ..... 4-42

# Tables


2-1 PBNP Transmission Line Rights-of-Way ..... 2-13
2-2 Terrestrial Species Listed by the FWS as Endangered or Threatened that Could Potentially Occur Within the PBNP Site or the Associated Transmission Line ROWs ..... 2-33
2-3 Housing Units and Occupied Housing Units for Manitowoc County and Municipalities during 1990 and 2000 ..... 2-37
2-4 Manitowoc County Public Water Suppliers and Capacities ..... 2-38
2-5 School District Enrollment in Communities near PBNP ..... 2-38
2-6 Traffic Counts for State Route 42 and County Road V ..... 2-39
2-7 Land Use in Manitowoc County, 1999 ..... 2-40
2-8 Population of Manitowoc County and Selected Municipalities ..... 2-43
2-9 Population Projections for Wisconsin and Manitowoc County ..... 2-43
2-10 Occupations in Nearby Municipalities and Manitowoc County ..... 2-44
2-11 Unemployment Rates for Manitowoc County in 2004 ..... 2-44
2-12 Total Tax Revenues and Shared Revenue Utility Payments for the Town of Two Creeks ..... 2-46
2-13 Total Tax Revenues and Shared Revenue Utility Payments for Manitowoc County .. 2-47

3-1 Category 1 Issues for Refurbishment Evaluation ..... 3-2
3-2 Category 2 Issues for Refurbishment Evaluation ..... 3-3

4-1 Category 1 Issues Applicable to the Operation of the PBNP Cooling System during the Renewal Term ..... 4-2
4-2 Category 2 Issues Applicable to the Operation of the PBNP Cooling System during the Renewal Term ..... 4-10
4-3 Fish Impinged at PBNP during the 1975–1976 Impingement Study ..... 4-15
4-4 Category 1 Issues Applicable to PBNP Transmission Lines during the Renewal Term ..... 4-22
4-5 Category 2 and Uncategorized Issues Applicable to PBNP Transmission Lines during the Renewal Term ..... 4-25
4-6 Category 1 Issues Applicable to Radiological Impacts of Normal Operations during the Renewal Term ..... 4-28
4-7 Category 1 Issues Applicable to Socioeconomics during the Renewal Term ..... 4-29
4-8 Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics during the Renewal Term ..... 4-31

4-9 Category 1 Issue Applicable to Groundwater Use and Quality during the Renewal Term ..... 4-43
4-10 Category 2 Issue Applicable to Threatened or Endangered Species during the Renewal Term ..... 4-44

5-1 Category 1 Issue Applicable to Postulated Accidents during the Renewal Term ..... 5-3
5-2 Category 2 Issue Applicable to Postulated Accidents during the Renewal Term ..... 5-4
5-3 Core Damage Frequency ..... 5-6
5-4 Breakdown of Population Dose by Containment Release Mode ..... 5-7

6-1 Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid-Waste Management during the Renewal Term ..... 6-2

7-1 Category 1 Issues Applicable to the Decommissioning of PBNP following the Renewal Term ..... 7-2

8-1 Summary of Environmental Impacts of the No-Action Alternative ..... 8-3
8-2 Summary of Environmental Impacts of Coal-Fired Generation Using Closed-Cycle Cooling at the PBNP Site and an Alternate Site ..... 8-10
8-3 Summary of Environmental Impacts of Coal-Fired Generation with a Once-Through Cooling System at the PBNP Site ..... 8-23
8-4 Summary of Environmental Impacts of Natural Gas-Fired Generation Using Closed-Cycle Cooling at the PBNP Site and an Alternate Site ..... 8-26
8-5 Summary of Environmental Impacts of Natural Gas-Fired Generation with Once-Through Cooling at the PBNP Site ..... 8-33
8-6 Summary of Environmental Impacts of New Nuclear Power Generation Using Closed-Cycle Cooling at the PBNP Site and an Alternate Site ..... 8-36
8-7 Summary of Environmental Impacts of a New Nuclear Power Plant with Once-Through Cooling at the PBNP Site ..... 8-44
8-8 Summary of Environmental Impacts of 646 MW(e) of Natural Gas-Fired Generation, 200 MW(e) of Purchased Power, and 190 MW(e) from Demand-Side Management Measures (Combination of Alternatives) ..... 8-52

9-1 Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation (from Chapters 4 and 8) ..... 9-8

A-1 Individuals Providing Comments during Scoping Comment Period ..... A-2
A-2 Comments Received on the Draft SEIS ..... A-17

Tables

E-1 Consultation Correspondence ..... E-1
E-2 Federal, State, Local, and Regional Licenses, Permits, Consultations, and Other Approvals for PBNP ..... E-2

F-1 GEIS Environmental Issues Not Applicable to PBNP ..... F-1

G-1 PBNP Core Damage Frequency for Internal Events ..... G-3
G-2 Breakdown of Population Dose by Containment Release Mode ..... G-4
G-3 Level 1 PRA Summary ..... G-6
G-4 SAMA Cost/Benefit Screening Analysis ..... G-21
G-5 Uncertainty in the Calculated CDF for PBNP ..... G-31

# Executive Summary

By letter dated February 25, 2004, the Nuclear Management Company, LLC (NMC), submitted an application on behalf of the owner, the Wisconsin Electric Power Company (WEPCO), to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Point Beach Nuclear Plant Units 1 and 2 (PBNP) for an additional 20-year period. If the OLs are renewed, State regulatory agencies and PBNP's owner, WEPCO, will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, then the plants must be shut down at or before the expiration dates of the current OLs, which are October 5, 2010, for Unit 1 and March 8, 2013, for Unit 2.

The NRC has implemented Section 102 of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321) in Title 10 of the Code of Federal Regulations (CFR) Part 51. In 10 CFR 51.20(b)(2), the Commission requires preparation of an environmental impact statement (EIS) or a supplement to an EIS for renewal of a reactor OL. In addition, 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2.[a]

Upon acceptance of the NMC application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping. The staff visited the PBNP site in June 2004 and held public scoping meetings on June 15, 2004, in Mishicot, Wisconsin. In the preparation of this supplemental environmental impact statement (SEIS) for PBNP, the staff reviewed the NMC Environmental Report (ER) and compared it to the GEIS; consulted with other agencies; conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, and considered the public comments received during the scoping process. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part I, of this SEIS.

A draft SEIS was published in January 2005. The staff held two public meetings in Mishicot, Wisconsin, on March 3, 2005, to describe the preliminary results of the NRC environmental review, to answer questions, and to provide members of the public with information to assist them in formulating comments on this SEIS. When the 75-day comment period ended, the staff considered and dispositioned all of the comments received. These comments are addressed in Appendix A, Part II, of this SEIS.

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(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action.

The Commission has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and where authorized, Federal (other than NRC) decisionmakers.

The evaluation criterion for the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> ... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that would ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of reactor operation–generic determination of no significant environmental impact"] and in accordance with § 51.23(b).

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the analysis in the GEIS reached the following conclusions:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated as Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a

plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the PBNP OLs) and alternative methods of power generation. Based on projections made by the U.S. Department of Energy's Energy Information Administration, gas- and coal-fired generation appear to be the most likely power-generation alternatives if the power from PBNP is replaced. These alternatives are evaluated assuming that the replacement power generation plant is located at either the PBNP site or some other unspecified alternate location.

NMC and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither NMC nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process nor the staff has identified any new issue applicable to PBNP that has a significant environmental impact. These determinations included consideration of public comments. Therefore, the staff relies upon the conclusions of the GEIS for all of the Category 1 issues that are applicable to PBNP.

NMC's license renewal application presents an analysis of the applicable Category 2 issues. The staff has reviewed the NMC analysis for each issue and has conducted an independent review of each issue. Six Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at PBNP. Four Category 2 issues are not discussed in this SEIS, because they are specifically related to refurbishment. NMC has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of PBNP for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant operation and are not expected to affect the environment outside of the bounds of the plant operations evaluated in the U.S. Atomic Energy Commission's 1972 *Final Environmental Statement Related to Operation of Point Beach Nuclear Plant Units 1 and 2.*

Eleven Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Five of the Category 2 issues and environmental justice apply to refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For all 11 Category 2 issues and

environmental justice, the staff concludes that the potential environmental impacts would be of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for PBNP and the plant improvements already made, the staff concludes that none of the candidate SAMAs is cost-beneficial. Although none of the SAMAs appear cost-beneficial in the baseline analysis, the staff concluded that one SAMA could be cost-beneficial when uncertainties or alternative discount rates are taken into account. However, this SAMA does not relate to adequately managing the effects of aging during the period of extended operation. Therefore, it need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted.

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. For purposes of this analysis, where PBNP license renewal impacts are deemed to be SMALL, the staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources.

If the PBNP OLs are not renewed and the units cease operation on or before the expiration of their current operating licenses, then the adverse impacts of likely alternatives would not be smaller than those associated with continued operation of PBNP. The impacts may, in fact, be greater in some areas.

The recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for PBNP are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the ER submitted by NMC; (3) consultation with other Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

# Abbreviations/Acronyms

| | |
|---|---|
| ° | degree(s) |
| μm | micrometer(s) |
| | |
| ac | acre(s) |
| AC | alternating current |
| ACC | averted cleanup and decontamination costs |
| ADAMS | Agencywide Document Access and Management System |
| AEC | U.S. Atomic Energy Commission |
| AFW | auxiliary feedwater |
| AOC | averted offsite property damage costs |
| AOE | averted occupational exposure costs |
| AOSC | averted onsite costs |
| APE | averted public exposure |
| AQCR | Air Quality Control Region |
| ATC | American Transmission Company |
| ATWS | anticipated transient without scram |
| AVD | AVD Archaeological Services, Inc. |
| | |
| Bq | becquerel(s) |
| BTU | British thermal unit(s) |
| | |
| C | Celsius |
| CAA | Clean Air Act |
| CCW | component cooling water |
| CDF | core damage frequency |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second (same as $ft^3$/sec) |
| Ci | curie(s) |
| cm | centimeter(s) |
| $cm^2$ | square centimeter(s) |
| COE | cost of enhancement |
| CST | condensate storage tank |
| cu | cubic |
| CWA | Clean Water Act of 1977 |
| | |
| d | day(s) |
| dB | decibel(s) |
| DBA | design-basis accident |

| | |
|---|---|
| DC | direct current |
| DOE | U.S. Department of Energy |
| DOI | U.S. Department of Interior |
| DSM | demand-side management |
| ECCS | emergency core cooling system |
| EIA | Energy Information Administration (of DOE) |
| EIS | environmental impact statement |
| ELF-EMF | extremely low frequency-electromagnetic field |
| EOP | emergency operating procedure |
| ESA | Endangered Species Act of 1973 |
| EPA | U.S. Environmental Protection Agency |
| ER | Environmental Report |
| ESRP | *Standard Review Plans for Nuclear Power Plants, Supplement 1: Operating License Renewal* |
| F | Fahrenheit |
| FES | Final Environmental Statement |
| FR | *Federal Register* |
| FSAR | final safety analysis report |
| ft | foot (feet) |
| $ft^2$ | square feet |
| $ft^3$ | cubic feet |
| $ft^3/s$ | cubic feet per second (same as cfs) |
| FWS | U.S. Fish and Wildlife Service |
| GEIS | *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437 |
| GEn&SIS | Geographical, Environmental, and Siting Information System |
| GLARC | Great Lakes Archaeological Research Center, Inc. |
| gpd | gallon(s) per day |
| gpm | gallon(s) per minute |
| h | hour(s) |
| ha | hectare(s) |
| HEP | Human Error Probability |
| HLW | high-level waste |
| HRA | human reliability analysis |
| Hz | hertz |
| IGCC | integrated coal gasification combined cycle |

| | |
|---|---|
| in. | inch(es) |
| in.$^2$ | square inches |
| IPE | Individual Plant Examination |
| IPEEE | Individual Plant Examination of External Events |
| ISFSI | independent spent fuel storage installation |
| ISLOCA | interfacing systems loss-of-coolant accident |
| J | joule(s) |
| kg | kilogram(s) |
| KNPP | Kewaunee Nuclear Power Plant |
| km | kilometer(s) |
| km$^2$ | square kilometer(s) |
| kV | kilovolt(s) |
| kW | kilowatt(s) |
| kWh | kilowatt-hour(s) |
| L | liter(s) |
| lb | pound(s) |
| LOCA | loss-of-coolant accident |
| LOOP | loss of offsite power |
| m | meter(s) |
| m$^3$ | cubic meter(s) |
| mA | milliampere(s) |
| MAAP | Modular Accident Analysis Program |
| MACCS2 | MELCOR Accident Consequence Code System 2 |
| MCPPC | Manitowoc County Planning and Park Commission |
| MFW | main feedwater |
| mGy | milligray |
| mi | mile(s) |
| min | minute(s) |
| mph | mile(s) per hour |
| mrad | millirad(s) |
| MRCC | Midwestern Regional Climate Center |
| mrem | millirem(s) |
| MSIV | main steam isolation valve |
| mSv | millisievert(s) |
| MT | metric ton(s) (tonne[s]) |
| MTHM | metric ton(s) heavy metal |
| MW | megawatt(s) |

| | |
|---|---|
| MWd/MTU | megawatt day(s) per metric ton of uranium |
| MW(e) | megawatt(s) electric |
| MWh | megawatt hour(s) |
| MW(t) | megawatt(s) thermal |
| NAS | National Academy of Sciences |
| NEPA | National Environmental Policy Act of 1969 |
| NESC | National Electrical Safety Code |
| ng | nanogram(s) |
| NHPA | National Historic Preservation Act |
| NIEHS | National Institute of Environmental Health Sciences |
| NMC | Nuclear Management Company, LLC |
| NOAA | National Oceanographic and Atmospheric Administration |
| $NO_x$ | nitrogen oxide(s) |
| NPDES | National Pollutant Discharge Elimination System |
| NRC | U.S. Nuclear Regulatory Commission |
| NRHP | National Register of Historic Places |
| ODCM | Offsite Dose Calculation Manual |
| OL | operating license |
| PBNP | Point Beach Nuclear Plant Units 1 and 2 |
| pCi | picocurie(s) |
| PCBs | polychlorinated biphenyls |
| PCS | power conversion system |
| $PM_{10}$ | particulate matter, 10 micrometers or less in diameter |
| ppb | parts per billion |
| ppm | parts per million |
| PRA | probabilistic risk assessment |
| PWR | pressurized-water reactor |
| RAI | request for additional information |
| RCP | reactor cooling pump |
| RCS | reactor coolant system |
| rem | roentgen equivalent man |
| RHR | residual heat removal |
| ROW | right-of-way |
| RPC | replacement power costs |
| RWST | refueling water storage tank |
| s | second(s) |

| | |
|---|---|
| SAMA | Severe Accident Mitigation Alternative |
| SAR | safety analysis report |
| SBO | station blackout |
| SEIS | Supplemental Environmental Impact Statement |
| SER | safety evaluation report |
| SGTR | steam generator tube rupture |
| SHPO | State Historic Preservation Office |
| SI | safety injection |
| $SO_2$ | sulfur dioxide |
| $SO_x$ | sulfur oxide(s) |
| sp. | species (singular) |
| spp. | species (plural) |
| SRV | safety relief valve |
| Sv | sievert(s) |
| SW | service water |
| U.S. | United States |
| USC | United States Code |
| USCB | U.S. Census Bureau |
| USGS | U.S. Geological Survey |
| USDOT | U.S. Department of Transportation |
| WDA | Wisconsin Department of Administration |
| WDNR | Wisconsin Department of Natural Resources |
| WDOT | Wisconsin Department of Transportation |
| WDR | Wisconsin Department of Revenue |
| WDWD | Wisconsin Department of Workforce Development |
| WEPCO | Wisconsin Electric Power Company |
| WHS | Wisconsin Historical Society |
| WPDES | Wisconsin Pollutant Discharge Elimination System |
| yd | yard(s) |
| yr | year(s) |

# 1.0 Introduction

Under the U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), renewal of a nuclear power plant operating license (OL) requires the preparation of an environmental impact statement (EIS). In preparing the EIS, the NRC staff is required first to issue the statement in draft form for public comment and then issue a final statement after considering public comments on the draft. To support the preparation of the EIS, the staff has prepared a *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS is intended to (1) provide an understanding of the types and severity of environmental impacts that may occur as a result of license renewal of nuclear power plants under 10 CFR Part 54, (2) identify and assess the impacts that are expected to be generic to license renewal, and (3) support 10 CFR Part 51 to define the number and scope of issues that must be addressed by the applicants in plant-by-plant renewal proceedings. Use of the GEIS guides the preparation of complete plant-specific information in support of the OL renewal process.

The Nuclear Management Company, LLC (NMC) operates Point Beach Nuclear Plant Units 1 and 2 (PBNP) in Wisconsin on behalf of the owner, the Wisconsin Electric Power Company (WEPCO), under OLs DPR-24 and DPR-27, which were issued by the NRC. These OLs will expire on October 5, 2010, for Unit 1 and March 8, 2013, for Unit 2. On February 25, 2004, NMC submitted an application to the NRC for renewal of the PBNP OLs for an additional 20 years under the procedures in 10 CFR Part 54. NMC is a *licensee* for the purposes of its current OLs and an *applicant* for the renewal of the OLs. Pursuant to 10 CFR 54.23 and 51.53(c), NMC submitted an Environmental Report (ER) (NMC 2004a) in which NMC analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed license renewal action, and evaluated mitigation measures for reducing adverse environmental impacts.

This report is the plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the NMC license renewal application. This SEIS is a supplement to the GEIS because it relies, in part, on the findings of the GEIS. The staff will also prepare a separate safety evaluation report in accordance with 10 CFR Part 54.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

## 1.1 Report Contents

The following sections of this introduction (1) describe the background for the preparation of this SEIS, including the development of the GEIS and the process used by the staff to assess the environmental impacts associated with license renewal, (2) describe the proposed Federal action to renew the PBNP OLs, (3) discuss the purpose and need for the proposed action, and (4) present the status of NMC's compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies that are responsible for environmental protection.

The chapters of this SEIS closely parallel the contents and organization of the GEIS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 and 4, respectively, discuss the potential environmental impacts of plant refurbishment and plant operation during the renewal term. Chapter 5 contains an evaluation of potential environmental impacts of plant accidents and includes consideration of severe accident mitigation alternatives (SAMAs). Chapter 6 discusses the uranium fuel cycle and solid waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to license renewal. Finally, Chapter 9 summarizes the findings of the preceding chapters and draws conclusions about the adverse impacts that cannot be avoided, the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and the irreversible or irretrievable commitment of resources. Chapter 9 also presents the staff's recommendation with respect to the proposed license renewal action.

Additional information is included in appendixes. Appendix A contains public comments received on the environmental review for license renewal and staff responses. Appendixes B through G, respectively, list the following:

- The preparers of the supplement
- The chronology of the NRC staff's environmental review correspondence related to this SEIS
- The organizations contacted during the development of this SEIS
- NMC's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and sent during the evaluation process)
- GEIS environmental issues that are not applicable to PBNP
- SAMAs.

## 1.2 Background

Use of the GEIS, which examines the possible environmental impacts that could occur as a result of renewing individual nuclear power plant OLs under 10 CFR Part 54, and the established license renewal evaluation process support the thorough evaluation of the impacts of renewal of OLs.

### 1.2.1 Generic Environmental Impact Statement

The NRC initiated a generic assessment of the environmental impacts associated with the license renewal term to improve the efficiency of the license renewal process by documenting the assessment results and codifying the results in the Commission's regulations. This assessment is provided in the GEIS, which serves as the principal reference for all nuclear power plant license renewal EISs.

The GEIS documents the results of the systematic approach that was taken to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. For each potential environmental issue, the GEIS (1) describes the activity that affects the environment, (2) identifies the population or resource that is affected, (3) assesses the nature and magnitude of the impact on the affected population or resource, (4) characterizes the significance of the effect for both beneficial and adverse impacts, (5) determines whether the results of the analysis apply to all plants, and (6) considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The NRC's standard of significance for impacts was established using the Council on Environmental Quality (CEQ) terminology for "significantly" (40 CFR 1508.27, which requires consideration of both "context" and "intensity"). Using the CEQ terminology, the NRC established three significance levels – SMALL, MODERATE, or LARGE. The definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, as follows:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The GEIS assigns a significance level to each environmental issue, assuming that ongoing mitigation measures would continue.

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, **Category 1** issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste (HLW) and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this SEIS unless new and significant information is identified.

**Category 2** issues are those that do not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues were not categorized. The two issues not categorized were environmental justice and chronic effects of electromagnetic fields. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the renewal term, and 8 apply to both refurbishment and operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

### 1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OLs is required to submit an ER as part of its application (10 CFR 54.23). The license renewal evaluation process involves careful review of the applicant's ER and assurance that all new and potentially significant information not already addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

In accordance with 10 CFR 51.53(c)(2) and (3), the ER submitted by the applicant must

- Provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B in accordance with 10 CFR 51.53(c)(3)(ii)
- Discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action.

In accordance with 10 CFR 51.53(c)(2), the ER does not need to

- Consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered, or (2) relevant to mitigation
- Consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives
- Discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b)
- Contain an analysis of any Category 1 issue unless there is significant new information on a specific issue – this is pursuant to 10 CFR 51.53(c)(3)(iii) and (iv).

New and significant information is (1) information that identifies a significant environmental issue not covered in the GEIS and codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, or (2) information that was not considered in the analyses summarized in the GEIS and that leads to an impact finding that is different from the finding presented in the GEIS and codified in 10 CFR Part 51.

In preparing to submit its application to renew the PBNP OLs, NMC developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the

environmental impacts of license renewal for PBNP would be properly reviewed before submitting the ER and to ensure that such new and potentially significant information related to renewal of the licenses would be identified, reviewed, and assessed during the period of NRC review. NMC reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained valid with respect to PBNP. This review was performed by personnel from NMC and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (ESRP), NUREG-1555, Supplement 1 (NRC 2000). The search for new information includes (1) a review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) a review of records of public comments; (3) a review of environmental quality standards and regulations; (4) coordination with Federal, State, and local environmental protection and resource agencies; and (5) review of the technical literature. New information discovered by the staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of the issue that are not affected by the new information.

Chapters 3 through 7 discuss the environmental issues considered in the GEIS that are applicable to PBNP. At the beginning of the discussion of each set of issues, there is a table that identifies the issues to be addressed and lists the sections in the GEIS where the issue is discussed. Category 1 and Category 2 issues are listed in separate tables. For Category 1 issues for which there is no new and significant information, the table is followed by a set of short paragraphs that state the GEIS conclusion codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, followed by the staff's analysis and conclusion. For Category 2 issues, in addition to the list of GEIS sections where the issue is discussed, the tables list the subparagraph of 10 CFR 51.53(c)(3)(ii) that describes the analysis required and the SEIS sections where the analysis is presented. The SEIS sections that discuss the Category 2 issues are presented immediately following the table.

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts with the environmental impacts of alternatives. The evaluation of the NMC license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the *Federal Register* (69 FR 19559–19561 [NRC 2004a]) on April 13, 2004. The staff published a notice of intent to prepare an EIS and conduct scoping in the *Federal Register* (69 FR 26624–26626 [NRC 2004b]) on May 13, 2004.

Two public scoping meetings were held on June 15, 2004, in Mishicot, Wisconsin. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Point Beach Nuclear Plant Units 1 and 2, Manitowoc County, Wisconsin* (NRC 2004c) dated September 3, 2004. Comments applicable to this environmental review are presented in Part I of Appendix A.

The staff followed the review guidance contained in NUREG-1555 (NRC 2000). The staff and contractors retained to assist the staff visited the PBNP site on June 16 and 17, 2004, to gather information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping and consulted with Federal, State, regional, and local agencies. A list of the organizations consulted is provided in Appendix D. Other documents related to PBNP were reviewed and are referenced in this report.

On January 26, 2005, the NRC published a Notice of Availability of the draft SEIS in 70 FR 3744–3745 (NRC 2005a). A 75-day comment period began on the date of publication of the U.S. Environmental Protection Agency Notice of Filing of the draft SEIS to allow members of the public to comment on the preliminary results of the NRC staff's review. During this comment period, two public meetings were held in Mishicot, Wisconsin, on March 3, 2005. During these meetings, the staff described the preliminary results of the NRC environmental review and answered questions to provide members of the public with information to assist them in formulating their comments. The comment period for the PBNP draft SEIS ended on April 13, 2005. Comments made during the 75-day public comment period are presented in Part II of Appendix A of this SEIS. The NRC responses to these comments are also provided.

This SEIS presents the staff's analysis that considers and weighs the environmental impacts of the proposed renewal of the PBNP OLs, the environmental impacts of alternatives to license renewal, and mitigation measures available for avoiding adverse environmental impacts. Chapter 9, "Summary and Conclusions," provides the NRC staff's recommendation to the Commission on whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

## 1.3 The Proposed Federal Action

The proposed Federal action is renewal of the PBNP OLs. The PBNP site is located on the western shore of Lake Michigan in Manitowoc County, Wisconsin, approximately 48 km (30 mi) southeast of Green Bay and 24 km (15 mi) north-northeast of Manitowoc (NMC 2004a, 2004b).

PBNP has two Westinghouse pressurized water reactors. Each reactor was originally designed to produce a reactor thermal output of 1518.5 megawatts thermal (MW[t]) and to generate

523.8 megawatts electric (MW[e]) of gross electrical power (NMC 2004a). Each unit underwent a low-pressure turbine retrofit modification that increased the unit design output to 537.96 MW(e). In 2003, PBNP underwent a 1.4 percent uprate, which increased the rated thermal output to 1540 MW(t) and increased the gross electrical power to 545 MW(e) (518 MW[e] net). Plant cooling is provided by a once-through cooling water system that withdraws water from Lake Michigan and dissipates heat by discharge back into Lake Michigan. PBNP produces approximately 25 percent of the electricity that WEPCO provides to approximately 1.08 million customers (NMC 2004a).

The current OL for Unit 1 expires on October 5, 2010, and for Unit 2 on March 8, 2013. By letter dated February 25, 2004, NMC submitted an application to the NRC (NMC 2004b) to renew these OLs for an additional 20 years of operation (i.e., until October 5, 2030, for Unit 1 and March 8, 2033, for Unit 2).

## 1.4 The Purpose and Need for the Proposed Action

Although a licensee must have a renewed license to operate a reactor beyond the term of the existing OL, the possession of that license is just one of a number of conditions that must be met for the licensee to continue plant operation during the term of the renewed license. Once an OL is renewed, State regulatory agencies and the plant owner (WEPCO) will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the jurisdiction of the State or the purview of the owners.

Thus, for license renewal reviews, the NRC has adopted the following definition of purpose and need from the GEIS, Section 1.3 (NRC 1996):

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and where authorized, Federal (other than NRC) decisionmakers.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 (Title 42 United States Code [USC] 2011) or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy planning decisions of State regulators and utility officials as to whether a particular nuclear power plant should continue to operate. From the perspective of the licensee and the State regulatory authority, the purpose of renewing an OL is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant's license.

## 1.5 Compliance and Consultations

NMC and/or WEPCO are required to hold certain Federal, State, and local environmental permits in order to operate PBNP, as well as meet relevant Federal and State statutory requirements. In the PBNP ER (NMC 2004a), NMC provided a list of the authorizations from Federal, State, and local authorities for current operations as well as environmental approvals and consultations associated with renewal of the PBNP OLs. Authorizations and consultations relevant to the proposed OL renewal action are included in Appendix E.

The staff has reviewed the list and consulted with the appropriate Federal, State, and local agencies to identify any compliance or permit issues or significant environmental issues of concern to the reviewing agencies. These agencies did not identify any new and significant environmental issues. The ER (NMC 2004a) states that NMC is in compliance with applicable environmental standards and requirements for PBNP. The staff also has not identified any environmental issues that are both new and significant.

## 1.6 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment,* Part 1508, "Terminology and Index."

Atomic Energy Act of 1954, as amended. 42 USC 2011 et seq.

National Environmental Policy Act of 1969 (NEPA), as amended. 42 USC 4321, et seq.

Nuclear Management Company, LLC. (NMC). 2004a. *Point Beach Nuclear Plant Operating License Renewal Application Environmental Report.* Two Rivers, Wisconsin.

Nuclear Management Company, LLC. (NMC). 2004b. *Application for Renewed Operating Licenses, Point Beach Nuclear Plant Units 1 and 2.* Two Rivers, Wisconsin.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Section 6.3-Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report.* NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

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# 2.0 Description of Nuclear Power Plant and Site and Plant Interaction with the Environment

Point Beach Nuclear Plant Units 1 and 2 (PBNP) are located in Manitowoc County, Wisconsin, on the western shore of Lake Michigan. The plant consists of two units. Each unit is a pressurized-water reactor with steam generators producing steam that turns turbines to generate electricity. Plant cooling is provided by a once-through system using water from Lake Michigan. The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

## 2.1 Plant and Site Description and Proposed Plant Operation during the Renewal Term

PBNP is located on the western shore of Lake Michigan, approximately 48 km (30 mi) southeast of Green Bay and 24 km (15 mi) north-northeast of Manitowoc (Nuclear Management Company, LLC [NMC] 2004a). The area within 10 km (6 mi) of PBNP includes portions of Manitowoc and Kewaunee counties and is largely rural, characterized by farmland, woods, and small residential communities. The nearest town is Two Creeks, approximately 2 km (1 mi) north-northwest of the site. PBNP is approximately 10 km (6 mi) east-northeast of Mishicot, 13 km (8 mi) north of Two Rivers, and 18 km (11 mi) south of Kewaunee. The Oneida Indian Reservation is located on the western edge of Green Bay, approximately 56 km (35 mi) northwest of the plant. The PBNP property covers approximately 510 ha (1260 ac). Structures and parking lots occupy about 28 ha (70 ac). Figures 2-1 and 2-2 show the site location and features within 80 km (50 mi) and 10 km (6 mi), respectively (NMC 2004a).

### 2.1.1 External Appearance and Setting

PBNP is owned by Wisconsin Electric Power Company (WEPCO) and operated by NMC. Site structures include two reactor containments, auxiliary and service buildings, turbine building, office building, switchyard, pump house, cooling water intake and discharge structures, and an independent spent fuel storage installation (ISFSI) (NMC 2004a). Approximately 425 ha (1050 ac) are used for agriculture. The remaining area is a mixture of woods, wetlands, and open areas. The site includes approximately 3 km (2 mi) of continuous frontage on the western shore of Lake Michigan.

The local terrain is gently rolling to flat, with elevations varying from 1.5 to 18 m (5 to 60 ft) above the normal level of Lake Michigan. The land surface slopes gradually toward the lake from higher glacial moraine areas west of the site. Low bluffs face the Lake Michigan shore,

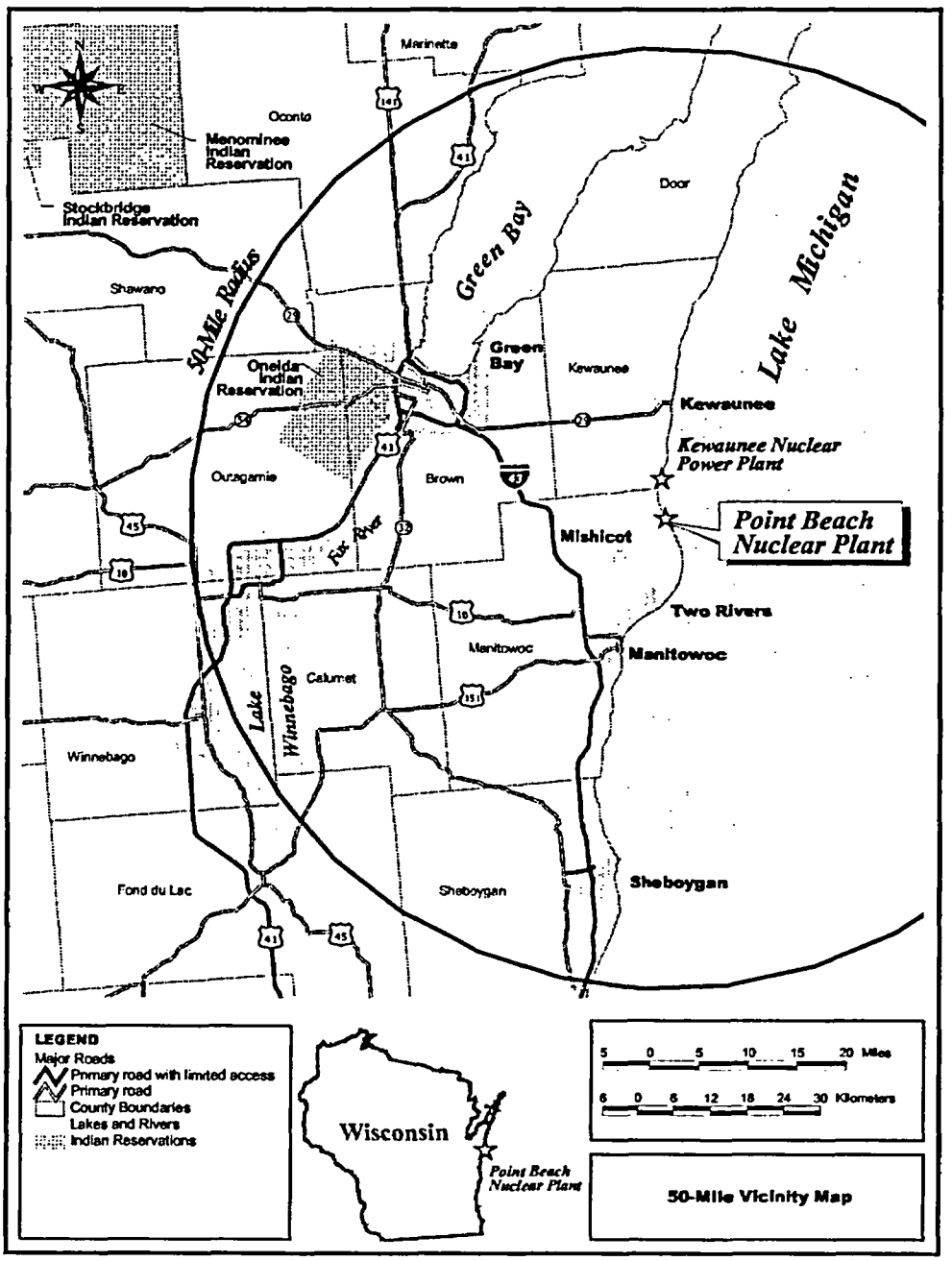


**Figure 2-1.** Location of PBNP, 80-km (50-mi) Region

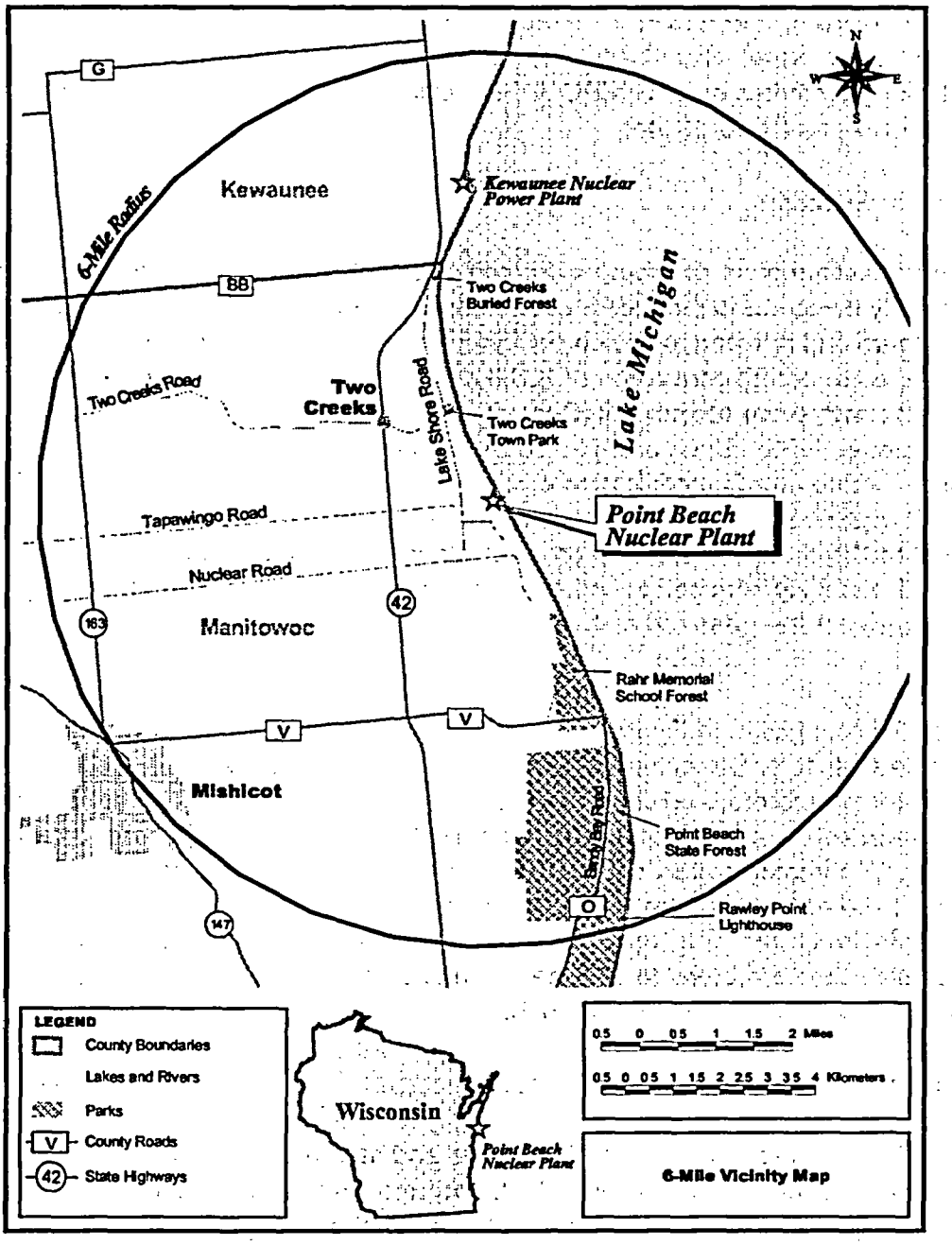


**Figure 2-2.** Location of PBNP, 10-km (6-mi) Region

with evidence of marked erosion near the center of the PBNP site. At this point, the beach is narrow (ranging in width from 6 m to 15 m [20 ft to 50 ft]), with bare mud slopes showing active erosion due to Lake storms. Historically, shoreline recession has ranged from 0.8 m to 1.5 m (2.5 ft to 5 ft) per year in this area. WEPCO has provided riprap to control further recession of the shoreline at the site (NMC 2004a).

### 2.1.2 Reactor Systems

PBNP has two Westinghouse reactors moderated and cooled by pressurized light water. Each unit was originally designed to produce a reactor thermal output of 1518.5 megawatts thermal (MW[t]). All steam and power conversion equipment, including each turbine generator, was originally designed to permit generation of 523.8 megawatts of gross electrical power (MW[e]). Unit 1 achieved commercial operation in December 1970, and Unit 2 achieved commercial operation in October 1972. Since being placed into commercial operation, each unit underwent a low-pressure turbine retrofit modification that increased the unit design output to 538 MW(e). In 2003, PBNP underwent a 1.4 percent power uprate, which increased the rated thermal output to 1540 MW(t) and increased the gross electrical power to 545 MW(e) (518 MW[e] net). New PBNP fuel is slightly enriched to contain a nominal 5.0 weight percent of uranium-235, with an average burnup for the peak rod of 45,000 megawatt-days per metric ton uranium (NMC 2004a).

The PBNP facility is depicted in Figure 2-3. Each reactor is housed in its own containment structure (labeled "Reactor Structures" in Figure 2-3), together with its primary cooling system, associated steam generators, and circulation system. Each reactor containment structure is a steel-lined, reinforced-concrete cylinder with a hemispheric dome and a flat reinforced-concrete foundation mat. A common gallery containing the principal radioactive waste systems and the control room is located between the two reactor units, which lie north and south of the common gallery in a single structure. The containment structures are encased in vinyl coated steel buildings that are colored to blend in with the green and brown Wisconsin countryside (U.S. Atomic Energy Commission [AEC] 1972).

### 2.1.3 Cooling and Auxiliary Water Systems

Lake Michigan is the source of water for the cooling and auxiliary water systems at PBNP, which operates as a once-through cooling plant. Water from Lake Michigan reaches PBNP through a submerged offshore intake. Water returns to Lake Michigan through a surface shoreline discharge. The system removes waste heat from the condensers as well as other plant equipment and discharges water through separate flumes for each unit. At peak capacity, water is circulated at a maximum rate of 22 $m^3/s$ (777 $ft^3/s$) through each condenser and then

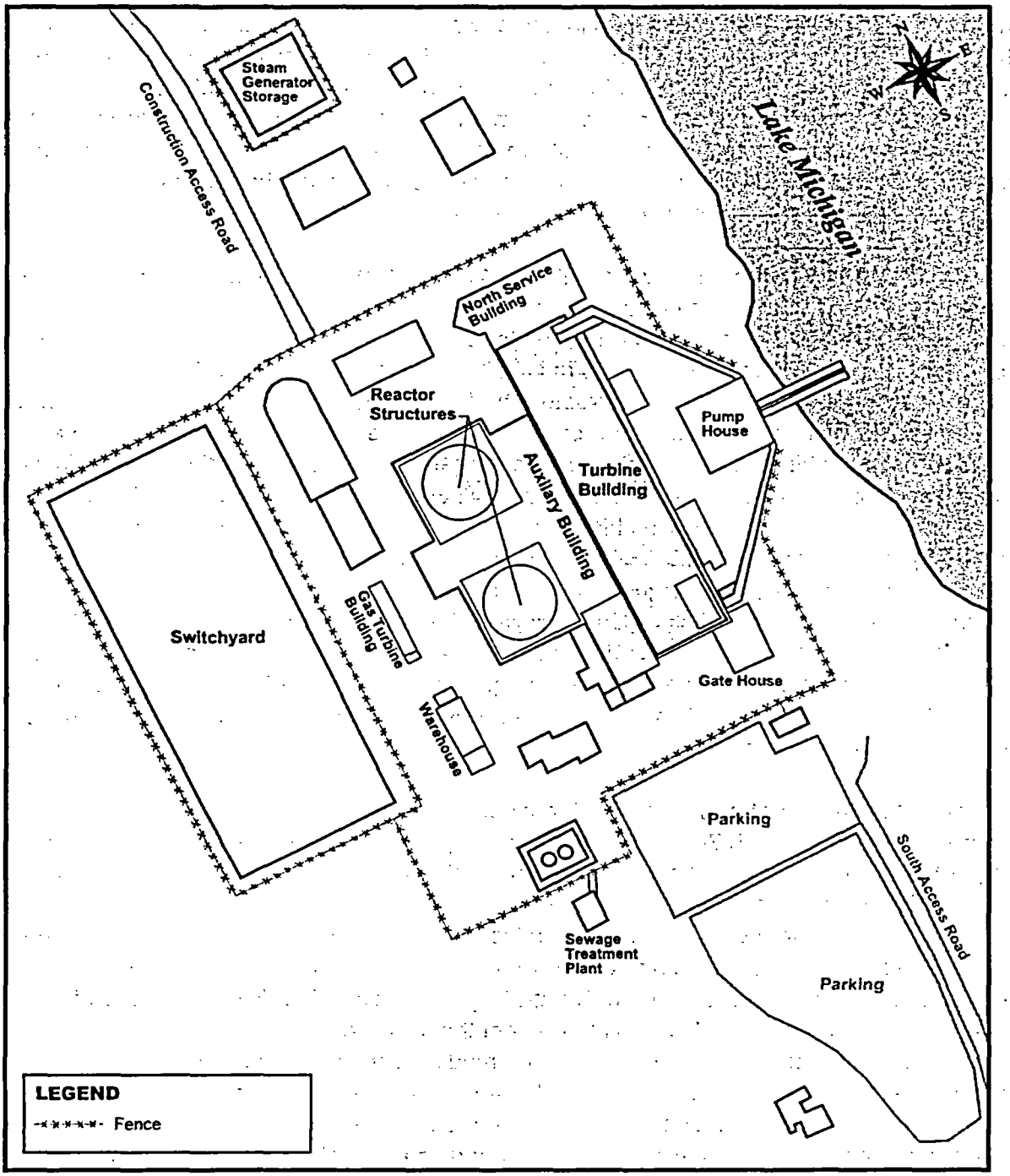


**Figure 2-3.** PBNP Site Layout

returned to the Lake. The maximum total intake of water by PBNP is approximately 44 $m^3/s$ (1554 $ft^3/s$) when both units are at full power operation. The consumptive net loss within the plant is minimal (less than 0.1 percent of the total intake) (WEPCO 2003, NMC 2004a). Thus, with both units operating at full power, a maximum outflow of approximately 44 $m^3/s$ (1554 $ft^3/s$) would be returned to the Lake. The water withdrawn for these systems flows first through the offshore intake structure to the forebay, then to the condensers and other equipment. Auxiliary water systems include the service water system and the fire protection system.

Lake water is provided to the forebay through two 4.3-m (14-ft) diameter pipes buried beneath the lakebed. Water enters these pipes at the offshore intake structure. The offshore intake structure is an annulus of steel pilings with limestone blocks between the steel pilings. The cylinder stands upright on the lakebed 533 m (1750 ft) offshore in 6.7 m (22 ft) of water. As originally designed, the offshore intake structure had a top elevation of 2.4 m (8 ft) above water level. However, the original structure attracted a large number of birds during the spring and fall migration and contributed to a number of bird mortalities. In May 2001, the offshore intake structure was reconfigured to address the bird mortality issue. As modified, the offshore intake structure stands approximately 3.4 m (11 ft) tall above the lake floor, has an outside diameter of 34 m (110 ft), and an inside chamber with a diameter of 18 m (60 ft); the offshore intake structure is now completely submerged. The top is covered with a steel superstructure supporting a trash rack made of high-density polyethylene having approximately 18 x 46 cm (7 x 18 in.) openings. In addition, in 2002, WEPCO installed a permanent fish deterrent system around the intake structure under a compliance agreement with the U.S. Fish and Wildlife Service (FWS). This system makes use of high-frequency sound (125 kilohertz) to minimize the influx of fish into the intake structure.

Water enters the chamber through the trash rack as well as through void spaces around the limestone blocks and through 76 cm (30 in.) diameter pipes that penetrate the blocks in a ring 1.5 m (5 ft) above the lakebed. The pipes are covered with 3 x 5 cm (1.2 x 2 in.) bar grating to prevent debris and large fish from entering the intake system. In 1980, the original intake structure was modified to reduce problems with ice formation. Modifications consisted of the installation of four 2 x 2 m (6.5 x 6.5 ft) concrete pipes near the lake bottom in the south half of the intake crib. The pipes are covered with a grating that is hinged for lowering in the winter months (usually December 1 to March 1) to prevent the formation of frazzle ice on the grate and the subsequent restriction of water flow. The modification was also designed to lower the velocity of water approaching the offshore intake structure. Three of the four pipes were retained during the May 2001 modification. A trash rack, bar grates, and traveling screens are located in the forebay, where small debris and trapped fish are collected in baskets and removed before they can enter the circulating water system.

Water circulated through the condensers is discharged to the Lake through two steel piling troughs at the lake surface extending in opposite directions (at 30-degree angles from the plant

centerline) approximately 61 m (200 ft) out into Lake Michigan. The normal temperature increase over the ambient water temperature at the point of discharge is about 13 °C (23 °F). The momentum of the discharge velocity is sufficient to create a high degree of mixing with the Lake water in the immediate vicinity.

The system is designed to control the formation of needle ice within the intake structure during the winter months by using warm water feedback. The recirculation of heated effluent back through the pump house forebay reduces the net rate of water withdrawal from the Lake to 10 $m^3/s$ (353 $ft^3/s$) for each unit (NMC 2004a).

Sodium hypochlorite and various biocides are injected into the cooling water at the pump house forebay to control aquatic nuisances and algal growth. In addition, an electrolytic system continuously adds copper to the service water at a rate of 5 to 10 parts per billion to control biological fouling of the service water.

### 2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

PBNP uses liquid, gaseous, and solid radioactive waste management systems to collect and treat the radioactive materials that are a by-product of PBNP operations. These systems process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to maintain levels as low as reasonably achievable before they are released to the environment. The PBNP waste processing systems meet the design objectives of Title 10 of the Code of Federal Regulations (CFR), Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

Radioactive material in the reactor coolant is the primary source of gaseous, liquid, and solid radioactive wastes in light-water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods, but small quantities escape from the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system is also responsible for coolant contamination. Nonfuel solid waste results from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid waste also consists of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant design modifications, operations, and routine maintenance activities. Solid waste is shipped to a waste processor for volume reduction before disposal or is sent directly to the licensed disposal facility. Spent resins and filters are dewatered and packaged for shipment to licensed offsite processing or disposal facilities (NMC 2003a).

Fuel assemblies that have exhausted a certain percentage of their fuel and have been removed from the reactor core for disposal contain spent fuel. PBNP currently operates on a nominal 18-month refueling cycle. The spent fuel is currently stored on site in the spent fuel pool in the auxiliary building adjacent to the containment building or in dry cask storage at the onsite ISFSI.

The Offsite Dose Calculation Manual (ODCM) for PBNP describes the methods used for calculating the concentration of radioactive material in the environment and the estimated potential offsite doses associated with liquid and gaseous effluents from PBNP (NMC 2003b). The ODCM also specifies controls for release of liquid and gaseous effluents to ensure compliance with the NRC regulations.

### 2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

Radioactive fluids entering the waste disposal system are collected in tanks for analysis prior to discharge and/or further treatment. Each unit has a steam generator blowdown tank and one reactor coolant drain tank inside each containment. Units 1 and 2 share one laundry and hot shower tank, one chemical tank, one waste holdup tank, two waste condensate tanks, and one waste distillate tank. As the primary means for processing all radioactive liquid waste effluents, the blowdown evaporator system is designed to remove radioactive particulates and gases from radioactive liquid waste and from steam generator blowdown water in the event of primary to secondary leakage. Evaporator bottoms and ion exchange resins are pumped to the primary auxiliary building truck bay for dewatering prior to shipment for disposal. All piping, pumps, and valves carrying the liquid wastes are stainless steel and have provisions to minimize leakage, prevent over-pressurization, and isolate equipment as required for operation and maintenance (NMC 2003a).

All liquid waste components except the reactor coolant drain tank are located in the auxiliary building and any leakage from the tank or piping would be collected in the building sump to be pumped back into the liquid waste system. The building sump and basement volume are sufficient to hold the full volume of a liquid holdup tank without overflowing to areas outside the building. The full volume of either the volume control tank or the waste holdup tank would be contained in the auxiliary building (NMC 2003a).

All liquid wastes are monitored prior to release. The radiation monitoring system monitors the effluent, closing the discharge valve if the amount of radioactive material in the effluent exceeds preset values. These values are established using the methodology described in the ODCM (NMC 2003b).

During 2003, there was a total amount of radioactive material (fission and activation products) of $5 \times 10^9$ Bq (0.16 Ci) and a total amount of tritium of $2.77 \times 10^{13}$ Bq (748 Ci) released from

PBNP. These levels are typical of past years and are within regulatory limits (NMC 2000, 2001, 2002). See Section 2.2.7 for a discussion of the calculated doses to the maximally exposed individual as a result of these releases. Absent a change in licensed power levels, NMC does not anticipate any increase in liquid waste releases during the license renewal period.

### 2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

PBNP ventilation is designed to maintain gaseous effluents to levels as low as reasonably achievable. This is done by a combination of holdups for decay of short-lived radioactive material, filtration, and monitoring. Gases from the primary containment system are held in decay tanks for up to 45 days prior to release through the auxiliary building ventilation stack. Gases from other areas of the plant, such as the spent fuel pool, radioactive waste handling area, auxiliary building, service building, and chemistry laboratory are filtered and monitored prior to release. The primary release points at PBNP are the auxiliary building vent stack, the Unit 1 and 2 containment purge stacks, and the drumming areas vent stack. These four release points are equipped with shutoff valves that close if the activity levels exceed the alarm set point of the monitor. The basis for the value of the alarm set point is discussed in the ODCM. The unmonitored release point is the exhaust from the turbine building, where airborne radioactive material is not expected. Areas of the plant that could contain low levels of radioactive contaminants in the event of primary to secondary leakage, such as the turbine building, are not provided with high-efficiency particulate air filters or carbon absorber equipment, because releases from these areas are insignificant.

During 2003, the total amount of radioactive material released from PBNP (NMC 2004c) occurred in the following forms:

- Fission and activation gas of $3.3 \times 10^{10}$ Bq (0.89 Ci)
- Iodine of $5.5 \times 10^{6}$ Bq ($1.5 \times 10^{-4}$ Ci)
- Total particulate of $3.2 \times 10^{6}$ Bq ($8.7 \times 10^{-5}$ Ci)
- Total tritium of $2.3 \times 10^{12}$ Bq (61.5 Ci).

These releases are typical of past years (NMC 2000, 2001, 2002). See Section 2.2.7 for a discussion of the calculated doses to the maximally exposed individual as a result of these releases. Absent a change in licensed power levels, NMC does not anticipate any increase in gaseous waste releases during the license renewal period.

### 2.1.4.3 Solid-Waste Processing

The solid-waste system at PBNP is designed to package and/or solidify radioactive waste for shipment to an approved offsite burial facility. Solid waste consists of chemical laboratory samples, spent resins, used filter cartridges, radioactively contaminated hardware, and compacted wastes such as rags, paper, and clothing.

Spent resins from the demineralizers, filter cartridges, and the concentrates from the evaporators are packaged and stored on site until shipment for offsite disposal. Miscellaneous materials such as paper, plastic, wood, and metal are collected and shipped off site for vendor supplied volume reduction (i.e., incineration, supercompaction, metal melt, decontamination, etc.) followed by disposal.

Spent resins from the chemical and volume control system and other system demineralizers are flushed to a shielded, lined, stainless steel storage tank located in the auxiliary building basement. When the tank is full, the resin is dewatered and liquids from the dewatering operation are sent to the waste holdup tank. Following resin dewatering, the tank and its shield are transferred by the seismically qualified auxiliary building crane to the truck access area or to the new-fuel storage area where the resin is sluiced to a disposable cask liner. When the disposable liner is full, the liner is dewatered to meet disposal site criteria. The disposable liner is then shipped off site for disposal at a suitable burial site or stored until shipment for offsite burial.

Dry active waste is stored in SeaLand containers in designated locations in the outside yard portion of the radiation control area before shipment. Also, boxes loaded with dry active waste are stored in the outside yard area of the radiation control area before shipment. Routine surveys and inspections are performed to verify container integrity (NMC 2003a).

Spent fuel is currently stored on site in the spent fuel pool in the auxiliary building adjacent to the containment building or in dry cask storage at the onsite ISFSI (NMC 2004b).

Disposal and transportation of solid waste are performed in accordance with the applicable requirements of 10 CFR Parts 61 and 71, respectively. There have been no releases to the environment from radioactive solid wastes generated at PBNP (State of Wisconsin 2003, 2004a).

The total amount of radioactive material shipped for disposal in 2003 was $6.5 \times 10^{12}$ Bq (175.3 Ci) (NMC 2004c). These shipments are representative of the shipments made in the past several years (NMC 2000, 2001, 2002). Absent a change in licensed power levels, NMC does not anticipate any increase in radioactive waste shipments during the license renewal period.

### 2.1.5 Nonradioactive Waste Systems

Various nonradioactive wastewater management and disposal activities are conducted at PBNP. They include collection, treatment, and disposal of the following principal effluents: sanitary waste, demineralizer regeneration neutralization tank discharge, steam generator blowdown, reverse osmosis reject wastewater, microfiltration unit backwash, water treatment plant backwash, potable water treatment system filter backwash, heating system condensate, and wastewater from various sumps and floor drains.

After the appropriate treatment processes, the wastewater streams are discharged to Lake Michigan and monitored and regulated according to Wisconsin Pollutant Discharge Elimination System (WPDES) permit number WI-0000957-07-0 administered by the Wisconsin Department of Natural Resources (WDNR) (WDNR 2004a).

Sanitary wastewater is treated in an onsite treatment system. The effluent is commingled with other wastewater and subsequently discharged with the cooling-water discharges. Waste liquid sludge is hauled off site for disposal. Land application of sludge is considered as an alternative disposal method. However, no land application has occurred in the last 6 years. The sludge is taken to the Green Bay or Manitowoc wastewater treatment plants for disposal.

A wastewater retention pond previously used for low-volume process wastewater and treated sanitary waste effluent was abandoned in 2002. The site was restored to its pre-excavation grades and planted with native plant species (GeoSyntec Consultants 2002). A vacuum fabric filter system is now used for treating the wastewater. The vacuum fabric filter system removes suspended solids to provide final clarification prior to discharge.

All nonradioactive solid waste is disposed of using licensed disposal methods appropriate for the waste types. Hazardous, nonradioactive waste generated by PBNP is regulated under the Resource Conservation and Recovery Act (42 United States Code [USC] 6901 et seq.), which is administered by the WDNR. Hazardous waste activity is registered with the U.S. Environmental Protection Agency (EPA) under Identification No. WID093422657. Hazardous wastes generated on the PBNP site, such as contaminated soil and other materials, paints, oils, solvent wastes, outdated chemical products, and corrosive reagents, are managed and disposed of by shipping off site in accordance with applicable rules and regulations. In 2003, approximately 32.2 MT (35.5 tons) of hazardous waste were generated at PBNP (We Energies 2004a).

Nonradioactive and nonhazardous waste materials such as excess dirt and debris from past construction activities, including clean soil, broken pavement, and building materials, have been collected at an onsite spoil pile at the PBNP site. The spoil pile is established and maintained in

conformance with the applicable requirements of the WDNR. The pile is stabilized by years of natural vegetative growth. A visual inspection of the pile is conducted annually to check for erosion as part of the Storm Water Pollution Prevention Plan.

### 2.1.6 Plant Operation and Maintenance

Maintenance activities conducted at PBNP include inspection, testing, and surveillance to maintain the current licensing basis of the plant and ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating, but some activities require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. NMC refuels PBNP on a nominal 18-month, staggered schedule. During refueling outages, which last from 30 to 40 days, site employment increases above the 740 permanent workforce by 300 temporary workers (NMC 2004a).

The final safety analysis report (NMC 2003a) regarding the effects of aging on systems, structures, and components was included as part of the PBNP application for renewal of its operating license (OL), in accordance with 10 CFR Part 54. Chapter 3 and Appendix B of the PBNP license renewal application (NMC 2004b) describe the programs and activities that would manage the effects of aging during the license renewal period. NMC expects to conduct activities related to the management of aging effects during normal plant operation, or refueling and other outages, but plans no outages specifically for the purpose of refurbishment. NMC does not plan to add significant additional full-time staff (non-outage workers) at PBNP during the period of the renewed license.

### 2.1.7 Power Transmission System

In its Environmental Report (ER), the applicant identified three 345-kilovolt (kV) transmission lines that connect PBNP to the power grid (NMC 2004a). A fourth 345-kV line connects the Kewaunee Nuclear Power Plant (KNPP) to the substation at PBNP. Currently the four lines are owned and maintained by the American Transmission Company (ATC). The transmission lines are described below and the characteristics of each right-of-way (ROW) are shown in Table 2-1.

**Table 2-1.** PBNP Transmission Line Rights-of-Way

| Substation | Rights-of-Way | Number of Lines | kV | Approximate Length km | Approximate Length (mi) | Approximate Width m | Approximate Width (ft) | Approximate Area ha | Approximate Area (ac) |
|---|---|---|---|---|---|---|---|---|---|
| Granville | L-111 | 1 | 345 | 32.0 | 20.0 | 67 | 220 | 210 | 530 |
| Arcadian | L-121 | 1 | 345 | 29.0 | 18.0 | 67 | 220 | 190 | 480 |
| North Appleton | L-151 | 1 | 345 | 47.5 | 29.7 | 67 | 220 | 320 | 790 |
| PBNP | Q-303 | 1 | 345 | 9.0 | 5.6 | 67 | 220 | 61 | 150 |

Source: NMC 2004a

Line L-111 connects to the Granville substation via a previously existing line. The tie point is in the southwest quadrant of Section 16, Franklin Township. The length of the line is 32 km (20 mi) (NMC 2004a).

Line L-121 connects to the Arcadian substation via a previously existing line. The tie point is in the southwest quadrant of Section 9, Franklin Township. The length of the line is 29 km (18 mi) (NMC 2004a).

Line L-151 connects to the North Appleton substation via a previously existing line. The tie point is in the northwestern quadrant of Section 7, Wrightstown Township. The length of the line is 47.5 km (29.7 mi) (NMC 2004a).

Line Q-303 runs 9.0 km (5.6 mi) north to the substation at KNPP (NMC 2004a).

Each ROW is 67 m (220 ft) wide. Figure 2-4 shows the transmission system for PBNP. For the specific purpose of connecting PBNP to the power grid, ATC has a total of 118 km (73.3 mi) of transmission lines occupying approximately 791 ha (1955 ac) of easement (NMC 2004a). The ROWs pass through land that is primarily rolling hills covered in forest and farmland. These ROWs pass through rural areas with low population densities. The lines cross numerous State and Federal highways, including Wisconsin Highways 42 and 147 and Interstate 43. ROWs that pass through farmland generally continue to be managed as such. ATC plans to maintain these lines indefinitely as they are an integral part of the larger transmission system. These transmission lines are expected to remain a permanent part of the regional transmission system after decommissioning of PBNP.

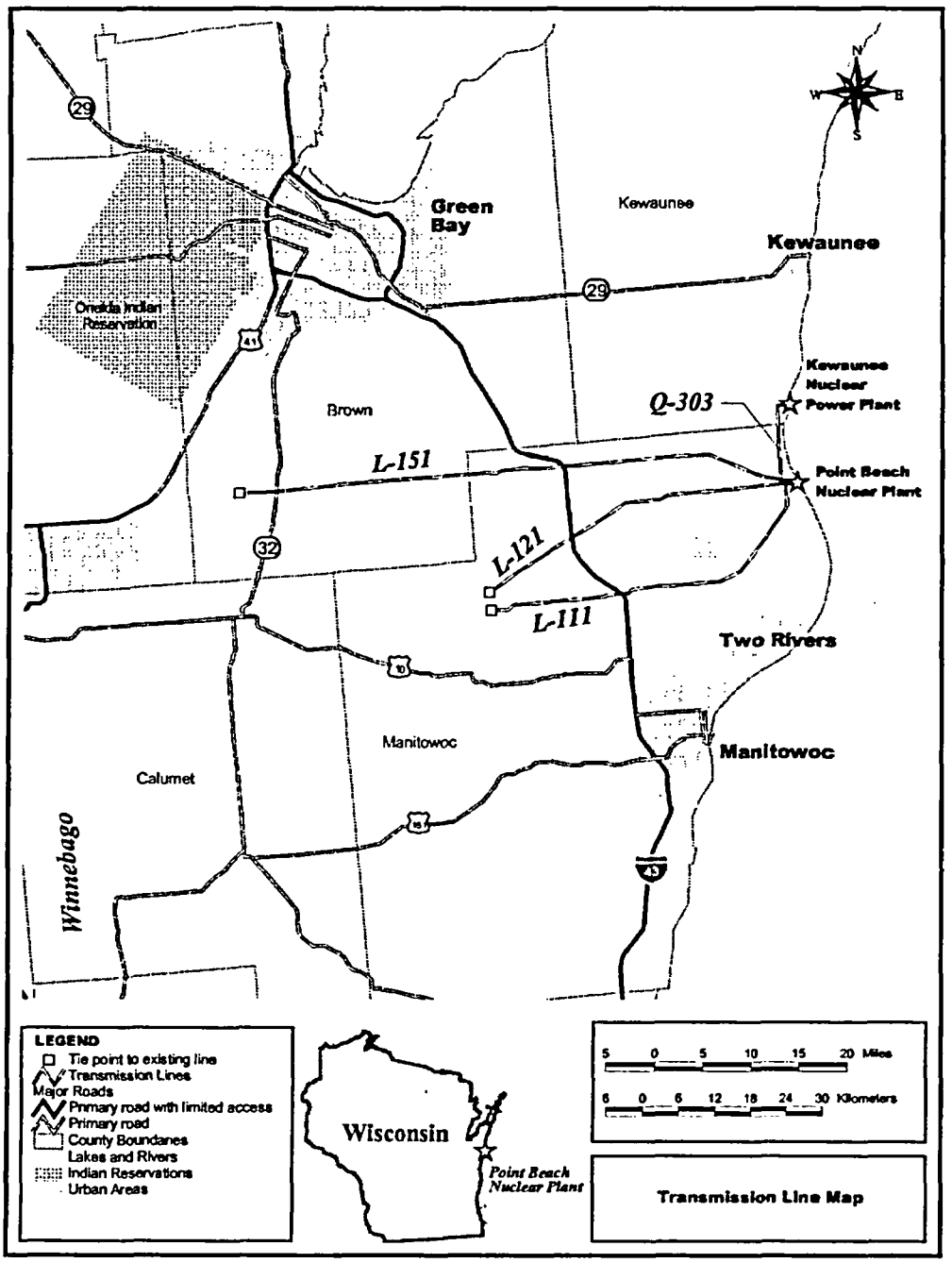


**Figure 2-4.** PBNP Transmission Lines

The transmission lines were designed and constructed in the late 1960s and early 1970s in accordance with then existing *Wisconsin Electrical Code* and industry standards. ATC implements a ROW inspection and maintenance program to ensure that the transmission facilities continue to conform to design standards. ATC manages transmission line ROWs using a wire zone/border zone concept. The wire zone is directly below the transmission lines, where the vegetation is primarily low-growing forbs and grasses. The border zone extends from the wire zone to the edge of the ROW, where woody species less than 5 m (15 ft) tall provide a transition to the surrounding habitats (ATC 2004).

The maintenance and inspection program uses aerial patrols to check for encroachments, broken conductors, broken or leaning structures, and signs of tree burning. Any of these conditions could be evidence of clearance problems. Additionally, ground inspections are performed to further examine clearance at questionable locations, observe the integrity of structures, and identify dead or diseased trees that might fall on the lines. Problems that are found are brought to the attention of the appropriate organization for corrective action. ATC has a vegetation management program for trimming and clearing tall trees that may impinge upon the conductors (ATC 2004b). The program also involves removing invasive plants from the ROW. The specific clearing activities implemented are dependent upon the type and amount of vegetation in a given area and are modified as needed for sensitive habitats and stream crossings. Vegetation management activities may include tractor mowing, manual chainsaw clearing, and application of herbicides by a State-licensed, commercial applicator. Trimming is usually performed every 5 to 7 years, depending on the growth rates of vegetation in a given area.

ATC recognizes that transmission line ROWs provide ancillary compatible uses including wildlife habitat, biodiversity corridors, recreation, and aesthetics. ATC practices a vegetation management program that utilizes physical, chemical, and biological treatments to promote stable, diverse, low-growing plant communities in a way that promotes wildlife habitat and reduces environmental impacts.

## 2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment near PBNP as background information. They also provide detailed descriptions when needed to support the analysis of potential environmental impacts of refurbishment and operation during the renewal term, as discussed in Chapters 3 and 4. Section 2.2.9 describes the historic and archaeological resources in the area, and Section 2.2.10 describes possible impacts associated with other Federal project activities.

### 2.2.1 Land Use

PBNP is situated on the western shore of Lake Michigan in Manitowoc County, Wisconsin, approximately 48 km (30 mi) southeast of Green Bay and 24 km (15 mi) north-northeast of the City of Manitowoc. Lake Michigan is the second largest of the Great Lakes by volume at 4900 $km^3$ (nearly 4 billion acre-feet) and third largest by area, covering approximately 57,800 $km^2$ (22,300 $mi^2$) (Environment Canada 1995). Major tributaries of Lake Michigan include the Fox-Wolf, Grand, and Kalamazoo rivers. Two small creeks are located within the PBNP site boundaries and drain to the north and south. One of the creeks discharges into the Lake about 457 m (1500 ft) north of the site, while the other discharges near the center of the site. During the spring, water often ponds in shallow depressions because of the poor drainage characteristics of the soil, due largely to a high clay content.

The PBNP site boundary includes 3.2 km (2 mi) of continuous frontage on Lake Michigan. Low bluffs face the shoreline with evidence of marked erosion near the center of the site. At this point, the beach is narrow, ranging in width from 6 m to 15 m (20 ft to 50 ft). The bluff faces are bare mud slopes and show active erosion during storm events. It is estimated that the shoreline is receding at a rate of approximately 0.8 m to 1.5 m (2.5 ft to 5 ft) per year. To counter this erosion, WEPCO has placed riprap along the most sensitive stretches (NMC 2004a).

The plant site boundary encompasses approximately 510 ha (1260 ac) (NMC 2004a), all owned by WEPCO. Within the plant site boundary, there are nine leases totaling approximately 425 ha (1050 ac) issued to local farmers. The land subject to the leases is used primarily for grain crops, but some is allowed to remain uncultivated or stand fallow. The balance of land within the site boundary is a combination of open space, woods, and wetlands. The developed portion of the site resides primarily along the shoreline, but there are some ancillary structures, notably the ISFSI. The zoning of the PBNP site is exclusively agricultural (Manitowoc County Planning and Park Commission [MCPPC] 2004).

Originally, there were several residences on the land that is now occupied by the PBNP site. Only one of these former residences still stands, but it is unoccupied. It is occasionally used for training purposes by the plant's security forces. There are no other residential structures on the plant site itself.

The area within 10 km (6 mi) of PBNP includes portions of Manitowoc and Kewaunee counties and is largely rural, characterized by farmland, woods, and small residential communities. Zoning of the land adjacent to the plant site is agricultural with the exception of the Town of Two Creeks, which has a small area zoned for both residential and business. The nearest residential community to PBNP is the Town of Two Creeks, approximately 1.6 km (1 mi) north-northwest of the site (Figure 2-2). Other nearby communities include the Village of

Mishicot (approximately 10 km [6 mi] west-southwest of the plant), the City of Two Rivers (13 km [8 mi] to the south) and Kewaunee (18 km [11 mi] to the north). The largest metropolitan area within 80 km (50 mi) is the City of Green Bay, located 48 km (30 mi) to the northwest. Approximately 81 percent of the plant's workforce resides in Manitowoc County, with the majority living in the cities of Manitowoc and Two Rivers.

Section 307(c)(3)(A) of the Coastal Zone Management Act [16 USC 1456(c)(3)(A)] requires that applicants for Federal licenses to conduct an activity in a coastal zone certify that the proposed activity is consistent with the enforceable policies of the State's coastal management program. A copy of the certification is also to be provided to the Federal agency. The State is to notify the applicant and the Federal agency whether the State concurs with or objects to the applicant's certification. According to 15 CFR Part 930, this notification is to occur within 6 months of the State's receipt of the certification. PBNP is within Wisconsin's coastal zone for purposes of this Act. NMC submitted a consistency certification to the Wisconsin Department of Administration (WDA) on March 2, 2004 (NMC 2004d). According to WDA procedures, concurrence by the Coastal Management Council's staff can be presumed in the absence of its objection within six months of the commencement of its review (WDA 2005). WDA did not notify the applicant or the NRC of any objection to the consistency certification within the specified time frame; thus, the Coastal Management Council's concurrence can be presumed. Therefore, renewal of the operating licenses for PBNP Units 1 and 2 can be presumed to be consistent with Wisconsin's Coastal Management Program.

### 2.2.2 Water Use

Lake Michigan is the source of water for cooling and auxiliary water systems at PBNP. PBNP uses a once-through condenser cooling system with a submerged offshore intake and a surface shoreline discharge. The withdrawal rate from the Lake through each condenser is 22 $m^3/s$ (777 $ft^3/s$), or approximately $1.33 \times 10^6$ L/min (350,000 gpm). Water is then returned to the Lake with minimal net loss.

Groundwater supplies in the vicinity of PBNP are obtained primarily from the Silurian aquifer. This aquifer is in the uppermost bedrock, which consists of Silurian-age Niagara Dolomite. It lies below approximately 33 m (110 ft) of unconsolidated glacial material primarily consisting of clay with some sand, silt, and gravel. Underlying the Silurian-age deposits are relatively uniform layers of Ordovician-age formations composed of shale, dolomite, and limestone. Domestic-quality water for drinking and sanitary purposes is withdrawn from groundwater by five active domestic supply wells at PBNP having an average flow rate of about 24 L/min (6.5 gpm), or 35,000 L/day (9300 gpd). The main well at PBNP is drilled to a depth of 78 m (257 ft). The normal water level in this well is at 3.5 m (12 ft) below grade, which indicates an artesian condition in the Silurian aquifer (NMC 2004a). PBNP is not connected to a municipal water system.

### 2.2.3 Water Quality

Lake Michigan provides safe drinking water for 10 million people, wildlife habitat, food production and processing, an active sport and sustenance fishery, and other valuable commercial and recreational activities (EPA 2000). However, threats to the Lake Michigan ecosystem still exist that result in fish consumption advisories, beach closures, and impairment of aquatic organisms and wildlife.

The water quality of Lake Michigan has been degraded by industrial, municipal, agricultural, navigational, and recreational water users for more than 150 years. Although major point sources of pollutants have been curtailed since the enactment of the Federal Water Pollution Control Act (also known as the Clean Water Act of 1977 [CWA]) (33 USC 1326 et seq.), the lake continues to receive pollutants such as polychlorinated biphenyls (PCBs) and mercury from the atmosphere. The United States and Canada, in consultation with State and provincial governments, are working to restore and maintain the chemical, physical, and biological integrity of the water of the Great Lakes Basin ecosystem under the provisions of the Great Lakes Water Quality Agreement, signed in 1972 and amended in 1987 (EPA 2005).

As part of this effort, the Lake Michigan Technical Committee developed a *Lake Michigan Lakewide Management Plan* (EPA 2000) that describes the current state of Lake habitats (open waters, wetlands, tributary streams), identifies areas of concern, and recommends future steps that should be taken to protect and restore Lake Michigan ecosystems. These recommendations range from controls on ballast water to remediation of contaminated (sediment) sites and the implementation of total maximum daily load strategies for tributary streams. The *Lake Michigan Lakewide Management Plan* lists a number of areas in which improvements have been made (e.g., reduction of point source pollutants entering the basin and protection and restoration of wetlands) but notes that other areas still need improvement (e.g., deposition of toxic air pollutants in the watershed and nonpoint source pollutants). The *Lake Michigan Lakewide Management Plan* is one of the most comprehensive sources of information available on the current state of health of the Lake Michigan ecosystem (EPA 2000).

In accordance with the CWA, the water quality of plant effluent discharges is regulated through the National Pollutant Discharge Elimination System (NPDES). WDNR is the agency delegated by the EPA to issue discharge permits in Wisconsin. PBNP wastewater discharges to Lake Michigan are regulated and monitored under WPDES permit number WI-0000957-07-0 administered by the WDNR (WDNR 2004a). The current permit was issued July 1, 2004, and is due to expire June 30, 2009.

The permit contains effluent limitations necessary to ensure that the water-quality standards for Lake Michigan are met. The current permit requires monitoring of discharge streams from the

condenser cooling water, deicing line for the water intake crib (during winter), demineralization regeneration neutralization tank, steam generator blowdown, sewage treatment plant effluent, liquid sludge line from sanitary wastewater treatment system, low-volume wastewater (from sumps, drains, and backwash), plant process wastewater, and microfiltration unit backwash from the plant. Monitoring requirements and discharge limitations exist for flow, pH, suspended solids, oil and grease, biochemical oxygen demand, total residual chlorine, and whole effluent toxicity for the discharge streams as applicable. The current permit requires monitoring and reporting of PBNP discharges to Lake Michigan, but the permit does not have any thermal water-quality standards for compliance. The permit also requires a study of the cooling-water intake to assess any potential adverse impacts and notes that, where applicable, the best technology available must be implemented to prevent the impingement and entrainment of fish and aquatic life. Any new regulations promulgated by the EPA or the State would be reflected in future permits (WDNR 2004a).

From 1968 to 2002, PBNP used a wastewater retention pond to collect process wastewater and sewage treatment plant effluent, and settle out the suspended solids. Originally pond water was discharged to a small, onsite creek, which discharged to Lake Michigan. However, in the mid-1970s, the pond, creek, and adjacent soils were found to be slightly contaminated with low levels of radionuclides. Soils in a nearby wetland outside the pond basin were found to be contaminated with low levels of cesium and cobalt-60. In response, the wastewater retention pond discharges were rerouted into the facility, monitored, and released to Lake Michigan with the cooling water discharges (NMC 2004a).

Active wastewater treatment in the pond ended in 2002, and WEPCO subsequently closed the wastewater retention pond as prescribed by WDNR regulations. The pond was dewatered, and the sediments were either removed or stabilized in place and covered with layers of soil. Soils in the nearby wetland contaminated in excess of the NRC decommissioning guidelines were removed and disposed of at a licensed offsite facility. The site was restored to its pre-excavation grades and planted with native plant species (NMC 2004a). The abandonment plan for the wastewater retention pond (GeoSyntec Consultants 2002) was reviewed for compliance and approved by WDNR, who verified that currently there are no groundwater-related issues of concern to WDNR at PBNP (WDNR 2002, 2005). There are currently no discharges to groundwater from PBNP requiring permits by regulatory agencies (WDNR 2005).

### 2.2.4 Air Quality

PBNP is located near the Town of Two Creeks on the western shore of Lake Michigan in Manitowoc County, Wisconsin. Overall, the ground surface at the PBNP site is gently rolling to flat with elevations varying from 1.5 m to 18 m (5 ft to 60 ft) above the level of Lake Michigan. The climate of the region is influenced by the west-to-east flow of storms along the northern

portion of the country and from the southwest to the Great Lakes. Lake Michigan influences the wind and temperature regimes in the vicinity of PBNP. The site is well ventilated with infrequent calms. Prevailing winds during spring and summer are onshore lake breezes. Beginning in the summer, a flow from the south-southwest appears that is reinforced in the fall by offshore flows from west-southwest and west-northwest. During winter, the flow is from the northwest through south-southwest (NMC 2003a).

The average annual temperature is 7.2 °C (45 °F), with an average daytime winter temperature of –1.7 °C (29 °F) and an average daytime summer temperature of 25 °C (77 °F). The maximum monthly average daily temperature is 26.4 °C (79.6 °F) (July) and the minimum monthly average daily temperature is –11.8 °C (10.8 °F) (January) (Midwestern Regional Climate Center [MRCC] 2003).

Average total annual precipitation is about 71 cm (28 in.) per year with 55 percent falling in the months of May through September. For the period of 1971 to 2000, rainfall ranged from a monthly average high of 9.47 cm (3.73 in.) in August, to a monthly average low of 3.15 cm (1.24 in.) in February (MRCC 2003). Average annual snowfall is about 114 cm (45 in.) per year with a maximum of 38 cm (15 in.) in 24 hours occurring in January 1947. Ice storms are infrequent in this region of Wisconsin (MRCC 2003).

Tornadoes occur in the state, but the only one that caused major property damage and injury to people within an 80-km (50-mi) radius of PBNP occurred in 1959 in Green Bay, 48 km (30 mi) northwest of the site. Based on statistics for the 30 years from 1954 through 1983 (Ramsdell and Andrews 1986), the probability of a tornado striking the site is expected to be about $4.0 \times 10^{-4}$ per year.

Average wind speeds at the site are approximately 16 km/h (10 mph). Wind power potential is generally rated on a scale of 1 through 7. Areas suitable for wind turbine applications have a rating of 3 or higher. The western shore of Lake Michigan, which forms the eastern edge of Wisconsin, has an annual average wind power rating of class 3. This rating is due primarily to the prevailing westerly winds. Eastward moving storm systems are responsible for the easterly winds that flow off the lake during the winter and late autumn. Thus, on the annual average, the wind power potential on the western shore is less than on the eastern shore but still reflects the influence of Lake Michigan. Lake breezes, which are maximized in the spring, also contribute to the wind power potential along this shoreline (Elliot et al. 1987).

The PBNP site is located within the Lake Michigan Intrastate Air Quality Control Region (AQCR), formerly known as the Menominee-Escanaba (Michigan)-Marinette (Wisconsin) Interstate Air Quality Control Region (40 CFR 81.67). This AQCR comprises the territorial

areas encompassed by the following Wisconsin counties: Brown, Calumet, Door, Fond du Lac, Green Lake, Kewaunee, Manitowoc, Marinette, Marquette, Menominee, Oconto, Outagamie, Shawano, Sheboygan, Waupaca, Waushara, and Winnebago.

The Lake Michigan Intrastate AQCR is in attainment for all air-quality criteria pollutants, with the exception of ozone. The AQCR was previously in attainment with the 1-hour ozone standard. In 1997, the EPA revised the national standard for ground-level ozone from a 1-hour "peak" standard of 0.12 ppm to an 8-hour "average" standard of 0.08 ppm. This new standard is commonly referred to as the 8-hour standard and was upheld by the U.S. Supreme Court in February 2001 (*Whitman, Administrator of EPA, et al. v. American Trucking Associations, Inc., et al.*). In April 2004, the EPA published the 8-hour ozone nonattainment designations and announced that the 1-hour standard will be phased out. The EPA designated Manitowoc County as a "basic" nonattainment area, with attainment to be achieved no later than June 2009 (EPA 2004a). The EPA indicated that areas designated as "basic" must comply with the more general nonattainment requirements of the Clean Air Act of 1970 (CAA) (42 USC 7401 et seq.) (EPA 2004b). This change in attainment status for Manitowoc County will not significantly affect the ongoing operations of PBNP. Over time, continued nonattainment may increase the likelihood that additional emission controls will be required for stationary sources. Any such new controls would employ demonstrated cost-effective technologies and would only minimally impact plant operations. Kewaunee County, immediately north of Manitowoc County, is also designated as a "basic" nonattainment area for ozone, whereas the Sheboygan and Milwaukee-Racine areas to the south are "moderate" nonattainment areas with respect to the 8-hour ozone standard. There are no Class I Federal areas, in which visibility is an important value designated in 40 CFR Part 81, within 160 km (100 mi) of the PBNP site.

Diesel engines, boilers, a gas turbine, and other activities and facilities associated with the PBNP site emit various nonradioactive air pollutants to the atmosphere. Air emissions from these sources are subject to the terms and conditions of a CAA Title V air pollution control operation permit issued by the WDNR Air Management Program (Permit Number 436034500-P10).

The air permit includes limits on emissions of particulate matter and opacity for all of the permitted sources of nonradioactive air emissions. The combustion turbine may not be operated more than 228.83 hours per month, as determined by the average over any 12 consecutive months. There are no significant changes proposed for nonradioactive air emissions from the PBNP site during the license renewal period, and there are no significant changes proposed to the limits and conditions of the air permit.

### 2.2.5 Aquatic Resources

The principal aquatic resource in the vicinity of PBNP is Lake Michigan, which is the source and receiving body for the PBNP Units 1 and 2 cooling systems. The PBNP site lies on the western shore of Lake Michigan and occupies approximately 3 km (2 mi) of Lake Michigan shoreline (NMC 2004a). At the site, low bluffs face the Lake Michigan shore with evidence of marked erosion near the center of the PBNP site. At this point the beach is narrow (ranging in width from 6 to 15 m [20 to 50 ft]) with bare mud slopes showing active erosion. Historically, shore recession has ranged from 0.8 to 1.5 m (2.5 to 5 ft) per year in this area. WEPCO has provided riprap to control further recession of the shoreline at the site (NMC 2004a). The transmission lines associated with PBNP cross several streams and rivers including Kriwanek Creek, Devils River, Branch River, Neshota River, West Twin River, and East Twin River (AEC 1972). Transmission line ROW maintenance activities in the vicinity of stream and river crossings include procedures to avoid impacts to existing waterway channels and shorelines (including maintaining buffer zones at stream and river crossings and, as appropriate, using hand cutting at sensitive habitats and wetlands, using established waterway crossings, and not using herbicides unless approved for aquatic use) (ATC 2004a, ATC 2004b, NRC 2004). This is also discussed in Section 2.1.7.

Lake Michigan is used for a variety of purposes, including commercial and recreational boating, sport and commercial fishing, and tourism. The major changes and modifications that have had the greatest effect on aquatic resources of Lake Michigan include: (1) lakefront industrial, urban, and residential developments; (2) water quality impairment from industrial, municipal, agricultural, navigational, and recreational water uses; (3) overfishing; and (4) invasion of exotic species (EPA 2002). The Lake Michigan ecosystem continues to experience profound changes because of development, impacts of invasive species, and pollution. Overall, the status of Lake Michigan habitats, including open water, wetlands, coastal shore, and tributaries, is mixed to deteriorating (EPA 2002). The WDNR has prepared an integrated plan to guide the management of sport and commercial fisheries in the Wisconsin waters of Lake Michigan (WDNR 2004b).

Some fish cannot be sold commercially because of high levels of PCBs, mercury, or other substances (Fuller et al. 1995). Mercury is a growing concern in fish in Lake Michigan and its tributary streams (EPA 2002). Wisconsin has published health advisories governing the consumption of fish, including those from Lake Michigan waters. Mercury and PCBs are the two main contaminants that account for the fish advisories in Wisconsin. PCBs are the only contaminants for which advisories apply within Lake Michigan (WDNR 2004c). For the Wisconsin waters of Lake Michigan, advisories are provided for rainbow smelt (*Osmerus mordax*), Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), rainbow trout (*O. mykiss*), brown trout (*Salmo trutta*), lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), bloater (*C. hoyi*), and yellow perch (*Perca flavescens*). Depending

on fish species and size, the advisories range from no more than one meal a week (e.g., rainbow trout) to do not eat (e.g., lake trout over 69 cm [27 in.]). Women of childbearing years, nursing mothers, and children under age 15 are cautioned to space their fish meals according to the advisories. Additional advisories are provided for other fish species for Wisconsin's inland waters, the Mississippi River, Green Bay, and Lake Superior (WDNR 2004c).

Despite the multiple competing uses of Lake Michigan, the overall fish biodiversity is fairly high. Almost 100 species of fish occur in Lake Michigan (UWSGI 2001a). Lake Michigan supports commercial, recreational, and tribal fishing. Commercial and tribal fishing totals over 6.6 million kg (14.6 million lb) annually (EPA 2002). Lake whitefish is the primary commercial species. Lake whitefish and lake trout constitute the tribal fisheries (Stein et al. 2003). Some commercial fishing is also done for bloater, rainbow smelt, and yellow perch (Madenjian et al. 2004; Hasz 2004). The 2003 commercial catches for the Wisconsin waters of Lake Michigan were lake whitefish - 600,104 kg (1,323,002 lb); bloater - 571,086 kg (1,259,029 lb) (includes marketable and unmarketable bloaters caught incidental to targeted rainbow smelt harvests); rainbow smelt - 46,075 kg (101,578 lb); and yellow perch - 8669 kg (19,111 lb) (for the 2002/2003 harvest year in Green Bay, commercial harvest of yellow perch in the rest of Lake Michigan has been closed since September, 1996) (Kroeff 2004; Peeters 2004; Hogler and Surendonk 2004; Hasz 2004; Hirenthota 2004). The yellow perch population density in Lake Michigan has declined dramatically since the early 1990s, with its age structure shifting towards older fish due to limited recruitment (WDNR 2004b). The commercial fishery for the introduced alewife (*Alosa pseudoharengus*) was closed in 1991 and has not reopened (Madenjian et al. 2002).

The number of fish caught by sport fishing within the Wisconsin waters of Lake Michigan (including Green Bay) in 2003 were lake trout - 23,881; rainbow trout - 48,548; brown trout - 23,654; coho salmon - 50,625; Chinook salmon - 317,619, northern pike (*Esox lucius*) - 3344; smallmouth bass (*Micropterus dolomieu*) - 19,253; yellow perch - 156,321; and walleye (*Stizostedion* vitreum) - 22,806 (Eggold 2004).

The top-level predators of Lake Michigan are currently dominated by introduced species of trout and salmon. The native burbot (*Lota lota*) and lake trout (the original top predators in Lake Michigan) have been recovering due to sea lamprey (*Petromyzon marinus*) control (Madenjian et al. 2004). Burbot abundance increased throughout the 1980s and 1990s, peaking in 1997, but numbers have declined in recent years (Madenjian et al. 2004). Lake trout have also increased in abundance, but numbers are maintained by stocking programs rather than by natural reproduction. About 2.4 million yearling lake trout are annually stocked into Lake Michigan (Bronte and Schuette 2002). Reasons that self-sustaining populations of lake trout have yet to be reestablished in Lake Michigan may include loss of suitable spawning habitat, environmental contamination, predation on larval lake trout by alewife, thiamine

deficiency from a diet of alewife, and a loss of genetically distinct strains (EPA 2002). Current efforts to restore the lake trout to Lake Michigan focus on stocking a variety of lake trout strains in offshore refuges that offer protection from fishing (NMC 2004a).

Alewife, rainbow smelt, bloater, deepwater sculpin (*Myoxocephalus thompsoni*), and slimy sculpin (*Cottus cognatus*) constitute the bulk of the forage biomass in Lake Michigan (Eshenroder et al. 1995; Madenjian et al. 2004). In 2003, the alewife was the most important prey fish in Lake Michigan, with an estimated lake-wide biomass of 42,876 metric tons (47,262 tons), which is equivalent to about 16.5 billion adult alewives (Madenjian et al. 2004). There is now a major effort to manage the non-native alewife population because of its importance as the major prey for introduced salmonids. The 2003 lake-wide biomass of bloater, rainbow smelt, deepwater sculpin, and slimy sculpin were estimated at 20,682 metric tons (22,798 tons), 1386 metric tons (1528 tons), 32,787 metric tons (36,141 tons), and 2385 metric tons (2629 tons), respectively (Madenjian et al. 2004). The biomass of Lake Michigan forage fish, taken as a group, increased from the 1970s to the late 1980s, peaked in 1989, and appears to have declined steadily since 1989. The overall decline in forage fish biomass over the 1990s is due primarily to the decline in the bloater (Madenjian et al. 2004).

Fish species reported from the PBNP site area include rainbow trout, brook trout (*Salvelinus fontinalis*), lake trout, coho salmon, Chinook salmon, round whitefish (*Prosopium cylindraceum*), lake whitefish, bloater, lake herring or cisco (*Coregonus artedi*), alewife, gizzard shad (*Dorosoma cepedianum*), rainbow smelt, trout-perch (*Percopsis omiscomaycus*), fathead minnow (*Pimephales promelas*), spottail shiner (*Notropis hudsonius*), black bullhead (*Ameiurus melas*), longnose sucker (*Catostomus catostomus*), white sucker (*C. commersoni*), ninespine stickleback (*Pungitius pungitius*), bluegill (*Lepomis macrochirus*), yellow perch, and slimy sculpin (AEC 1972; WEPCO 1976). The habitats most suitable for reproduction by the Great Lakes fish community (i.e., coastal wetlands, bedrock, sandy beach-dunes, and bluffs; Wei et al. 2004) do not occur in the immediate vicinity of PBNP.

At least 160 species of plants, plankton, macroinvertebrates, and fish have been introduced into the Great Lakes since the early 1800s through the canal system interconnection with the Atlantic Ocean (e.g., sea lamprey, alewife, and white perch [*Morone americana*]), ship ballast (e.g., Asiatic clam [*Corbicula fluminea*], zebra mussel [*Dreissena polymorpha*], spiny water flea [*Bythotrephes longimanus,* formerly known as *B. cederstroemi*], and round goby [*Neogobius melanostomus*]), or as intentionally introduced species (e.g., common carp [*Cyprinus carpio*], rainbow smelt, and various salmonids) (EPA 2002; Peeters 1998). Bait and pet releases have also contributed to the introduction of invasive species. About 10 percent of the invasive species have resulted in significant economic costs and/or ecological harm (WDNR 2003a). The presence of invasive species, coupled with increased loss of nearshore wetlands and tributary habitats, precludes the possibility for full restoration of the original fish

community of Lake Michigan (WDNR 2004b). The WDNR (2003a) has developed a comprehensive management plan to prevent further introductions of invasive species and to control existing populations of aquatic nuisance species.

In the mid-1960s, American and Canadian fish and game agencies began stocking trout and salmon species into the Great Lakes to control alewife and rainbow smelt numbers and to improve the sport fishery. The non-native salmonids that have been introduced to the Great Lakes between 1870 and 1960 include Atlantic species (Atlantic salmon [*Salmo salar*] and brown trout); Pacific species (Chinook salmon, coho salmon, rainbow trout, sockeye salmon [*Oncorhynchus nerka*], chum salmon [*O. keta*], cutthroat trout [*O. clarkii*], cherry salmon [*O. masou*], and pink salmon [*O. gorbuscha*]); and Arctic species (Arctic charr [*Salvelinus alpinus*]) (Crawford 2001).

Many of the introduced trout and salmon flourished, and by the 1970s, Lake Michigan fishermen were landing many large trout and salmon. Catch rates peaked in the mid-to-late 1980s, and then leveled off, as alewife numbers declined (Crawford 2001). Since the mid-1970s, salmonid stocking in Lake Michigan has involved the brook trout, brown trout, lake trout, rainbow trout/steelhead, Chinook salmon, coho salmon, and splake (hybrid between lake trout and brook trout). Among these species, only the lake trout was released to reestablish a reproducing population. The other species were stocked to provide a put-grow-take sport fishery and to control alewives. However, sustainable reproduction of lake trout has not occurred and natural reproduction of brown trout has been limited. Significant reproduction does occur for rainbow trout, Chinook salmon, and coho salmon (Eshenroder et al. 1995). Nearly 14.5 million trout and salmon are stocked annually in Lake Michigan (Eshenroder et al. 1995). About 70 percent of the Great Lakes trout and salmon fishery is dependent upon fish stocking (MDNR 2004). Atlantic salmon have not been stocked in the Lake since 1989 (Bronte and Schuette 2002). Tiger trout (hybrid between brook trout and brown trout) were stocked in the Wisconsin waters of Lake Michigan from 1974 through 1977. Their stocking was discontinued due to poor returns (WDNR 2003b).

Currently, the only major objective for salmonid stocking is the development and maintenance of recreational fisheries (Crawford 2001). Salmonid spawning in a number of streams on the Wisconsin shoreline of Lake Michigan is not conducive to natural reproduction because the stream temperatures are too high for survival of trout fingerlings, and heavy sediment loads smother eggs (WDNR 2003b). The stocking of salmonids may have resulted in the introduction of some non-native fish diseases and parasites to the Great Lakes and caused genetic alteration of native salmonids through hybridization and introgression and/or through declines in the abundance of native salmonids (brook trout and lake trout). Also, stocked salmonids may

present a direct threat to native and non-native forage fish and invertebrates, while placing competitive pressure upon native fish species for food and habitat resources (Crawford 2001). Nevertheless, the lake whitefish has made a recovery in the northern waters of Lake Michigan since salmonid stocking began (Eshenroder et al. 1995).

Because of concern that alewife and rainbow smelt populations in Lake Michigan were not adequate to support the booming populations of trout and salmon, fisheries managers in states bordering Lake Michigan began to reduce the stocking rates of Chinook salmon in 1999. This appears to have allowed alewife and rainbow smelt populations to stabilize, while improving the growth and overall health of trout and salmon.

In 2003, salmonid stockings into the Wisconsin waters of Lake Michigan (including its tributary streams) were brook trout - 23,877; brown trout - 1,080,538; Chinook salmon - 1,614,700; coho salmon - 540,145; lake trout - 724,774; steelhead - 758,275; and splake - 22,086. The numbers stocked in the area of Manitowoc and Kewaunee counties were brook trout - none; brown trout - 216,672; Chinook salmon - 488,718; coho salmon - 229,621; lake trout - 119,950; steelhead - 402,927; and splake - none (Burzynski 2004).

The native fish species of Lake Michigan have been affected by the introduced aquatic species, most notably the sea lamprey and alewife. The sea lamprey, first discovered in Lake Michigan in 1936, contributed to the collapse of top predator populations (e.g., lake trout and burbot) by the late 1940s (Eshenroder et al. 1995). Combined with overfishing, the sea lamprey contributed to the extirpation of the longjaw cisco (*Coregonus alpanae*), deepwater cisco (*C. johannae*), and blackfin cisco (*C. nigripinnis*) from Lake Michigan (Fuller et al. 2004). Sea lamprey abundance remains higher than desired in Lake Michigan. This limits rehabilitation efforts for lake trout, despite the stocking program previously mentioned (Stein et al. 2003). Other impediments to sustainable reproduction of lake trout in Lake Michigan relate to the following: (1) the lake-wide population is too low, (2) spawning aggregations are too diffuse and in inappropriate locations, and (3) there is poor survival of early-life stages (Bronte et al. 2003).

Declines in predator species allowed the alewife, which invaded Lake Michigan in 1949, to proliferate and further disrupt native aquatic food webs (Eshenroder et al. 1995). By 1967, the alewife made up about 85 percent of the fish biomass of the Lake (Peeters 1998). The population explosion of alewives contributed to the decline of native fishes such as the bloater, emerald shiner (*Notropis atherinoides*), lake whitefish, lake herring, deepwater sculpin, spoonhead sculpin (*Cottus ricei*), and yellow perch (Eshenroder et al. 1995; Peeters 1998; Madenjian et al. 2002; Fuller et al. 2004).

Alewives are easily stressed and, during peak population levels, can be subject to large die-offs in the spring. They are affected by both osmotic stress associated with life in fresh water and exposure to fluctuating water temperatures when they move to inshore waters (e.g., exposure

to colder waters during an upwelling event can cause the fish to die [UWSGI 2002]). Susceptibility to cold is related to inadequate lipid reserves in the spring (Eshenroder et al. 1995). In the spring, alewives are also in a weakened condition due to a lack of forage in the winter and by stress related to spawning (UWSGI 2001b). Adult alewives feed little, if at all, during their spawning migration (DFO 2004). Large numbers of spawning alewives can occur in nearshore waters as a result of strong year classes produced in the previous three or more years. Fish that become weak or die during rapid temperature change can be blown into windrows close to shore or can wash onto beaches (UWSGI 2002). Adult mortality following spawning may be as high as 40 to 60 percent (DFO 2004). Therefore, potentially large numbers of both moribund and dead alewives can be found in the nearshore waters during the spawning season. The alewife spawning season generally occurs from late May to early August, peaking in June and July (Jude 1995).

Native to the Atlantic coastal region, the white perch invaded the Great Lakes in 1950 (WDNR 2004d). It preys on eggs of walleye and other species (including its own), zooplankton, macroinvertebrates, and minnows. The white perch may compete with yellow perch, emerald shiner, and spottail shiner for food resources (Fuller 2003).

The round goby first began appearing in southern Lake Michigan in 1994 (Fuller and Benson 2003). It feeds on the eggs and young of other bottom-dwelling fish species, zebra mussels, snails, soft-shelled crayfish, aquatic insects, and zooplankton. The round goby inhabits a wide variety of habitats, but prefers rock, cobble, or riprap (Manz 1998). It has a long spawning season (e.g., it may spawn up to six times during the breeding season) and aggressively defends its spawning area. It displaces native sculpins and darters, and impacts recreationally important centrarchids (sunfish and bass) and lake trout (Great Lakes Science Center 2003; Marsden and Chotkowski 1995; Manz 1998; Ray and Corkum 1997). However, to date, no lake-wide changes in the abundance of any Lake Michigan biota has been ascribed to the round goby invasion (Madenjian et al. 2002). The ruffe (*Gymnocephalus cernuus*) has also made its way into Lake Michigan. This species also has the potential to disrupt the fish community structure within the Lake through competition or modification of plankton and macroinvertebrate populations (Jude 1995).

Changes in the phytoplankton and zooplankton communities of Lake Michigan may be occurring as a result of contaminants, nutrients, and invasive species such as the spiny water flea and zebra mussel (EPA 2002). For example, phytoplankton abundance and production in nearshore waters of Lake Michigan have been decreasing since 1970, probably due to reduction in phosphorus loadings (Madenjian et al. 2002). Makarewicz et al. (1994) examined trends in phytoplankton abundance in Lake Michigan from 1983 to 1992 (and, to a limited extent, historical trends) and related them to "top-down mediated changes" observed in the fish and zooplankton communities. Bacillariophyta (diatoms) dominated spring samples in all years but one (1989), making up 69 percent to 95 percent of total algal biomass. Depending on the

composition of the zooplankton community, summer phytoplankton samples were dominated by diatoms, Chlorophyta (green algae), Chrysophyta (yellow-green or yellow-brown algae), and Pyrrhophyta (dinoflagellates). The presence of the large-bodied zooplankton (e.g., *Daphnia* spp.) resulted in increasing abundance of colonial and filamentous algae; while low numbers of *Daphnia* spp. were associated with an increasing abundance of small, unicellular phytoplankton. Makarewicz et al. (1994) also noted that large zooplankton (e.g., large cladocerans, calanoid copepods, and cyclopoid copepods) became more abundant in 1983 through 1985 after a sharp decline in the abundance of the planktivorous alewife in 1982 and 1983.

The introduction of the spiny water flea caused a significant decline in three native species of *Daphnia* (Lehman 1991). Another non-native cladoceran, the fishhook water flea (*Cercopagis pengoi*), has also invaded the Great Lakes (WDNR 2004e). These species compete with planktivorous larval fish for food and have been implicated as a factor in the decline of alewives in the following Great Lakes: Erie, Huron, Michigan, and Ontario (Liebig and Benson 2004). Their spiny tails make it difficult for them to be eaten by young fishes (WDNR 2004e). However, they are a food source for larger yellow perch, white perch, walleye, white bass (*Morone chrysops*), alewife, bloater, Chinook salmon, emerald shiner, spottail shiner, rainbow smelt, lake herring, lake whitefish, and deepwater sculpin (Liebig and Benson 2004). Another invasive water flea, *Daphnia lumholtzi*, also has head and tail spines that make it difficult for young fish to consume. This protection can allow it to potentially replace native species of *Daphnia* (WDNR 2003a).

The Lake Michigan substrate in the area of the PBNP site is characterized by coarse, shifting sand and gravel overlying hard clay. The substrate is not favorable for the growth of rooted vegetation (AEC 1972).

The macroinvertebrate community in the PBNP site area was described as "depauperate" due to the substrates being characterized by coarse, shifting sand and gravel overlying hard clay, which limits its suitability for macroinvertebrate colonization. Amphipods (e.g., *Diporeia* spp.), opossum shrimps (i.e., *Mysis relicta*), oligochaetes (aquatic worms), sphaeriids (fingernail clams), and chironomids (midge larvae) dominated the macroinvertebrate community near the PBNP site (AEC 1972; WEPCO 1976). Since the early 1970s, nearshore benthic communities in Lake Michigan have undergone dramatic changes as a result of reductions in nutrient loads (phosphorus) and the establishment of the zebra mussel. Higher nutrient loads in the 1950s and 1960s were associated with higher productivity and densities of amphipods, oligochaetes, and sphaeriids (Nalepa et al. 1998). Lower nutrient loads, the result of changes mandated by the CWA and NPDES programs that reduced point and nonpoint source pollutants in the 1970s and 1980s, produced declines in oligochaetes and sphaeriids throughout southern Lake Michigan.

The zebra mussel, a non-native and invasive species, has had an important effect on Lake Michigan's aquatic communities by consuming zooplankton and phytoplankton, fundamentally altering food webs and displacing native mussels. The first zebra mussel was discovered in Lake Michigan in May 1988, in Indiana Harbor at Gary, Indiana. By 1990, adult zebra mussels had been found at multiple sites in southern Lake Michigan, and by 1992 ranged along the eastern and western shoreline in the southern two-thirds of the Lake, as well as in Green Bay and Grand Traverse Bay (Fleischer et al. 2001). Zebra mussels appeared in the immediate vicinity of PBNP by 1991 (Lee 1991).

Because they are capable of filtering up to 1 L/day (0.3 gpd) per adult (Lei 1993), and are present in high densities (up to several thousand per square meter), zebra mussels remove large numbers of phytoplankton and zooplankton from the water column. As a consequence, water clarity increases, and plankton populations tend to decline precipitously. Secondary impacts can be positive (increased water clarity and increased light transmissivity allow submerged aquatic vegetation to become established in deeper waters) or negative (some species of fish and waterfowl feed heavily on zebra mussels, which bioconcentrate contaminants) (Schloesser et al. 1996).

Zebra mussels displace native clams and mussels by interfering with their feeding, growth, reproduction, and respiration, often directly by attaching to the clam or mussel. Hundreds of zebra mussels may attach to a single large unionid. Because zebra mussels also have a high reproductive potential, they often move (or are carried) into an area and can eliminate native unionid mussels within two to four years (Schloesser et al. 1996). Zebra mussels can also exclude gastropods (snails) and net-spinning caddisflies from hard substrates through competition for food and space (Stewart et al. 1998a). However, they consistently cause increases in the total macroinvertebrate biomass and densities of hydrozoans, flatworms and amphipods on hard benthic substrates because their shells enhance surface area, substrate heterogeneity, and accumulation of benthic organic matter (Horvath et al. 1999; Stewart et al. 1998a).

It is suspected that lakewide population declines of *Diporeia* spp. are linked to the introduction of the zebra mussel, which has severely limited the food available to *Diporeia* spp. (EPA 2002). Declines of *Diporeia* spp. might be the cause of decline in the abundance of lake whitefish and slimy sculpin (Madenjian et al. 2004; Stein et al. 2003) and in the decline in alewife condition (Madenjian et al. 2002). Reduced biomass of phytoplankton, zooplankton, and *Diporeia* spp. caused by zebra mussels may adversely affect rainbow smelt and young salmonids, which in turn would affect predators of these fishes. However, freshwater drum (*Aplodinotus grunniens*), rock bass (*Ambloplites rupestris*), yellow perch, and other benthivorous fish species consume large numbers of gammarid amphipods, crayfish, zebra mussels, and other benthic macroinvertebrates (Stewart et al. 1998a, 1998b).

The zebra mussel presents a potential serious biofouling problem at power plants. They can accumulate on the inside of intake tunnels; intake cribs; and screenhouse walls, floors, trash racks, and out-of-service traveling screens. Zebra mussels are controlled at PBNP by a number of methods: chlorination (e.g., sodium hypochlorite) of the condensers; continuous copper ion injection; and a formulation of the aquatic herbicide endothall (a registered molluscicide known as EVAC). Limitations on these biocides are provided in the WPDES permit (WDNR 2004a). The cooling water system is described in Section 2.1.3.

The amphipod *Echinogammarus ischnus* and the quagga mussel *Dreissena bugensis* (a species similar to the zebra mussel) have recently been reported in Lake Michigan. Both species will likely contribute to further food-web modifications in the Lake. The quagga mussel may further decrease the abundance of *Diporeia* spp. in offshore areas through competition for food resources, while *Echinogammarus ischnus* may become an important food item for many fish species (Nalepa et al. 2001).

Although not technically aquatic organisms, waterfowl are often found in the vicinity of PBNP, especially during their seasonal migrations. During September 1990, carcasses of double-crested cormorants (*Phalacrocorax auritus*) were discovered in the screenwash from the traveling water screens and in the forebay of the plant. The intake structure originally extended 2.4 m (8 ft) above the water surface. Double-crested cormorants are abundant in the area during spring and fall migrations and are attracted to schools of fish in the vicinity of, and within, the intake structure. They would enter the interior of the intake structure to feed, and because they must run along the surface for a substantial distance to become airborne, they were unable to fly out of the intake structure (NMC 2004a). After several failed attempts to reduce or eliminate mortality of cormorants, the intake structure was redesigned in May 2001, and placed below the water surface to eliminate any further mortality (NMC 2004a).

No Federally listed threatened or endangered aquatic species occur in Lake Michigan in the vicinity of PBNP (We Energies 2004b; NMC 2004a). Four state-listed aquatic species potentially occur in Lake Michigan within the PBNP site area or within some of the waterbodies crossed by the transmission lines associated with PBNP. The following provides a discussion of these state-listed aquatic species.

The monkeyface (*Quadrula metanevra*), a freshwater mussel species, is listed as threatened in Wisconsin. It inhabits medium-to-large rivers in gravel or mixed sand and gravel substrates (WDNR 2003c). It has declined due to habitat destruction and water pollution. Locks and dams may have also limited access of host species to the mussel's habitat (WDNR 2003c). Reported hosts include the green sunfish (*Lepomis cyanellus*), bluegill, and sauger (*Stizostedion canadense*) (NatureServe 2004). The monkeyface is known from the Branch River, which is crossed by one of the transmission lines associated with PBNP.

The lake sturgeon (*Acipenser fulvescens*) is listed as a species of special concern in Wisconsin. Wisconsin has one of the largest self-sustaining lake sturgeon populations in the world (WDNR 2003d), with the largest concentration occurring in Green Bay (WDNR 2004b). Two Lake Michigan tributaries, the Manitowoc and Milwaukee rivers, do not currently support remnant lake sturgeon populations, but offer suitable habitat for reproduction. In 2003, stocking of early life stages of lake sturgeon were conducted in these rivers (WDNR 2004b). Since the mid-nineteenth century, exploitation, pollution, habitat degradation, and habitat loss have resulted in substantial declines in the lake sturgeon (Hay-Chmielewski and Whelan 1997; Lake Michigan Technical Committee 2002). The lake sturgeon inhabits low- and moderate-gradient big rivers and lakes. Preferred substrates include firm sand, gravel, or rock. In the Great Lakes, lake sturgeon lives in shoal water (NatureServe 2004). The lake sturgeon may migrate as far as 125 to 400 km (78 to 250 mi) between non-spawning and spawning habitats (NatureServe 2004). Once mature, females spawn only once every four to six years. However, a female can produce 50,000 to 700,000 eggs per spawn and can live to be 80 years old or more. Eggs of lake sturgeon are preyed upon by common carp, suckers, catfish, and other sturgeons (NatureServe 2004). The lake sturgeon preys upon invertebrates such as leeches, snails, small clams, and aquatic insects (NatureServe 2004). In the Wisconsin portion of the Lake Michigan basin, the lake sturgeon occurs in Green Bay, Lake Michigan, the Menominee River upstream to White Rapids Dam, the Fox River upstream to Lake Puckaway, and the Wolf River upstream to Shawano. It is uncommon to rare in the Wisconsin portion of Lake Michigan (WDNR 2003d). A lake sturgeon management plan has been developed for Wisconsin (WDNR 2003d).

The redfin shiner (*Lythrurus umbratilis*) is listed as threatened in Wisconsin. It usually occurs in turbid waters at depths of 10 to 152 cm (4 to 60 in.) over silt, gravel, and rubble substrates in pool areas of low-gradient, medium-sized streams. However, it requires clear water during spawning, which may account for its limited occurrence. They spawn in nests and nesting territories of sunfish species (WDNR 2003e). The redfin shiner schools near the surface and feeds on filamentous algae, macrophytes, and aquatic and terrestrial invertebrates (WDNR 2003e). The redfin shiner is known from the West Twin River watershed, which is crossed by the transmission lines associated with PBNP.

The greater redhorse (*Moxostoma valenciennesi*) is listed as threatened in Wisconsin. It inhabits medium- to large-sized rivers, reservoirs, and large lakes at depths <1 m (3 ft) (WDNR 2003f). The greater redhorse prefers clear water with substrates of clean sand, gravel, or boulders. Spawning beds consist of gravel with mixtures of sand and rubble in moderate to swift currents. The range and abundance of the greater redhorse have declined due to siltation, pollution, and other habitat degradation (NatureServe 2004). The eggs of the greater redhorse are preyed upon by yellow perch and American eels (*Anguilla rostrata*) (NatureServe 2004). Molluscs, aquatic insects, and crustaceans are its main diet, although it also consumes some plant material (NatureServe 2004). However, its presence is now known

to be more common than previously thought in Wisconsin, accounting for its change in status from state-endangered to state-threatened (WDNR 2003f). The greater redhorse occurs in some of the streams and rivers crossed by the PBNP transmission lines (e.g., Branch River, Neshota River, East Twin River, and West Twin River; NMC 2004a).

### 2.2.6 Terrestrial Resources

The PBNP site is located on 510 ha (1260 ac) on the western shore of Lake Michigan (NMC 2004a). The site and surrounding area consist primarily of agricultural land and forest. Approximately 42 ha (104 ac) of the property are devoted to industrial use. The site consists of land leased for farming and woodlots up to 19 ha (47 ac) in size. The woodlots occupy a total of about 40 ha (100 ac), making up about 9 percent of the PBNP property. The plant communities forming the overstory include a variety of trees such as quaking aspen (*Populus tremuloides*), American beech (*Fagus grandifolia*), Canadian hemlock (*Tsuga canadensis*), and maple (*Acer* spp.) (AEC 1972). The woodlots are maintained in a natural state and provide food, cover, and nesting sites for a variety of wildlife.

The terrestrial wildlife that occurs at PBNP and surrounding areas is typical of that found in similar habitats throughout Wisconsin (AEC 1972). Common mammals include white-tailed deer (*Odocoileus virginianus*), eastern cottontail rabbit (*Sylvilagus floridanus*), northern raccoon (*Procyon lotor*), gray fox (*Urocyon cinereoargenteus*), eastern gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), and masked shrew (*Sorex cinereus*). Upland birds that occur on the property include ring-necked pheasant (*Phasianus colchicus*), wild turkey (*Meleagris gallopavo*), American goldfinch (*Carduelis tristis*), eastern bluebird (*Sialia sialia*), blue jay (*Cyanocitta cristata*), and eastern meadowlark (*Sturnella magna*). Several waterfowl also occur there, including the Canada goose (*Branta canadensis*), the wood duck (*Aix sponsa*), and the double-crested cormorant (*Phalacrocorax auritus*). Additionally, the site is occupied by several common amphibians and reptiles such as the tiger salamander (*Ambystoma tigrinum*), northern leopard frog (*Rana pipiens*), American toad (*Bufo americanus*), and the painted turtle (*Chrysemys picta*).

The PBNP property contains about 3 km (2 mi) of Lake Michigan shoreline. The shoreline consists of mostly narrow, bare beaches ranging from 6 to 15 m (20 to 50 ft) wide that extend from the water's edge to low bluffs created by years of erosion. Riprap has been placed along the edges of the bluffs to reduce erosion, which had been occurring at the rate of 0.8 m to 1.5 m (2.5 ft to 5 ft) per year (AEC 1972). The shoreline on the PBNP property does not contain any sand dunes. NMC protects species that require beach habitat by restricting unauthorized public access to the Lake Michigan beach area of the PBNP site with a line of boulders at the north and south boundaries, buoy markers off the shoreline to mark restricted

waters, and 24-hour surveillance by security personnel (We Energies 2004b). Additional protections have been implemented for the Federally endangered piping plover (*Charadrius melodus*) (We Energies 2004d).

No Federally or State-listed threatened or endangered species of terrestrial wildlife are known to occur at the PBNP site or associated transmission line ROWs (NMC 2004a; We Energies 2004b). Three Federally listed threatened or endangered species have been recorded in Manitowoc County: the bald eagle (*Haliaeetus leucocephalus*), piping plover, and dune (or Pitcher's) thistle (*Cirsium pitcheri*) (WDNR 2004f). The dwarf lake iris (*Iris lacustris*), also a Federally listed species, has been recorded in Brown County, through which a portion of the L-151 transmission line ROW traverses. Table 2-2 presents those Federally and State-listed species that have been recorded in Brown and Manitowoc counties and could potentially occur on the PBNP site or transmission line ROWs if suitable habitat were available.

**Table 2-2.** Terrestrial Species Listed by the FWS as Endangered or Threatened that Could Potentially Occur within the PBNP Site or the Associated Transmission Line ROWs

| Scientific Name | Common Name | Federal Status[a] | State Status[a] |
|---|---|---|---|
| **Birds** | | | |
| *Haliaeetus leucocephalus* | bald eagle | T | S |
| *Charadrius melodus* | piping plover | E | E |
| **Plants** | | | |
| *Cirsium pitcheri* | dune (or Pitcher's) thistle | T | T |
| *Iris lacustris* | dwarf lake iris | T | T |

(a) E = endangered, T = threatened, S = Wisconsin species of special concern.
Sources: WDNR 2004f, 2004g, 2004h, 2004i, 2004j

The bald eagle is Federally listed as threatened in the lower 48 states (FWS 2004b). This species is a large raptor that is found along the coastline around lakes and rivers. Eagles generally nest in tall trees or on cliff faces near water and away from human disturbance. No bald eagle nesting occurs on the PBNP site, and no bald eagles have been observed to forage in the vicinity of the plant (We Energies 2004b). The transmission lines associated with PBNP extend for the most part to the west, away from Lake Michigan and bald eagle foraging habitat.

The piping plover is Federally listed as endangered in the Great Lakes region. Great Lakes piping plovers breed along sparsely vegetated beaches, cobble pans, and sand spits along the shoreline. The FWS defines their essential breeding habitat as greater than 7 m (23 ft) wide beach, greater than 0.4 km (0.25 mi) of shoreline length, dune area of 1.95 ha (4.82 ac),

patches of cobble or debris cover, and areas of beach with up to 50 percent of vegetation cover (FWS 2003). The nearest stretch of shoreline that is designated as critical breeding habitat is at Point Beach State Forest, approximately 5 km (3 mi) to the south, where about 13 km (8 mi) of shoreline have been designated as suitable, although no records of breeding at that location exist (FWS 2001). Portions of the shoreline managed by PBNP also appear to be suitable nesting habitat (We Energies 2004d). In October 2004, We Energies commissioned a habitat study of the shoreline. The study showed that the habitat, although not optimal, could support piping plover nesting (We Energies 2004d). The only breeding plovers known within Wisconsin in recent years have been along the shores of Lake Superior (WDNR 2004g).

The dune (or Pitcher's) thistle is Federally listed as threatened over its entire range (FWS 2004b). The preferred site for the dune (or Pitcher's) thistle is an area between a sandy beach and a fully vegetated dune next to the shorelines of the Great Lakes (WDNR 2004b). The primary threats to the species are disturbance through recreational activities (all terrain vehicle use, trampling, etc.) and overstory encroachment (NatureServe 2004). No suitable habitat for this species has been identified at the PBNP site or along associated transmission line ROWs.

The dwarf lake iris is Federally listed as threatened over its entire range (FWS 2004b). The dwarf lake iris is endemic to the northern shores of Lake Michigan and Lake Huron. This species is found in association with the Niagara Escarpment, a limestone formation that extends from the Door Peninsula to the north of PBNP through Michigan and Ontario to New York. In Wisconsin, the dwarf lake iris is found on the northwestern shore of Lake Michigan and the eastern shore of Green Bay in Brown and Door counties (WDNR 2004b). The primary threat to this species is habitat degradation due to overstory encroachment (NatureServe 2004). This species apparently thrives with frequent natural disturbance, does not appear to be detrimentally impacted by human disturbance, and is reported to do well in old field conditions (NatureServe 2004). The dwarf lake iris has not been recorded at the PBNP site or along associated transmission line ROWs.

The only terrestrial State-listed threatened or endangered species believed to occur in the vicinity of PBNP transmission lines is the snow trillium (*Trillium nivale*) (WDNR 2004j, 2004k). Populations are known to occur in mesic forests in the Kriwanek Creek drainage, which is crossed by line L-121, and the Devil's Creek drainage, which is crossed by line L-151. However, this species is not recorded as occurring in these transmission line ROWs.

### 2.2.7 Radiological Impacts

NMC conducts a radiological environmental monitoring program in and around the PBNP site. An environmental monitoring program was initiated before plant operations began in 1970. Through this program, radiological impacts to employees, the public, and the environment are monitored, documented, and compared to the appropriate standards. Results are published annually. The objectives of the radiological environmental monitoring program are the following:

- Provide representative measurements of radiation and radioactive materials in the exposure pathways and of the radionuclides that have the highest potential for radiation exposures to members of the public.

- Supplement the radiological effluent monitoring program by verifying that measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of effluent measurements and the modeling of the environmental exposure pathways.

Radiological releases are summarized in the Annual Monitoring Reports (e.g., NMC 2004c). The limits for all radiological releases are specified in the PBNP ODCM (NMC 2003b); these limits are designed to meet Federal standards and requirements.

Because land in the area is used primarily for farming and dairy operations, environmental components, such as soil and vegetation, are sampled to detect changes in radiological conditions at the base of the terrestrial food chain for animals. Because dairy farming is a major industry in the area, milk produced in the area is also sampled. Air particulate samples and thermoluminescent dosimeters at various locations provide the means to detect significant changes in environmental radioactivity that would result from plant releases to the atmosphere.

Locations for terrestrial radiological sampling emphasize monitoring around the site boundary and at various other points out to a distance of approximately 8 km (5 mi). A single sampling location well beyond a distance of approximately 16 km (10 mi) is used to provide an estimate of background levels.

Aquatic samples, such as lakewater, algae, and shoreline sediment, are collected from Lake Michigan locations both north and south of the wastewater discharge point and analyzed for radioactivity.

For 2003, NMC assessed doses to the maximally exposed individual from gaseous and liquid effluents at several locations based on actual liquid and gaseous effluent release data. In all cases, doses were well below the 25 mrem/yr limit as defined in the ODCM and the EPA

radiation standards in 40 CFR Part 190 (NMC 2003b). A breakdown of the calculated maximum dose to an individual located at the site boundary from liquid and gaseous effluents released during 2003 is summarized as follows:

- The total body dose from liquid effluents at the site discharge was $8 \times 10^{-5}$ mSv (0.008 mrem), which is about 0.14 percent of the 0.06 mSv (6 mrem) dose design objective specified in 10 CFR Part 50, Appendix I. The critical organ dose due to the liquid effluents at the site discharge was $8 \times 10^{-5}$ mSv (0.008 mrem). This dose was about 0.04 percent of the 0.20 mSv (20 mrem) dose design objective (NMC 2004c).

- The air dose from noble gases in gaseous effluents was $3.45 \times 10^{-6}$ mGy ($3.45 \times 10^{-4}$ mrad) gamma, which is 0.002 percent of the 0.2 mGy (20 mrad) gamma dose design objective, and $1.27 \times 10^{-6}$ mGy ($1.27 \times 10^{-4}$ mrad) beta, which is 0.03 percent of the 0.4 mGy (40 mrad) beta dose design objective (NMC 2004c).

- The critical organ dose from gaseous effluents due to iodine-131, iodine-133, tritium, and particulates with half-lives greater than 8 days was $3.12 \times 10^{-4}$ mSv (0.03 mrem), which is 0.1 percent of the 0.3 mSv (30 mrem) dose design objective (NMC 2004c).

Absent a change in licensed power levels, NMC does not anticipate any increase in radiological impacts during the license renewal period.

### 2.2.8 Socioeconomic Factors

The staff reviewed the ER (NMC 2004a) and information obtained from county, city, school district, and local economic development staff. The following sections describe the housing market, public services, offsite land use, visual aesthetics and noise, demography, and economy in the region surrounding the PBNP site.

#### 2.2.8.1 Housing

NMC employs a nuclear related permanent workforce of approximately 740 employees and an additional 231 contract employees at PBNP. Approximately 81 percent of the employees live in Manitowoc County. The remaining 19 percent are distributed across 12 counties, with numbers ranging from 1 to 73 employees per county (NMC 2004a). Given the predominance of employees living in Manitowoc County, and the absence of the likelihood of significant socioeconomic effects in other counties, the focus of this analysis is Manitowoc County, particularly the City of Manitowoc, the City of Two Rivers, the Town of Two Creeks, and the Village of Mishicot (79 percent of the PBNP employees live in these municipalities).

The PBNP reactors are each on a nominal 18-month refueling cycle. During refueling outages, nuclear related site employment increases above the 740 permanent workforce by approximately 300 workers for temporary duty (30 to 40 days) (NMC 2004a). Most of these temporary contractor employees are assumed to be located in the same geographic areas as the permanent PBNP staff. These workforce numbers are within the GEIS estimated range of 200 to 900 additional workers per reactor outage.

Table 2-3 shows an overview of occupied and unoccupied housing units available in Mishicot, Two Creeks, Manitowoc, Two Rivers, and Manitowoc County for 1990 and 2000, the last year for which data are available. The County as a whole had a vacancy rate slightly greater than 5 percent. The vacancy rates in specific communities varied from 5 to 9 percent and showed similar trends from 1990 to 2000.

**Table 2-3.** Housing Units and Occupied Housing Units for Manitowoc County and Municipalities during 1990 and 2000

| | Total Units | | Occupied Units | | Percent of Units Occupied | |
|---|---|---|---|---|---|---|
| | 1990 | 2000 | 1990 | 2000 | 1990 | 2000 |
| Mishicot | 503 | 614 | 488 | 582 | 97.02 | 94.79 |
| Two Creeks | 164 | 202 | 148 | 184 | 90.24 | 91.09 |
| Manitowoc (City) | 13,729 | 15,007 | 13,145 | 14,235 | 95.75 | 94.86 |
| Two Rivers | 5414 | 5547 | 5164 | 5221 | 95.38 | 94.12 |
| Manitowoc County | 31,843 | 34,651 | 30,112 | 32,721 | 94.56 | 94.43 |

Source: Wisconsin Department of Administration (WDA) 2004a

### 2.2.8.2 Public Services

- **Water Supply**

Within Manitowoc County, municipal water is largely supplied by municipal or village water utilities. PBNP is not connected to a local utility and pumps groundwater for its own use. The primary municipal water suppliers in Manitowoc County are listed in Table 2-4 along with their average daily output and maximum capacities.

The total daily use shown here is 10.6 million gpd for the entire County. This closely agrees with U.S. Geological Survey (USGS) estimates of 10.44 million gpd of surface-water use and 1.05 million gpd groundwater use for Manitowoc County (USGS 2002).

**Table 2-4.** Manitowoc County Public Water Suppliers and Capacities

| Water Supplier | Average Daily Use (gpd) | Maximum Daily Capacity (gpd) |
|---|---|---|
| Cleveland Waterworks | 120,000 | 1,150,000 |
| Kellnersville Waterworks | 320,000 | 500,000 |
| Kiel Waterworks | 415,000 | 2,660,000 |
| Manitowoc Waterworks | 8,000,000 | 11,000,000 |
| Maribel Waterworks | 25,000 | 720,000 |
| Mishicot Waterworks | 150,000 | 1,200,000 |
| Reedsville Waterworks | 45,000 | 1,000,000 |
| St. Nazianz Waterworks | 60,000 | 1,000,000 |
| Two Rivers Waterworks | 1,300,000 | 4,000,000 |
| Valders Waterworks | 120,000 | 1,440,000 |
| Whitelaw Waterworks | 55,000 | 720,000 |
| **Total** | **10,610,000** | **25,390,000** |

Source: NMC 2004a

- **Education**

In 2000, approximately 14,369 students attended schools in the districts located near the PBNP site. The region's school districts do not track the number of PBNP employees' children enrolled. Table 2-5 shows the total enrollment for students in the PBNP vicinity.

**Table 2-5.** School District Enrollment in Communities near PBNP

| District | Pre-Kindergarten | Grades K–6 | Grades 7–12 |
|---|---|---|---|
| Manitowoc | 2285 | 3670 | 3695 |
| Mishicot | 360 | 705 | 69 |
| Two Rivers | 755 | 1470 | 1360 |

- **Transportation**

The region within an 80-km (50-mi) radius of PBNP is served by Interstate 43, which runs north-south near the lake front in southern Manitowoc County. At the City of Manitowoc, Interstate 43 turns inland to Green Bay. The region is also served by Canadian National rail

lines connecting to Neenah to the west and Milwaukee to the south. A rail line runs part of the way from Manitowoc to Green Bay. The Manitowoc County airport is located on the northern edge of the City of Manitowoc.

State Route 42 runs north-south from Two Rivers to Kewaunee and passes about 1.6 km (1 mi) to the west of PBNP. It is used by most employees coming from Two Rivers, Manitowoc, or Mishicot to access the plant. From Mishicot, employees reach State Route 42 via County Road V. Employees access the plant by turning east off State Route 42 onto Nuclear Road and traveling approximately 2.4 km (1.5 mi) to the plant entrance (Figure 2-2).

Traffic counts for State Route 42 and County Road V are shown in Table 2-6. The State does not make level of service determinations in rural nonmetropolitan areas unless it has been deemed necessary. The Wisconsin Department of Transportation (WDOT) has not calculated level of service determinations for either of the roads listed (WDOT 2002).

**Table 2-6.** *Traffic Counts for State Route 42 and County Road V*

| Route No. | Location | AADT |
|---|---|---|
| State Route 42 | North of County Road V | 3800 |
| | South of County Road V | 3700 |
| County Road V | East of State Route 42 | 330 |
| | West of State Route 42 | 1200 |

AADT = Annual average daily traffic volumes for 2002.
Source: WDOT 2002

### 2.2.8.3 Offsite Land Use

PBNP is situated in northern Manitowoc County close to the Kewaunee County line. Both of these counties are on the western shore of Lake Michigan, and both are largely rural with a heavy dependence upon agriculture. Manitowoc County maintains information on land use, which is derived from aerial photographs and periodically updated.

Land use in Manitowoc County is predominantly agricultural; approximately 58 percent of its land area is devoted to agriculture. Of the remainder, much of the land is undeveloped woodland, wetland, or land not used for crops; only 7 percent is classified as urban or developed (Table 2-7). The approximately 1400 farms within the County cover a total of $1.05 \times 10^5$ ha ($2.6 \times 10^5$ ac), averaging 75 ha (186 ac) per farm. Of the 1400 farms, approximately 375 are dairy farms with 45,300 cows. Manitowoc County ranks 5th in Wisconsin and 27th in the United States in milk production. Other crops in the County include alfalfa

(26,000 ha [64,200 ac]), corn (24,700 ha [61,000 ac]), oats (3035 ha [7500 ac]), barley (4450 ha [11,000 ac]), soybeans (8500 ha [21,000 ac]), and snap beans (1950 ha [4800 ac]). Total farm and farm-related employment accounts for approximately 20 percent of the total County employment (University of Wisconsin 2004a).

**Table 2-7.** Land Use in Manitowoc County, 1999

| Land Use | Hectares | Acres | Percent of Total |
|---|---|---|---|
| Agriculture | 89,416 | 220,953 | 58.0 |
| Buildings | 10,617 | 26,235 | 6.9 |
| Non-Cropland | 15,088 | 37,284 | 9.8 |
| Non-Metallic Mining | 684 | 1690 | 0.4 |
| Roads | 3412 | 8432 | 2.2 |
| Surface Water | 1750 | 4326 | 1.1 |
| Wetlands | 376 | 930 | 0.3 |
| Woodlands | 32,921 | 81,352 | 21.3 |
| **Total** | **154,264** | **381,202** | **100.0** |

Source: Yanda 2004

Kewaunee County is also heavily dependent on agriculture. Of the approximately $88 million generated from agriculture sales in Kewaunee County in 2002, approximately $67 million was generated from dairy farms (University of Wisconsin 2004b). There are around 970 farms in Manitowoc County, of which 318 are dairy farms. The average size of a farm is approximately 73 ha (181 ac). Other agricultural crops include corn, alfalfa, soybeans, small grains, and vegetables. Approximately 2300 jobs are related to agriculture, which represents approximately 20 percent of the Manitowoc County total (University of Wisconsin 2004a).

A few industrial areas are located south of the PBNP site in the towns of Two Rivers and Manitowoc and to the west in the Fox River Valley. KNPP is the nearest industrial site, located approximately 8 km (5 mi) north of PBNP. KNPP is a single unit 535-MW(e) pressurized water reactor located on approximately 367 ha (908 ac).

The Point Beach State Forest is located approximately 4.8 km (3 mi) south of the PBNP site and offers fishing, boating, hiking, camping, and picnicking. The Rahr Memorial School Forest is located 1.6 km (1 mi) south of the plant and offers a wide range of educational and outdoor activities. Two Creeks Town Park is located north of the PBNP site and also provides some

lakeside recreation. The Two Creeks Buried Forest unit of the Ice Age National Scientific Reserve is located approximately 3.2 km (2 mi) north of the plant. This reserve is affiliated with the National Park Service and provides public access to remnants of a buried forest.

In an effort to decrease urban sprawl, the State established a statute outlining the development of farmland preservation areas. The MCPPC prepared the *Manitowoc County Farmland Preservation Plan* in 1981 (currently undergoing revision) to provide guidance to the communities within the County in their efforts to guide future growth and protect valuable farmlands (MCPPC 1981). This plan qualifies lands designated as "restrictive agriculture" for tax credits and makes it difficult to change the zoning of the land from agriculture to another designation.

There are 18 towns in Manitowoc County. Land-use planning and city growth are managed at the town or city level and not at the regional or county level. Many of the communities use zoning to direct the extent and nature of growth. Zoning has remained relatively unchanged since the preparation of the *Manitowoc County Farmland Preservation Plan.* The area around the PBNP site has remained zoned for agriculture, and no significant industrial, business, or residential development has occurred near the site boundaries.

#### 2.2.8.4 Visual Aesthetics and Noise

PBNP is located in Manitowoc County on the western shore of Lake Michigan. The local terrain is gently rolling to flat, with elevations varying from 1.5 to 18 m (5 to 60 ft) above the normal level of Lake Michigan. The land surface slopes gradually toward the Lake from higher glacial moraine areas west of the site. However, higher ground adjacent to the Lake diverts the drainage to the north and south.

The site occupies an area of approximately 510 ha (1260 ac), all owned by WEPCO. Structures and parking lots occupy approximately 28 ha (70 ac). Of the balance, approximately 425 ha (1050 ac) are divided among nine leases and used for agriculture. The crops grown on the leased land are primarily grain crops and include corn, soybeans, and wheat. The remainder of the site consists of woods, wetlands, and open space. The site includes approximately 3.2 km (2 mi) of shoreline on Lake Michigan (NMC 2004a).

Structures at PBNP include two reactor containment buildings; associated auxiliary, service, turbine, and office buildings; a switchyard; a pump house; and cooling-water intake and discharge structures. The largest of the structures (the reactor containment buildings) are approximately 19 m (63 ft) high. The plant is visible from State Highway 42 for several miles in either direction but is not a prominent feature to the residents of the Town of Two Creeks.

From the Lake, the plant is visible for many miles to the north and south, as is KNPP located 8 km (5 mi) to the north. The PBNP reactor containment structures are encased in vinyl coated steel buildings that are colored to blend with the green and brown Wisconsin countryside (AEC 1972).

The PBNP transmission line ROWs occupy approximately 1344 ha (3321 ac) (NRC 1996) and run through rural, agricultural land. From PBNP, three of the transmission lines run east-west and connect the plant to the existing State power grid. The fourth line connects PBNP to KNPP 8 km (5 mi) to the north. While the transmission line towers are typically at or slightly above the level of the wooded areas, which helps obscure them from populated areas, they are very visible in open and agricultural areas. In a few locations, the towers are visible to the residents of Two Creeks. The transmission lines in open areas are visible for several miles from roadways and for a much shorter distance when the ROWs run through wooded areas.

Noise from operations at the PBNP site is barely noticeable, except very close to the reactor containment buildings. While some noise may reach the leased lands which are located within the site boundary, no noise from normal plant operations reaches the residential areas around the Town of Two Creeks.

### 2.2.8.5 Demography

In 2000, the population of Wisconsin was approximately 5.36 million (U.S. Census Bureau [USCB] 2004). Table 2-8 shows the population for Manitowoc County and selected municipalities. From 1990 to 2000, Wisconsin had an average annual growth rate of approximately 1.0 percent. The average annual growth rate of Manitowoc County during the same period was 0.3 percent (USCB 2004). Wisconsin and Manitowoc County are both projected to grow relatively slowly over the next 30 years. (As shown in Table 2-9, a projected average annual growth rate for Wisconsin as a whole of 0.6 percent, versus 0.3 percent for Manitowoc County.)

**Table 2-8.** Population of Manitowoc County and Selected Municipalities

| | Total Population | | | |
|---|---|---|---|---|
| **Municipality or County** | **1970** | **1980** | **1990** | **2000** |
| Two Creeks | 580 | 489 | 466 | 551 |
| Mishicot | 938 | 1503 | 1296 | 1422 |
| Manitowoc (City) | 33,430 | 32,547 | 32,521 | 34,053 |
| Two Rivers | 13,732 | 13,354 | 13,030 | 12,639 |
| Manitowoc County | 82,294 | 82,918 | 80,421 | 82,887 |

Source: WDA 2004b

**Table 2-9.** Population Projections for Wisconsin and Manitowoc County

| Year | Wisconsin [a] | Manitowoc County [b] |
|---|---|---|
| 2000 | 5,363,715 | 82,893 |
| 2005 | 5,563,896 | 84,574 |
| 2010 | 5,751,470 | 86,307 |
| 2015 | 5,931,386 | 88,055 |
| 2020 | 6,110,878 | 89,860 |
| 2025 | 6,274,867 | 90,821 |
| 2030 | 6,415,923 | 91,327 |

(a) Based on 0.6 percent annual growth (WDA 2004c)
(b) Based on 0.3 percent annual growth (WDA 2004d)

- **Transient Population**

There is little transient population for agriculture in the vicinity of PBNP. Almost all of the laborers on farms in the area are believed to be residents in the area. Seasonal migrant labor plays little or no role in field agriculture in the PBNP region.

- **Agricultural Labor**

Although this is an agricultural region, agriculture employs a relatively small fraction of the workforce in the communities near PBNP and within Manitowoc County, as shown in Table 2-10.

### 2.2.8.6 Economy

Although much of the land use in the region is agricultural, only a very small portion of the population is actually employed in agricultural occupations, as shown in Table 2-10. The majority of the population is employed in production, managerial, and office occupations.

**Table 2-10.** Occupations in Nearby Municipalities and Manitowoc County

| Occupations | Mishicot | Manitowoc (City) | Two Rivers | Manitowoc County |
|---|---|---|---|---|
| Management, Professional, and Related Occupations | 182 | 4011 | 1357 | 10,448 |
| Service Occupations | 133 | 2639 | 862 | 5793 |
| Sales and Office Occupations | 146 | 3866 | 1194 | 8880 |
| Farming, Fishing, and Forestry Occupations | 10 | 96 | 36 | 820 |
| Construction, Extraction, and Maintenance Occupations | 80 | 1450 | 549 | 4264 |
| Production, Transportation, and Material Moving Occupations | 191 | 4640 | 2271 | 12,748 |

Source: WDA 2004e

Within Manitowoc County, the median household income is $43,286 per year (USCB 2000). During the first six months of 2004, the unemployment rate ranged between 6.7 and 9.8 percent (Table 2-11). For comparison, the unemployment rate for Wisconsin ranged from 4.8 to 6.5 percent during the same period (Wisconsin Department of Workforce Development [WDWD] 2004).

**Table 2-11.** Unemployment Rates for Manitowoc County in 2004

| | Employed | Unemployed | Unemployment Rate |
|---|---|---|---|
| January | 43,955 | 4000 | 9.1 |
| February | 44,051 | 4302 | 9.8 |
| March | 43,969 | 4093 | 9.3 |
| April | 43,568 | 3206 | 7.4 |
| May | 43,723 | 2936 | 6.7 |
| June | 44,680 | 3065 | 6.9 |

Source: WDWD 2004

In Wisconsin, public utilities are exempt from local property taxation and, instead, are taxed by the State. Public utilities pay gross revenue taxes to the State in lieu of property taxes. Gross revenue taxes paid by utilities become part of the State's general purpose revenue, which goes to fund the Wisconsin Shared Revenue Program, which provides the largest aid payment for municipalities and is an important source of revenue for counties.

The shared revenue program has several separate payment types, including a utility payment. Only shared revenue utility payments are distributed to counties and municipalities based on the presence of an electric utility facility. The other payments are distributed based on a formula that is independent of utility valuation or location (Wisconsin Department of Revenue [WDR] 2003a). The utility payment consists of three components: net book value, spent nuclear fuel storage, and the minimum payment (WDR 2003a). The minimum payment component does not apply to PBNP. The formulas and rules controlling the net book value and spent nuclear fuel storage components are slightly different for counties and municipalities. The rules for counties are the following:

> Utility. The utility payment consists of three components: (a) A payment based on the net book value of qualifying property of electric and gas utilities. For property in towns, the county received 6 mills on the net book value. For property in villages or cities, the county received 3 mills. The total value of qualifying property for payment purposes in a municipality (the basis on which county payments are calculated) may not exceed $125 million per utility company or for a jointly owned power plant. Payments could also not exceed $100 per capita. (b) A payment of $50,000 to counties in which spent nuclear fuel was stored. (c) If a county had a generating plant having a rated capacity of 200 megawatts or more, the payment could not be less than $75,000 (WDR 2003a).

The rules for municipalities are the following:

> Utility. The utility payment consisted of three components: (a) A payment based on the net book value (original cost less depreciation) of qualifying property (production plants, substations, and general structures, excluding land) of electric and gas utilities. For property in towns, the town received 3 mills on the net book value. For property in villages or cities, the village or city received 6 mills. The total value of qualifying property for payment purposes in a municipality could not exceed $125 million per utility company or for a jointly owned power plant. Payments could also not exceed $300 per capita. (b) A payment of $50,000 to municipalities in which spent nuclear fuel was stored. If the nuclear fuel storage facility was located within one mile of another municipality, the municipality where the fuel was stored received $40,000 and the nearby municipality received $10,000. (c) If a municipality had a generating plant having a rated capacity of 200 megawatts or more, the payment could not be less than $75,000.

Note that the shared revenue formula changed to a megawatt based payment for plants put into operation or repowered after January 1, 2004. However, this does not apply to PBNP.
The Town of Two Creeks and Manitowoc County are the recipients of the shared revenue utility payments attributable to PBNP. Tables 2-12 and 2-13 list the total tax revenues of the Town of Two Creeks and Manitowoc County and the shared revenue utility payments from the State. As is presented in the tables, the shared revenue utility payments attributable to PBNP represent approximately 14 to 20 percent (excluding the 1999 payment) of the tax revenues of Two Creeks. The shared revenue utility payments attributable to PBNP represent approximately 1.4 to 2.0 percent of the total tax revenues of Manitowoc County.

**Table 2-12.** Total Tax Revenues and Shared Revenue Utility Payments for the Town of Two Creeks

| Year | Total Tax Revenues[a, b, c] | Shared Revenue Utility Payment on behalf of PBNP[d] | Percent of Total Tax Revenues |
|---|---|---|---|
| 1996 | $982,600[a] | $190,100 | 19.3 |
| 1997 | $1,026,300 | $191,900 | 18.7 |
| 1998 | $937,200 | $193,400 | 20.1 |
| 1999 | $270,500[e] | $194,600 | 72.0 |
| 2000 | $1,420,800 | $194,600 | 13.7 |
| 2001 | $881,800 | $216,500 | 24.5 |
| 2002 | $933,100 | $217,100 | 23.3 |

(a) Data for 1996 through 2000 from NMC 2004a
(b) Data for 2001 from WDR 2003b
(c) Data for 2002 from WDR 2004
(d) Calculated based on WDR 2003a
(e) The Town of Two Creeks' 1999 interest income was negative due to market fluctuations.

**Table 2-13.** Total Tax Revenues and Shared Revenue Utility Payments for Manitowoc County

| Year | Total Tax Revenues[a, b, c] | Shared Revenue Utility Payment on behalf of PBNP[d] | Percent of Total Tax Revenues |
|---|---|---|---|
| 1996 | $40,129,000 | $800,000 | 2.0 |
| 1997 | $41,556,900 | $800,000 | 1.9 |
| 1998 | $47,112,400 | $800,000 | 1.7 |
| 1999 | $51,694,700 | $800,000 | 1.5 |
| 2000 | $55,931,600 | $800,000 | 1.4 |
| 2001 | $67,044,000 | $800,000 | 1.2 |
| 2002 | $57,966,000 | $800,000 | 1.4 |

(a) Data for 1996 through 2000 from NMC 2004a
(b) Data for 2001 from WDR 2003b
(c) Data for 2002 from WDR 2004
(d) Calculated based on WDR 2003a

## 2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at the PBNP site and the surrounding area.

### 2.2.9.1 Cultural Background

Wisconsin was last glaciated beginning about 25,000 years ago. The glaciers reached their greatest extent 14,000 to 16,000 years ago, and the last glacial advance (the Two Rivers, or Valderan) dates to about 12,400 years ago. The topography of Wisconsin is strongly influenced by glacial and postglacial geological deposits. These landforms affected the pattern of human use and settlement. Until about 12,000 to 14,000 years ago, all of northern and eastern Wisconsin was buried by ice sheets. By about 12,000 years ago, the glaciers had retreated and exposed most of the current area of Wisconsin. The western shore of postglacial Lake Michigan, however, continued to expand and retreat for the next several thousand years (Illinois State Museum 2004) in a complex manner dictated by impoundment of water against the retreating ice, new outlets opening up as the ice retreated, and a rebounding of the land surface (isostatic uplift) as the weight of the glacial ice was removed.

- **Native American Prehistory**

The distribution of Paleo-Indian remains, the earliest known prehistoric tradition, in Wisconsin correlates with the last stages of glacial activity and the fluctuating lake levels (R. Mason 1997). Paleo-Indians are believed to have exploited newly opened postglacial environments and to have been organized in small mobile hunting societies (R. Mason 1997). In general, early Paleo-Indian groups appear to have been more numerous in southern Wisconsin than in the north where glacial conditions persisted longer (R. Mason 1997). Paleo-Indian groups hunted large, now extinct megafauna, such as mastodon, mammoth, and caribou, that lived on the lush vegetation that colonized postglacial soils (R. Mason 1997). By the later Paleo-Indian period, the levels of the Great Lakes may have been significantly lower than present. Paleo-Indian sites of this period may now be submerged several hundred feet below the current surface (R. Mason 1997). The later Paleo-Indian sites, while retaining a basic hunting orientation, used woodworking tools that reflect the increasing forestation of the previously glaciated land. Late Paleo-Indian sites are widespread and continue to reflect small mobile populations. Instead of megafauna, the species hunted during the later period included deer, caribou, bison, turtle, beaver, and other small mammals (R. Mason 1997).

With the onset of warmer climatic conditions, a further shift in subsistence patterns becomes obvious. Beginning sometime between 10,000 and 7500 years ago, Archaic Tradition populations consisting of small groups of hunters and gatherers living in caves, rock shelters, along rivers, and around lakes and wetlands, replaced the older Paleo-Indian Tradition. Archaic peoples may have been direct descendants of Paleo-Indians or may represent a migration of people from the south (Stoltman 1997). These hunter-gatherers subsisted on fish, wild plants, nuts, acorns, and modern game animals such as elk and deer (Stoltman 1997). Settlement appears to have been sparse; small mobile groups, relying on diverse hunting and gathering subsistence, seem to have been the typical pattern (Stoltman 1997). At least one extensive Archaic local Wisconsin quarry site is known; however, stone tool materials from neighboring Illinois are also found at Archaic sites (Stoltman 1997). By about 4000 to 6000 B.C., Archaic sites were more widely distributed throughout Wisconsin. Drier, warmer conditions with a rise in herbaceous species characterize this period. Archaic tool assemblages expand to include fishing gear, ground stone plant processing tools, axes, and copper tools (Stoltman 1997). Copper artifacts (such as harpoons, axes, adzes, chisels, knives, and drills) are widely found in eastern Wisconsin and in Manitowoc County (Stoltman 1997). Beginning about 2500 years ago, the Woodland Tradition replaced the Archaic Tradition across most of Wisconsin (Stoltman 1997).

The Red Ochre Complex, an elaborate ceremonial burial complex distributed widely across the Midwest and the Great Lakes areas, serves as a marker of the transition between the preceding Archaic Tradition and the subsequent Woodland Tradition. Because information about the complex is largely limited to burial sites, its connections to the Archaic and Woodland

Traditions remains uncertain (Stevenson et al. 1997). Use of copper for ornaments increased; evidence of fishing and wild rice harvesting exists. Toward the end of the Red Ochre period, mounds and Woodland pottery are found in association with the sites (Stevenson et al. 1997).

By about 2500 years ago, the presence of pottery marks the beginning of early Woodland Tradition in Wisconsin. Typically, the Woodland Tradition is characterized by a transition from subsistence based on hunting and gathering to one based more heavily on horticulture. Use of bows and arrows and pottery and construction of effigy mounds, many of which were in the form of animals and humans, are hallmarks of the Woodland Tradition. As the Woodland Tradition developed, cultivation became more prominent in the economy, and increasingly settled village sites became more common (Stevenson et al. 1997).

The middle Woodland occupation (roughly 1500 to 2200 years ago) has distinctive characteristics that include construction of conical burial mounds and evidence of widespread interaction throughout central and eastern North America. The characteristics of this network, called the Hopewell Interaction Sphere, include elaborate ceremonialism, extensive trade of exotic manufactured items and raw materials, and large mound construction. The Hopewell influence in Wisconsin appears to consist of a veneer of ceremonialism on a traditional way of life that was otherwise largely unchanged (Stevenson et al. 1997).

Late Woodland sites (occupied 700 to 1600 years ago) show a decline in Hopewellian ceremonialism but continue the tradition of mound construction, primarily in form of animal and human shapes, in the southern half of Wisconsin. Burials are associated with some, but not all, mounds (Stevenson et al. 1997). Cultivation of corn became increasingly prominent, and villages became more permanent (Stevenson et al. 1997).

An exception to the typical Woodland Tradition is the intrusion of a few Middle Mississippian sites in Wisconsin about 1000 years ago. These sites are related to the development of planned permanent towns and ceremonial sites in Iowa, Minnesota, Missouri, and Illinois, particularly the site of Cahokia. Hierarchical structure, extensive trade networks, and intensive agriculture characterized these societies. Several sites in south-central Wisconsin represent a northern extension of Mississippian culture. Aztalan, a palisaded village containing four platform mounds and a series of dwellings, is the best known of these sites in Wisconsin (Goldstein and Freeman 1997). The relationship of such sites with the surrounding Woodland Tradition is unclear, and the influence of the Mississippian culture on Woodland culture in Wisconsin appears to have been transitory (Green 1997).

The transition from Woodland Tradition to later cultures is poorly understood. About 1000 years ago, overlapping the late Woodland and Mississippian traditions, sites referred to as the Oneota culture, recognized by distinctive pottery styles, appear in the archaeological record. Permanent villages, some fortified, were established; subsistence was based on corn, beans,

squash, aquatic resources, and a variety of wild plants and game. Hunting and gathering, probably on a seasonal basis, supplemented the basic agricultural economy (Overstreet 1997). Differences between Oneota and existing Woodland cultures may have been one of degree, rather than kind. The origin of Oneota groups is a subject of debate. They may have migrated into Wisconsin from the south or developed out of an interaction of late Woodland Tradition with Mississippian culture at such sites as Aztalan (Overstreet 1997). Late Woodland and Oneota communities may have coexisted in several areas of Wisconsin for a period of time. Expanding Mississippian culture in Wisconsin may have forced Oneota populations out of areas of eastern Wisconsin. Following the collapse of Mississippian influence, Oneota communities returned to the abandoned areas, and by about 700 years ago, they were the predominant culture in most of southern Wisconsin (Overstreet 1997).

During the later period of Oneota culture, villages were concentrated in several areas, such as the Fox River valley in eastern Wisconsin. Subsistence patterns appear to have remained relatively constant throughout Oneota history until the onset of European contact (circa 1600 to 1650). Oneota settlements in eastern Wisconsin were abandoned by the time of French contact. The causes for this rapid depopulation may include disease, warfare, or out-migration (Overstreet 1997). The Ho-Chunk (formerly Winnebago) Indians are commonly believed to be descendants of Oneota populations, but the archaeological evidence is weak.

At the time of the first European contact (1600 to 1650), eastern Wisconsin was occupied by several Native American groups (Ho-Chunk, Potawatomi, Menominee, and Chippewa). Disruption of Native American communities in eastern North America by ecological shifts (Cronon 1983), societal collapse, disease, and dislocation by European settlers created waves of population shifts as these tribal groups pushed north and westward (Bragdon 2001). Wisconsin tribal groups, responding to these pressures, shifted their areas of use around Wisconsin, Michigan, and other areas of the Midwest.

- **Historic Period**

During the first half of the 17th century, Iroquoian Huron Indians controlled trade across the northern Great Lakes and restricted French incursions into the western Great Lakes area. Between 1648 and 1650, other Iroquoian groups, under pressure because of declining reserves of fur bearing animals, attacked the Huron villages causing a mass exodus of Hurons to the north and west. Huron camps between the Door Peninsula and southern Lake Michigan are evidence of this migration. With the collapse of the Huron control of Great Lakes trade, northern Wisconsin was opened to European intrusion, Iroquois raids, and large-scale migrations of refugees.

"Some places were literally emptied of people, and areas receiving them experienced crowding, confusion, and disruption of old ways. Villages were established with mixed populations as

older patterns of interrelationship were abandoned....The wars of the Iroquois additionally drove many refugees into Wisconsin from the southern end of Lake Michigan, and people whose former homes were as far east as Ohio sought refuge here, most before any reliable historic records were kept of their movements" (C. Mason 1997).

The first European known to have visited the area was Jean Nicolet, a French explorer, who reached Green Bay in 1634. Green Bay was subsequently established as the first French fur trading settlement, and a number of other trading posts were established during the late 1600s and 1700s. Between 1665 and 1728, French Jesuits established missions in conjunction with the trading posts and in various parts of the Green Bay/Fox River area (C. Mason 1997). French influence continued until the end of the French and Indian War. As the French withdrew from the western Great Lakes, items of British manufacture replaced French trade goods in Native American communities (C. Mason 1997). Throughout the historic period, Wisconsin Native American societal structures and ecological conditions were disrupted. Native economies were supplanted or supplemented by an emphasis on hunting for the fur trade. European trade goods increasingly replaced traditional tools and utensils.

The United States acquired ownership of the northern Midwest at the close of the American Revolution, but de facto control remained with the British until the War of 1812. By 1825, the United States had confirmed the rights of three Native American groups (Menominee, Potawatomi, and Ho-Chunk) to land in eastern Michigan (Wisconsin Historical Society [WHS] 2000). However, as a result of later treaties that ceded land to the United States, some tribal groups with ancestral interests in Wisconsin were forced to move to Iowa, Michigan, Kansas, and Oklahoma or were resettled in much smaller reservations (Great Lakes Inter-Tribal Council 2003). During the 1820s and 1830s, the Oneida and Mohican Indians of New York negotiated various treaties with Menominee and Ho-Chunk tribes and with the Federal government for land on the western shore of Lake Michigan. Groups of Oneida and Mohicans began to relocate to that area and were eventually settled on small reservations south of Green Bay.

Wisconsin was sparsely settled by Europeans prior to becoming a U.S. territory. Lead mining drew the first wave of Euro-American immigrants to southwestern Wisconsin in the 1820s. In 1834, Wisconsin was surveyed and opened to Euro-American settlers. The fur trade, which had been a lucrative enterprise from the time of French influence, declined rapidly in the 1830s, and by the time of the Civil War, logging, especially in the heavily forested northern areas, had become the primary industry. Initially, loggers floated white pine logs down the rivers to sawmill towns. As the supply of pines was exhausted, railroads were constructed to haul the next most desirable species (maple and other hardwoods that would sink when waterlogged) to the mills (Birmingham et al. 1997). Wood product industries developed to exploit Wisconsin's forests. In eastern Wisconsin, a substantial tanning industry developed based on the availability of "tanbark" derived from large stands of hemlock that grew in that area. A number of tanneries were located in the area of Two Rivers. The Village of Two Creeks, located directly north of

PBNP, was founded by Guido Pfister who established the Pfister (later Pfister and Vogel) Leather Company there in 1861 (Wojta 1945). Pfister acquired rights to about 607 ha (1500 ac) of hemlock forest along the shores of Lake Michigan between Two Creeks and the current location of PBNP. The Two Creeks tanning industry flourished for about 20 years, but was finally abandoned and moved to Milwaukee in 1882 (Spevacek 1985). The primary factor in the decline of the tanning industry was the massive loss of local hemlock and tanbark as a result of the Peshtigo fires of 1871 (Vogl 1986).

The Village of Two Creeks (variously named Rowley, Nero, or East Two Creeks) was the largest community in the immediate vicinity of PBNP from 1861 to 1920. Initially established for the Pfister Leather Company, the town developed a substantial shipping industry. Tanned hides and leather goods, farm products, and wood products were shipped from Two Creeks to other Great Lakes ports (Spevacek 1985). This commercial activity persisted after the closure of the Pfister and Vogel Leather Company. In 1918, under severe drought conditions, a fire destroyed nine buildings in the village. As a result of the extensive destruction, East Two Creeks was abandoned, and what remained of the community relocated west of the original lakeshore location.

Although the tanning industry was short lived, eastern Wisconsin developed an extensive fishing and shipbuilding industry, with a major center in the City of Manitowoc during the 1800s and 1900s. Dairy farming also became a significant enterprise. Logging continued to be a significant industry through the 1920s. Drawn by its natural resources and economic opportunities, immigrants from many areas of Europe (Scandinavia, northern and eastern Europe, and the British Isles) and the eastern United States settled in Wisconsin. The rich ethnic diversity of its people is reflected in the architecture and industries of its farms (WHS 1996), churches, and villages. Between 1836 and 1850 (2 years after statehood), the population of Wisconsin increased from less than 12,000 people to 305,000 (State of Wisconsin 2004b).

- **Native American Tribes**

There are 11 Federally recognized Native American tribes resident in Wisconsin. There are six groups of Chippewa (Bad River Band of the Lake Superior Chippewa, Lac Courte Oreilles Band of Lake Superior Chippewa Indians, Lac du Flambeau Band of Lake Superior Chippewa Indians, St. Croix Chippewa Indians, Sakaogon Chippewa Community, and the Red Cliff Band of Lake Superior Chippewa Indians); the Ho-Chunk (formerly Winnebago) Nation; the Forest County Potawatomi Community; the Oneida Tribe of Indians; the Menominee Indian Tribe; and the Stockbridge Munsee Community (formerly Stockbridge Munsee Community of Mohican Indians) (Bureau of Indian Affairs 2002). In addition to Native American groups resident in

Wisconsin, three other groups of Potawatomi (Hannahville Indian Community, Michigan; Citizen Potawatomi Nation, Oklahoma; Prairie Band of Potawatomi Nation, Kansas) have cultural interests in Manitowoc and Kewaunee counties (National Park Service 2004).

### 2.2.9.2 Historic and Archaeological Resources at PBNP Site

During the development of the final environmental statement (FES) (AEC 1972), archaeological site file searches were conducted at the WHS to identify cultural resources that might be present at PBNP. The FES reported that an "Indian burial site" was located north of the plant but was not disturbed by construction. A number of farm buildings of unknown history were reported to have been razed.

In 1993, the Great Lakes Archaeological Research Center, Inc. (GLARC) conducted a field inventory of approximately 16 ha (40 ac) that was proposed for use as an ISFSI facility. They also examined the sites files, archives, and maps maintained by the WHS. No prehistoric or historic sites were located during the field inventory. GLARC also noted three prehistoric campsites and one historic Euro-American site within 3.2 km (2 mi) of the project area (GLARC 1993).

In the course of preparing this SEIS, the WHS records of historic properties were examined. As of August 2004, a number of historic properties within Manitowoc and Kewaunee counties have been listed on the National Register of Historic Places (NRHP), 10 in Kewaunee County (WHS 2004a) and 19 in Manitowoc County (WHS 2004b). The nearest, the Rawley Point Light Station, falls within a 10-km (6-mi) radius of PBNP. In addition to sites listed on the NRHP, the WHS records list more than 170 additional historic buildings in Manitowoc County that are of historical interest. None of these are in the immediate vicinity of PBNP.

Local histories indicate that the first houses built in Two Creeks township were located within the PBNP site boundaries. The first house was built in 1842, and the second in 1847 (Wojta 1945). County plat maps of Two Creeks township show the presence of structures and a north-south road within the PBNP site boundaries as early as 1872 to 1878. A pier at the northern boundary of the PBNP site is also shown on County maps from the 1870s (Snyder et al. 1878). A standing fisherman's shed built about 1948 is also located within the PBNP site boundaries. The fishing shed was evaluated for significance under the National Historic Preservation Act (16 USC 470 et seq.) (We Energies 2004c). On October 21, 2004, the WHS issued a determination that the fishing shed is not eligible for inclusion on the NRHP (WHS 2004c).

Records at the WHS identify a number of prehistoric and historic sites in the vicinity of the PBNP site and three sites located within the PBNP site boundary. A cultural resources field investigation of the leased farmlands within the PBNP site has recently been completed

(AVD Archaeological Services, Inc. [AVD] 2004). In addition to the sites identified in the WHS records, this investigation found prehistoric and historic artifacts at 19 locations: 15 isolated artifacts, one prehistoric lithic artifact scatter, and three historic artifact scatters. One of the historic scatters is associated with a nearby residence. Another historic scatter is probably associated with a nearby foundation and possible grave site, and the third historic scatter is also associated with a foundation. AVD recommended that the four artifact scatters be avoided during any future land disturbance (AVD 2004). Alternatively, additional evaluations could be conducted to determine if these sites were eligible for the NRHP. Unless construction is planned at the isolated artifact locations, no further investigation was recommended (AVD 2004).

In addition to the known sites within the PBNP site boundaries, the surrounding areas (within approximately 10 km [6 mi] of the plant site) are known to contain 25 archaeological sites. The majority of these are prehistoric campsites and villages, most of them of unknown cultural affiliation. Other campsites and villages in this area have been attributed to the Woodland Tradition. Other sites within this area include one prehistoric Native American and two Euro-American cemeteries, a shipwreck (the Pathfinder), and a French trading post/landing site dating to the 1700s. The landing site, reported to be that of Jean (variously Jacques) Vieau is located north of the plant site. The historic village of Two Creeks, although not listed in the WHS site records, also lies due north of the PBNP site.

In addition to cultural resources, a portion of the Two Creeks Buried Forest unit of the Ice Age National Scientific Reserve, a paleontological resource, is exposed near the plant site. Its extent within and beneath the plant site has not been documented. The buried forest contains preserved remains of a periglacial forest that was buried by the last glacial advance over Wisconsin. Cultural resources are not likely to be associated with the buried forest unit.

### 2.2.10 Related Federal Project Activities and Consultations

The staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the PBNP OLs. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparation of the SEIS.

As discussed in the NMC ER (NMC 2004a), KNPP is located on the western shore of Lake Michigan in Kewaunee County, approximately 8 km (5 mi) north of the PBNP site. KNPP is a single unit, 535-MW(e) pressurized-water reactor with a thermal power rating of 1650 MW. The KNPP site consists of approximately 367 ha (908 ac), jointly owned by Wisconsin Public Service Corporation and Alliant Energy. Under an arrangement similar to that of PBNP, NMC

holds the OL for KNPP and is responsible for plant operation and maintenance. At KNPP, a maximum of 1.6 million L/min ($4.2 \times 10^5$ gpm) of cooling water and up to 95,000 L/min (25,000 gpm) of water for in-plant use are drawn from and discharged to Lake Michigan as a once-through system. Groundwater from an onsite well is used for potable and sanitary water. Studies conducted of the hydrologic characteristics of this portion of Lake Michigan indicate that the discharge heat of KNPP does not interact with the discharge heat of PBNP (Wisconsin Public Service Corporation 1972).

NMC conducts a radiological environmental monitoring program on and in the vicinity of KNPP. A total of 17 parameters are measured, including four air samples (e.g., airborne particulates), nine terrestrial samples (e.g., well water), and four aquatic samples (e.g., fish). Radionuclide concentrations from the surveillance program are compared to levels measured at control locations and in preoperational studies. These comparisons indicated only background level radioactivity in all samples collected in the year 2000.

PBNP has a 20-MW(e), oil-fired combustion turbine used for spinning reserve, alternate power supply during plant blackouts, and peaking purposes. The combustion turbine is fully capable of operating independent of the remainder of the plant. PBNP operates the combustion turbine pursuant to Chapter 285 of the Wisconsin Statutes and the plant's air pollution control operation permit issued under the CAA by the WDNR.

The NRC is required under Section 102(c) of the National Environmental Policy Act of 1969 to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. The NRC consulted with the FWS; the consultation is described in Section 4.6, and correspondence, including the Biological Assessment, is included in Appendix E.

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10 CFR Part 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

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# 3.0 Environmental Impacts of Refurbishment

Environmental issues associated with refurbishment activities are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this supplemental environmental impact statement (SEIS) unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

License renewal actions may require refurbishment activities for the extended plant life. These actions may have an impact on the environment that requires evaluation, depending on the type of action and the plant-specific design. Environmental issues associated with refurbishment that were determined to be Category 1 issues are listed in Table 3-1.

Environmental issues related to refurbishment considered in the GEIS for which these conclusions could not be reached for all plants, or for specific classes of plants, are Category 2 issues. These are listed in Table 3-2.

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(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

**Table 3-1.** Category 1 Issues for Refurbishment Evaluation

| ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections |
|---|---|
| **SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)** | |
| Impacts of refurbishment on surface-water quality | 3.4.1 |
| Impacts of refurbishment on surface-water use | 3.4.1 |
| **AQUATIC ECOLOGY (FOR ALL PLANTS)** | |
| Refurbishment | 3.5 |
| **GROUNDWATER USE AND QUALITY** | |
| Impacts of refurbishment on groundwater use and quality | 3.4.2 |
| **LAND USE** | |
| Onsite land use | 3.2 |
| **HUMAN HEALTH** | |
| Radiation exposures to the public during refurbishment | 3.8.1 |
| Occupational radiation exposures during refurbishment | 3.8.2 |
| **SOCIOECONOMICS** | |
| Public services: public safety, social services, and tourism and recreation | 3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6 |
| Aesthetic impacts (refurbishment) | 3.7.8 |

Category 1 and Category 2 issues related to refurbishment that are not applicable to Point Beach Nuclear Plant Units 1 and 2 (PBNP) because they are related to plant design features or site characteristics not found at PBNP are listed in Appendix F.

The potential environmental impacts of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Nuclear Management Company, LLC (NMC) indicated that it has performed an evaluation of structures and components pursuant to Title 10 of the Code of Federal Regulations (CFR) 54.21 to identify activities that are necessary to continue operation of PBNP during the requested 20-year period of extended operation. These activities include replacement of certain components as well as new inspection activities and are described in the Environmental Report (NMC 2004).

**Table 3-2.** Category 2 Issues for Refurbishment Evaluation

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections | 10 CFR 51.53 (c)(3)(ii) Subparagraph |
|---|---|---|
| **TERRESTRIAL RESOURCES** | | |
| Refurbishment impacts | 3.6 | E |
| **THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)** | | |
| Threatened or endangered species | 3.9 | E |
| **AIR QUALITY** | | |
| Air quality during refurbishment (nonattainment and maintenance areas) | 3.3 | F |
| **SOCIOECONOMICS** | | |
| Housing impacts | 3.7.2 | I |
| Public services: public utilities | 3.7.4.5 | I |
| Public services: education (refurbishment) | 3.7.4.1 | I |
| Offsite land use (refurbishment) | 3.7.5 | I |
| Public services, transportation | 3.7.4.2 | J |
| Historic and archaeological resources | 3.7.7 | K |
| **ENVIRONMENTAL JUSTICE** | | |
| Environmental justice | Not addressed[a] | Not addressed[a] |

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. If an applicant plans to undertake refurbishment activities for license renewal, environmental justice must be addressed in the applicant's environmental report and the staff's environmental impact statement.

However, NMC stated that the replacement of these components and the additional inspection activities are within the bounds of normal plant component replacement and inspections; therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in the final environmental statement (U.S. Atomic Energy Commission 1972). In addition, NMC's evaluation of structures and components as required by 10 CFR 54.21 did not identify any major plant refurbishment activities or modifications necessary to support the continued operation of PBNP beyond the end of the existing operating licenses. Therefore, refurbishment is not considered in this SEIS.

## 3.1 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Nuclear Management Company, LLC. (NMC). 2004. *Point Beach Nuclear Plant Operating License Renewal Application Environmental Report.* Two Rivers, Wisconsin. February 2004.

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U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report.* NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

# 4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, and are applicable to the Point Beach Nuclear Plant Units 1 and 2 (PBNP). Section 4.1 addresses issues applicable to the PBNP cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality, while Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses potential new information that was raised during the scoping period, and Section 4.8 discusses cumulative

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

impacts. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.9. Finally, Section 4.10 lists the references for Chapter 4. Category 1 and Category 2 issues that are not applicable to PBNP because they are related to plant design features or site characteristics not found at PBNP are listed in Appendix F.

## 4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to the PBNP cooling system operation during the renewal term are listed in Table 4-1. Nuclear Management Company, LLC (NMC) stated in its Environmental Report (ER) (NMC 2004a) that it is not aware of any new and significant information associated with the renewal of the PBNP operating licenses (OLs). The staff has not identified any new and significant information during its independent review of the NMC ER (NMC 2004a), the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft supplemental environmental impact statement (SEIS). Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts would be SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

**Table 4-1.** Category 1 Issues Applicable to the Operation of the PBNP Cooling System during the Renewal Term

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections |
|---|---|
| SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS) | |
| Altered current patterns at intake and discharge structures | 4.2.1.2.1 |
| Altered thermal stratification of lakes | 4.2.1.2.3 |
| Temperature effects on sediment transport capacity | 4.2.1.2.3 |
| Scouring caused by discharged cooling water | 4.2.1.2.3 |
| Eutrophication | 4.2.1.2.3 |
| Discharge of chlorine or other biocides | 4.2.1.2.4 |
| Discharge of sanitary wastes and minor chemical spills | 4.2.1.2.4 |
| Discharge of other metals in wastewater | 4.2.1.2.4 |
| Water use conflicts (plants with once-through cooling systems) | 4.2.1.3 |

**Table 4-1.** (contd)

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections |
|---|---|
| **AQUATIC ECOLOGY (FOR ALL PLANTS)** | |
| Accumulation of contaminants in sediments or biota | 4.2.1.2.4 |
| Entrainment of phytoplankton and zooplankton | 4.2.2.1.1 |
| Cold shock | 4.2.2.1.5 |
| Thermal plume barrier to migrating fish | 4.2.2.1.6 |
| Distribution of aquatic organisms | 4.2.2.1.6 |
| Premature emergence of aquatic insects | 4.2.2.1.7 |
| Gas supersaturation (gas bubble disease) | 4.2.2.1.8 |
| Low dissolved oxygen in the discharge | 4.2.2.1.9 |
| Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses | 4.2.2.1.10 |
| Stimulation of nuisance organisms | 4.2.2.1.11 |
| **HUMAN HEALTH** | |
| Noise | 4.3.7 |

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license *renewal term.*

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

- Altered thermal stratification of lakes. Based on information in the GEIS, the Commission found that

  > Generally, lake stratification has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its review of monitoring programs, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of altered thermal stratification of lakes during the renewal term beyond those discussed in the GEIS.

- Temperature effects on sediment transport capacity. Based on information in the GEIS, the Commission found that

  > These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's review of monitoring programs, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of scouring caused by discharged cooling water during the renewal term beyond those discussed in the GEIS.

- Eutrophication. Based on information in the GEIS, the Commission found that

  > Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's review of monitoring programs, the staff's evaluation of other available information including plant monitoring data and technical reports, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information including the Wisconsin Pollutant Discharge Elimination System (WPDES) permit for PBNP, discussion with the Wisconsin Department of Natural Resources (WDNR 2004a), or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information including the WPDES permit for PBNP, discussion with the WPDES compliance office (WDNR), or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- Discharge of other metals in wastewater. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information including the WPDES permit for PBNP, discussion with the WDNR, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

- Water-use conflicts (plants with once-through cooling systems). Based on information in the GEIS, the Commission found that

  > These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of water-use conflicts for plants with once-through cooling systems during the renewal term beyond those discussed in the GEIS.

- Accumulation of contaminants in sediments or biota. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

  > Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's review of monitoring programs, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concluded that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

  > Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

  > Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of thermal plume barriers to migrating fish during the renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to effect the larger geographical distribution of aquatic organisms.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's review of monitoring programs, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- Premature emergence of aquatic insects. Based on information in the GEIS, the Commission found that

  > Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of premature emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas bubble disease). Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's review of monitoring programs, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. Based on information in the GEIS, the Commission found that

  > These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms. Based on information in the GEIS, the Commission found that

  > Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of

other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term that are applicable to PBNP are discussed in the sections that follow and are listed in Table 4-2.

**Table 4-2.** Category 2 Issues Applicable to the Operation of the PBNP Cooling System during the Renewal Term

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections | 10 CFR 51.53(c)(3)(ii) Subparagraph | SEIS Section |
|---|---|---|---|
| AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS) | | | |
| Entrainment of fish and shellfish in early life stages | 4.2.2.1.2 | B | 4.1.1 |
| Impingement of fish and shellfish | 4.2.2.1.3 | B | 4.1.2 |
| Heat shock | 4.2.2.1.4 | B | 4.1.3 |

## 4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For plants with once-through cooling systems, entrainment of fish and shellfish in early life stages into cooling-water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the NMC ER (NMC 2004a); visited the PBNP site; and reviewed the applicant's WPDES Permit No. WI-0000957-07-0 (Table E-2, Appendix E), effective on

July 1, 2004, and in force until June 30, 2009 (WDNR 2004a), documents submitted to WDNR in support of the WPDES Permit application, and correspondence between the applicant and WDNR.

Section 316(b) of the Clean Water Act of 1977 (CWA) (33 United States Code [USC] 1326 et seq.) requires that the location, design, construction, and capacity of the cooling-water intake structure reflect the best technology available for minimizing adverse environmental impacts. Entrainment of fish and shellfish into the cooling-water system is a potential adverse environmental impact that can be minimized by use of the best available technology.

On July 9, 2004, the U.S. Environmental Protection Agency (EPA) published a final rule in the *Federal Register* (EPA 2004) addressing cooling-water intake structures at existing power plants whose flow levels exceed a minimum threshold value of 190,000 $m^3/d$ (50 million gpd). The rule is Phase II in EPA's development of 316(b) regulations and establishes national requirements applicable to the location, design, construction, and capacity of cooling-water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, implemented through National Pollutant Discharge Elimination System (NPDES) (or equivalent state) permits, minimize the adverse environmental impacts associated with the continued use of the intake systems. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES (or equivalent state) permit. Licensees may be required as part of the permit renewal to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigation measures as a result of this regulation. The new performance standards are designed to significantly reduce entrainment losses due to water withdrawals associated with cooling water intake structures used for power production. Any site-specific mitigation would result in less impact from entrainment during the license renewal period.

Condenser cooling water is withdrawn from Lake Michigan through two, 4.3-m (14-ft) diameter pipes buried beneath the lakebed. Water enters these pipes at the offshore intake structure, a cylinder of steel pilings filled with limestone blocks that stands upright on the lakebed approximately 530 m (1750 ft) offshore in 6.7 m (22 ft) of water (NMC 2004a). At peak capacity, water is circulated at a maximum rate of 22 $m^3/s$ (777 cfs) for each unit.

As a condition of an earlier WPDES permit, the applicant was required to perform a one-year intake monitoring study to determine potential impacts to the environment caused by the cooling-water intake system (WEPCO 1976). Forty-nine entrainment samples were collected between April 15 and October 31, 1975. It was estimated that 2,082,525 fish larvae were entrained at PBNP during the study period. Among these, 20 percent (416,505) were alewife (*Alosa pseudoharengus*), 61 percent (1,270,340) were rainbow smelt (*Osmerus mordax*),

17 percent (354,029) were sculpin (probably slimy sculpin [*Cottus cognatus*] based on impingement collections), and two percent (41,651) were longnose sucker (*Catostomus catostomus*). Additionally, an estimated 4,661,410 fertilized alewife eggs were entrained (WEPCO 1976).

To interpret the impacts of entrainment on the fish community of Lake Michigan, entrainment losses must be compared to the distribution, abundance, and life history of the species that occur near the PBNP and assess the associated impacts on individual fish populations and community structure.

Entrainment of fish eggs can be compared to the production of eggs per fish. For example, an individual alewife produces between 10,000 to 12,000 eggs (Scott and Crossman 1973). Therefore, the 4.66 million alewife eggs entrained in 1975 (WEPCO 1976) would be equivalent to the egg production output of only 388 to 460 gravid females. Levels of egg entrainment at PBNP would be expected to be relatively low as the habitats in the plant vicinity are not preferred spawning habitat (e.g., coastal wetlands, bedrock, sandy beach-dunes, or bluffs; Wei et al. 2004). In contrast, egg entrainment (consisting mostly of alewives) at D.C. Cook Nuclear Plant, which is located on the eastern shore of Lake Michigan in an area of extensive sandy beach-dune habitat, ranged from 743.2 million to 7.0 billion eggs per year between 1975 and 1982 (Noguchi et al. 1985).

Natural mortality of alewife larvae has been shown to be in excess of 90 percent (WEPCO 1976). Therefore, of the 416,505 alewife larvae entrained at PBNP during 1975, it could be assumed that only 41,650 would have survived to be age I alewives. In 1972, there were about 10 billion age I alewives in Lake Michigan. Therefore, loss of alewife larvae due to entrainment at PBNP represents only a small fraction of one percent of the standing crop of alewives in Lake Michigan (WEPCO 1976). Annual mortality for older alewives is 40 to 60 percent (DFO 2004). Using the more conservative 60 percent mortality rate, an expected 25,000 alewife larvae would have been lost due to entrainment at PBNP. This is a very small percentage of the billions of adult alewives that occur in Lake Michigan (i.e., 16.5 billion in 2003; [Madenjian et al. 2004]).

Using similar assumptions, the 1,270,340 rainbow smelt larvae entrained in 1975 would equate to 127,034 age I rainbow smelt. It was conservatively estimated that nearly 60 million age I rainbow smelt occurred in Lake Michigan in 1974 (WEPCO 1976). Therefore, entrained rainbow smelt larvae at PBNP would have been only 0.2 percent of this amount.

In the early 1970s, there was an estimated 100 to 200 million sculpins (all species combined) beyond the larval stage in Lake Michigan (WEPCO 1976). Therefore the 354,029 sculpin larvae entrained at PBNP during 1975 would equate to a small fraction of one percent of the lakewide sculpin population (assuming a 90 percent larval mortality rate). Overall, larval

entrainment losses at PBNP during 1975 represent a very small percentage of the lakewide production for the alewife, rainbow smelt, and slimy sculpin. Furthermore, as long as discharge temperatures do not exceed 37.8°C (100°F) some degree of entrainment survival can be expected (LaJeone and Monzingo 2000).

Macroinvertebrates entrained between April 15 and October 31, 1975, included the amphipod *Diporeia* spp. and the opossum shrimp *Mysis relicta* (WEPCO 1976). Approximately 14 million amphipods (*Diporeia* spp.) and 10 million *Mysis relicta* were entrained during this period. *Diporeia* densities near PBNP at the 7.3-m (24-ft) contour were estimated at about 1.2 million/ha (3 million/ac), while at deeper depths they have been estimated at densities of 14 million/ha (35 million/ac) (WEPCO 1976).

No significant phytoplankton mortality from thermal and physical stresses associated with entrainment was observed during the early years of plant operations. Zooplankton mortality varied from 8 to 19 percent of entrained organisms (AEC 1972). This level of entrainment mortality would not have a significant impact on the nearshore zooplankton community in the area of the PBNP.

Based on its review of the WEPCO (1976) study, the WDNR determined that the location and operation of the PBNP intake had minimal environmental impact as a result of entrainment (WDNR 1978).

The recently renewed WPDES permit for PBNP takes into account the new EPA 316(b) requirements for once-through cooling systems. The permit requires the applicant to conduct a study of the cooling-water intake for potential adverse environmental impacts in accordance with Section 316(b) of the CWA. The proposal for the study was submitted to WDNR on December 24, 2004, with the comprehensive demonstration study due in 2007 (WDNR 2004a). Any requirements resulting from the water intake study would be reflected in future WPDES permits. Under the conditions of the recently renewed WPDES permit, the location and operation of the intake would continue to have minimal environmental impact.

The staff considered mitigation measures for the continued operation of PBNP. Based on its assessment to date, the staff expects that the measures in place at PBNP (i.e., an offshore intake located where there are no bays or points to act as fish nurseries or other attracting features [except for the limestone blocks of the intake structure itself]; and the intake structure constructed in a location devoid of unique spawning habitat [NMC 2004a; Wei et al. 2004]) provide adequate mitigation for impacts related to entrainment. The acoustic fish-deterrent system installed in 2002 to reduce fish impingement (see Section 4.1.2) would also reduce

spawning activities near the intake for species such as alewife. This would also reduce entrainment of fish eggs and larvae. The staff concludes that the potential impacts of entrainment of fish and shellfish in the early life stages into the cooling water intake system would be SMALL.

### 4.1.2 Impingement of Fish and Shellfish

For plants with once-through cooling systems, impingement of fish and shellfish on debris screens of cooling-water system intakes is considered a Category 2 issue, requiring a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the NMC ER (NMC 2004a); visited the PBNP site; and reviewed the applicant's WPDES Permit No. WI-0000957-07-0 (Table E-2, Appendix E), effective on July 1, 2004, and in force until June 30, 2009 (WDNR 2004a), documents submitted to WDNR in support of the WPDES Permit application, and correspondence between the applicant and WDNR.

Condenser cooling water is withdrawn from Lake Michigan through two, 4.3-m (14-ft) diameter pipes buried beneath the lakebed. Water enters these pipes at the offshore intake structure, a cylinder of steel pilings filled with limestone blocks that stands upright on the lakebed approximately 530 m (1750 ft) offshore in 6.7 m (22 ft) of water (NMC 2004a). At peak capacity, water is circulated at a maximum rate of 22 $m^3/s$ (777 cfs) for each unit. Bar grates and eight traveling screens with 0.95-cm (0.38-in.) square mesh are located in the forebay, where debris and impinged fish can be removed before they enter the cooling-water system.

Section 316(b) of the CWA requires the location, design, construction, and capacity of cooling water intake structures to reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Impingement of fish and shellfish on the debris screens of the cooling water intake system is a potential adverse environmental impact that can be minimized by use of the best available technology.

On July 9, 2004, EPA published a final rule in the *Federal Register* (69 FR 41575) (EPA 2004) addressing cooling water intake structures at existing power plants whose flow levels exceed a minimum threshold value of 190,000 $m^3/d$ (50 million gpd). The rule is Phase II in EPA's development of 316(b) regulations and establishes national requirements applicable to the location, design, construction, and capacity of cooling water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, which are implemented through NPDES (or equivalent state) permits, minimize the adverse environmental impacts associated with the continued use of the intake systems. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES (or equivalent state) permit. Licensees may be required as part of the permit renewal to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures as a result of this regulation. The new

performance standards are designed to significantly reduce impingement losses due to plant operation. Any site-specific mitigation would result in less impact from impingement during the renewal period.

As a condition of an earlier WPDES permit, the applicant was required to perform a one-year intake monitoring study (March 1, 1975, to February 29, 1976) to determine potential impacts to the environment caused by the cooling-water intake system (WEPCO 1976). Further impingement studies were carried out from 2001 to 2003. The results of these studies are summarized below.

During a one-year period between March 1, 1975, and February 29, 1976, an impingement study was conducted at PBNP. Over 313,000 fish from 31 species (including one hybrid trout) were collected in eighty-eight 24-hour impingement samples that were generally obtained every fourth day of plant operation (WEPCO 1976). Total estimated impingement for the year was 1,056,724 fish, with numbers of fish impinged monthly ranging from 113 (March 1975) to 467,869 (June 1975). Except for alewife and rainbow smelt, all species were impinged infrequently or in low numbers. Therefore, an impingement summary for most species is more readily evaluated by species groups. Alewives and rainbow smelt constituted over 99 percent of all fish impinged during the study. The total numbers of alewives, rainbow smelt, and other fish groups impinged during the one-year study period are listed in Table 4-3.

**Table 4-3.** Fish Impinged at PBNP during the 1975–1976 Impingement Study

| Species or Fish Group | Number | Percent of Total Impinged[a] |
|---|---|---|
| Alewife (*Alosa pseudoharengus*) | 886,394 | 84 |
| Rainbow smelt (*Osmerus mordax*) | 161,389 | 15 |
| Forage fishes | 7285 | 0.69 |
| Salmonids | 468 | 0.04 |
| Game and food fishes | 979 | 0.09 |
| Rough fishes | 209 | 0.02 |

(a) Totals may not equal 100 percent due to rounding.
Source: WEPCO 1976.

The number of alewives impinged at PBNP represented only about 0.003 percent of the Lake Michigan alewife population and 0.009 percent of the annual lakewide mortality of alewives during the early 1970s. Only 0.005 percent of the adult alewives in Lake Michigan were impinged at PBNP in 2003 (WEPCO 1976; Madenjian et al. 2004). In addition, most of the impinged alewives were assumed to be dead or dying individuals associated with the annual spring die-off (WEPCO 1976). At two coal-fired power plants located at Lake Erie, more than

73 percent of the impinged fishes (excluding gizzard shad [*Dorosoma cepedianum*]) was composed of dead or terminally ill fishes whose condition was not a result of impingement. Seventy-seven percent of the total impinged fishes at these plants were gizzard shad. Most of them exhibited the typical symptoms associated with natural winter and spring mortality (White et al. 1987). Therefore, impinged fish, including most of the alewives at PBNP, cannot be considered wholly the result of plant-induced impingement mortality.

The estimated 161,389 rainbow smelt impinged at PBNP during the 1975 to 1976 study had an equivalent weight of 973 kg (2145 lb) (WEPCO 1976). In comparison, the 2003 commercial catch of rainbow smelt for the Wisconsin waters of Lake Michigan totaled 46,075 kg (101,578 lb) (Hogler and Surendonk 2004), and the lake-wide biomass of rainbow smelt was estimated at 1386 metric tons (1528 tons) (Madenjian et al. 2004). By weight, the impinged rainbow smelt represent 2.1 percent and 0.07 percent of the commercial catch and lake-wide population, respectively.

Excluding alewife and rainbow smelt, 12 species made up the forage group. The slimy sculpin was the most numerous of these, and would account for the prevalence of sculpin larvae collected in the entrainment samples (discussed in Section 4.1.1). Among the other forage species impinged, the more numerous included gizzard shad and ninespine stickleback (*Pungitius pungitius*) (WEPCO 1976).

Most of the salmon and trout species (salmonids) that occur in the Wisconsin waters of Lake Michigan were found in impingement samples. These included rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), lake trout (*S. namaycush*), tiger trout (hybrid brook trout and brown trout, no longer stocked in the Wisconsin waters of Lake Michigan), Chinook salmon (*tshawytscha*), and coho salmon (*O. kisutch*). The impingement totals for the trout and salmon species were 452 and 16, respectively. The number of salmonids impinged was only a small fraction of the numbers stocked annually into Lake Michigan (i.e., an average of 14.5 million) (Bronte and Schuette 2002). The impinged salmonids were equated to a loss of only 56 salmonids, or 0.013 percent, of the recreational catch of 1974. This was based on an estimate that 12 percent of the stocked salmonids were caught by fishermen (WEPCO 1976). In 2003, the sport fishery catch for salmonids (lake trout, rainbow trout, brown trout, coho salmon, and Chinook salmon) in the Wisconsin waters of Lake Michigan totaled 464,327 (Eggold 2004). The 468 salmonids estimated to have been impinged in the WEPCO (1976) study are only 0.1 percent of this total.

The game and food fishes collected in impingement samples included three coolwater species (bloater [*Coregonus hoyi*], lake whitefish [*C. clupeaformis*], and round whitefish [*Prosopium cylindraceum*]) and six warmwater species (northern pike [*Esox lucius*], channel catfish [*Ictalurus punctatus*], largemouth bass [*Micropterus salmoides*], bluegill [*Lepomis macrochirus*],

and yellow perch [*Perca flavescens*]). As only a total of 979 individuals of these species were impinged (WEPCO 1976), their loss would have an insignificant effect on the Lake Michigan populations of these species.

The rough fishes impinged at PBNP included common carp (*Cyprinus carpio*), white sucker (*Catostomus commersoni*), and longnose sucker. As only 209 individuals were impinged (WEPCO 1976), their loss would not be considered significant.

Generally, immature fish were more prevalent in the impingement samples (WEPCO 1976). This is attributed to (1) the greater relative abundance of younger fish, (2) juvenile fish of some species may concentrate in nearshore waters, and (3) immature fish are weaker swimmers than adults. Small fish could potentially pass through the openings in the screenwash collection basket and be returned to the Lake. However, the intake screens are cleaned on a regular schedule and when a pressure differential value is exceeded across the screens because of fouling. The extended period of time the fish remain on the intake screens, in addition to the high-pressure spray water during the screen cleaning process, would result in a potentially high mortality rate to the impinged fish. Larger fish retained with other debris collected in the screenwash collection basket are not returned to the Lake. Therefore, there is no impingement survival for larger fish.

Based on its review of the WEPCO (1976) study, the WDNR determined that the location and operation of the PBNP intake had minimal environmental impact as a result of impingement (WDNR 1978). None of the State-listed fish species that may occur near PBNP (discussed in Section 2.2.5) were collected in the impingement samples.

In 2002, WEPCO installed a permanent fish-deterrent system around the intake structures under a compliance agreement with the U.S. Fish and Wildlife Service (FWS). This system makes use of high-frequency sound (125 kHz) to minimize the influx of fish into the intake structures. The decision to add a fish-deterrent system was based in part on an unusual event at Unit 2 on June 27, 2001, when an influx of thousands of alewives caused a reduction in intake water levels. The clogged intake screens reduced water levels in the plant circulating water pump bay area that supplies cooling water to the plant. Some of the traveling water screens were severely damaged by the weight of the fish. Fish baskets were ripped off, and some screens were bowed. The condenser water boxes and condensate coolers were partially plugged with fish. The volume of fish removed from the forebay, the condenser water boxes, and the condensate coolers following the June 27, 2001, event was estimated at approximately 4500 kg (10,000 lb). Another large influx of alewives into the forebay occurred on July 3, 2001. Approximately 1700 kg (3800 lb) of fish were removed from the forebay during this event. A third event occurred on July 7, 2001, with approximately 1400 kg (3000 lb) of fish removed from the forebay (WEPCO 2000; NMC 2001). NMC attributed these incursions to several factors, predominately the attraction of alewives to the warm water discharge. There was exceptionally

cold lake water that summer. This suggested that, at some point, the discharge plume may have drifted over the intakes (NMC 2001). There was an estimated 42,876 metric tons (47,262 tons) of alewives in Lake Michigan in 2003 (Madenjian et al. 2004). The loss of the alewives due to this unusual impingement event was insignificant relative to the lakeside population levels. The fish deterrent system used at PBNP is identical to the system currently in use at the James A. Fitzpatrick Nuclear Plant (Ross et al. 1993) on Lake Ontario and at D.C. Cook Nuclear Plant located on the eastern shore of Lake Michigan near Bridgman, Michigan. The system has a minimum sound pressure of 170 dB at about 10 m (33 ft) from the intake and 190 dB at 1 m (3 ft) from the intake (Ross et al. 1993).

Operation of the fish-deterrent system at the James A. Fitzpatrick Nuclear Plant decreased fish densities near the intake by as much as 96 percent, and the number of alewives impinged decreased by as much as 87 percent. Following an unusually cold winter, alewife impingement was reduced by 81 to 84 percent. The lower percent reduction following a cold winter was probably due to the deterrent system not being as effective on alewives that are in poor condition (Ross et al. 1993, 1996). The use of a similar sound deterrent system for a power plant located on a Belgium estuary decreased total fish impingement by 60 percent (Maes et al. 2004). Avoidance response varied among species, with impingement rates for the Atlantic herring (*Clupea harengus*), a species similar to the alewife, decreasing by 95 percent. During periods of maximum herring abundance in the estuary, more than 99 percent of the herring were deterred by the sound system (Maes et al. 2004). The use of high-frequency sound is considered a practical alternative to physical barriers to prevent alewives from entering power plant intakes (Dunning et al. 1992). Since the system was installed at PBNP, NMC staff has observed avoidance behavior by schools of alewife.

After the modification of the intake (i.e., change from a partially above- to below-water structure), NMC recorded birds and fish recovered from the trash basket associated with the screen-wash system for the traveling screens from 2001 to 2003. NMC reported these results to the FWS (NMC 2002, 2003a, 2004b). The following summarizes the results from those reports.

In the June 1, 2001, to December 31, 2003, monitoring program (NMC 2002, 2003a, 2004b), fish larger than 15 cm (6 in.) contributed to a greater percentage of impinged fish than what was found in the previous investigation by WEPCO (1976). This was due to the fact that only fish retained in the screen-wash basket were analyzed, rather than all fishes impinged. As a result, a greater percentage of the collected fish were salmonids, larger game and food fish species, and larger rough fish species, with a low prevalence of smaller forage fish. During the course of the study, 110 salmonids, 288 game and food fish, 932 rough fish, 62 unidentifiable fish, and 226 other fish (i.e., 195 alewives <15 cm [<6 in.], 27 unidentifiable fish <15 cm [<6 in.], and four unidentifiable forage fish >15 cm [>6 in.]) were collected. The species of about 20 percent of the fish from the salmonid, game and food fish, and rough fish groups could not

be identified. Among those that could be identified were lake trout (salmonid group), burbot (*Lota lota*) and lake whitefish (*Coregonus clupeaformis*) (food and game group), and freshwater drum (*Aplodinotus grunniens*) and suckers (rough fish group) (NMC 2002, 2003a, 2004b). Based on commercial, recreational, or lake-wide populations for the fish caught during the impingement monitoring study (Section 2.2.5), the low number of fish impinged would have a negligible impact on the Lake Michigan fish community.

No double-crested cormorants were collected in the June 1, 2001, to December 31, 2003, impingement samples (NMC 2002, 2003a, 2004b). A total of 33 birds were collected. These were primarily gull species. The FWS will continue to work with the licensee regarding the bird impingement and mortality issue at PBNP (U.S. Department of the Interior 2005).

The recently renewed WPDES permit for PBNP takes into account the new EPA 316(b) requirements for once-through cooling systems. The permit requires the applicant to conduct a study of the cooling-water intake for potential adverse environmental impacts in accordance with Section 316(b) of the CWA. The proposal for the study was submitted to WDNR on December 24, 2004, with the "comprehensive demonstration study" due in 2007 (WDNR 2004a). Any requirements resulting from the water intake study would be reflected in future WPDES permits. Under the conditions of the recently renewed WPDES permit, the location and operation of the intake would continue to have minimal environmental impact.

The staff considered mitigation measures for the continued operation of PBNP. Based on the assessment to date, the staff expects that the measures in place at PBNP (e.g., an offshore intake located where there are no bays or points to act as fish nurseries or other attracting features [except for the limestone blocks of the intake structure]; and the intake structure constructed in a location devoid of unique spawning habitat [AEC 1972; NMC 2004a; Wei et al. 2004]) provide mitigation for impacts related to impingement. The acoustic fish-deterrent system installed in 2003 also reduces fish impingement, especially for species such as alewife. The staff concludes that the potential impacts of impingement of fish and shellfish in the early life stages into the cooling water intake system would be SMALL, and further mitigation measures would not be warranted.

### 4.1.3 Heat Shock

For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The NRC considers impacts on fish and shellfish that result from heat shock to be a Category 2 issue because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996). Information to be considered includes (1) the type of cooling system (whether once-through or cooling pond) and (2) evidence of a CWA Section 316(a) variance or

equivalent State documentation. To perform this evaluation, the staff reviewed the NMC ER (NMC 2004a); visited the PBNP site; reviewed the applicant's 316(a) demonstration submitted to the WDNR; and reviewed the applicant's WPDES Permit No. WI-0000957-07-0 (Table E-2, Appendix E), effective on July 1, 2004, and in force until June 30, 2009 (WDNR 2004a), documents submitted to WDNR in support of the WPDES Permit application, and correspondence between the applicant and WDNR.

Section 316(a) of the CWA establishes a process whereby applicants can obtain facility-specific thermal discharge limits (CWA 1977). Based on the thermal studies it conducted in 1975, WEPCO submitted an application to WDNR for exemption from thermal standards (equivalent to a CWA Section 316[a] demonstration). WDNR approved the exemption from the thermal standards, and the current WPDES permit, WI-0000957-07-0, does not contain thermal effluent limitations. However, the applicant is required to monitor the temperature daily at the discharge and report these data on a yearly basis (WDNR 2004a).

PBNP has a once-through heat-dissipation system that uses water from Lake Michigan for condenser cooling. Water is circulated through the condensers and returned to the lake through two steel-piling troughs extending in opposite directions (at a 30-degree angle from the plant centerline) approximately 61 m (200 ft) out into Lake Michigan. The average temperature differential between the intake and discharge as reported in 1976 was 16°C (29°F), with a maximum of 19°C (34°F) (WEPCO 1976). During the winter de-icing period, the ambient Lake Michigan water temperature is about 0.6°C (33°F). Highest intake temperature during the January-February 1976 period was 15.6°C (60°F), indicating that the maximum theoretical increase in intake temperatures due to de-icing was 15°C (27°F), with an average influent temperature of 7.8°C (46°F), giving a routine temperature increase of 7.2°C (13°F) (WEPCO 1976). A predictive model was used to estimate the extent of the thermally-affected zones for varying temperatures and weather conditions. The applicant estimated that the total surface area enclosed within the 0.6°C, 1.1°C, 2.8°C, 5.6°C, and 8.3°C (1°F, 2°F, 5°F, 10°F, and 15°F) isotherms would be 1781 ha, 465 ha, 146 ha, 8 ha, and 2.4 ha (4400 ac, 1150 ac, 360 ac, 20 ac, and 6 ac), respectively, when both units are operating. Out to depths of 6 m (20 ft), the temperature field would probably extend to the bottom. Beyond a depth of 6 m (20 ft), as depth increases, the thermal plume would be expected to become progressively shallower and confined to the surface layer. This would extend to the limit of stability of the thermal plume which is generally accepted as the 0.6°C (1°F) isotherm (AEC 1972). Lake Michigan has a surface area of 5.78 million ha (14.28 million ac), so any thermal influence of PBNP on aquatic species would be very localized.

Any thermal plume impacts can be considered to be very localized due to the small maximum plume size relative to that within the nearshore areas of northwestern Lake Michigan. Also, discharges are located within a relatively featureless sandy substrate that has several positive features for minimizing thermal impacts: (1) rapid plume dissipation; (2) no bays or points to

act as fish nurseries or other attracting features; and (3) no substantial unique spawning grounds occur in the plant area (AEC 1972; NMC 2004a, Wei et al. 2004). Also, local currents are sufficiently strong that the substrate is continually scoured resulting in relatively turbid waters that are not attractive to fish species as a spawning area (AEC 1972).

The PBNP thermal discharges are located such that fish do not become entrapped in areas of elevated temperatures. Thus, acute thermal impacts (e.g., death or immediate disability) are unlikely. Fish and other biota are constantly exposed to large, natural fluctuations of water temperatures, especially during upwellings and downwellings, which are common features in the nearshore zone to which aquatic biota have adapted (Jude 1995). The inshore waters in the PBNP area reach an annual maximum of 14.4 to 20.6°C (58 to 69°F) (AEC 1972). Thus, the thermal discharge temperature at the point of discharge during summer would normally range as high as 30.6 to 36.7°C (87 to 98°F), with a predicted maximum of 39.4°C (103°F). Generally, the maximum plume temperature differential would be within the tolerance range for most warmwater species (Talmage and Opresko 1981). Furthermore, the thermal plume encompassed by the 0.6 to 2.8°C (1 to 5°F) isotherms are sufficiently large that fishes would not be abruptly exposed to higher temperature differentials that could be potentially harmful. Coldwater species, such as salmonids, would be able to avoid adverse temperatures. Also, no strong currents or physical obstruction are present that would force fish to remain in areas of potentially harmful water temperatures (AEC 1972).

The WDNR is in the process of developing thermal effluent rules based on water quality. It is likely that the current discharge will need to be evaluated against these new rules. This evaluation will be covered under the WPDES permitting process, and NMC will comply with any additional applicable permit requirements regarding thermal discharge that may be imposed in the future.

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, the WPDES permit, the 316(a) demonstration, and other public sources, such as public comments on the draft SEIS. The staff has evaluated the potential impacts to aquatic resources due to heat shock during continued operation. The staff concludes that the potential impacts to fish and shellfish due to heat shock would be SMALL and further mitigation measures would not be warranted.

## 4.2 Transmission Lines

The NMC ER (NMC 2004a) describes four transmission lines that connect PBNP with the transmission system (Figure 2-4 and Table 2-1). These transmission line rights-of-way (ROW) cover approximately 791 ha (1955 ac) over a total length of approximately 117 km (73 mi). Tree trimming is normally required only every 5 to 7 years, depending on vegetation growth

rates in a given area. Clearing activities are dependent upon the types and amount of vegetation in the ROWs. Clearing may include tractor mowing, manual chainsaw clearing, and application of herbicides by a State-licensed, commercial applicator.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to transmission lines from PBNP are listed in Table 4-4. The applicant stated in its ER that it is not aware of any new and significant information associated with the renewal of the PBNP OLs. The staff has not identified any new and significant information during its independent review of the NMC ER (NMC 2004a), the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts would be SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

**Table 4-4.** Category 1 Issues Applicable to PBNP Transmission Lines during the Renewal Term

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections |
|---|---|
| **TERRESTRIAL RESOURCES** | |
| Power line right-of-way management (cutting and herbicide application) | 4.5.6.1 |
| Bird collisions with power lines | 4.5.6.2 |
| Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock) | 4.5.6.3 |
| Flood plains and wetland on power line right of way | 4.5.7 |
| **AIR QUALITY** | |
| Air quality effects of transmission lines | 4.5.2 |
| **LAND USE** | |
| Onsite land use | 4.5.3 |
| Power line right of way | 4.5.3 |

A brief description of the staff's review and GEIS conclusions, as codified in Table B-1, for each of these issues follows. (For each issue below, the "NMC ER" refers to NMC 2004a.)

- Power line right-of-way management (cutting and herbicide application). Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, consultation with the FWS and the WDNR, the staff's evaluation of other information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line right-of-way maintenance during the renewal term beyond those discussed in the GEIS.

- Bird collisions with power lines. Based on information in the GEIS, the Commission found that

  > Impacts are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, consultation with FWS and WDNR, the staff's evaluation of other information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock). Based on information in the GEIS, the Commission found that

  > *No significant impacts of electromagnetic fields on terrestrial flora and fauna* have been identified. Such effects are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Flood plains and wetlands on power line rights-of-way. Based on information in the GEIS, the Commission found that

  > Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, consultation with the FWS and the WDNR, the staff's evaluation of other information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line rights-of-way on flood plains and wetlands during the renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

  > Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- Onsite land use. Based on the information in the GEIS, the Commission found that

  > Projected onsite land use changes required during ... the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no onsite land-use impacts during the renewal term beyond those discussed in the GEIS.

- Power line rights-of-way. Based on information in the GEIS, the Commission found that

  > Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line rights-of-way on land use during the renewal term beyond those discussed in the GEIS.

There is one Category 2 issue related to transmission lines, and another issue related to transmission lines is being treated as a Category 2 issue. These issues are listed in Table 4-5 and are discussed in Sections 4.2.1 and 4.2.2.

**Table 4-5.** Category 2 and Uncategorized Issues Applicable to PBNP Transmission Lines during the Renewal Term

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections | 10 CFR 51.53(c)(3)(ii) Subparagraph | SEIS Section |
|---|---|---|---|
| | HUMAN HEALTH | | |
| Electromagnetic fields, acute effects (electric shock) | 4.5.4.1 | H | 4.2.1 |
| Electromagnetic fields, chronic effects | 4.5.4.2 | NA | 4.2.2 |

## 4.2.1 Electromagnetic Fields – Acute Effects

In the GEIS (NRC 1996), the staff found that it was not possible to determine the significance of the electric shock potential without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) criteria (NESC 1997). Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

In its supplement to the ER for operating Point Beach Unit 2 (WEPCO 1971), WEPCO (the operator prior to NMC) identified three 345-kilovolt (kV) transmission lines that were built to

connect PBNP to the electric grid. A fourth 345-kV transmission line was constructed by Wisconsin Public Service Corporation to connect the Kewaunee Nuclear Power Plant (KNPP) to the substation at PBNP (see Section 2.1.7 for additional details). WEPCO and the Wisconsin Public Service Corporation have since transferred ownership of their transmission lines to the American Transmission Company (ATC). These lines are approximately 118 km (73 mi) long and occupy approximately 791 ha (1955 ac) of easement. The transmission lines were designed and constructed in the late 1960s and early 1970s in accordance with the Wisconsin Electrical Code and industry guidance that was current when the lines were built (NMC 2004a).

NMC performed an analysis to demonstrate that the four transmission lines at PBNP are in compliance with the NESC 5-mA, electric-field-induced current limit (NMC 2004a). NMC's analysis of these transmission lines began by identifying the limiting case road crossing for each line. The limiting case is the configuration along each line where the potential for induced-current shock would be greatest. Once the limiting case was identified, NMC calculated the electric field strength for each transmission line, then calculated the induced current.

NMC calculated electric field strength and induced current using a computer code called ACDCLINE (Version 3.0) (Electric Power Research Institute 1992). The results of this computer program have been field verified through actual electric field measurements by several utilities. The input parameters included the design features of the limiting case scenario, the NESC requirement that line sag be determined at 48.9 °C (120 °F) conductor temperature, and the maximum vehicle size under the lines. The maximum size vehicle was modeled as a tractor-trailer truck.

The analysis determined that none of the transmission lines has the capacity to induce more than 5 mA, the NESC limit of electric field-induced current, in a tractor-trailer truck parked beneath the lines. Therefore, the PBNP transmission line designs conform to the NESC provisions for preventing electric shock from induced current (NMC 2004a).

NMC's assessment under 10 CFR Part 51 concludes that electric shock is of small significance for PBNP transmission lines. Because of the small significance of the issue, mitigation measures, such as installing warning signs at road crossings or increasing clearances, are not warranted. This conclusion would remain valid into the future, provided there are no changes in line use, voltage, current, and maintenance practices and no changes in land use under the lines – conditions over which the ATC has control.

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, public comments, and other public sources. Using this information, the staff

has evaluated the potential impacts for electric shock resulting from operation of PBNP and associated transmission lines. The staff concludes that the potential impacts for electric shock during the renewal term would be SMALL.

### 4.2.2 Electromagnetic Fields – Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2 and will not be designated until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. A recent report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the staff to change its position with respect to the chronic effects of electromagnetic fields. The staff considers the GEIS finding of "not applicable" still appropriate and will continue to follow developments on this issue.

## 4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to PBNP in regard to radiological impacts are listed in Table 4-6. NMC stated in its ER (NMC 2004a) that it is not aware of any new and significant information associated with the renewal of the PBNP OLs. The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those

discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts would be SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

**Table 4-6.** Category 1 Issues Applicable to Radiological Impacts of Normal Operations during the Renewal Term

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections |
|---|---|
| HUMAN HEALTH | |
| Radiation exposures to public (license renewal term) | 4.6.2 |
| Occupational radiation exposures (license renewal term) | 4.6.3 |

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Radiation exposures to the public (license renewal term). Based on information in the GEIS, the Commission found that

  > Radiation doses to the public will continue at current levels associated with normal operations.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

  > Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

  The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

## 4.4 Socioeconomic Impacts of Plant Operations during the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-7. NMC stated in its ER (NMC 2004a) that it is not aware of any new and significant information associated with the renewal of PBNP OLs.

The staff has not identified any new and significant information during the staff's independent review of the NMC ER, the staff's scoping process, the staff's site visit, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For these issues, the staff concluded in the GEIS that the impacts would be SMALL and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

**Table 4-7.** Category 1 Issues Applicable to Socioeconomics during the Renewal Term

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections |
|---|---|
| SOCIOECONOMICS | |
| Public services: public safety, social services, and tourism and recreation | 4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6 |
| Public services: education (license renewal term) | 4.7.3.1 |
| Aesthetic impacts (license renewal term) | 4.7.6 |
| Aesthetic impacts of transmission lines (license renewal term) | 4.5.8 |

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Public services: public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term). Based on information in the GEIS, the Commission found that

  Only impacts of small significance are expected.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  No significant impacts are expected during the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  No significant impacts are expected during the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, the staff's evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-8 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS.

**Table 4-8.** Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics during the Renewal Term

| ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections | 10 CFR 51.53(c)(3)(ii) Subparagraph | SEIS Section |
|---|---|---|---|
| | SOCIOECONOMICS | | |
| Housing impacts | 4.7.1 | I | 4.4.1 |
| Public services: public utilities | 4.7.3.5 | I | 4.4.2 |
| Offsite land use (license renewal term) | 4.7.4 | I | 4.4.3 |
| Public services, transportation | 4.7.3.2 | J | 4.4.4 |
| Historic and archaeological resources | 4.7.7 | K | 4.4.5 |
| Environmental justice | Not addressed[a] | Not addressed[a] | 4.4.6 |

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in the staff's environmental impact statement.

### 4.4.1 Housing Impacts during Operations

To determine housing impacts, the applicant chose to follow Appendix C of the GEIS (NRC 1996), which presents a population characterization method that is based on two factors, "sparseness" and "proximity" (GEIS, Section C.1.4 [NRC 1996]). Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80 km (50 mi). Each factor has categories of density and size, and a matrix is used to rank the population category as low, medium, or high (GEIS, Table C.1 and Figure C.1 [NRC 1996]).

The staff examined population densities within specified distances from the PBNP site, employing the NRC's Geographical, Environmental, and Siting Information System (GEn&SIS) to analyze the 2000 census data (NRC 2004b). As derived from the 2000 U.S. Census Bureau (USCB) information, 94,536 people live within 32 km (20 mi) of PBNP and 757,469 people live within 80 km (50 mi) of PBNP. This equates to a population density of 75 persons/km$^2$ (195 persons/mi$^2$) within an 80-km (50-mi) radius (note that this accounts for the fact that PBNP is located on Lake Michigan, so only a portion of the area within an 80-km (50-mi) radius is land area). The largest city within 80 km (50 mi) is Green Bay, Wisconsin, with a population of 102,313 (USCB 2000a).

All or parts of 12 counties and the City of Green Bay are located within 80 km (50 mi) of PBNP. Approximately 81 percent of the employees live in Manitowoc County. The remaining 19 percent are distributed across 12 counties, with numbers ranging from 1 to 73 employees