NUREG-1437, Vol. 1
Supplement 28

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 28

Regarding
Oyster Creek Nuclear Generating Station

Final Report - Main Report

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

AVAILABILITY OF REFERENCE MATERIALS IN NRC PUBLICATIONS

NRC Reference Material

As of November 1999, you may electronically access NUREG-series publications and other NRC records at NRC's Public Electronic Reading Room at http://www.nrc.gov/reading-rm.html.
Publicly released records include, to name a few, NUREG-series publications; *Federal Register* notices; applicant, licensee, and vendor documents and correspondence; NRC correspondence and internal memoranda; bulletins and information notices; inspection and investigative reports; licensee event reports; and Commission papers and their attachments.

NRC publications in the NUREG series, NRC regulations, and *Title 10, Energy*, in the Code of *Federal Regulations* may also be purchased from one of these two sources.

1. The Superintendent of Documents
   U.S. Government Printing Office
   Mail Stop SSOP
   Washington, DC 20402–0001
   Internet: bookstore.gpo.gov
   Telephone: 202-512-1800
   Fax: 202-512-2250
2. The National Technical Information Service
   Springfield, VA 22161–0002
   www.ntis.gov
   1–800–553–6847 or, locally, 703–605–6000

A single copy of each NRC draft report for comment is available free, to the extent of supply, upon written request as follows:
Address: Office of Administration,
Printing and Mail Services Branch
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

E-mail: DISTRIBUTION@nrc.gov
Facsimile: 301–415–2289

Some publications in the NUREG series that are posted at NRC's Web site address http://www.nrc.gov/reading-rm/doc-collections/nuregs are updated periodically and may differ from the last printed version. Although references to material found on a Web site bear the date the material was accessed, the material available on the date cited may subsequently be removed from the site.

Non-NRC Reference Material

Documents available from public and special technical libraries include all open literature items, such as books, journal articles, and transactions, *Federal Register* notices, Federal and State legislation, and congressional reports. Such documents as theses, dissertations, foreign reports and translations, and non-NRC conference proceedings may be purchased from their sponsoring organization.

Copies of industry codes and standards used in a substantive manner in the NRC regulatory process are maintained at—
The NRC Technical Library
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852–2738

These standards are available in the library for reference use by the public. Codes and standards are usually copyrighted and may be purchased from the originating organization or, if they are American National Standards, from—
American National Standards Institute
11 West 42nd Street
New York, NY 10036–8002
www.ansi.org
212–642–4900

Legally binding regulatory requirements are stated only in laws; NRC regulations; licenses, including technical specifications; or orders, not in NUREG-series publications. The views expressed in contractor-prepared publications in this series are not necessarily those of the NRC.

The NUREG series comprises (1) technical and administrative reports and books prepared by the staff (NUREG–XXXX) or agency contractors (NUREG/CR–XXXX), (2) proceedings of conferences (NUREG/CP–XXXX), (3) reports resulting from international agreements (NUREG/IA–XXXX), (4) brochures (NUREG/BR–XXXX), and (5) compilations of legal decisions and orders of the Commission and Atomic and Safety Licensing Boards and of Directors' decisions under Section 2.206 of NRC's regulations (NUREG–0750).

NUREG-1437, Vol. 1
Supplement 28

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 28

Regarding Oyster Creek Nuclear Generating Station

Final Report - Main Report

Manuscript Completed: December 2006
Date Published: January 2007

Division of License Renewal
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, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51). In the GEIS (and its Addendum 1), the NRC 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 AmerGen Energy Company, LLC (AmerGen), to renew the OL for Oyster Creek Nuclear Generating Station (OCNGS) 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 NRC staff's recommendation regarding the proposed action.

Regarding the 69 issues for which the GEIS reached generic conclusions, neither AmerGen nor the NRC staff has identified information that is both new and significant for any issue that applies to OCNGS. In addition, the NRC staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the NRC staff concludes that the impacts of renewing the OCNGS OL would not be greater than the impacts identified for these issues in the GEIS. For each of these issues, the NRC 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 OCNGS are addressed in this SEIS. For most issues, the NRC staff concludes that the significance of the potential environmental impacts of renewal of the OL would be SMALL. The NRC staff also concludes that no additional mitigation is warranted. The NRC staff determined that information provided during the scoping process did not identify any new issue that has a significant environmental impact. For aquatic resources, the NRC staff determined that the impacts of continued operation of the once-through cooling system during the license renewal term could, for some species, be MODERATE if species composition and abundance of aquatic organisms in Barnegat Bay have

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

changed substantially from the 1970s and 1980s when the last studies of the effects of OCNGS operations were conducted. Alternatives to continued operation of the existing once-through cooling system that would mitigate impacts on aquatic resources were evaluated.

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for OCNGS 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 Environmental Report submitted by AmerGen; (3) consultation with Federal, State, and local agencies; (4) the NRC staff's own independent review; and (5) the NRC staff's consideration of public comments received during the scoping process.

Contents

Figures

Tables

Tables

Executive Summary

By letter dated July 22, 2005, AmerGen Energy Company, LLC (AmerGen), submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Oyster Creek Nuclear Generating Station (OCNGS) for an additional 20 years. If the OL is renewed, State regulatory agencies and AmerGen 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 OL is not renewed, then the plant must be shut down at or before the expiration date of the current OL, which is April 9, 2009. Should the NRC staff's license renewal review not be completed by this date, the plant may continue to operate past that date until the NRC staff has taken final action to either approve or deny the license renewal.

The NRC has implemented Section 102 of the National Environmental Policy Act (NEPA), Title 42, Section 4321, of the *United States Code* (42 USC 4321) in Title 10, Part 51, of the *Code of Federal Regulations* (10 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 AmerGen 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 NRC staff visited the OCNGS site in October 2005 and held public scoping meetings on November 1, 2005, in Toms River, New Jersey. In the preparation of this Supplemental Environmental Impact Statement (SEIS) for OCNGS, the NRC staff reviewed the AmerGen Environmental Report (ER) and compared it with 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.

The draft SEIS was published in June 2006. The NRC staff held two public meetings in Toms River, New Jersey on July 12, 2006, 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 the draft SEIS. When the comment

---

(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.

period ended, the NRC staff considered and addressed all of the comments received. These comments are addressed in Appendix A, Part II, of this SEIS.

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 NRC 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 NRC 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 will 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 NRC 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 NRC staff's consideration of all 92 environmental issues identified in the GEIS. The NRC 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 OL for OCNGS) 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 OCNGS is replaced. These alternatives are evaluated assuming that the replacement power-generation plant is located at either the OCNGS site or at some other unspecified alternate location. In response to draft conditions presented in the proposed New Jersey Pollutant Discharge Elimination System permit issued in July 2005, the NRC staff also considered the environmental impacts of alternatives to the existing once-through cooling-water system employed at OCNGS.

AmerGen and the NRC staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither AmerGen nor the NRC 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, the NRC staff did not identify during the scoping process or during its review, any new issue applicable to OCNGS that had a significant environmental impact. Therefore, the NRC staff relies upon the conclusions of the GEIS for all of the Category 1 issues that are applicable to OCNGS.

AmerGen's license renewal application presents an analysis of the Category 2 issues. The NRC staff has reviewed the AmerGen 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 OCNGS. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment only. AmerGen 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 OCNGS 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 1974 *Final Environmental Statement Related to Operation of Oyster Creek Nuclear Generating Station, Jersey Central Power and Light Company*.

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 this SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For most (nine) Category 2 issues and environmental justice, the NRC staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the NRC 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 NRC staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for OCNGS and the plant improvements already made, the NRC staff concludes that several SAMAs are potentially cost-beneficial. However, none of these SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

For two Category 2 issues (entrainment of fish and shellfish in early life stages and impingement of fish and shellfish), the NRC staff determined that the existing once-through cooling system could have a MODERATE impact if species composition and abundance of aquatic organisms in Barnegat Bay have changed substantially from the 1970s and 1980s during which the last studies of the effects of OCNGS operations on bay-wide populations were conducted.

Also, the NRC staff found that impacts on Federally protected sea turtles would be SMALL during the proposed renewal period. If the NRC renews the OCNGS license, the renewed license would contain requirements consistent with the Incidental Take Statement in the 2006 Biological Opinion.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate in most cases, and no additional mitigation measures were deemed sufficiently beneficial to be warranted. Additional mitigation may be required by the state of New Jersey that would result in reduction of impacts related to cooling-system operation.

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 OCNGS license renewal impacts are deemed to be SMALL, the NRC staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources. For aquatic resources, the staff concluded that the cumulative impacts could be SMALL to MODERATE.

If the OCNGS OL is not renewed and the plant ceases operation on or before the expiration of its current OL, then the adverse impacts of likely alternatives would not be smaller than those associated with continued operation of OCNGS. 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 OCNGS 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 AmerGen; (3) consultation with other Federal, State, and local agencies; (4) the NRC staff's own independent review; and (5) the NRC staff's consideration of public comments.

Abbreviations/Acronyms

µCi	microcurie(s)
µg	microgram(s)
µm	micrometer(s)
µSv	microsievert(s)
ac	acre(s)
AC	alternating current
ACC	air-cooled condenser or averted cleanup and decontamination costs
ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
AmerGen	AmerGen Energy Company, LLC
AOC	Area of Concern or averted offsite property damage costs
AOE	averted occupational exposure
AOSC	averted onsite costs
APE	averted public exposure
AQCR	Air Quality Control Region
ASLB	Atomic Safety and Licensing Board
ASME	American Society of Mechanical Engineers
ASMFC	Atlantic States Marine Fisheries Commission
ATSDR	Agency for Toxic Substances and Disease Registry
ATWS	anticipated transient without scram
ATV	all-terrain vehicle
BA	Biological Assessment
BBNEP	Barnegat Bay National Estuary Program
BO	Biological Opinion
BOD	biochemical oxygen demand
Btu	British thermal unit(s)
BWR	boiling-water reactor
BWROG	Boiling-Water Reactor Owners Group
°C	degree(s) Celsius
CAA	Clean Air Act
CAFRA	Coastal Area Facility Review Act
CCC	Caribbean Conservation Corporation
CDF	core damage frequency or combined disposal facility

CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Ci	curie(s)
cm	centimeter(s)
CO	carbon monoxide
CO_2	carbon dioxide
COE	cost of enhancement
CPC	Center for Plant Conservation
CREST	Continuous Radiological Environmental Surveillance Telemetry
CWA	Clean Water Act
CWPCF	Central Water Pollution Control Facility
CZMA	Coastal Zone Management Act
d	day(s)
DBA	design-basis accident
DC	direct current
DDT	dichloro-diphenyl-trichloroethane
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DPR	demonstration project reactor
DSM	demand-side management
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ELF-EMF	extremely low frequency-electromagnetic field
EPA	U.S. Environmental Protection Agency
EPACT	Energy Policy Act of 2005
ER	Environmental Report
ESA	Endangered Species Act
ESMP	Environmental Surveillance and Monitoring Program
Exelon	Exelon Corporation
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FACA	Federal Advisory Committee Act
FES	Final Environmental Statement
FPRA	Fire Probabilistic Risk Assessment
FR	Federal Register

FSAR	Final Safety Analysis Report
ft	foot (feet)
ft^3	cubic foot (feet)
FWS	U.S. Fish and Wildlife Service
g	gram(s)
gal	gallon(s)
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
GL	Generic Letter
GLCF	Global Land Cover Facility
gpd	gallon(s) per day
gpm	gallon(s) per minute
HEPA	high-efficiency particulate air
HLW	high-level waste
hp	horsepower
hr	hour(s)
Hz	hertz
IEEE	Institute of Electrical and Electronic Engineers
in.	inch(es)
INEEL	Idaho National Engineering and Environmental Laboratory
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
ISRA	Industrial Site Recovery Act
ITS	Incidental Take Statement
J	joule(s)
JCP&L	Jersey Central Power & Light Company
kg	kilogram(s)
kV	kilovolt(s)
kW	kilowatt(s)
kWh	kilowatt hour(s)
L	liter(s)
lb	pound(s)
LERF	large early release frequency
LLTF	Lessons Learned Task Force
LOCA	loss-of-coolant accident
LOOP	loss of offsite power

m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mA	milliampere(s)
MAAP	Modular Accident Analysis Program
MACCS2	Melcor Accident Consequence Code System 2
MAFMC	Mid-Atlantic Fishery Management Council
MDOC	Maine Department of Conservation
MEI	maximally exposed individual
mg	milligram(s)
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
mL	milliliter(s)
mm	millimeter(s)
MMACR	modified maximum averted cost risk
MMSC	Marine Mammal Stranding Center
mph	mile(s) per hour
mrem	millirem(s)
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTBE	methyl tertiary-butyl ether
MTU	metric ton(s)-uranium
MW	megawatt(s)
MWd	megawatt-day(s)
MW(e)	megawatt(s) electric
MW(t)	megawatt(s) thermal
MWh	megawatt hour(s)
NAGPRA	Native American Graves Protection and Repatriation Act
NAS	National Academy of Sciences
NCES	National Center for Educational Statistics
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NFSC	Northeast Fisheries Science Center
ng	nanogram(s)
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJDHSS	New Jersey Department of Health and Senior Services
NJONLM	New Jersey Office of Natural Lands Management

NJPDES	New Jersey Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxide(s)
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
OCDP	Ocean County Department of Planning
OCNGS	Oyster Creek Nuclear Generating Station
OCPB	Ocean County Planning Board
ODCM	Offsite Dose Calculation Manual
OL	operating license
ONJSC	Office of New Jersey State Climatologist
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi	picocurie(s)
PL	Public Law
$PM_{2.5}$	particulate matter, 2.5 microns or less in diameter
PM_{10}	particulate matter, 10 microns or less in diameter
ppm	part(s) per million
ppt	part(s) per thousand
PRA	Probabilistic Risk Assessment
PSD	Prevention of Significant Deterioration
psig	pound(s) per square inch
RAI	request for additional information
REMP	radiological environmental monitoring program
RG	Regulatory Guide
RI	Remedial Investigation
ROI	region of interest
RPC	replacement power cost
RPHP	Radiation and Public Health Project
rpm	revolution(s) per minute
RRW	risk reduction worth

s	second(s)
SAMA	severe accident mitigation alternative
SAR	Safety Analysis Report
SAV	submerged aquatic vegetation
SCR	selective catalytic reduction
SECA	Solid State Energy Conservation Alliance
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
SERI	Systems Energy Resources, Inc.
SHPO	State Historic Preservation Office
SI	Site Investigation
SJRCDC	South Jersey Resource Conservation and Development Council
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
Sv	sievert
SWPCF	Southern Water Pollution Control Facility
TDS	total dissolved solids
TEL	threshold effect level
TLAA	time-limited aging analysis
TS	Technical Specification
TSS	total suspended solids
UFSAR	Updated Final Safety Analysis Report
URSGWC	URS Greiner Woodward Clyde
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VAC	volts alternating current
VOC	volatile organic compound
W	watt(s)
yr	year(s)

1.0 Introduction

Under the U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), which implement the National Environmental Policy Act (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 NRC 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 need to 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.

AmerGen Energy Company, LLC (AmerGen), operates the Oyster Creek Nuclear Generating Station (OCNGS) in eastern New Jersey under OL DPR-16, which was issued by the NRC. This OL will expire in April 2009. On July 22, 2005, AmerGen submitted an application to the NRC to renew the OCNGS OL for an additional 20 years under 10 CFR Part 54 (AmerGen 2005a). AmerGen is a *licensee* for the purposes of its current OL and an *applicant* for the renewal of the OL. Pursuant to 10 CFR 54.23 and 51.53(c), AmerGen submitted an Environmental Report (ER) (AmerGen 2005b) in which AmerGen analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects.

This report is the plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the AmerGen license renewal application. This SEIS is a supplement to the GEIS because it relies, in part, on the findings of the GEIS. The NRC 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 the NRC staff used to assess the environmental impacts associated with license renewal, (2) describe the proposed Federal action to renew the OCNGS OL, (3) discuss the purpose and need for the proposed action, and (4) present the status of AmerGen'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 ensuing 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. Chapter 6 discusses the uranium fuel cycle and solid waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to the station's existing once-through cooling system and 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 man's environment and the maintenance and enhancement of long-term productivity; and the irreversible or irretrievable commitment of resources. Chapter 9 also presents the NRC staff's recommendation with respect to the proposed license renewal action.

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

- The contributors to the supplement,
- A chronology of the NRC staff's environmental review correspondence related to this SEIS,
- The organizations contacted during the development of this SEIS,
- AmerGen's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence, including an Essential Fish Habitat Assessment, prepared and sent during the evaluation process),
- GEIS environmental issues that are not applicable to OCNGS, and
- Severe accident mitigation alternatives (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 effects, (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 presented 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 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 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 NRC 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 uncategorized issues are 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.

The NRC staff has identified a requirement that was not addressed in the GEIS related to essential fish habitat (EFH). The consultation requirements of Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act require that Federal agencies consult with the Secretary of Commerce on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Concurrent with issuance of this SEIS, the NRC staff has requested initiation of an EFH consultation with the National Marine Fisheries Service (NMFS). The EFH Assessment to support this consultation is presented in Appendix E of this SEIS. The NMFS, in a letter dated September 28, 2006 (NMFS 2006), provided its response to our assessment along with its conservation recommendation. The NRC responded to the NMFS recommendation in a letter dated December 5, 2006 (NRC 2006a). Copies of both letters are found in Appendix E.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OL is required to submit an ER as part of its application. 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), and

- 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); and

- Contain an analysis of any Category 1 issue unless there is significant new information on a specific issue – this is pursuant to 10 CFR 51.23(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 OCNGS OL, AmerGen developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for OCNGS would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the OL for OCNGS would be identified, reviewed, and assessed during the period of NRC review. AmerGen 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 OCNGS. This review was performed by personnel from AmerGen 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*, NUREG-1555, Supplement 1 (NRC 2000). The search for new information includes (1) review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) review of records of public comments; (3) 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 NRC 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 OCNGS. 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 NRC 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 AmerGen license renewal application began with publication of a Notice of Acceptance for docketing and opportunity for a hearing in the *Federal Register* (NRC 2005a) on September 15, 2005. The NRC staff published a Notice of Intent to prepare an EIS and conduct scoping in the *Federal Register* (NRC 2005b) on September 22, 2005. Two public scoping meetings were held on November 1, 2005, in Toms River, New Jersey. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Oyster Creek Nuclear Generating Station, Ocean County, New Jersey* (NRC 2006b) dated February 21, 2006. Comments that are applicable to this environmental review are presented in Part I of Appendix A.

The NRC staff followed the review guidance contained in NUREG-1555, Supplement 1 (NRC 2000). The NRC staff and contractors retained to assist the NRC staff visited the OCNGS site on October 11 through 14, 2005, to gather information and to become familiar with the site and its environs. The NRC 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 OCNGS were reviewed and are referenced.

This SEIS presents the NRC staff's analysis that considers and weighs the environmental effects of the proposed renewal of the OL for OCNGS, the environmental impacts of alternatives to license renewal, the environmental impacts of alternatives to the current once-through cooling system, and mitigation measures available for avoiding adverse environmental effects. 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.

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 Toms River, New Jersey on July 12, 2006. During these meetings, the NRC staff described the preliminary results of the NRC environmental review and answered questions related to it to provide members of the public with information to assist them in formulating their comments.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OL for OCNGS. OCNGS is located in eastern New Jersey adjacent to Barnegat Bay, approximately 60 mi south of Newark, 35 mi north of Atlantic City, and 60 mi east of Philadelphia, Pennsylvania. OCNGS is a single-unit plant with a boiling-water reactor and steam turbine supplied by General Electric. The reactor has a design power level of 1930 megawatts thermal (MW(t)) and a net power output of 640 megawatts electric (MW(e)). Plant cooling is provided by a once-through system that draws water from Barnegat Bay via the South Branch of the Forked River and a man-made intake canal, and that discharges heated water back to Barnegat Bay via a discharge canal and Oyster Creek. OCNGS produces electricity to supply the needs of more than 600,000 customers. The current OL for OCNGS expires on April 9, 2009. By letter dated July 22, 2005, AmerGen submitted an application to the NRC (AmerGen 2005a) to renew this OL for an additional 20 years of operation (i.e., until April 9, 2029).

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 owners of the plant 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.

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

> 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 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

AmerGen is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In its ER, AmerGen (2005b) provided a list of the authorizations from Federal, State, and local authorities for current operations as well as environmental approvals and consultations associated with OCNGS license renewal.

Authorizations and consultations relevant to the proposed OL renewal action are included in Appendix E.

The NRC 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 states that AmerGen is in compliance with applicable environmental standards and requirements for OCNGS. The NRC staff 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."

AmerGen Energy Company, LLC (AmerGen). 2005a. *License Renewal Application, Oyster Creek Nuclear Generating Station, Docket No. 50-219, Facility Operating License No. DPR-16*. Forked River, New Jersey. (July 22, 2005).

AmerGen Energy Company, LLC (AmerGen). 2005b. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

Atomic Energy Act of 1954 (AEA). 42 USC 2011, et seq.

Magnuson-Stevens Fishery Conservation and Management Act of 1976 (FCMA). 16 USC 1801, et seq.

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

National Marine Fisheries Service (NMFS). 2006. Letter from Mr. Peter D. Colosi, Jr., NOAA, National Marine Fisheries Service, Northeast Regional Office to F. Gillespie, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Essential Fish Habitat Consultation Regarding License Renewal of Oyster Creek Nuclear Generating Station (TAC No. MC7625)." (September 28, 2006).

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

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2005a. “AmerGen Energy Company, LLC, Oyster Creek Nuclear Generating Station; Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License No. DRP-16 for an Additional 20-Year Period.” *Federal Register*, Vol. 70, No. 178, pp. 54585–54586. Washington, D.C. (September 15, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2005b. “AmerGen Energy Company, LLC, Oyster Creek Nuclear Generating Station; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process.” *Federal Register*, Vol. 70, No. 183, pp. 55635–55637. Washington, D.C. (September 22, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2006a. Letter from P.T. Kuo, U.S. Nuclear Regulatory Commission, Rockville, Maryland, to P.D. Colosi, national Marine Fisheries Service, Gloucester, Massachuset. Subject: “Response to Essential Fish Habitat Conservation Recommendation Regarding the Proposed License Renewal of Oyster Creek Nuclear Generating Station.” (December 5, 2006).

U.S. Nuclear Regulatory Commission (NRC). 2006b. *Environmental Impact Statement Scoping Process: Summary Report – Oyster Creek Nuclear Generating Station, Ocean County, New Jersey*. Washington, D.C. (February 21, 2006).

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

The Oyster Creek Nuclear Generating Station (OCNGS) is owned and operated by AmerGen Energy Company, LLC (AmerGen), a wholly owned subsidiary of Exelon Corporation (Exelon). OCNGS is located adjacent to Barnegat Bay in Lacey and Ocean Townships, Ocean County, New Jersey. The plant consists of a single boiling-water reactor that produces steam that turns turbines to generate electricity. The site includes a reactor building, a turbine building, an office building, radioactive waste buildings, a stack, a dry spent fuel storage facility, and several other support buildings. 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

This section provides a description of the OCNGS plant, the site on which it is located, and the regional setting. In addition, summary descriptions are provided for the reactor system, radioactive waste management and effluent control systems, the cooling- and auxiliary-water systems, the nonradioactive waste management systems, plant operation and maintenance, as well as the power transmission system.

2.1.1 External Appearance and Setting

The OCNGS is located on approximately 800 ac of land. The property is approximately 9 mi south of Toms River, New Jersey, about 50 mi east of Philadelphia, Pennsylvania, 60 mi south of Newark, New Jersey, and 35 mi north of Atlantic City, New Jersey. Barnegat Bay is adjacent to the OCNGS property. Figures 2-1 and 2-2 show the site location and features within 50 mi and 6 mi, respectively (AmerGen 2005a).

The 800-ac OCNGS property boundaries are shown in Figure 2-3. The property lies between two streams, the South Branch of Forked River (to the north) and Oyster Creek (to the south). During construction, a semicircular canal was dredged between the two streams to create a horseshoe-shaped cooling-water system that consists of the lower reaches of the South Branch of Forked River, the dredged canal, and the lower reaches of Oyster Creek. Barnegat Bay is adjacent to the property on the east. For condenser cooling, water is withdrawn from Barnegat Bay via the South Branch of Forked River and man-made intake canal, circulated through the plant's condensers, and returned to the bay via the man-made discharge canal and Oyster Creek (AmerGen 2005a).

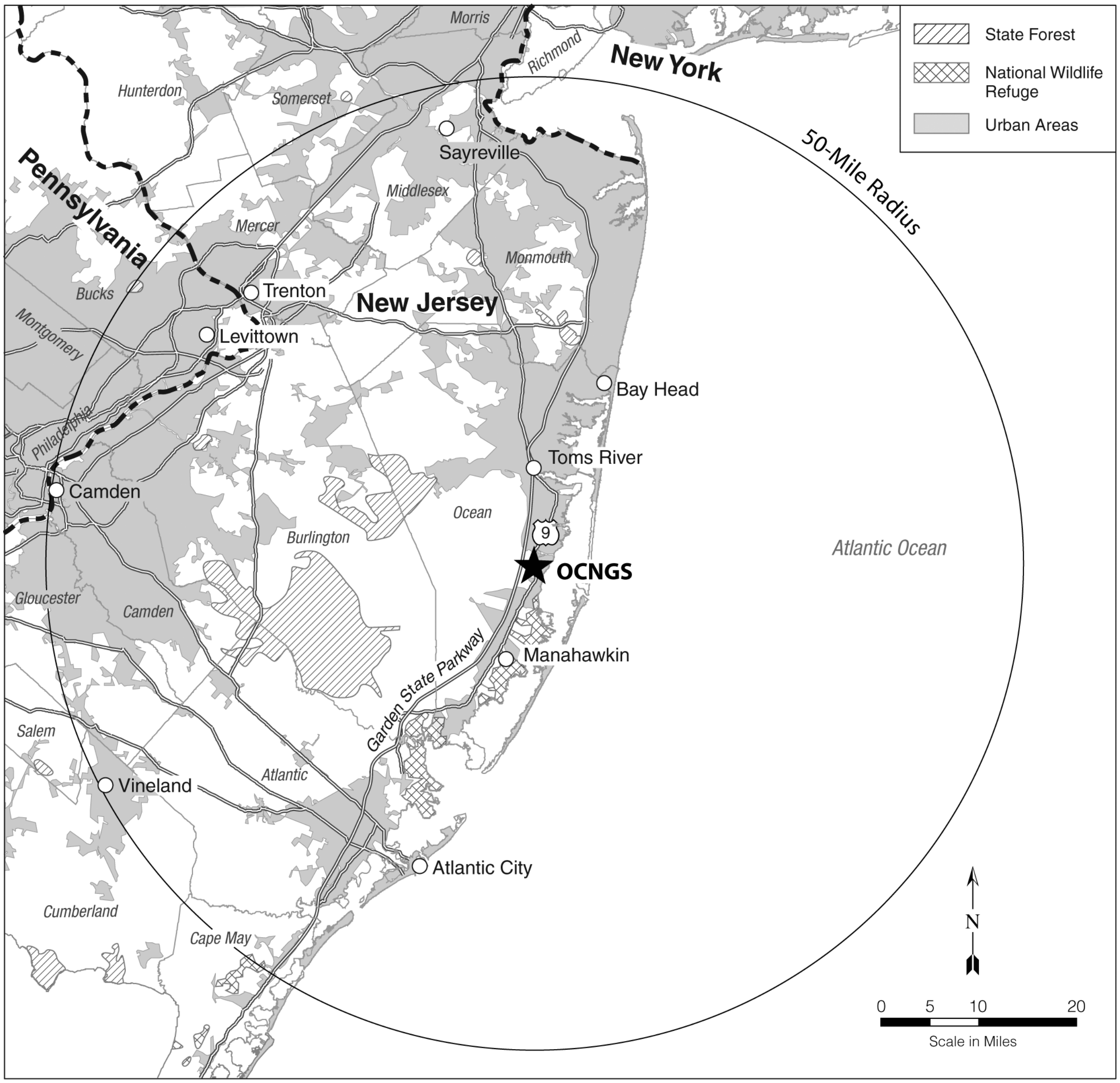

Figure 2-1. Location of Oyster Creek Nuclear Generating Station, 50-mi Region (Source: AmerGen 2005a)

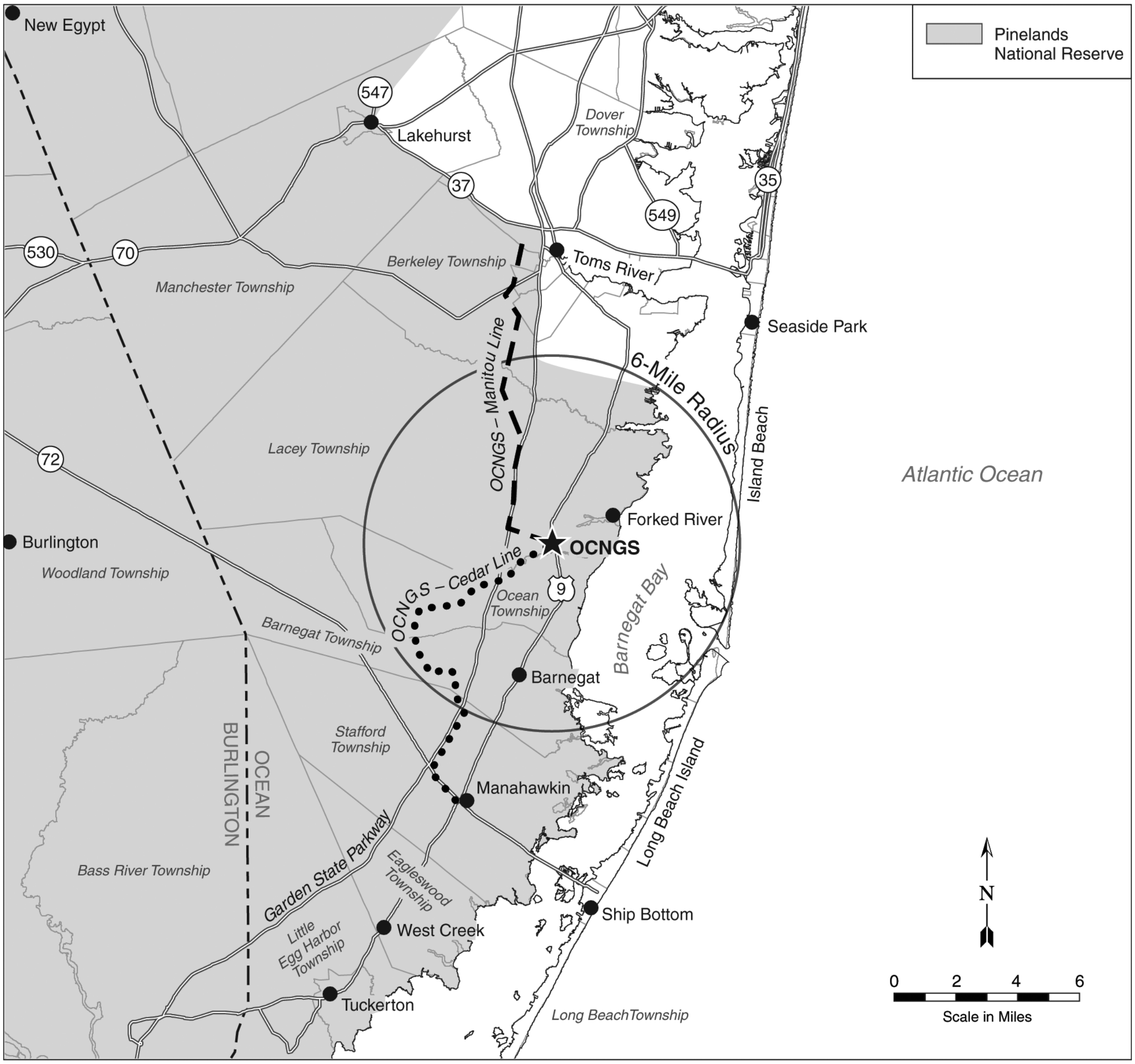

Figure 2-2. Location of Oyster Creek Nuclear Generating Station, 6-mi Region (Source: AmerGen 2005a)

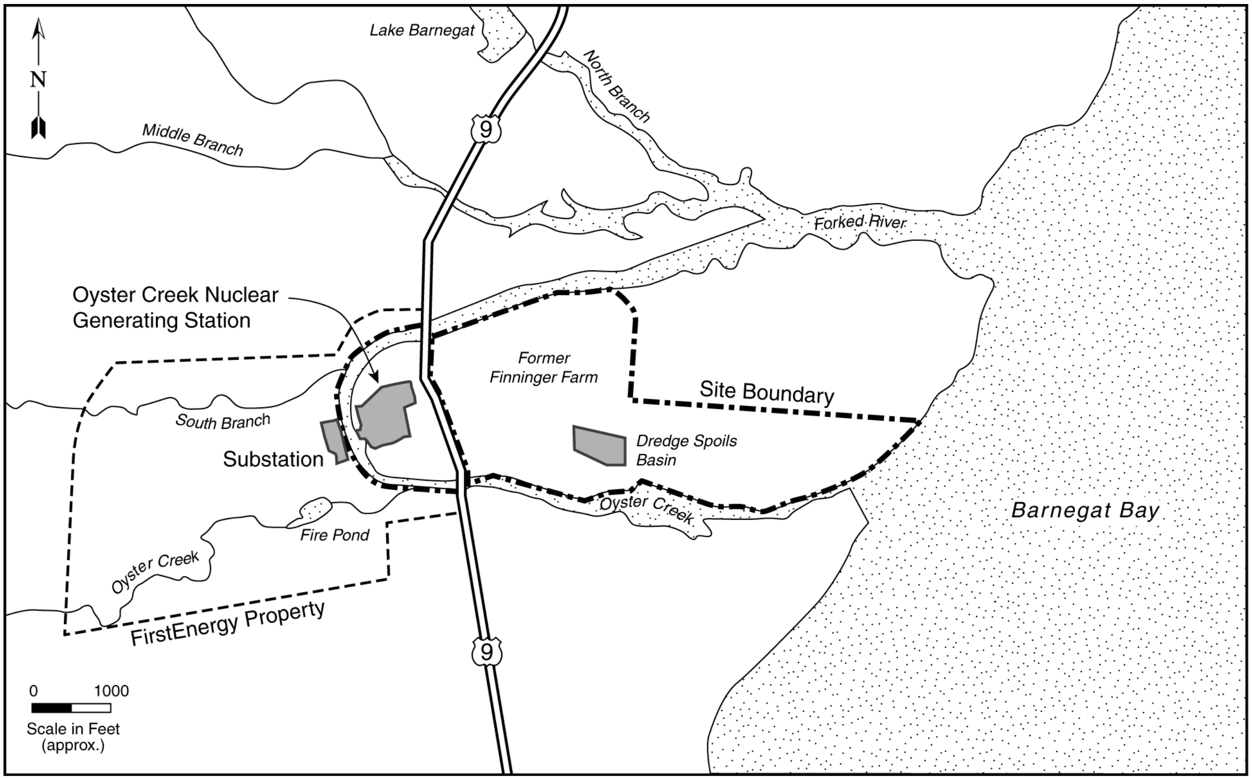

Figure 2-3. Oyster Creek Nuclear Generating Station Site Boundary
(Source: AmerGen 2005a)

As shown in Figure 2-3, the OCNGS property is bisected by U.S. Highway 9. The OCNGS power-generating and supporting facilities are located within an approximately 150-ac area to the west of U.S. Highway 9. The tract of land east of U.S. Highway 9 is approximately 650 ac and is referred to as the former Finninger Farm. The former Finninger Farm is largely undeveloped and contains old fields, abandoned orchards, forests, wetlands, and marshlands. A dredge spoils basin for sediment removed from Oyster Creek and Forked River is also located in this portion of the site (AmerGen 2005a). The property immediately to the west of the OCNGS property is owned by FirstEnergy, an Ohio utility. The FirstEnergy property contains a 66-megawatt-electric (MW(e)) dual-fired combustion turbine power plant that can provide emergency offsite power to OCNGS. In addition, it contains the substation for the OCNGS power transmission system.

The OCNGS property is located in the coastal pine barrens of New Jersey and is within the Pinelands National Reserve (Figure 2-2). The terrain surrounding the site is relatively flat along the shoreline to gently rolling inland. The area immediately surrounding the plant is a mix of vacant lands, agricultural lands, and woodlands. Only about 25 percent of the land in the surrounding area is developed because development within the Pinelands National Reserve is strictly controlled (AmerGen 2005a).

Based on 2000 U.S. Census Bureau (USCB) data, approximately 4.2 million people live within 50 mi of the site (AmerGen 2005a). The population density of 1132 persons/mi^2 is considered a high population area based on the criteria described in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a]

Along Barnegat Bay to the east of OCNGS, the land is residentially developed for year-round and seasonal use. Barnegat Bay is bordered by the mainland to the west, Point Pleasant and Bay Head to the north, the barrier islands to the east, and Manahawkin Causeway to the south. Barnegat Bay is a popular summer resort area that experiences large population increases during the summer months. Within a mile of the OCNGS, the summer population is more than double the permanent population (AmerGen 2003a). The bay is enclosed by a barrier beach and is a narrow, shallow tidal basin that is approximately 43 mi long, 3 to 9 mi wide, with an average depth of 5 ft (BBNEP 2002).

The OCNGS lies in an area known geologically as the coastal plain. The coastal plain is underlain by a thick wedge of unconsolidated sediments. The buildings and structures are built generally on Cohansey sand (AmerGen 2003a).

2.1.2 Reactor Systems

OCNGS is a nuclear-powered, steam electricity-generating facility that began commercial operation on December 23, 1969. OCNGS is powered by a boiling-water reactor manufactured by General Electric and features a Mark I containment. The unit produces a reactor core power of 1930 megawatts-thermal (MW(t)), with a net electrical capacity of 640 MW(e).

The OCNGS site layout is shown in Figure 2-4. Major buildings and structures include the reactor building, turbine building, administration building, low-level radioactive waste storage building, security building, emergency diesel generator building, intake and discharge structure, ventilation stack, and several storage tanks. The site also includes an independent spent fuel storage facility for dry storage of spent nuclear fuel.

The reactor's primary containment is a pressure suppression system consisting of a dry well, a pressure-absorption chamber, and vent pipes connecting the dry well to the pressure-absorption chamber. The dry well is a steel pressure vessel with a spherical lower portion and

(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.

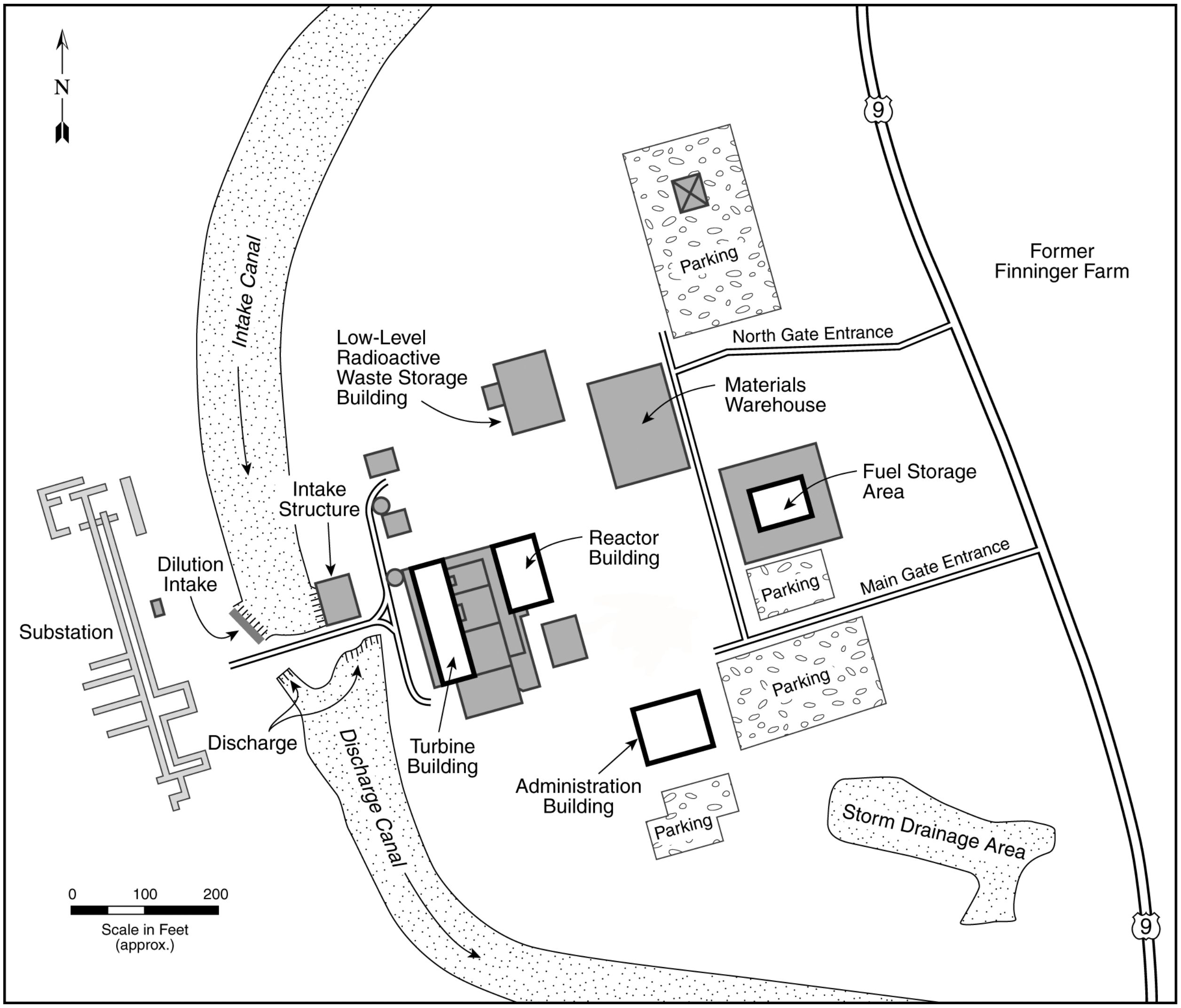

Figure 2-4. Oyster Creek Nuclear Generating Station Site Layout
(Source: AmerGen 2005a)

a cylindrical upper portion. The pressure absorption chamber is a steel pressure vessel in the shape of a torus, located below and encircling the dry well, and is approximately half-filled with water. The vent system from the dry well terminates below the water level in the torus, so that in the event of a pipe failure in the dry well, the released steam passes directly to the water where it is condensed (AmerGen 2003a).

Secondary containment is provided by the reactor building, which is constructed of reinforced concrete to the refueling floor. Above the refueling floor, the structure is a steel framework with insulated, corrosion-resistant metal siding. The reactor building also houses all refueling equipment, including the spent fuel storage pool and the new fuel storage vault.

The reactor fuel is uranium dioxide pellets sealed in Zircaloy-2 tubes. The uranium-235 in the fuel pellets is enriched to no more than 5 percent. The reactor is refueled on a 24-month refueling cycle. Spent fuel is currently stored onsite in the storage pool, as well as in the independent spent fuel storage facility.

2.1.3 Cooling- and Auxiliary-Water Systems

OCNGS has a once-through cooling system that uses water from Barnegat Bay. Cooling water is withdrawn from the bay, first through the lower reaches of Forked River and then through a 150-ft-wide intake canal. Heated cooling water is discharged to a 150-ft-wide discharge canal that flows into Oyster Creek, which in turn flows into the bay. The intake and discharge canals are divided by a berm (Figure 2-4). Dilution pumps move water from the intake canal directly into the discharge canal to lower the water temperature in the discharge canal. Details on the circulating- and dilution-water systems are presented below. Unless otherwise noted, the discussion of the circulating-water system was taken from the Updated Final Safety Analysis Report (UFSAR) (AmerGen 2003a), the Final Environmental Statement (FES) (AEC 1974), or the Environmental Report (ER) (AmerGen 2005a).

The station intake structure for the circulating-water system has two bays, each equipped with trash bars, a 3/8-in.-mesh traveling screen, a screen-wash system, a fish-return system, two service-water pumps, two emergency service-water pumps, and two circulating-water pumps. Each of the circulating-water pumps can provide up to 115,000 gallons per minute (gpm) of cooling water to the condensers. An angled boom in the intake canal immediately in front of the intake prevents large mats of eelgrass and algae from clogging the intake system.

The trash bars consist of almost-vertical steel bars on 3-in. centers with an effective opening of 2.5 in. After passing through the trash bars, water passes through 3/8-in. mesh traveling screens equipped with Ristroph buckets. A low-pressure screen wash washes off aquatic organisms and debris impinged on the traveling screens into the Ristroph buckets. The Ristroph buckets empty into a fish flume that conveys the fish and shellfish to the head of the discharge canal in the area of the dilution pump discharge (NJDEP 2005a). The Ristroph fish-return system improves the survival of the fish impinged on the screens.

Sodium hypochlorite is injected into the circulating-water and plant service-water systems, and chlorine gas is injected into the augmented off-gas/new radioactive waste service-water system to minimize biological fouling in the pipes and condensers. The main condenser's six sections are chlorinated one at a time so that the sections are consecutively chlorinated for 20 minutes each during the daily cycle for a maximum of 2 hr per day of chlorination (NJDEP 2005a).

Each bay of the intake structure has a service-water pump with a pump capacity of 6000 gpm, a second service-water pump with a pump capacity of 2000 gpm, two emergency service-water pumps with a pump capacity of 4150 gpm each, and a screen-wash pump with a pump capacity of 900 gpm. These pumps are located immediately downstream of the traveling screens. Service water provides cooling water to the reactor building and turbine building heat exchangers. The service water empties into the discharge canal and mixes with the circulating and dilution water.

The three dilution-water pumps are low-head, axial flow pumps with 7-ft impellers, and each pump is rated at 260,000 gpm. They are located on the western side of the intake canal and are protected by trash racks. Because the intake to the dilution pumps lacks traveling screens, fish and other aquatic organisms may be drawn through the pumps. There is no fish-return system on the intake to the dilution pumps. The low-head axial pump design allows for some impingement and entrainment survivability (NJDEP 2005a). The purpose of the dilution pumps is to decrease the temperature of the discharge, which otherwise would encourage migratory fish to stay during the spring and fall, and to reduce thermal stress on organisms in the discharge canal during the summer. The use of the dilution pumps is addressed in the New Jersey Pollutant Discharge Elimination System (NJPDES) permit. Only two of the three pumps operate concurrently during normal operations. During a shutdown, dilution pumping serves to minimize the impact of thermal shock on organisms in Oyster Creek and Barnegat Bay. In the winter, a recirculation tunnel transfers water from the discharge to the intake as needed to prevent icing.

Maximum flow with all circulating pumps and all three dilution pumps working is 1.25 million gpm. At this flow rate, velocities in the intake and discharge canals are typically less than 2.0 ft per second. Typically only two of the three dilution pumps are in operation, so the total flow is typically less than 1 million gpm.

Intake design and operation are regulated under the Clean Water Act (CWA) through the discharge permitting system. The New Jersey Department of Environmental Protection (NJDEP) has responsibility for issuing the NJPDES permit that addresses the effect of station operation on impingement and entrainment. The July 2005 draft NJPDES permit has not been finalized. The final requirements, limits, and conditions of the renewed permit were not available at the time the U.S. Nuclear Regulatory Commission (NRC) staff performed the assessment presented in this Supplemental Environmental Impact Statement (SEIS). For the purpose of this assessment, the staff has evaluated the impacts of continued operation during the renewal period under the existing expired 1994 permit. However, based on the staff's review of the draft permit and discussions with the NJDEP, the staff has determined that there is a reasonable possibility that OCNGS would be required to install a closed-cycle cooling system. The NRC staff has included a section in Chapter 8 of this SEIS that evaluates the impact of alternatives to the existing once-through cooling system for OCNGS – both a closed-cycle option that uses mechanical-draft cooling towers and a second alternative that includes a combination of design and construction technologies, operational measures, and restoration that would result in compliance with the U.S. Environmental Protection Agency (EPA) Phase II requirements (Title 40, Parts 9, 122 et al. of the *Code of Federal Regulations* [40 CFR Parts 9, 122 et al.]).

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

Radioactive wastes resulting from plant operations are classified as liquid, gaseous, and solid wastes. OCNGS uses liquid, gaseous, and solid radioactive waste management systems to collect and process these wastes before they are released to the environment or shipped to offsite disposal facilities. The waste disposal system meets the release limits as set forth in 10 CFR Part 20 and the dose design objectives of 10 CFR Part 50, Appendix I ("Numerical Guide for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As is Reasonably Achievable' for Radiological Material in Light-Water-Cooled Nuclear Power Reactor Effluents"), and controls the processing, disposal, and release of radioactive wastes. Unless otherwise noted, the description of the radioactive waste management systems and effluent control systems for liquid, gaseous, and solid wastes presented here (Sections 2.1.4.1, 2.1.4.2, and 2.1.4.3, respectively) is based on information provided in the OCNGS UFSAR (AmerGen 2003a) and was confirmed during the NRC staff's site visit.

The liquid and gaseous radioactive waste systems are designed to reduce the radioactivity in the wastes such that the concentrations in routine discharges are below the applicable regulatory limits. If necessary, liquid waste releases to the discharge canal occur in batches that are monitored during discharge and diluted by the circulating water. However, it is OCNGS operating policy since the late 1980s not to routinely release radioactive liquid effluents to the environment. Gaseous wastes are processed and routed to a common tall stack for release to the atmosphere, or released through rooftop vents on the turbine and off-gas buildings. The liquid and gaseous effluents are continuously monitored, and discharge is stopped if the effluent concentrations exceed predetermined levels.

The Offsite Dose Calculation Manual (ODCM) for OCNGS (AmerGen 2005b) describes the methods used for calculating radioactivity concentrations in the environment and the estimated potential offsite doses associated with liquid and gaseous effluents from OCNGS. The ODCM also specifies controls for release of liquid and gaseous effluents to ensure compliance with NRC regulations.

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; however, as a result of fuel cladding failure and corrosion, 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 wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service as well as contaminated protective clothing, paper, rags, and other trash generated from plant operations, design modification, and routine maintenance activities. The solid waste disposal system is designed to package solid wastes for removal to offsite treatment or disposal facilities. Some solid low-level waste is stored onsite temporarily before offsite shipment.

Fuel assemblies that have exhausted a certain percentage of their fuel and that are removed from the reactor core for disposal are called spent fuel. OCNGS currently operates on a 24-month refueling cycle. Spent fuel is temporarily stored in a spent fuel pool in the reactor building or in an onsite independent spent fuel storage installation.

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

The liquid radioactive waste system receives and processes all radioactive or potentially radioactive liquid wastes from multiple sources. These wastes are collected in sumps and drain tanks at various locations throughout the plant and then transferred to the appropriate collection tanks in the new radioactive waste building for treatment, storage, and disposal. The liquid wastes received are of different purities and chemical compositions. The liquid radioactive waste system is used to process these wastes to make them suitable for reuse within the plant or, if necessary, for release to the discharge canal where dilution occurs with the circulating water. As noted above, OCNGS has not routinely released liquid wastes since the late 1980s.

The principal sources of liquid wastes are equipment leakage, drainage, and process waste produced by plant operations. Limited segregation is employed to collect wastes with similar levels of chemical contaminants to permit effective treatment. Liquid wastes are broadly categorized into two categories, high-purity waste and chemical/floor drain waste.

The first category, high-purity liquid waste, is liquid effluent with a low conductivity, thus making it generally reclaimable for reuse within the nuclear facility. High-purity liquid waste is processed in two identical process trains, each consisting of a collection tank, feed pump, dewatering filter, demineralizer, resin trap, and sample tank. These wastes are collected in the waste collector tank from a variety of sources, including the equipment drain sumps in the dry well, reactor building, and old radioactive waste building, and from the chemical waste sample tanks.

The high-purity waste is processed through filters and demineralizers. Waste sample tanks are provided to receive filtered demineralized waste from the process trains. Two tanks are provided so that one is available for filling, while the contents of the adjacent tank are being recirculated and sampled prior to discharge. If the water is satisfactory for reuse, it is transferred to the condensate storage tank and used as makeup water. In the event the water is surplus to the plant's makeup requirements, processed wastes can be discharged.

The second category, chemical/floor drain waste, is liquid waste with a relatively high mineral content and/or suspended matter and varying levels of radioactivity. These wastes typically come from floor drain sumps in the dry well, reactor building, old and new radioactive waste buildings, and turbine building, as well as the laboratory drain tank. The chemical/floor drain treatment system consists of either an evaporator-based or a demineralizer-based process train that is fed from three collection tanks. Treated water from this system is normally recycled to the high-purity waste collection tank.

If a release is necessary, processed waste suitable for discharge to the environment is routed to a single monitored release point, which is the termination point of the service-water piping at the discharge canal. Normally, all process wastewater surplus to plant makeup requirements would be discharged to the environment through the high-purity waste system. Wastes being discharged are sampled, analyzed, and released in accordance with the ODCM. This wastewater is diluted by the normal circulating-water system flow.

The NRC staff reviewed the annual liquid effluent releases reported in the OCNGS Annual Radioactive Effluent Release Reports for the years 2000 through 2004 (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). During this 5-year period, there were no routine liquid effluent releases from the liquid radioactive waste processing system. In 2000, one liquid radioactive discharge consisting of 620 gal containing approximately 0.000014 Ci of tritium was made to the discharge canal. This discharge was the result of flushing the fire service system. AmerGen does not anticipate any significant annual increases in liquid waste effluents during the renewal period. See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual (MEI) as a result of liquid effluent releases.

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

At OCNGS, gaseous releases may occur from the 368-ft above-grade plant stack and vents on the turbine and off-gas buildings. Sources of releases from the stack are the main condenser steam-jet air ejectors, building ventilation, and gland seal off-gases. Releases from the turbine building vents result from steam leakage primarily in the heater bay and condenser area. OCNGS ventilation systems are designed to maintain gaseous effluents at levels as low as reasonably achievable. This is done by a combination of holdups for decay of short-lived radioactive material, filtration, and monitoring. Continuous radiation monitoring is provided at various points in the system.

During normal operation, noncondensable gases are produced in the reactor coolant and must be continuously removed to maintain turbine efficiency. These gases include hydrogen and oxygen from radiolysis of water, mixed fission products, activation products, and air from condenser in-leakage. Off-gas is discharged from the condenser via steam-jet air ejectors and passed through holdup piping and high-efficiency particulate air (HEPA) filters before entering the augmented off-gas system. The off-gas is then passed through a flame arrestor and a system where hydrogen and oxygen are catalytically recombined into water. After recombination, the off-gas is routed to a chiller to remove moisture, and then through four charcoal delay beds that provide a long delay period for radioisotope decay as the off-gas passes through. The off-gas is then passed through HEPA filters before it is routed to the 368-ft plant stack for release to the environment.

The NRC staff reviewed the gaseous effluent releases reported in the OCNGS Annual Radioactive Effluent Release Reports for the years 2000 through 2004 (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). During this 5-year period, the average annual release of radioactive effluents was about 265 Ci/yr, consisting of the following:

- 226 Ci/yr of fission and activation gases,
- 0.21 Ci/yr of iodines,
- 0.024 Ci/yr of beta and gamma emitters as particulates, and
- 38.5 Ci/yr of tritium.

All gaseous effluents were well within the NRC regulatory limits. AmerGen does not anticipate any significant annual increases in gaseous waste effluents during the renewal period. See Section 2.2.7 for a discussion of the theoretical doses to the MEI as a result of gaseous releases.

2.1.4.3 Solid Waste Processing

The solid waste management system at OCNGS is designed to collect, process, store, package, and prepare wet and dry solid radioactive waste materials for offsite shipment. Some solid waste is temporarily stored onsite in shielded structures to permit radioactive decay and/or accumulation prior to shipment from the plant. Solid wastes consist of spent resins, filter sludges, evaporator bottoms, concentrated wastes, dry compressible wastes, air filters from radioactive ventilation systems, irradiated components (control rods, etc.), contaminated clothing and tools, paper and rags from contaminated areas, and used reactor equipment.

The wet solid waste handling system processes concentrated liquid wastes, chemical filter sludges, high-purity filter sludges, reactor water cleanup filter sludges and resins, fuel pool cleanup filter sludges and resins, dewatered sludges, and demineralizer resins from various plant demineralizers. Spent resins are transferred into disposable high-integrity containers fitted with dewatering filters. Concentrated liquid wastes may be solidified or shipped to a licensed processor. A vendor-supplied mobile solidification system can be made available upon demand. Filter sludge may be dewatered similar to spent resin, or solidified similar to concentrated liquid waste.

Dry solid wastes are low-activity-level wastes consisting of contaminated air filters, miscellaneous paper, rags, solid laboratory wastes, clothing, tools, and equipment parts. The dry solid waste is normally stored temporarily in various work areas and then moved to the process area. Most waste of this type has relatively low radioactive content and may be handled manually. This waste is compressed into authorized containers for offsite shipment or interim onsite storage.

Transportation and disposal of solid radioactive wastes are performed in accordance with the applicable requirements of 10 CFR Part 71 and Part 61, respectively. During the period 2000 through 2004, an average of 29 waste shipments per year were made from OCNGS to treatment or disposal facilities. The annual average amount of solid radioactive waste shipped from OCNGS was 1060 m^3/yr, containing 4080 Ci/yr of activity (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). AmerGen does not anticipate any significant annual increase in solid radioactive waste during the renewal period.

2.1.5 Nonradioactive Waste Systems

The principal nonradioactive wastes from OCNGS consist of hazardous (chemical) waste, solid waste, and sanitary waste. A smaller waste stream also includes medical waste.

As is the case with any large industrial facility, OCNGS generates a variety of wastes that are classified as hazardous under the Resource Conservation and Recovery Act (RCRA). Such wastes include paint-related materials, spent solvents used for cleaning and degreasing, and universal wastes such as batteries and fluorescent light bulbs. OCNGS is classified by the state of New Jersey as a small quantity generator of hazardous waste under EPA Permit No. NJD980649172. General plant trash such as paper, metals, garbage, food and grease, are collected as part of routine plant operation activities. OCGNS also has a recycling program to segregate and recycle scrap metals and paper products. Approximately 150 tons of general office trash and recyclables were generated in 2005, including food and grease, used oil, corrugated cardboard, office paper, copper, brass, steel, and aluminum. OCNGS employs five separate contractors to manage the disposal and/or recycling of the wastes mentioned above.

OCGNS is also a Category 1 medical waste generator in the state of New Jersey, generating less than 50 pounds of medical waste per year for minor or emergency treatment on site during routine plant operation, and uses New Jersey licensed medical waste contractor to dispose of such wastes (AmerGen 2006a).

Sanitary wastewater from all plant locations enters a concrete equalizing tank via a 6-in. sanitary collection main. The equalizing tank discharges via an 8-in. gravity line to the Lacey Municipal Utilities Authority Sewer System and subsequently to the Ocean County Utilities Authority regional collection system. A radiation monitoring system is provided to continuously monitor radiation levels in the effluent.

The EPA's Office of Pollution Prevention and Toxics makes available pollution prevention resources and a clearinghouse that identifies potential waste reduction measures for businesses and industry. OCGNS does not have a formal waste minimization plan. However, its waste management practices contain elements of such a program, e.g., spill plan, measures to reduce some solid waste streams by recycling office paper, cardboard, and scrap metal, etc.

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for the safe and reliable operation of a nuclear power plant. Maintenance activities conducted at OCNGS include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as the replacement of a major component. The reactor is refueled on a 24-month schedule.

As part of the License Renewal Application (Application), AmerGen conducted an aging management review to manage the impacts of aging on systems, structures, and components in accordance with 10 CFR Part 54. Section 4 of the Application documents the evaluations of time-limited aging analyses (TLAAs) for the license renewal period. Appendix B of the Application provides descriptions of the programs and activities that would manage the impacts of aging for the renewal period. These summary descriptions of aging management program activities and TLAAs would be incorporated into the UFSAR for OCNGS following the issuance of the renewed OL. AmerGen expects to conduct the activities related to the management of aging impacts during plant operation or normal refueling and other outages, but does not plan any outages specifically for the purpose of refurbishment.

2.1.7 Power Transmission System

OCNGS transmits its generated power over the GPU Energy transmission system. The plant depends on the local 34.5-kilovolt (kV) subtransmission and distribution systems to serve as the offsite power source for the OCNGS safety-related loads in the event of a plant trip. A function of the offsite power system is to provide a backup source of alternating current (AC) power to the station when the main generator is incapable of supplying station loads through the auxiliary transformer. Offsite AC power normally supplies the station auxiliary loads through the startup transformers during plant startup. After the station is operating and supplying electric power to the grid, offsite power acts as a standby source of power (AmerGen 2003a).

The connection of the facility with the 34.5-kV GPU Energy system is via the 34.5-kV Oyster Creek substation. The 34.5-kV Oyster Creek substation has two parallel buses with a tie breaker between them. The tie breaker connecting the buses will open automatically if either bus is faulted. Each of the buses can be supplied by a separate line from other GPU Energy substations, following different rights-of-way. Beyond the transformer-side disconnects at the OCNGS substation, the line and corridor easements are owned, operated, and held by FirstEnergy, an Ohio utility (AmerGen 2005a).

The electricity generated by OCNGS is supplied to the grid through a 230-kV transmission system. Two AmerGen-owned station transformers are located between the turbine building and the intake and discharge canals. The delivery of generated power to the grid is via two transmission lines, the OCNGS-to-Manitou and the OCNGS-to-Cedar lines (Figure 2-2). The OCNGS-to-Manitou line is a double-circuit line hung on a single set of steel towers that runs 11.1 mi in a northerly direction from the 230-kV substation at OCNGS to the Manitou substation near Toms River. The OCNGS-to-Cedar connection is through a double-circuit line that is 14 mi long. The transmission line corridor for this line runs in a primarily southerly direction, varies in width from 25 to 100 ft, and portions parallel the Garden State Parkway.

The OCNGS-to-Manitou transmission line corridor is 240 ft wide, approximately parallels the Garden State Parkway, and occupies approximately 320 ac (Figure 2-2). The corridor passes through land that is primarily pine forest and swamp forest; the line is located entirely within the Pinelands National Reserve (Figure 2-2). The areas are mostly remote, with low population densities, but there are some residential subdivisions adjacent to the line. Approximately 1 mi of the line passes through Double Trouble State Park, which is about 12 mi to the north of OCNGS. The line crosses numerous county roads and the Garden State Parkway. FirstEnergy plans to maintain this transmission line, which is integral to the larger transmission system, indefinitely. The transmission line will remain a permanent part of the transmission system even after OCNGS is decommissioned. The OCNGS-to-Manitou line is considered within the scope of the OCNGS license renewal.

The OCNGS-to-Cedar transmission line is owned by Atlantic City Electric (formerly Conectiv), a mid-Atlantic electric distribution company. The line is not considered within the scope of OCNGS license renewal because it was constructed and placed into operation recently. Only transmission lines that originally connected the station to the grid are considered within the scope of license renewal. Although the OCNGS-to-Cedar line is out of scope, it is described here for completeness. An environmental assessment was prepared that evaluated the impacts associated with construction and operation of the OCNGS-to-Cedar line (ENSR International 2004).

Jersey Central Power & Light Company (JCP&L), now a subsidiary of FirstEnergy, designed and constructed the OCNGS-to-Manitou transmission line in accordance with industry guidance that was current when the line was built (AmerGen 2005a). Ongoing surveillance and maintenance of the transmission facilities ensure continued conformance to design standards.

Vegetation management on the OCNGS-to-Manitou transmission line corridor is conducted on a scheduled 4-year rotation. For the OCNGS-to-Manitou line, the maintained portion of the corridor extends 30 ft to either side of the line. Within this clear zone all trees with diameters greater than 6 in. at 4.5 ft from the ground are pruned such that the pruning will result in 4 years of adequate clearance. If a tree must be removed at the stump (at ground level), the stump is treated with herbicide by licensed applicators to prevent resprouting. However, a majority of the transmission line is located on land administered by the New Jersey Pinelands Commission, and herbicide use is not allowed on these locations. Vegetation management on these portions of the corridor consists of cutting only.

The transmission line corridor is examined twice yearly for vegetation-management issues; one of the examinations is conducted entirely from low-flying aircraft. The 4-year vegetation treatment cycle includes a combination of hand cutting, mowing, and low-spray herbicide application. As stated, no herbicides are used on lands under the administration of the New Jersey Pinelands Commission. The Pinelands Commission will be issuing comprehensive vegetation-management guidelines for rights-of-way on its lands during 2007, and these new guidelines will be incorporated by FirstEnergy.

Vegetation management on the OCNGS-to-Manitou transmission line corridor follows NJDEP guidelines for Integrated Pest Management and the Edison Electric Institute Environmental Stewardship Strategy for Electric Utility Rights-of-Way. The guidelines stress the importance of developing a low-growing, sustainable vegetation community that will not pose a hazard to the transmission facilities. The primary means of accomplishing this goal is a combination of mechanical removal of large trees and application of herbicides to a selected group of plant species, primarily trees, to prevent regrowth. Manual and mechanical cutting (usually with a bush hog or similar powered cutting device) results in woody debris that can be used as windrows, or chipped and left onsite to enrich the soil. Mechanical methods allow very specific control of key danger trees and are employed exclusively near and around wetland locations to avoid the use of herbicides.

Chemical herbicides are only used on a small portion of the southern and northern ends of the line to treat incompatible tall-growing trees and vines. All chemicals that are used for vegetation management are approved for that use by the EPA. In addition, the state of New Jersey requires that all individuals employed by FirstEnergy who apply herbicide:

- View the Edison Electric Institute Environmental Stewardship Strategy for Electric Utility Rights-of-Way videotape and supporting documents,

- Possess a valid Commercial Pesticide Applicator license issued by the NJDEP, and

- Are certified in Category 6B (Right-of-Way Pest Control).

The application of herbicides follows general best management practices and includes:

- Spot treatments, if and where available, that target specific species;
- Application under appropriate environmental conditions (i.e., no spraying on windy days or immediately prior to forecast of heavy rain); and
- Application through the use of appropriate drift reduction techniques, such as the use of low-pressure sprayers when possible.

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment near OCNGS as background information. They also provide detailed descriptions where 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

The OCNGS site is located in Lacey and Ocean Townships, Ocean County, on the southeastern coast of New Jersey, and about 9 mi south of Toms River, New Jersey. OCNGS plant facilities are located approximately 2 mi inland from Barnegat Bay on 152 ac of land located between Oyster Creek to the south, the South Branch of Forked River to the north, and U.S. Highway 9 to the east (Figure 2-2). The land to the east of U.S. Highway 9 (about 650 ac) was formerly farmland (the Finninger Farm; Figure 2-3) that is undergoing succession; vegetation currently consists of grasses, native pines, and small oaks (AmerGen 2005a). Material dredged from Oyster Creek and the South Branch of Forked River has been placed in a dredge spoils basin on the former Finninger Farm (Figure 2-3).

The nearest population center is Forked River Beach housing development, located on the shoreline at the mouth of Forked River, approximately 1 mi east of the OCNGS site. The OCNGS site is located in the Pinelands National Reserve and is adjacent to Barnegat Bay, which draws large numbers of summer visitors (AmerGen 2003a). A State game farm located approximately 2 mi north of the site is used for raising quail and pheasant (AmerGen 2005a).

The OCNGS site lies on the New Jersey Coastal Plain. The area in which the site is located varies from relatively flat along the shoreline to rolling inland. The majority of the area in the immediate vicinity of the OCNGS site consists of abandoned farmland (65 percent), forested land (25 percent), and surface water (10 percent) (AmerGen 2005a).

A number of buildings and other permanent structures occupy approximately 80 ac of the OCNGS site. These include an intake structure, a turbine building, a reactor containment building, an administration building, and a waste storage building (AmerGen 2005a; Figure 2-4). The plant area is fenced off from the remainder of the owner-controlled area and is under the control of plant security personnel. The site boundary of the owner-controlled area is posted (AmerGen 2005a).

Section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA; *United States Code*, Title 16, Section 1456(c)(3)(A) (16 USC 1456(c)(3)(A))) requires that applicants for Federal licenses certify that any proposed activity in a coastal zone is consistent with the enforceable policies of the State's coastal zone program (NRC 2004). A copy of the certification is also to be provided to the State. The State is to notify the Federal agency whether the State concurs with or objects to the applicant's certification. This notification is to occur within 6 months of the State's receipt of the certification. OCNGS is within New Jersey's coastal zone for purposes of the Act (NJDEP 2005b).

On January 21, 2005, AmerGen submitted an application (in AmerGen 2005a) for a Federal Consistency Determination Request for license renewal for OCNGS by the NRC. On August 19, 2005, the NJDEP determined that AmerGen's request for a Federal consistency determination was inconsistent with New Jersey's Coastal Zone Management Plan because there was insufficient information in the January 21, 2005, application, and that the application was not in compliance with Basic Coastal Policy 5, which controls public access to waterfront areas (NJDEP 2005i). Under the provisions of a September 19, 2005, Memorandum of Understanding, negotiated by the U.S. Department of Commerce, National Marine Fisheries Service (NMFS), between the NJDEP and AmerGen (provided in Appendix E), AmerGen withdrew its consistency certification, and the NJDEP withdrew its consistency objection. AmerGen resubmitted its consistency certification to the NJDEP on December 1, 2006 (AmerGen 2006b). The State of New Jersey has 6 months from the date of submittal to review the application.

2.2.2 Water Use

Construction of OCNGS in the 1960s resulted in the dredging and widening of portions of the South Branch of Forked River and Oyster Creek. Dredged material from construction was placed on the OCNGS site. Oyster Creek was again dredged in 1978, and the South Branch of Forked River was dredged in 1984 and 1997 (URSGWC 2000). Depth monitoring takes place every 2 years. Materials dredged in 1978, 1984, and 1987 were placed in a 17.5-ac bermed area on the former Finninger Farm (Figure 2-3). Characteristics of dredged sediments are presented in Section 2.2.3.

As described in Section 2.1.3, the facility uses water in the circulating-water system, the service-water system, and the dilution-water system. Other plant uses are detailed below.

The fire pond is a source of water for fire fighting at OCNGS. It was created by damming Oyster Creek in approximately 1966. Water naturally exits the pond by flowing over the dam. The pond and pump house is owned by JCP&L and leased by AmerGen. Freshwater from the fire pond also is used for dilution pump lube oil cooling and pump seal water (NJDEP 2005a).

A pipe runs over the top of the water surface of the intake canal along the east side of the U.S. Highway 9 bridge over the river. The original purpose of this pipe was to supply water to basins on the OCNGS property as a means of addressing possible saltwater intrusion into aquifers. However, this potential problem was determined to be of no concern, and the pipe is inactive.

OCNGS lies in the Atlantic Coastal Plain physiographic province. The site's near-surface geology consists of the Pleistocene Cape May Formation over the Miocene Kirkwood-Cohansey Formation. URS Greiner Woodward Clyde (URSGWC 2000) summarized the local geology and hydrogeology. The Cape May Formation is predominantly a medium to fine sand. The Cohansey Formation is a medium to fine sand with clay lenses, while the Kirkwood Formation is a very fine to fine sand with some coarse to fine gravel. The Cape May and Cohansey Formations generally function as a single, unconfined hydrologic unit, while the Kirkwood Formation exhibits confined conditions. At the site, the Cape May Formation is a sandy unit typically 20 ft thick and underlain by clay that is typically 15 to 18 ft thick, if not breached by an excavation. The Cohansey Formation is about 60 to 75 ft thick and is underlain by 10 to 20 ft of thick clay. The Kirkwood Formation is below this clay. In combination, the Kirkwood-Cohansey Formation may range in thickness up to 350 ft, and well yields are typically 500 to 1000 gpm (USGS 2001). A thick sequence of additional coastal plain sediments underlies the Kirkwood-Cohansey Formations (USGS 2001).

Two onsite groundwater wells provide water for reactor makeup, potable and nonpotable domestic uses, and the sanitation system. Information on the two production wells at OCNGS is available in a water use registration (NJDEP 2001a), which is required for users of less than 100,000 gallons per day (gpd). The South Well was drilled in 1964 to a depth of 300 ft and is finished in the Kirkwood-Cohansey Formation aquifer. Its yield is 600 gpm and its pumping capacity is 200 gpm. It is located south of the turbine building, between the diesel generator building and the machine shop, and is used for makeup and potable domestic water. It is flush-mounted, with aboveground controls. The North Well was drilled in 1987 to a depth of 162 ft and is also finished in the Kirkwood-Cohansey Formation aquifer. Its yield is 300 gpm and its pumping capacity is 225 gpm. The North Well is used for potable domestic water for the administration and cafeteria buildings, and it may be used for makeup water if needed. It is located at the northwestern corner of the north parking lot.

The wells' water usages are metered, with meter calibration every 5 years (NJDEP 2001a). The total combined pumping capacity for the North and South Wells is 425 gpm. The actual total production of these wells during 2001 was 7,379,654 gal or an average of 14 gpm over the year.

In 2001, the South Well produced 5,205,454 gal (9.9 gpm) and the North Well produced 2,174,200 gal (4.1 gpm) (AmerGen 2005a). Extraction wells for groundwater remediation are discussed in Section 2.2.3.

The NJDEP maintains a website of permits, inspections, and violations pertaining to water supply systems (NJDEP 2005d). The system shows two inspections of the North and South Wells since the startup of the online information system in July 2000. Both June 2003 and June 2005 inspections resulted in no violations related to the groundwater production wells.

2.2.3 Water Quality

The water quality of OCNGS effluents is regulated through the NJPDES program. The NJPDES permit specifies the discharge standards and monitoring requirements for each discharge. Compliance with the NJPDES process, other provisions of the CWA (e.g., Sections 316(a), 316(b), 401, and 404), and other regulatory requirements are expected to provide adequate control of potential effluent effects. Under these regulatory programs, AmerGen treats wastewater effluents, collects and properly disposes of potential contaminants, and undertakes pollution prevention activities that comply with regulatory requirements and minimize the risk of adverse environmental impacts.

The NJPDES permit was issued in 1994 (NJDEP 1994) and expired in 1999. A provision of the CWA and NJPDES regulations allows facilities to continue to operate under an expired permit provided that the permittee makes a timely renewal application, which is the case with OCNGS. In July 2004, the EPA issued Phase II regulations for existing electricity-generating plants that meet eligibility criteria as set forth in 40 CFR 125.91, including a design intake flow of 50 million gpd or more. The regulations established national performance standards with respect to Section 316(b) of the CWA. The regulations call for reducing impingement mortality by 80 to 95 percent of baseline, and reducing organisms entrained into the cooling system by 60 to 90 percent of baseline (EPA 2004). A draft permit was issued by the NJDEP in July 2005 (NJDEP 2005a) that emphasized the goal of reducing impingement and entrainment losses at the facility. The draft NJPDES permit provides the licensee two alternatives. The first is to reduce intake flow to the level commensurate of that of closed-cycle cooling. The second alternative, should a closed-cycle cooling system be unavailable to OCNGS, is for AmerGen to install and operate a combination of design and construction technologies, operational measures, and restoration measures with the goal of meeting the impingement and entrainment performance standards. The second alternative would also require the licensee to begin a wetlands restoration and enhancement program in the Barnegat Bay watershed. Preliminary State calculations suggest that the licensee could require a significant amount of wetland restoration to compensate for the losses from entrainment and impingement. As of the date of publication of the SEIS, the NJDEP had not issued a final NJPDES permit.

OCNGS has seven NJPDES discharge locations. These are described in detail in an NJDEP fact sheet (NJDEP 2005a). The discharges are summarized in Table 2-1.

Table 2-1. OCNGS NJPDES Discharge Locations

Discharge Name	Flow Rate (gpd)	Description
DSN001A	592,000,000	Chlorinated, once-through, noncontact cooling water from the circulating-water and service-water systems. Discharged to the discharge canal.
DSN002A	3,500,000	Chlorinated, noncontact cooling water from the radioactive waste treatment system's heat exchanger and augmented off-gas heat exchanger. Discharged to the intake canal.
DSN004A	60,000	Stormwater, noncontact cooling water from the reactor building and emergency service-water heat exchangers, laboratory and sampling streams, and floor drains by sumps. Discharged to the discharge canal.
DSN005A	732,000,000	Dilution water pumped directly from the intake canal to the discharge canal.
DSN007A	30	Dilution pump seal wastewater treated by an oil/water separator. Discharged to the intake canal.
DSN008A	2,400,000	Intake screen washwater. Originally into hot discharge, but now in an underwater discharge in the seawall between DSN001A and DSN005A.
DSN009A	Used only as needed	Fish sampling pool, discharged to the intake canal.

Source: NJDEP 2005a

Water-related information since July 2000 is available on the NJDEP website (NJDEP 2005d). On September 23, 2002, the dilution pumps were turned off during maintenance, resulting in a water temperature increase and a fish kill (NJDEP 2005d). The event was prosecuted by the State of New Jersey, and a fine was levied against the applicant. Other NJPDES sampling events and standard compliance inspections since July 2000 showed no violations. Discharge monitoring data include chlorine-produced oxidants (total residual chlorine), flow, toxicity testing, net rate of addition of heat, pH, water temperature, temperature difference between intake and discharge, velocity at intake, total suspended solids (TSS), petroleum hydrocarbons, and total organic carbon. Downstream water temperature is also monitored at the U.S. Highway 9 bridge over Oyster Creek.

NJPDES violations that occurred prior to July 2000 were identified during interviews with OCNGS staff. The described violations include failure to collect samples, oil/water separator malfunction and minor discharges at DSN007A, total residual chlorine exceedence due to malfunction, and violations of the TSS limit at a wastewater treatment plant discharge at DSN004A in the 1980s.

Originally, OCNGS had its own wastewater treatment plant, with discharge to DSN004A. In 1982, the plant connected to the municipal sewage system of the Lacey Township Municipal Utilities Authority (URSGWC 2000; NJDEP 2005a). Continuous radiological monitoring of wastewater is performed before it leaves the site. Sampling is performed periodically and reported to the municipality.

Dredging of Oyster Creek and Forked River is under the jurisdiction of the U.S. Army Corps of Engineers (USACE), and a Waterfront Development Permit is required under New Jersey's Waterfront Development Law. Suction dredging has been performed to minimize the impact of the dredging, and dredged materials have been conveyed to the dredge spoils basin (Figure 2-3) using hard piping. During the license renewal period, periodic dredging may take place in the intake and discharge canals, Forked River, or Oyster Creek. The dredging would be consistent with past techniques and requirements.

The sale of OCNGS from JCP&L to AmerGen in 2000 triggered an Industrial Site Recovery Act (ISRA) investigation under New Jersey State law. Under the ISRA, a Preliminary Assessment (PA) was conducted in 1998 to 1999, followed by a Site Investigation/Remedial Investigation (SI/RI) performed in 1999 to 2000 (URSGWC 2000). These investigations focused on nonradiological issues. Potential radiological environmental problems were addressed during the ISRA assessment in a companion document, a combined PA/SI (McLaren/Hart, Inc. 2000). These documents provided information on numerous areas of concern (AOCs) at the site and described releases to groundwater, soil, surface water, and sediment, all of which may have potential impacts on water quality.

The nonradiological SI/RI assessment (URSGWC 2000) detailed the history, usage, and potential problems at more than 100 AOCs, including hydrocarbon fuel storage areas, transformers, waste storage areas, and others. For the bulk of the AOCs, the report recommended no further action on the basis of sampling results. For seven AOCs, however, there were exceedences of State soil or groundwater cleanup criteria for volatile organic compounds (VOCs) (chlorobenzene, methyl tertiary-butyl ether [MTBE], tetrachloroethene, and trichloroethene), total polychlorinated biphenyls (PCBs), and metals (antimony, thallium, and zinc). These issues, which are described below, were recommended for future remedial action.

The chlorobenzene exceedence was a sample taken at the site's former wastewater treatment facility. The soil sample had a concentration of 1.6 mg/kg; the State limit is 1 mg/kg (URSGWC 2000). Use of this facility ended with connection to the municipal sewer system in 1982.

Thallium was detected in a soil sample at a seepage pit associated with maintenance of water treatment equipment used in facility processes. The maximum concentration was 8.3 mg/kg; the State limit is 2 mg/kg (URSGWC 2000).

Metals were found in soil samples at a former sand blasting site at OCNGS. Concentrations were up to 22.9 mg/kg of antimony and 1790 mg/kg of zinc; the State limits are 14 and 1500 mg/kg, respectively (URSGWC 2000).

In October 1986, a diesel fuel line leak was discovered near the diesel generator building. Approximately 15,000 gal of fuel leaked into the soil and groundwater (JCP&L 2003). Petroleum compounds appear to be within the upper Cape May Formation, which is generally separated from the lower Cohansey Formation by a clay layer throughout most of the site. Although this clay is 15 ft thick, it was breached during foundation construction around the turbine and reactor buildings. Recovery wells on the eastern side of the diesel generator building extract both groundwater and hydrocarbons, and a monitoring well network is used to assess hydraulic gradients and contaminant concentrations. The water table is approximately 13 ft below ground surface (URSGWC 1999). February 1999 measurements showed up to 0.4 ft of fuel oil on the water table (URSGWC 1999). April 2002 data were similar (JCP&L 2003). A group of injection wells located between the contaminant source area and the turbine building is used to force potable water between the contaminated groundwater and the breach in the clay unit, thereby protecting the Cohansey Formation from shallower groundwater contamination. The injection water is obtained from the South Well. The fuel remains generally contained between the machine shop and the diesel generator building, with hydraulic gradients toward the recovery wells (JCP&L 2003). The South Well was monitored as a precaution for 1 year following the diesel leakage.

Subsurface diesel movement was influenced by nearby infrastructure. A 30-in. pipe that conveys water to DSN004A is located near the leak. Diesel fuel followed the backfill material around the pipe. An excavation was conducted to remove the contaminated backfill and replace it with a bentonite-based backfill. A well point was installed in this location to collect diesel fuel.

Water and product extracted by the set of recovery wells undergo treatment at an onsite facility that was installed in 1994 (JCP&L 2003). Discharge of the water from the operation of the groundwater treatment system to the sanitary sewer system is permitted by the county (Appendix E). The permit allows for self-monitoring, with limits on flow, pH, TSS, chemical oxygen demand, petroleum hydrocarbons, benzene, toluene, ethylbenzene, and total xylenes.

Tetrachloroethene was discovered during the diesel leak investigation. This contaminant was attributed to spills and spraying of the solvent, which was kept in drum racks formerly along the eastern side of the storage building. The concentration in groundwater ranges up to 400 µg/L; the State limit is 1 µg/L. May 2002 measurements showed values up to 26 µg/L (JCP&L 2003). The May sampling also showed a detection of trichloroethene in one well at 4.4 µg/L; the State limit is 1 μg/L (JCP&L 2003). In the 1970s, a warehouse was constructed for housing these drums, and outdoor storage ceased. Their combined pumping rate is less than 1 gpm.

Ongoing oversight of the remediation and monitoring systems for both diesel fuel and VOCs is being conducted by the New Jersey Bureau of Environmental Evaluation, Cleanup, and Responsibility Assessment (JCP&L 2003).

The ISRA process discovered MTBE in groundwater at the northern end of the north parking lot (URSGWC 2000). This compound is associated with gasoline, and its presence is attributed to a filling station or to occasional spills from aboveground tanks. A concentration of 1000 μg/L was measured, which exceeds the State limit of 70 μg/L. JCP&L has assessed the plume with a monitoring well network. Sampling in 2004 showed decreasing trends and all concentrations below the regulatory limit. The NJDEP has called for no further action (NJDEP 2006a). A 1991 closure of another aboveground tank facility because of soil and groundwater contamination was reviewed by the NJDEP (URSGWC 1999).

At the M1B Main Transformer, 300 gal of dielectric fluid (without PCBs) leaked in July 1989 (URS 2005). Several hundred cubic yards of soil were excavated because of the discovery of PCBs in the soil. These PCBs were attributed to leaks from prior use of PCB-containing dielectric fluids. Some soils that exceeded a total petroleum hydrocarbon limit were left in place because excavation of them would have jeopardized the integrity of nearby structures (URS 2005). As a result of the incident, yearly pressure testing of pipelines began in an effort to avoid another failed line (URSGWC 2000). Ongoing groundwater monitoring has been taking place under a Memorandum of Agreement with the NJDEP (URSGWC 2000). PCBs were discovered in subsurface soil samples at several of the site's other transformers. The PCB concentration was up to 2.1 parts per million (ppm); the State limit is 0.49 ppm (URSGWC 2000). Groundwater sampling at one transformer location indicated tetrachloroethene levels as high as 6.7 μg/L.

Supplemental remedial activities were conducted in 2002 (URS 2005). The tasks under these assessments included additional soil sampling, monitoring well installation, and groundwater sampling. Despite the sale of OCNGS, JCP&L retained responsibility for nonradiological environmental liabilities associated with its past operations at the site.

The radiological preliminary site assessment (McLaren/Hart, Inc. 2000) addressed many potential radiological AOCs. Soil sampling conducted within site drainages showed radiological contamination indicators cobalt-60 and cesium-137 at or below background levels. Sediment sampling in the discharge canal in 1994 through 1998 indicated decreasing cesium-137 in sediment samples attributed to decreased liquid discharges since 1989 (McLaren/Hart, Inc. 2000). Four groundwater monitoring wells downgradient of the reactor building showed no radionuclides above background levels.

The radiological preliminary site assessment (McLaren/Hart, Inc. 2000) documents a number of historical onsite releases of potentially contaminated water to site soils. Onsite soil sampling has indicated cobalt-60 and cesium-137 contamination above background levels in several locations, some of which have been excavated, removed, and disposed of in accordance with NRC regulations. Numerous other portions of the site were considered in the radiological assessment; radionuclides in soil, sediment, surface water, or groundwater (if detectable) were generally at background levels.

Prior to the 1997 dredging, 86 soil samples were collected at the dredge spoils basin located on the Finninger Farm portion of the OCNGS site (Figure 2-3). These samples represent dredged sediments from dredging actions conducted after OCNGS became operational. Samples were analyzed for cobalt-60 and cesium-137. One sample had detectable cobalt-60 at 0.075 pCi/g. Forty samples had detectable cesium-137, with a maximum activity concentration of 0.2 pCi/g. A total of nine Forked River sediment cores was collected prior to the 1997 dredging project. Eight of the samples had detectable cobalt-60 and cesium-137, with maximum activity concentrations of 0.088 pCi/g and 0.27 pCi/g, respectively.

Annual environmental monitoring of the site and its surroundings is conducted under the Radiological Environmental Monitoring Program (REMP). REMP reports include surface water, groundwater, and sediment sampling results. Monitoring results for the 5-year period of 2000 through 2004 indicate that the radiation and radioactivity in the environmental media monitored around the plant are well within applicable regulatory limits. The only radionuclide consistently detected is cesium-137 in sediment, a result of historical plant releases and fallout from nuclear weapons testing (AmerGen 2001b, 2002b, 2003c, 2004b, 2005c).

2.2.4 Air Quality

Although New Jersey is one of the smallest states in the United States, it has five distinct climatic regions. The geology, distance from the Atlantic Ocean, and prevailing atmospheric flow patterns produce distinct variations in the daily weather in each of the climatic regions (Northern, Central, Pine Barrens, Southwestern, and Coastal). With its coastal location, OCNGS experiences both continental and oceanic influences that compete for dominance. In autumn and early winter when the ocean is warmer than the land surface, the Coastal region experiences warmer temperatures than interior regions of the State. In the spring months, ocean breezes keep temperatures along the coast cooler. Being adjacent to the Atlantic Ocean, with its high heat capacity (compared with land), seasonal temperature fluctuations tend to be more gradual and less prone to extremes (Ludlum 1983).

Sea breezes play a major role in the coastal climate. When the land is warmed by the sun, heated air rises, allowing cooler air at the ocean surface to spread inland. Sea breezes often penetrate 5 to 10 mi inland, but under more favorable conditions can affect locations 25 to 40 mi inland. Sea breezes are most common in spring and summer.

Coastal storms, often characterized as Nor'easters, are most frequent between October and April. These storms track over the coastal plain or up to several hundred miles offshore, bringing strong winds and heavy rains. Rarely does a winter go by without at least 1 significant coastal storm; sometimes there are 5 to 10 in a year. Tropical storms and hurricanes are also a special concern along the coast. In some years, they contribute a significant amount to the precipitation totals of the region. Coastal damage during times of high tide can be severe when tropical storms or Nor'easters affect the region (Ludlum 1983).

Meteorological records from the National Weather Service Toms River cooperative weather station (Coop ID 288816) are generally representative of the OCNGS site. Mean or normal daily minimum and maximum temperatures measured at Toms River from 1971 through 2000 range from 21.8°F in January to 63.8°F in July, and from 40.6°F in January to 86.1°F in August, respectively (ONJSC 2005). Day-night temperatures typically vary by 20 to 25°F throughout the year. Mean or normal monthly temperatures for the same period range from 31.2°F in January to 75.0°F in July (ONJSC 2005). Local precipitation occurs throughout the year, with only slight increases in rainfall over the annual average during the summer months. Measurable precipitation falls on approximately 120 days each year. Fall months are usually the driest with an average of 8 days of measurable precipitation. Other seasons average between 9 and 12 days of precipitation per month. The highest and lowest monthly precipitation typically occur in August (5 in.) and October (3.6 in.), respectively. The mean annual precipitation for the region is 48.8 in. (ONJSC 2005).

Most areas of New Jersey receive 25 to 30 thunderstorms per year, with fewer storms near the coast than farther inland. Statewide, approximately five tornadoes occur each year, and in general, they tend to be weak. Over the past 55 years, severe thunderstorms with winds exceeding 58 mph and/or with property damage or injury occurred on average about once every other year (NOAA 2005). During the period from the middle of March to the middle of November, the daily occurrence of thunderstorms with high winds was rare, with a total of only 20 severe thunderstorm and wind damage reports filed for Ocean County from January 1, 1950, to May 31, 2005. From 1950 to 2005, a total of 10 tornadoes touched down in Ocean County (NOAA 2005). Four of these produced major property damage, greater than $2.5 million. These storms were categorized in the low, moderate, significant, and severe intensity ranges of the Fujita Tornado Scale, that is, F-0 or F-1, F-2, and F-3 category tornados, respectively.[a] One F-3 tornado struck on July 21, 1983, but it did not cause any injuries and/or fatalities. Based on statistics for the 30 years from 1954 through 1983 (Ramsdell 2005), the probability of a tornado striking a point in a 1-degree latitude-longitude square at the site is expected to be about 1×10^{-4} per year. Oyster Creek Severe Weather Procedure AG-108, Rev. 4, has been

(a) Tornado wind speeds for the F-0 to F-4 categories are in the following ranges: F-0: 40 to 72 mph; F-1: 73 to 110 mph; F-2: 113 to 157 mph; F-3: 158 to 206 mph; and F-4: 207 to 260 mph (Fujita 1987).

implemented at OCNGS as a guideline to provide the station with items to be considered in the event severe weather is forecasted to impact the area.

In October 2005, coastal New Jersey and much of the coastal Northeast recorded historical record precipitation amounts (NOAA 2005). Torrential rains in the northeastern United States caused extensive flooding in parts of Maine, New Hampshire, Massachusetts, Connecticut, New York, and New Jersey between October 7 and 12. Rainfall amounts of 6 to 10 in. were common in the affected areas. Additional rainfall during October 14 to 16 caused further flooding from New Jersey northward into New England. Totals ranged from 4 to 8 in. in parts of the region, flooding rivers and streams, and placed considerable strain on reservoir and lake dams.

Wind resources are expressed in terms of wind power classes, ranging from Class 1 to Class 7 (Elliott et al. 1986). Each class represents a range of mean wind power density or approximate mean wind speed at specified heights above the ground. Areas along the shoreline of New Jersey, including Ocean County, have fair to good wind power potential. The wind power resource for this part of the State is rated Class 2 and 3. Areas designated Class 3 or greater are suitable for most wind energy applications, whereas Class 2 areas are marginal, and Class 1 areas are generally not suitable for wind power.[a]

Meteorological conditions on the OCNGS site are monitored from the main meteorological tower, which is 120 m tall. Winds (speed and direction) are measured at two levels on the tower (at 10 m and 116 m) and include horizontal wind direction variations. Temperature is measured at three levels: 10 m, 46 m, and 116 m. Atmospheric stability is determined by using the "delta T" method, which determines differences in temperature readings between the 60-m and 10-m levels. Summaries of annual readings recorded from both levels can be found in the OCNGS radiological effluent release reports (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). Tower measurements taken over a 5-year period, from January 2000 through December 2004, show that winds are predominantly from the west at 4 to 7 mph at the 10-m level and from the west-northwest at 13 to 24 mph at the 116-m level.

Air quality in a given area is a function of the air pollutant emissions (type of pollutant; rate, frequency, and duration; exit conditions; and location of release), atmospheric conditions (climate and meteorology), the area itself (size of airshed and topography of the area), and the pollutants transported from outside the area. Air quality within a 31-mi radius of OCNGS is generally considered good, with the exception of the area just north and adjacent to the Atlantic County-designated moderate ozone nonattainment area (1-hr and 8-hr ozone standards) and the area just south of the Monmouth County moderate ozone nonattainment area (8-hr standard). Monmouth County is also a nonattainment area for particulate matter with a mean aerodynamic diameter of less than 2.5 micrometers ($PM_{2.5}$). To the northwest, Warren

(a) Wind power densities ranging from 0 to 100 W/m^2 at 10 m (above ground) and 0 to 200 W/m^2 at 50 m (NREL 2005).

County is designated as a sulfur dioxide nonattainment area. Localized sources include man-made sources of commercial, residential, and transportation-related emissions. Natural sources of windblown dust contribute to temporary increases in particulate air pollution.

The NJDEP has regulatory authority over air quality in nine Air Quality Control Regions (AQCRs) within the state of New Jersey. OCNGS is located in Ocean County, New Jersey, and is within AQCR 6, the Northern Coastal region, which includes Monmouth and Ocean Counties. AQCR 6 is located in central New Jersey and borders the Atlantic Ocean. This region is designated as being in attainment for all criteria pollutants (40 CFR 81.333). OCNGS is located about 20 mi north of the 6600-ac Brigantine Wilderness Area.

The two small emergency diesel generators, EDG1 and EDG2, serving OCNGS are rated at a nominal capacity of approximately 241 and 256 hp, respectively. The generators and associated diesel fuel oil tanks are housed within separate vaults in a reinforced concrete building southwest of the turbine building. The one-story structure is at approximately grade elevation near the eastern bank of the discharge canal. Technical Specification Section 3.7.C, “Gas Turbine Generators,” requires a minimum volume of 14,000 gal of diesel fuel oil in the 15,000-gal fuel oil storage tank. The diesel generators are used for emergency backup power and provide a standby source of electric power for equipment required for mitigation of the consequences of an accident, for safe shutdown, and for maintenance of the station in a safe condition under postulated event and accident scenarios (AmerGen 2003a). The diesel generators are tested with a 1-hr test burn duration performed biweekly under the plant’s “Emergency Diesel Generator Load Test” procedure (Oyster Creek Procedure 636.4.013). The EDG1 and EDG2 units have certificates to operate under the New Jersey Air Pollution Control Act (Appendix E). This would apply to operations during emergency situations, routine maintenance, and routine exercising (e.g., test firing the engine for 1 hr every other week to ensure reliability).

There is also a main forced-draft heating boiler (Unit No. 1, SHB001) fired with No. 2 fuel oil and one auxiliary boiler (Unit No. 2, SHB002). Unit No. 1 is used primarily for space heating for the plant, while the Unit No. 2 boiler is currently designated as a backup to Unit No. 1. Unit No. 2 was at one time used as an evaporator boiler. Unit No. 1 is rated at 350 hp, while the backup Unit No. 2 is rated at 1550 hp. Both units are permitted to operate under the New Jersey Air Pollution Control Act (Appendix E).

There are two fire pond diesel engines each dedicated to drive two separate emergency fire water pumps. The diesel engines are both rated at 300 hp (one at 1800 rpm and the other at 1920 rpm) and are connected to two vertical shaft centrifugal main pumps (fired biweekly). The pumps have a water spray capacity of 2000 gpm and have the capability of delivering 2250 gpm. Each engine has its own fuel supply located adjacent to a metal pump house. The pump house contains only the fire and pond pumps and their associated control equipment. The fire pumps are arranged to start automatically if the pressure drops due to a large water demand. Either pump can be manually started from the control room or at the pump house. Two 400-gpm-capacity automatic electric pond pumps maintain pressure on the fire system. These pumps and associated tanks constitute an emergency supply when the primary water supply is not available. All units are permitted to operate under the New Jersey Air Pollution Control Act (Appendix E).

Maintenance tests for each generator are conducted as needed and last 24 hours. Twenty-four-hour endurance burns are run on a staggered test schedule, once every 18 months. Under the air pollution rules and regulations of the NJDEP, Part 2, R 336.1212 (insignificant activities exemptions), emergency diesel generators meeting certain operating criteria are exempt from State operating permit requirements. The rules define emergency power-generating units as stationary internal combustion engines that operate as a mechanical or electrical power source only when the usual supply of power is unavailable. These sources are provided a permit exemption if their annual emissions are less than significance levels as defined in R 336.1119. This would apply to operations during emergency situations, routine maintenance, and routine exercising (e.g., test firing the engine for 1 hr a week to ensure reliability). Since all of the emergency diesel generators operate for a small number of test hours per year, emissions from these sources are not regulated under New Jersey's Permit Operating Program. In addition to the emergency diesel generators, the three No. 2 diesel-oil-fired boilers are used for evaporator heating, plant space heating, and feedwater purification. Two units are rated at 690 hp and the third at 750 hp. All three units are permitted to operate under the New Jersey Air Pollution Control Act (Appendix E).

2.2.5 Aquatic Resources

OCNGS is located approximately 2.5 mi west of Barnegat Bay, a protected estuary along the central New Jersey coast, and is bounded to the north by the South Branch of Forked River and to the south by Oyster Creek. Cooling water is withdrawn from the South Branch of Forked River and discharged into Oyster Creek, which drains into Barnegat Bay.

Prior to the construction of OCNGS, the South Branch of Forked River and Oyster Creek were low-salinity systems that experienced minimal tidal intrusions from Barnegat Bay. During plant construction, the river and creek were dredged and widened to accommodate OCNGS cooling-water requirements; most of the natural aquatic communities that occurred within these portions of the river and creek were destroyed. These modifications also reversed the direction of the South Branch of Forked River, with water now flowing west through the power plant cooling system rather than east into Barnegat Bay. As a result, the South Branch of Forked River and Oyster Creek are now more similar physically and ecologically to Barnegat Bay than they were prior to OCNGS construction (Kennish et al. 1984; BBNEP 2001).

The most detailed account of the physical, chemical, and biological baselines associated with Forked River, Oyster Creek, and Barnegat Bay before, during, and after construction is available in *Ecology of Barnegat Bay, New Jersey* (Kennish and Lutz 1984). In support of requirements in CWA Sections 316(a) and 316(b), a single demonstration study was conducted between 1965 and 1977. This demonstration study included qualitative comparisons of preoperational and operational conditions, thermal plume mapping, spatial comparisons of water quality and biotic correlations between areas near the plant and reference locations, and estimates of biotic losses relative to impingement, entrainment, and thermal impact (Summers et al. 1989; AmerGen 2005a). This demonstration study was subsequently reviewed by Versar, Inc., under contract to the NJDEP, and a final report was issued in 1989 (Summers et al. 1989). After designation of Barnegat Bay as a National Estuary Program site in July 1995, a series of documents was prepared that characterized the bay and developed conservation, management, and monitoring plans for the estuary and its watershed (BBNEP 2001, 2002, 2003).

2.2.5.1 General Characteristics of Aquatic Systems near OCNGS

Barnegat Bay is a shallow, lagoon-type estuary that is separated from the Atlantic Ocean by a nearly contiguous barrier island complex (Chizmadia et al. 1984; BBNEP 2001). The bay is approximately 43 mi long and 3 to 9 mi wide, with a depth of 3 to 23 ft; the greatest depths are associated with the Intracoastal Waterway, a dredged channel running parallel to the U.S. eastern seaboard (Chizmadia et al. 1984; BBNEP 2002). The total volume of water in the bay is estimated to be 60 billion gal (Guo et al. 2004). The estuary is bordered by the mainland to the west, Point Pleasant and Bay Head to the north, barrier islands to the east, and Manahawkin Causeway to the south. Freshwater enters the bay from numerous streams, including, from north to south, Manasquan River and Canal, Metedeconk River, Kettle Creek, Toms River, Cedar Creek, Stout Creek, Forked River, and Oyster Creek (Chizmadia et al. 1984). Seawater enters the bay from the north through the Point Pleasant Canal via Manasquan Inlet, and from the south through the Little Egg Inlet. There is also a connection between the Atlantic Ocean and Barnegat Bay through Barnegat Inlet, a narrow navigable passage through the barrier islands located to the east-southeast of Oyster Creek. Over the years the configuration of the Barnegat Inlet jetty system and the entrance channel have undergone extensive modifications by the USACE. A major program was initiated in 1988 to realign the south jetty and dredge accumulated sediments from the channel (NRC 2005b).

Because of the limited connection of Barnegat Bay to the Atlantic Ocean, tides in the bay are attenuated relative to the open ocean, and complete turnover of water within the bay is estimated to occur every 96 tidal cycles, with 1 tidal cycle completed every 12.7 hr (Chizmadia et al. 1984). This agrees with recent work by Guo et al. (2004), who estimated the average annual flushing time of Barnegat Bay to be as long as 49 days. Water salinity generally ranges from 11 to 32 parts per thousand (ppt); the highest salinity is associated with the inlets, and the lowest is along the western shoreline near the mouths of various rivers and creeks. Water temperature in Barnegat Bay ranges from an average of 35°F in winter to 75°F in summer (Chizmadia et al. 1984; BBNEP 2001).

The sediments of Barnegat Bay are typical of a shallow estuary. Substrate in central portions of the bay is composed primarily of fine to medium sand, with muddier sand present closer to the western shore. The substrate in intertidal areas adjacent to the mouths of Forked River and Oyster Creek is primarily sandy mud (Chizmadia et al. 1984). The barrier islands and mainland shores of Barnegat Bay support a network of coastal wetlands and salt marshes that represent important habitats for juvenile fish and invertebrates (BBNEP 2001). In recent years, concern has been raised regarding the loss of salt marsh habitat along the eastern seaboard (Hartig and Gornitz 2001; GLCF 2005). Some causes of the observed losses are not known; the causes are assumed, however, to be a combination of sea level rise and hydrological changes that result in an inadequate supply of sediment required for marsh maintenance (Hartig and Gornitz 2001).

On the basis of analysis of satellite imagery, aerial photography, digital land-use and land cover data, and historical maps of Barnegat Bay, Lathrop and Bognar (2001) concluded that the estuary has been significantly affected by land-use activities. Human development increased from 18 to 28 percent between 1972 and 1995, resulting in impacts on riparian corridors, bulkheading of shorelines, and loss of salt marshes. Lathrop and Bognar (2001) concluded, however, that "through government legislation and regulation, some of the most destructive past practices, such as dredging and filling of coastal salt and freshwater marshes and large-scale development of the headwater portions of the bay's watershed, have been largely eliminated." The past and current impacts on Barnegat Bay's salt marshes are discussed further in Section 2.2.5.4.

Because Barnegat Bay is a shallow, protected estuary with limited tidal flushing, it is particularly susceptible to natural and anthropogenic impacts. In response to growing concerns about these impacts, New Jersey required a comprehensive study of the nature and extent of anthropogenic impacts on the bay and watershed (BBNEP 2002). The result was a series of publications describing the current conditions of the bay, recommendations for managing the resources, and a watershed management plan (BBNEP 2002). After acceptance of Barnegat Bay into the EPA's U.S. National Estuary Program in 1995, additional technical and guidance documents were developed, including the *Barnegat Bay Estuary Program Characterization Report* (BBNEP 2001) and the *Final Comprehensive Conservation Management Plan* (BBNEP 2002) that identified the following concerns for Barnegat Bay and its watershed as "priority problems":

- Degraded water quality over extensive areas of the bay;
- Declines in fish and shellfish populations due to disease, reproductive failure, or mortality;
- Changes in abundance, diversity, and distribution of important estuarine organisms;

- Loss of submerged aquatic vegetation (SAV) (e.g., eelgrass [*Zostera marina*] beds), wetlands, and coastal salt marshes;

- Closure of shellfish beds due to chemical or microbial contamination; and

- Outbreaks of human disease associated with swimming in contaminated waters or eating contaminated fish or shellfish.

Federal, State, and local agencies have worked collaboratively to define and address the above issues since Barnegat Bay was included in the National Estuary Program.

2.2.5.2 Chemical Contaminants in Aquatic Systems near OCNGS

According to the Barnegat Bay National Estuary Program (BBNEP 2001), several classes of toxic chemicals are often present in urbanized estuaries at concentrations that could result in adverse impacts on important aquatic resources. Chemicals of potential concern include halogenated hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), heavy metals, and pesticides and their degradation products (e.g., dichloro-diphenyl-trichloroethane [DDT], dichloro-diphenyl-dichloroethylene [DDE], and dichloro-diphenyl-dichloroethane [DDD]). Although there is no major industrial activity within the watershed except for OCNGS, there are numerous nonpoint sources within the watershed that could influence the water or sediment quality of Barnegat Bay. These sources include stormwater discharges, river runoff, deposition of contaminants from the atmosphere, and contamination related to recreational and commercial boating activities. In an evaluation of particle-associated contaminants in Barnegat Bay-Little Egg Harbor, Moser and Bopp (2001), concluded that although the concentrations of metal contaminants have been decreasing since 1970, there are still locations where concentrations are elevated relative to background. A comparison of metal concentrations in sediment samples reported in Moser and Bopp (2001), with threshold effect levels (TELs) and probable effect levels (PELs) summarized by the National Oceanic and Atmospheric Administration (NOAA) (1999), indicates that cadmium, chromium, nickel, lead, and zinc generally exceed TELs, which suggests that the potential for adverse impacts exists. Sediment sample data showed a relatively similar distribution of concentrations from approximately Kettle Creek south to the Oyster Creek study area, with the highest metal concentrations associated with samples from marinas. There is no evidence that the surficial sediments near OCNGS contain higher concentrations of trace metals than other areas within the estuary. Total PAH concentrations in sediment samples collected near OCNGS (Moser and Bopp 2001) are well below sediment TEL criteria, suggesting a small potential for adverse impacts. The highest PAH concentrations appear to be associated with marinas.

OCNGS is considered the largest point source of pollution in the Barnegat Bay system. The plant releases biocides (primarily chlorine and chloramine products) and, in the past, also released low levels of radioactive isotopes to Oyster Creek and Barnegat Bay. Biocide usage is restricted by the current NJPDES permit for the facility, which also requires the measurement of TSS, pH, petroleum hydrocarbons, total organic carbon, and water temperature at various operational locations. During the development of this SEIS, the NRC staff reviewed NJDEP inspection reports from November 1999 to April 2005; OCNGS annual environmental monitoring reports to the NRC from 1999 to 2004; and acute toxicological test results from three permitted NJPDES outfalls (DSN001, DSN002, and DSN004) from 2000 to 2004. NJDEP inspection reports did not identify any compliance issues, and acute toxicity was not observed in the 96-hr test using mysid shrimp (*Mysidopsis bahia*) to evaluate a dilution series of representative effluent samples from these outfalls.

2.2.5.3 Important Fish and Shellfish near OCNGS

During a 3-year study from September 1975 to August 1978, 108 species of fish representing 57 families were collected in western Barnegat Bay from the mouth of Cedar Creek to the mouth of Double Creek (Tatham et al. 1984). Of the 108 species collected, 20 were identified as resident species, 34 were considered warmwater migrants, 12 were coolwater migrants, 35 were classified as local marine strays, and 7 were considered freshwater strays (Tatham et al. 1984). Five species accounted for 90 percent of the catch, including three resident species and two warmwater migrant species (Table 2-2). Shellfish, shrimp, and other species in Barnegat Bay that are commercially, recreationally, or ecologically important include the hard clam (*Mercenaria mercenaria)*, blue crab (*Callinectes sapidus*), sand shrimp (*Crangon septemspinosa*), opossum shrimp (*Neomysis integer*), and a variety of other crabs, marine snails, and sea stars (Table 2-3).

The Fishery Conservation and Management Act of 1976, as amended by the Sustainable Fisheries Act in 1996, requires Essential Fish Habitat (EFH) consultations with the NMFS for species with designated EFH identified by regional fishery management councils. Because EFH designations for Barnegat Bay encompass the entire bay and adjacent ocean habitats, the list of species addressed in the EFH Assessment (Appendix E) includes additional species that are less common in Barnegat Bay when compared with previous studies.

What follows is a brief summary of life history characteristics of some fish and shellfish considered to be commercially, recreationally, or ecologically important. This list includes species that represent the most abundant and important forage and piscivorous fishes in Barnegat Bay, as defined by Tatham et al. (1984); the two species of shellfish that are commercially, recreationally, or ecologically important (hard clam and blue crab); and a brief description of the shrimp species most common to the bay. Included in this discussion is an overview of shipworms, which are wood-boring bivalves that are represented by both native and introduced species.

Table 2-2. Resident, Seasonally Abundant, or Ecologically Important Fish in Barnegat Bay, 1975 to 1978

Scientific Name[(a)]	Common Name	Classification	Use of Estuary[(b)]
Anchoa mitchilli[(c)]	bay anchovy	warmwater migrant	Sp, SN
Anguilla rostrata	American eel	resident	SN
Apeltes quadracus	four-spined stickleback	resident	Sp, SN
Brevoortia tyrannus	Atlantic menhaden	warmwater migrant	SN
Chasmodes bosquianus	striped blenny	resident	Sp, SN
Cynoscion regalis	weakfish	warmwater migrant	SN
Cyprinodon variegatus	sheepshead minnow	resident	Sp, SN
Fundulus heteroclitus	common mummichog	resident	Sp, SN
Fundulus majalis	striped mummichog	resident	Sp, SN
Gobiosoma bosci	naked goby	resident	Sp, SN
Hippocampus erectus	seahorse	resident	Sp, SN
Hypsoblennius hentzi	feather blenny	resident	Sp, SN
Leiostomus xanthurus[(c)]	spot	warmwater migrant	SN
Lucania parva	rainwater killifish	resident	Sp, SN
Menidia beryllina	inland silverside	resident	Sp, SN
Menidia menidia[(c)]	Atlantic silverside	resident	Sp, SN
Morone americana	white perch	resident	Sp, SN
Morone saxatilis	striped bass	local marine stray	–
Ophidion marginatum	striped cusk-eel	resident	MN
Opsanus tau	oyster toadfish	resident	Sp, SN
Pomatomus saltatrix	bluefish	warmwater migrant	SN
Pseudopleuronectes americanus[(c)]	winter flounder	resident	Sp, SN
Syngnathus fuscus	northern pipefish	resident	Sp, SN
Tautoga onitis	tautog	resident	Sp, SN
Tautogolabrus adspersus	cunner	resident	Sp, SN
Trinectes maculatus	hogchoker	resident	Sp, SN

(a) Species in bold text were identified in past studies as commercially, recreationally, or ecologically important.
(b) Sp = uses estuary for spawning; SN = significant use of estuary as nursery area; MN = minor use of estuary for spawning; – = no regular use of estuary.
(c) Species collectively accounting for 90 percent of the catch from 1975 to 1978.
Source: Adapted from Tatham et al. 1984

Table 2-3. Invertebrate Species in Barnegat Bay That Are Commercially, Recreationally, or Ecologically Important

Scientific Name[(a)]	Common Name	Importance
Asterias forbesi	sea star	Predator on juvenile hard clam
Bankia gouldi	shipworm	Destruction of wooden structures
Busycon canaliculatum	channeled whelk	Predator on juvenile hard clam
Busycon carica	knobbed whelk	Predator on juvenile hard clam
Callinectes sapidus	blue crab	Recreational and commercial harvest
Cancer irroratus	rock crab	Predator on juvenile hard clam
Carcinus maenas	green crab	Predator on juvenile hard clam
Crangon septemspinosa	sand shrimp	Predator on winter flounder eggs, prey item for fish, recreational and commercial harvest
Eupleura caudata	thick-lipped oyster drill	Predator on juvenile hard clam
Limulus polyphemus	horseshoe crab	Commercial harvest, predator on juvenile hard clam
Lunatia heros	northern moon snail	Predator on juvenile hard clam
Mercenaria mercenaria	hard clam	Recreational and commercial harvest
Neomysis americana	mysid shrimp	Contributor to food web
Neomysis integer	opossum shrimp	Contributor to food web
Polinices duplicatus	lobed moon shell	Predator on juvenile hard clam
Teredo navalis	shipworm	Destruction of wooden structures

(a) Species in bold text are known to be affected by OCNGS operations.
Source: Kennish and Lutz 1984

Bay Anchovy

The bay anchovy (*Anchoa mitchilli*, family Engraulidae) was one of the most abundant species observed in the 1970s by Tatham et al. (1984). Considered a warmwater migrant, this species uses the estuary for spawning and as a nursery ground (Table 2-2). There is no recreational or commercial use for this species. The bay anchovy occurs along both the Atlantic and Gulf of Mexico coastlines and is abundant off the coasts of Massachusetts, Rhode Island, New York, and New Jersey (FWS/DOI/USACE 1989a). Adults seldom exceed 9 cm in length and are found in a variety of habitats, including shallow to moderately deep offshore waters, nearshore waters off sandy beaches, open bays, muddy coves, and river mouths. Mysid shrimp are the principal food for adults; copepods are the principal food for larvae and juveniles (Bigelow and Schroeder 1953; FWS/DOI/USACE 1989a). Anchovies are ecologically important because they are a primary food source for a variety of fish and birds and represent a key component of regional food webs (FWS/DOI/USACE 1989a). Studies conducted by Morgan et al. (1995) suggest that the bay anchovy demonstrates little genetic variation and no discernable stock structure, probably because of the enormous population size and the movement and mixing of various stocks. In the mid-Atlantic region, spawning generally occurs where water temperatures are at least 54°F, but it may occur at temperatures as low as 48°F. Adult bay anchovies appear to exhibit a relatively high tolerance to fluctuations in both temperature and salinity, and have demonstrated a tolerance to high water temperatures associated with thermal discharges (FWS/DOI/USACE 1989a). The primary anthropogenic stressors impacting the bay anchovy are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005). Bay anchovy eggs and larvae are also common in OCNGS entrainment samples, with annual losses approaching 25 million. Approximately 250,000 anchovies were impinged during the 316(a) and 316(b) studies, and survivability after impingement was poor (Summers et al. 1989).

Recent population trends for the bay anchovy are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS's Northeast Fisheries Science Center (NMFS 2005a). Commercial landing data for the state of New Jersey also are not available from the NMFS's Office of Science and Technology (NMFS 2005b). The Mid-Atlantic Fishery Management Council (MAFMC) has not identified the bay anchovy as a managed species, and no EFH has been designated for this species.

American Eel

The American eel (*Anguilla rostrata*, family Anguillidae) is a catadromous species with a range extending from Greenland south along the Atlantic coast of Canada and the United States to Panama (FishBase 2005). Eels are used as bait by both commercial and recreational fishermen. Eels spend most of their lives in freshwater or estuarine environments and return to the sea to spawn. The American eel is a resident species in Barnegat Bay that utilizes the estuary as a nursery area (Table 2-2).

American eels typically grow to a length of 122 cm and to a weight of approximately 7.3 kg; they mature at 8 to 24 years (Bigelow and Schroeder 1953). Eels are extremely resilient and can survive in a variety of freshwater, estuarine, and marine habitats (FWS/DOI/USACE 1987). This catadromous species spends most of its time in freshwater systems. The primary anthropogenic stressors on American eels are physical habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication associated with urban development, and sediment delivery changes in nearshore systems based on activities in the watershed (Buchsbaum et al. 2005). It is possible that the dam on Oyster Creek created during construction of OCNGS and used to impound water for fire fighting has restricted the upstream migration of American eels. The impact of this structure cannot be determined because this species was not evaluated during the 316(b) determination (EA 1986), and there are no current estimates of American eel abundance in Oyster Creek. It is likely, however, that the low water dam is not a significant barrier to upstream migration of elvers because of the low height of the dam and the tenacity of elvers to ascend such structures. Removal of this dam, however, would eliminate this potential barrier. The species was reported as present in Oyster Creek and the South Branch of Forked River in the OCNGS FES (AEC 1974), but it is not commonly impinged or entrained.

Current population abundances of American eels in Barnegat Bay are not known. Commercial landings in New Jersey were less than 50 metric tons from 1950 to 1965, then gradually increased to approximately 100 metric tons until about 1975, when the fishery again declined. New Jersey commercial landings peaked in 1984 at nearly 250 metric tons and have gradually decreased since. The commercial harvest in 2004 was slightly less than 55 metric tons and reflects harvests typical of the 1950s and early 1960s (NMFS 2005b). Eels are challenging to manage because they occupy a variety of habitats that often cross species management jurisdictions (ASMFC 2005f).

The Atlantic States Marine Fishery Commission (ASMFC) has developed a fishery management plan for this species. Currently, no EFH for the American eel has been identified in Barnegat Bay. The current fishery management plan requires all States and jurisdictions to establish a minimum recreational size limit of 6 in. and a recreational possession limit of no more than 50 eels per person. Commercial management measures require the States and jurisdictions to maintain existing commercial fishery regulations or adopt policies that are more environmentally protective. In addition, ASMFC (2006a) recommends “that, at a minimum, States be required to provide accurate catch and effort data for use in future stock assessments.” The most recent estimate of eel abundance confirms that eel abundance, estimated from the total weight landed by commercial fisheries, peaked in the late 1970s and early 1980s and has declined since that time (ASMFC 2006b). The species is currently under status review to determine its eligibility for listing under the Endangered Species Act.

Four-spined Stickleback

The four-spined stickleback (*Apeltes quadracus*, family Gasterosteidae) is a common fish along the U.S. Atlantic Coast. It represents one of the most abundant species observed in Barnegat Bay (Tatham et al. 1984) and uses the estuary for spawning and as a nursery area for young (Table 2-2). The four-spined stickleback is a small fish, ranging in size from approximately 3 to 6 cm. Commercial use of this fish appears to be related to use in private and public aquariums (FishBase 2005). This species is common in salt marshes, is generally found in nearshore areas, and is tolerant of freshwater. Four-spined sticklebacks spawn from early spring to mid-summer, and eggs tend to sink and stick together in clumps on the bottom, where they are guarded by the female during the incubation period. Four-spined sticklebacks are an important part of nearshore marine and estuarine food webs and are eaten by larger fish. Their chief food appears to be copepods and small crustaceans (Bigelow and Schroeder 1953). Four-spined sticklebacks are considered to be highly tolerant of a variety of stressors, with a minimum population doubling time of less than 15 months (FishBase 2005). The primary anthropogenic stressors impacting four-spined sticklebacks include physical habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005). Stickleback eggs, larvae, and adults are not commonly entrained or impinged at OCNGS.

Recent population trends for the four-spined stickleback are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (2005a). Commercial landing data for the state of New Jersey were also not available from the NMFS (2005b). The MAFMC has not identified the four-spined stickleback as a managed species; therefore, no EFH has been designated for this species.

Atlantic Menhaden

Atlantic menhaden (*Brevoortia tyrannus*, family Clupeidae) are common to estuaries and coastal waters, with a range extending from Nova Scotia to Florida. The commercial harvest of this species represents a significant source of income along the Atlantic Coast (ASMFC 2005e). Adult menhaden average about 30 to 38 cm in length, and they weigh between 300 and 450 g (FWS/DOI/USACE 1989e). The primary food of adult and juvenile fish is plankton, which they obtain with highly specialized gill rakers (Bigelow and Schroeder 1953). Menhaden represent an important food source for a variety of larger fish, including the striped bass, bluefish, and weakfish. The Atlantic menhaden, a warmwater migrant, makes significant use of Barnegat Bay as a nursery area (Table 2-2). Menhaden have a large geographic range and exhibit a high tolerance for variable salinity and temperature; they have been found in water ranging in salinity from 1 to 36 ppt and at temperatures ranging from approximately 41 to 95°F. They appear to have age-specific salinity and temperature requirements, and these parameters affect (1) the tolerance of the species to other environmental stressors, (2) larval development, (3) growth, and (4) overall activity (FWS/DOI/USACE 1989e). The primary anthropogenic stressors to this species are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication from contaminant runoff associated with urban development, and possibly habitat changes associated with long-term climatic changes (Buchsbaum et al. 2005). Atlantic menhaden are impinged at OCNGS, and survivability after impingement is poor. However, no life stages of menhaden have been identified in entrainment samples (Summers et al. 1989). Menhaden are also susceptible to heat shock related to OCNGS operations (Summer et al. 1989; Kennish 2001d).

Recent population trends for menhaden are not available for Barnegat Bay, but statistics on commercial catches in the waters of New Jersey from 1950 to 2003 are available (NMFS 2005b). The highest recorded landings of menhaden from New Jersey occurred from about 1950 to 1963, when landings often exceeded 100,000 metric tons. The fishery sharply declined from about 1963 to 1966, briefly rebounded in the 1970s, and has averaged less than 9000 metric tons from 1982 to 2003 (NMFS 2005b). Overfishing is believed to explain the declines observed in the 1960s, but the reason for the recent trends is not well understood (ASMFC 2005e).

At present, Atlantic menhaden is not identified as a managed species by the MAFMC (2005); therefore, no EFH has been designated for this species. The ASMFC (2005c) does not consider the menhaden stock overfished. This may be because the fishing mortality rate target has been met in recent years.

Weakfish

The weakfish (*Cynoscion regalis*, family Sciaenidae) is one of the most abundant fishes in the nearshore and offshore waters of the Atlantic Coast, with a range extending from Massachusetts to Florida (FWS/DOI/USACE 1989d). The weakfish, a warmwater migrant, makes significant use of the Barnegat Bay estuary as a nursery ground (Table 2-2). Weakfish represent a valuable recreational and commercial resource and have supported fisheries along the Atlantic Coast since the 1800s (ASMFC 2005d).

Weakfish migrate from offshore wintering grounds to nearshore areas during the spring when the water warms, and spawn shortly after completing the nearshore migration. Weakfish move in schools and are usually found a few feet below the surface of the water. Growth is rapid, and most weakfish spawn at the end of their first year of life. Most weakfish range in size from 35 to 66 cm and weigh between 0.5 to 2.7 kg (Bigelow and Schroeder 1953). Weakfish feed at night; their primary food includes penaeid shrimp, anchovies, and small fish. They exhibit a relatively high tolerance for temperature and salinity extremes and have been found in water at temperatures ranging from approximately 48 to 88°F and with salinities ranging from 0.1 to 32.3 ppt (FWS/DOI/USACE 1989d). Weakfish are not commonly entrained or impinged at OCNGS according to Summers et al. (1989).

Recent population trends for the weakfish are not available for Barnegat Bay, but commercial catch statistics for the state of New Jersey from 1950 to 2004 show that the largest commercial landings occurred from about 1970 to 1987, when catches routinely exceeded 1000 metric tons. The largest recorded commercial catch (nearly 3000 metric tons) occurred in 1979. Since that time, the landings for New Jersey have steadily declined and now represent the lowest catches observed since 1950 (NMFS 2005b; ASMFC 2005c). The MAFMC (2005) does not identify weakfish as a managed species; the ASMFC, however, has developed a fishery management plan. The ASMFC considers the weakfish fishery depleted and overfished and believes the stock rebuilding process will take several years (ASMFC 2005c). There is no designated EFH for weakfish in Barnegat Bay.

Spot

Spot (*Leiostomus xanthurus*, family Sciaenidae) is a common species along the U.S. Atlantic Coast, with a range extending from the Gulf of Maine to Florida. They are most abundant from Chesapeake Bay south to South Carolina and are known to migrate seasonally, entering bays and estuaries in the spring and moving offshore later in the summer to spawn (ASMFC 2005a). Spot are important to both commercial and recreational fishermen in the mid-Atlantic region and are an important part of nearshore food webs as both predator and prey. Spot, one of the most abundant resident species in Barnegat Bay, make significant use of the estuary as a nursery area (Table 2-2). Spot grow to a length of 33 to 36 cm and reach sexual maturity at 2 to 3 years of age, with a maximum lifespan of about 5 years. Juvenile spot feed primarily on plankton, copepods, mysids, and amphipods. Larger individuals feed on bivalves, polychaetes, and other infaunal species. Spot are an important food source for a variety of birds and fish (FWS/DOI/USACE 1989b). Spot are highly tolerant of a wide range of temperature and salinity conditions and have been found in water at temperatures ranging from 46 to 88°F and with salinities ranging from 0 to 60 ppt (FWS/DOI/USACE 1989b). Spot are not commonly entrained or impinged at OCNGS according to Summers et al. (1989).

Recent population trends for spot are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (NMFS 2005a), nor is it identified as a managed species by the MAFMC (MAFMC 2005). In 1987, the ASMFC adopted a fishery management plan for spot, and at present, participating states include Delaware south to Florida (ASMFC 2005a). Commercial landing data for the state of New Jersey from 1950 to 2003 showed that the largest harvests occurred between 1951 and 1957 (NMFS 2005b). The highest recorded landing was 140.6 metric tons in 1952. From 1993 to 2004, commercial landings have ranged from 0.5 to 14.2 metric tons with no apparent trend (NMFS 2005b). The ASMFC (2005a) concluded that the current condition of the stock is unknown, and there are no rebuilding goals in the fishery management plan for this species. There is no designated EFH for spot in Barnegat Bay.

Atlantic Silverside

The Atlantic silverside (*Menidia menidia*, family Atherinidae) is a small, schooling fish common in bays, estuaries, and salt marshes along the northern Atlantic Coast, with a geographic range extending from New Brunswick and Nova Scotia south to Florida (FWS/DOI/USACE 1983a). Commercial use of this fish appears to be related to aquarium supply and for use in aquatic toxicological testing (FishBase 2005). The Atlantic silverside, one of the most abundant species in Barnegat Bay, uses the estuary for spawning and as a nursery area for young fish (Table 2-2). Silversides grow to a length of approximately 14 cm. Silversides are an important part of the marine food web and are an important food source for a variety of larger fish, including bluefish (*Pomatomus saltatrix*), Atlantic mackerel (*Scomber scombrus*), and striped bass (*Morone saxatilis*) (FWS/DOI/USACE 1983a), and for piscivorous birds (Burger 2005).

Silversides reach reproductive maturity at 1 year and are believed to live only 1 or 2 years. Spawning generally occurs during the day at high tide on a semilunar cycle in water temperatures of 48 to 54°F. Eggs are adhesive and attach to available vegetation; larvae are planktonic and tend to remain in the spawning area. Egg production of the Atlantic silverside is estimated to range from 4725 to 13,525 eggs per female (FWS/DOI/USACE 1983a). Juvenile and adult silversides are opportunistic feeders; prey items include copepods, mysids, amphipods, cladocerans, fish eggs, squid, polychaetes, planktonic larvae, and a variety of algae, diatoms, and detritus (Bigelow and Schroeder 1953). Silversides exhibit a high tolerance to temperature and can survive in temperatures between 37 and 88°F, but juveniles prefer a temperature range of 64 to 77°F. Adults are tolerant of salinity ranging from freshwater to 37.8 ppt. The primary anthropogenic stressors impacting silversides are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005). Atlantic silverside eggs and larvae are not commonly entrained at OCNGS; however, adults were present in impingement samples during the 316(b) study (Summers et al. 1989). Average annual losses were approximately 14,000 individuals.

Recent population trends for the Atlantic silverside are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (2005a). Commercial landing data for the state of New Jersey also are not available from the NMFS (2005b). The MAFMC has not identified the Atlantic silverside as a managed species; therefore, no EFH has been designated for this species.

Striped Bass

The striped bass (*Morone saxatilis*, family Moronidae) has represented one of the most important commercial fisheries on the Atlantic Coast for centuries, and the fishery has been regulated since Europeans settled in North America. Striped bass typically spend the majority of their lives in shallow, nearshore waters or the ocean, and may live 30 years. The striped bass, considered a local marine stray, does not utilize Barnegat Bay for either spawning or as a nursery area (Tatham et al. 1984). More recent assessments to determine utilization of Barnegat Bay by striped bass have not been conducted. Sexual maturity is reached at 3 years for males and 6 for females. Spawning occurs either in freshwater or in estuaries receiving riverine input. Females may produce up to 500,000 eggs (ASMFC 2005g). Juvenile striped bass less than 30 cm long generally weigh less than 0.5 kg, 91-cm-long specimens typically weigh 9 kg, and those longer than 152 cm may weigh more than 23 kg (Bigelow and Schroeder 1953). Larval striped bass feed primarily on planktonic invertebrates; adults feed primarily on small schooling fish such as herring and shad. Bass may be preyed upon by larger fish and are also susceptible to parasitism by nematodes (FWS/DOI/USACE 1989f).

Temperature changes appear to affect striped bass reproduction; a sudden rise may trigger spawning, a sudden drop its cessation. Spawning generally occurs in a temperature range of

57 to 75°F. Normal development and hatching of striped bass eggs require dissolved oxygen levels of at least 3 to 5 mg/L, and the apparent minimum dissolved oxygen level for adults appears to be 3 mg/L. Optimal salinity is approximately 0 to 3 ppt for eggs and larvae, and as the larvae grow into adults, their tolerance for higher salinity increases (FWS/DOI/USACE 1989f).

The primary anthropogenic stressors of striped bass are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication and contaminant runoff associated with urban development, and sediment delivery changes in nearshore systems based on activities in the watershed (Buchsbaum et al. 2005). Striped bass are not commonly entrained or impinged at OCNGS; they are, however, susceptible to heat shock (Summers et al. 1989; Kennish 2001c).

The current population size of striped bass in Barnegat Bay is not known, but it was not considered a dominant species by Tatham et al. (1984). Commercial harvest data for striped bass caught in New Jersey are available from 1950 to 1995 (NMFS 2005b). During that time, commercial landings fluctuated greatly, ranging from 0.1 to 452 metric tons. Landings of more than 200 metric tons occurred in 1952, 1962 to 1965, 1968, 1973, and 1974. Landings declined dramatically after 1974, and were 0.2 metric ton or less until 1987. Since that time, resource management actions initiated by many coastal states have allowed the populations to rebound, and the fishery is once again healthy and considered restored (ASMFC 2005g, 2006c; NMFS 2005a). However, the MAFMC has not identified striped bass as a managed species; therefore, no EFH has been designated for this species.

Bluefish

The bluefish (*Pomatomus saltatrix*, family Pomatomidae) is a migratory, pelagic species that is found throughout most of the world in temperate coastal waters (ASMFC 2005h). These fish can live up to 12 years, reach a maximum size of approximately 106 cm, and can weigh more than 11 kg (Bigelow and Schroeder 1953). The bluefish is an important recreational and commercial fish along the Atlantic Coast, and is a warmwater migrant in Barnegat Bay that utilizes the estuary as a significant nursery area (Tatham et al. 1984). In the mid-Atlantic region, spawning occurs during the summer in waters over the continental shelf, and adults that have completed spawning move inshore to the coast of New Jersey and occupy bays, estuaries, and inlets (FWS/DOI/USACE 1989g). Bluefish are voracious predators that feed on a large variety of fish and invertebrates. In the mid-Atlantic region, bluefish spawn in water at temperatures ranging from 63 to 75°F and at salinities of approximately 30 to 32 ppt. Larvae appear to require a temperature of at least 50°F to survive. The primary anthropogenic stressors of bluefish are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005). Bluefish are not commonly entrained or impinged at OCNGS; they are, however, susceptible to heat shock related to OCNGS operations (Summers et al. 1989; Kennish 2001d).

Recent bluefish population data are not available for Barnegat Bay, but commercial landing data for New Jersey are available from 1950 to 2003 (NMFS 2005b). Bluefish landings from 1950 to 1957 exceeded 400 metric tons, then declined to 41.2 metric tons in 1958. Landings gradually increased, peaking at 1362 metric tons in 1986. Landings have gradually declined since that time to the present levels of between 400 and 600 metric tons from 1995 to 2003. Bluefish are managed under a fishery management plan developed by the MAFMC and the ASMFC. Management measures include bag limits in the recreational fishery and commercial quotas. The stock is rebuilding, and full recovery is predicted by 2008 (ASMFC 2005h, 2006d). EFH has been designated for bluefish in Barnegat Bay. Recently, the ASMFC (2006d) concluded that "...bluefish are not overfished and overfishing is not occurring" and further states "trends in State and Northeast Fisheries Science data show a decreasing trend in fishing mortality, and an increasing trend in population numbers. Population abundance estimates show a general increase in overall abundance since 1997."

Winter Flounder

Winter flounder (*Pseudopleuronectes americanus*, family Pleuronectidae) are common in estuaries and nearshore waters along the Atlantic Coast from Newfoundland to Chesapeake Bay and represent an important commercial and recreational fishery resource. Winter flounder, one of the most abundant species in Barnegat Bay, is a resident species that uses the Barnegat Bay estuary as spawning and nursery grounds (Table 2-2). This right-eyed species (eyes on the right side of the body) grows to a length of 30 to 38 cm and generally weighs between 0.5 and 0.9 kg (Bigelow and Schroeder 1953). The preferred substrate is muddy sand. In the mid-Atlantic region, females mature at the age of 2 or 3 years and produce between 500,000 and 1.5 million eggs per spawn (ASMFC 2005b). Winter flounder are migratory and tend to move from nearshore areas to deeper water during the summer months, returning to nearshore areas in the late fall and winter to spawn. Winter flounder tend to return to their natal estuaries to spawn. The primary predators of adult winter flounder are striped bass and bluefish. Larval and juvenile winter flounder are often eaten by birds and burrowing shrimp. Winter flounder have a high tolerance for a broad range of temperature and salinity conditions and are commonly found in water at temperatures ranging from 32 to 77°F and salinities ranging from 5 to 35 ppt (FWS/DOI/USACE 1989c). The primary anthropogenic stressors of winter flounder are physical habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication associated with urban development, and sediment delivery changes in nearshore systems based on activities in the watershed (Buchsbaum et al. 2005). Mean annual entrainment of winter flounder larvae exceeds 4.3 billion on the basis of 316(b) studies; winter flounder are also impinged at OCNGS, but they appear to exhibit high post-impingement survival after traveling through the intake fish return system (Summers et al. 1989).

Recent population trends for the winter flounder are not available for Barnegat Bay. A fishery management plan exists for this species, and the Northeast Regional Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC) concluded in 2003 that the Southern New England/Mid-Atlantic winter flounder stock (Cape Cod, Massachusetts, to the Delaware/Maryland border) is overfished and that overfishing continues to occur (NMFS 2003). This conclusion was confirmed in 2005 by the ASMFC (2005c). Commercial landing data for New Jersey from 1950 to 2003 (NMFS 2005a) show a large variation in catch, with a period of high harvest followed by a series of years of decreasing harvest. Over the past 53 years, peak catches (>150 metric tons) occurred in the late 1960s and early 1980s. Catches of less than 50 metric tons have occurred in the 1950s, early 1970s, and late 1990s. From 1999 to 2003, catches have approached or exceeded 250 metric tons with the exception of 2002, when 109.6 metric tons of winter flounder were landed by commercial fishermen working in New Jersey waters (NMFS 2005a).

The most recent stock assessment and required management actions are presented in ASMFC (2005i). In its recommendations to the Secretary of Commerce, the ASMFC indicates "... the Southern New England/Mid-Atlantic stock of the winter flounder continues to be overfished and in need of conservation. It would be inconsistent with this approach to allow any meaningful increase in fishing mortality." Given the decline in the resources, the ASMFC requires mandatory compliance with recreational fishing restrictions that include a 12-in. minimum size limit, a 10-fish creel limit, and a 60-day open season. Commercial restrictions include a 12-in. minimum size limit and a minimum of 6.5-in. square or diamond mesh in the cod-end of the net. States are also required to maintain existing closures and implement Federal rolling closures that affect State waters (ASMFC 2005i). These restrictions imply that the winter flounder stocks have continued the decline along the eastern seaboard to an extent requiring significant fishing restrictions. The NMFS has already identified EFH for all life stages of winter flounder in Barnegat Bay.

Northern Pipefish

The northern pipefish (*Syngnathus fuscus*, family Syngnathidae) has a large distribution in the western Atlantic Ocean, ranging from the Gulf of St. Lawrence to Florida. This species is common in seagrass beds in bays and estuaries and also frequents freshwater (FishBase 2005). Commercial use of this fish is limited to use in private and public aquariums (FishBase 2005). The northern pipefish, a resident species in Barnegat Bay, makes significant use of the estuary for spawning and also as a nursery area (Table 2-2). Northern pipefish feed primarily on small copepods and amphipods, on fish eggs, and in some cases on very small fish. Breeding occurs during the spring and summer months, and eggs are incubated for approximately 10 days. Young are retained in a brood pouch until their yolk sac has disappeared (Bigelow and Schroeder 1953). The primary anthropogenic stressors affecting northern pipefish are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development

(Buchsbaum et al. 2005). Northern pipefish larvae and juveniles are occasionally entrained, and adults are occasionally impinged at OCNGS.

Recent population trends for the northern pipefish are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (2005a). Commercial landing data for the state of New Jersey also are not available from the NMFS (2005b). The MAFMC has not identified the northern pipefish as a managed species; therefore, no EFH has been designated for this species.

Blue Crab

The blue crab (*Callinectes sapidus*, family Portunidae) is an important commercial and recreational resource along the Atlantic seaboard, and one of the largest blue crab fisheries is associated with Barnegat Bay. Blue crabs are an important part of marine and estuarine food webs, serving as both prey during early developmental stages and predators as adults on a variety of invertebrates. They are also important detritivores and scavengers (FWS/DOI/USACE 1989h; BBNEP 2001). Blue crabs reach sexual maturity in about 2 years, and generally live 4 years or less. Males are capable of mating in more than one season; females mate only once, immediately after their terminal molt. In the mid-Atlantic region, mating generally occurs during the summer, larvae are released into the water and are transported by currents. After settling to the bottom, juvenile blue crabs molt, grow rapidly, and migrate away from high-salinity water into brackish waters, where they mature. Juvenile and adult blue crabs are often associated with eelgrass beds, where they seek cover (BBNEP 2001).

Blue crab megalope and zoea are susceptible to entrainment by OCNGS, and juveniles and adults are commonly impinged. Although estimated annual losses of megalope and zoea exceed 150 million organisms, this number represents only a small fraction of total entrainment. Blue crab juveniles and adults exhibit a high survivability after impingement, with greater than 87 percent survival occurring in studies conducted in support of the 316(a) and 316(b) studies (Summers et al. 1989).

Data on commercial blue crab landings in New Jersey are available for 1950 to 2003 (NMFS 2005b). Landings were variable from about 1950 to 1982, ranging from a low of about 61 metric tons to more than 1000 metric tons from 1973 to 1976. Beginning in about 1982, the landings began to increase and exceeded 2000 metric tons in all but two years. In 1993 and 1995, the New Jersey landings were approximately 3500 metric tons, the largest harvests recorded since 1950 (NMFS 2005b). From 1989 to 1997, blue crab landings in Barnegat Bay represented between 8 and 24 percent of the total blue crab landings in the state of New Jersey. During that time, the value of the resource ranged from $282,000 to $635,000 and represented approximately 9 to 23 percent of the total commercial fishery value for New Jersey. In characterizing the “species of special emphasis” associated with the Barnegat Bay Complex, the FWS (2006) has ranked the blue crab resource as “BW5,” which indicates that the

"... species is demonstrably secure throughout the Bight [New York Bight watershed, which includes Barnegat Bay], though it may be quite rare in parts of the Bight, especially at the periphery of the species' range in the Bight. The species is generally determined to be common to abundant by both States in which it occurs, including within the Bight, and is in no danger of extirpation in either State portion of the watershed or in the open marine waters of the Bight." There appears to be a thriving recreational blue crab fishery in Barnegat Bay, suggesting that the populations of blue crabs are currently sufficient to sustain both commercial and recreational harvests. The MAFMC has not identified the blue crab as a managed species; therefore, no EFH has been designated for this species in Barnegat Bay.

Shrimp

A variety of shrimp species is present in Barnegat Bay, including sand shrimp, grass shrimps (*Palaemonetes vulgaris* and *P. pugio*), opossum shrimp, and mysid shrimp (*Neomysis americana*). Sand shrimp are commercially and recreationally important as bait and are a primary predator of winter flounder eggs. Grass shrimp are both predators on small benthic fauna and prey items to larger fish. Mysid shrimp represent a valuable food source for recreationally and commercially important finfish (BBNEP 2001). Population estimates for these species are not available for Barnegat Bay, but sand shrimp is the most common species entrained and impinged in the OCNGS cooling-water system. Annual entrainment losses were estimated to be more than 300 billion organisms in the 316(b) study, and annual impingement losses of sand shrimp were more than 8 million organisms (Summers et al. 1989). No shrimp EFH has been designated in Barnegat Bay.

Hard Clam

The hard clam (*Mercenaria mercenaria*, family Veneridae) represents one of the most important commercial and recreational resources along the Atlantic Coast of the United States. This species is found in intertidal and subtidal waters from the Gulf of St. Lawrence to Texas. It is most abundant from Massachusetts to Virginia (FWS/DOI/USACE 1983b). An adult female hard clam produces millions of eggs annually. Hard clams have thick shells and short siphons. The clam ranges in length from 60 to 70 mm; some specimens may exceed 120 mm. The spawning season for hard clams extends from approximately May through August. Temperature is the primary determinant of spawning and is also an important factor in gamete maturation and survival. Hard clams spawn when water temperatures increase above 68-73°F (CBP 2003). Clams become sexually mature at 2 or 3 years of age, but maturity is determined by size, not age (FWS/DOI/USACE 1983b). Hard clams are filter feeders and obtain food by filtering small plankton from the water column. Because of this and their location in intertidal and subtidal estuaries, they are susceptible to changes in the quality and quantity of their food source (size and species of plankton), changes in salinity and temperature, the presence of contaminants and bacterial pollutants, and the effects of harmful algal blooms. In recent years, declines in clam harvests have been attributed to a variety of environmental factors, including the presence of brown, green, and red algal (*Aureococcus anophagefferens*, *Nannochloris atomus*, and *Alexandrium fundyense*, respectively) blooms; degraded quality of the water in nearshore regions; and anthropogenic or other changes that have changed the salinity and temperature regimes in the region (New York SeaGrant 1999; MacKenzie 2003). Hard clam larvae were commonly entrained at OCNGS during the 316(b) study, and annual entrainment losses exceeded 112 billion eggs and larvae (Summers et al. 1989).

The population of hard clams in Barnegat Bay was once quite large but has decreased dramatically in the last three decades. In 1879, the Barnegat Bay hard clam fishery produced 150,000 bushels, and yields of 100,000 bushels were common until the early 1970s (Mackenzie 2003). Since that time, harvests in Barnegat Bay and Great South Bay have dropped dramatically and now represent only a fraction of the historical harvests. Likely reasons for the observed declines include deterioration of water quality, the presence of deleterious plankton blooms, impacts associated with chemical and bacterial contaminants associated with nearshore runoff, and the presence of predators such as blue crabs and starfish (MacKenzie and Pikanowski 1999; MacKenzie 2003). Recent information published by New York SeaGrant (2004) suggests that hard clams, when crowded, are also susceptible to disease from the presence of a single-celled microscopic parasite, currently referred to as “Quahog Parasite Unknown” or QPX. The MAFMC has not identified the hard clam as a managed species; therefore, no EFH has been designated for this species.

Shipworms

Shipworms are highly specialized mollusks of the family Teredinidae. The destructive potential of shipworms has existed as long as wooden ships, piers, bridges, and floating structures have existed. Many shipworm species are protandrous, initially developing as males and changing sex later in life. Spawning in Barnegat Bay occurs from about April to October, and larval settlement occurs between July and December (BBNEP 2001). It is during the settlement phase that the larval shipworm enters wooden substrate; the larvae must encounter a suitable substrate within a short time in order to survive. The optimal conditions for reproduction and survival include water temperatures of 50 to 86°F and salinities ranging from 10 to 32 ppt. During the winter months, in the absence of warm water, shipworms experience high mortality; the few remaining adults, however, allow the population to continue.

Shipworms have been studied in Barnegat Bay since 1885. Extensive studies of shipworms in the Barnegat Bay estuary were conducted during the early 1970s to better understand the environmental impacts of OCNGS thermal discharges on both resident and introduced shipworm species (Richards et al. 1984). At the time the plant was constructed, there were several marinas along the southern shore of Oyster Creek. Prior to construction and operation of OCNGS, the creek was predominately freshwater, and untreated wooden structures were commonly used for marinas, docks, and other structures. In the late 1960s and early 1970s, many of the boats that moored at the marina had wooden hulls that were not affected by marine fouling organisms, including shipworms, because shipworms cannot survive in freshwater. Thus, vessel owners often economized on antifouling products for their vessels. After startup of OCNGS in 1969, salinity in Oyster Creek became similar to that of Barnegat Bay, and shipworm habitat was created in the creek, especially in areas influenced by the thermal plume. After establishment of shipworms in Oyster Creek, infestation of the marinas along Oyster Creek by both native and invasive shipworm species was devastating to both the untreated pilings and the wooden hull boats.

Four teredinid species were identified during the 1970s and 1980s: *Bankia gouldi*, *Teredo navalis*, *T. bartschi*, and *T. furcifera*. *B. gouldi* was the dominant species along the western perimeter of Barnegat Bay and had the largest range in the estuary. *T. navalis* was dominant along the eastern perimeter. *T. bartschi* and *T. furcifera* are subtropical species that were introduced and became adapted to the OCNGS thermal discharge during the 1970s and 1980s. From March 1980 to August 1982, Hoagland and Crockett (1980, 1982a,b,c) and Hoagland (1982a,b) conducted a series of studies to evaluate shipworm species composition, distribution, and population dynamics. During these studies, untreated wood panels were deployed at 12 stations in Oyster Creek, the South Branch of Forked River, and Barnegat Bay to evaluate shipworm impacts, and laboratory studies were conducted to determine the temperature and thermal tolerance levels of various species. These studies indicated that the occurrence of the invasive species *T. bartschi* was confined to Oyster Creek until the summer of 1982, when it was observed in the South Branch of Forked River. *T. navalis* was the most common shipworm in the study area. Shipworms that occurred outside of the OCNGS thermal influence experienced significant dieoff in winter months. Laboratory experiments demonstrated that *T. bartschi* became inactive at temperatures and salinities below 41°F and 24 ppt, respectively, and that *T. navalis* showed signs of osmotic stress below 10 ppt at 64°F (Hoagland and Crockett 1982b) but is able to exist at temperatures as low as 39°F (Hoagland and Crockett 1982c). Experiments also indicated that pediveligers of *T. bartschi* prefer not to settle on wood already containing adults (Hoagland and Crockett 1982a). According to the BBNEP (2001), the introduced species *T. bartschi* and *T. furcifera* are no longer found in the study area. This is probably due to the widespread replacement of untreated wood structures with treated materials that are toxic to shipworms and the use of concrete or other materials in pilings rather than untreated wood.

2.2.5.4 Other Important Aquatic Resources near OCNGS

Submerged Aquatic Vegetation

A variety of macroalgae and vascular plants are present as SAV in Barnegat Bay, and 116 species of benthic algae were documented by Loveland and Vouglitois (1984), with the dominant species including sea lettuce (*Ulva lactuca*), graceful red weed (*Gracilaria tikvahiae*), dead man's fingers (*Codium fragile*), eelgrass, *Ceramium fastigiatum*, and *Agardhiella subulata* (BBNEP 2001). SAV species exhibit significant spatial and temporal variation that is influenced by a variety of factors, including water temperature, salinity, sediment transport, solar radiation, and turbidity. Most sessile plants, such as eelgrass, occur within approximately 3 to 6 feet of the surface, but some, such as sea lettuce, are free-floating and drift according to the prevailing wind and tides. Eelgrass probably represents the most important SAV species because it provides a critical habitat for many species of fish, invertebrates, and plants (McLain and McHale 1996). Eelgrass abundance and density can be indicators of overall water quality and environmental health; however, it is often difficult to compare density estimates between studies because of differences in measurement techniques.

Current research suggests that existing eelgrass beds in Barnegat Bay are susceptible to a variety of stressors, including “wasting disease” caused by the protist *Labyrinthula zosterae*, and the occurrence of dense brown, green, and red algal blooms that block sunlight and interfere with photosynthesis. McLain and McHale (1996) concluded that “eelgrass beds in Barnegat Bay are not a healthy biotype,” and recent work by Gastrich et al. (2004) has shown that more than 50 percent of the SAV in Barnegat Bay and Little Egg Harbor exists in areas with a high frequency of algal blooms. Other potential stressors on SAV include damage inflicted by boats, harvesting, climatic fluctuations, changes to soil structure and fertility, lack of adequate water circulation, and changes to tidal range and water exchanges based on dredging or channel modifications. Nonpoint pollution and eutrophication of the bay’s water also appear to contribute to some phytoplankton blooms, which result in severe shading of eelgrass. In the 2005 State of the Bay Technical Report (BBNEP 2005b), BBNEP scientists concluded that significant declines in SAV have occurred in New Jersey estuaries over the past 30 years, and recent trend analysis suggests that although the overall SAV distribution has remained relatively stable over the past 5 years, large fluctuations still occur at a localized scale. BBNEP (2005b) indicates that there are major information gaps related to the relative importance of eutrophication and brown tide blooms on SAV health in the estuary.

Salt Marshes

Salt marshes are shallow-water estuarine habitats that provide food and refuge to many fish and invertebrates, habitat for a variety of birds and mammals, and recreational value to human populations. Tidal salt marsh habitat surrounding Barnegat Bay was estimated to occupy 36,694 ac in 1888; mapping conducted in 1995 identified a total of 24,561 ac, representing a 33 percent loss (BBNEP 2001). This was considered to be an overestimate of loss because of differences in measurement techniques and inherent errors associated with salt marsh estimates (BBNEP 2001). The actual loss is estimated at about 28 percent and appears to have occurred during a 30-year period from World War II to the enactment of the New Jersey Wetlands Act of 1970 (Lathrop and Bognar 2001). The authors concluded, however, that “whereas on the whole Barnegat Bay lost more than about one-quarter of its salt marshes during the past century, some areas have actually experienced an increase in salt marsh area, most notably in the vicinity of the Barnegat Inlet, presumably due to the stabilization of the inlet earlier this century.”

Most of the loss is attributed to development along the coastal shorelines and dredging conducted by the USACE to maintain access to ports and marinas. Because a series of complex environmental interactions is necessary to maintain salt marshes, anthropogenic impacts associated with changes in hydrology, sediment transport, water salinity, and other factors are very important. Because of the high degree of development that has occurred in Barnegat Bay, the shoreline has been heavily altered, with approximately 36 percent of the nearshore areas bulkheaded and 70 percent of the adjacent upland ecosystem developed (Lathrop and Bognar 2001). Passage of the New Jersey Wetlands Act has helped to slow the loss of salt marshes, but a small and steady loss continues in Barnegat Bay (BBNEP 2001).

Benthic Infauna

Investigations of benthic communities were conducted in Barnegat Bay during the 1960s, 1970s, and 1990s to document spatial and temporal trends resulting from the operation of OCNGS (Kennish 2001a). During the early studies, the dominant species included the bivalve mollusc *Mulinaria lateraliz*, the polychaete *Pectinaria gouldii*, and the gastropod *Acteocina canaliculata*. Between 1969 and 1973, the densities of these species decreased significantly, with mean densities dropping from 9000 to 17,000 individuals per m^2 in 1969 to less than 500 per m^2 in 1973 (Kennish 2001a; BBNEP 2001). It is not possible to determine specific locations associated with these decreases, nor is it possible to determine whether OCNGS was an important contributor to the declines. However, localized impacts on benthic communities in the vicinity of the plant intake and discharge canals have been documented (Kennish 2001a). These impacts are related to both dredging and excavations required for cooling-water flow, the effects of heated water discharges into Oyster Creek, and the replacement of freshwater and low-salinity environments in Oyster Creek and Forked River with higher salinity conditions typical of estuaries (BBNEP 2001). At present, a large variety of mobile epifauna inhabit Barnegat Bay, including sand shrimp, grass shrimp, mysid shrimp, mud crabs (*Neopanope texana*, *Panopeus herbstii*, and *Rhithropanopeus harrisii*), hard clams, horseshoe crabs (*Limulus polyphemus*), and a variety of gastropods and starfish (Kennish 2001a). The current abundance of these organisms in the estuary has not been estimated with any precision.

Phytoplankton, Zooplankton, and Algal Blooms

Barnegat Bay supports an extensive assemblage of phytoplankton that is responsible for the primary production that is the foundation of marine and estuarine food webs. There is a great deal of variation in the abundance and distribution of phytoplankton and zooplankton, and population cycles vary monthly, seasonally, and annually. A long-term study by the NJDEP (Olsen and Mahoney 2001) evaluated phytoplankton species composition and abundance from 1987 through 1998 and identified a total of 132 species, with 51 of these being new to the Barnegat Bay-Little Egg Harbor estuary. Dinoflagellates and diatoms represented the majority of the species observed, accounting for 100 of the 132 species and 72 percent of the total abundance.

Zooplankton in Barnegat Bay represent the principal herbivorous component of the estuarine ecosystem because they are consumers of phytoplankton and detritus (Kennish 2001b). No recent investigations of zooplankton abundance or species composition have been conducted in Barnegat Bay, but a series of studies was conducted in the bay from about 1975 to 1977 in support of the NJPDES 316(a) and 316(b) demonstrations related to the cooling-water system (Tatham et al. 1977). Dominant species observed during this time were the calanoid copepods *Acartia hudsonica*, *A. tonsa*, and *Oithona colcarva*. *A. hudsonica* dominated during the winter; during the summer, *A. tonsa* and/or *O. colcarva* dominated (Kennish 2001b). All of these species have been identified in entrainment samples from OCNGS. In general, zooplankton abundance is closely tied to phytoplankton abundance, with the highest zooplankton populations occurring in the late spring and summer months following phytoplankton blooms.

Harmful algal blooms occur in bays and estuaries (usually in the summer months) when algal abundances are high enough to affect water clarity and dissolved oxygen content and create unhealthy conditions for fish, invertebrates, and humans. During the 1950s, intense blooms of green algae (*Nannochloris atomus* and *Stichococcus* spp.) were believed to be responsible for the failure of the oyster industry, and prolonged blooms of the dinoflagellate *Prorocentrum micans* from 1968 to 1972 caused sickness and discomfort for bathers (Olsen and Mahoney 2001). During the summer of 1985, *N. atomus* was present in the New York Bight, and residents of Barnegat Bay reported yellowish brown water in lower Barnegat Bay and off Long Beach Island (Olsen 1996). At present, blooms of the pelagophyte *Aureococcus anophagefferens* have created "brown tides" that are suspected of inhibiting the feeding and growth of the hard clam and causing mass mortalities of bay scallops (*Argopecten irradians*) and blue mussels (*Mytilus edulis*), and destruction of eelgrass beds (Olsen and Mahoney 2001).

Based on a 3-year study from 2000 to 2002, Gastrich et al. (2004) estimated that 50 percent of the SAV habitat in Barnegat Bay and Little Egg Harbor was categorized as having a high frequency of Category 2 or 3 blooms, with Category 2 blooms defined as having cell densities of 35,000 to 200,000 cells/mL and Category 3 blooms defined as having cell densities of 200,000 cells/mL or higher. Gastrich et al. (2004) concluded that regional climatic and/or hydrologic changes appear to be major factors in bloom production, and that an increase in salinity associated with extended drought conditions is a critical factor in the initiation of brown tide blooms in Barnegat Bay. Navigational improvements to the Barnegat Inlet in the late 1980s and early 1990s have increased mean tidal ranges in the bay by more than 30 percent, allowing a greater influx of high-salinity water from the Atlantic Ocean to Barnegat Bay. It is also possible that eutrophication of the bay from agricultural and urban runoff is contributing to some of the harmful algal blooms; however, there is no evidence that dissolved organic nitrogen is responsible for brown tide abundance (Gastrich et al. 2004).

2.2.5.5 Threatened or Endangered Aquatic Species

Aquatic species that are listed by the Federal government as threatened or endangered and have the potential to occur in the vicinity of the OCNGS site or along the OCNGS-to-Manitou transmission line corridor are presented in Table 2-4. This list is made up of five sea turtle species, but there is no designated critical habitat in the vicinity of the OCNGS site. There are no other threatened or endangered species that have been observed in Barnegat Bay, the South Branch of Forked River, or Oyster Creek.

Table 2-4. Aquatic Species Listed as Endangered or Threatened by the U.S. Fish and Wildlife Service or National Marine Fisheries Service That Are Known to Occur or Could Occur in the Vicinity of the OCNGS Site or along the Transmission Line Corridor

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]
Caretta caretta	loggerhead sea turtle	T	E
Lepidochelys kempii	Kemp's ridley sea turtle	E	E
Dermochelys coriacea	leatherback sea turtle	E	E
Eretmochelys imbricata	hawksbill sea turtle	E	E
Chelonia mydas	green sea turtle	T	T

(a) Listing status: E = endangered; T = threatened.

Loggerhead Sea Turtle

The loggerhead sea turtle (*Caretta caretta*, family Cheloniidae) was Federally listed as threatened throughout its range in 1978 (NMFS 2005c) and is listed as endangered by the State of New Jersey (NJDEP 2005e). Loggerhead sea turtles are found in temperate and tropical waters throughout the world and feed in coastal bays and estuaries and in the shallow waters along the continental shelves of the Atlantic, Pacific, and Indian Oceans, where they spend most of their lives. Adult carapace lengths range from 73 to 107 cm, and adults can weigh up to 159 kg.

Their diet consists of shellfish, including horseshoe crabs, clams, and mussels. Adult females return to coastal beaches to lay eggs at intervals of 2, 3, or 4 years, and generally lay between 100 to 126 eggs per season (CCC 2005). Loggerheads are the most common sea turtle in the coastal waters of the United States, and the current number of adult females along the U.S. Atlantic and Gulf coasts is believed to be 44,780 (CCC 2005). The Caribbean Conservation Corporation (CCC) stated that worldwide population estimates for this species do not exist, and that the U.S. estimate is based on the number of nesting females obtained from nesting beach monitoring reports and publications (CCC 2005). The greatest threats to survival include the destruction or alteration of nesting and feeding habitats, incidental capture by commercial and recreational fishermen, entanglement in shallow-water debris, and direct physical impact from collisions with commercial or recreational vessel traffic (NMFS 2005c). From 1977 to 2004, 809 loggerhead sea turtle strandings were reported for the New Jersey coast (NRC 2005b).

The operation of the once-through cooling-water system at OCNGS can result in sea turtle mortalities due to impingement and subsequent drowning on intake trash racks. Between 1969 and 2006, eight loggerhead sea turtles (six alive, two dead) were removed from the OCNGS cooling-system trash bars. These impingements occurred in 1992, 1994, 1998, 2000, and 2006 (NRC 2005b; AmerGen 2006c,d,e). The significance of these impingements is discussed in Section 4.6.1.

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle (*Lepidochelys kempii*, family Cheloniidae) was Federally listed as endangered throughout its range in 1970 (NMFS 2005c). The State of New Jersey also considers this turtle endangered (NJDEP 2005e). Kemp's ridley sea turtles are usually found in the Gulf of Mexico; juveniles, however, have been known to range north, entering the waters of New Jersey and Barnegat Bay. The average carapace length of adults is 65 cm; adults can weigh from 35 to 45 kg. Their preferred habitat is shallow areas with sandy or muddy bottoms; their primary diet includes crab, mussels, shrimp, sea urchins, squid, and jellyfish. The Kemp's ridley sea turtle nests annually, arriving at nesting grounds in Mexico in large aggregations. Females lay an average of 110 eggs in each nest, and egg incubation is about 55 days (CCC 2005). The Kemp's ridley sea turtle is considered the most endangered sea turtle, and its population is believed to be in the early stages of recovery. The lowest number of nests (740) was observed in 1985; since that time, however, the number of nests appears to have increased by about 11 percent (NMFS 2000).

The number of nests observed at the primary nesting location (Rancho Nuevo, Tamaulipas, Mexico) in 2000 was 3788, an increase of 2523 nests at that location since 1994 (NRC 2005b). The greatest threats to the survival of Kemp's ridley sea turtles are from human activities, including destruction of nests and collection of eggs and interactions with commercial fisheries (CCC 2005).

Kemp's ridley sea turtles have been observed in Barnegat Bay and have been impinged on OCNGS cooling-system intake trash bars. There were no incidences of impingement until 1992. Since that time, 28 Kemp's ridley sea turtles have been impinged, and approximately 12 of these were either dead when found or died shortly thereafter. Sixty-eight Kemp's ridley sea turtle strandings were reported for the New Jersey coast from 1977 to 2004, with 48 of 68 strandings (71 percent) occurring since 1992 (NRC 2005b). The significance of the impingements at OCNGS is discussed in Section 4.6.1.

Leatherback Sea Turtle

The leatherback sea turtle (*Dermochelys coriacea*, family Dermochelyidae) was Federally listed as endangered throughout its range in 1970 (NMFS 2005c). The state of New Jersey also considers this species endangered (NJDEP 2005e). The leatherback sea turtle is found worldwide and has the largest north-south range of all sea turtle species. Adults generally have a carapace length of 121 to 183 cm and weigh between 250 and 700 kg. The largest recorded leatherback was almost 305 cm and weighed 916 kg (CCC 2005). Leatherback sea turtles feed almost exclusively on jellyfish and other soft-bodied organisms (CCC 2005). Females nest every 2 to 3 years but often change nesting beaches, making population estimates difficult (CCC 2005; NMFS 2005c). The current population estimate for this species is variable, given the difficulty of determining nesting locations and the number of females. The NMFS (2005c) estimates the number of female leatherbacks to be 20,000 to 30,000; the CCC (2005) reports 35,860 nesting females. Pritchard (1983) suggests that the world population estimate may be more than 100,000 females because of the discovery of nesting beaches in Mexico. The primary threats to leatherback sea turtles include capture and suffocation in commercial fishing nets and the ingestion of marine debris (plastic bags, balloons, etc.) that are mistaken for jellyfish (CCC 2005). From 1980 to 2001, 229 leatherback sea turtle strandings were observed along the New Jersey coast. No sightings or impingements of this species have been observed at OCNGS since the station became operational (NRC 2005b).

Hawksbill Sea Turtle

The hawksbill sea turtle (*Eretmochelys imbricata*, family Cheloniidae) was Federally listed as endangered in 1970 (NMFS 2005c). The state of New Jersey also considers this species endangered (NJDEP 2005e). This species is primarily tropical, but has been observed along the Atlantic seaboard as far north as Maine. Most sightings along the eastern U.S. coast have been in Florida and Texas (NRC 2005b; CCC 2005). Hawksbill sea turtles range in length from 76 to 91 cm and weigh between 45 and 70 kg. They feed primarily within coral reef systems. Their narrow heads and jaws allow them to feed on sponges, anemones, squid, and shrimp that exist in crevices and cracks within the reefs. Females nest at intervals of 2 or more years, and lay an average of 160 eggs in each nest. Nesting may occur between two to four times per season (CCC 2005). The CCC (2005) estimates that there are 22,900 nesting females worldwide, and the NMFS (2005c) believes that the nesting populations are generally declining. The only stable populations were observed in 1983 in Yemen, Oman, the Red Sea, and Australia. The primary threats to this species include harvesting for its shell to create “tortoise shell” ornaments, removal of eggs from nesting sites, destruction or disruption of nesting beaches due to dredging, beachfront armoring, or coastal erosion, and the disorientation of adults and juveniles from artificial lighting of shorelines (NMFS 2005c). No strandings of hawksbill sea turtles have been reported on the coast of New Jersey, and no sightings or impingements of this species have been observed at OCNGS (NRC 2005b).

Green Sea Turtle

The green sea turtle (*Chelonia mydas*, family Cheloniidae) was Federally listed as threatened in U.S. waters and as endangered in Mexican waters in 1970. The state of New Jersey considers this species threatened (NJDEP 2005e). Green sea turtles are found in temperate and tropical waters throughout the world. This species is found in the U.S. Virgin Islands, Puerto Rico, and along the shorelines of the Gulf and Atlantic Coasts from Texas to Massachusetts (NMFS 2005c). Adult carapace lengths range from 76 to 91 cm, and adults weigh between 136 and 180 kg. The largest green sea turtle ever found was 152 cm long and weighed 395 kg (CCC 2005). The diet of this species changes as it grows. Young green sea turtles eat polychaetes, small crustaceans, aquatic insects, grasses, and algae. Older green turtles are primarily herbivorous and eat seagrasses and algae (CCC 2005). Green sea turtles nest at intervals of 2 or more years, may nest up to 5 times per season, and produce about 115 eggs per nest, with an incubation period of about 60 days (CCC 2005). The present population estimate for this species is 88,520 nesting females worldwide (CCC 2005); between 200 and 1100 females are believed to nest on U.S. beaches (NMFS 2005c). The primary threats to this species include the commercial harvest of eggs for food and incidental catch in commercial fishing nets. Sixteen green sea turtles have been stranded on New Jersey beaches since 1977; four green turtles have been impinged on the OCNGS trash racks since 1969 (three alive and one dead). All OCNGS impingements occurred between 1999 and 2003 (NRC 2005b). The significance of these impingements at OCNGS is discussed in Section 4.6.1.

2.2.6 Terrestrial Resources

2.2.6.1 Description of Terrestrial Resources in the Vicinity of OCNGS

The 800-ac OCNGS site and the associated 11.1-mi-long OCNGS-to-Manitou transmission line are located within the Barnegat Bay watershed (which encompasses much of Ocean County) and are mostly within the Pinelands National Reserve (Figure 2-2) (AmerGen 2005a). The Pine Barrens is a heavily forested, 1.1 million-ac area of coastal plain located within central and southern New Jersey. “Barrens” refers to the nutrient-poor, sandy soils of the area that limit the growth of agricultural crops.

The OCNGS site consists of man-made structures, dredge spoils, cleared land, upland forest, Atlantic white cedar (*Chamaecyparis thyoides*) swamps, salt marshes, and grasslands. The OCNGS site is bisected by U.S. Highway 9 (Figure 2-3). The 150-ac tract west of U.S. Highway 9 contains the plant-related facilities and a 60-ac, mostly undeveloped, buffer strip that includes a small area of emergent scrub-shrub and forested wetlands. The 650-ac tract east of U.S. Highway 9 is the former Finninger Farm. It is primarily composed of forests (25 percent), abandoned farmland (65 percent), and surface waters (10 percent). The eastern third of Finninger Farm has been colonized by the invasive non-native common reed (*Phragmites australis*), with beaches and tidal wetlands occurring along the eastern edge of the property

(AmerGen 2005a). A dredge spoils basin on the former Finninger Farm area has been used for disposal of material dredged from the OCNGS intake and discharge canals. The dredge spoils basin occupies about 17.5 ac (2.7 percent) of the Finninger Farm area (Figure 2-3). Monitoring equipment, used as part of the ongoing radiological monitoring program, and a helicopter landing area are located on the Finninger Farm portion of the OCNGS site. Otherwise, the Finninger Farm area now functions as an undeveloped buffer (AmerGen 2005a).

The 240-ft wide, 230-kV OCNGS-to-Manitou transmission line parallels the Garden State Parkway for much of its length. Much of the transmission line right-of-way traverses pitch pine (*Pinus rigida*) forests and Atlantic white-cedar swamp forests (AEC 1974). However, it also crosses several streams (e.g., three branches of Forked River, Huckleberry Branch, Deep Hollow Branch, Cedar Creek, Factory Branch, and Jakes Branch) and associated wetlands, bogs, ponds, and agricultural lands (AmerGen 2005a). The OCNGS-to-Manitou transmission line parallels the eastern boundary of Forked River Wildlife Management Area for about 1 mi, and about 1.5 mi of the transmission line occurs within the northeastern corner of Forked River Wildlife Management Area. About 1 mi of the transmission line also crosses through the Double Trouble State Park (AmerGen 2005a).

A second transmission line connects OCNGS to the grid. As discussed in Section 2.1.7 of this SEIS, the OCNGS-to-Cedar transmission line is outside the scope of the OCNGS license renewal because it was constructed and placed in operation recently. A separate environmental assessment was prepared that evaluated the impacts associated with construction and operation of this transmission line (ENSR International 2004).

Natural habitats and associated biota within the Barnegat Bay watershed have been adversely impacted by a wide variety of factors, including nonpoint source pollution; water-quality degradation; and habitat loss, fragmentation, and alteration. Habitat fragmentation and associated human development have resulted in an increase in predators (e.g., blue jay [*Cyanocitta cristata*], American crow [*Corvus brachyrhynchos*], raccoon [*Procyon lotor*], red fox [*Vulpes vulpes*], and feral cats [*Felis silvestris*]); the brown-headed cowbird (*Molothrus ater*), a brood parasite; herbivores (e.g., white-tailed deer [*Odocoileus virginianus*]); and invasive plant species (BBNEP 2001; New Jersey Audubon Society 2005). A loss of about 20 percent of the upland forests and 6 percent of the wetland forests occurred within the Barnegat Bay watershed between 1972 and 1995 (Lathrop et al. 1999). Also, about 71 percent of Barnegat Bay's shoreline buffer zone has been developed or altered, leaving only 29 percent in its natural land cover; about 28 percent of Barnegat Bay's salt marshes have been lost to development (Lathrop et al. 1999).

More than 60 percent of New Jersey's vascular plant species are not native to the region. These species can crowd out native species and alter the structure and function of natural communities (Snyder and Kaufman 2004). Wetlands are especially susceptible to invasive species, with purple loosestrife (*Lythrum salicaria*) and common reed being two of the major threats. The invasive non-native upland plant species of most concern are the autumn olive (*Eleagnus umbellata*), multiflora rose (*Rosa multiflora*), and Japanese barberry (*Berberis thunbergii*) (Snyder and Kaufman 2004).

In general, about 15 percent of the Pine Barrens has been modified for agricultural and urban uses, 20 percent is wetlands, and the remaining 65 percent is upland forests (McCormick 1978). Upland forest types of the Pine Barrens include pine, mixed pine-hardwood, and hardwood forests. Pine forests are dominated by pitch pine, oaks (*Quercus* spp.), northern bayberry (*Myrica pensylvanica*), red maple (*Acer rubrum*), and sassafras (*Sassafras albidum*). Mixed pine-hardwood forests are characterized by pitch pine, oaks, black tupelo (*Nyssa sylvatica*), and sassafras; oaks are more numerous than in the pine forests. The hardwood forests are characterized by black, white, scarlet, and blackjack oaks (*Q. velutina*, *Q. alba*, *Q. coccinea*, and *Q. marilandica*) (AEC 1974). The understory of the upland forests is dominated by either scrub oak (*Q. ilicifolia*) or various heath plants such as mountain laurel (*Kalmia latifolia*), huckleberries (*Gaylussacia* spp.), and blueberries (*Vaccinium* spp.) (FWS 1997; BBNEP 2001). Herbaceous plants are sparse within upland forests of the Pine Barrens. Common species include bracken fern (*Pteridium aquilinum*) and common wintergreen (*Chimaphila umbellata*) (McCormick 1978).

The intensity and frequency of fires are among the most important factors controlling the composition of upland forests. If fires are controlled in the Pine Barrens and no other disturbances such as cutting occur, the pine forests are eventually replaced by hardwood forests (Little 1978; McCormick 1978).

Three distinct vegetation areas occur within the coastal marshes of Ocean County: (1) the area covered by water during every high tide that is dominated by smooth cordgrass (*Spartina alterniflora*); (2) the area sometimes covered by normal high tides that is dominated by the short form of smooth cordgrass, sedges, and marsh grass; and (3) the area that is only inundated by the spring and fall tides and winter storm tides and that has a greater diversity of vegetation (BBNEP 2001). The wetland plant communities that occur within the Pine Barrens include (1) Atlantic white cedar forests; (2) broadleaf or hardwood swamp forests dominated by red maple and black tupelo; (3) pitch pine lowland and pine transition forests; (4) shrubby wetlands; and (5) herbaceous wetlands, including both submerged and aquatic vegetation (BBNEP 2001). About 20 shrub species are found in the understory of wetland forests and are dominated by blueberries, swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), and greenbriers (*Smilax* spp.) (BBNEP 2001). Wetlands occupy about 22 percent of the Oyster Creek watershed (Zampella et al. 2004).

About 30 amphibian species occur within the Pine Barrens, but only about 10 species are common because of the naturally acidic conditions (pH of 3.6 to 5.2) of many of the Pine Barrens aquatic habitats. The Pine Barrens treefrog (*Hyla andersonii*) and carpenter frog (*Rana virgatipes*) are among the few amphibian species that can tolerate these acidic conditions (Hastings 1978). Frog and toad species that have widespread and stable populations within the Pine Barrens include the spring peeper (*Pseudacris crucifer*), gray treefrog (*H. versicolor*), bullfrog *(R. catesbeiana*), green frog *(R. clamitans*), wood frog *(R. sylvatica*), southern leopard frog *(R. sphenocephala*), pickerel frog *(R. palustris*), and Fowler's toad (*Bufo fowleri*) (BBNEP 2001). These species mostly breed in altered habitats (e.g., abandoned gravel pits) where acidity is less extreme. Salamanders that are common to the Pine Barrens include the red salamander (*Pseudotriton ruber*) and redback salamander (*Plethodon cinereus*) (Hastings 1978).

About 30 reptile species occur within the Pine Barrens. Common turtle species include the eastern box turtle (*Terrapene carolina*), northern painted turtle (*Chrysemys picta*), spotted turtle (*Clemmys guttata*), and snapping turtle (*Chelydra serpentina*) (Hastings 1978). The fence lizard (*Sceloporus undulatus*) is the most common lizard species. Several snakes (e.g., eastern kingsnake [*Lampropeltis getula*] and northern water snake [*Nerodia sipedon*]) occur within the wetlands of the Pine Barrens. Most other reptile species occur within upland forested habitats, including the scarlet snake (*Cemophora coccinea*), black racer (*Coluber constrictor*), corn snake (*Elaphe guttata*), eastern hognose snake (*Heterodon platirhinos*), milk snake (*L. triangulum*), and rough green snake (*Opheodrys aestivus*) (Hastings 1978; BBNEP 2001).

Amphibian and reptile species have declined in Ocean County over the past several decades because of habitat degradation and loss, road mortality, pollution, illegal collecting and killing, and predation from domestic and feral animals (BBNEP 2001).

At least 290 bird species have been observed within the Edwin B. Forsythe National Wildlife Refuge (FWS 1993a), a multiparceled refuge that is located along the coastal and near-coastal portions of Ocean and Atlantic Counties. The refuge parcels closest to OCNGS occur immediately north of Forked River and south of Oyster Creek (FWS 2004a). Only about 50 bird species are common within the Pine Barrens. Among these species are the eastern towhee (*Pipilo erythrophthalmus*), blue jay (*Cyanocitta cristata*), Carolina chickadee (*Poecile carolinensis*), pine warbler (*Dendroica pinus*), prairie warbler (*D. discolor*), black-and-white warbler (*Mniotilta varia*), ovenbird (*Seiurus aurocapillus*), and brown thrasher (*Toxostoma rufum*). The gray catbird (*Dumetella carolinensis*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), American redstart (*Setophaga ruticilla*), and field sparrow (*Spizella pusilla*) are common in dense riparian vegetation. The red-winged blackbird (*Agelaius phoeniceus*), swamp sparrow (*Melospiza georgiana*), and song sparrow (*M. melodia*) are common among emergent vegetation. Various heron, egret, and duck species occur in the Pine Barren rivers and lakes (Hastings 1978). Some 20 species of colonial-nesting birds nest within the Barnegat Bay estuarine habitats, including beach nesting birds (e.g., black skimmer [*Rynchops niger*] and least tern [*Sterna antillarum*]), tree and shrub nesting birds (e.g., herons, egrets, and ibises), and some gull and tern species that nest on salt marsh islands and dredged spoil islands (BBNEP 2001). The abundance of some bird species within estuarine habitats has been decreasing over the past several decades because of loss of habitat, disturbance, and predation (BBNEP 2001).

Barnegat Bay is located within the Atlantic flyway and is an important migration and wintering habitat for more than 20 waterfowl species. The more common species include American black duck (*Anas rubripes*), mallard (*A. platyrhynchos*), American widgeon (*A. americana*), green-winged teal (*A. crecca*), brandt (*Branta bernicla*), Canada goose (*B. canadensis*), bufflehead (*Bucephala albeola*), common goldeneye (*B. clangula*), canvasback (*Aythya valisineria*), greater scaup (*Aythya marila*), lesser scaup (*A. affinis*), red-breasted merganser (*Mergus serrator*), common merganser (*M. merganser*), hooded merganser (*Lophodytes cucullatus*), mute swan (*Cygnus olor*), and long-tailed duck (*Clangula hyemalis*) (BBNEP 2001). In winter, waterfowl congregate in the open water of Barnegat Bay, including open waters near OCNGS. Waterfowl provide considerable economic and recreational value to the area (e.g., hunting and bird-watching) (BBNEP 2001).

Many shorebird species pass through the Barnegat Bay region during spring and fall migrations. The most abundant species are the sanderling (*Calidris alba*), semipalmated sandpiper (*C. pusilla*), red knot (*C. canutus*), dunlin (*C. alpina*), semipalmated plover (*Charadrius semipalmatus*), short-billed dowitcher (*Limnodromus griseus*), and ruddy turnstone (*Arenaria interpres*). The willet (*Catoptrophorus semipalmatus*), American oystercatcher (*Haematopus palliatus*), and piping plover (*Charadrius melodus*) are the only shorebird species that nest within Barnegat Bay. The habitat for these three species has been diminished or altered because of beach stabilization, residential and commercial development, disturbance, and predation (BBNEP 2001). The Barnegat Bay estuary is also an important staging and overwintering area for seabirds such as cormorants (*Phalacrocorax* spp.), scoters (*Melanitta* spp.), loons (*Gavia* spp.), northern gannet (*Morus bassanus*), sooty shearwater (*Puffinus griseus*), and Wilson's storm petrel (*Oceanites oceanicus*) (BBNEP 2001).

The most common raptor species within the Barnegat Bay estuary are osprey (*Pandion haliaetus*), peregrine falcon (*Falco peregrinus*), and northern harrier (*Circus cyaneus*). The greatest threat to these species is human disturbance; however, limited nesting site availability, predation, and contaminants also impact the species to varying extents (BBNEP 2001). The red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*) are among the more common raptor species.

Most neotropical migrant birds within the Barnegat Bay watershed are forest, scrub-shrub, and grassland species. Habitat loss and fragmentation are the primary impacts on this group of birds (BBNEP 2001).

About 34 mammal species occur within the Pine Barrens; approximately 20 are common (Hastings 1978). Mammals common within forested habitats include white-tailed deer, red fox, gray fox (*Urocyon cinereoargenteus*), raccoon, long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), eastern gray squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), eastern chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), white-footed mouse (*Peromyscus leucopus*), and woodland vole (*Microtus pinetorum*). The red fox and raccoon are widespread both on the mainland and barrier islands. Shrubland and grassland species include meadow vole (*M. pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), woodchuck (*Marmota monax*), and eastern cottontail (*Sylvilagus floridanus*). Those occurring within wetlands and along streams and rivers include American mink (*Mustela vison*), northern river otter (*Lontra canadensis*), North American beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), southern bog lemming (*Synaptomys cooperi*), and least shrew (*Cryptotis parva*) (BBNEP 2001).

Hunting and trapping of mammals occur within the Barnegat Bay watershed. The white-tailed deer, eastern cottontail, and gray squirrel are the most commonly hunted species, while some hunting also occurs for raccoon and foxes. Trapping occurs for raccoon, striped skunk, foxes, long-tailed weasel, mink, and beaver (BBNEP 2001).

2.2.6.2 Threatened or Endangered Terrestrial Species

Federally and State-listed, proposed, or candidate terrestrial species found in Ocean County are presented in Table 2-5. For some bird species, there is a dual State status, one for the breeding population and the other for the migratory or winter population (NJDEP 2001b). On October 12, 2005, the NRC contacted the U.S. Fish and Wildlife Service (FWS) and requested information on Federally listed and proposed threatened and endangered species, candidate species, and critical habitat on and near the OCNGS site (NRC 2005a). In its response, the FWS stated that except for an occasional transient bald eagle (*Haliaeetus leucocephalus*), no Federally listed or proposed threatened or endangered species under FWS jurisdiction are known to occur within the OCNGS area (FWS 2005b). However, the Federally protected swamp pink (*Helonias bullata*), the Federally protected Knieskern's beaked-rush (*Rhynchospora knieskernii*), and the Federal candidate bog asphodel (*Narthecium americanum*) have been reported within 2.8, 1.5, and 1.3 mi, respectively, of the project area (FWS 2005b). The 10 Federally protected species and the single candidate species for Federal listing that are reported from Ocean County are discussed in this section. No designated critical habitats for Federally listed species occur on either the OCNGS site or the associated OCNGS-to-Manitou transmission line corridor.

Table 2-5. Federally Listed and State-Listed Terrestrial Species Potentially Occurring on or in the Vicinity of OCNGS and Associated Transmission Line

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Plants				
Amaranthus pumilus	seabeach amaranth	T	E	Barrier island beaches
Arnoglossum atriplicifolium	pale Indian plantain	–	E	Wooded slopes, rocky stream margins, open woods
Cardamine longii	Long's bittercress	–	E	Moist alluvial soils in woods
Cirsium virginianum	Virginia thistle	–	E	Bogs and wet pine barrens
Clitoria mariana	butterfly-pea	–	E	Upland rocky woods, sandstone glades, ravines, ridges
Corema conradii	broom crowberry	–	E	Sandy pine barrens, sandhills
Desmodium pauciflorum	few-flower tick-trefoil	–	E	Moist woods, ravines, bluff bases
Eleocharis tortilis	twisted spike-rush	–	E	Swamps, wet woods, thickets
Eriophorum tenellum	rough cotton-grass	–	E	Bogs and wet, peaty substrates
Eupatorium resinosum	Pine Barren boneset	–	E	Open bogs, swamps, streamsides
Eurybia radula	low rough aster	–	E	Wet woods, swamps
Fraxinus profunda	pumpkin ash	–	E	Swamps, bottomlands
Galactia volubilis	downy milk-pea	–	E	Dry thickets, borders of woods
Glaux maritima	sea-milkwort	–	E	Seashores, salt marsh borders
Gnaphalium helleri	small everlasting	–	E	Dry clearings, wood and field borders
Helonias bullata	swamp pink	T	E	Swamps, bogs
Hottonia inflata	featherfoil	–	E	Wet sloughs, ditches
Jeffersonia diphylla	twinleaf	–	E	Rich, damp, open woods
Juncus caesariensis	New Jersey rush	–	E	Pineland bogs, cedar swamps
Juncus torreyi	Torrey's rush	–	E	Wet meadows, prairies, swamps, marshes
Limosella subulata	awl-leaf mudwort	–	E	Tidal mudflats, muddy or sandy shores

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Linum intercursum	sandplain flax	–	E	Dry, open sandplain grasslands, sand barrens, rights-of-way, mowed fields
Luzula acuminata	hairy wood-rush	–	E	Woods, clearings, bluffs
Melanthium virginicum	Virginia bunchflower	–	E	Meadows, moist woods, seepages, damp clearings, wet thickets
Myriophyllum tenellum	slender water-milfoil	–	E	Water up to 5 ft deep; in sand, granitic gravel, mud, peat
Myriophyllum verticillatum	whorled water-milfoil	–	E	Shallow waters
Narthecium americanum	bog asphodel	C	E	Moist savannahs, sandy bogs
Oenothera humifusa	sea-beach evening-primrose	–	E	Beach dunes and other dry, sandy coastal sites
Onosmodium virginianum	Virginia false-gromwell	–	E	Pinelands, dry sandy woods, open sands
Plantago pusilla	dwarf plantain	–	E	Fields, roadsides, open woods
Polygonum glaucum	sea-beach knotweed	–	E	Sandy beaches above the tide limit
Prunus angustifolia	chickasaw plum	–	E	Dry thickets, woodland edges
Ranunculus cymbalaria	seaside buttercup	–	E	Brackish to saline shores
Rhododendron atlanticum	dwarf azalea	–	E	Moist, flat pine woods and coastal savannahs
Rhynchospora globularis	coarse grass-like beaked-rush	–	E	Upland prairies, sandy and rocky stream banks, sink-hole ponds
Rhynchospora knieskernii	Knieskern's beaked-rush	T	E	Early-successional wet areas in gravel and clay pits, rights-of-way, recent burns, muddy swales, cleared areas
Rhynchospora microcephala	small-head beaked-rush	–	E	Early successional wetlands, disturbed wet areas
Schoenoplectus maritimus	saltmarsh bulrush	–	E	Estuarine intertidal emergent wetlands

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	Habitat
Schwalbea americana	chaffseed	E	E	Open pine flat woods, longleaf pine/oak sandhills, pitch pine lowland forests, seepage bogs, palustrine pine savannahs, ecotonal areas between peaty wetlands and xeric sandy soils
Scirpus longii	Long's woolgrass	–	E	Swamps, marshes, wet meadows
Spiranthes laciniata	lace-lip ladies'-tresses	–	E	Bogs, marshes, shallow ponds
Stylisma pickeringii var. *pickeringii*	Pickering's morning-glory	–	E	Sand hills and sandy woods with little or no vegetation; can occur in roadsides and disturbed areas
Tridens flavus var. *chapmanii*	Chapman's redtop	–	E	Roadsides, open woodlands, dry fields
Triglochin maritima	seaside arrow-grass	–	E	Saline to freshwater marshes and shores
Utricularia biflora	two-flower bladderwort	–	E	Shallow pools
Utricularia minor	lesser bladderwort	–	E	Shallow pools, wet meadows, bogs, shores
Uvularia puberula var. *nitida*	Pine Barren bellwort	–	E	Moist to dry, open woods
Verbena simplex	narrow-leaf vervain	–	E	Meadows, fields, prairies
Xyris fimbriata	fringed yellow-eyed-grass	–	E	Wet prairies, savannahs and pine flat woods, pond and lake margins, wet depressions, ditches
Zigadenus leimanthoides	death-camus	–	E	Sandy pinelands and bogs
Insects				
Cicindela dorsalis dorsalis	northeastern beach tiger beetle	T	E	Long, wide, and relatively undisturbed sandy beaches
Nicrophorus americanus	American burying beetle	E	E	Coastal grassland, scrub areas

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Amphibians				
Ambystoma tigrinum tigrinum	eastern tiger salamander	–	E	Old fields and woods under logs or in underground tunnels and burrows; breeds in shallow woodland ponds, old gravel pits, and farm ponds that lack fish predators
Hyla andersonii	Pine Barrens treefrog	–	E	Atlantic white cedar swamps and pitch pine lowlands with dense mats of sphagnum moss; preferred habitats have an open canopy, dense shrub layer, and heavy ground cover with sands and muck; breeding ponds are less than 24 in. deep with clean, acidic waters
Hyla chrysoscelis	southern gray treefrog	–	E	Small freshwater ponds, old fields and mixed forest uplands; breeds in vernal ponds and other aquatic habitats where predatory fish are absent
Reptiles				
Glyptemys insculpta	wood turtle	–	T	Freshwater streams and rivers used for mating, feeding, and hibernation; terrestrial habitats (e.g., open fields, thickets, mid-successional forests, agricultural fields and pastures) used for egg laying and foraging
Glyptemys muhlenbergii	bog turtle	T	E	Calcareous fens, sphagnum bogs and wet, grassy pastures; habitats are well-drained with water depths rarely exceeding 4 in.
Crotalus horridus horridus	timber rattlesnake	–	E	Swamps and pine-oak forests; usually dens in cedar swamps and along stream banks

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Elaphe guttata guttata	corn snake	–	E	Sandy upland pine forests with uprooted trees, stump holes and rotten logs with an understory of low brush and a stream or pond in the area; forages along open fields and forest edges
Pituophis melanoleucus melanoleucus	northern pine snake	–	T	Dry pine-oak forests on infertile sandy soils within which they dig hibernacula and summer dens; openings important for nesting and basking
Birds				
Accipiter cooperii	Cooper's hawk	–	T (B, MW)	Riparian and wetland forests; breeding habitats include large, remote red maple, black gum, and, occasionally, Atlantic white cedar swamps; forest edges and small openings along streams and roads used for hunting
Ammodramus savannarum	grasshopper sparrow	–	T (B)	Breeds in grasslands, upland meadows, pastures, hayfields and old fields that contain short- to medium-height bunch grasses with patches of bare ground, a shallow litter layer, scattered forbs, and a few shrubs; non-breeding habitat similar, but less restrictive
Bartramia longicauda	upland sandpiper	–	E	Grasslands, fallow fields, and meadows that are often associated with pastures, farms, or airports; nests in upland meadows and short grass grasslands where vegetation height does not exceed 28 in.

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	Habitat
Botaurus lentiginosus	American bittern	–	E (B)	Freshwater emergent wetlands, coastal salt or brackish marshes, and grassy fields during migration or winter; nests in freshwater emergent wetlands
Calidris canutus	red knot	–	T	Open landscapes and coastal areas; nests on bare soil, grass, and pebbles
Charadrius melodus	piping plover	T	E	Oceanfront beaches and barrier islands; forage on intertidal beaches, washover areas, exposed mudflats and sandflats, wracklines and shorelines; typically nests on stretches of beach between dunes and high-tide line with nests often located in flat areas with shell fragments and sparse vegetation
Circus cyaneus	northern harrier	–	E (B)	Open landscapes such as tidal marshes, emergent wetlands, fallow fields, grasslands, meadows, airports, and agricultural areas; forage over marshes, fields, bushes, and edge habitats that contain low vegetation
Cistothorus platensis	sedge wren	–	E	Wet meadows, freshwater marshes lacking cattails, bogs, and drier portions of salt or brackish coastal marshes
Falco peregrinus	peregrine falcon	–	E	Open landscapes and rocky places or cliffs; nests on cliffs, deciduous trees, buildings, nesting platforms, and bridges (no cliff nests remain in New Jersey); forages over open areas such as marshes, beaches, and open water

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	Habitat
Haliaeetus leucocephalus	bald eagle	T	E	Forested areas associated with large bodies of water; nesting sites not reported from project area; tidal areas of southern New Jersey provide winter foraging
Laterallus jamaicensis	black rail	–	T (B, MW)	Coastal salt and brackish marshes, nests in areas of elevated marshes that only flood during extremely high tides
Melanerpes erythrocephalus	red-headed woodpecker	–	T (B, MW)	Open forests, forest edges, and grasslands with scattered trees; nests on snags, deciduous and coniferous trees, and man-made structures
Nyctanassa violacea	yellow-crowned night-heron	–	T (B, MW)	Hunts along shores of tidal creeks and tide pools within salt and brackish marshes, shallow water and mudflats; nests on barrier islands, dredge spoil islands, and bay islands that contain forested wetlands; residential neighborhoods, parks, campgrounds, or other areas in close association with humans also used for nesting
Nycticorax nycticorax	black-crowned night-heron	–	T (B)	Forests, scrub-shrub, marshes, and ponds used for nesting, roosting, and foraging; heronries located in swamps, coastal dune forests, vegetated dredge spoil islands, scrub thickets, or mixed *Phragmites* marshes that are close to water

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Pandion haliaetus	osprey	–	T (B, MW)	Lakes, rivers, and seashore areas; nests on deciduous and coniferous trees, snags, man-made structures (e.g., transmission line support structures), and, infrequently, open ground within coastal marshes
Podilymbus podiceps	pied-billed grebe	–	E (B)	Nests in freshwater marshes associated with ponds, bogs, lakes, reservoirs, and slow-moving rivers with breeding sites typically having fairly deep water (up to 6.6 ft) interspersed with submerged or floating aquatic vegetation and dense emergent vegetation; nonbreeding season habitats more diverse
Pooecetes gramineus	vesper sparrow	–	E	Cultivated fields, grasslands, fallow fields, and pastures; habitats typically are dry and well-drained and sparsely vegetated with patches of bare ground, low vegetation and scattered shrubs, or saplings; nests placed within clumps of herbaceous cover
Rynchops niger	black skimmer	–	E	Nests on open sandy beaches, inlets, sandbars, offshore islands, and dredge disposal islands that are sparsely vegetated and contain shell fragments; forages in shallow tidal creeks, inlets, and ponds

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Sterna antillarum	least tern	–	E	Barrier island beaches, mainland beach strands, unvegetated sandy dredge spoil sites and sand piles near sand and gravel mining pits; forages in bays, lagoons, estuaries, and rivers and lakes along the coast
Sterna dougallii dougallii	roseate tern	E	E	Nests on barrier islands and salt marshes often within densely vegetated dunes; forages over shallow coastal waters, inlets, and offshore areas
Strix varia	barred owl	–	T (B, MW)	Remote, contiguous, old-growth wetland forests with open understory; nests on snags and deciduous and coniferous trees
Mammals				
Lynx rufus	bobcat	–	E	Swamps, river bottoms, and forests; generally uses rough, broken habitats that have a mixture of successional stages and dense cover

(a) Listing status: B = State breeding population for bird species; C = candidate; E = endangered; MW = migratory or winter population for bird species; T = threatened; – = not listed.
Sources: NJDEP 2001b, 2005e,f,g; SJRCDC 2002; Nearctica.com 2003; ENSR International 2004; MDOC 2004; Biological Research Associates 2005; CPC 2005; NatureServe 2005; Robert W. Freckmann Herbarium 2005; Kantrud 1996; USDA (undated)

Seabeach Amaranth

The seabeach amaranth (*Amaranthus pumilus*, family Amaranthaceae), Federally listed as threatened, historically occurred on barrier island beaches from Massachusetts to South Carolina. Significant numbers are now only known from New York and the Carolinas, with small populations in Delaware, Maryland, and New Jersey (NJONLM 2003; NatureServe 2005). The seabeach amaranth requires extensive areas of barrier island beaches and inlets that allow it to colonize suitable habitat as it becomes available (FWS 1996). The seabeach amaranth inhabits the coastal overwash flats at the accreting ends of barrier islands and the lower foredunes. On ocean beaches, the seabeach amaranth occurs above mean high tide, and during the growing season it is intolerant of even occasional flooding (FWS 1996; NatureServe 2005). Seeds can remain viable in buried sand for years and germinate after being brought near the surface following severe storms (NatureServe 2005). Threats to the seabeach amaranth include beach erosion and tidal inundation, herbivory by webworms (the caterpillar of various species of small moths), habitat fragmentation, beach stabilization structures, dune fencing, development, recreational use, and all-terrain vehicles (ATVs) (FWS 1996; CPC 2005; NatureServe 2005). Habitat for the seabeach amaranth does not occur on the OCNGS site or the OCNGS-to-Manitou transmission line right-of-way.

Swamp Pink

The Federally listed threatened swamp pink (*Helonius bullata*, family Liliaceae) has been reported from two locations within 2.8 mi of the OCNGS site (FWS 2005a). The swamp pink is an obligate wetland species that occurs in forested freshwater wetlands and requires habitat that is saturated but not flooded (FWS 1991a; CPC 2005). It is generally associated with evergreen trees such as Atlantic white cedar, pitch pine, American larch, and black spruce (CPC 2005). The swamp pink usually occurs in mucky substrates along small streams, headwater wetlands, and spring seepage areas (FWS 2005a). It is shade tolerant; it requires enough canopy to reduce competition from more aggressive species and cannot survive in open sun (FWS 1991a). In areas with little canopy, white-tailed deer are more likely to consume the plant (CPC 2005). It is usually found as clumps of plants rather than as individuals, because new plants grow from rootstocks and there is limited dispersal of seeds. Large populations may be in the thousands, with densities of more than five plants per square foot (FWS 1991a). It flowers from early April to mid-May and has basal leaves that remain green throughout the year (NatureServe 2005). The species is impacted by changes in hydrology, habitat loss and degradation, illegal collecting, trampling, and reduced genetic variation (FWS 1991a, 2005a; CPC 2005). Based on the habitat requirements of the swamp pink, it may occur on isolated areas of the undeveloped portions of the OCNGS site and near the OCNGS-to-Manitou transmission line right-of-way. As it occurs in forested wetlands, it would be unlikely that the swamp pink would occur within the right-of-way. Botanical surveys have not been performed in the project area for rare plants to confirm the presence of the species.

Bog Asphodel

The Federal candidate species bog asphodel (*Narthecium americanum*, family Liliaceae) is reported from within the OCNGS site and from several other locations within 1.3 mi of the site (FWS 2005a). Existing populations are known only from the New Jersey Pine Barrens (NatureServe 2005). It inhabits moist savannahs; broad, wet, sandy bogs along streams in the Pine Barrens; lowland oxbow meanders; iron ore streamlet seeps; and borders of Atlantic white cedar swamps (FWS 2005a; NJDEP 2005f). The bog asphodel is dependent on water moving through the substrate (NJDEP 2005f). It reproduces by both seeds and vegetative propagation through rhizomes (CPC 2005). It cannot tolerate extended periods of flooding or drought, or heavy shade. The species is threatened by habitat loss, hydrologic changes (e.g., due to flooding by cranberry growers, beaver activity, and impoundments), natural vegetation succession (e.g., shading), herbivory by white-tailed deer, and crushing by ATVs (CPC 2005; FWS 2005a; NJDEP 2005f). Based on the habitat requirements of the bog asphodel, it may occur on isolated areas of the undeveloped portions of the OCNGS site and along the OCNGS-to-Manitou transmission line right-of-way. Botanical surveys have not been performed in the project area for rare plants to confirm the presence of the species.

Knieskern's Beaked-Rush

The Federally listed threatened Knieskern's beaked-rush (*Rhynchospora knieskernii*, family Cyperaceae) has been reported within 1.5 mi from the OCNGS site (FWS 2005a). It occurs in early successional wetlands with a fluctuating water table in the Pine Barrens of New Jersey, as well as in disturbed sites such as borrow and clay pits, ditches, rights-of-way, and unimproved roads (FWS 2005a). Being intolerant of shade, it occurs on mostly bare substrates with limited vegetation (FWS 2005a). It generally occurs on highly acidic, nutrient poor, fine-grained mineral soils over clay deposits; the largest populations occur on natural bog iron deposits (CPC 2005; NatureServe 2005). It is generally found on bare or sparsely vegetated areas that are maintained by fire, flooding, or human disturbances such as along rights-of-way or in inactive sand and clay pits (FWS 1993b; NatureServe 2005). Existing populations are only known from the Pine Barrens (FWS 1993b; NatureServe 2005). The Knieskern's beaked-rush is threatened by habitat loss (e.g., from agriculture, development, and habitat modification), loss of fire-maintained habitats, ATVs, trash dumping, recreation (e.g., trampling), drought, illegal collecting, and natural succession, which increases shading and competition from other plants (FWS 1993b, 2005a; CPC 2005; NatureServe 2005). Based on the habitat requirements of the Knieskern's beaked-rush, it may occur on isolated areas of the undeveloped portions of the OCNGS site and along the OCNGS-to-Manitou transmission line right-of-way. Botanical surveys have not been performed in the project area for rare plants to confirm the presence of the species.

Chaffseed

The Federally listed endangered chaffseed (*Schwalbea americana*, family Scrophulariaceae) is a coastal plains species that inhabits acidic, sandy, or peaty soils in open pine flatwoods, pitch pine lowland forests, seepage bogs, palustrine pine savannahs, and other grass- and sedge-dominated habitats (FWS 1995; NatureServe 2005). The chaffseed is considered a facultative wetland species; it can sometimes inhabit drier upland areas and is rarely found in inundated wetlands (CPC 2005). The chaffseed occurs in species-rich plant communities that are dominated by grasses and sedges. It is parasitic on the roots of a number of woody plants (CPC 2005) and blooms from about June to late July (NatureServe 2005). The chaffseed can persist in an area as long as the habitat remains relatively open by periodic activities such as fire, mowing, and fluctuating water tables (FWS 1995; CPC 2005). Threats to the chaffseed include habitat conversion to farmland, residential development, road building, overcollection, mowing during the flowering period, trampling, and fire suppression that promotes woody vegetation (FWS 1995; CPC 2005; NatureServe 2005). Within Ocean County, the chaffseed has only been reported from the northeastern portion at Point Pleasant Beach. All recorded occurrences of the chaffseed in New Jersey are historical rather than recent (SJRCDC 2002). It is highly unlikely that the chaffseed occurs on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

Northeastern Beach Tiger Beetle

The Federally listed threatened northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*, family Cicidelidae) is one of four subspecies of *C. dorsalis*. The 0.5- to 0.6-in. long beetle inhabits long, wide, relatively undisturbed sandy beaches along the Atlantic Ocean from Cape Cod to central New Jersey and along both shores of Chesapeake Bay (FWS 1994; NJDEP 2005e). It occurs from the foredune to the high-tide line. The adults are most active in July. The larvae live in burrows in the sand (NatureServe 2005). The life cycle takes 2 to 3 years, and the larvae seal off their burrows when they initiate hibernation in early fall (NatureServe 2005). Adults scavenge on dead fish and hunt invertebrates while the larvae sit and wait for passing prey (NatureServe 2005). Threats to the northeastern beach tiger beetle include ATVs, coastal development, beach stabilization, and severe storms that remove surface sands (FWS 1994; NatureServe 2005). All recorded occurrences of the northeastern beach tiger beetle in Ocean County are historical rather than recent (SJRCDC 2002). It is presumed to be extirpated from New Jersey (FWS 1994). Habitat for the species does not occur on the OCNGS site or the OCNGS-to-Manitou transmission line right-of-way.

American Burying Beetle

The Federally listed endangered American burying beetle (*Nicrophorus americanus*, family Silphidae) is the largest native member of the carrion beetle family in North America and averages 1.2 in. long. It originally occurred throughout temperate eastern North America, but natural populations now occur only on Block Island off of the coast of Rhode Island and in eastern Oklahoma (FWS 1991b). Adults primarily live aboveground but overwinter within soil. They are active from April through September and require an air temperature of 60°F for activity. Eggs are laid adjacent to buried carrion (NatureServe 2005). Carrion availability is probably more important to the American burying beetle's occurrence than the type of vegetation or soils (FWS 1991b). Habitat loss, modification, and, especially, fragmentation are largely responsible for the decline of the American burying beetle resulting in (1) the elimination or reduction of bird species such as the passenger pigeon (*Ectopistes migratorius*), wild turkey (*Meleagris gallopavo*), and greater prairie chicken (*Tympanuchus cupido*) that provide a carrion source; and (2) the increase in competitive scavengers such as the American crow, raccoon, foxes, Virginia opossum, and skunks (FWS 1991b; NJDEP 2005e). Other threats include insecticide and bug-zapper use and disturbance of soils (NatureServe 2005). The American burying beetle is presumed to be extirpated in New Jersey (NJDEP 2005f).

Bog Turtle

The Federally listed threatened bog turtle (*Glyptemys muhlenbergii*, family Emydinae) is one of the smallest of North American turtles, measuring up to 3.9 in. long. It inhabits calcareous fens, sphagnum bogs, and wet, grassy pastures that have soft, muddy substrates and perennial groundwater seepage, where water depths rarely exceed 4 in. (NJDEP 2005e). Because open areas are favored for basking and nesting, succession may lead to dispersal or loss of bog turtles from an area (NJDEP 2005e). Bog turtles are generally active from April to October. They hibernate in abandoned muskrat houses, burrows, or other natural cavities beneath tussocks or shrub thickets (FWS 2004b). Bog turtles reach maturity at about 8 years of age and can live more than 30 years. They are omnivorous, although the diet is dominated by insects (FWS 2004b; NatureServe 2005). Controlled livestock grazing can create beneficial habitat conditions, while overgrazing can degrade water quality or lead to the growth of undesirable plant species. Linear drainage ditches provide alternative habitats for bog turtles (NJDEP 2005e). Threats to the bog turtle include habitat loss, fragmentation and modification, hydrologic modification, reduced habitat quality due to succession and invasive plant species encroachment, heavy livestock grazing, disturbance or trampling by humans, excessively high raccoon populations, pesticide application for mosquito control, and illegal collecting (FWS 2001; FWS 2004b; NJDEP 2005e; NatureServe 2005). Recent Ocean County occurrences for the bog turtle include Berkeley Township (SJRCDC 2002). Although the bog turtle was not included in the FWS species list for this project (FWS 2005b), the northern portion of the OCNGS-to-Manitou transmission line right-of-way occurs within this township and crosses habitat that may be suitable for the bog turtle.

Piping Plover

The Federally listed threatened piping plover (*Charadrius melodus*, family Charadriidae) is a small shorebird that inhabits oceanfront beaches and barrier islands. It typically nests on the stretch of beach between the dunes and the high-tide line, often in flat areas with shell fragments and sparse vegetation (NJDEP 2005e). During the nonbreeding season, the piping plover inhabits coastal beaches, barrier islands, inlets, sandflats, mudflats, and dredged-material islands. They forage on invertebrates on intertidal beaches, washover areas, exposed mudflats and sandflats, wracklines, and shorelines (NJDEP 2005e). The Atlantic Coast piping plover breeding population occurs between Newfoundland and southeastern Quebec, south to North Carolina (FWS 2002). It has increased from 790 pairs in 1986 to 1386 pairs in 1999; the number of breeding pairs in New Jersey, however, has remained stable at around 120 pairs (NJDEP 2005e). The piping plover mainly winters from North Carolina to Florida, with some migrating to Mexico and the Caribbean (FWS 2002; NatureServe 2005). Early threats to the piping plover included market hunting and egg collecting. More recent and continuing threats include coastal development, increased recreational use, and increases of mammalian and avian predators. Storm tides may also inundate and destroy nests (FWS 2002; NJDEP 2005e). Habitat for the piping plover does not occur on the OCNGS site or the OCNGS-to-Manitou transmission line right-of-way.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*, family Accipitridae) is Federally listed as threatened, but proposed for delisting (FWS 1999), and inhabits forested areas that are adjacent to large bodies of water. Bald eagles in New Jersey are mostly associated with the Delaware River and Bay and rivers that flow into the Atlantic Ocean and Delaware Bay (NJDEP 2005e). However, occasionally, transient individuals may occur in the OCNGS area (FWS 2005b). The bald eagle is known to nest in Brick Township (northeastern portion of Ocean County), with historical nesting having occurred in Little Egg Harbor Township (the southern end of the county) (SJRCDC 2002). The bald eagle generally requires a nesting location that is free from human disturbance. A nest tree is typically taller than the trees immediately surrounding it. Foraging habitat consists of large water bodies with nearby large trees for perching. Wintering habitat is similar but requires open, ice-free water (NJDEP 2005e). Portions of the Delaware River and tidal areas of southern New Jersey marshes provide suitable winter foraging areas (NJDEP 2005e).

Historical threats to the bald eagle include habitat destruction, shootings and poisonings, and DDT. By 1970, only one eagle nest remained in New Jersey (NJDEP 2005e). Active management of bald eagles has increased the number of active bald eagle nests statewide (NJDEP 2005e). During the 2004 nesting season, there were 48 eagle pairs, of which 44 were active (had nests with eggs). Thirty-two of the nests were successful in producing 54 young, while 10 nests failed to produce hatchlings because of contaminants and human disturbance (Smith et al. 2004). None of the bald eagle nests were located near OCNGS or within the Barnegat Bay watershed. During the 2004 winter survey, a total of 177 bald eagles were observed in New Jersey. Only 36 were observed along the Atlantic Coast subregion (Smith et al. 2004), and none of these were within the OCNGS area. Ongoing threats to bald eagles in New Jersey include disturbance, habitat destruction, and accumulation of contaminants (Smith et al. 2004). Bald eagles are expanding their range and developing new nest sites in the mid-Atlantic region, and it is possible that nest sites could someday be located closer to the OCNGS site or vicinity.

Roseate Tern

The Federally listed endangered roseate tern (*Sterna dougallii dougallii*, family Sternidae) nests on barrier islands and salt marshes. Nesting colonies are located above the high-tide line often where dense stands of beach grasses and seaside goldenrod (Solidago sempervirens) provide cover. When displaced from optimal breeding sites by gulls, the roseate tern may nest in open areas. The roseate tern forages over shallow coastal waters, inlets, and offshore seas (NJDEP 2005e). Past threats to the roseate tern included killing the birds to obtain their feathers for the millinery trade. Other threats included habitat loss, disturbance, competition from gulls, and predation. The last nesting pair in the State was recorded in 1980 (NJDEP 2005e). No nesting activity or other use of the OCNGS site or vicinity by roseate terns has been recorded.

2.2.7 Radiological Impacts

A REMP has been conducted around the OCNGS site since 1966. Through this program, radiological impacts on workers, the public, and the environment are monitored, documented, and compared with the appropriate standards. The objectives of the REMP are to assess dose impacts on members of the public from OCNGS operations, to verify in-plant controls for the containment of radioactive materials, to measure accumulation of radioactivity in the environment, to provide reassurance to the public that the program is capable of adequately assessing the impacts and identifying noteworthy changes in the radiological status of the environment, to provide data on measurable levels of radiation and radioactive materials in the site environs, and to evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure (AmerGen 2005c).

Each year, results of measurements of radiological releases and environmental monitoring are summarized in two annual reports: the OCNGS Annual Radiological Environmental Operating Report (AmerGen 2005c) and the OCNGS Radioactive Effluent Release Report (AmerGen 2005b). The limits for all radiological releases are specified in the ODCM, and these limits are designed to meet Federal standards and requirements.

The REMP includes monitoring of the concentrations of beta and gamma emitters, iodine, and strontium in the air; concentrations of gamma emitters in surface water, well water, fish, clams, sediment, and vegetation; concentrations of tritium in surface and well water; and direct radiation (gamma dose on thermoluminescent dosimeter locations) (AmerGen 2005c). For trending purposes, radiological and direct radiation measurements are compared with past years. Sampling locations are chosen based on meteorological factors, preoperational planning, and results of land-use surveys. A number of locations, in areas very unlikely to be affected by plant operations, are selected as controls. Monitoring results for the 5-year period of 2000 through 2004 indicate that the radiation and radioactivity in the environmental media monitored around the plant are well within applicable regulatory limits. The only plant-related radionuclide consistently detected is cesium-137 in sediment, a result of historical plant releases and fallout from nuclear weapons testing (AmerGen 2001b, 2002b, 2003c, 2004b, 2005c).

From December 1969 until the late 1980s, the OCNGS periodically discharged liquid wastes containing radioactive contaminants to the discharge canal and Oyster Creek, in accordance with liquid effluent discharge limits specified by the NRC. These liquid discharges occurred as batches and contained water from the reactor system and an onsite laundry. All batches of liquid wastes were analyzed for radionuclide content before discharge to ensure compliance with release limits. Maximum discharges occurred in 1970 to 1972. OCNGS has not routinely released liquid wastes since the late 1980s.

Radionuclide concentrations in the Barnegat Bay environment have been extensively studied, as documented in several studies (Kennish 2001c; Moser and Bopp 2001; Blanchard and Kahn 1979). These studies demonstrated that during the 1970s and 1980s, radioactive liquid effluents from OCNGS reached all parts of the Bay and resulted in detectable levels of radionuclides in biota (e.g., fish, clams, crabs, invertebrates, and marine plants) and sediment samples. The Blanchard and Kahn study (1979) documents a comprehensive radiological surveillance program in Barnegat Bay conducted by the EPA during the time of maximum OCNGS discharges. The study showed low but detectable levels of radionuclides from OCNGS effluents in fish, clams, and crabs from Barnegat Bay; samples collected near Oyster Creek had the highest levels. The study also showed increased radionuclide concentrations in vegetation and sediment. The primary radionuclides contained in sediment samples were cobalt-60, with concentrations ranging up to 19,000 pCi/kg, and cesium-137, with concentrations ranging up to 2000 pCi/kg. The highest sediment concentrations also were observed near Oyster Creek. For comparison, background sediment samples ranged up to 20 pCi/kg for cobalt-60 and 450 pCi/kg for cesium-137. The Blanchard and Kahn study (1979) also included estimates of the radiation dose to MEIs from consuming contaminated seafood and beach exposures to contaminated sediments. The estimated doses were less than 1 mrem/yr, much less than regulatory limits and the average dose to an individual from background of approximately 360 mrem/yr in the United States.

For trending purposes in the REMP, radiological measurements are compared with results from past years. The trend analyses for 1984 to 2004 reveal significant reductions in measured radionuclide concentrations in clams and sediments near OCNGS. For example, mean cobalt-60 concentrations in 1984 were approximately 12 pCi/kg in clams and 250 pCi/kg in sediments. By the late 1990s, cobalt-60 concentrations in clam and sediment samples were equal to background levels. A similar, but less rapid, decrease has been observed for cesium-137 in sediments. In 1984, mean cesium-137 concentrations in sediment samples were approximately 500 pCi/kg, decreasing to a mean of 30 pCi/kg in 2004. In part, these reductions are the result of the cessation of liquid discharges and radioactive decay (cobalt-60 has a half-life of 5.3 years, and cesium-137 has a half-life of 30 years).

As noted in Kennish (2001c), radionuclide concentrations measured in Barnegat Bay in samples of biota and sediment are well within government regulatory limits for environmental and biotic media. Moreover, there is no evidence that radioactive releases from OCNGS have affected biota or impacted habitats in the Barnegat Bay-Little Egg Harbor estuary (Kennish 2001c). As stated previously, OCNGS has not routinely released liquid radioactive wastes since the late 1980s and has no plans to resume doing so.

In addition to monitoring radioactivity in environmental media, AmerGen annually assesses doses to the MEIs from gaseous and liquid effluents at several locations based on effluent release data and mathematical modeling methods approved by the NRC. Calculations are performed using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM. Radiation dose results for the 5-year period of 2000 through 2004 (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b) were as follows:

- The average total body dose to an individual from all effluents was 2.2×10^{-2} mrem/yr, which is about 0.1 percent of the annual limit of 25 mrem for members of the public specified in the ODCM. Over this period, the maximum annual total body dose to an individual from all effluents was 2.6×10^{-2} mrem/yr, which is also about 0.1 percent of the annual limit of 25 mrem.

- The average dose to the thyroid of an individual from all effluents was 9.4×10^{-2} mrem/yr, which is about 0.1 percent of the annual limit of 75 mrem for the thyroid specified in the ODCM. Over this period, the maximum annual thyroid dose from all effluents was 2.1×10^{-1} mrem/yr, which is about 0.3 percent of the annual limit of 75 mrem.

These results confirm that OCNGS is operating in compliance with 10 CFR Part 50, Appendix I, 10 CFR Part 20, and 40 CFR Part 190. AmerGen does not anticipate any significant changes to the radioactive effluent releases or exposures from OCNGS operations during the renewal period, and, therefore, the impacts on the environment are not expected to change.

In addition to the REMP conducted by AmerGen, the Bureau of Nuclear Engineering, within the NJDEP, operates and maintains an Environmental Surveillance and Monitoring Program (ESMP) for the four nuclear power-generating stations in New Jersey, one of which is OCNGS (NJDEP 2005h). The purpose of the ESMP is to monitor the various pathways by which people and the environment could be exposed to radiation. Data are collected not only beyond the owner-controlled area, but at various locations onsite. Groundwater sampling is conducted within the OCNGS site boundary. Tap water is sampled from the OCNGS site administration building. Direction radiation measurements using thermoluminescent dosimeters are taken at various locations within the OCNGS site boundary, including the independent spent fuel storage facility. In addition, a Continuous Radiological Environmental Surveillance Telemetry (CREST) system is in place that consists of three pressurized ion chamber devices that measure direct radiation at various locations within the OCNGS site boundary, including the independent spent fuel storage facility. Historically, the results of the ESMP are consistent with those collected by the REMP (NJDEP 2006b).

2.2.8 Socioeconomic Factors

The NRC staff reviewed the AmerGen ER (2005a) and information obtained from county, city, school district, and local economic development staff. The following sections describe the housing market, community infrastructure, population, and economy in the region surrounding the OCNGS site.

2.2.8.1 Housing

The majority (81 percent) of OCNGS employees live in Ocean County; most of the remaining employees are located in Monmouth (6 percent) and Burlington (4 percent) Counties (Table 2-6). Given the residential location of OCNGS employees, the most significant impacts of plant operations are likely to occur in Ocean County. The focus of the analysis in this SEIS is on the impacts of OCNGS operations in this county.

OCNGS employs a permanent workforce of approximately 470 employees. AmerGen refuels OCNGS every 24 months. During refueling, approximately 1300 additional workers are employed for a 20-day period (AmerGen 2005a). The majority of these temporary workers reside in the same communities as the permanent employees at the plant (AmerGen 2005a).

The number of housing units and housing vacancies in Ocean County are shown in Table 2-7. The total number of housing units in the county grew at an annual rate of 1.2 percent over the period 1990 to 2000, while the number of occupied units grew at an average annual rate of 1.8 percent over the same period. With an annual average population growth rate of almost 1.7 percent during this period, there was a slight decline (–0.7 percent) in the annual rate of growth in the number of vacant units during this period.

2.2.8.2 Public Services

Water Supply

Water supplies in Ocean County come primarily from groundwater sources (Table 2-8). Currently, the county has 20 water suppliers, with four suppliers providing 76 percent of total capacity. In 1985, the New Jersey Water Supply Administration created two Water Supply Critical Areas to regulate all groundwater or surface-water diversions in excess of 10,000 gpd in order to protect deep aquifers from the intrusion of salt water (AmerGen 2005a). Since 1989, when restrictions on withdrawals from deep aquifers and the substitution of water from shallow aquifers and surface water began to take effect, deep aquifers have partially recovered (AmerGen 2005a).

Table 2-6. OCNGS Permanent Employee Residence Information by County and City

City and County[a]	Percent of Total
OCEAN COUNTY	
Forked River	15.5
Barnegat	14.9
Toms River	12.4
Tuckerton	7.4
Lanoka Harbor	6
Manahawkin	5.4
Others	19
Total Ocean County	80.6
OTHER COUNTIES	
Monmouth	6.2
Burlington	4.3
Others	8.9
Total other counties	19.4
Grand total	100

(a) Addresses are for both unincorporated (county) and incorporated (cities and towns) areas.
Source: NRC 2006a

Table 2-7. Housing Units and Housing Units Vacant (Available) in Ocean County During 1990 and 2000

	1990	2000	Percentage Change 1990 to 2000
Housing units	219,863	248,711	13.1
Occupied units	168,147	200,402	19.2
Vacant units	51,716	48,309	–6.6

Source: USCB 2005a

Table 2-8. Major Public Water Supply Systems in Ocean County in 2004

Water System[(a)]	Source	Average Daily Use (million gpd)	Maximum Capacity (million gpd)
United Water – Toms River	Groundwater	12.3	30.2
Brick Township MUA	Surface water	9.2	47.3
New Jersey American Water Company – Lakewood	Surface water	3	7.9
New Jersey American Water Company – Ocean City	Groundwater	2.8	12.2
Jackson Township MUA	Groundwater	2.5	11
Lakewood Township MUA	Groundwater	2	2.2
Manchester Township MUA	Groundwater	1.9	7.6
Lacey Township MUA	Groundwater	1.9	7.2
Stafford Township MUA	Groundwater	1.4	NA
Crestwood Village Water Company	Groundwater	1.4	6.1
Little Egg Harbor	Groundwater	1.3	6
Point Pleasant	Groundwater	1	4.7
Long Beach Township	Groundwater	1	7.5

(a) MUA = Municipal Utilities Authority.
NA = not available.
Source: AmerGen 2005a

Although the majority of the water supply systems in the county have additional capacity to meet new water demands (AmerGen 2005a), there have been a number of proposals to increase water system allocations and divert groundwater between systems.

OCNGS withdraws water from two wells located onsite at a rate of 14 gpm; the capacity of these wells is 425 gpm (AmerGen 2005a). The plant does not use groundwater from local municipal systems.

Fire protection for the plant is provided by Forked River Fire Company and the Lanoka Harbor Fire Company (Township of Lacey 2005).

Education

OCNGS is located in the Lacey Township Public School District, which had a total enrollment of 4224 students in 2003 (Public School Review 2005). There are 282 teachers currently employed in the district (Public School Review 2005), and expenditures are currently $8661 per student (Standard and Poor's 2005). Enrollment has grown in recent years, together with expenditures per student, while the number of teachers in the district has remained stable over the same period (Standard and Poor's 2005; Public School Review 2005).

Including the Lacey Township Public School District, there are 20 public school districts in Ocean County, which had a total enrollment in 2003 of 79,175 students (Public School Review 2005). Average expenditure per student in the public school districts in the county is $11,533, compared with $13,173 for New Jersey as a whole in 2003 (Standard and Poor's 2005). There were an additional 62 private schools in the county in 2004, with an enrollment of 13,702 students, and one vocational school (NCES 2005).

Transportation

Access to OCNGS is via U.S. Highway 9, approximately 1.0 mi east of the plant. U.S. Highway 9 runs parallel to the Garden State Parkway. Both roads are intersected by Lacey Road, to the north of the site, and Warren Grove Road to the south. Most OCNGS employees traveling from the northern and southern parts of Ocean County use these roads to reach the site (AmerGen 2005a).

Moderate increases in traffic have occurred on many of the roads in the vicinity of the plant, in particular on the Garden State Parkway and U.S. Highway 9, which have seen large increases in commuter and commercial traffic. One segment of U.S. Highway 9 for which traffic counts are available were assessed in the ER (AmerGen 2005a). This segment extends from the north of the plant as far as Beachwood. Traffic conditions on most of this road segment vary between medium density, stable flow during off-peak hours, to high capacity traffic, where congestion is likely at a number of intersections during rush hours (AmerGen 2005a).

2.2.8.3 Offsite Land Use

Ocean County occupies an area of 638 mi^2. Land use in the county is primarily forest (45 percent of total land area), recreation (16 percent), and government (16 percent), with a smaller land area occupied by residential (7 percent), industrial (3 percent), and commercial land uses (1 percent) (Table 2-9).

Table 2-9. Land Use in Ocean County

Land Use	Percent of Total
Forest	45
Recreation	16
Government	16
Vacant	10
Residential	7
Industrial	3
Commercial	1
Agriculture	1
Other	1
Total	100

Source: OCPB 1988

Located close to the large metropolitan centers of New York and northern New Jersey, land in the county has come under increasing development pressure, with rapid increases in population resulting from the suburbanization of the New York and New Jersey metropolitan population. The county is popular as a retirement location, which has also increased the demand for land in the county. The county is also a popular recreation and tourism destination, activities that provide a significant source of employment and income in Ocean County. Barnegat Bay and the coastal shoreline, parks, and recreational areas are strong attractions for summer and fall visitors and seasonal residents; a relatively large proportion of land area in the county is devoted to public and semipublic uses. The Federal government also has a large presence in the county at the Lakehurst Naval Air Engineering Center and Fort Dix, both located in the northwestern part of the county (OCPB 1988; OCDP 2005a).

Residential, commercial, and industrial development in the county has mainly occurred along the Garden State Parkway and along U.S. Highway 9, particularly in the Toms River and Lacey Township areas. Competition for land, especially for land in lakefront locations for summer and retirement homes, has been intense in recent years. As a result of these developments, both the coastal shoreline and older residential and farmland areas in the county are confronting severe growth pressure.

Recognizing the importance of balanced residential and commercial development and the importance of environmental protection, Ocean County developed a series of planning goals and objectives in its Comprehensive Master Plan (OCPB 1988). Under this plan, the county provides support in a number of program areas, including the coordination of the road transportation network, public transit system, and low-income housing, and also provides support to other entities, such as businesses considering locations within the county.

Although the county plays a wide-ranging role in coordinating resources for the management of growth, land-use planning and the control of commercial and residential growth in the county are primarily the concern of individual townships. Lacey Township, for example, in the 1991 Township of Lacey Master Plan (Township of Lacey 1991) recognized that residential and commercial growth would continue to occur in the township and established the township as a provider of infrastructure and services to facilitate orderly growth. As part of the process of managing growth, the Master Plan intends that the township provide contiguous land areas to compatible users while protecting the environment, encourage residential development of appropriate density, protect the aesthetic character of the township, and maintain navigable waterways (Township of Lacey 1991).

Ocean County has large amounts of land protected from development, with large tracts of land in State Parks, State Forests, Wildlife Management Areas, the Forsythe National Wildlife Refuge, and various county parks. Large parts of Ocean County and Lacey Township lie within the Pinelands National Reserve, a large area of protected pine forest in the southeastern part of the State (AmerGen 2005a). The Pinelands Protection Act is intended to protect the Pinelands region from severe development pressure. Under the provisions of the Act, county and municipal master plans and land-use ordinances must conform to the Pinelands Comprehensive Management Plan, which places restrictions on the density of various land uses within the region (OCPB 1988). Under the Ocean County Natural Lands Trust Funds Program established in 1997, the county can acquire land for conservation and farmland preservation, with almost 7000 ac preserved in the northern part of the county under this program (OCDP 2005b). The NJDEP also regulates land use in the county, applying New Jersey Coastal Permit Program rules and CZMA rules to determine how State laws, including the Coastal Area Facility Review Act, the Waterfront Development Law, the Wetlands Act, and the Tidelands Act, are used to control development in coastal areas (NJDEP 2005c). Barnegat Bay and Little Egg Harbor, which stretch the entire length of the county, are protected under the National Estuary Program (OCDP 2005b).

2.2.8.4 Visual Aesthetics and Noise

OCNGS is located 2 mi inland from Barnegat Bay. The plant has a once-through cooling system that draws cooling water from Barnegat Bay, and no cooling towers are used. The New Jersey shoreline in Ocean County attracts summer tourists and seasonal residents who enjoy the recreational and environmental attractions of the area.

The OCNGS site is 800 ac of mostly open and wooded land. Plant buildings include a rectangular turbine building (88 ft high); a rectangular reactor containment building (119 ft high); a rectangular waste storage building (44 ft high); and a single stack (368 ft high)

(AmerGen 2003a). The plant stack and buildings can be readily seen from most directions, including from U.S. Highway 9, the Garden State Parkway, Seaside Park, New Jersey, and the Barnegat Bay shoreline. The transmission lines connected to the OCNGS substation can also be readily seen from all directions, including from both U.S. Highway 9 and the Garden State Parkway.

Noise measurements are not available for the OCNGS site. However, noise generated by OCNGS operations is mitigated at the nearest offsite receptor because the plant is buffered by undeveloped land along Forked River to the north of the site and Oyster Creek to the south. Between the river and creek, the plant is buffered toward the east by a small wooded area along the length of U.S. Highway 9, thus reducing the conspicuousness of any noise generated by OCNGS operations. Most equipment is located within the plant buildings. Higher noise levels are created on the first Saturday of each month when onsite and offsite warning sirens are tested.

2.2.8.5 Demography

In 2000, 434,476 people were living within 20 mi of OCNGS, resulting in a density of 610 persons/mi^2. This density translates to Category 4 (*least sparse* – greater than or equal to 120 persons/mi^2 within 20 mi), using the GEIS measure of sparseness (AmerGen 2005a). At the same time, 4,243,462 persons were living within 50 mi of the plant, for a density of 1132 persons/mi^2. This density is given a Category 4 rating (*in close proximity* – greater than or equal to 190 persons/mi^2 within 50 mi) for proximity. Although there are no growth controls that would limit housing development in this area, planning goals and objectives at the county and township levels encourage balanced residential and commercial development (see Section 2.2.3.3 of this SEIS) (NRC 2006b,c).

Table 2-10 shows population trends for Ocean County, where the majority of OCNGS employees live. Annual average growth rates in Ocean County show rapid growth during the 1970s and 1980s, followed by moderate increases during the 1990s. The annual average growth rate in New Jersey over the period 1990 to 2000 was 0.9 percent. Growth is forecasted to continue at moderate levels over the period 2000 to 2020.

Transient Population

The transient population in the vicinity of the OCNGS site consists primarily of tourists visiting the Toms River area and the various recreational facilities in this area (AmerGen 2005a). It is estimated that peak visitation levels associated with campgrounds and beaches in the area reach almost 500,000 (BBNEP 2005a). People visiting summer homes and attendance at local colleges in the area also represent a substantial portion of the transient population in the area.

Table 2-10. Population Growth in Ocean County, 1970 to 2020

Year	Population	Annual Growth (Percent)[a]
1970	208,470	–[b]
1980	346,038	5.2
1990	433,203	2.3
2000	510,916	1.7
2010	593,300	1.5
2020	677,000	1.3

(a) Annual percent growth rate is calculated over the previous decade.
(b) – = no data available.
Source: AmerGen 2005a

Migrant Farm Labor

Although seasonal or migrant workers are employed during the summer and fall months in the area around the plant, the majority of agricultural laborers reside in the area (AmerGen 2005a). Only a small number of seasonal migrant agricultural workers reside in Ocean County, where agriculture is less important to the county economy than it is in adjacent counties.

2.2.8.6 Economy

Employment and Income

Total employment in Ocean County was 119,759 in 2002 (USCB 2005b). Service industries dominate employment in the county with almost 53 percent of total employment (63,195 people employed). The largest employer within 10 mi of the plant is the Saint Barnabas Health Care System, which has 4600 employees countywide (Table 2-11). Wholesale and retail trade also play an important part in the local economy, with more than 25 percent of local employment (30,413 people). Manufacturing employs only 6 percent (6767 people) of the county workforce. Personal income in Ocean County was $17.8 billion in 2003 (in 2004 dollars), with a per capita income of $33,883 (2004 dollars) (DOC 2005).

Unemployment

Unemployment in Ocean County was moderately high at 4.9 percent in 2004 (DOL 2005). The unemployment rate for New Jersey as a whole in 2004 was 4.8 percent.

Table 2-11. Major Employers Within 10 mi of the OCNGS Site

Firm	Number of Employees
Saint Barnabas Health Care System	4600
Lakewood Naval Air Warfare Center	3437
Toms River Regional School System	2235
Ocean County Government	1964
Southern Ocean County Hospital	1056
Dover Township Municipal Government	837
Lacey Township Board of Education	736
Ocean County College	712
Health South Rehabilitation Hospital	500
Southern Regional School District	500
AmerGen Energy Company, LLC	450

Source: OCDP 2005a

Taxes

Property taxes are paid by OCNGS to Lacey Township, Ocean Township, and Ocean County. Lacey Township and Ocean Township collect tax revenues from the plant to cover local expenditures and forward the balance to the county. A large majority (99 percent) of the initial OCNGS payment is made to Lacey Township. Revenues are used by each taxing entity to fund public safety, public schools, local government operations, road maintenance, and the library system.

The plant is not a significant source of tax revenue for local and county government. Over the period 2002 to 2004, on average, approximately 4 percent (about $1.9 million in 2004 dollars) of annual tax revenues spent in Lacey Township came from OCNGS property taxes (Table 2-12). About 1 percent (about $100,000 in 2004 dollars) of Ocean Township annual tax revenues, on average, over the period 2002 to 2004 came from OCNGS.

Utility restructuring legislation has been in place in New Jersey since 1997. However, the long-term impact of the restructuring of the electric power industry in the State and its impact on OCNGS are not yet known. Any changes in assessed valuation of plant property and equipment that may potentially occur could affect property tax payments to the townships and the county. However, any impacts on tax revenues as a result of restructuring would not occur as a direct result of license renewal.

Table 2-12. OCNGS Contribution to Lacey Township Tax Revenues

Year	Total Lacey Township Tax Revenues (millions $ 2004)	Property Tax Paid to Lacey Township for OCNGS (millions $ 2004)	Percent of Total Tax Revenues
2002	42.6	1.8	4.1
2003	46.2	1.9	4.1
2004	48.3	1.9	3.9

Sources: AmerGen 2005a; NRC 2006d

2.2.9 Historic and Archaeological Resources

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

2.2.9.1 Cultural Background

The area in and around the OCNGS site has the potential for significant prehistoric and historic resources. Many sites (shell middens and small camps) have been recorded within the New Jersey Pinelands and to the north, in the vicinity of OCNGS (Section 2.2.9.2). Human occupation in this region roughly follows a standard chronological sequence for prehistory in the Eastern United States: Paleo-Indian Period (13000 BC to 8000 BC); Archaic Period (8000 BC to 1000 BC); Woodland Period (1000 BC to AD 1600). In general, the Paleo-Indian Period is characterized by highly mobile bands of hunters and gatherers. A typical Paleo-Indian site might consist of an isolated stone point or knife (of a style characteristic of the period) in an upland area along large river valleys or ancient lake beds. The Archaic Period represents a transition from a highly mobile existence to a more sedentary existence. It is a period of increased local resource exploitation (e.g., predominantly deer and small mammals, fish, and other aquatic resources, nuts, and seeds), more advanced tool development, and increased complexity in social organization. The Woodland Period is a continuation of the complexities begun during the Archaic Period with the introduction of ceramic technology. Pottery, the principal distinguishing feature between Archaic and Woodland period sites, begins to appear in the archaeological record during this time. Generally, the Woodland people lived in wood and bark dwellings in small permanent or semipermanent settlements.

The historic period in this region began with the arrival of the first European settlers in the mid-1600s. However, the earliest accounts of Europeans arriving in Ocean County are of Giovanni da Verrazano in 1524 and Henry Hudson in 1609. At that time, the Late Woodland people who were first contacted called themselves the “Lenape.” Historic Native American nations and Tribes known to have inhabited this region include the Delaware, the Lenni-Lenape, and the Mohicans.

Ocean County has 27 sites listed on the National Register of Historic Places; 5 of these properties are located within approximately 6 mi of the OCNGS Site: Barnegat City Public School (Barnegat Light Museum), Barnegat Lighthouse, Double Trouble State Park Historic District, Falkinburg Farmstead, and Manahawkin Baptist Church. Nearly 100 additional properties in Ocean County have been identified as State Historic Preservation Office-opinion eligible, including the Garden State Parkway Historic District, which includes the entire Garden State Parkway right-of-way; some of those properties have been listed on the New Jersey State Register of Historic Places (NJDEP 2006c).

2.2.9.2 Historic and Archaeological Resources at the OCNGS Site

The OCNGS site occupies approximately 800 ac. In addition, 320 ac of land along 11.1 mi of right-of-way are occupied by the OCNGS-to-Manitou transmission line (AmerGen 2005a). Approximately 20 percent (150 ac) of the OCNGS site was disturbed by construction of the nuclear power plant facilities and related infrastructure, including roads and parking lots. The remaining 80 percent (650 ac) is the former Finninger Farm property (previously used as a cattle farm), most of which is undeveloped and relatively undisturbed. Portions of the Finninger Farm were disturbed by canal dredging operations, including a relatively recent 17.5-ac dredge spoils area with bermed containment. Intact archaeological sites could be present within the undeveloped areas of the farm. Some previous disturbance has also occurred along the transmission line corridor.

No archaeological surveys were completed at the OCNGS site prior to station construction (AEC 1974). However, during the site visit (October 2005), a review of NJDEP site files identified 20 sites recorded within the vicinity of Forked River and Oyster Creek. These sites, predominantly prehistoric middens and surface sites, were recorded as part of the Pinelands Prehistoric Archaeological Resources Inventory in 1980 (NJPC 2005). The inventory was based on the work of archaeologists and amateur collectors in the area. One of these sites may be located on the Finninger Farm property.

Although no known sites of significance to Native Americans have been identified at the OCNGS site, the appropriate Federally recognized Native American Tribes have been contacted and asked to participate in the National Environmental Policy Act (NEPA) review (Appendix E).

2.2.10 Related Federal Project Activities and Consultations

The NRC staff reviewed the possibility that activities of other Federal agencies might interact with the renewal of the OL for OCNGS. 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 this SEIS.

The NRC staff has determined that there are no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparing this SEIS. Federally owned facilities within 50 mi of OCNGS are the Lakehurst Naval Air Engineering Center and Fort Dix, both located in the northwestern part of Ocean County; the Edwin B. Forsythe National Wildlife Refuge in Atlantic County; and the Naval Weapons Station in Monmouth County. There are no Native American lands within 50 mi of OCNGS.

The NRC is required under Section 102(c) of NEPA 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 has consulted with the FWS and NMFS on threatened and endangered species and with the NMFS on EFH. The consultations are described in Sections 2.2.5.5, 2.2.6.2, 4.6, and 4.7. Correspondence regarding these consultations and NRC's EFH assessment are included in Appendix E.

2.3 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energ*y, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

10 CFR Part 61. *Code of Federal Regulations*, Title 10, *Energy*, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

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

40 CFR Parts 9, 122 et al. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 122, "National Pollutant Discharge Elimination System – Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities, Final Rule."

40 CFR Part 81. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 125. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System."

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

AmerGen Energy Company, LLC (AmerGen). 2001a. *2000 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (February 26, 2001).

AmerGen Energy Company, LLC (AmerGen). 2001b. *2000 Annual Radiological Environmental Operating Report, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (April 26, 2001).

AmerGen Energy Company, LLC (AmerGen). 2002a. *2001 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (February 26, 2002).

AmerGen Energy Company, LLC (AmerGen). 2002b. *2001 Annual Radiological Environmental Operating Report, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (April 26, 2002).

AmerGen Energy Company, LLC (AmerGen). 2003a. *Oyster Creek Nuclear Generating Station, Updated Final Safety Analysis Report, Revision 13*. Docket No. 50-219. Forked River, New Jersey. (April 2003).

AmerGen Energy Company, LLC (AmerGen). 2003b. *2002 Annual Radioactive Effluent Release Report, Addendum, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (December 18, 2003).

AmerGen Energy Company, LLC (AmerGen). 2003c. *2002 Annual Radiological Environmental Operating Report, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (April 30, 2003).

AmerGen Energy Company, LLC (AmerGen). 2004a. *2003 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (February 27, 2004).

AmerGen Energy Company, LLC (AmerGen). 2004b. *2003 Annual Radiological Environmental Operating Report, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (April 29, 2004).

AmerGen Energy Company, LLC (AmerGen). 2005a. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

AmerGen Energy Company, LLC (AmerGen). 2005b. *2004 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (March 1, 2005).

AmerGen Energy Company, LLC (AmerGen). 2005c. *2004 Annual Radiological Environmental Operating Report, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (April 29, 2005).

AmerGen Energy Company, LLC (AmerGen). 2006a. Email from W. Maher, AmerGen Energy Company, LLC, Forked River, New Jersey, to U.S. Nuclear Regulatory Commission, Washington, D.C. Subject: "RE: Non-rad Wastes." (December 4, 2006).

AmerGen Energy Company, LLC (AmerGen). 2006b. Letter from T. Rausch, AmerGen Energy Company, LLC, Forked River, New Jersey, to U.S. Nuclear Regulatory Commission, Washington, D.C. Subject: "Federal Consistency Certification for Oyster Creek Generating Station License Renewal Application." (December 1, 2006).

AmerGen Energy Company, LLC (AmerGen). 2006c. *Sea Turtle Incidental Take Report 2006-1*. Docket No. 50-219. Forked River, New Jersey. (July 24, 2006).

AmerGen Energy Company, LLC (AmerGen). 2006d. *Sea Turtle Incidental Take Reports 2006-2, 2006-3, 2006-4, & 2006-5.* Docket No. 50-219. Forked River, New Jersey. (August 14, 2006).

AmerGen Energy Company, LLC (AmerGen). 2006e. *Sea Turtle Incidental Take Report 2006-6*. Docket No. 50-219. Forked River, New Jersey. (October 30, 2006).

Atlantic States Marine Fisheries Commission (ASMFC). 2005a. "Species Profile: Spot. Popular South Atlantic Stock Benefits from Bycatch Reduction Efforts." Excerpted from *ASMFC Fisheries Focus*, Vol. 14, Issue 4/5, May/June 2005. Available URL: http://www.asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005b. "Species Profile: Winter Flounder. New ASMFC Amendment Under Development." Available URL: http://www/asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005c. "ASMFC Stock Status Overview." Available URL: http://www.asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005d. "Species Profile: Weakfish Coastwide Reductions in Fishing Mortality and Bycatch Reduction Devices Yield Big Results." Available URL: http://www.asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005e. "Species Profile: Atlantic Menhaden Stock Healthy Coastwide, But Questions Remain Regarding Localized Stock Conditions." Excerpted from *ASMFC Fisheries Focus*, Vol. 14, Issue 2, March 2005. Available URL: http://www.asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005f. "Species Profile: American Eel. Plan Seeks to Improve Our Understanding of the Species Through Data Collection." Excerpted from *ASMFC Fisheries Focus*, Vol. 12, Issue 1, March 2003. Available URL: http://www.asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005g. "Species Profile: Striped Bass. The Challenges of Managing a Restored Species." Excerpted from ASMFC *Fisheries Focus*, Vol. 13, Issue 1, January 2004. Available URL: http://www.asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005h. "Species Profile: Bluefish. Joint Plan Seeks to Restore Premier Fighting Fish." Available URL: http://www.asmfc.org (Accessed November 10, 2005).

Atlantic States Marine Fisheries Commission (ASMFC). 2005i. "Fishery Management Report No. 43, Amendment 1 to the Interstate Fishery Management Plan for Inshore Stocks of Winter Flounder." November 2005. Available URL: http://www.asmfc.org (Accessed September 29, 2006).

Atlantic States Marine Fisheries Commission (ASMFC). 2006a. "Addendum I to the Interstate Fishery Management Plan for American Eel." Approved by the American Eel Management Board, February 22, 2006. Available URL: http://www.asmfc.org/ (Accessed September 29, 2006).

Atlantic States Marine Fisheries Commission (ASMFC). 2006b. "Stock Assessment Report No. 06-01 of the Atlantic States Marine Fisheries Commission." Terms of Reference and Advisory Report to the American Eel Stock Assessment Peer Review (January 2006).

Atlantic States Marine Fisheries Commission (ASMFC). 2006c. "Overview of Stock Status, Atlantic Striped Bass, *Morone saxatilis*." Available URL: http://www/asmfc.org (Accessed September 29, 2006).

Atlantic States Marine Fisheries Commission (ASMFC). 2006d. "Species Profile: Bluefish Joint Plan Seeks to Restore Premier Fighting Fish." Excerpted from *ASMFC Fisheries Focus*, Vol. 15, Issue 4, May 2006. Available URL: http://www/asmfc.org (Accessed September 29, 2006).

Barnegat Bay National Estuary Program (BBNEP). 2001. "The Barnegat Bay Estuary Program Characterization Report." Scientific and Technical Advisory Committee, Toms River, New Jersey. Available URL: http://www.bbep.org/char_rep.htm (Accessed September 22, 2005).

Barnegat Bay National Estuary Program (BBNEP). 2002. "Comprehensive Conservation and Management Plan." May 2002. Available URL: http://www.bbep.org (Accessed August 8, 2005).

Barnegat Bay National Estuary Program (BBNEP). 2003. "Monitoring Program Plan." May 2003. Available URL: http://www.bbep.org/dwnloads/Mon_PlanPlan.pdf (Accessed August 8, 2005).

Barnegat Bay National Estuary Program (BBNEP). 2005a. "Barnegat Bay Estuary." Available URL: http://www.bbep.org/ (Accessed December 2005).

Barnegat Bay National Estuary Program (BBNEP). 2005b. *2005 State of the Bay Technical Report*. Available URL: http://www.bbep.org (Accessed October 1, 2006).

Bigelow, H.B., and W.C. Schroeder. 1953. "Fishes of the Gulf of Maine." Fishery Bulletin 74 of the Fish and Wildlife Service 53, Contribution 592. Woods Hole Oceanographic Institute, Woods Hole, Massachusetts, United States Government Printing Office, Washington, D.C. Available URL: http://www.gma.org/fogm/ (Accessed August 8, 2005).

Biological Research Associates. 2005. "Nature Photography by Shirley Denton." Biological Research Associates, Tampa, Florida. Available URL: http://www.biologicalresearch.com/Plants/long_list.php (Accessed September 27, 2005).

Blanchard, R.L., and B. Kahn. 1979. "Abundance and Distribution of Radionuclides Discharged from a BWR Nuclear Power Station into a Marine Bay." *Nuclear Safety*, Vol. 20, pp. 190–205.

Buchsbaum, R., J. Pederson, and W.E. Robinson. 2005. "The Decline of Fisheries Resources in New England: Evaluating the Impact of Overfishing, Contamination, and Habitat Degradation." MIT Sea Grant College Program, Massachusetts Institute of Technology, Cambridge, Massachusetts. Available URL: http://18.48.1.217/publications/NEFishResources/ (Accessed December 9, 2005).

Burger, J. 2005. "Habitat Use and Foraging Behavior of Birds in Barnegat Bay." Rutgers University. Available URL: http://lifesci.rutgers.edu/~Burger/habitat.htm (Accessed December 9, 2005).

Caribbean Conservation Corporation (CCC). 2005. "Information on Sea Turtles and Threats to Their Survival." Caribbean Conservation Corporation & Sea Turtle Survival League. Available URL: http://www.cccturtle.org/contents.htm (Accessed December 16, 2005).

Center for Plant Conservation (CPC). 2005. "Recovering America's Vanishing Flora." St. Louis, Missouri. Available URL: http://centerforplantconservation.org (Accessed September 27, 2005).

Chesapeake Bay Program (CBP). 2003. Hard Clam. Available URL: http://www.chesapeakebay.net/hard_clam.htm (Accessed December 1, 2006).

Chizmadia, P.A., M.J. Kennish, and V.L. Ohori. 1984. "Physical Description of Barnegat Bay," Chapter 1 in *Ecology of Barnegat Bay*, M.J. Kennish and R.A. Lutz, eds. Springer-Verlag, New York, New York.

Clean Water Act of 1977 (CWA). 33 USC 1326, et seq. (common name of the Federal Water Pollution Control Act [FWPCA] of 1977).

Coastal Zone Management Act of 1972 (CZMA). 16 USC 1451, et seq.

EA Engineering Science and Technology, Inc. (EA). 1986. *Entrainment and Impingement Studies at the Oyster Creek Nuclear Generating Station, 1984–1985.* Sparks, Maryland.

Elliott, D.L., C.G. Holladay, W.R. Barchet, H.P. Foote, and W.F. Sandusky. 1986. *Wind Energy Resource Atlas of the United States*. DOE/CH 10093-4, U.S. Department of Energy, Washington, D.C.

Endangered Species Act of 1973 (ESA). 16 USC 1531, et seq.

ENSR International. 2004. *Environmental Assessment Prepared for: United States Fish and Wildlife Service for Land Exchange with Connective Power Delivery Involving the Edwin B. Forsythe National Wildlife Refuge*. ENSR International, Langhorne, Pennsylvania. (May 28, 2004).

Fishery Conservation and Management Act of 1976 (FCMA). Public Law 94-164. 16 USC 1801, et seq.

FishBase. 2005. "A Global Information System on Fishes." Available URL: http://www.fishbase.org/home.htm (Accessed August 8, 2005).

Fujita, T.T. 1987. *U.S. Tornadoes Part 1 70-Year Statistics*. Satellite and Mesometeorology Research Project. Research Paper Number 218, University of Chicago, Chicago, Illinois.

Gastrich, M.D., R. Lathrop, S. Haag, M.P. Weinstein, M. Danko, D.A. Caron, and R. Schaffner. 2004. "Assessment of Brown Tide Blooms, Caused by *Aureococcus anophagefferens*, and Contributing Factors in New Jersey Coastal Bays: 2000–2002." *Harmful Algae*, Vol. 3, pp. 305–320.

Global Land Cover Facility (GLCF). 2005. "Coastal Marsh Project, Research Description and Rationale." Available URL: http://glcf.umiacs.umd.edu/data/coastalMarsh/research.shtml (Accessed September 5, 2005).

Guo, Q., N.P. Psuty, G.P. Lordi, S. Glenn, M.R. Mund, and M.D. Gastrich. 2004. "Research Project Summary, Hydrographic Study of Barnegat Bay." New Jersey Department of Environmental Protection, Division of Science, Research, and Technology. Available URL: http://www.state.nj.us/dep/dsr/research/hydrographic.pdf (Accessed September 8, 2005).

Hartig, E.K., and V. Gornitz. 2001. "The Vanishing Marshes of Jamaica Bay: Sea Level Rise or Environmental Degradation?" *Science Briefs*, December 2001. Available URL: http://www.giss. nasa.gov/research/briefs/hartig_01 (Accessed September 5, 2005).

Hastings, R. 1978. "Vertebrates of the Pine Barrens." *Frontiers*, Winter Edition. Available URL: http://www.bcls.lib.nj.us/pinelands/vertebrate.shtml (Accessed September 20, 2005).

Hoagland, K.E. 1982a. "Ecological Studies of Wood-Boring Bivalves in the Vicinity of the Oyster Creek Nuclear Generating Station. Progress Report, March–May 1982." Prepared for the U.S. Nuclear Regulatory Commission by the Wetlands Institute, Lehigh University, Bethlehem, Pennsylvania.

Hoagland, K.E. 1982b. "Ecological Studies of Wood-Boring Bivalves in the Vicinity of the Oyster Creek Nuclear Generating Station. Progress Report, June–August 1982." Prepared for the U.S. Nuclear Regulatory Commission by the Wetlands Institute, Lehigh University, Bethlehem, Pennsylvania.

Hoagland, K.E., and L. Crockett. 1980. "Ecological Studies of Wood-Boring Bivalves in the Vicinity of the Oyster Creek Nuclear Generating Station. Progress Report, March–May 1980." Prepared for the U.S. Nuclear Regulatory Commission by the Wetlands Institute, Lehigh University, Bethlehem, Pennsylvania.

Hoagland, K.E., and L. Crockett. 1982a. "Ecological Studies of Wood-Boring Bivalves in the Vicinity of the Oyster Creek Nuclear Generating Station. Progress Report, June–August 1981." Prepared for the U.S. Nuclear Regulatory Commission by the Wetlands Institute, Lehigh University, Bethlehem, Pennsylvania.

Hoagland, K.E., and L. Crockett. 1982b. “Ecological Studies of Wood-Boring Bivalves in the Vicinity of the Oyster Creek Nuclear Generating Station. Progress Report, September–November 1981.” Prepared for the U.S. Nuclear Regulatory Commission by the Wetlands Institute, Lehigh University, Bethlehem, Pennsylvania.

Hoagland, K.E., and L. Crockett. 1982c. “Ecological Studies of Wood-Boring Bivalves in the Vicinity of the Oyster Creek Nuclear Generating Station. Progress Report, December 1981–February 1982.” Prepared for the U.S. Nuclear Regulatory Commission by the Wetlands Institute, Lehigh University, Bethlehem, Pennsylvania.

Industrial Site Recovery Act of 1992 (ISRA). N.J.S.A. 13:1K and N.J.S.A. 7:26B.

Jersey Central Power & Light Company (JCP&L). 2003. *Oyster Creek Nuclear Generating Station Groundwater Assessment/Remediation Activities Semi-Annual Report, January–June 2002 for ISRA Case No. 99575*. Morristown, New Jersey. (May 2003).

Kantrud, H.A. 1996. “The Alkali (*Scirpus maritimus* L.) and Saltmarsh (*S. robustus* Pursh) Bulrushes: A Literature Review.” Information and Technology Report 6. National Biological Service, Northern Prairie Wildlife Research Center, Jamestown, North Dakota. Available URL: http://www.npwrc.usgs.gov/resource/literatr/bulrush/bulrush.htm (Accessed September 26, 2005).

Kennish, M.J. 2001a. “Benthic Communities of the Barnegat Bay – Little Egg Harbor Estuary.” *Journal of Coastal Research*, Special Issue 32, pp. 167–177.

Kennish, M.J. 2001b. “Zooplankton of the Barnegat Bay – Little Egg Harbor Estuary.” *Journal of Coastal Research*, Special Issue 32, pp. 163–166.

Kennish, M.J. 2001c. “Characterization of the Barnegat Bay – Little Egg Harbor Estuary and Watershed.” *Journal of Coastal Research*, Special Issue 32, pp. 3–12.

Kennish, M.J., 2001d. “State of the Estuary and Watershed: An Overview.” *Journal of Coastal Research*, Special Issue 32, pp. 243–273.

Kennish, M.J., and R.A. Lutz. 1984. “Lecture Notes on Coastal and Estuarine Studies.” In *Ecology of Barnegat Bay, New Jersey*, M.J. Kennish and R.A. Lutz, eds. Springer-Verlag, New York, New York.

Kennish, M.J., M.B. Roche, and T.R. Tatham. 1984. “Anthropogenic Effects on Aquatic Communities.” In *Ecology of Barnegat Bay, New Jersey*, M.J. Kennish and R.A. Lutz, eds. Springer-Verlag, New York, New York.

Lathrop, R.G., and J.A. Bognar. 2001. “Habitat Loss and Alteration in the Barnegat Bay Region.” *Journal of Coastal Research*, Special Issue 32, pp. 212–228.

Lathrop, R.G., Jr., J.A. Bognar, A.C. Hendrickson, and P.D. Bowers. 1999. “Data Synthesis Effort for the Barnegat Bay Estuary Program: Habitat Loss and Alteration in the Barnegat Bay Region.” Cook College, Rutgers University, Center for Remote Sensing and Spatial Analysis, New Brunswick, New Jersey. Available URL: http://crssa.rutgers.edu/projects/runj/datasnth.html (Accessed September 23, 2005).

Little, S. 1978. “Fire Effects in New Jersey’s Pine Barrens.” *Frontiers*, Winter Edition. Available URL: http://www.bcls.lib.nj.us/pinelands/fire.shtml (Accessed September 20, 2005).

Loveland, R.E., and J.J. Vouglitois. 1984. “Benthic Fauna.” In *Ecology of Barnegat Bay, New Jersey,* M.J. Kennish and R.A. Lutz, eds. Springer-Verlag, New York, New York.

Ludlum, D.M. 1983. *The New Jersey Weather Book*. Rutgers University Press, New Brunswick, New Jersey.

MacKenzie, C.L. 2003. “Comparison of Invertebrate Abundances in Four Bays of the Northeastern United States: Two Bays with Sparse Quahogs and Two Bays with Abundant Quahogs.” Northeast Fisheries Science Center Reference Document 03-10. Available URL: http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0310/ (Accessed December 9, 2005).

MacKenzie, C.L., and R. Pikanowski. 1999. “A Decline in Starfish, *Asterias forbesi*, Abundance and a Concurrent Increase in Northern Quahog, *Mercenaria mercenaria*, Abundance and Landings in the Northeastern United States.” *Marine Fisheries Review*, Vol. 61(2), pp. 66–71.

Maine Department of Conservation (MDOC). 2004. “*Cardamine longii* Fern. Long’s Bitter-cress.” Natural Areas Program, Augusta, Maine. Available URL: http://www.mainenatural areas.org/docs/rare_plants/links/factsheets/Cardaminelongii.pdf (Accessed September 26, 2005).

McCormick, J. 1978. “Vegetation of the Pine Barrens.” *Frontiers*, Winter Edition. Available URL: http://www.bcls.lib.nj.us/pinelands/vegetation.shtml (Accessed September 20, 2005).

McLain, P., and M. McHale. 1996. “Barnegat Bay Eelgrass Investigations 1995–96.” In *Proceedings of the Barnegat Bay Ecosystem Workshop*, November 14, 1996. Barnegat Bay Estuary Program. Rutgers Cooperative Extension of Ocean County. Toms River, New Jersey.

McLaren/Hart, Inc. 2000. *Preliminary Assessment/Site Investigation Report – Radiological, GPU Nuclear, Inc. Oyster Creek Nuclear Generation Station, U.S. Route No. 9, Forked River,* *New Jersey, Site Remediation Program Case No. E99575*. Prepared for GPU Nuclear, Inc., and AmerGen Energy Company, LLC. (February 28, 2000).

Mid-Atlantic Fishery Management Council (MAFMC). 2005. "Mid-Atlantic Fishery Management Council – Species Managed." Available URL: http://www.mafmc.org/mid-atlantic/species/species.htm (Accessed December 9, 2005).

Morgan, R.P., B.M. Baker, and J.H. Howard. 1995. "Genetic Structure of Bay Anchovy (*Anchoa mitchilli*) Populations in Chesapeake Bay." *Estuaries*, Vol. 18(3), pp. 482–493.

Moser, F.C., and R.F. Bopp. 2001. "Particle-Associated Contaminants in the Barnegat Bay-Little Egg Harbor Estuary." *Journal of Coastal Research*, Special Issue 32, pp. 229–242.

National Center for Educational Statistics (NCES). 2005. "Private School Information." Available URL: http://nces.ed.gov/surveys/pss/privateschoolsearch/ (Accessed September 2005).

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

National Marine Fisheries Service (NMFS). 2000. "Assessment Update for the Kemp's Ridley and Loggerhead Sea Turtle Populations in the Western North Atlantic: A Report of the Turtle Expert Working Group." NOAA Technical Memorandum NMFS-SEFSC-444. Available URL: http://www.nmfs.noaa.gov/pr/readingrm/Turtles/tewg2000.pdf (Accessed December 16, 2005).

National Marine Fisheries Service (NMFS). 2003. "A Report of the 36th Northeast Regional Stock Assessment Workshop. 36th Northeast Regional Stock Assessment Workshop (36th SAW). Stock Assessment Review Committee (SARC) Consensus Summary of Assessments." Document 03-06. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Region. Available URL: http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0306/crd0306.pdf (Accessed December 9, 2005).

National Marine Fisheries Service (NMFS). 2005a. "Status of Fishery Resources Off the Northeastern United States." Available URL: http://www.nefsc.noaa.gov/sos/spsyn/species.html (Accessed December 9, 2005).

National Marine Fisheries Service (NMFS). 2005b. "Annual Commercial Landing Statistics." Available URL: http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html (Accessed August 8, 2005).

National Marine Fisheries Service (NMFS). 2005c. "Marine Turtles." Available URL: http://www.nmfs.noaa.gov/pr/species/turtles/ (Accessed December 16, 2005).

National Oceanic and Atmospheric Administration (NOAA). 1999. "NOAA Sediment Quick Reference Tables (SQUIRT)." Available URL: http://response.restoration.noaa.gov/book_shelf/ 122_squirt_cards.pdf (Accessed August 8, 2005).

National Oceanic and Atmospheric Administration (NOAA). 2005. "Storm Events for New Jersey." Available URL: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms (Accessed November 17, 2005).

National Renewable Energy Laboratory (NREL). 2005. "Table 1.1, Classes of Wind Power Density at 10 m and 50 m." Available URL: http://rredc.nrel.gov/wind/pubs/atlas/tables/1-1T.html (Accessed October 16, 2005).

NatureServe. 2005. "NatureServe Explorer: An Online Encyclopedia of Life (Web Application). Version 4.5." Arlington, Virginia. Available URL: http://www.natureserve.org/explorer (Accessed September 23, 2005).

Nearctica.com. 2003. "Wildflowers of Eastern North America." Available URL: http://www.nearctica.com/flowers/index.htm (Accessed October 4, 2005).

New Jersey Audubon Society. 2005. "Forest Health and Ecological Integrity Stressors and Solutions. Policy White Paper." New Jersey Audubon Society, Bernardsville, New Jersey. Available URL: http://www.njaudubon.org/Conservation/ForestHealthWhitePaper.pdf (Accessed September 16, 2005).

New Jersey Department of Environmental Protection (NJDEP). 1994. "New Jersey Pollutant Discharge Elimination System Permit Number NJ0005550."

New Jersey Department of Environmental Protection (NJDEP). 2001a. Letter from R. Hudgins, Bureau of Water Allocation, to J. Vouglitois, AmerGen Energy Company, LLC, Forked River, New Jersey. Subject: "Water Use Registration No. 11108W." (July 25, 2001).

New Jersey Department of Environmental Protection (NJDEP). 2001b. "New Jersey Rare Species and Natural Community Lists by County." Division of Fish & Wildlife, Trenton, New Jersey. Available URL: http://www.state.nj.us/dep/parksandforests/natural/heritage/countylist.html (Accessed September 16, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005a. "Fact Sheet on the New Jersey Pollutant Discharge Elimination System (NJPDES) Surface Water Renewal Permit Action for Oyster Creek Facility." Available URL: http://www.state.nj.us/dep/dwq/pdf/oysterck_factsh.pdf (Accessed December 20, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005b. "Coastal Management Program: Map of NJ Coastal Zone." Available URL: http://www.nj.gov/dep/cmp/czm_map.html (Accessed December 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005c. "Land Use Regulation Program: Coastal Programs." Available URL: http://www.state.nj.us/dep/landuse/coast.html (Accessed December 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005d. "New Jersey Open Public Records Act Website." Available URL: http://datamine.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&Select+a+Site:=15856 (Accessed December 21, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005e. "New Jersey's Endangered and Threatened Wildlife." Division of Fish & Wildlife, Trenton, New Jersey. Available URL: http://www.nj.gov/dep/ fgw/tandespp.htm (Accessed December 16, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005f. "Element Stewardship Abstracts." Division of Fish & Wildlife, Trenton, New Jersey. Available URL: http://www.state.nj.us/dep/parksandforests/natural/heritage/rarelist.html (Accessed September 16, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005g. "Online Field Guide for Reptiles and Amphibians." Division of Fish & Wildlife, Trenton, New Jersey. Available URL: http://www.njfishandwildlife.com/ensp/fieldguide_herps.htm (Accessed September 22, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005h. "Environmental Surveillance and Monitoring Program." Available URL: http://www.nj.gov/dep/rpp/nee/index.htm (Accessed November 16, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005i. Letter from M. Mauriello, NJDEP, Trenton, New Jersey, to K. Jury, AmerGen Energy Company, LLC, Kennett Square, Pennsylvania. Subject: "Inconsistent Determination for a Federal Consistency Request for License Renewal of AmerGen's Oyster Creek Nuclear Generating Station." (August 19, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2006a. E-mail from M. Morrison, NJDEP, Trenton, New Jersey, to J. Quinn, Argonne National Laboratory, Argonne, Illinois. Subject: "Oyster Creek MTBE." (March 15, 2006).

New Jersey Department of Environmental Protection (NJDEP). 2006b. E-mail from K. Tuccillo, NJDEP, Trenton, New Jersey, to F. Monette, Argonne National Laboratory, Argonne, Illinois. Subject: "Confirmation of Site Audit Information." (November 22, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2006c. "New Jersey Department of Environmental Protection Historic Preservation Office, New Jersey and National Register of Historic Places: Ocean County." Available URL: http://www.state.nj.us/dep/hpo/1identify/ nrsr_lists.htm (Accessed January 13, 2006).

New Jersey Office of Natural Lands Management (NJONLM). 2003. "Sea-Beach Amaranth *Amaranthus pumilus* Rafinesque. Endangered Plants of New Jersey Fact Sheet." Trenton, New Jersey. Available URL: http://www.fws.gov/northeast/nyfo/es/amaranthweb/fact_sheets/NJ.pdf (Accessed September 21, 2005).

New Jersey Pinelands Commission (NJPC). 2005. E-mail from K. Gonick, NJPC, New Lisbon, New Jersey, to K. Wescott, Argonne National Laboratory, Argonne, Illinois. (November 22, 2005).

New York SeaGrant. 1999. "New York Sea Grant's Hard Clam Population Dynamics Initiative." Available URL: http://www.seagrant.sunysb./edu/HardClam/Publications.htm (Accessed December 7, 2005).

New York SeaGrant. 2004. "Unknown Parasite Is Hard on Clams." Available URL: http://www.seagrant.sunysb./edu/HardClam/QPX-Spr04CL.pdf (Accessed December 7, 2005).

Ocean County Department of Planning (OCDP). 2005a. "Leading Employers in Ocean County, 2004." Available URL: http://www.co.ocean.nj.us/planning/databook/54LEAD.pdf (Accessed September 2005).

Ocean County Department of Planning (OCDP). 2005b. *Ocean County Data Book*. 12th Ed. Ocean County Board of Chosen Freeholders, Toms River, New Jersey. (January 2005).

Ocean County Planning Board (OCPB). 1988. *Comprehensive Master Plan*. Toms River, New Jersey.

Office of New Jersey State Climatologist (ONJSC). 2005. "Monthly Station Normals Based on Data from 1971–2000, Toms River Station, Coop ID 288816." Available URL: http://climate.rutgers.edu/stateclim_v1/norms/monthly/index.html (Accessed November 22, 2005).

Olsen, P.S. 1996. "Development and Distribution of Phytoplankton Blooms Causing Brown Water in the Barnegat Bay System." *Proceedings of the Barnegat Bay Ecosystem Workshop, November 14, 1996*. Barnegat Bay Estuary Program. Rutgers Cooperative Extension of Ocean County. Toms River, New Jersey.

Olsen, P.S., and J.B. Mahoney. 2001. "Phytoplankton in the Barnegat Bay – Little Egg Harbor Estuarine System: Species Composition and Picoplankton Bloom Development." *Journal of Coastal Research*, Special Issue 32, pp. 115–143.

Pritchard, P. 1983. "Leatherback Turtle," pp. 125–132 in *Proceedings of the Western Atlantic Turtle Symposium*, Vol. 1. Bacon, P., et al., eds. Center for Environmental Education, Washington, D.C.

Public School Review. 2005. "New Jersey Public Schools." Available URL: http://www.public schoolreview.com/public_schools/stateid/NJ (Accessed September 2005).

Ramsdell, J.V. 2005. *Tornado Climatography of the Contiguous United States*. NUREG/CR-4461, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, D.C.

Richards, B.R., R.E. Hillman, and N.J. Maciolek. 1984. "Shipworms." In *Ecology of Barnegat Bay, New Jersey*, M.J. Kennish and R.A. Lutz, eds. Springer-Verlag, New York, New York.

Robert W. Freckmann Herbarium. 2005. *Vascular Plants*. University of Wisconsin, Stevens Point, Wisconsin. Available URL: http://143.236.2.135/VascularPlants.html (Accessed October 4, 2005).

Smith, L., K.E. Clark, and L.J. Niles. 2004. "New Jersey Bald Eagle Management Project 2004." New Jersey Department of Environmental Protection, Division of Fish & Wildlife, Trenton, New Jersey. Available URL: http://www.njfishand wildlife.com/ensp/pdf/eglrpt04.pdf (Accessed September 22, 2005).

Snyder, D., and S.R. Kaufman. 2004. "An Overview of Nonindigenous Plant Species in New Jersey." New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, New Jersey. Available URL: http://www.state.nj.us/dep/parksandforests/natural/heritage/InvasiveReport.pdf (Accessed September 16, 2005).

South Jersey Resource Conservation and Development Council (SJRCDC). 2002. "Comprehensive List of New Jersey Municipalities with Extant and Historic Occurrences of Federally Listed Threatened, Endangered, and Candidate Species." Hammonton, New Jersey. Available URL: http://www.sjrcd.org/th/list_of_species.doc (Accessed January 10, 2006).

Standard and Poor's. 2005. "SchoolMatters." Available URL: http://www.schoolmatters.com/ (Accessed September, 2005).

Summers, J.K., A.F. Holland, S.B. Weisberg, L.C. Wendling, C.F. Stroup, R.L. Dwyer, M.A. Turner, and W. Burton. 1989. *Technical Review and Evaluation of Thermal Effects*

Studies and Cooling Water Intake Structure Demonstration of Impact for the Oyster Creek Nuclear Generating Station. Revised Final Report. Prepared by Versar, Inc., Columbia, Maryland, for New Jersey Department of Environmental Protection, Division of Natural Resources. (May 1989).

Tatham, T.R., D.J. Danila, and D.L. Thomas. 1977. *Ecological Studies for the Oyster Creek Generating Station*, Technical Report. Ichthyological Associates, Inc., Ithaca, New York.

Tatham, T.R., D.L. Thomas, and D.J. Danila. 1984. "Fishes of Barnegat Bay." In *Ecology of Barnegat Bay, New Jersey*, M.J. Kennish and R.A. Lutz, eds. Springer-Verlag, New York, New York.

Township of Lacey. 1991. *Township of Lacey Master Plan*. Prepared by the Planning Board of the Township of Lacey, New Jersey.

Township of Lacey. 2005. "Lacey Township, New Jersey, Homepage." Available URL: http://www.laceytownship.org/content/18/default.aspx (Accessed December 2005).

URS. 2005. *Remedial Investigation – Response to October 13, 2004 NJDEP Comment Letter, Oyster Creek Nuclear Generating Station, U.S. Route No. 9, Forked River, New Jersey, ISRA Case No. E99575*, Final Report. Wayne, New Jersey. Prepared for Jersey Central Power & Light, Morristown, New Jersey. (February 11, 2005).

URS Greiner Woodward Clyde (URSGWC). 1999. *Preliminary Assessment Report – Non-Radiological, GPU Nuclear, Inc. Oyster Creek Nuclear Generation Station, U.S. Route No. 9, Forked River, New Jersey*. Prepared for GPU Nuclear, Inc. (December 1999).

URS Greiner Woodward Clyde (URSGWC). 2000. *Site Investigation/Remedial Investigation – Non-Radiological, GPU Nuclear, Inc. Oyster Creek Nuclear Generation Station, U.S. Route No. 9, Forked River, New Jersey*. Prepared for GPU Nuclear, Inc. (January 2000).

U.S. Atomic Energy Commission (AEC). 1974. *Final Environmental Statement Related to Operation of Oyster Creek Nuclear Generating Station, Jersey Central Power and Light Company*. Docket No. 50-219. Directorate of Licensing. Washington, D.C.

U.S. Census Bureau (USCB). 2005a. "American Fact Finder – Data Sets, Decennial Census." Washington, D.C. Available URL: http://factfinder.census.gov/ (Accessed September 2005).

U.S. Census Bureau (USCB). 2005b. "County Business Patterns." Washington, D.C. Available URL: http://www.census.gov/epcd/cbp/view/cbpview.html (Accessed September 2005).

U.S. Department of Agriculture (USDA). Undated. "Northeast Wetland Flora: Field Office Guide to Plant Species." U.S. Department of Agriculture Resources Conservation Service, Northeast Technical Center, Chester, Pennsylvania. Available URL: http://www.npwrc.usgs.gov/resource/plants/florane/florane.htm (Accessed October 5, 2005).

U.S. Department of Commerce (DOC). 2005. "Local Area Personal Income." Bureau of Economic Analysis. Available URL: http://www.bea.gov/bea/regional/reis/ (Accessed September 2005).

U.S. Department of Labor (DOL). 2005. "Local Area Unemployment Statistics." Bureau of Labor Statistics. Available URL: ftp://ftp.bls.gov/pub/time.series/la/ (Accessed September 2005).

U.S. Environmental Protection Agency (EPA). 2004. "Fact Sheet: Cooling Water Intake Structures – Section 316(b)." Available URL: http://www.epa.gov/waterscience/316b/phase2final-fs.pdf (Accessed December 20, 2005).

U.S. Fish and Wildlife Service (FWS). 1991a. "Swamp Pink (*Helonias bullata*) Recovery Plan." Newton Corner, Massachusetts. Available URL: http://ecos.fws.gov/docs/recovery_plans/1991/910930c.pdf (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 1991b. "American Burying Beetle (*Nicrophorus americanus*) Recovery Plan." Newton Corner, Massachusetts. Available URL: http://ecos.fws.gov/docs/recovery_plans/1991/910927.pdf (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 1993a. "Birds of Edwin B. Forsythe National Wildlife Refuge, New Jersey." Oceanville, New Jersey. Available URL: http://www.fws.gov/northeast/forsythe/What2Expect.html (Accessed January 13, 2006).

U.S. Fish and Wildlife Service (FWS). 1993b. "Knieskern's Beaked-Rush (*Rhynchospora knieskernii*) Recovery Plan." Hadley, Massachusetts. Available URL: http://ecos.fws.gov/docs/recovery_plans/1993/930929b.pdf (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 1994. "Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis* Say) Recovery Plan." Hadley, Massachusetts. Available URL: http://ecos.fws.gov/recovery_plans/1994/940929b.pdf (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 1995. "American Chaffseed (*Schwalbea americana*) Recovery Plan." U.S. Fish and Wildlife Service, Hadley, Massachusetts. Available URL: http://ecos.fws.gov/docs/recovery_plans/1995/950929c.pdf (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 1996. "Recovery Plan for Seabeach Amaranth (*Amaranthus pumilus*)." Atlanta, Georgia. Available URL: http://ecos.fws.gov/docs/recovery_plans/1996/961112b.pdf (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 1997. "Significant Habitats and Habitat Complexes of the New York Bight Watershed." Charlestown, Rhode Island. Available URL: http://training.fws.gov/ library/pubs5/begin.htm (Accessed January 12, 2006).

U.S. Fish and Wildlife Service (FWS). 1999. "Endangered and Threatened Wildlife and Plants; Proposed Rule to Remove the Bald Eagle in the Lower 48 States from the List of Endangered and Threatened Wildlife." *Federal Register*, Vol. 64, No. 128, pp. 36454–36464. Washington, D.C. (July 6, 1999).

U.S. Fish and Wildlife Service (FWS). 2001. "Bog Turtle (*Clemmys muhlenbergii*) Northern Population Recovery Plan." Hadley, Massachusetts. Available URL: http://ecos.fws.gov/docs/recovery_plans/2001/010515.pdf (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 2002. "Piping Plover Atlantic Coast Population." Hadley, Massachusetts. Available URL: http://www.fws.gov/northeast/pipingplover/ overview.html (Accessed September 23, 2005).

U.S. Fish and Wildlife Service (FWS). 2004a. "Edwin B. Forsythe National Wildlife Refuge." Oceanville, New Jersey. Available URL: http://www.fws.gov/northeast/forsythe/GenBrochure_04.pdf (Accessed September 20, 2005).

U.S. Fish and Wildlife Service (FWS). 2004b. "The Bog Turtle (*Clemmys muhlenbergii*) Protecting New Jersey's Rarest Turtle." Pleasantville, New Jersey. Available URL: http://www.fws.gov/ northeast/njfieldoffice/Fact%20Sheets%20PDF%20holding/Bog_turtle.pdf (Accessed September 21, 2005).

U.S. Fish and Wildlife Service (FWS). 2005a. Letter from C.G. Day, U.S. Fish and Wildlife Service, Pleasantville, New Jersey, to M.P. Gallagher, AmerGen Energy Company, LLC, Kennett Square, Pennsylvania. Subject: "Information on Federally Listed Species in the Vicinity of the Oyster Creek Generating Station." (January 25, 2005).

U.S. Fish and Wildlife Service (FWS). 2005b. Letter from C.G. Day, U.S. Fish and Wildlife Service, Pleasantville, New Jersey, to M.T. Lesar, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Scoping Comments for the Oyster Creek Nuclear Generating Station License Renewal Environmental Impact Statement." (November 23, 2005).

U.S. Fish and Wildlife Service (FWS). 2006. "Significant Habitats and Habitat Complexes of the New York Bight Watershed: Barnegat Bay Complex." U.S. Fish and Wildlife Service's

Southern New England – New York Bight Coastal Ecosystems Program. Available URL: http://training.fws.gov/library/pubs5/web_link/text/toc.htm#6 (Accessed October 1, 2006)

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1983a. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic). Atlantic Silverside." FWS/OBS-82/11.10. October. Available URL: http://www.nwrc.usgs.gov/wdb/pub/0117.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1983b. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic). Hard Clam." FWS/OBS-82/11.18. October. Available URL: http://www.nwrc.usgs.gov/wdb/pub/0200.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1987. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic). American Eel." Biological Report 82(11.74). August. Available URL: http://www.nwrc.usgs.gov/wdb/pub/0113.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989a. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic). Bay Anchovy." Biological Report 82(11.97). February. Available URL: http://www.nwrc.usgs.gov/wdb/pub/0161.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989b. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic). Spot." Biological Report 82(11.98). January. Available URL: http://www.nwrc.usgs.gov/wdb/pub/0180.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989c. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North-Atlantic). Winter Flounder." Biological Report 82(11.87). February. Available URL: http://www.nwrc.usgs.gov/wdb pub/0102.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989d. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic). Weakfish." Biological Report

82(11.109). August. Available URL: http://www.nwrc.usgs.gov/wdb/ pub/0159.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989e. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic). Atlantic Menhaden." Biological Report 82(11.108). August. Available URL: http://www.nwrc.usgs.gov/ wdb/pub/0187.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989f. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South-Atlantic). Striped Bass." Biological Report 82(11.118). December. Available URL: http://www.nwrc.usgs.gov/wdb/ pub/0134.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989g. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South-Atlantic). Bluefish." Biological Report 82(11.96). April. Available URL: http://www.nwrc.usgs.gov/wdb/pub/0171.pdf (Accessed December 9, 2005).

U.S. Fish and Wildlife Service, U.S. Department of the Interior, and U.S. Army Corps of Engineers (FWS/DOI/USACE). 1989h. "Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic). Blue Crab." Biological Report 82(11.100). March. Available URL: http://www.nwrc.usgs.gov/wdb/pub/0135.pdf (Accessed December 9, 2005).

U.S. Geological Survey (USGS). 2001. "Aquifer and Well Characteristics in New Jersey." Available URL: http://nj.usgs.gov/gw/table_1.html (Accessed August 3, 2005).

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

U.S. Nuclear Regulatory Commission. (NRC). 2004. "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues." Appendix D to NRC Office Instruction LIC-203, Rev. 1. Office of Nuclear Reactor Regulation. Washington, D.C. (May 24, 2004).

U.S. Nuclear Regulatory Commission (NRC). 2005a. Letter from P.T. Kuo, U.S. Nuclear Regulatory Commission, Rockville, Maryland, to C.G. Day, U.S. Fish and Wildlife Service, Pleasantville, New Jersey. Subject: "Request for List of Protected Species Within the Area Under Evaluation for the Oyster Creek Nuclear Generating Station License Renewal." (October 12, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2005b. *Biological Assessment, Oyster Creek Nuclear Generating Station, Sea Turtle Impact Assessment*. Docket No. 50-219. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2006a. E-mail from T. Allison, Argonne National Laboratory, Argonne, Illinois, to M. Masnik, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Conversation with W. Maher." (April 24, 2006).

U.S. Nuclear Regulatory Commission (NRC). 2006b. E-mail from T. Allison, Argonne National Laboratory, Argonne, Illinois, to M. Masnik, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Communications with David McKeon." (April 24, 2006).

U.S. Nuclear Regulatory Commission (NRC). 2006c. E-mail from T. Allison, Argonne National Laboratory, Argonne, Illinois, to M. Masnik, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Housing Growth Controls in Lacey Township." (April 24, 2006).

U.S. Nuclear Regulatory Commission (NRC). 2006d. E-mail from T. Allison, Argonne National Laboratory, Argonne, Illinois, to M. Masnik, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Conversation with W. Maher." (April 24, 2006).

Zampella, R.A., N.A. Procopio, K.J. Laidig, and J.F. Bunnell. 2004. "The Essential Character of the Oyster Creek Watershed." Pinelands Commission, New Lisbon, New Jersey. Available URL: http://www.state.nj.us/pinelands/infor/broch/OysterCreekReport.pdf (Accessed September 22, 2005).

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.

(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 Oyster Creek Nuclear Generating Station (OCNGS) because they are related to plant design features or site characteristics not found at OCNGS are listed in Appendix F.

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. AmerGen Energy Company, LLC (AmerGen), indicated that it has performed an integrated plant assessment evaluating structures and components pursuant to Title 10, Part 54, Section 54.21, of the *Code of Federal Regulations* (10 CFR 54.21) to identify activities that are necessary to continue operation of OCNGS 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 (ER) (AmerGen 2005).

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 ER and the U.S. Nuclear Regulatory Commission staff's environmental impact statement.

The integrated plant assessment that AmerGen conducted under 10 CFR Part 54 did not identify the need to undertake any major refurbishment or replacement actions to maintain the functionality of important systems, structures, and components during the OCNGS license renewal period. 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."

AmerGen Energy Company, LLC (AmerGen). 2005. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station.* Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vols. 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, Vol. 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 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, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, and are applicable to the Oyster Creek Nuclear Generating Station (OCNGS). Section 4.1 addresses issues applicable to the OCNGS 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. Category 1 and Category 2 issues that are not applicable to OCNGS because they are related to plant design features or site characteristics not found at OCNGS 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 OCNGS cooling-system operation during the renewal term are listed in Table 4-1. AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS operating license (OL). The U.S. Nuclear Regulatory Commission (NRC) staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft Supplemental Environmental Impact Statement (SEIS). Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For all of the Category 1 issues, the NRC staff concluded in the GEIS that the impacts would be SMALL, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to be warranted.

A brief description of the NRC staff's review and the GEIS conclusions, as codified in 10 CFR Part 51, 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. During the scoping meeting on November 1, 2005, a member of the public raised an issue concerning excessive sediment deposition at the mouths of the finger canals along Forked River. Station operation may contribute to the deposition of sediment in the canals. This issue is addressed in Section 4.7 of this SEIS, but it was not considered new and significant information. The NRC staff concludes that there would be no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

Table 4-1. Category 1 Issues Applicable to the Operation of the OCNGS 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	
Altered current patterns at intake and discharge structures	4.2.1.2.1
Altered salinity gradients	4.2.1.2.2
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
AQUATIC ECOLOGY	
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
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

- Altered salinity gradients. Based on information presented in the GEIS, the Commission found that

> Salinity gradients 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of altered salinity gradients during the renewal term beyond those discussed in the GEIS.

- <u>Temperature effects on sediment transport capacity</u>. 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

- <u>Scouring caused by discharged cooling water</u>. 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of scouring caused by discharged cooling water during the renewal term beyond those discussed in the GEIS.

- <u>Eutrophication</u>. Based on information on eutrophication 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, evaluation of other available information (including plant monitoring data and technical reports), and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information (including the New Jersey Pollutant Discharge Elimination System [NJPDES] permit for OCNGS, or discussion with the New Jersey Department of Environmental Protection [NJDEP]), and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 National Pollutant Discharge Elimination System (NPDES) permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information (including the NJPDES permit for OCNGS, or discussion with the NJDEP), and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information (including the NJPDES permit for OCNGS, or discussion with the NJDEP), and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of available information, and public comments on the draft SEIS. In the mid-1970s, the owners of the OCNGS replaced the Admiralty brass condenser tubes with condenser tubes made of titanium. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, evaluation of other available information, and public comments on the draft SEIS.

Therefore, the NRC staff concludes that there would be no impacts associated with the 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information (including the NJPDES permit for OCNGS), and public comments on the draft SEIS. The NJPDES permit for OCNGS stipulates that OCNGS not schedule routine shutdowns during the months of December, January, February, or March to reduce the possibility of cold shock. Despite this, three recent cold-shock incidents have been recorded at OCNGS during plant shutdowns. In these cases, warmwater fish species occupying the warm waters of the discharge area died from cold shock when unplanned shutdowns occurred. Recent cold-shock-related fish kills occurred in 2000, 2001, and 2006. Of the 3547 fish killed on January 21, 2000, 84 percent were striped bass (*Morone saxatilis*). On November 11, 2001, 98 percent of the 1407 fish killed were warmwater species (crevalle jacks [*Caranx hippos*], blue runners [*Caranx crysos*], and lookdowns [*Selene vomer*]). On January 25, 2006, OCNGS reduced power by 50 percent due to a recirculation pump failure. On January 28, OCNGS ceased power production completely, and dead fish were observed in the discharge canal from January 29 to February 3. Of the 80 dead fish observed, 78 were bluefish (*Pomatomus saltatrix*) (AmerGen 2006a).

The number of fish killed during these infrequent events is not considered large enough to either destabilize or noticeably alter any important attribute of the resource. The frequency and magnitude of fish kills due to cold shock have declined noticeably since OCNGS operation began in 1969. The OCNGS fish kill monitoring procedure requires a survey of the discharge canal and parts of Oyster Creek; the survey is conducted on foot or by boat using dip nets to retrieve stressed and dead fish (AmerGen 2002a). In the past, underwater cameras and scuba divers have been used to observe the extent of fish kills. Such observations have not indicated that there were many expired fish at or near the bottom of the discharge canal or Oyster Creek. Based on the operating history of OCNGS, the NRC staff concludes that the impacts of cold shock are consistent with those described in the GEIS. Such impacts would be minor and would have no detectable impact on Barnegat Bay fish resources.

- 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of thermal plume barriers on 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 affect the larger geographical distribution of aquatic organisms.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts on the distribution of aquatic organisms 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, evaluation of other available information, and public comments on the draft SEIS. A study conducted from 1976 to 1980 in Barnegat Bay (Vouglitois 1983) measured water chemistry (including dissolved oxygen) at the mouths of several creeks that are tributaries to Barnegat Bay, including Forked River and Oyster Creek. This study found no statistically significant differences between dissolved oxygen at any of the sampling locations, indicating that OCNGS was not noticeably affecting dissolved oxygen content in Oyster Creek, Forked River, or adjacent portions of Barnegat Bay. Therefore, the NRC staff concludes that there would be no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- <u>Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses</u>. 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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.

- <u>Stimulation of nuisance organisms</u>. 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 single nuclear power plant referred to above is OCNGS. During the 1970s and 1980s, four wood-boring teredinid species were observed in Barnegat Bay. Two species (*Bankia gouldi* and *Teredo navalis*) are common to the bay, and two species (*T. bartschi* and *T. fucifera*) are native to tropical and subtropical regions, but were likely introduced to the bay and became established in the areas affected by thermal discharges of OCNGS. According to the Barnegat Bay National Estuary Program (BBNEP) (2001), the two tropical species are no longer found in the estuary. It is likely that the prevalence of the other species has also decreased because of the removal and replacement of wooden structures with other materials. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 OCNGS 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 OCNGS Cooling System During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR Part 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY			
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 power plants with once-through cooling-systems, the entrainment of fish and shellfish in early life stages by nuclear power plant cooling systems is considered a Category 2 issue that requires plant-specific assessment for license renewal. The NRC staff independently reviewed the AmerGen ER (AmerGen 2005a), visited the site, and reviewed the applicant's current NJPDES permit and the NJDEP fact sheet describing the OCNGS draft permit and the permit renewal process (NJDEP 2005). The NRC staff also reviewed relevant scientific articles and compilations associated with the study area, documents and technical reports from the NJDEP and its contractor (Versar, Inc.), the National Marine Fisheries Service (NMFS), the U.S. Geological Survey, and the BBNEP. The NRC staff also spoke to scientists at Rutgers University who have conducted research in Barnegat Bay.

Section 316(b) of the Clean Water Act (CWA) (Title 33, Section 1326, of the *United States Code* [33 USC 1326]) requires that the location, design, construction, and capacity of the cooling-water intake structures reflect the best technology available for minimizing adverse environmental impacts.

On July 9, 2004, the U.S. Environmental Protection Agency (EPA) published a final rule (EPA 2004) addressing cooling-water intake structures with flow levels exceeding a minimum threshold value of 50 million gallons per day (gpd) at existing power plants. The EPA has developed 316(b) Phase II regulations that establish national requirements applicable to the location, design, construction, and capacity of cooling-water intake structures at existing facilities that exceed a 50-million-gpd threshold value for water withdrawals. The national requirements, which are implemented through NPDES permits, are designed to minimize the adverse environmental impacts, including entrainment losses, associated with the continued use of the intake systems. This rule allows for five compliance alternatives. Two of these alternatives address attainment of the new performance standards that are designed to significantly reduce entrainment losses resulting from plant operation. Licensees are required to demonstrate compliance with the Phase II regulations at the time of renewal of their NPDES permit. As part of the NPDES renewal, licensees may be required to alter the intake structure, redesign the cooling system, modify station operation, or take other actions, such as restoration, to demonstrate compliance.

On June 9, 1999, OCNGS applied for a renewal for its NJPDES surface-water permit. Until this renewal permit is finalized, the existing permit remains in effect. The draft permit, dated July 21, 2006, described in the NJDEP fact sheet (NJDEP 2005), incorporates the NJDEP's determination pursuant to Section 316(b) of the CWA and also proposes implementation of regulations for Section 316(b) of the CWA for existing facilities. The NRC staff evaluated the aquatic impacts of OCNGS during the renewal period using the terms and limitations contained in the existing 1994 OCNGS NJPDES permit. The projected impacts associated with the terms and limitations contained in the draft permit are evaluated in Section 8.1 of this SEIS.

A single demonstration study was conducted for OCNGS between 1965 and 1977 to comply with Sections 316(a) and 316(b) of the CWA. Additional studies were conducted from 1978 to 1986. The demonstration study formed the basis for establishing the operational impacts of the once-through cooling-water system on important environmental resources. In 1987, the NJDEP contracted Versar, Inc., to assist in the technical review of the 316(a) and 316(b) demonstration study. Versar submitted the final technical review to the NJDEP in 1989 (Summers et al. 1989). Because the Versar review formed the basis of the NJDEP's decision to allow continued operation of the OCNGS under NJPDES rules, the NRC staff reviewed the information contained in both Summers et al. (1989) and EA Engineering Science and Technology, Inc. (EA 1986) to determine the impact of continued operations relative to the EPA Phase II rules. The NJDEP fact sheet (NJDEP 2005) was also reviewed to determine current guidance concerning NJPDES-related issues.

Estimates of microzooplankton (zooplankton smaller than 0.5 mm) entrainment by OCNGS were made in 1975 and 1976. Collections were conducted using a fixed net deployed in the discharge canal. The majority (71 percent) of the entrained organisms were copepods, and the total number of organisms (all taxa) entrained from September 1975 to August 1976 was estimated to be 6.9×10^{13} individuals (EA 1986). The numbers passing through the circulating-water system and dilution pumps were approximately equal because EA assumed that the densities of microzooplankton at both intake locations were equivalent, and that the total entrainment was regulated by flow rate. Summers et al. (1989) noted that collection efficiency was not stated in the EA report, but that most of the samples were apparently taken from one fixed discharge location. Summers et al. (1989) also noted that it was unlikely that the collection method employed at OCNGS resulted in 100 percent efficiency, and that the true collection efficiency could be as low as 13 percent because of the extrusion and loss of small fish larvae passing through the fixed nets, or avoidance of the nets entirely by more motile species. Thus, on the basis of the Summers et al. (1989) analysis, it is possible that the entrainment numbers presented by EA (1986) were underestimates of actual entrainment. However, as described later in this section, these numbers were adjusted for the purposes of evaluating impacts.

Macrozooplankton (zooplankton larger than 0.5 mm) entrainment studies were conducted from September 1975 to August 1981 (EA 1986). Collections were made using a fixed net deployed in the discharge canal. Mysid shrimp (family Mysidae) and *Crangon* spp. zoea made up the majority of macrozooplankton entrained during the study period. The total annual entrainment (September through August) ranged from 6.0×10^{10} to nearly 8.0×10^{10} organisms during the 6-year study. The exception to this was an annual entrainment of slightly less than 3.0×10^{10} organisms during the September 1978 through August 1979 sampling period (EA 1986). The uncertainties associated with macrozooplankton entrainment estimates are similar to those described above for microzooplankton.

Ichthyoplankton (larval fish) entrainment studies were conducted at OCNGS from September 1975 through August 1981. Larvae and eggs of bay anchovy (*Anchoa mitchilli*), and larvae of winter flounder (*Pseudopleuronectes americanus*), sand lance (*Ammodytes* spp.), and goby (unidentified species) represented the largest percentage of entrained organisms for all sampling years. Entrainment abundances varied considerably from year to year; the highest annual entrainment was observed in the 1975 to 1976 sampling year (3.2×10^{10} organisms), and the lowest entrainment was observed in 1979 to 1980 (1.5×10^{9} organisms) (EA 1986). The eggs of the bay anchovy were entrained from April through October, with the highest entrainment abundance from May to July. Larval and juvenile forms of the bay anchovy were entrained from May through December, with the highest entrainment occurring in July 1977. Goby larval entrainment was most common in the warmer months, occurring from May through October, with maximum entrainment abundances observed in July. Larvae of the sand lance and winter flounder were the most common organisms entrained from January to April, with the highest density for sand lance larval entrainment occurring in January 1976 (EA 1986).

Because the 316(a) and 316(b) demonstration report did not provide estimates of circulating-water system macrozooplankton entrainment losses for each year or estimates of dilution pump entrainment losses, Summers et al. (1989) conservatively estimated losses by assuming a 100 percent mortality rate for all entrained organisms (circulating-water system and dilution pumps). Entrainment loss is presented in Table 4-3; as the table indicates, the majority of the losses are associated with larval, juvenile, and adult opossum shrimp (*Neomysis integer*), and larvae of the hard clam (*Mercenaria mercenaria*). The smallest losses are associated with blue crab (*Callinectes sapidus*) zoea (34 million lost) and larvae (148 million lost).

To evaluate the impact of these entrainment losses, the NRC staff evaluated three assessments concerning the potential impact of entrainment at OCNGS on ecologically, recreationally, or commercially important species: (1) the conclusions of the 316(a) and (b) demonstration presented in EA (1986), (2) the conclusions based on Versar's review of the EA study (Summers et al. 1989), and (3) the conclusions and recommendations provided in the NJDEP fact sheet (NJDEP 2005) regarding the renewal of the OCNGS NJPDES permit. The NRC staff also compared its assessment of impact with the conclusions stated in Kennish (2001), because that author also reviewed the 316(a) and 316(b) demonstration data. A summary of the conclusions associated with entrainment impact follows.

Based on the findings of the 316(a) and 316(b) demonstration, the overall conclusion regarding the environmental impacts of entrainment was that ". . . although some losses of entrained macrozooplankton have occurred, no obvious changes in the community due to the operation of OCNGS was [were] suggested" and ". . . it does not appear that the OCNGS operation has either affected the structure of the sand shrimp (*Crangon septemspinosa*) or blue crab population or reduced the standing crop of juvenile and adult blue crab in the bay" (EA 1986).

Table 4-3. Estimated Mean and Standard Error for Annual Entrainment Losses for Entrainable Organisms at OCNGS from 1975 to 1981

		Entrainment Losses (millions of organisms)				
		Circulation Pump		Dilution Pump		
Scientific Name	Common Name	Mean	Standard Error	Mean	Standard Error	Total
Anchoa mitchilli	bay anchovy egg	5,182	3,299	5,071	3,106	10,253
Anchoa mitchilli	bay anchovy larvae	6,545	2,543	6,794	2,607	13,339
Callinectes sapidus	blue crab megalopae	80	22	68	18	148
Callinectes sapidus	blue crab zoea	17	9	17	9	34
Crangon septemspinosa	sand shrimp, juvenile and adult	3,633	1,227	4,048	1,157	7,681
Crangon septemspinosa	sand shrimp zoea	7,225	1,732	6,383	1,231	13,608
Mercenaria spp.	clam larvae	63,530	NA[(a)]	48,800	NA	112,330
Neomysis integer	opossum shrimp, juvenile and adult	101,302	21,119	108,587	13,531	209,889
Pseudopleuronectes americanus	winter flounder larvae	2,099	1,588	2,231	1,685	4,330

(a) NA = not available.
Source: Summers et al. 1989

For entrainment impacts on fish, the report concludes, "Similarly, the fish community in the bay has not experienced any variation in species composition or abundance of populations that reproduce in the bay that were not also noted for other southern New Jersey and mid-Atlantic estuaries, and therefore, these reductions in Barnegat Bay were attributed to environmental factors that affect those populations through the mid-Atlantic area rather than OCNGS entrainment losses." The report concluded that "although little data exist on zoo- and ichthyoplankton communities in the bay prior to 1969, it does not appear that entrainment of these forms at the OCNGS has affected either the invertebrate populations in the bay or the various component populations to a point where changes were detected."

Based on their review of EA (1986), Summers et al. (1989) concluded that the "continued operation of the Oyster Creek NGS at the estimated levels of losses to representative important species populations, without modification to the intake structures and/or operating practices, does not threaten the protection and propagation of balanced, indigenous populations." It is believed that this statement was made with regard to entrainment, impingement, and thermal impacts, but it is not specifically stated as such in the Summers et al. (1989) report. It should be noted that the Summers et al. (1989) entrainment estimates were adjusted upward to account for sampling-gear inefficiency, and that entrainment mortality through both the circulating-water system and dilution pumps was assumed to be 100 percent to provide an environmentally conservative assessment. This was a particularly conservative assessment because the organisms entrained through the dilution pumps are not subjected to the same hydrodynamic and thermal stresses present in the circulating-water system.

This assessment (Summers et al. 1989) was based on population and ecosystem modeling (equivalent adult model, production foregone model, and spawning/nursery area of consequence model) to determine the environmental consequences of impingement and entrainment. The results of these models evaluate the combined losses associated with both impingement and entrainment. Using conservative assumptions to estimate OCNGS impingement and entrainment losses, data available on population sizes, and survival rates and trophic relationships, Summers et al. (1989) concluded that population losses were rapidly compensated for by reproduction (e.g., sand shrimp), were a small fraction of the bay population (e.g., blue crab and winter flounder), or had little effect on higher trophic levels (e.g., bay anchovy and opossum shrimp).

After reviewing the 316(b) demonstration study, Kennish (2001) reached a similar conclusion to that of Summers et al. (1989), stating “despite the large numbers of eggs, larvae, and small life forms of Barnegat Bay organisms lost via in-plant passage at the OCNGS, these losses have not resulted in detectable impacts on biotic communities in Barnegat Bay. Effects of operation of the OCNGS on aquatic communities appear to be restricted to the discharge canal and Oyster Creek.”

Although the NJDEP (2005) acknowledged the Summers et al. (1989) conclusion that OCNGS did not appear to produce “unacceptable, substantial long-term population and ecosystem level impacts,” the agency stated that it is not necessary to prove that an impact on a population is occurring to require the applicant to meet Section 316(b) performance standards. The NJDEP goes on to state that “this rationale is consistent with the Phase II regulations which specify compliance alternatives, including national performance standards, and do not define adverse environmental impact.” The entrainment performance standard in the EPA’s Phase II regulations requires that entrainment losses for all life stages of fish and shellfish be reduced by 60 to 90 percent from a calculated baseline.

In September 2005, after discussions and approval by the NJDEP, the applicant began an intake sampling program for entrainment as part of an effort to demonstrate compliance with the new regulations. Based on the results of this and other studies, the state of New Jersey may require additional mitigation measures, such as the installation of cooling towers or restoration, to reduce or offset entrainment.

Preliminary entrainment data collected by the applicant suggest that the species composition and relative numbers of organisms entrained at OCNGS are similar to those observed during the earlier 316(b) demonstration study. However, because of the high variability associated with the original 316(b) data and the current information, it is not possible with the data currently available to determine if entrainment has changed significantly since the original study was conducted. Because a bay-wide assessment was not included in the current study design, there are no current population data available for ecologically, recreationally, or commercially important fish or shellfish that would be necessary for a bay-wide assessment of impact to fish and shellfish populations.

On the basis of the review of the original 316(b) study, the NRC staff has concluded that the operation of OCNGS has resulted in localized entrainment-related impact at near-field locations that include Forked River, Oyster Creek, and adjacent portions of Barnegat Bay. This determination is consistent with Section 4.2.1.2.1 of the GEIS, which determined that these impacts are unavoidable for plants utilizing a once-through cooling system design. Because of a lack of recent monitoring data on fish and shellfish populations in Barnegat Bay, it is not possible at this time to determine whether the composition and abundance of representative important species have significantly changed since the 1980s. Sufficient entrainment data associated with the ongoing Phase II demonstration study are not yet available for review, and an assessment of representative important species populations in central Barnegat Bay was not included in the Phase II study design. The NRC staff concludes that if the composition and abundance of representative important species in Barnegat Bay are similar to those observed in the 1970s and 1980s, the impact of entrainment related to OCNGS operations would likely continue to be SMALL because the basic operation of the OCNGS cooling system has not significantly changed since the original 316(b) study was conducted. If, however, the composition or abundance of representative important species has been noticeably altered by changes in natural and other anthropogenic stressors in central Barnegat Bay relative to those in the 1970s and 1980s, the incremental impacts due to entrainment associated with OCNGS could be MODERATE. The impact is not considered large because there are no indications that the fish populations in the bay are destabilized.

Recently, the status of winter flounder stocks has been a concern of fisheries management agencies along the eastern seaboard. The southern New England mid-Atlantic stock abundance of winter flounder has continued to decline despite fishery management efforts intended to reverse this trend (ASMFC 2005). If future monitoring efforts demonstrate a similar decline in Barnegat Bay, the ongoing entrainment losses at OCNGS will need to be considered as part of an integrated management program to address this issue.

Because recent population data are not available, the NRC staff cannot arrive at a definitive conclusion concerning the current impact of entrainment associated with OCNGS. The NRC staff recommends that additional environmental monitoring studies be conducted in the bay by the appropriate resource agencies, universities, or non-governmental organizations to determine if changes in abundance or population structure of representative important species have occurred during the past three decades and to establish a baseline reflective of current conditions. The NRC staff further recommends that the experimental designs for these studies reflect the need to evaluate both anthropogenic and natural stressors present in Barnegat Bay at spatial and temporal scales sufficient to address the inherent variability within the system. Integrated monitoring studies will enable resource managers to better understand the relative contribution of individual or collective environmental stressors on Barnegat Bay and enable prioritization of management actions designed to reduce the overall impact on the ecosystem. Regardless of the determination of impacts, compliance with the EPA's Phase II regulations may require modifications to the facility's cooling system or the implementation of restoration measures.

During the preparation of this SEIS, the NRC staff considered mitigation measures to reduce entrainment losses at OCNGS during the license renewal period. The mitigation measures are discussed in the staff's evaluation of alternatives to the existing station cooling system. That analysis is presented in Section 8.1 of this SEIS.

4.1.2 Impingement of Fish and Shellfish

For power plants with once-through cooling-systems, the impingement of fish and shellfish in early life stages by nuclear power plant cooling systems is considered a Category 2 issue that requires plant-specific assessment for license renewal. The NRC staff independently reviewed the AmerGen ER (AmerGen 2005a), visited the site, and reviewed the applicant's current NJPDES permit and the NJDEP fact sheet describing the OCNGS draft permit and the permit renewal process (NJDEP 2005). The NRC staff also reviewed relevant scientific articles and compilations associated with the study area, documents and technical reports from NJDEP and its contractor (Versar, Inc.), the NMFS, the U.S. Geological Survey, and the BBNEP. The NRC staff also spoke to scientists at Rutgers University who have conducted research in Barnegat Bay.

Section 316(b) of the CWA requires that the location, design, construction, and capacity of the cooling-water intake structures reflect the best technology available for minimizing adverse environmental impacts.

On July 9, 2004, the EPA published a final rule (EPA 2004) addressing cooling-water intake structures with flow levels exceeding a minimum threshold value of 50 million gpd at existing power plants. The EPA has developed Phase II 316(b) regulations that establish 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 permits, are designed to minimize the adverse environmental impacts, including impingement losses, associated with the continued use of the intake systems. This rule allows for five compliance options. Two of these options address the attainment of the new performance standards, which are designed to significantly reduce impingement mortality resulting from plant operation. Licensees are required to demonstrate compliance with the Phase II regulations at the time of renewal of their

NPDES permit. As part of the NPDES renewal, licensees may be required to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures, such as restoration, as a result of this regulation.

On June 9, 1999, OCNGS applied for a renewal for its NJPDES surface-water permit. Until this renewal permit is finalized, the existing permit remains in effect. The draft permit, dated July 21, 2006, provided in the NJDEP fact sheet (NJDEP 2005) incorporated the NJDEP's determination pursuant to Section 316(b) of the CWA and also proposes implementation of regulations for Section 316(b) of the CWA for existing facilities. The NRC staff evaluated the aquatic impacts of OCNGS during the renewal period using the terms and limitations contained in the existing 1994 OCNGS NJPDES permit. The projected impacts associated with the terms and limitations contained in the draft permit are evaluated in Section 8 of this SEIS.

Impingement mortality studies were conducted between 1975 and 1978, and in 1985 (EA 1986). During 1975 and 1978, immediate and latent mortality estimates were calculated as a part of impingement sampling. Immediate mortality was determined by transferring impinged organisms collected from the intake screens to insulated coolers filled with ambient water and observing the number alive, dead, and damaged after 5 to 10 min. Latent mortality was determined by holding impinged organisms recovered from the screens in ambient and heated water for 96 hours, then determining the number alive and dead (Summers et al. 1989). The heated water procedure was intended to simulate the conditions impinged organisms would encounter after they were released into the discharge canal. In 1985, immediate mortality was determined as a part of the latent mortality procedure, but insulated coolers were not used. A detailed explanation of the experimental procedures used for the latent mortality test was not described in the demonstration study (EA 1986), but Summers et al. (1989) noted in its review of EA (1986) that it appears that the timing of the impingement mortality tests encompassed all seasons and most of the species of interest.

Table 4-4 presents the summary information for immediate and latent mortality estimates using both conventional and Ristroph screens, because the study years reflected the use of both technologies. The experimental design did not evaluate all species under each scenario. Bay anchovies and Atlantic menhaden (*Brevoortia tyrannus*) appeared to exhibit the highest overall impingement mortality. Mortality for the bay anchovy ranged from 81 to 99 percent for both screen types and mortality estimators; immediate and latent mortalities for Atlantic menhaden were 73 and 86 percent, respectively, for conventional screens only. Mortality associated with Ristroph screens was not evaluated for Atlantic menhaden. Winter flounder, sand shrimp, and blue crab exhibited lower impingement mortality. Winter flounder impingement mortality ranged from 2 to 23 percent under all screen and mortality scenarios. Sand shrimp impingement mortality ranged from 5 to 50 percent under all screen and mortality scenarios, with the lowest mortality observed on Ristroph screens followed by immediate assessment of survival (Table 4-4). Blue crab impingement mortality was only conducted for conventional screen technology, and was 12 and 13 percent for immediate and latent mortality estimation procedures, respectively.

Table 4-4. Total Mortality Rate Estimates (Percent) Determined from Immediate and Latent Mortality Studies from 1975 to 1978 and 1985

		Percent of Organisms Killed			
		Conventional Screens		Ristroph Screens	
Scientific Name	Common Name	Ambient (immediate)	Heated (latent)	Ambient (immediate)	Heated (latent)
Anchoa mitchilli	bay anchovy	96	99	81	96
Brevoortia tyrannus	Atlantic menhaden	73	86	NA[(a)]	NA
Callinectes sapidus	blue crab	12	13	NA	NA
Crangon septemspinosa	sand shrimp	14	29	5	50
Menidia menidia	Atlantic silverside	41	48	20	33
Pseudopleuronectes americanus	winter flounder	4	4	7	23

(a) NA = data not available.
Source: Summers et al. 1989

Estimates of annual impingement losses were made at OCNGS from September 1975 to December 1985. According to Summers et al. (1989), the frequency of sampling and time of day when samples were collected changed appreciably over the 10-year period. For 9 of 10 years, samples were collected in an enlarged section of the sluiceway associated with the fish-return system by using a sampler with a 10.7-mm screen mesh. During the last year of the study, the fish-return system was modified so that the screen wash could be diverted into a holding pool. A sampler with a 6.4-mm screen mesh was used to collect previously impinged organisms (Summers et al. 1989). On the basis of the differences between the mesh size of the traveling screens (9.5 mm) and the mesh sizes of the sampling devices used (10.7 mm for 9 years, 6.4 mm for 1 year), Summers et al. (1989) concluded that impingement was underestimated for the first 9 years of the study and overestimated for the last year of the study.

Recent information provided by the NJDEP's Division of Fish and Wildlife in comments on the draft SEIS suggests that sampling gear mesh size and Ristroph screen size may have been equivalent to the existing mesh size at OCNGS except for the last study year, when the sampling gear mesh size was 6.4 mm. Difference in gear mesh size during the first 9 years may have been due to the way the screen size was measured (e.g., whether or not the wire adjacent to the opening was included in the measurement). Because the NRC staff cannot determine the actual size of the sampling gear mesh during the first 9 years, the conclusions of

Summers et al. (1989) are assumed to be correct and represent a conservative, environmentally protective approach.

Based on the Summers et al. (1989) review of the demonstration study (EA 1986), it appears that there were significant uncertainties associated with the estimated number of impinged organisms, the impingement survivability for all impinged species, and the overall efficiency of the equipment used to capture the impinged organisms. The main findings of the Summers et al. (1989) review are as follows:

- The mesh size of the impingement sampling equipment (10.7 mm for nine study years; 6.4 mm for one study year) did not match the mesh size used in the conventional or Ristroph screens (9.5 mm). This suggests that actual impingement abundances could be either under- or overestimated.

- The demonstration study assumed 100 percent intake screen collection efficiency, even though no collection efficiency studies were conducted on the vertical traveling screens, and the collection efficiency in the study conducted on the Ristroph screens in 1985 ranged from 53 to 90 percent in May and November testing months, respectively.

- The Ristroph screen collection efficiency study conducted in 1985 evaluated only one species, Atlantic silverside (*Menidia menidia*), and the design involved releasing preserved, fin-clipped specimens in front of the intake screens and recollection in screen wash samples for 30 min.

Summers et al. (1989) estimates for average annual impingement loss based on the survivability in heated water and a 53-percent screen collection efficiency (worst case-scenario) are presented in Table 4-5. These estimates are for the current Ristroph screen configuration at OCNGS and have omitted the 1982-to-1983 data because an extended plant outage occurred at that time. The largest average annual impingement losses are associated with sand shrimp, with an average annual loss of 8,023,555 individuals. The large standard error associated with this estimate probably reflects the high degree of variability in impingement data, seasonal trends, and/or the influence of other environmental factors. The average annual impingement losses of bay anchovy and blue crab each exceed 250,000 individuals, and the mean annual impingement loss of Atlantic silversides is estimated to be 122,769 individuals. Average annual impingement losses of winter flounder and Atlantic menhaden are approximately equal and were slightly less than 14,000 individuals each.

The NRC staff evaluated three assessments concerning the potential impact of impingement at OCNGS for ecologically, recreationally, or commercially important fish and shellfish species: (1) the conclusions of the 316(a) and 316(b) demonstration presented in EA (1986), (2) the conclusions based on Versar's review of the EA study (Summers et al. 1989), and (3) the conclusions and recommendations provided in the NJDEP fact sheet (NJDEP 2005) regarding the renewal of the OCNGS NJPDES permit. The NRC staff also compared its assessment of impacts with the conclusions stated in Kennish (2001), because the author also reviewed the 316(a) and 316(b) demonstration data. A summary of the conclusions associated with impingement impacts follows.

Table 4-5. Average Annual Impingement Loss at OCNGS

		Number of Organisms Impinged[a]	
Scientific Name	**Common Name**	**Mean**	**Standard Error**
Anchoa mitchilli	bay anchovy	253,567	62,490
Brevoortia tyrannus	Atlantic menhaden	13,964	3,472
Callinectes sapidus	blue crab	276,361	112,604
Crangon septemspinosa	sand shrimp	8,023,556	4,292,019
Menidia menidia	Atlantic silverside	122,769	47,203
Pseudopleuronectes americanus	winter flounder	13,378	3,952

(a) Data from 1980 to 1985; 1982 and 1983 data not available. Based on mortality rate for heated water and 53 percent screen collection efficiency.
Source: Summers et al. 1989

On the basis of the results of impingement monitoring conducted during the demonstration study, the species experiencing the largest losses due to impingement are the bay anchovy, sand shrimp, and blue crab (EA 1986). In assessing impingement impacts on these species, EA (1986) compared the estimated number impinged with population estimates for Barnegat Bay that were developed during the demonstration study. For the bay anchovy, EA concluded that the impingement losses of bay anchovy at OCNGS represented between 2 and 10 percent of the estimated population of Barnegat Bay. EA also noted that population estimates associated with trawl studies generally result in high variability, given the distribution of the fish in the water column, and suggested that the actual populations of bay anchovy are much higher than the trawl-derived estimates. EA (1986) concluded that “no evidence exists that the population of this species in Barnegat Bay has decreased substantially because of the operation of the OCNGS.” Similar conclusions were reached for impingement impacts on sand shrimp and blue crab. EA estimated that sand shrimp losses associated with impingement represented approximately 1.5 percent of the estimated population in Barnegat Bay (Good Luck Point to Gulf Point), and that operation of the plant did not harm the community that existed at that time. Blue crab losses to impingement at OCNGS in July 1976 represented approximately 3.5 percent of the estimated population in Barnegat Bay at that time, and losses in August 1977 represented less than 1 percent of the estimated bay population. EA concluded that these losses did not harm the blue crab population or fishery because commercial landings had not decreased since OCNGS began operation, and the population structure of the species during the study period was similar to Great Bay, an estuary south of Barnegat Bay that is not influenced by OCNGS.

Summers et al. (1989) stated that the impingement estimates were probably underestimated for 9 years and overestimated for the last study year. Despite these concerns, Summers et al. (1989) concluded that “continued operation of the Oyster Creek NGS at the estimated levels of losses to representative important species populations, without modification to intake structures and/or operating practices, does not threaten the protection and propagation of balanced, indigenous populations.”

The Summers et al. (1989) assessment was based on population and ecosystem modeling (equivalent adult model, production foregone model, and spawning/nursery area of consequence model) to determine the environmental consequences of impingement and entrainment. The results of these models evaluate the combined losses associated with both impingement and entrainment. Using conservative assumptions to estimate OCNGS impingement and entrainment losses, data available on population sizes, and survival rates and trophic relationships, Summers et al. (1989) concluded that population losses were rapidly compensated for by reproduction (e.g., sand shrimp), were a small fraction of the bay population (e.g., blue crab and winter flounder), or had little effect on higher trophic levels (e.g., bay anchovy and opossum shrimp).

After reviewing the 316(b) demonstration study data, Kennish (2001) reached a similar conclusion to Summers et al. (1989), stating “population surveys of fishes and macroinvertebrates indicate that the standing crop lost through impingement was <10 percent for species in central Barnegat Bay. No evidence exists that losses of organisms through impingement on the intake screens have had a discernible effect on invertebrate and fish communities in the bay.”

Although the NJDEP (2005) acknowledged the Summers et al. (1989) conclusion that OCNGS did not appear to produce “unacceptable, substantial long-term population and ecosystem level impacts,” the agency stated that it is not necessary to prove that an impact on a population is occurring to require the applicant to meet Section 316(b) national performance standards. The NJDEP goes on to state that “this rationale is consistent with the Phase II regulations which specify compliance alternatives, including national performance standards, and do not define adverse environmental impact.” The impingement standard in the EPA’s Phase II regulations requires that impingement mortality for all life stages of fish and shellfish be reduced by 80 to 95 percent from a calculated baseline.

In September 2005, after discussions and approval by the NJDEP, the applicant began an intake sampling program for impingement as part of an effort to demonstrate compliance with the new regulations. Based on the results of this and other studies, the state of New Jersey may require additional mitigation measures, such as the installation of cooling towers or restoration, to reduce or offset impingement. Preliminary impingement data collected by the applicant suggest that the species composition and relative numbers of organisms impinged at OCNGS are similar to those observed during the earlier 316(b) demonstration study. However, because of the high variability associated with the original 316(b) data and the current information, it is not possible with the data currently available to determine if impingement has changed significantly since the original study was conducted. Because a bay-wide assessment was not included in the current study design, there are no current population data available for ecologically, recreationally, or commercially important fish or shellfish that would be necessary for a bay-wide assessment of impact to fish and shellfish populations.

On the basis of the review of the original 316(b) study, the NRC staff has concluded that the operation of OCNGS has resulted in a localized impingement related impact at near-field locations that include Forked River, Oyster Creek, and adjacent portions of Barnegat Bay. This determination is consistent with Section 4.2.1.2.1 of the GEIS, which determined that these impacts are unavoidable for plants utilizing a once-through cooling system design. Unlike entrainment, impingement survival is variable and appears to be species-specific.

Based on mortality evaluations conducted during the 316(b) study, the bay anchovy exhibits the lowest impingement survival (1 to 19 percent), and the winter flounder exhibits the highest impingement survival (77 to 96 percent). The 316(b) impingement mortality study included only a few representative important species, and, thus, provides an incomplete picture of overall impingement survival.

Because of a lack of recent monitoring data on fish and shellfish populations in Barnegat Bay, it is not possible at this time to determine whether the composition and abundance of representative important species have significantly changed since the 1980s. Sufficient impingement data associated with the ongoing Phase II demonstration study are not yet available for review, and an assessment of representative important species populations in central Barnegat Bay was not included in the Phase II study design. The NRC staff concludes that if the composition and abundance of species in Barnegat Bay are similar to those observed in the 1970s and 1980s, the impact of impingement related to OCNGS operations would likely continue to be SMALL because the basic operation of the OCNGS cooling system has not changed significantly since the original 316(b) study. If, however, the composition or abundance of species has been noticeably altered by changes in natural and other anthropogenic stressors in central Barnegat Bay relative to those in the 1970s and 1980s, the incremental impacts due to impingement associated with OCNGS could be MODERATE. The impact is not considered large because there are no indications that fish populations in the bay are destabilized.

Because recent population data are not available, the NRC staff cannot arrive at a definitive conclusion concerning the current impact of impingement associated with OCNGS. The staff recommends that additional environmental monitoring studies be conducted in the bay by the appropriate resource agencies, universities, or non-governmental organizations to determine if changes in abundance or population structure of representative important species have occurred during the past three decades and to establish a baseline reflective of current conditions. The NRC staff further recommends that the experimental designs for these studies reflect the need to evaluate both anthropogenic and natural stressors present in Barnegat Bay at spatial and temporal scales sufficient to address the inherent variability within the system. Integrated monitoring studies will enable resource managers to better understand the relative contribution of individual or collective environmental stressors on Barnegat Bay, and enable prioritization of management actions designed to reduce the overall impact on the ecosystem. Regardless of the NRC's determination of impacts, compliance with the EPA's Phase II regulations may require modifications to the facility's cooling system or the implementation of restoration measures.

During the preparation of this SEIS, the NRC staff considered mitigation measures to reduce impingement losses at OCNGS during the license renewal period. The mitigation measures are discussed in the staff's evaluation of alternatives to the existing station cooling system. That analysis is presented in Section 8.1 of this SEIS.

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 for license renewal. Impacts on fish and shellfish resources resulting from heat shock are 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 and (2) evidence of a CWA Section 316(a) variance or equivalent State documentation. To perform this evaluation, the NRC staff reviewed the AmerGen ER (2005a); visited the OCNGS site; reviewed the facility's 316(a) demonstration study (EA 1986); reviewed Versar's evaluation of the 316(a) demonstration (Summers et al. 1989); reviewed the applicant's existing NJPDES permit for OCNGS; reviewed the proposed NJDEP draft permit and accompanying NJDEP fact sheet (NJDEP 2005); and reviewed public comments on the draft SEIS. The fact sheet describes the principal facts and the significant legal and policy issues considered by the NJDEP during the preparation of the draft permit that will govern activities at OCNGS until the permit expires on April 30, 2009. As of the date of publication of this Final SEIS, the NJDEP has not issued a final NJPDES Permit for OCNGS. Although 316(a) demonstration data presented in EA (1986) were reviewed, the staff's emphasis was placed on the Versar and NJDEP analyses and conclusions because they directly relate to NJPDES permit issues.

During the 316(a) demonstration study conducted between 1969 and 1976, four types of analyses were conducted to determine the thermal impacts associated with the OCNGS cooling-water discharge: (1) dye studies to define the circulation patterns in Barnegat Bay and to estimate the potential dimensions and characteristics of the thermal plume; (2) thermal plume studies that included the use of towed thermistors and infrared thermographic overflights with a ground-truth component; (3) recirculation studies that involved the measurement of water temperature at the mouth of Forked River and consideration of meteorological and plant-related activities to determine the extent of heated water circulation back into the OCNGS system after its release into Barnegat Bay; and (4) hydrothermal modeling. All of these studies were required to fully understand the dynamics of the thermal plume and to determine whether OCNGS operations complied with NJDEP discharge requirements.

The NJDEP fact sheet (NJDEP 2005) identified the following thermal surface-water quality standards applicable to Barnegat Bay, Forked River, and Oyster Creek:

- Ambient water temperatures in the receiving waters shall not be raised by more than 2.2°C (4°F) from September through May, nor more than 0.8°C (1.5°F) from June through August, nor cause temperature to exceed 29.4°C (85°F), except in designated heat dissipation areas.

- Heat dissipation in streams (including saline estuarine waters) shall not exceed one-quarter of the cross section and/or volume of the water body at any time; nor more than two-thirds of the surface from shore to shore at any time.

The fact sheet concludes that the heat dissipation areas ". . . may be exceeded by special permission, or on a case-by-case basis, when a discharger can demonstrate that a larger heat dissipation area meets the tests for a waiver under Section 316 of the Federal Clean Water Act."

The results of the dye studies conducted as part of the 316(a) demonstration showed that circulation in Barnegat Bay is primarily driven by wind, and in five of six surveys, there was a potential for recirculation of the discharge water from Oyster Creek back to the mouth of Forked River.

In their review of the 316(a) thermal plume demonstration studies, Summers et al. (1989) identified several study design concerns (primarily related to the estimation of ambient temperature) that influenced the results presented in EA (1986). The primary concern was the placement of an ambient water temperature station at the mouth of Forked River. Summers et al. (1989) believed that a temperature monitoring station at this location would potentially be influenced by the heated water circulation patterns identified in the dye studies and would result in a "potentially serious" underestimation of the 4°F and 1.5°F thermal plumes. They concluded that the 316(a) demonstration did not correctly assess the true ambient temperature of Barnegat Bay, and thus, the use of water temperature monitoring cannot identify the true extent of the 4°F and 1.5°F plumes (Summers et al. 1989). The Summers et al. (1989) review suggested that of the two methods used (towed thermistors and low-altitude overflights), the overflight procedure represented the best technology for measuring temperature in Barnegat Bay. The results of the overflights demonstrated that the thermal plume extent and width often violated State surface-water quality standards, thereby requiring a thermal variance as described in the 1994 NJPDES permit.

The 316(a) demonstration study (EA 1986) estimated the recirculation of heated water by monitoring Forked River intake for 23 days and comparing the intake temperature time series with a time series of power production from OCNGS; air temperature in Newark, New Jersey; and the southerly wind component. The conclusion in the demonstration study was that the potential for recirculation was small. Summers et al. (1989) disagreed with this assessment, pointing out that the required data to understand fully the complex interactions among water temperature, air temperature, and other factors were not available, and that the results of the EA (1986) analyses contradict the dye study results.

Summers et al. (1989) also were critical of the hydrodynamic modeling conducted to support the 316(a) demonstration and concluded that the two-dimensional steady-state mass and heat balance model used ". . . was a poor reflection of the dynamic conditions characterizing Barnegat Bay" and that ". . . the modeling regime chosen does not represent the best available methods for evaluating plume characteristics."

The NRC staff's conclusion is that the analysis conducted by Summers et al. (1989) provided the most realistic and complete description of thermal impacts associated with OCNGS and was taken into account during the NJDEP's development of the draft NJPDES permit.

Failure of the dilution pump system resulted in a number of heat-shock-related fish kills at OCNGS. However, the frequency and magnitude of the fish kills due to heat shock have declined noticeably since OCNGS operation began in 1969. The OCNGS fish kill monitoring procedure requires a survey of the discharge canal and parts of Oyster Creek; the survey is conducted on foot or by boat using dip nets to retrieve stressed and dead fish (AmerGen 2002a). In the past, underwater cameras and scuba divers have been used to observe the extent of fish kills. Such observations have not indicated that there were many expired fish at or near the bottom of the discharge canal or Oyster Creek. Fish kill information for 1999 to 2004 documented in OCNGS Annual Environmental Monitoring Reports (GPU Nuclear, Inc. 2000; AmerGen 2001a, 2002b, 2003a, 2004a, 2005b) shows that only one heat-shock-related event was documented in this time period. On September 23, 2002, 5876 fish were killed, of which 75 percent were striped bass, Atlantic menhaden, and white perch (*Morone americana*). Mortality was attributed to heat shock because of accidental shutdown of the dilution pumps during a routine electrical maintenance procedure. During that event, the water temperature in the discharge canal at the U.S. Highway 9 bridge rose from approximately 91 to 101°F within 3 hours of pump shutdown; the temperature at this location remained at 100°F for several hours until the dilution pump operation was restored (AmerGen 2003a). The 2002 event was considered a permit violation, and the required notifications were made to the NRC and the NJDEP. Following this incident, an Administrative Order and Notice of Civil Administrative Penalty Assessment were issued to AmerGen citing the permit violation and the natural resource damage resulting from this violation (AmerGen 2003a).

On the basis of their review of the 316(a) demonstration study presented in EA (1986), Summers et al. (1989) concluded that OCNGS did not comply with the NJDEP's Surface Water Quality Standards for thermal discharges, but noted that the discharge effects were localized and small and did not result in adverse impacts on Barnegat Bay. In response, the NJDEP granted OCNGS a variance to thermal discharge requirements. In the 2005 fact sheet accompanying the draft permit, the NJDEP noted that in the June 30, 1994, draft renewal permit, the department had concluded that the existing thermal limitations and operating requirements met the 316(a) criteria based on the results of the OCNGS demonstration study (NJDEP 2005). However, the following conditions required in the 1994 permit also apply during the renewal period:

- OCNGS is required to continuously monitor the temperature of Oyster Creek at the U.S. Highway 9 bridge. A maximum water temperature of 97°F at a level of 4 ft below the water surface is permitted at this location.

- OCNGS is allowed to increase its heat load, effluent temperature, and delta-T (change in temperature) limitations at outfall DSN001A (Oyster Creek discharge canal) during a Maximum Emergency Generation Event following a procedure described in the NJDEP's fact sheet (2005).

On the basis of a review of available information, including that provided by the applicant during the site visit, the Summers et al. (1989) report, the NJDEP fact sheet (NJDEP 2005), and the 316(a) demonstration study presented in EA (1986), the NRC staff concludes that the impacts of thermal releases would be SMALL and would be confined to near-field areas, including the discharge canal, Oyster Creek, and adjacent portions of Barnegat Bay.

During the preparation of this SEIS, the NRC staff considered mitigation measures to reduce heat shock losses at OCNGS during the license renewal period. The mitigation measures are discussed in the staff's evaluation of alternatives to the existing station cooling system. That analysis is presented in Section 8.1 of this SEIS.

4.2 Transmission Lines

The Final Environmental Statement (FES) for OCNGS (AEC 1974) describes one transmission line that connects OCNGS with the regional electric grid. That line, the 230-kV OCNGS-to-Manitou line is 11.1 mi long and runs north of the OCNGS substation and generally parallel to the Garden State Parkway. The northern phase of a second 230-kilovolt (kV) transmission line was recently completed from the OCNGS substation to the Cedar substation in Ocean County. The line is owned by Atlantic City Electric (formerly Conectiv), a mid-Atlantic electric distribution company. The line is not considered within the scope of license renewal because it was not constructed for the specific purpose of connecting the station to the grid at the time of initial station licensing.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to the within-scope transmission line from OCNGS are listed in Table 4-6. AmerGen stated in its ER (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the NRC staff concluded in the GEIS that the impacts would be SMALL and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to be warranted.

Table 4-6. Category 1 Issues Applicable to the OCNGS Transmission Line 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, and livestock)	4.5.6.3
Floodplains and wetlands 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 NRC staff's review and GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, for each of these issues follows:

- 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS) and the NJDEP Endangered and Nongame Species Program, evaluation of other information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, consultation with the FWS and the NJDEP Endangered and Nongame Species Program, evaluation of other information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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, and 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Floodplains 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, consultation with the FWS and the NJDEP Endangered and Nongame Species Program, evaluation of other information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of power line rights-of-way on floodplains 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 rights-of-way would continue with no change in restrictions. The effects of these restrictions are of small significance.

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

There are two issues related to the transmission line that are listed in Table 4-7 and discussed in Sections 4.2.1 and 4.2.2.

Table 4-7. Category 2 and Uncategorized Issues Applicable to the OCNGS Transmission Line During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR Part 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[a]	4.2.2

(a) NA = not addressed.

4.2.1 Electromagnetic Fields – Acute Effects

Based on the GEIS, the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been found to be a problem at most operating plants and generally is not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this SEIS.

In the GEIS (NRC 1996), the NRC staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) criteria (IEEE 2002), it was not possible to determine the significance of the electric shock potential. 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 impact of the proposed action on the potential shock hazard from the transmission lines 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.

OCNGS is connected to the grid by two transmission lines, the OCNGS-to-Manitou line and the OCNGS-to-Cedar line. Only the OCNGS-to-Manitou line is within the scope of the license renewal review and is discussed below. AmerGen performed field measurements to support its assertion that the OCNGS-to-Manitou 230-kV transmission line is in compliance with the NESC 5-milliampere (mA), electric-field-induced current limit. Field measurements demonstrate that the electric-field-induced current from this transmission line is below the NESC recommendations for preventing electric shock from induced currents (AmerGen 2005a). Additionally, AmerGen calculated the electric field strength and induced current at locations where the potential for induced shock would be the greatest. These calculations determined that there are no locations under the transmission line that have the capacity to induce more than a 5-mA current inside a vehicle parked beneath the line.

The NRC staff has reviewed the available information, including that obtained from the applicant, the site visit, the scoping process, and other public sources. Using this information, the NRC staff evaluated the potential impacts for electric shock resulting from operation of OCNGS and its associated transmission line. It is the NRC staff's conclusion that the potential impacts from electric shock during the renewal term would be SMALL, and that no additional mitigation measures are warranted.

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 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 (DOE). A NIEHS 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 NRC staff to change its position with respect to the chronic effects of electromagnetic fields. Footnote 4 to Table B-1 states: "If in the future, the

Commission finds that, contrary to current indications, a consensus has been reached by appropriate Federal health agencies that there are adverse health effects from electromagnetic fields, the Commission will require applicants to submit plant-specific reviews of those health effects as part of their license renewal applications. Until such time, applicants for license renewal are not required to submit information on this issue." The NRC staff considers the GEIS finding of "Uncertain" 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 OCNGS in regard to radiological impacts are listed in Table 4-8. AmerGen stated in its ER (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant information during its independent review of the ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For these issues,

Table 4-8. 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

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

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

- <u>Radiation exposures to the public (license renewal term)</u>. 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be 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 4-9. AmerGen stated in its ER (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For these issues, the NRC staff concluded in the GEIS that the impacts would be SMALL, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to be warranted.

A brief description of the NRC 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 on public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

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

Table 4-9. 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

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

  Only impacts of small significance are expected.

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

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

  No significant impacts are expected during the license renewal term.

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

Table 4-10 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS.

4.4.1 Housing Impacts During Operations

In determining 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 20 mi of the site, and proximity measures population density and city size within 50 mi. Each factor has categories of density and size (GEIS Table C.1), and a matrix is used to rank the population category as low, medium, or high (GEIS Figure C.1).

Table 4-10. 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 NRC staff's SEIS.

In 2000, 434,476 people were living within 20 mi of OCNGS, for a density of 610 persons/mi^2. This density translates to Category 4 (least sparse), using the GEIS measure of sparseness (AmerGen 2005a). At the same time, 4,243,462 persons were living within 50-mi of the plant, for a density of 1132 persons/mi^2. The NRC proximity matrix assigns a Category 4 rating (in close proximity) for this measure as well. The combined spareness and proximity categories indicate a “high population area.” Although there are no growth controls that would limit housing development in this area, planning goals and objectives at the county and township level encourage balanced residential and commercial development (see Section 2.2.8.3).

10 CFR Part 51, Subpart A, Appendix B, Table B-1, states that impacts on housing availability are expected to be of small significance at plants located in a high population area where growth-control measures are not in effect. The OCNGS site is located in a high population area, and Ocean County is not subject to growth-control measures that would limit housing development. Based on the NRC criteria, AmerGen expects housing impacts to be small during the license renewal period (AmerGen2005a).

Small impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). The AmerGen ER assumes that an additional staff of 60 permanent workers might be needed during the license renewal period to perform routine maintenance and other activities.

The housing vacancy rate in 2000 was 19.4 percent in Ocean County (USCB 2005a). If these vacancy rates continue, small increases in the number of workers required at the plant would not require any new housing construction.

The NRC staff reviewed the available information relative to housing impacts and AmerGen’s conclusions. Based on this review, the NRC staff concludes that the impact on housing during the license renewal period would be SMALL, and additional mitigation is not warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand, and thus there is no need to add new facilities or infrastructure. Impacts are considered MODERATE if overtaxing of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service (e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. The GEIS indicates that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies (NRC 1996).

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the OCNGS-permitted withdrawal rate and actual use of water.

The NRC staff has reviewed the available information, including permitted and actual water-use rates at OCNGS, and water-use and water supply capacities for the major water supply systems in Ocean County. Based on this information, the NRC staff concludes that the potential impacts of OCNGS operation during the license renewal period would be SMALL. During the course of its evaluation, the NRC staff considered mitigation measures for continued operation of OCNGS. Based on this evaluation, the NRC staff determined that mitigation measures in place at OCNGS are appropriate, and that no additional mitigation measures are warranted.

4.4.3 Offsite Land Use During Operations

Offsite land use during the license renewal term is a Category 2 issue (10 CFR Part 51, Subpart A, Appendix B, Table B-1). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, notes that “significant changes in land use may be associated with population and tax revenue changes resulting from license renewal.”

Section 4.7.4 of the GEIS defines the magnitude of land-use changes as a result of plant operation during the license renewal term as follows:

SMALL – Little new development and minimal changes to an area’s land-use pattern.

MODERATE – Considerable new development and some changes to the land-use pattern.

LARGE – Large-scale new development and major changes in the land-use pattern.

Tax revenue can affect land use because it enables local jurisdictions to provide the public services (e.g., transportation and utilities) necessary to support development. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven land-use impacts during the license renewal term should consider (1) the size of the plant’s payments relative to the community’s total revenues, (2) the nature of the community’s existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant’s tax payments are projected to be small relative to the community’s total revenue, tax-driven land-use changes during the plant’s license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction’s revenue, the significance level would be SMALL. If the plant’s tax payments are projected to be medium to large relative to the community’s total revenue, new tax-driven land-use changes would be MODERATE. If the plant’s tax payments are projected to be a dominant source of the community's total revenue, new tax-driven land-use changes would be LARGE. This would be especially true where the community has no pre-established pattern of development or has not provided adequate public services to support and guide development.

Lacey and Ocean Townships receive tax payments from AmerGen. AmerGen paid an average of $1.9 million annually in property taxes to Lacey Township over the 3-year period from 2002 to 2004, or approximately 4 percent of the township's revenues. Ocean Township received an average of $0.01 million annually from taxes paid by AmerGen over the same 3-year period. These payments represent a small, positive impact on the fiscal condition of the township.

Because no refurbishment or new construction activities are associated with the license renewal, no additional sources of plant-related tax payments are expected that could influence land use in the township or the county. The continued collection of property taxes from OCNGS will result in small indirect tax-driven land-use impacts through sewer and water system improvements and expansion, lower property taxes, and improved educational services and facilities. This source of revenue allows the township, school district, and county to keep tax rates below the levels they would otherwise have in order to fund the higher levels of public infrastructure and services, schools, and government services.

Ocean County's population growth rates over the last 30 years have been rapid (Table 2-10). AmerGen projects that 60 additional employees would be needed to support OCNGS operations during the license renewal term; thus, land-use changes from OCNGS population-related growth would be negligible. While the county has experienced significant residential, industrial, and commercial growth during this 30-year period, the importance of balanced residential and commercial development and the importance of environmental protection is reflected in the planning goals and objectives at the county (NRC 2006) and township level (Township of Lacey 1991).

AmerGen projects that annual property taxes from OCNGS to Lacey and Ocean Townships will remain relatively constant throughout the license renewal period. However, the New Jersey Public Service Commission is currently implementing electric utility restructuring legislation that was enacted in June 2000, and the impacts are not fully known at this time. Any changes to the OCNGS tax rates due to the restructuring would be independent of license renewal (AmerGen 2005a).

No adverse impacts on offsite land use would occur because of license renewal. Consequently, the NRC staff concludes that offsite land-use impacts would likely be SMALL, and additional mitigation is not warranted.

4.4.4 Public Services: Transportation Impacts During Operations

Table B-1, 10 CFR Part 51, states: "Transportation impacts (level of service) of highway traffic generated . . . during the term of the renewed license are generally expected to be of small significance. However, the increase in traffic associated with additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." All applicants are required by 10 CFR Part 51.53(c)(3)(ii)(J) to assess the impacts of highway traffic generated by the proposed project on the level of service of local highways during the term of the renewed license.

Given the small number of additional workers required during the renewal period, there would be no detectable impacts on the transportation network in the vicinity of the OCNGS site.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) requires that Federal agencies take into account the effects of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Renewal of an OL is an undertaking that could potentially affect historic properties. Therefore, according to the NHPA, the NRC is to make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office (SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

AmerGen contacted the New Jersey SHPO on October 7, 2004, regarding preparation of its application for license renewal (AmerGen 2005a). The SHPO responded on October 15, 2004, that license renewal will not impact historic and archaeological properties. The NRC contacted the SHPO and five Native American Tribes on October 12, 2005. A representative from the SHPO responded to the NRC on November 2, 2005, reiterating the conclusion of the previous letter to the applicant (October 15, 2004) and expressing the requirement for further consultation only if additional activities become part of license renewal.

The NRC staff conducted a site file search for the OCNGS property at the SHPO in Trenton, New Jersey, on October 13, 2005. Although, to date, no surveys have been conducted at the OCNGS site and the potential exists for cultural resources to be present within the site boundaries, it does not appear that the proposed license renewal would adversely affect cultural resources. The applicant has indicated that no refurbishment or replacement activities (including additional land-disturbing activities) at the plant site (or along the existing transmission line corridor) are planned for the license renewal period (AmerGen 2005a). Therefore, continued operation of OCNGS would likely protect any cultural resources present within the OCNGS site boundary by protecting those lands from development and providing secured access. However, because there is the potential for cultural resources to be present at the site and along the OCNGS-to-Manitou transmission line, the applicant should take care during normal operations and maintenance activities not to inadvertently affect cultural resources. To avoid such adverse impacts, any ground-disturbing activity in an undisturbed area should be preceded by an evaluation of cultural resources in consultation with the New Jersey SHPO and appropriate Native American Tribes as required under Section 106 of the NHPA. Environmental review procedures that include consultation are in place at OCNGS regarding undertakings that would disturb previously undisturbed soils or sediments at or below the surface in order to ensure the protection of cultural resources.

Based on this analysis of cultural resources, the NRC staff concludes that the impact of continued operation of the OCNGS during the license renewal period would be SMALL, and that further mitigation is not necessary.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy that requires that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its actions on minority[a] or low-income populations. The memorandum accompanying Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969 (NEPA). The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although the Executive Order is not mandatory for independent agencies, the NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues Rev. 1* (NRC 2004a). In 2004, the Commission issued a final *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* (NRC 2004b).

The scope of the review, as defined in NRC guidance (NRC 2004a), includes identification of impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and information pertaining to mitigation. It also includes evaluation of whether these impacts are likely to be disproportionately high and adverse.

(a) The NRC guidance for performing environmental justice reviews defines “minority” as American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; or Hispanic ethnicity. “Other” races and multiracial individuals may be considered as separate minorities (NRC 2004a).

The NRC staff looks for minority and low-income populations within a 50-mi radius of the site. For the NRC staff's review, a minority population exists in a census block group[(a)] if the percentage of each minority and aggregated minority category within the census block group exceeds the corresponding percentage of minorities in the State of which it is a part by 20 percentage points, or the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population exists if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the State of which it is a part by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent.

For the OCNGS review, the NRC staff examined the geographic distribution of minority and low-income populations within 50 mi of the site, employing data from the 2000 Census (USCB 2005b). The analysis was supplemented by field inquiries to the planning department and social service agencies in Ocean County.

Figures 4-1 and 4-2 show the geographic distribution of census block groups for the minority and low-income populations within 50 mi of the site, respectively. A number of block groups within Ocean County exceed the NRC thresholds defining minority; these are located in Lakewood Township to the north of OCNGS. Other block groups exceeding the thresholds within the 50-mi region are located in Philadelphia County, Pennsylvania, and Camden, Middlesex and Mercer Counties in New Jersey. Census block groups exceeding the thresholds defining a low-income population within Ocean County also are located in Lakewood Township. Block groups exceeding the thresholds for low-income within the 50-mi region are located in Philadelphia County, Pennsylvania, and Camden, Mercer, and Monmouth Counties in New Jersey.

With the locations of minority and low-income populations identified, the NRC staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Based on NRC staff guidance (NRC 2001), air, land, and water resources within about 50 mi of the OCNGS site were examined. Within that area, all of the potential environmental impacts were considered SMALL.

The pathways through which the environmental impacts associated with OCNGS license renewal can affect human populations are discussed in each topical section. The NRC staff evaluated whether minority and low-income populations could be disproportionately affected by

(a) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Census Bureau (USCB) collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance with USCB guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2005b).

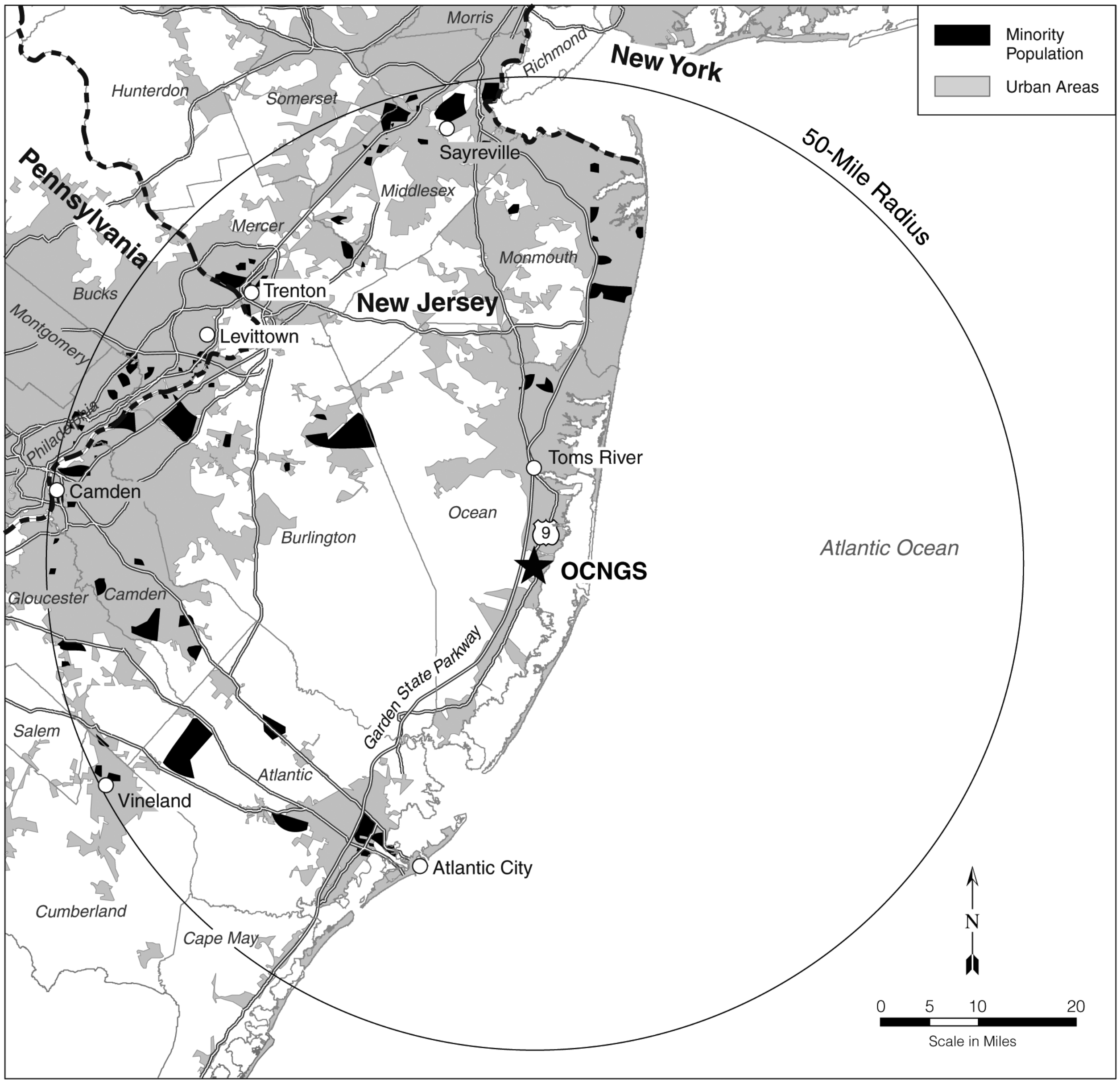

Figure 4-1. Geographic Distribution of Minority Populations Within 50 mi of the Oyster Creek Nuclear Generating Station Based on Census Block Group Data

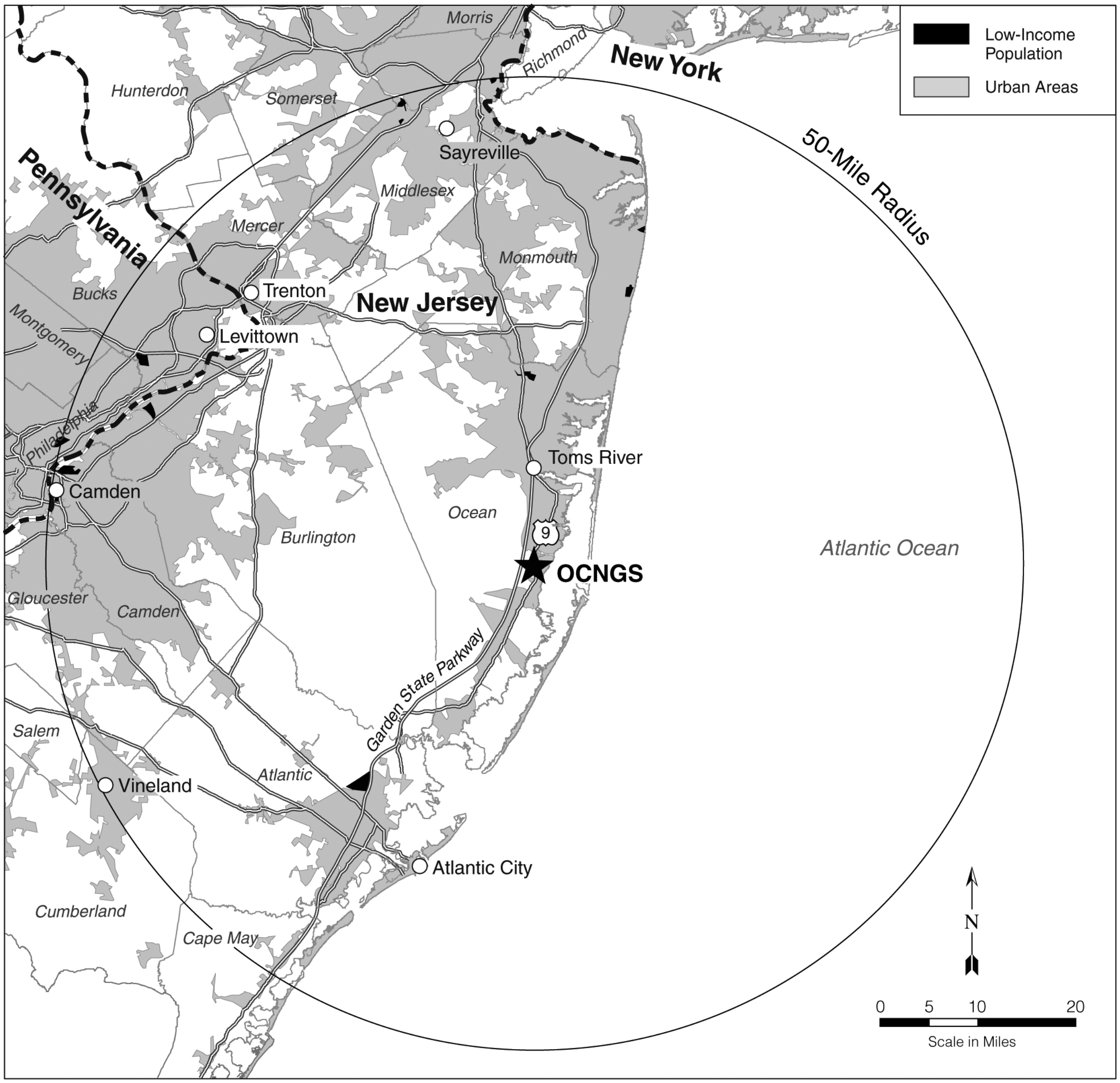

Figure 4-2. Geographic Distribution of Low-Income Populations Within 50 mi of the Oyster Creek Nuclear Generating Station Based on Census Block Group Data

these impacts. The NRC staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing that would be affected and, in turn, adversely affect minority and low-income populations. In addition, the NRC staff did not identify any location-dependent disproportionately high and adverse impacts affecting these minority and low-income populations. The NRC staff concludes that offsite impacts from OCNGS on minority and low-income populations would be SMALL, and no special mitigation actions are warranted.

4.5 Groundwater Use and Quality

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to OCNGS groundwater use and quality are listed in Table 4-11. AmerGen stated in its ER that it is not aware of any new and significant information associated with the renewal of the OCNGS OL (AmerGen 2005a). The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS.

Table 4-11. Category 1 Issues Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
GROUNDWATER USE AND QUALITY	
Groundwater-use conflicts (potable and service water; plants that use <100 gpm)	4.8.1.1
Groundwater quality degradation (saltwater intrusion)	4.8.2.1

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

A brief description of the NRC staff's review and the GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, follows.

- Groundwater-use conflicts (potable and service water; plants that use <100 gpm). Based on information in the GEIS, the Commission found that

  > Plants using less than 100 gpm are not expected to cause any groundwater-use conflicts.

  As discussed in Section 2.2.2, OCNGS groundwater use is less than 100 gpm. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no groundwater-use conflicts during the renewal term beyond those discussed in the GEIS.

- Groundwater-quality degradation (saltwater intrusion). Based on information in the GEIS, the Commission found that

  > Nuclear power plants do not contribute significantly to saltwater intrusion.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no groundwater-quality degradation impacts associated with saltwater intrusion during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to groundwater use and quality for OCNGS.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-12.

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they or their critical habitat would be adversely affected by continued operation of the nuclear plant during the license renewal term. The presence of threatened or endangered species or their critical habitat in the vicinity of the OCNGS site is discussed in Sections 2.2.5.5 and 2.2.6.2.

On October 12, 2005, the NRC contacted the FWS and the NMFS to request information on Federally listed threatened and endangered species and the impacts of license renewal (NRC 2005a,b). In response, on November 23, 2005, the FWS concluded that the proposed project would not adversely affect Federally listed species under the FWS's jurisdiction (FWS 2005). The NMFS concluded an Endangered Species Act (ESA) Section 7 consultation with the NRC in September 2005 regarding sea turtle impingement at OCNGS (NMFS 2005).

Additionally, on November 21, 2006, NMFS issued a Biological Opinion (BO) (NMFS 2006) for NRC's proposed action of license renewal of OCNGS. The 2006 BO, which includes an updated Incidental Take Statement, would take effect if the NRC renews the license for the OCNGS. In the interim, the September 22, 2005, BO will be in force.

4.6.1 Aquatic Species

Aquatic species that are Federally listed as threatened or endangered and that occur in the vicinity of OCNGS or the OCNGS-to-Manitou transmission line are limited to five species of sea turtles. These species include the loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and green (*Chelonia mydas*) sea turtles. There are no Federally listed fish or marine mammal species, nor are there any Federally designated critical habitats in the project area.

Table 4-12. Category 2 Issue Applicable to Threatened or Endangered Species During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR Part 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

The primary impact of OCNGS operations on listed sea turtle species is impingement on the trash racks associated with the once-through cooling system. OCNGS is required to notify the NRC and the NMFS of any captures of a sea turtle associated with OCNGS operations. Most impinged turtles at OCNGS are found on the trash racks associated with either the circulating-water or dilution-water intake systems. In many cases, the dead sea turtles captured at OCNGS appeared to have died elsewhere; in some cases, dead sea turtles exhibited wounds consistent with injuries from small boat propellers.

Standardized protocols have been developed in conjunction with the NMFS to ensure that turtles are safely removed from the intakes, evaluated to determine whether they are alive or dead, identified to determine species and life stage, and examined for boat propeller wounds or other trauma. Because of the increase in sea turtle impingement from 1991 to 1993, trash rack monitoring was increased in 1994 from once to twice per 8-hour shift during the period June 1 to October 1. This schedule is currently employed at OCNGS. If recovered turtles are comatose or appear dead, resuscitation is attempted. If resuscitation is unsuccessful, the turtle is necropsied. Past difficulties in the preparation, storage, and shipping of turtles for necropsy have resulted in the loss of important data concerning the cause of death. The inability to determine the cause of death is due to the freezing rather than the refrigeration of recovered dead turtles. After August 14, 2001, OCNGS procedures were modified to require refrigeration.

When a live turtle is captured, the turtles are taken to the Marine Mammal Stranding Center (MMSC) in Brigantine, New Jersey, by OCNGS Environmental Affairs Department personnel. MMSC determines if, when, and where the captured turtle can be released to the wild, and makes the necessary arrangements. The details of each sea turtle capture are provided in Annual Environmental Operating Reports that OCNGS submits to the NRC.

Sea turtle capture and mortality data at OCNGS from 1969 to 2006 are summarized in Table 4-13. No sea turtle captures were reported at the OCNGS circulating-water or dilution-water intakes from 1969 to 1991, and no captures of leatherback or hawksbill sea turtles have been reported since the plant began operating. Beginning in 1992, loggerhead and Kemp's ridley sea turtle captures began to occur at OCNGS. Green sea turtle captures began in 1999 (Table 4-13). Since 1992, 40 sea turtles have been captured, including 8 loggerhead sea turtles (6 alive, 2 dead), 28 Kemp's ridley (16 alive, 12 dead), and 4 green (3 alive, 1 dead). The reasons for the appearance of sea turtles at or near the intakes of OCNGS beginning in 1992 are unknown. One possible explanation is the increase in access to Barnegat Bay resulting from modifications to Barnegat Inlet by the U.S. Army Corps of Engineers that began in 1988, including the completion of a new alignment of the south jetty in 1991, and significant dredging and deepening of the Barnegat Inlet from 1991 to 1993 (NRC 2005c). It is also possible that the increased captures are related to an overall regional increase in sea turtle abundance based on stranding data from New Jersey coastal and estuarine waters.

The allowable incidental take[a] for listed sea turtles at OCNGS is determined by the NMFS. Because the NMFS-authorized incidental take limit was exceeded in 2004, the NRC initiated formal consultation with the NMFS to request a modification to the existing take limit. As part of the formal consultation, the NRC provided a Biological Assessment (BA) to the NOAA Fisheries Northeast Region on March 29, 2005 (NRC 2005c). This document provided a chronology of events leading to the initiation of consultation, a detailed description of Barnegat Bay, a description of OCNGS operations (including a description of the current water intake system), life-history information on sea turtle species that have been observed in Barnegat Bay or coastal New Jersey, and a detailed account of sea turtle occurrences at or near OCNGS. The NRC BA noted that no sea turtles had been impinged at OCNGS from 1969 to 1991, and that the increased impingements since that time may be related to (1) modifications to Barnegat Inlet that were completed in 1991 that increased the inlet depth, tidal exchange, and access for turtles, and (2) evidence that sea turtle population levels (particularly the Kemp's ridley) have been increasing rapidly over the past several years based on a review of academic journal articles and the proceedings of sea turtle workshops held in 1998 and 2000.

(a) Take is defined in ESA Section 9 as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct."

Table 4-13. Sea Turtles Impinged on Trash Racks at OCNGS, 1969 to 2006

	Number of Individual Turtles Impinged (no. live/no. dead)			
Year	**Loggerhead**	**Kemp's Ridley**	**Green**	**Totals**
1969 to 1991	0/0	0/0	0/0	0/0
1992	1/1	1/0	0/0	2/1
1993	0/0	0/1	0/0	0/1
1994	1/1	0/2	0/0	1/3
1995	0/0	0/0	0/0	0/0
1996	0/0	0/0	0/0	0/0
1997	0/0	0/1	0/0	0/1
1998	1/0	0/0	0/0	1/0
1999	0/0	1/0	0/1	1/1
2000	2/0	1/1	1/0	4/1
2001	0/0	0/2	1/0	1/2
2002	0/0	2/0	0/0	2/0
2003	0/0	1/0	1/0	2/0
2004	0/0	5/3	0/0	5/3
2005	0/0	1/1	0/0	1/1
2006	1/0	4/1	0/0	5/1
Totals	6/2	16/12	3/1	25/15

Sources: NRC 2005c; AmerGen 2006b,c,d

The NMFS reviewed the NRC BA and issued a new BO on September 22, 2005. This BO revised the incidental take limits as follows:

- The number of Kemp's ridley takes was increased from 5 total (2 lethal) to 8 total (4 lethal),
- The number of loggerhead takes was reduced from 5 total (2 lethal) to 2 total (1 lethal), and
- The number of green turtle takes was reduced from 2 total (1 lethal) to 1 total (1 lethal).

In the BO, the NMFS stated that "NMFS expects NRC to implement the reasonable and prudent measures and terms and conditions as outlined in the ITS (incidental take statement). The measures of the ITS are non-discretionary and must be undertaken by NRC for the incidental take exemption to apply."

OCNGS currently operates under the restrictions of the 2005 BO. The 2006 BO (NMFS 2006) would be in effect if the NRC renews the OCNGS license. In the 2006 BO, NMFS concluded that continued OCNGS operation "may adversely affect but is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley or green sea turtles" and that it is not likely to appreciably reduce the likelihood of survival and recovery of loggerhead, green, or Kemp's ridley sea turtles. The 2006 BO has revised incidental take limits:

- No more than 8 (3 lethal) sea turtles may be taken,

- Of the 8 allowable incidental takes, no more than 3 (1 lethal) can be a loggerhead turtle, and

- Of the 8 allowable incidental takes, no more than 1 (1 lethal) can be a green turtle.

If the NRC renews the OCNGS license, the renewed license would include requirements consistent with the ITS in the 2006 BO. On the basis of the above, the NRC staff concludes that the impact of OCNGS operations during the license renewal period would be SMALL for all species of sea turtles. Additional mitigation measures beyond those required in the ITS would not be warranted.

4.6.2 Terrestrial Species

The FWS (2005) stated that, except for an occasional transient bald eagle (*Haliaeetus leucocephalus*), no other Federally listed or proposed threatened or endangered species or critical habitat under FWS jurisdiction are known to occur within the OCNGS affected area, and that the proposed project would not adversely affect Federally listed species or critical habitat under FWS jurisdiction (FWS 2005).

Bald eagles in New Jersey are mostly associated with the Delaware River and Bay and rivers that flow into the Atlantic Ocean and Delaware Bay (NJDEP 2004). However, the bald eagle is an occasional transient near the project area, and it is possible that a pair could nest on or adjacent to the OCNGS site during the license renewal period (FWS 2005). It would be expected that any bald eagle activity near OCNGS would be centered within Barnegat Bay, rather than more inland where the OCNGS-to-Manitou transmission line right-of-way is located. Transmission lines pose a potential collision hazard to migrant and resident bird species, including those that are Federally listed such as the bald eagle. In the GEIS, the NRC assessed the impacts of transmission lines on avian populations (NRC 1996). The NRC concluded that mortality resulting from bird collisions with transmission lines associated with an additional 20 years of operation would be of SMALL significance. This conclusion was based on (1) no indication in the existing literature that collision mortality is high enough to result in population-level impacts, and (2) the lack of known instances where nuclear power plant lines affect large numbers of individuals in local areas. See Section 4.2 of this SEIS for a related discussion of this topic. Continued operation of OCNGS and operation and maintenance of the OCNGS-to-Manitou transmission line during the license renewal period are not likely to adversely affect the bald eagle.

Therefore, the NRC staff concludes that the impact on threatened or endangered terrestrial species of an additional 20 years of operation of OCNGS and the OCNGS-to-Manitou transmission line would be SMALL and mitigation is not warranted.

4.7 Evaluation of New and Potentially Significant Information on Impacts of Operations During the Renewal Term

The NRC staff reviewed the discussion of environmental impacts in the GEIS and conducted its own independent review (including comments received during the scoping period) to identify new and significant information on environmental issues listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation of OCNGS during the renewal term. Processes for identification and evaluation of new information are described in Section 1.2.2. Several issues were raised during scoping that are examined here to determine whether they represent new and significant information.

An emergency fire pond was built during the original construction of the OCNGS facility. This 8.5-ac pond was created by impounding Oyster Creek upstream of the discharge canal to provide water for fighting fires at the facility. In its scoping comments, the FWS noted that “it appears that Oyster Creek was a functioning waterway capable of supporting fish passage and possibly spawning habitat. Oyster Creek has the potential to offset expected adverse impacts from the proposed license renewal via the construction of a fish ladder” (FWS 2005). The existing dam may form a barrier to migratory anadromous or catadromous species such as the American shad (*Alosa sapidissima*) or the American eel (*Anguilla rostrata*); however, there is no evidence to suggest that shad are currently using the creek as a spawning or nursery area. The American eel was reported as present in Oyster Creek and Forked River in the FESs for Forked River Nuclear Station Unit 1 (AEC 1973) and for OCNGS (AEC 1974). However, the fire pond dam would not hinder upstream migration of elvers. American shad, considered a coolwater migrant of Barnegat Bay (Tatham et al. 1984), was not reported as being present in either Oyster Creek or Forked River in either FES. An NJDEP review of anadromous fish spawning runs in New Jersey conducted in the late 1970s found no evidence of American shad spawning runs in Oyster Creek.

The upper reaches of Oyster Creek are currently relatively undeveloped and may represent an opportunity for the development of anadromous and catadromous fish runs. However, the NRC staff considers the issue of the presence of the fire pond dam and the potential blockage of fish passage outside of the scope of license renewal, because the existence of the pond is unaffected by the decision to renew the license. Additionally, although AmerGen maintains and operates the fire pond, it is on land owned by First Energy or its subsidiaries. The NRC staff considers it appropriate for the owners of the fire pond to work directly with the State and Federal agencies to evaluate the desirability of improving fish passage over the dam.

During the scoping period, a member of the public brought up the issue of sediment deposition patterns in Forked River and expressed concern that this deposition has resulted in navigation problems at some of the entrances to the finger canals along the river. The impacts associated with alteration of current patterns due to station operations were considered in the GEIS. Section 4.2.1.2.1 of the GEIS specifically discusses the operation of OCNGS with respect to the impacts associated with the alteration of flow in both Forked River and Oyster Creek. The GEIS states that substantial hydrological and water-quality changes in Forked River and Oyster Creek resulted in only minor effects in Barnegat Bay. Also according to the GEIS, "changes to current patterns are of small significance if they are localized near the intake and discharge of the power plant and do not alter water use or hydrology in the wider area." The NRC staff finds that the GEIS adequately addressed the issue of sediment transport and finds that no new and significant information exists to suggest that the conclusion in the GEIS is no longer valid. Although the GEIS found that the alteration of current patterns was of small significance for this specific facility, the fact remains that the shoaling at the mouth of the finger canals, that is quite possibly the result of station operations, is impeding recreational boating for people along the affected canals. Mitigation of this impact is beyond the scope of license renewal. The NRC staff recommends that the homeowners work with the applicant to resolve this issue.

4.8 Cumulative Impacts

The NRC staff considered potential cumulative impacts in its environmental analysis of operations of OCNGS. For the purposes of this analysis, past actions are those related to the resources at the time of the plant licensing and construction, present actions are those related to the resources at the time of current operation of the power plant, and future actions are considered to be those that are reasonably foreseeable through the end of plant operation, which would include the 20-year license renewal term. The geographic area over which past, present, and future actions would occur is dependent on the type of action considered and is described below for each impact area.

The impacts of the proposed action, as described in Sections 4.1 through 4.6, are combined with other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

4.8.1 Cumulative Impacts on Aquatic Resources

The geographic area considered for the analysis of the cumulative impacts on aquatic resources focused on Oyster Creek, Forked River, and central Barnegat Bay. There is limited industrial and urban development in other portions of the Oyster Creek and Forked River watersheds.

Large estuaries are influenced by a variety of factors that alter marine and estuarine food webs, species compositions, or distributions of species that are ecologically, commercially, or recreationally important. OCNGS is the largest point-source of pollution in the Barnegat Bay estuary. The NRC staff concurs with the general conclusions of the 316(a) and 316(b) studies conducted during the 1970s and 1980s that the impacts of OCNGS operations were localized and confined to near-field locations that included Oyster Creek, Forked River, and adjacent portions of Barnegat Bay. The aquatic resources at these locations are substantially influenced by the operation of the plant, and in some cases, wholly dependent on its continued operation. As previously discussed, the impact of plant operations on far-field locations (e.g., central Barnegat Bay) cannot be determined definitively at this time using existing information.

The 2005 State of the Estuary Report (BBNEP 2005) identified a variety of anthropogenic stressors to the Barnegat Bay estuary that were not associated with OCNGS. Degraded water quality has been attributed to nutrient loading associated with nearshore development and the presence of bacterial contamination from failed septic systems. Changes in ecosystem structure and function may be the result of many factors, including the loss of wetland and salt marsh areas due to dredging, filling, and nearshore development, and climatic changes that alter predator-prey relationships or species compositions. The emergence of harmful algal blooms contributes to declines in submerged aquatic vegetation (SAV), and both phenomena may be responses to nutrient loading and changes in estuary hydrodynamics related to dredging, channel improvement programs, and loss of coastal habitat due to diking and filling activities.

Expected changes to Forked River and Oyster Creek during the license renewal term include maintenance dredging associated with the intake and discharge canals to facilitate water flow. Maintenance dredging at OCNGS and dredging associated with local docks and marinas will continue to occur and contribute to cumulative impacts. Expected changes or modifications to Barnegat Bay include as-needed maintenance dredging of the Intracoastal Waterway and periodic dredging of Barnegat Inlet. Barnegat Bay is also expected to be impacted by continued urbanization and development, including the construction of new over-water or near-water structures, and an increase in dikes, bulkheading, and sheet pile walls. Expected future environmental impacts include the loss of sensitive habitat (e.g., salt marsh communities, SAV), continued nonpoint source impacts on the estuary from stormwater runoff and contaminated groundwater, increased eutrophication associated with nutrient inputs, and potential closures of beaches due to algal blooms or bacterial contamination. Runoff associated with U.S. Highway 9 and residences along Forked River and Oyster Creek represents a potential ongoing impact, but the extent and magnitude are unknown. The above topics have been raised as important issues by local, State, and Federal resource agencies in Barnegat Bay and in other nearshore areas along the Atlantic seaboard.

During the construction of OCNGS in the late 1960s, the freshwater and low-salinity habitats associated with Oyster Creek and the South Branch of Forked River at that time were destroyed. When the once-through cooling system began operation, the water requirements of the plant reversed the flow of the lower reaches of the South Branch of Forked River and increased the flow of lower Oyster Creek with the discharge of water containing biocides, trace metals, radioisotopes, and other chemicals. These alterations resulted in habitat modification and loss in the lower portions of both Oyster Creek and Forked River, and long-term changes to the water quality (temperature, salinity, and chemical contamination) of those areas. For the most part, the upstream portions of the Oyster Creek and Forked River watersheds are undeveloped. No other past, present, or future activities have been identified that could significantly alter the physical and chemical characteristics of Oyster Creek and Forked River.

The dam on Oyster Creek that was installed south of OCNGS to create a pond to meet the facility's needs for fire fighting may form a barrier to migratory anadromous or catadromous species (e.g., American shad or American eel). It is possible that future coordination with the FWS may result in a modification to this structure to allow for fish passage.

Physical and chemical cumulative impacts on Barnegat Bay have occurred as a result of jetty realignment and maintenance dredging of Barnegat Inlet and the Intracoastal Waterway. Increased development in nearshore locations causes impacts related to habitat loss and chemical pollution consistent with urbanized waterways. Impacts associated with the seasonally large number of recreational vessels on Barnegat Bay may adversely affect abundance, distribution, and habitat of aquatic resources in the estuary. These impacts are expected to continue to occur in Barnegat Bay during the license renewal term.

Cumulative impacts on the aquatic food web could include the loss of important phytoplankton and zooplankton species due to entrainment into the OCNGS once-through cooling system and from exposure to heated cooling water containing biocides and other chemicals. On the basis of the 316(a) and 316(b) studies conducted in the 1970s and 1980s, the impacts of OCNGS appeared to be localized and had not noticeably impacted the marine and estuarine food webs of Barnegat Bay. Because there are no current population level monitoring data available in the estuary, it is not possible to determine if this assessment is still valid.

Like most eastern urbanized estuaries, Barnegat Bay is subject to a variety of environmental stressors that contribute to cumulative impacts. For example, harmful algal blooms have occurred in Barnegat Bay during the past two decades; however, it does not appear that OCNGS operations are contributing to the outbreaks. Rather, it is likely that some harmful algal species are responding to increased nutrient loading in the estuary because of nonpoint source pollution associated with coastal development, while others are responding to the salinity and temperature changes in the bay associated with recent navigational improvements to Barnegat Inlet. Further baywide investigations at the ecosystem level are needed to adequately assess long-term cumulative impacts on Barnegat Bay.

Operation of the OCNGS once-through cooling system may adversely affect ecologically, commercially, or recreationally important species. Impacts may include entrainment of small life stages, impingement of juvenile or adult forms, toxicity due to exposure to chemicals associated with the cooling-water discharge, or toxicological or behavioral changes associated with exposure to heated water in the discharge canal or in areas of Barnegat Bay influenced by the thermal plume. The NJDEP (2005) identified a variety of representative important species that may be impacted by the operation of the OCNGS cooling system. It was assumed that the impacts demonstrated for these surrogate species would be applicable to other species and scalable to both population and ecosystem levels. Species identified included representatives of important fish (winter flounder, bay anchovy), sand shrimp, opossum shrimp, blue crab, hard clam, eelgrass (*Zostera marina*), shipworms, and Kemp's ridley sea turtle. Summers et al. (1989) concluded that continued operation of OCNGS would not "threaten the protection and propagation of balanced, indigenous populations." Because recent population level monitoring data from the estuary are not available, it is not possible for the NRC staff to determine whether the conclusions of Summers et al. (1989) are still valid, though comments received on the draft SEIS contend that the current condition of Barnegat Bay does not resemble the past. Unfortunately, without comprehensive monitoring data, these statements cannot be confirmed or dismissed. It appears that the only consistent opinion is that Barnegat Bay is influenced by a variety of environmental stressors, and, under certain conditions, one or many may significantly influence the food web of Barnegat Bay. For example, excessive fishing pressure coupled with abnormal climatic conditions, increased predation, and OCNGS entrainment and impingement may result in a detectible reduction in the winter flounder (*Pseudopleuronectes americanus*) population of Barnegat Bay.

Threatened or endangered aquatic species that may be affected by the operation of the OCNGS cooling system are limited to five species of sea turtles (loggerhead, Kemp's ridley, leatherback, hawksbill, and green; see Section 4.6.1 of this SEIS). In many cases, the dead sea turtles captured at OCNGS appeared to have died elsewhere, and in some cases, dead sea turtles exhibited wounds consistent with injuries from small boat propellers. The increase in sea turtle captures at OCNGS since 1992 may be related to navigation improvements at Barnegat Inlet, which allow easier passage into Barnegat Bay, or an overall increase in sea turtle populations along the New Jersey coast. The NRC recently conducted consultation with the NMFS regarding the proposed action of license renewal. The consultation considered cumulative impacts on threatened and endangered sea turtles, and these impacts are reflected in the November 21, 2006, BO (NMFS 2006).

Because the Barnegat Bay estuary is influenced by many controlling factors, the incremental contributions of OCNGS operation cannot be quantified precisely without additional study. The NRC staff expects localized impacts associated with entrainment, impingement, and thermal discharges to continue in Oyster Creek, Forked River, and adjacent portions of Barnegat Bay. At far-field locations in central Barnegat Bay, the cumulative impacts would be considered SMALL if the food web structure and current composition and abundance of representative important species in Barnegat Bay are similar to those observed during the 316(a) and 316(b) demonstration studies of the 1970s and 1980s. If the food web or the composition and abundance of representative important species are noticeably altered due to changes in natural or other anthropogenic stressors, cumulative impacts could be considered MODERATE. These determinations assume that the contributions of other anthropogenic or natural stressors would remain relatively constant during the license renewal period (e.g., fishing pressure or nonpoint pollution would not dramatically increase or decrease). Significant changes in environmental stressors not directly linked to OCNGS operations could increase or decrease the relative contribution of OCNGS operations to the cumulative impact on the aquatic resources of Barnegat Bay. Mitigation of impacts to aquatic resources is considered in Section 8.1 of the SEIS.

4.8.2 Cumulative Impacts on Terrestrial Resources

This section analyzes past, present, and future actions that could result in adverse cumulative impacts on terrestrial resources, including wildlife populations, upland habitat, wetlands, floodplains, and land use. For the purposes of this analysis, the geographic area that encompasses the past, present, and foreseeable future actions that could contribute to adverse cumulative impacts on terrestrial resources includes Ocean County, which contains OCNGS and its associated transmission line.

Past land use changes include construction of the OCNGS facility and the OCNGS-to-Manitou transmission line. Substantial residential and commercial development has occurred in the area since OCNGS was constructed, and this development is expected to continue (see Section 2.2.8.3). Development in Lacey Township and Ocean County is governed by master plans that favor balanced growth and environmental protection. In addition, those portions of the county that lie within the Pinelands National Reserve are managed under provisions of the Pinelands Protection Act, the intent of which is to protect the region from overdevelopment. The Pinelands Comprehensive Management Plan places restrictions on the density of development within the region.

As described in Section 2.1.7, the New Jersey Pinelands Commission (NJPC 1981) will be issuing comprehensive vegetation-management guidelines for rights-of-way during 2007. The transmission line operator will incorporate these new guidelines into its vegetation-management practices. None of the management procedures are expected to alter wetland or floodplain hydrology or adversely affect vegetation characteristics of these habitats or other habitats.

Ten Federally listed threatened or endangered terrestrial species and one candidate for Federal listing are listed for Ocean County, but there is no critical habitat designated in the county (Section 2.2.6.2). Of these, the only species that could potentially be affected by OCNGS operations is the bald eagle. The bald eagle is only an occasional transient in the project area (FWS 2005), and OCNGS is not expected to contribute to cumulative impacts on this species.

The NRC staff concludes that the incremental contribution to cumulative impacts on terrestrial resources resulting from the continued operation of OCNGS and the OCNGS-to-Manitou transmission line would be SMALL and that no additional mitigation would be warranted.

4.8.3 Cumulative Impacts on Human Health

The radiological dose limits for protection of the public and workers have been developed by the EPA and the NRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. These dose limits are codified in 40 CFR Part 190 and 10 CFR Part 20. For the purpose of this analysis, the area within a 50-mi radius region of interest (ROI) of the OCNGS site was included. There are no other nuclear fuel cycle facilities within the 50-mi ROI. The Hope Creek and Salem 1 and Salem 2 nuclear power plants are co-located in New Jersey approximately 75 mi southwest of OCNGS. The Limerick nuclear power plant is located in Pennsylvania, approximately 79 mi to the northwest of OCNGS. A portion of the population within the OCNGS ROI is also within the 50-mi ROIs for these other nuclear plants.

As stated in Section 2.2.7, AmerGen has conducted a radiological environmental monitoring program (REMP) around the OCNGS site since 1966, with the results presented annually in the OCNGS Annual Radiological Environmental Operating Report (AmerGen 2001b, 2002c, 2003b, 2004b, 2005c). The REMP measures radiation and radioactive materials from all sources, including, but not limited to, OCNGS emissions, and thus considers cumulative radiological impacts. On the basis of an evaluation of REMP results, the NRC staff concluded in Sections 2.2.7 and 4.3 that impacts of radiation exposure on the public and workers (occupational) from operation of OCNGS during the renewal term would be SMALL. With respect to the future, the REMP has not identified increasing levels or the accumulation of radioactivity in the environment over time. In addition, the staff is not aware of any plans or proposals for new nuclear facilities in the vicinity of OCNGS that would potentially contribute to cumulative radiological impacts. The NRC and the State of New Jersey would regulate any future actions in the vicinity of the OCNGS site that could contribute to cumulative radiological impacts. The NRC staff has not identified any other potential cumulative impacts in human health for the population surrounding OCNGS including impacts from electromagnetic fields. Therefore, the staff concludes that future cumulative impacts on human health would be SMALL, and that no further mitigation measures are warranted.

4.8.4 Cumulative Socioeconomic Impacts

For the analysis of cumulative socioeconomic impacts, the geographic range of analysis is Ocean County. When combined with the impact of other potential activities, such as likely residential development and population growth in the area surrounding the plant, socioeconomic impacts resulting from OCNGS license renewal would not produce a noticeable incremental change in any of the impact measures used. Therefore, the NRC staff determined that the impacts on employment, personal income, housing, local public services, utilities, and education occurring in the local socioeconomic environment as a result of license renewal activities, in addition to the impacts of other potential economic activity in the area, would be SMALL compared with other contributors. Additionally, the contribution of continued operation of the facility during the renewal period on transportation and environmental justice issues would likewise be SMALL. There are no reasonably foreseeable scenarios that would alter these conclusions in regard to cumulative impacts. Therefore, the staff concludes that future cumulative socioeconomic impacts would be SMALL, and that no further mitigation measures are warranted.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

The geographic range of analysis for cumulative impacts on groundwater would encompass wells finished in the Cohansey aquifer and the Kirkwood Formation.

Groundwater in the region generally flows eastward to the coast, following the bedding of the coastal plain aquifers (URS 2005). Clay units are present throughout the subsurface with varied thicknesses and depths. Well users in the vicinity of OCNGS rely on wells that are at a minimum depth of approximately 60 to 70 ft (URS 2005). These wells tap the Cohansey aquifer at a depth sufficient to avoid saltwater intrusion or contamination from septic systems. Deeper wells are finished in the Kirkwood Formation, which has higher water quality. Shallower wells are also present but are generally used for lawn irrigation (URS 2005). On the OCNGS property, the canals influence the shallow groundwater system, resulting in shallow flow toward the canals (URS 2005).

The combined average groundwater pumping rate at OCNGS in 2001 was 14 gpm. This is well below the GEIS Category 2 threshold for groundwater use of 100 gpm. The facility does not have plans for further groundwater withdrawal with development, either by increased pumping or additional extraction wells. Compared to regional water withdrawal rates and projected increases, OCNGS operational uses are considered inconsequential.

As described in Section 2.2.3 of this SEIS, site exceedences of groundwater standards have included petroleum hydrocarbons, volatile organic compounds, and methyl tertiary-butyl ether as documented and investigated during the Industrial Site Recovery Act process. However, the areal extent of contamination remains on the facility's property, and various remedial and monitoring systems operate under State regulation; therefore, the contamination will not contribute to offsite regional groundwater impacts.

On the basis of actual and planned pumping rates and the fact that increasing the groundwater extraction would require State approval, the NRC staff concludes that the cumulative impact on groundwater resources through water usage would be SMALL, and that additional mitigation would not be warranted. On the basis of groundwater quality, the NRC staff concludes that the cumulative impact on the quality of local groundwater resources also would be SMALL. Additional mitigation would not be warranted as long as monitoring and remediation continue, where necessary, under State regulatory oversight.

4.8.6 Conclusions Regarding Cumulative Impacts

The NRC staff considered the potential impacts resulting from operation of OCNGS during the license renewal term and other past, present, and future actions in the vicinity of OCNGS. The NRC staff's determination is that the potential cumulative impacts resulting from OCNGS operation during the license renewal term would be SMALL with the exception of cumulative impacts on aquatic resources, which could range from SMALL to MODERATE depending on the food web structure and abundance of representative important species in central Barnegat Bay.

4.9 Summary of Impacts of Operations During the Renewal Term

Neither AmerGen nor the NRC staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with OCNGS operation during the renewal term. Consequently, the NRC staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 11 Category 2 issues applicable to OCNGS operation during the renewal term as well as for environmental justice and chronic effects of electromagnetic fields. For 9 issues and environmental justice, the NRC staff concluded that the potential environmental impact of renewal term operations of OCNGS would be of SMALL significance in the context of the standards set forth in the GEIS, and that additional mitigation would not be warranted. For two issues (impingement and entrainment) impacts are likely SMALL but could be MODERATE. In addition, the NRC staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields; therefore, no impact level was assigned for that issue.

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. The NRC staff concluded that the impacts of continued operation of OCNGS during the license renewal period would not, except for aquatic resources, result in significant cumulative impacts on potentially affected resources. For aquatic resources, the cumulative impact would likely be SMALL but could be MODERATE.

4.10 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

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

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

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

AmerGen Energy Company, LLC (AmerGen). 2001a. *Annual Environmental Operating Report – 2000, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (March 14, 2001).

AmerGen Energy Company, LLC (AmerGen). 2001b. *2000 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (February 26, 2001).

AmerGen Energy Company, LLC (AmerGen). 2002a. *Oyster Creek Generating Station Procedure: Fish Kill Monitoring*. Docket No. 50-219. Forked River, New Jersey. (January 11, 2002).

AmerGen Energy Company, LLC (AmerGen). 2002b. *Annual Environmental Operating Report – 2001, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (February 22, 2002).

AmerGen Energy Company, LLC (AmerGen). 2002c. *2001 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (February 26, 2002).

AmerGen Energy Company, LLC (AmerGen). 2003a. *Annual Environmental Operating Report – 2002, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (March 31, 2003).

AmerGen Energy Company, LLC (AmerGen). 2003b. *2002 Annual Radioactive Effluent Release Report, Addendum, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (December 18, 2003).

AmerGen Energy Company, LLC (AmerGen). 2004a. *Annual Environmental Operating Report – 2003, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (March 29, 2004).

AmerGen Energy Company, LLC (AmerGen). 2004b. *2003 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (February 27, 2004).

AmerGen Energy Company, LLC (AmerGen). 2005a. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

AmerGen Energy Company, LLC (AmerGen). 2005b. *Annual Environmental Operating Report – 2004, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (March 31, 2005).

AmerGen Energy Company, LLC (AmerGen). 2005c. *2004 Annual Radioactive Effluent Release Report, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (March 1, 2005).

AmerGen Energy Company, LLC (AmerGen). 2006a. *Oyster Creek Generating Station Plant Shutdown Monitoring Report*. Docket No. 50-219. Forked River, New Jersey. (February 24, 2006).

AmerGen Energy Company, LLC (AmerGen). 2006b. *Sea Turtle Incidental Take Report 2006-1*. Docket No. 50-219. Forked River, New Jersey. (July 24, 2006).
AmerGen Energy Company, LLC (AmerGen). 2006c. *Sea Turtle Incidental Take Reports 2006-2, 2006-3, 2006-4, & 2006-5.* Docket No. 50-219. Forked River, New Jersey. (August 14, 2006).

AmerGen Energy Company, LLC (AmerGen). 2006d. *Sea Turtle Incidental Take Report 2006-6*. Docket No. 50-219. Forked River, New Jersey. (October 30, 2006).

Atlantic States Marine Fisheries Commission (ASMFC). 2005. "Amendment 1 to the Interstate Management Plan for Inshore Stocks of Winter Flounder." Available URL: http://www.asmfc.org/ (Accessed October 17, 2006).

Barnegat Bay National Estuary Program (BBNEP). 2001. "The Barnegat Bay Estuary Program Characterization Report." Scientific and Technical Advisory Committee. Toms River, New Jersey. January. Available URL: http://www.bbep.org/Char_rep.htm (Accessed August 8, 2005).

Barnegat Bay National Estuary Program (BBNEP). 2005. "Barnegat Bay Estuary." Available URL: http://www.bbep.org/ (Accessed December 2005).

Clean Water Act of 1977 (CWA). 33 USC 1326, et seq. (common name of the Federal Water Pollution Control Act [FWPCA] of 1977).

Council on Environmental Quality (CEQ). 1997. *Environmental Justice: Guidance Under the National Environmental Policy Act*. Executive Office of the President, Washington, D.C.

EA Engineering Science and Technology, Inc. (EA). 1986. *Entrainment and Impingement Studies at the Oyster Creek Nuclear Generating Station, 1984–1985*. Sparks, Maryland.

Endangered Species Act of 1973 (ESA). 16 USC 1531, et seq.

Executive Order 12898. "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations." *Federal Register*. Vol. 59, No. 32, pp. 7629–7633. Washington, D.C. (February 16, 1994).

GPU Nuclear, Inc. 2000. *Annual Environmental Operating Report–1999, Oyster Creek Nuclear Generating Station*. Docket No. 50-219. Forked River, New Jersey. (March 24, 2000).

Institute of Electrical and Electronics Engineers, Inc. (IEEE). 2002. *National Electrical Safety Code*.

Kennish, M.J. 2001. "State of the Estuary and Watershed: An Overview." *Journal of Coastal Research*, Special Issue 32, pp. 243–273.

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

National Historic Preservation Act of 1966 (NHPA). 16 USC 470, et seq.

National Institute of Environmental Health Sciences (NIEHS). 1999. *NIEHS Report on Health Effects from Exposure to Power Line Frequency and Electric and Magnetic Fields*. Publication No. 99-4493, Research Triangle Park, North Carolina.

National Marine Fisheries Service (NMFS). 2005. *Biological Opinion Regarding Continued Operation of the Oyster Creek Nuclear Generating Station on the Forked River and Oyster Creek, Barnegat Bay, New Jersey*. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Regional Office. Gloucester, Massachusetts. (September 22, 2005).

National Marine Fisheries Service (NMFS). 2006. *Endangered Species Act Section 7 Consultation Biological Opinion*. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Regional Office. Gloucester, Massachusetts. (November 21, 2006).

New Jersey Department of Environmental Protection (NJDEP). 2004. "New Jersey's Endangered and Threatened Wildlife." Division of Fish & Wildlife, Trenton, New Jersey. Available URL: http://www.njfishandwildlife. com/tandespp.htm (Accessed September 22, 2005).

New Jersey Department of Environmental Protection (NJDEP). 2005. "Fact Sheet, NJPDES # NJ0005550." Division of Water Quality, Bureau of Point Source Permitting – Region 1. Available URL: http://www.state.nj.us/dep/dwq/pdf/oysterck_factsh.pdf (Accessed August 4, 2005).

New Jersey Pinelands Commission (NJPC). 1981. "Pinelands Comprehensive Management Plan." Pinelands Commission, New Lisbon, New Jersey.

New Jersey Pinelands Protection Act of 1979. L.1979,c. 1ll, s. 1, eff. June 28, 1979.

Summers, J.K., A.F. Holland, S.B. Weisberg, L.C. Wendling, C.F. Stroup, R.L. Dwyer, M.A. Turner, and W. Burton. 1989. *Technical Review and Evaluation of Thermal Effects*

Studies and Cooling Water Intake Structure Demonstration of Impact for the Oyster Creek Nuclear Generating Station. Revised Final Report. Prepared by Versar, Inc., Columbia, Maryland, for the New Jersey Department of Environmental Protection, Division of Natural Resources. (May 1989).

Tatham, T.R., D.L. Thomas, and D.J. Danila. 1984. "Fishes of Barnegat Bay." In *Ecology of Barnegat Bay, New Jersey*, M.J. Kennish and R.A. Lutz, eds. Springer-Verlag, New York, New York.

Township of Lacey. 1991. *Township of Lacey Master Plan*. Prepared by the Planning Board of the Township of Lacey, New Jersey.

URS. 2005. *Remedial Investigation – Response to October 13, 2004 NJDEP Comment Letter, Oyster Creek Nuclear Generating Station, U.S. Route No. 9, Forked River, New Jersey, ISRA Case No. E99575*. Final Report. Wayne, New Jersey. Prepared for Jersey Central Power & Light Company, Morristown, New Jersey. (February 11, 2005).

U.S. Atomic Energy Commission (AEC). 1973. *Final Environmental Statement Related to the Forked River Nuclear Station Unit 1, Jersey Central Power and Light Company.* Docket No. 50-363. Directorate of Licensing. Washington, D.C.

U.S. Atomic Energy Commission (AEC). 1974. *Final Environmental Statement Related to Operation of Oyster Creek Nuclear Generating Station, Jersey Central Power and Light Company*. Docket No. 50-219. Directorate of Licensing. Washington, D.C.

U.S. Census Bureau (USCB). 2005a. "American Fact Finder – Data Sets, Decennial Census." Washington, D.C. Available URL: http://factfinder.census.gov/ (Accessed September 2005).

U.S. Census Bureau (USCB). 2005b. "American Fact Finder – Glossary." Washington, D.C. Available URL: http://factfinder.census.gov/ (Accessed September 2005).

U.S. Environmental Protection Agency (EPA). 2004. "National Pollutant Discharge Elimination System-Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities; Final Rule." *Federal Register*. Vol. 69, No. 131, pp. 41575–41624. Washington, D.C. (July 9, 2004).

U.S. Fish and Wildlife Service (FWS). 2005. Letter from C.G. Day, U.S. Fish and Wildlife Service, Pleasantville, New Jersey, to M.T. Lesar, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Scoping Comments for the Oyster Creek Nuclear Generating Station License Renewal Environmental Impact Statement." (November 23, 2005).

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

U.S. Nuclear Regulatory Commission (NRC). 2001. "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues." Appendix D to NRC Office Instruction LIC-203. Washington, D.C. (June 21, 2001).

U.S. Nuclear Regulatory Commission (NRC). 2004a. "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues." Rev. 1. Appendix D to NRC Office Instruction LIC-203. Washington, D.C. (May 24, 2004).

U.S. Nuclear Regulatory Commission (NRC). 2004b. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions." *Federal Register*, Vol. 69, pp. 52040–52048. Washington, D.C. (August 24, 2004).

U.S. Nuclear Regulatory Commission (NRC). 2005a. Letter from P.T. Kuo, U.S. Nuclear Regulatory Commission, Rockville, Maryland, to C.G. Day, U.S. Fish and Wildlife Service, Pleasantville, New Jersey. Subject: "Request for List of Protected Species Within the Area Under Evaluation for the Oyster Creek Nuclear Generating Station License Renewal." (October 12, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2005b. Letter from P.T. Kuo, U.S. Nuclear Regulatory Commission, Rockville, Maryland, to P.A. Kurkul, NOAA's National Marine Fisheries Service, Gloucester, Massachusetts. Subject: "Request for List of Protected Species and Essential Fish Habitat Within the Area Under Evaluation for Oyster Creek Nuclear Generating Station License Renewal." (October 12, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2005c. "Biological Assessment for the Reinitiation of a Formal Consultation for Continued Operation of the Oyster Creek Nuclear Generating Station (TAC MC4079)." Rockville, Maryland. (March 29, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2006. E-mail from T. Allison, Argonne National Laboratory, Argonne, Illinois, to M. Masnik, U.S. Nuclear Regulatory Commission, Rockville, Maryland. Subject: "Conversation with Alan Avery." April 24, 2006.

Vouglitois, J.J. 1983. *The Ichthyofauna of Barnegat Bay, New Jersey – Relationships Between Long-Term Temperature Fluctuations and the Population Dynamics and Life History of*

Temperate Estuarine Fishes During a Five-Year Period, 1976–1980. Master's Thesis. Rutger's University, New Brunswick, New Jersey.

5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents 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 issue 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 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 describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents and severe accidents, as discussed below.

(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 Addendum 1.

5.1.1 Design-Basis Accidents

In order to receive U.S. Nuclear Regulatory Commission (NRC) approval to operate a nuclear power facility, an applicant for an initial operating license (OL) must submit a Safety Analysis Report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

Design-basis accidents (DBAs) are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents, without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in Title 10, Part 50 and Part 100, of the *Code of Federal Regulations* (10 CFR Part 50 and 10 CFR Part 100).

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the OL. The results of these evaluations are found in license documentation such as the applicant's Final Safety Analysis Report (FSAR), the NRC staff's Safety Evaluation Report (SER), the Final Environmental Statement (FES), and Section 5.1 of this Supplemental Environmental Impact Statement (SEIS). A licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximally exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable, and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Oyster Creek Nuclear Generating Station (OCNGS), is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
POSTULATED ACCIDENTS	
Design-basis accidents	5.3.2; 5.5.1

Based on information in the GEIS, the Commission found that

> The NRC staff has concluded that the environmental impacts of design-basis accidents are of small significance for all plants.

AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts related to DBAs beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, regardless of offsite consequences. In the GEIS, the NRC staff assessed the impacts of severe accidents using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Severe accidents initiated by external phenomena, such as tornadoes, floods, earthquakes, fires, and sabotage, traditionally have not been discussed in quantitative terms in FESs and were not specifically considered for the OCNGS site in the GEIS (NRC 1996). However, in the GEIS, the NRC staff did evaluate existing impact assessments performed by the NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from beyond-design-basis earthquakes at existing nuclear power plants is SMALL. Additionally, compliance with the NRC regulatory requirements under 10 CFR Part 73 provides reasonable assurance that the risk from sabotage is SMALL. Even if such events were to occur, the Commission would expect that resultant core damage and radiological releases would be no worse than those expected from internally initiated events. Based on the above, the Commission concludes that the risk from sabotage and beyond-design-basis earthquakes at existing nuclear power plants is SMALL and that, in addition, the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents.

Based on information in the GEIS, the Commission found that

> The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to OCNGS, is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents 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
	POSTULATED ACCIDENTS		
Severe accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.3.4; 5.4; 5.5.2	L	5.2

The NRC staff has not identified any new and significant information with regard to the consequences from severe accidents during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of severe accidents beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the NRC staff has reviewed severe accident mitigation alternatives (SAMAs) for OCNGS. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

Section 51.53(c)(3)(ii)(L) of 10 CFR requires that license renewal applicants consider alternatives to mitigate severe accidents if the NRC staff has not previously evaluated SAMAs for the applicant's plant in an EIS or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for OCNGS; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluation for OCNGS conducted by AmerGen and described in the ER, and the NRC's review of this evaluation. The details of the review are described in the NRC staff evaluation that was prepared with contract assistance from Information Systems Laboratories, Inc. The entire evaluation for OCNGS is presented in Appendix G.

The SAMA evaluation for OCNGS was conducted with a four-step approach. In the first step, AmerGen quantified the level of risk associated with potential reactor accidents using the plant-specific Probabilistic Risk Assessment (PRA) and other risk models.

In the second step, AmerGen examined the major risk contributors and identified possible ways (i.e., SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. AmerGen initially identified 136 potential SAMAs for OCNGS. AmerGen screened out 99 SAMAs from further consideration because they are not applicable at OCNGS due to design differences, require extensive changes that would involve implementation costs known to exceed any possible benefit, have already been implemented at Oyster Creek, are of low benefit, or are addressed by a similar SAMA. The remaining 37 SAMAs were subjected to further evaluation.

In the third step, AmerGen estimated the benefits and the costs associated with each of the remaining SAMAs. Estimates were made of how much each SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997). The cost of implementing the proposed SAMAs was also estimated.

Finally, in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning that the benefits of the SAMA were greater than the cost (a positive cost-benefit). AmerGen found seven SAMAs to be potentially cost-beneficial in the baseline analysis, and eight additional SAMAs to be potentially cost-beneficial when alternative discount rates and analysis uncertainties are considered (AmerGen 2005).

AmerGen recognized that a combination of low-cost SAMAs can provide much of the risk reduction associated with higher-cost SAMAs, and may act synergistically to yield a combined risk reduction greater than the sum of the benefits for each SAMA if implemented individually. AmerGen assessed various combinations of the seven potentially cost-beneficial SAMAs identified in the baseline case. On the basis of this assessment, AmerGen identified a subset of four SAMAs, along with a priority for implementation based on individual maximum net values (SAMAs 109/125A, 134, 125B, and 127). AmerGen concluded that if these SAMAs are implemented, then the remaining three SAMAs identified as cost-beneficial in the baseline analysis would no longer be cost-beneficial. However, several SAMAs would remain potentially cost-beneficial when evaluated at the upper bound (AmerGen 2005).

The potentially cost-beneficial SAMAs do not relate to adequately managing the effects of aging during the period of extended operation; therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54. AmerGen's SAMA analyses and the NRC's review are discussed below in more detail.

5.2.2 Estimate of Risk

AmerGen submitted an assessment of SAMAs for OCNGS as part of the ER (AmerGen 2005). This assessment was based on the most recent Oyster Creek PRA available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the OCNGS Individual Plant Examination (IPE) (GPU Nuclear 1992) and Individual Plant Examination of External Events (IPEEE) (GPU Nuclear 1995).

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 1.1×10^{-5} per year. This CDF is based on the risk assessment for internally initiated events. AmerGen did not include the contribution to risk from external events within the OCNGS risk estimates; however, it did account for the potential risk reduction benefits associated with external events by increasing the estimated benefits for internal events by a factor of 2. The breakdown of CDF by initiating event is provided in Table 5-3.

As shown in Table 5-3, events initiated by loss of offsite power are the dominant contributors to CDF. Although not separately reported, station blackout sequences contribute about 43 percent of the total internal events CDF (4.48×10^{-6} per year), while anticipated transient without scram (ATWS) sequences are small contributors to CDF (2.89×10^{-7} per year).

In the ER, AmerGen estimated the dose to the population within 50 mi of the OCNGS site to be approximately 36 person-rem per year. The breakdown of the total population dose by containment release mode is summarized in Table 5-4. Containment failures within the early time frame (less than 6 hours following declaration of a general emergency) and intermediate time frame (within 6 to 24 hours following declaration of a general emergency) dominate the population dose risk at OCNGS.

Table 5-3. OCNGS Core Damage Frequency

Initiating Event	CDF (Per Year)	% Contribution to CDF
Loss of offsite power (LOOP)	4.2×10^{-6}	40
Manual shutdown	6.8×10^{-7}	7
Medium loss-of-coolant accident (LOCA)	6.5×10^{-7}	6
Reactor trip	5.8×10^{-7}	6
Loss of 4160-volts alternating current (VAC) Bus 1C	5.3×10^{-7}	5
Condenser bay area feedwater flood	4.9×10^{-7}	5
Loss of 4160-VAC Bus 1D	4.5×10^{-7}	4
Turbine trip	3.5×10^{-7}	3
Loss of circulating water	3.5×10^{-7}	3
Loss of feedwater	3.4×10^{-7}	3
Others	1.9×10^{-6}	18
Total CDF	1.05×10^{-5}	100

Table 5-4. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (person-rem[a] per year)	% Contribution
Early containment failure	23.6	66
Intermediate containment failure	10.3	29
Late containment failure	1.6	4
Bypass	0.4	1
Intact containment	0.1	negligible
Total Population Dose	36	100

(a) One person-rem = 0.01 person-Sv.

The NRC staff has reviewed AmerGen's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for candidate SAMAs. Accordingly, the NRC staff based its assessment of offsite risk on the CDFs and offsite doses reported by AmerGen.

5.2.3 Potential Plant Improvements

Once the dominant contributors to plant risk were identified, AmerGen searched for ways to reduce that risk. In identifying and evaluating potential SAMAs, AmerGen considered insights from the plant-specific PRA, SAMA analyses performed for other operating plants that have submitted license renewal applications, as well as SAMAs that could further reduce the risk of the dominant internal fires. AmerGen identified 136 potential risk-reducing improvements (SAMAs) to plant components, systems, procedures, and training.

Ninety-nine SAMAs were removed from further consideration because they are not applicable at OCNGS due to design differences, require extensive changes that would involve implementation costs known to exceed any possible benefit, have already been implemented at OCNGS, are of low benefit, or are addressed by a similar SAMA. A detailed cost-benefit analysis was performed for each of the 37 remaining SAMAs.

The NRC staff concludes that AmerGen used a systematic and comprehensive process for identifying potential plant improvements for OCNGS, and that the set of potential plant improvements identified by AmerGen is reasonably comprehensive and, therefore, acceptable.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

AmerGen evaluated the risk reduction potential of the remaining 37 SAMAs. The SAMA evaluations were performed by using realistic assumptions with some conservatism.

AmerGen estimated the costs of implementing the 37 candidate SAMAs through the application of engineering judgment, use of other licensees' estimates for similar improvements, and development of site-specific cost estimates. The cost estimates conservatively did not include the cost of replacement power during extended outages required to implement the modifications, nor did they include contingency costs associated with unforeseen implementation obstacles.

The NRC staff reviewed AmerGen's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and somewhat conservative (i.e., the estimated risk reduction is similar to or somewhat higher than what would actually be realized). Accordingly, the NRC staff based its estimates of averted risk for the various SAMAs on AmerGen's risk reduction estimates.

The NRC staff reviewed the bases for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates with estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The NRC staff found the cost estimates to be consistent with estimates provided in support of other plants' analyses.

The NRC staff concludes that the risk reduction and the cost estimates provided by AmerGen are sufficient and appropriate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

The cost-benefit analysis performed by AmerGen was based primarily on NUREG/BR-0184 (NRC 1997) and was executed consistent with this guidance. NUREG/BR-0058 (NRC 2004) has recently been revised to reflect the agency's revised policy on discount rates. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed – one at 3 percent and one at 7 percent (NRC 2004). AmerGen provided both sets of estimates (AmerGen 2005).

AmerGen identified seven potentially cost-beneficial SAMAs in the baseline analysis contained in the ER (using a 7 percent discount rate):

- SAMA 91 – modify procedures and training to allow operators to cross-tie emergency AC buses 1C and 1D under emergency conditions that require operation of critical equipment,
- SAMA 99 – modify procedures and training to operate the isolation condensers with no support systems available,
- SAMA 109/125A – provide portable DC battery charger capable of supplying 125-V buses in order to preserve isolation condenser and electromagnetic relief valve operability along with adequate instrumentation,
- SAMA 125B – add a bus cross-tie circuit breaker to Bus 1B2 to reduce the impact of fires in the 480-VAC switchgear room,
- SAMA 127 – increase operator training on the systems and operator actions determined to be important from the PRA,
- SAMA 130 – increase combustion turbine building integrity to withstand higher winds so that combustion turbines would be capable of withstanding a severe weather event, and
- SAMA 134 – increase fire pump house building integrity to withstand higher winds so that the fire system would be capable of withstanding a severe weather event.

When benefits are evaluated using a 3 percent discount rate, two additional SAMAs were determined to be potentially cost-beneficial:

- SAMA 10 – install an alternate path to the torus hard pipe vent via the wet well using a rupture disk, and

- SAMA 132 – modify procedures to allow switching of the combustion turbines to OCNGS while running.

AmerGen performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment (AmerGen 2005). If the benefits are increased by a factor of 2.5 to account for uncertainties, six additional SAMAs were determined to be potentially cost-beneficial (SAMAs 84, 106, 124, 125C, 129, and 138).

AmerGen recognized that a combination of low-cost SAMAs could provide much of the risk reduction associated with higher-cost SAMAs, and may act synergistically to yield a combined risk reduction greater than the sum of the benefits of each SAMA if implemented individually (AmerGen 2005). AmerGen assessed various combinations of the seven potentially cost-beneficial SAMAs identified in the baseline case. On the basis of this assessment, AmerGen identified a subset of four SAMAs, along with a priority for implementation based on individual maximum net values. In order of implementation priority, they are SAMAs 109/125A, 134, 125B, and 127. AmerGen concluded that if these four SAMAs are implemented, then the remaining SAMAs identified as cost-beneficial in the baseline analysis (i.e., SAMAs 91, 99, and 130) will no longer be cost-beneficial (AmerGen 2005).

The NRC staff noted that several SAMAs that are cost-beneficial at the upper bound (95th percentile) may remain cost-beneficial at the upper bound, even after implementing the four aforementioned SAMAs. Therefore, the staff asked AmerGen to provide an assessment of the upper bound net values for these SAMAs (i.e., SAMAs 10, 84, 106, 124, 125C, 129, 132, and 138), assuming that the four cost-beneficial SAMAs noted above are implemented (NRC 2005). In its response, AmerGen provided the upper bound net values for these SAMAs (AmerGen 2006). With the exception of SAMAs 84 and 138, these SAMAs remained individually cost-beneficial at the upper bound.

The NRC staff concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than the associated benefits.

5.2.6 Conclusions

The NRC staff reviewed AmerGen's analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by AmerGen are reasonable and sufficient for the license renewal submittal. Although the treatment of SAMAs for external events was somewhat limited by the unavailability of an external event PRA, the likelihood of there being cost-beneficial enhancements in this area was minimized by including several candidate SAMAs related to dominant seismic, fire, and wind events, and by increasing the estimated SAMA benefits for internal events by a factor of 2 to account for potential benefits in external events.

On the basis of its review of the SAMA analysis, the NRC staff concurs with AmerGen's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of all or a subset of potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the staff considers that further evaluation of these SAMAs by AmerGen is warranted. However, none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

5.3 References

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

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."

10 CFR Part 73. *Code of Federal Regulations*, Title 10, *Energy*, Part 73, "Physical Protection of Plants and Materials."

10 CFR Part 100. *Code of Federal Regulations*, Title 10, *Energy,* Part 100, "Reactor Site Criteria."

AmerGen Energy Company, LLC (AmerGen). 2005. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

AmerGen Energy Company, LLC (AmerGen). 2006. Letter from P.B. Cowan, AmerGen Energy Company, LLC, Kennett Square, Pennsylvania, to U.S. Nuclear Regulatory Commission, Document Control Desk, Rockville, Maryland, Subject: "Response to NRC Request for Additional Information Related to Severe Accident Mitigation Alternatives (SAMAs) for Oyster Creek Generating Station (TAC No. MC7625)." (January 9, 2006).

GPU Nuclear, Inc. 1992. Oyster Creek Nuclear Generating Station (OCNGS), Operating License No. DPR-16, Docket No. 50-219, Response to Generic Letter 88-20, "Individual Plant Examinations for Severe Accident Vulnerabilities (IPE)." (August 14, 1992).

GPU Nuclear, Inc. 1995. Oyster Creek Nuclear Generating Station (OCNGS), Operating License No. DPR-16, Docket No. 50-219, Response to Generic Letter 88-20, Supplement 4, “Individual Plant Examination for External Events (IPEEE) for Severe Accident Vulnerabilities.” (December 29, 1995).

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

U.S. Nuclear Regulatory Commission (NRC). 1997. *Regulatory Analysis Technical Evaluation Handbook*. NUREG/BR-0184, 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, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission*. NUREG/BR-0058, Rev. 4, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2005. Letter from M.T. Masnik, U.S. Nuclear Regulatory Commission, Rockville, Maryland, to C.N. Swenson, AmerGen Energy Company, LLC, Forked River, New Jersey. Subject: “Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives (SAMAs) for Oyster Creek Nuclear Generating Station (TAC No. MC7625).” (November 9, 2005).

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management 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 issue 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 that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, and are applicable to the Oyster Creek Nuclear Generating Station (OCNGS). The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle

---

(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.

Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The U.S. Nuclear Regulatory Commission (NRC) staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to OCNGS from the uranium fuel cycle and solid waste management are listed in Table 6-1.

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

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and HLW disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2;6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6; 6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005) that it is not aware of any new and significant information associated with the renewal of the OCNGS operating license (OL). The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER (2005), the site visit, the scoping process, evaluation of other available information, and public comments on the draft

SEIS. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For these issues, the NRC staff concluded in the GEIS that the impacts would be SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to be warranted.

A brief description of the NRC staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW). Based on information in the GEIS, the Commission found that

  Offsite impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this Part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, are small.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (collective effects). Based on information in the GEIS, the Commission found that

  The 100-year environmental dose commitment to the U.S. population from the fuel cycle, HLW and spent fuel disposal excepted, is calculated to be about 14,800 person-rem, or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the United States. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect that will not ever be mitigated (e.g., no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.

> Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA [National Environmental Policy Act] implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (spent fuel and HLW disposal). Based on information in the GEIS, the Commission found that

> For the HLW and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 mrem per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 mrem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 mrem per year. The lifetime individual risk from the 100 millirem annual dose limit is about 3×10^{-3}.
>
> Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*, October 1980 (DOE 1980). The evaluation estimated the 70-year whole-body dose commitment to the maximum

> individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other Federal agencies have expended considerable effort to develop models for the design and for the licensing of a HLW repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths, with an upper limit of 1,000 premature cancer deaths worldwide for a 100,000-metric tonne (MTHM) repository.
>
> Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and HLW disposal, this issue is considered Category 1.

On February 15, 2002, based on a recommendation by the Secretary of the Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The U.S. Congress approved this recommendation on July 9, 2002, in Joint Resolution 87, which designated Yucca Mountain as the repository for spent nuclear waste. On July 23, 2002, the President signed Joint Resolution 87 into law; Public Law 107-200, 116 Stat. 735 (2002) designates Yucca Mountain as the repository for spent nuclear waste. This development does not represent new and significant information with respect to the offsite radiological impacts from license renewal related to disposal of spent nuclear fuel and high-level nuclear waste.

Fuel Cycle

The U.S. Environmental Protection Agency (EPA) developed Yucca-Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated the EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000-year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63. In response to the Court's decision, the EPA issued its proposed revised standards to 40 CFR Part 197 on August 22, 2005 (70 FR 49014). In order to be consistent with the EPA's revised standards, the NRC proposed revisions to 10 CFR Part 63 on September 8, 2005 (70 FR 53313).

Therefore, for the HLW and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radioactive nuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, the NRC staff assumed that limits would be developed along the lines of the 1995 NAS report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository that would comply with such limits could and likely would be developed at some site.

Despite the current uncertainty with respect to these rules, some judgment as to the regulatory NEPA implications of offsite radiological impacts of spent fuel and HLW disposal should be made. The NRC staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the option of extended operation under 10 CFR Part 54 should be eliminated.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- <u>Nonradiological impacts of the uranium fuel cycle</u>. Based on information in the GEIS, the Commission found that

  The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional onsite land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

  The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

Fuel Cycle

- Onsite spent fuel. Based on information in the GEIS, the Commission found that

  The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated onsite with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

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

  No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

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

  The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by the NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting HLW to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in the summary table.

OCNGS meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts of transportation associated with license renewal beyond those discussed in the GEIS. There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 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."

10 CFR Part 63. *Code of Federal Regulations*, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

40 CFR Part 197. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 197, "Public Health and Environmental Radiation Protection Standards for Management and Disposal for Yucca Mountain, Nevada."

70 FR 49014. August 22, 2005. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV." *Federal Register*, U.S. Nuclear Regulatory Commission.

70 FR 53313. September 8, 2005. "Implementation of a Dose Standard After 10,000 Years." *Federal Register*, U.S. Nuclear Regulatory Commission.

Joint Resolution Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-Level Radioactive Waste and Spent Nuclear Fuel, pursuant to the Nuclear Waste Policy Act of 1982. 2002. Public Law 107-200. 116 Stat. 735.

AmerGen Energy Company, LLC (AmerGen). 2005. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*. Washington, D.C.

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

Fuel Cycle

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*. DOE/EIS-0046F, Washington, D.C.

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

7.0 Environmental Impacts of Decommissioning

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, NUREG-0586, Supplement 1 (NRC 2002). The U.S. Nuclear Regulatory Commission (NRC) staff's evaluation of the environmental impacts of decommissioning presented in NUREG-0586, Supplement 1, identifies a range of impacts for each environmental issue.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation 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 issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were 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 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. There are no Category 2 issues related to decommissioning.

(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.

7.1 Decommissioning

Category 1 issues in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, that are applicable to Oyster Creek Nuclear Generating Station (OCNGS) decommissioning following the renewal term are listed in Table 7-1. AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005) that it is aware of no new and significant information regarding the environmental impacts of OCNGS license renewal. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the NRC staff concluded in the GEIS that the impacts would be SMALL, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of OCNGS Following the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation doses	7.3.1; 7.4
Waste management	7.3.2; 7.4
Air quality	7.3.3; 7.4
Water quality	7.3.4; 7.4
Ecological resources	7.3.5; 7.4
Socioeconomic impacts	7.3.7; 7.4

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

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

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 person-rem caused by buildup of long-lived radionuclides during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no radiation dose impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

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

> Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts from solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

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

> Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts on air quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

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

> The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts on water quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

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

  > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

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

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, evaluation of other available information, and public comments on the draft SEIS. Therefore, the NRC staff concludes that there would be no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

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

AmerGen Energy Company, LLC (AmerGen). 2005. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

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

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*. NUREG-0586, Supplement 1, Washington, D.C.

8.0 Environmental Impacts of Alternatives

This chapter examines the potential environmental impacts associated with (1) alternatives to the Oyster Creek Nuclear Generating Station (OCNGS) cooling-water system; (2) denying the renewal of the OCNGS operating license (OL) (i.e., the no-action alternative); (3) replacing OCNGS electric-generation capacity using electric-generation sources other than OCNGS; (4) purchasing electric power from other sources to replace power generated by OCNGS; and (5) two combinations of generation and conservation measures to replace power generated by OCNGS. In addition, other alternatives that were deemed unsuitable for replacement of power generated by OCNGS are discussed.

Alternatives to the existing OCNGS cooling-water system are being considered because OCNGS is operating under the provisions of an expired New Jersey Pollutant Discharge Elimination System (NJPDES) permit. A draft NJPDES permit has been issued by the New Jersey Department of Environmental Protection (NJDEP) for public comment. The final requirements, limits, and conditions of the NJPDES permit were not available at the time the U.S. Nuclear Regulatory Commission (NRC) staff performed the assessment presented in this Supplemental Environmental Impact Statement (SEIS). Based on the NRC staff's review of the draft permit and discussions with the NJDEP, the staff has determined that there is a reasonable possibility that OCNGS would be required to either install a closed-cycle cooling system or employ a combination of design and construction technologies, operational measures, and restoration that would result in compliance with the intake performance standards.

The environmental impacts of alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (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.

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999),[(a)] with the additional impact categories of environmental justice and transportation.

8.1 Alternatives to the Existing OCNGS Cooling-Water System

OCNGS uses a once-through cooling-water system to remove waste heat and condense the main turbine exhaust steam in the station's three main condensers. Cooling water is withdrawn from the intake canal, which pulls water from Forked River and Barnegat Bay. The warmed cooling water is released to the discharge canal and Oyster Creek. Dilution pumps move unheated water from the intake canal to the discharge canal to reduce the added heat load to Oyster Creek. A more detailed description of the OCNGS cooling-water system is provided in Section 2.1.3 of this SEIS. An assessment of the impacts of the current cooling-water system on the environment is presented in Sections 4.1, 4.6, and 4.8 of this SEIS.

Surface-water withdrawals and discharges at OCNGS are regulated under the NJDPES permit program. OCNGS was issued an NJPDES permit in 1994, and that permit expired in 1999. A provision of the Clean Water Act (CWA) allows facilities to operate under an expired permit, provided that the permittee makes a timely renewal application. OCNGS has been operating under the 1994 permit since the permit expired in 1999. The NJDEP issued a draft permit on July 19, 2005 (NJDEP 2005), that addressed the U.S. Environmental Protection Agency's (EPA's) recently issued Phase II regulations for reducing impingement and entrainment losses at existing electricity-generating facilities. These regulations establish standards for compliance with the requirements of Section 316(b) of the CWA, which calls for intake structures to reflect the best technology available for minimizing adverse environmental impact. The EPA's Phase II regulations establish five compliance alternatives; two of these alternatives concern the attainment of a reduction in impingement mortality at the intake structure by 80 to 95 percent of baseline and a reduction of organisms entrained through the cooling system by 60 to 90 percent of baseline (EPA 2004a).

The NJDEP identified two alternatives to the current-cooling water system in the 2005 draft NJPDES permit for OCNGS. The NJDEP's preferred alternative is to "reduce intake capacity to a level commensurate with the use of a closed-cycle, recirculating cooling system." This alternative would require replacement of the existing once-through cooling system with a closed-cycle cooling system. The NJDEP indicated that if AmerGen Energy Company, LLC (AmerGen), can demonstrate that a closed-cycle cooling system is not available for OCNGS, AmerGen could implement another alternative, which is to "select, install, properly operate, and

(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.

maintain a combination of design and construction technologies, operational measures, and/or restoration measures that will, in combination with any existing design and construction technologies, operational measures, and/or restoration measures" endeavor to meet the national performance standards for impingement and entrainment. The impacts of implementing these two alternatives are evaluated in this section.

Uncertainties exist in the design details of alternative systems and the timing of construction activities. Currently, AmerGen is collecting data under a NJDEP-approved Proposal for Information Collection that will be part of a series of studies to be prepared by the applicant. The results of these studies (which could take several years to complete) would be used to assist in the selection of an alternative and to design the specific characteristics of that alternative. Issuance of a final NJPDES permit for OCNGS may include a time line for implementation. Implementation of either alternative is likely to take years, and construction may extend into the license renewal period. The second alternative considers a requirement to implement restoration measures, which could involve the restoration of wetlands, coupled with modifications to the existing intake structure and operations. The initial restoration of wetlands could start prior to license renewal and continue through some portion of the license renewal period.

8.1.1 Closed-Cycle Cooling Alternative

The NJDEP identified construction and operation of a closed-cycle cooling system at OCNGS as its preferred alternative to meet current national performance standards for impingement and entrainment losses. In a closed-cycle cooling system, the cooling water is recirculated through the condenser after the waste heat is removed, typically by circulating the water through large cooling towers.

The principal types of closed-cycle cooling systems currently used by the power industry are natural-draft and mechanical-draft cooling towers. The method of cooling associated with these cooling towers is the evaporation of water to the atmosphere. Natural-draft towers, with a characteristic hyperbolic shape often associated with nuclear power plants, rely on the passive movement of air through the towers to provide cooling. Natural-draft towers are usually quite large, up to 400 ft in diameter at the base and 520 ft in height. Mechanical-draft towers use fans to move air through the towers and are often less than 100 ft tall. In large power-plant applications, mechanical-draft towers are multicelled systems that are arranged in linear or round configurations, and in series or parallel configurations. Natural-draft and mechanical-draft cooling systems are referred to as "wet" closed-cycle cooling systems. "Dry" closed-cycle cooling systems use air to transfer heat to the atmosphere without the evaporation of water. Hybrid mechanical-draft systems combine wet and dry systems to cool water.

Hybrid systems can be configured in a variety of ways to accommodate system throughput parameters and site-specific environmental constraints, such as water and energy conservation.

The particular design that is chosen would depend on the objective(s) to be achieved, such as visible plume abatement, water conservation, or plant performance. Plume abatement, which refers to mitigating or eliminating cooling-tower-induced fog, is typically required in applications near major highways, airports, residential areas, or commercial areas. The drawback of this design is the energy penalty that results from the additional energy required to operate the hybrid towers. If both plume abatement and optimum plant performance are the objectives, custom hybrid designs are possible. There are maintenance and operations trade-offs and capital and operational costs that would need to be factored into any system design.

Because natural-draft and mechanical-draft wet and hybrid cooling-tower systems transfer waste heat to the atmosphere by evaporating water, water is naturally lost from the system. This results in an increased concentration of dissolved solids (salts and minerals) in the cooling-system water. Consequently, a fraction of this mineral-rich stream must be discharged to a receiving water body as “blowdown” to maintain proper cooling-system operation. Drift is circulating water, in the form of mist or liquid water droplets entrained in the exhaust air stream, that is transported by the air draft of the tower. Drift droplets contain suspended and dissolved solids that were constituents of the circulating water. The water required to replace water lost through evaporation, blowdown, and drift is called “makeup” water. The number of times water can be recirculated (cycles of concentration) is based on the ratio of total dissolved solids (TDS) in the recirculating (blowdown) water relative to the makeup water. For cooling-water systems that use salt water or brackish water, the industry standard is two or fewer cycles of concentration.

The water evaporated from cooling towers can form a visible plume and lead to localized fogging and icing, depending on atmospheric conditions. Fog formation occurs when warm moist vapor exits the cooling tower, cools to the dew-point temperature or below, and condenses onto condensation nuclei such as sea salt. Condensation occurs because the capacity of air to hold water vapor decreases as the air is cooled. These conditions occur frequently during winter months, but can also occur throughout the year, particularly during the spring or fall. Cooling and fog formation occur readily when the wet cooling-tower air is at supersaturation in the presence of sufficient concentrations of condensation nuclei. If these nuclei are in sufficiently high concentrations, fog formation can occur at less than (but near) saturation levels.

In response to an NRC request for additional information (NRC 2005), AmerGen provided an evaluation of six types of closed-cycle cooling systems: (1) natural-draft, (2) linear mechanical-draft, (3) round mechanical-draft, (4) dry air-cooled, (5) linear hybrid mechanical-draft, and (6) round hybrid mechanical-draft (AmerGen 2006). The evaluation considered several characteristics of each cooling system, including required land area, noise, energy penalty, cost, and construction time. A natural-draft tower was not considered a feasible alternative for the site for several reasons, including concern over visual aesthetics impacts resulting from a 500 ft tall tower, Federal Aviation Administration (FAA) concerns, and cost.

AmerGen identified a linear hybrid mechanical-draft closed-cycle cooling system, configured in series (dry following wet), as the optimal type for OCNGS (AmerGen 2006).

The hybrid design refers to a combination of a wet mechanical-draft cooling tower with a dry air-cooled component added to the top to minimize or eliminate ground fogging. The impacts of constructing and operating a linear hybrid mechanical-draft cooling-tower system were evaluated and are discussed in Section 8.1.1.2.

If plume abatement is not a primary objective, design alternatives exist that could achieve smaller energy penalties required to operate the tower while also allowing for sufficient reduction in the visible plume. One design alternative would be similar to the system selected as the most viable alternative by AmerGen, but with a larger footprint design (e.g., larger cell design) that would provide greater reduction in return water temperature, which would reduce turbine back pressure. Another design alternative would be a parallel wet-dry system, which would provide greater flexibility in setting wet-dry tower cell operation levels (actuator controls on groups of cells) to achieve the greatest plume abatement during the cold winter season and the lowest energy loss during the hot summer season.

At the public meeting held on July 12, 2006, the NRC committed to additional evaluation of a dry cooling system for OCNGS. There are basically two types of dry cooling systems, direct and indirect. In these dry cooling systems, evaporation of water is not used to cool circulating water. In a direct dry system, steam is condensed directly by air in a heat exchanger called an air-cooled condenser (ACC), and the condensate is returned to the steam cycle in a closed loop. Power plants that use direct dry systems are located primarily outside the United States and use fans (mechanical draft) to distribute air through the ACC. ACCs reject heat by conducting it directly from the condensing steam to the ambient air by forcing the air over the heat conducting surface. Indirect dry cooling systems incorporate the use of a dry cooling tower in combination with a steam surface condenser or with a direct contact jet condenser. Either mechanical- or natural-draft technologies can be used for providing the required cooling air flow. Indirect systems, which originated in Western Europe and the Middle East, offer increased flexibility with regard to location of the dry heat exchanger on the plant, but are not as economic as a direct dry system using an ACC (Szabo 1998). In the United States, most of the dry cooling system applications for power plants are for small plants with a capacity less than 100 megawatts electric (MW(e)) (Micheletti et al. 2002). Most installations are for small combined-cycle fossil fuel plants.

In an evaluation of cooling-system applications, the EPA concluded that “dry cooling is not technically or economically feasible for all facilities subject to this rule [316(b) regulations], would increase air emissions due to the energy penalty, has a cost more than three times that of the selected regulatory option, and would not significantly reduce impingement and entrainment beyond the regulatory approach selected by EPA to offset these drawbacks” (EPA 2001). Specifically, the EPA noted that the comparative energy penalty of a dry cooling plant in a hot environment at peak summer conditions could exceed 12 percent, thereby making dry cooling unfavorable in many areas of the United States for some types of power plants. A 12 percent penalty would be more than twice (about 76 MWe) the energy penalty estimated for AmerGen's preferred linear hybrid mechanical-draft system.

In addition to performance issues, dry cooling-system designs require larger footprints than conventional wet natural-draft hyperbolic cooling towers, wet mechanical-draft towers, or hybrid wet-dry systems. This larger size is due to differences in the heat transfer mechanisms or cooling thermodynamics between wet and dry systems. Wet systems rely on evaporative or latent heat transfer to cool the recirculating water, while dry systems rely on the difference in temperature between the air and the ACC coils or sensible heat transfer to return coolant water. Because sensible heat transfer is less efficient than evaporative heat transfer, dry cooling systems must be larger than wet cooling systems. Therefore, to achieve a comparable heat rejection, one study estimates that a direct dry cooling system will have a footprint approximately three to four times larger than a wet cooling tower (EPA 2001a). Given a base diameter of approximately 400 ft, a natural-draft cooling tower would occupy approximately 3 ac. A comparable dry tower would occupy approximately 9 to 12 ac. With additional associated structures and roadways, the total footprint for a dry tower system is estimated to be 15 to 20 ac or about 1.5 to 2 times the footprint of the proposed linear hybrid mechanical-draft system at OCNGS.

The NRC staff concluded that the energy penalty associated with operation of the dry towers, the large size of the footprint of the heat dissipation system, the significant capital cost of construction, and the lack of experience by the industry in retrofitting such a system to a nuclear plant eliminates such a system from serious consideration. Therefore, the staff did not conduct any further evaluation of dry cooling towers.

8.1.1.1 Description of the Closed-Cycle Cooling Alternative

The following summary description of the linear hybrid mechanical-draft cooling-tower system evaluated in this section is based on information provided by AmerGen (AmerGen 2006), unless otherwise noted.

The linear hybrid mechanical-draft cooling-tower system would include two new cooling-tower units and two new circulating-water pump houses. Heated water from the circulating-water discharge flume would be routed to the cooling towers via a 12-ft-diameter underground concrete pipe. After circulating through the cooling towers, cooled water would be routed to the circulating-water supply flume via a second 12-ft-diameter underground concrete pipe.

The potential location identified for the cooling towers is in the northern portion of the OCNGS site in an area bounded by the intake canal and U.S. Highway 9 (Figure 8-1). Approximately

13.5 ac would be disturbed during construction, with 10 ac permanently converted to structures or impervious surfaces.

Each cooling-tower unit would consist of 18 back-to-back cooling-tower cells installed in two rows constructed of fiberglass with polyvinyl chloride fill. Each cell would contain its own 250-horsepower mechanical-draft fan. Each cell also would include a "dry" section at the top that could be used to add heat to the exhaust plume to dissipate fog when fogging is likely to occur (winter). Each cooling tower would be 80 ft tall and located in a concrete basin 120 ft wide, 500 ft long, and 6 ft deep. The total design flow for the closed-cycle system would be 460,000 gallons per minute (gpm). A potential site configuration identifying the cooling tower units is shown in Figure 8-1.

The cooling towers would have two cycles of concentration. The current circulating-water intake would be reconfigured to provide makeup water. The makeup water design flow rate would be approximately 20,000 gpm, with 10,000 gpm required for water lost to evaporation and drift, and 10,000 gpm required for water lost to blowdown. The blowdown water would be piped to the existing dilution pump structure where it would flow into the discharge canal. One dilution pump (260,000 gpm) would remain in operation to dilute the blowdown.

AmerGen estimates that construction of the linear hybrid mechanical-draft cooling-tower system would take approximately 2 years. Construction would require several new structures as well as modifications to existing plant structures. New structures and equipment would include interconnections between the existing intake and discharge flumes and the new circulating-water piping; the two below-grade 12-ft-diameter pipes to convey circulating water to and from the cooling towers; two pumping stations; two cooling-tower units; and cooling-tower makeup and blowdown systems. The two 12-ft diameter circulating-water pipes would be located 60 ft below grade at their deepest point to avoid utility interferences, and would require continuous dewatering during construction. Modifications to existing plant structures and equipment would include the relining of existing cooling-water system flumes with steel plates in response to increased operating and transient pressures, and the replacement of the existing condenser-water boxes.

AmerGen estimates that the implementation of a closed-cycle cooling system would result in a net annual reduction in power production. The annual average power loss at OCNGS is estimated to be 32.5 MW(e). This loss is a result of the decrease in the steam turbine efficiency from cooling-tower-induced back pressure during spring, fall, and winter operations, plus the electrical demand required to operate the pumps, fan, and ancillary equipment associated with the cooling towers.

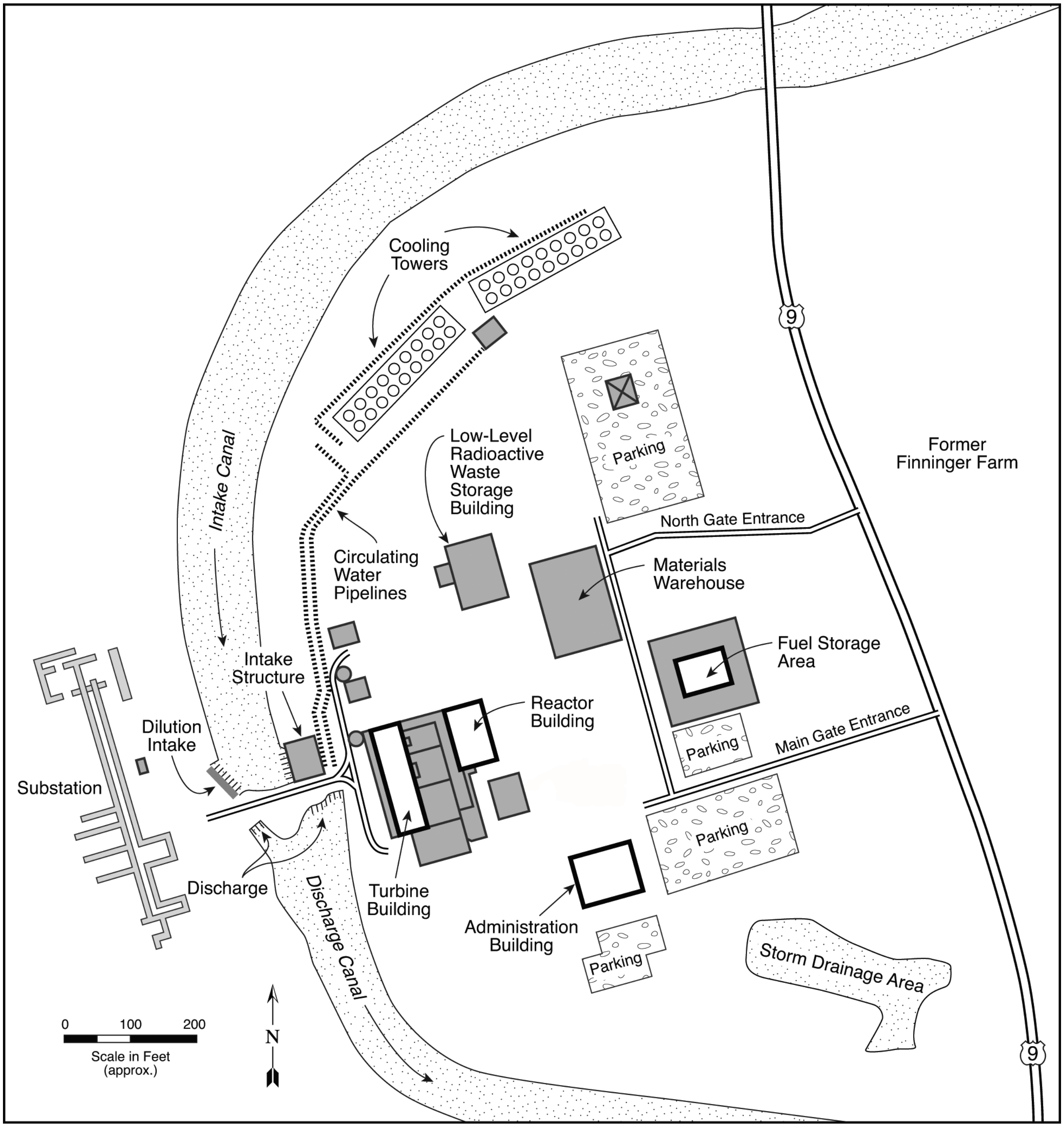

Figure 8-1. Potential Location and Configuration of a Linear Hybrid Mechanical-Draft Cooling-Tower System at OCNGS

8.1.1.2 Environmental Impacts of the Closed-Cycle Cooling Alternative

This section discusses the impacts that would occur if AmerGen replaced its existing once-through cooling system with the closed-cycle cooling system described in Section 8.1.1.1. The use of linear hybrid mechanical-draft cooling towers would result in a substantial reduction of water withdrawn from Forked River and Barnegat Bay. The assessment examines impacts related to both construction and operation of the linear hybrid mechanical-draft cooling system in each of 10 impact categories. Anticipated impacts of the closed-cycle cooling alternative are summarized in Table 8-1. For most issues, the impacts of operating this closed-cycle cooling system would be less than the impacts associated with the existing once-through cooling system presented in Sections 4.1, 4.6, and 4.8 of this SEIS. Some increase in impacts would occur to land use, aesthetics (visual and noise), and air quality (salt drift).

- **Land Use**

  Construction of cooling towers on the OCNGS site would disturb approximately 13.5 ac, with 10 ac permanently converted to structures or impervious surfaces such as roadways and parking areas (AmerGen 2006). The towers would be located on the site west of U.S. Highway 9, adjacent to existing OCNGS facilities and the intake canal; this site is currently occupied by grass, shrubs, and trees. The 150,000 yd^3 of excavated soil accumulated during construction would be used for fill material on the site and would not require offsite transportation or disposal (AmerGen 2006).

  Construction of cooling towers on the OCNGS site is under the jurisdiction of New Jersey's coastal management program within the NJDEP's Division of Land Use Regulation. Current restrictions under the requirements of the New Jersey Coastal Area Facility Review Act (CAFRA) limit the percentage of impervious surface area for Lacey Township; these restrictions would not necessarily limit the applicant's ability to build the cooling basin and towers on the OCNGS site (AmerGen 2006).

  The NRC staff concludes that the impact to onsite land use would be limited to approximately 13.5 ac of previously disturbed land on the existing OCNGS site; therefore, the impact would be SMALL. An effective storm water plan for the cooling tower complex and the possibility of converting some existing impervious surfaces (such as parking facilities) to surfaces that are pervious to water could offset any adverse impacts associated with groundwater infiltration.

  The development of cooling towers could result in land-use changes offsite, as a result of temporary increases in regional population during construction with direct and indirect employment at the site and in the economy of the surrounding area. During operation, local tax revenues may increase because of increases in property taxes levied on the plant leading to the construction of new public service facilities.

Table 8-1. Summary of Environmental Impacts of a Closed-Cycle Cooling Alternative and a Modified Existing Once-Through Cooling System with Restoration Alternative at the OCNGS Site

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	**Comments**	**Impact**	**Comments**
Land use	SMALL	Would require disturbance of about 13.5 ac of previously disturbed land on the OCNGS site. Could require a variance in restrictions to the percent of impervious land cover on the site. Minor impacts are anticipated to offsite land use.	SMALL to MODERATE	No impacts on onsite land use are anticipated. Would require disturbance of an unknown amount of land for restoration offsite, and restoration could affect land use in the surrounding area. Impact would depend on the location and size of the site chosen.
Ecology – aquatic resources	SMALL	Entrainment and impingement of aquatic organisms would be reduced from current levels commensurate with a 70 percent decrease in water intake rates. Thermal discharge and increased concentrations of salt and contaminants in blowdown would be mitigated with continued operation of the dilution-pump system. Impacts of construction would be reduced using best management practices to control erosion and runoff.	SMALL TO MODERATE	Impacts related to entrainment, impingement, cold shock, and heat shock would be slightly less than those under existing operations. Short-term adverse impacts on aquatic resources would result from restoration activities and could range from SMALL to MODERATE, depending on the location and size of the site chosen. Long-term benefits to aquatic resources from restoration are anticipated.

Table 8-1. (contd)

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	**Comments**	**Impact**	**Comments**
Ecology – terrestrial resources	SMALL	Approximately 13.5 ac of previously disturbed terrestrial habitats would be developed. Impacts on wetlands would be avoided to the extent practicable. Salt drift could favor salt-tolerant plant species adjacent to the cooling towers.	SMALL to MODERATE	No impacts on terrestrial ecology would result from modifications to the existing system at OCNGS. Short-term adverse impacts on terrestrial resources would result from restoration activities and could range from SMALL to MODERATE, depending on location and size of the site chosen. Long-term benefits to terrestrial resources from restoration are anticipated.
Water use and quality – surface water	SMALL	Thermal impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides would be released; however, they would be diluted with the dilution-pump system.	SMALL	No change in impacts from current levels are anticipated with operation of a modified once-through cooling system. Restoration activities could produce short-term adverse impacts on surface water, but these would be controlled using best management practices.
Water use and quality – groundwater	SMALL	Short-term dewatering of excavations, but no anticipated effect on groundwater resources.	SMALL	No change in impacts on groundwater from current levels are anticipated with operation of a modified once-through cooling system at OCNGS. No impacts on groundwater are expected from restoration activities.

Table 8-1. (contd)

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	**Comments**	**Impact**	**Comments**
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be SMALL. Impact of operations on air quality would be MODERATE, with an estimated 261 tons/yr PM_{10} emissions (mostly in the form of salt).	SMALL	No change in impacts on air quality from current levels are anticipated with operation of a modified once-through cooling system at OCNGS. Restoration could have minor short-term impacts if prescribed burning is used to maintain restored sites.
Waste	SMALL	Construction waste and small amounts of process waste (e.g., biocides) would be generated and disposed of at approved offsite facilities. Occasional dredging may be required, but spoils would be managed according to State regulations.	SMALL	Construction waste and small amounts of process waste (e.g., biocides) would be generated and disposed of at approved offsite facilities. Restoration activities could produce some wastes (e.g., plant material, soils, and dredged sediments) that would be disposed of according to State regulations.
Human health	SMALL	Minor impacts on the public and workers associated with potential exposure to radiation during excavation and construction activities. Minor risk to workers associated with industrial accidents. No impacts on human health during operations.	SMALL	Minor impacts on workers associated with cooling-system modification. Restoration activities would present a slight risk of injuries to workers.

Table 8-1. (contd)

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	Comments	Impact	Comments
Socioeconomics	SMALL	Up to 200 workers would be needed during the peak of the 2-year construction period. An additional 24 workers would be needed during operations. Increases would be unlikely to impact housing and public services. Increases in traffic would be small.	SMALL	Modifications to the existing cooling system would require little if any increase in the workforce at OCNGS. The impacts of restoration on employment and tax revenues resulting from construction and operation and from increases in tourism would be dependent on the location and size of the site chosen.
Aesthetics	SMALL to MODERATE	Minor short-term impacts on visual aesthetics and noise would occur during construction. Operation of cooling towers could produce a visible plume under some atmospheric conditions and also could increase noise levels at offsite locations.	SMALL	Construction activities would not significantly affect visual aesthetics or increase noise levels at OCNGS or surrounding areas. Restoration activities could have short-term adverse impacts on visual aesthetics, but would likely produce a long-term benefit.
Historic and archeological resources	SMALL	A cultural resource inventory would be needed to identify, evaluate, and mitigate the potential impact of construction on cultural resources. Given the fact that the site was previously disturbed, the impacts on cultural resources are expected to be SMALL.	SMALL to MODERATE	No impacts are anticipated on the OCNGS site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of restoration activities. Impacts would depend on the characteristics of the sites chosen.
Environmental justice	SMALL	No significant impacts are anticipated that could affect minority and low-income communities.	SMALL	No significant impacts are anticipated that could affect minority and low-income communities.

Cooling-system construction is likely to employ approximately 200 workers during peak construction months, and 100 workers for the remainder of the 2-year construction period (AmerGen 2006). Operation of the cooling system would require approximately 24 new permanent employees. A small number of additional jobs would be created indirectly in the region as a result of construction and operation of the cooling system. Compared with total employment in the regional economy, increases in direct and indirect employment would be minor, and would be unlikely to impact land use.

Construction of the closed-cycle cooling system at the site would increase the value of OCNGS property, producing a small increase in property tax revenues for Lacey and Ocean Townships during plant operation. Compared with the existing property tax base, however, these increases are expected to be inconsequential, and not likely to result in any impacts on offsite land use.

The NRC staff concludes that the impact on offsite land use of construction and operation of a closed-cycle cooling system would be SMALL. This is because there would be no utilization of any offsite land for construction and operation of the closed-cycle cooling system, and because changes in land use resulting from increased employment and tax revenues would be very small compared with existing levels in the township and county.

- **Ecology**

Aquatic ecology. Construction of the alternative closed-cycle cooling system may create short-term, localized impacts on aquatic resources from site runoff; these can be mitigated, however, through the use of physical barriers (e.g., silt fences and hay bales) or sediment traps. Because this alternative uses the existing intake, dilution-pump, and discharge systems, construction-related impacts would be reduced.

The closed-cycle cooling alternative would greatly reduce entrainment and impingement losses when compared with the existing once-through cooling system. The highest water use is expected to occur during the summer when the system functions in full evaporative-mode cooling. Using this operational mode, approximately 280,000 gpm (dilution and makeup water) would be withdrawn from Forked River, representing a 70 percent reduction in water use relative to the existing once-through system (980,000 gpm). This would result in a substantial reduction in entrainment-related losses relative to the losses sustained by the current once-through cooling system.

Makeup water (design requirement of 20,000 gpm) would be withdrawn from Forked River through the existing circulating-water intake that utilizes Ristroph traveling screens and a fish-return system. Half of this water is evaporated in the cooling tower, and the remainder is discharged into Oyster Creek through the existing discharge canal. The existing dilution-pump system would be used to withdraw approximately 260,000 gpm from Forked River and discharge it directly into Oyster Creek. The dilution-pump system includes trash racks but no traveling screens. Although impingement would be substantially reduced by using this system, the reductions in impingement losses would only be evident for those species known to have high impingement mortality (e.g., bay anchovy [*Anchoa mitchilli*], Atlantic silverside [*Menidia menidia*], and Atlantic menhaden [*Brevoortia tyrannus*]; see Section 4.1.2). Species with low impingement mortality (winter flounder [*Pseudopleuronectes americanus*], sand shrimp [*Crangon septemspinosa*], and blue crab [*Callinectes sapidus*]) would be less affected by this alternative. The reduction in flow may also reduce sea turtle impingements.

Under the closed-cycle cooling alternative, most water discharged into Oyster Creek would be unheated water from Forked River that is discharged through the dilution-pump system. Thus, it is likely that any thermal impacts would be confined to an even smaller part of the discharge canal and Oyster Creek, and the thermal plume that currently exists in Barnegat Bay would be significantly reduced.

Under the closed-cycle cooling alternative, evaporative cooling may result in the discharge of higher salinity water containing higher concentrations of biocides, minerals, trace metals, or other chemicals or constituents when compared with the discharge water characteristics associated with the existing once-through system. These impacts would be mitigated by the continued operation of the dilution-pump system, which would represent approximately 95 percent of the flow into the discharge canal under full evaporative-mode cooling.

Operation of the closed-cycle cooling alternative would produce substantially fewer impacts to the aquatic environment relative to those caused by the existing once-through system. The NRC staff concludes that the aquatic ecological impacts (including those on threatened and endangered sea turtles) from the construction and operation of the closed-cycle cooling alternative at the OCNGS site would be SMALL.

Terrestrial ecology. Construction of the closed-cycle cooling system would disturb 13.5 ac, with 10 ac permanently converted to structures or impervious surfaces. The area to be disturbed consists mostly of grasses, shrubs, and several mature trees (AmerGen 2006). The wetlands and their transition areas that occur within the 27.7-ac project area would be avoided to the extent practicable. A wetland determination and transition area determination would be undertaken prior to construction and, if necessary, a Freshwater Wetlands Permit and Transition Area Waiver would be required from the NJDEP (AmerGen 2006). Impacts on terrestrial ecology would include localized habitat loss and fragmentation, reduced productivity, and reductions in biological diversity. During the construction period, less mobile wildlife could be adversely affected, and some wildlife disturbance could occur from noise and the presence of construction personnel. Preconstruction surveys for threatened and endangered species would be necessary to determine if these species are present, and if any species are identified, potential agency constraints or mitigation may be required.

Fogging, humidity, and icing from cooling towers would be largely eliminated by the use of the hybrid cooling system; therefore, impacts on crops and ornamental vegetation from these events would be negligible. However, salt deposition from cooling-tower drift, even with the use of drift-elimination technology, could affect vegetation. When saltwater droplets are released to the air as a result of cooling-tower operations, they may land on vegetation or the soil. When the water evaporates, a layer of salt would remain, which could harm plant leaves or roots. The amount and effects of this salt would vary depending on a number of factors, including the concentration of salt in the droplets, the size of the droplets, the number of droplets per area, the species of plant affected, and various other factors, including the frequency of local precipitation.

One study of the impacts of salt drift on vegetation found that woody plants, like trees, were more sensitive to salt than nonwoody (herbaceous) species, like grasses. This study found that a 0.5 percent (5000 parts per million [ppm]) solution of chloride or 0.2 percent (2000 ppm) solution of sodium would cause margin or tip burn of woody plant leaves, with some species (including flowering dogwood [*Cornus florida*]) being more sensitive to salt spray (Lauver et al. 1978). Dogwoods, as one of the most sensitive native species, could be affected by rates as low as 4.4 lb/ac/month. Other species (e.g., witch hazel [*Hamamelis* spp.]) have tolerance levels that may be in excess of 3700 lb/ac/month (Talbot 1979).

In another study, it was found that species like eastern white pine (*Pinus strobus*), Canada yew (*Taxus canadensis*), American beech (*Fagus grandifolia*), and mosses are more affected by salt drift, while species like beach grass (*Ammophila breviligulata*) and goldenrod (*Solidago caesia*) were less affected (Roschow 1978). Salt may also pose a threat to vegetation if it accumulates in soils. This could occur if salt accumulates at rates of 89 lb/ac/month (McCormick et al. 1978).

In the EIS for the Forked River Nuclear Station (AEC 1973), which would have been located adjacent and to the west of OCNGS, it was stated that the chloride content of the surface soils within a 5-mi radius of the proposed plant averaged about 6 ppm, and that over time this concentration would increase by about 0.5 to 0.6 ppm of chloride from the operation of the plant's saltwater cooling tower. This increase in soil salinity was considered to be of negligible consequence.

Salt deposition below 8.9 lb/ac/month is not expected to cause visible leaf damage (NRC 1996). On average, salt deposition below this level would occur at distances greater than 2600 ft from the cooling towers; however, in the west direction, salt deposition below this level would occur at distances greater than 4300 to 4600 ft from the cooling towers (AmerGen 2006).

Most native and invasive species (such as the common reed [*Phragmites australis*]) that occur near the bay are salt tolerant; however, ornamental plants and some vegetation in natural habitats such as pinelands and wetlands may be adversely affected by localized salt deposition. Long-term impacts near OCNGS may result in a gradual change in some plant communities from salt-sensitive to salt-tolerant species (AEC 1973).

The cooling towers would be about 80 ft tall and would produce minimal ground fog and visible plume (AmerGen 2006). As a consequence, collisions of birds (including the bald eagle [*Haliaeetus leucocephalus*], a Federally listed species that could occasionally occur in the area) with the towers are expected to be negligible (NRC 1996). Noise from cooling-tower operations may cause localized disturbance to wildlife, although resident wildlife would be expected to acclimate to this noise source. No other wildlife impacts would be expected from cooling-tower operations.

Overall, the NRC staff concludes that the terrestrial ecological impacts (including those to threatened and endangered species) from the construction and operation of the closed-cycle cooling system alternative at the OCNGS site would be SMALL.

- **Water Use and Quality**

During construction of the alternative closed-cycle cooling system at OCNGS, changes in water usage would likely be negligible. Potable water demand for workers may increase, but commonly used portable toilet facilities would lessen the overall water demand onsite of the worker population. If concrete is mixed onsite, water needs would be a short-lived demand on site water resources. This water would likely come from the site's two wells, which, as discussed in Section 2.2.2, are typically pumped far below their capacities or their permitted rates.

Below-ground construction operations, such as the installation of two circulating-water pipelines, would create a need for localized dewatering of the Cape May Formation and the Miocene Cohansey-Kirkwood Formation. For the dewatering, a permit would be needed from the NJDEP (AmerGen 2006).

Construction of the closed-cycle cooling system would require an NJPDES permit for stormwater discharges from construction activities, in the form of a Construction General Permit issued by the Ocean County Soil Conservation District (AmerGen 2006). In addition, a Soil Erosion and Sediment Control Plan would need to be certified by the Ocean County Soil Conservation District. The use of silt fencing and other erosion-control practices during construction could minimize impacts on surface-water quality.

Construction of the closed-cycle cooling system would result in increased impervious surface cover, which is regulated under CAFRA. According to AmerGen (2006), it is uncertain whether the site's surface cover after the construction of cooling towers would meet CAFRA requirements. Further discussion of this topic is provided under the above land-use discussion.

During the operations of the closed-cycle cooling system, evaporative losses would be replaced with makeup water taken from the intake canal at a rate of 10,000 gpm (AmerGen 2006). Because of evaporation, the concentrations of dissolved and suspended solids in the circulating water would increase. These minerals would affect the operation and efficiency of the system because of scale deposits. A portion of the circulating water known as blowdown would be removed from the circulating-water system at a rate of 10,000 gpm. This water would have a higher mineral content but would be diluted in the discharge canal by a dilution pump operating at 260,000 gpm (AmerGen 2006). The reversed-flow condition in the portion of Forked River between the intake canal and Barnegat Bay would likely be maintained because of the continued operation of one dilution pump, but the flow rate in Forked River would decrease by about 70 percent.

Makeup water would be withdrawn from the intake canal through the intake structure and would pass through filter skids to remove silt, suspended solids, biological material, and windblown debris (AmerGen 2006). Calcium hardness of cooling water would be reduced by lime softening (AmerGen 2006). The reduced hardness would enable the cooling system to operate within 2 to 2.5 cycles of concentration. Excess lime sludge from the softening process would be collected, concentrated, and dewatered prior to offsite disposal.

Because of the warm environment in the closed-cycle system, biofouling organisms would be expected, and biocides, such as sodium hypochlorite, would be needed (AmerGen 2006). Other chemicals, such as acids, dispersants, scale inhibitors, foam suppressants, and dechlorinators may be needed (AmerGen 2006). The use of biocides or any other chemicals would require a revision to the NJPDES permit and ongoing monitoring (AmerGen 2006). Storage of additional chemicals at the facility could require a new or modified Discharge Prevention, Containment, and Countermeasure Plan and a Discharge Cleanup and Removal Plan (AmerGen 2006).

On the basis of these considerations, the NRC staff concludes that impacts of the closed-cycle cooling system alternative on surface water and groundwater use and quality would be SMALL.

- **Air Quality**

In assessing the impacts of constructing a closed-cycle system at OCNGS, the following assumptions were made based on AmerGen (2006): (1) construction would occur over a 2-year period; (2) 200 construction workers (100 workers for each of two shifts) would work over a 150-day period; (3) the balance of construction days would require 100 construction workers divided evenly between two shifts; and (4) the construction workforce would commute from within a 50-mi radius of the site.

Emissions generated during construction would consist of exhaust emissions of carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOCs), sulfur oxides (SO_x), and particulate matter (particulate matter with a mean aerodynamic diameter of 10 µm or less [PM_{10}]) from operation of gasoline and diesel-powered heavy-duty construction equipment, delivery vehicles, and worker's personal vehicles. Site clearing and excavation would generate fugitive dust (PM_{10}). Fugitive dust would also be generated from vehicular onsite construction traffic. The disturbed area for the cooling towers, pipelines, roadways, and laydown areas is estimated to be 13.5 ac. Given the small disturbed area that would be involved and commitment to best management construction practices (e.g., watering, silt fences, covering soil piles, revegetation, etc.), the fugitive dust impacts generated during construction should be minor. VOC emissions would be generated from asphalt paving and painting activities. The amount of pollutants emitted from construction vehicles and equipment and construction worker traffic would be small compared with total vehicular emissions in the region.

As noted in Section 3.3 of the GEIS (NRC 1996), a conformity analysis is required for each pollutant where the total direct and indirect emissions caused by a proposed Federal action would exceed established threshold emission levels in a nonattainment or maintenance area. Because of Ocean County's ozone nonattainment status, the generation of NO_x and VOCs, which combine in the presence of heat and sunlight to create ozone, is a source of concern. The generation of CO is also a potential concern because of the county's status as a CO maintenance area. New Jersey's threshold rates are a net increase of 25 tons/yr for VOCs, 25 tons/yr for NO_x and 100 tons/yr for CO (Table 3 of Title 7, Chapter 27, Subchapter 18, of the *New Jersey Administrative Code* [NJAC 7:27-18.7]). Since the estimated annual emissions (using emission factors from EPA 1995a) for all three pollutants are less than these threshold levels, a conformity determination would not be required (AmerGen 2006).

The design for the proposed hybrid cooling system would have the wet portion of the system operating fully and continuously throughout the year and the dry portion of the system off in the summer and in full operation the rest of the year. During times when fogging is most likely to occur (winter, spring, and fall), the tower would be operated in a combined mode with the dry section adding heat to the exhaust plume to dissipate the visible fog. During seasons when fogging is least likely to occur (summer), the tower would be operated in the full wet mode typical of operation of a conventional mechanical-draft cooling tower (AmerGen 2006).

Because the wet section of the linear hybrid-mechanical draft cooling-tower alternative would always be operated in a fully opened mode (AmerGen 2006), the direct contact between the cooling water and the air passing through the tower would cause some water to be entrained in the air stream and to be carried out of the wet section of the tower as drift droplets. As the water component of the drift evaporates in the atmosphere, dissolved and suspended solids in the water droplets become suspended particulates, which are typically classified as PM_{10} emissions. To minimize PM_{10} emissions, the OCNGS cooling towers would incorporate drift-elimination devices,[a] which are now designed to be capable of achieving a maximum drift-reduction level of 0.0005 percent of the amount of circulating-water flow. Since the actual magnitude of the drift losses is influenced by the number and size of the droplets produced within the cooling tower, which in turn are determined by the fill design, the air and water flow patterns, and other interrelated factors, the actual achievable drift reduction would vary. Tower maintenance and operation levels also can influence the formation of drift droplets. For example, excessive water flow and excessive airflow can influence water bypass of the drift eliminators, which can increase drift emissions.

The primary air pollutant of concern associated with the operation of the mechanical-draft hybrid cooling-tower alternative at OCNGS is particulate matter (PM_{10}) emissions from cooling-tower drift. These emissions can be estimated with the following operating parameter assumptions: (1) a water circulation rate of 460,000 gpm and (2) drift controlled to 0.00005 percent of the circulation rate. The maximum total suspended solids (TSS) and TDS in the circulating water are estimated to be 2.5×10^9 ppm (AmerGen 2006). Intake water density at the surface is 64.12 lb/ft^3 (3.5 percent salt content).

With these data, the total drift emissions rate (salt, other TDS, and TSS) from both cooling towers can be calculated as 60 lb/hr or 261 tons/yr. Approximately 70 percent of the drift is salt, with the remainder being impurities (e.g., chemical additives and bay water contaminants) in the circulating and makeup water. These drift emissions would exceed the threshold for major air pollution sources and would exceed the current NJDEP emission limit of 30 lb of particulate matter[b] per hour (as provided at NJAC 7:27-6.1). Since the salt drift

---

(a) High-efficiency drift eliminators of modern design can potentially control the drift to less than 0.0005 percent of the cooling-tower circulating-water flow. The drift eliminators used in cooling towers rely on inertial separation caused by direction changes while passing through the eliminators. Drift eliminators can be configured to include herringbone (blade-type), wave form, and cellular (or honeycomb) designs. The cellular units generally are the most efficient. Drift eliminators may include various materials, such as ceramics, fiber-reinforced cement, fiberglass, metal, plastic, and wood, installed or formed into closely spaced slats, sheets, honeycomb assemblies, or tiles (EPA 1995a). Some of the new designs use materials and unique configurations that include other features, such as interlaced monofilaments, each forming a V-shaped arrangement to enhance the drift removal further.

(b) Particles are defined in NJAC 7:27-6.1 as “any material, except uncombined water, which exists as liquid particles or solid particles at standard conditions.”

alone would exceed the State standard, water-contaminant treatment options (e.g., filtration) would not achieve compliance. AmerGen (2006) has examined saltwater desalinization technology and determined it to be cost-prohibitive. The hybrid closed-cycle cooling tower would need a Prevention of Significant Deterioration (PSD) construction permit and a Title V operating permit from the State, since the potential to emit PM_{10} exceeds 250 tons per year.

Since the potential to emit PM_{10} exceeds the 250 tons/yr major source definition under the PSD new-source construction and under the Title V operating permit regulations of the Clean Air Act (CAA), the alternative closed-cycle hybrid cooling tower would need a PSD construction permit and a Title V operating permit from the State.

AmerGen estimated air quality impacts associated with cooling-tower drift emissions by using a standard EPA conservative screening model called SCREEN3 (EPA 1995b). The screening analysis showed, even with the optimal drift-eliminator efficiency of 0.0005 percent, that the predicted downwind concentrations of PM_{10} emitted from the cooling tower would exceed the Federal and State ambient air quality standards, and the PSD PM_{10} Class II increments. State permitting requires demonstration of compliance with all Federal and State ambient air quality standards and the application of Best Available Control Technology for a new cooling tower installed at OCNGS.

The assessment of drift-deposition impacts of the proposed hybrid cooling-tower design would require application of applicable cooling-tower plume thermodynamics and buoyancy influences. The Seasonal Annual Cooling Tower Impact (SACTI) Code (EPRI 1987) was used to evaluate impacts of salt drift from linear hybrid mechanical-draft cooling towers at OCNGS (AmerGen 2006). The drift was modeled in the normal spring (wet-dry), summer (wet only), and fall (wet/dry) operational modes. The model results show that the maximum salt deposition of up to 60 lb/ac/month of salt could occur in the area near the switchyard during fall operations. On average, at 2600 ft and beyond, salt deposition remained below 8.9 lb/ac/month, NRC's level of significance for visible leaf damage (NRC 1996). However, with winds out of the east, deposition would be 22 lb/ac/month at 2600 ft in the spring. Surface salt deposition west of OCNGS would fall below the NRC level of significance at downwind distances between 4300 and 4600 ft when winds are from the east (AmerGen 2006).

For the linear hybrid mechanical-draft cooling towers considered in this assessment, the average annual net power loss or energy penalty over the four seasons was estimated to be 32.5 MW(e) (AmerGen 2006). This loss in power production at OCNGS could be offset by energy conservation, purchased power, generation at existing plants on the grid, or new power generation facilities. Although the replacement power would result in some impacts, it is expected that these impacts would be negligible and spread throughout the grid.

On the basis of the above considerations, the NRC staff concludes that the direct and indirect impacts of the alternative closed-cycle cooling system on air quality, particularly those related to increases in PM_{10}, which would result from salt drift, would be MODERATE. The new system would require a State permit for construction and operation, which would require air emissions within acceptable levels.

- **Waste**

Construction of the closed-cycle cooling alternative at OCNGS would generate some construction debris that would require disposal. Approximately 150,000 yd^3 of soil would be excavated during construction and used as fill material on the site. All construction-related waste would be disposed of at approved offsite facilities and in accordance with State regulations. As discussed in Section 2.2.3, sampling at OCNGS has identified several areas of chemical and radiological soil contamination that resulted from historical onsite releases. A number of these areas already have been excavated, removed, and disposed of in accordance with applicable regulations, and the likelihood of encountering significant contamination is considered small. Appropriate sampling and monitoring would be conducted before and during construction, and disposal of contaminated soils is not expected to become an issue.

Small amounts of biocides or other materials used in the cooling system would be produced during operations. Some of this material would be released to the environment in the blowdown water released to the discharge canal and Oyster Creek in accordance with the station's NJPDES permit. Any other such waste would be managed and disposed of in accordance with applicable State regulations at approved offsite facilities. The decrease in flow in the intake and discharge canals and in Forked River and Oyster Creek could change rates and patterns of sediment deposition, and periodic dredging could be required to maintain navigability. Dredge spoils would be managed according to State regulations.

On the basis of these considerations, the NRC staff concludes that waste-related impacts associated with the closed-cycle cooling alternative at OCNGS would be SMALL.

- **Human Health**

Potential human health impacts that could occur during construction of the closed-cycle cooling system at OCNGS include radiological impacts on members of the public and workers and industrial-type accidents and injuries. If current mitigation and as-low-as-reasonably-achievable (ALARA) practices are performing properly, additional mitigation would not be necessary and radiological human health impacts during construction would be inconsequential. AmerGen (2006) provided a site-specific estimate of the radiological dose to workers during OCNGS cooling-tower construction that is a small fraction of the refurbishment dose estimate presented in the GEIS (NRC 1996) for boiling-water reactors.

As discussed in Section 2.2.3 of this SEIS, sampling at OCNGS has identified several areas of chemical and radiological soil contamination that resulted from historical onsite releases. A number of these areas have been excavated, removed, and disposed of in accordance with applicable regulations. With appropriate workplace sampling, monitoring, and industrial hygiene practices, potential soil contamination is not expected to result in significant impacts on human health during cooling-tower construction activities.

During construction activities, there would be a relatively small risk to workers from typical industrial incidents and accidents. Accidental injuries are not uncommon in the construction industry, and accidents resulting in fatalities do occur. However, the occurrence of such events is mitigated by the use of proper industrial hygiene practices, worker safety requirements, and training.

Occupational and public health impacts during construction are expected to be controlled by continued application of accepted industrial hygiene, occupational health, and ALARA practices. Based upon the discussion presented above, the NRC staff concludes that human health impacts during construction of the closed-cycle cooling system would be minimal.

Potential impacts on human health from the operation of closed-cycle cooling towers at nuclear power plants are evaluated in Section 4.3.6 of the GEIS (NRC 1996). The GEIS evaluation focuses on the threat to occupational workers from microbiological organisms whose presence might be enhanced by the thermal conditions found in cooling towers. The microbiological organisms of concern are freshwater organisms. The closed-cycle system at OCNGS would operate using salt water for the circulating-water flow; consequently, enhancement of microbiological organisms is not expected to be a concern.

Therefore, the NRC staff concludes that there would be no impacts of microbiological organisms on human health during the renewal term under the closed-cycle cooling system alternative.

With respect to potential radiological impacts on workers and the public, the NRC staff concludes that operation of a closed-cycle cooling system at OCNGS would not result in any measurable increase in worker exposure or radiation dose to a member of the public. Overall, human health impacts for the closed-cycle cooling-system alternative at OCNGS would be SMALL.

- **Socioeconomics**

  Construction and operation of the closed-cycle cooling system at OCNGS could result in adverse impacts on housing, public services, and traffic in the local area. Impacts would result if increases in employment at the site were large compared with existing employment levels in the local economy, and if the majority of construction and operations workers were to move into the area from elsewhere, creating higher demand for public services that may not be supported by increases in local tax revenues.

  Construction of the system is likely to employ approximately 200 workers during peak construction months, and 100 workers for the remainder of the 2-year construction period (AmerGen 2006). Operation of OCNGS with a closed-cycle cooling system would result in the addition of 24 permanent employees to the operational workforce of 470. A small number of additional jobs would be created indirectly in the surrounding region. Compared with total employment in the region, increases in direct and indirect employment would be small. Additionally, because few if any of the additional workers are likely to migrate into the area from elsewhere, the projected small increase in employment would be unlikely to impact housing and public services. Increases in traffic on U.S. Highway 9, which carries between 14,660 and 20,926 vehicles per day (AmerGen 2005), also would be SMALL.

  During construction and operation of the closed-cycle cooling system at OCNGS, changes in employment at the site and in the region would be small compared with existing employment levels, and increases in employment are not expected to lead to the in-migration of people from outside the region. The NRC staff concludes that the impact of construction and operation of a closed-cycle cooling system at OCNGS on housing, public services, and traffic would be SMALL.

- **Aesthetics**

  During construction of a closed-cycle cooling system at OCNGS, there would be impacts on aesthetics, both in terms of visibility and noise. These are expected to be minor, however, because of their relatively short duration and the presence of vegetative buffers around construction areas.

  The hybrid mechanical-draft towers are expected to be approximately 80 ft tall and would be visible from many viewpoints, including from U.S. Highway 9, Seaside Park, and the Barnegat Bay shoreline. For comparison, the height of the reactor building is 119 ft and the single stack is 368 ft high.

  Operation of the hybrid mechanical-draft cooling towers might produce visual impacts if the plume from the towers were to produce significant quantities of fog and ice associated with the condensation of cooled water vapor. Salt deposition from the plume may also increase dampness and corrosion on surrounding property, which could impact the visual environment. The hybrid mechanical-draft cooling towers under consideration are designed to reduce fog and ice production in the local area. Hybrid mechanical-draft towers could produce more noise than mechanical-draft cooling towers because of the additional noise produced by heat exchangers and the mixing of air in each cooling unit (AmerGen 2006). The operation of cooling fans may also represent a major source of additional noise. It is possible that noise levels at the nearest residential structure would exceed State noise limits, even with the installation of cooling-tower silencing modifications. In the event of high noise impacts, the utility would investigate the possibility of exemptions from local ordinances, land easements, or silencing technologies (AmerGen 2006).

The NRC staff concludes that the impact of construction and operation of a closed-cycle cooling system at OCNGS on aesthetics and noise would be SMALL to MODERATE, based on the size of the cooling towers, the extent of mitigation of fog and ice resulting from condensation of cooled water vapor, and noise levels that would occur at offsite locations.

- **Historic and Archaeological Resources**

The OCNGS site has not been surveyed for historic and archaeological resources, and the potential exists for resources to be present within the site boundaries. Therefore, prior to any ground-disturbing activity, an archaeological survey of the 13.5-ac area proposed for construction of the closed-cycle system would have to be conducted by qualified archaeologists in consultation with the New Jersey State Historic Preservation Office (SHPO) and appropriate Native American Tribes, as required under Section 106 of the National Historic Preservation Act (NHPA). Although the area was disturbed during the original construction of the station, archaeologists would evaluate the level of disturbance to determine whether any intact subsurface resources could be present and develop a survey strategy on the basis of their preliminary evaluation. Although it is unlikely that intact archaeological deposits are present, insufficient data exist to eliminate the possibility of site presence without an on-the-ground inspection. If archaeological resources are present, they would have to be evaluated for eligibility for listing on the National Register of Historic Places (NRHP). No further action would be required of ineligible sites as long as the SHPO and Native American tribes concur with the determination. Eligible sites would require mitigation (e.g., avoidance or data recovery). Mitigation would be determined in consultation with the SHPO and Native American tribes; construction would be able to start once the mitigation efforts are completed and the results accepted. Although impacts of constructing a closed-cycle cooling system at OCNGS could range from SMALL to MODERATE, the impacts would most likely be SMALL because of the small likelihood of intact significant archaeological resources in this mostly disturbed portion of the site, and the ability to mitigate impacts if a significant site is found.

In the SHPO's opinion, the right-of-way of the Garden State Parkway is eligible for the New Jersey State Register of Historic Places. No visual impact on historic resources, including the Garden State Parkway, is anticipated as a result of operation of the closed-cycle cooling system. The impacts of operation of a closed-cycle cooling system on historical and archaeological resources would be SMALL.

- **Environmental Justice**

Construction and operation of cooling towers at OCNGS would have an impact on environmental justice if environmental impacts of cooling-system construction and operation affected minority and low-income populations in a disproportionately high and adverse manner.

Based on NRC staff guidance (NRC 2004), air, land, and water resources within 50 mi of the OCNGS site were examined. Within that area, a few potential environmental impacts (onsite land use, visual aesthetics, noise, PM_{10} emissions) could affect human populations in the immediate vicinity of the site but not in the areas where minority and low-income populations occur. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, which could result in any disproportionately high and adverse effects on minority and low-income populations. The NRC staff concludes that the environmental justice impacts of constructing and operating a closed-cycle cooling system at OCNGS would be SMALL.

8.1.2 Modified Existing Once-Through Cooling System with Restoration Alternative

The NJDEP identified construction and operation of a closed-cycle cooling system (Section 8.1.1) as its preferred alternative to demonstrate compliance with Section 316(b) regulations. However, the NJDEP provided AmerGen another option should the closed-cycle alternative prove to be unavailable to OCNGS. This alternative is to move toward attainment of national performance standards by using design and construction technologies, operational measures, and/or restoration measures. The objective of the NJDEP's restoration requirement is to offset any residual impingement and entrainment losses from the OCNGS cooling system by increasing productivity elsewhere in the Barnegat Bay system. The description and impacts of this alternative are discussed in this section.

8.1.2.1 Description of the Modified Existing Once-Through Cooling System with Restoration Alternative

This alternative would reduce impingement and entrainment losses by retrofitting the existing system with improved technology, altering operations of the system, and implementing restoration measures within Barnegat Bay to meet national performance standards that require

(1) reduction in impingement mortality for all life stages of fish and shellfish by 80 to 95 percent from baseline conditions, and (2) reduction in entrainment for all life stages of fish and shellfish by 60 to 90 percent from baseline conditions. In describing this alternative, the NJDEP acknowledged that there are limited design and construction technologies available to reduce entrainment at this time. As part of a Comprehensive Demonstration Study, and as set forth by the EPA in its Phase II regulations, the applicant must identify appropriate design and construction technologies by January 7, 2008.

The existing OCNGS once-through cooling system is described in Section 2.1.3. This system employs a Ristroph traveling screen system that reduces impingement losses by removing impinged organisms and returning them to the discharge canal, which then flows into Oyster Creek. The NJDEP evaluated various additional impingement-reduction technologies, including their technical feasibility, effectiveness, and costs, in the 1994 NJPDES permit for OCNGS. The alternative technologies that were identified to have the greatest potential to reduce impingement and entrainment at OCNGS were (1) replacing the existing 3/8-in. mesh traveling screens with fine-mesh screen panels; (2) retrofitting dilution-pump intakes with conventional 3/8-in. mesh or fine-mesh traveling screens; (3) retrofitting dilution-pump intakes with fine-mesh centerflow screens; and (4) replacing intakes with fine-mesh wedgewire screens. These options were eliminated from further consideration at OCNGS because they traded off reduced entrainment with increased impingement, or were impractical at the OCNGS site because of the high rate of biofouling or blockage. None of these systems are expected to further reduce losses by 50 percent or more (Summers et al. 1989).

Other possible modifications to the system that might reduce impingement include utilizing a newer traveling screen design (e.g., a multidisc screen system), installation of an acoustic deterrent system for fish, and optimization of the existing fish-return system to reduce fish injuries. The effectiveness of these technologies or operational changes in reducing entrainment and impingement is uncertain. As stated above, none of these alternatives are expected to reduce losses by 50 percent or more.

There are no feasible technologies for nuclear plants with once-through cooling that would substantially reduce entrainment without reducing flow through the plant. AmerGen could modify pumping rates or optimize dilution operations to reduce entrainment losses for targeted species at certain times of the year when they are more susceptible to entrainment.

The NJDEP considers restoration of wetlands in Barnegat Bay to be a viable alternative to minimize the residual impacts of cooling-water systems after the implementation of any additional design and operational modifications. These wetlands provide foraging habitat, provide shelter, serve as nursery areas for early life stages and juveniles of fish and shellfish, and contribute to the aquatic food web. An increase in wetlands in the Barnegat Bay watershed could support increased populations of some species affected by OCNGS cooling-system operations and, thus, offset entrainment and impingement losses of those species. It should be noted, however, that restoration may not offset losses of the species affected by operations, especially if restoration activities occur away from the area of Barnegat Bay near OCNGS.

In the draft NJPDES permit for OCNGS, the NJDEP estimated that a significant area of wetlands would need to be restored if impingement and entrainment losses at OCNGS could not be reduced, but recognized that additional studies would be needed before a final restoration design was determined. In the interim, the NJDEP indicated that it would require AmerGen to initiate a wetlands restoration and enhancement program of a minimum of 350 ac within the Barnegat Bay estuary (and possibly on the Finninger Farm portion of the OCNGS site) as soon as possible.

The NJDEP identified 103 high-priority sites within the Barnegat Bay watershed that could be considered by AmerGen for restoration (NJDEP 2005). The NJDEP also offered methods to implement restoration and focused on options identified in the Barnegat Bay National Estuary Program (BBNEP) *Comprehensive Conservation and Management Plan* (BBNEP 2002), including:

- Protect and improve vegetated buffer zones adjacent to coastal wetlands and freshwater tributaries to maintain continuous riparian corridors for habitat protection and low-impact recreational pursuits,

- Control erosion in threatened shoreline areas, and

- Manage tidal wetlands to preserve unditched wetlands and to rehabilitate wetlands that have been ditched or otherwise altered.

These options will not directly offset impingement or entrainment losses unless they improve survivability of the species and life stages that are affected by operations.

Wetland restoration activities as applied to the mitigation of cooling-water intake structure impacts were described by Hlohowskyj et al. (2003). In general terms, any wetland restoration project requires a number of actions that result in short-term disturbance but long-term benefits. Initial restoration activities typically include (1) establishment of the required hydrologic regime, (2) soil and site preparation, and (3) planting. Hydrologic modification of a site can include installation of structures that control the inflow and outflow of water, the removal of dikes or berms that prevent flooding, the removal of drainage tiles or ditches that drain water away from a site, and the creation of channels or basins. Soil preparation could include grading and recontouring, removal of contaminated sediments, or replacement of sediments. Whenever possible, the original wetland soils are salvaged and used in the restored wetland. Restoration often requires the removal of invasive non-native plant species (e.g., common reed and purple loosestrife [*Lythrum salicaria*]) through the use of herbicides (e.g., glyphosate), prescribed burning, biocontrol, or a combination of techniques. Following the removal of invasive species, the planting of native wetland and upland species along a hydrologic gradient is often required.

Once initial restoration activities are complete, restored wetlands usually require periodic maintenance such as prescribed burning, herbicide application, and planting to maintain the desired mix of native plant species. These activities could be required throughout the license renewal period.

8.1.2.2 Environmental Impacts of the Modified Existing Once-Through Cooling System with Restoration Alternative

This section discusses the impacts that would occur if AmerGen modified its existing once-through cooling system and undertook a wetland restoration program to offset impacts of the existing system on aquatic ecology. Because of the lack of a viable retrofit technology with which to modify the current cooling system to significantly reduce entrainment losses, and the current use of a Ristroph fish return system to reduce impingement mortality, there likely would be little change in the current impacts associated with continued operation of the existing cooling system. Wetland restoration would result in short-term adverse impacts on some resources, but is expected to produce long-term benefits. Anticipated impacts of this alternative also are summarized in Table 8-1.

- **Land Use**

  Modification of the existing once-through cooling system at OCNGS is not likely to require any new land; the majority of modification would take place on land currently occupied by OCNGS facilities. Temporary storage and laydown areas would likely use existing storage areas, parking lots, and other previously disturbed areas. At least some restoration of wetlands could occur on the OCNGS site, especially on the Finninger Farm portion of the site. Most of the Finninger Farm portion of the site has not been disturbed since the plant was constructed and is not currently used for operations. Restoration of lands on this portion of the site would not constitute a change in land use.

  The NRC staff concludes that the impact on onsite land use of modifying the existing once-through cooling system at the OCNGS site would be SMALL, with no new land required.

  Modification of the existing once-through cooling system with restoration alternative could result in land-use changes offsite. It is estimated that the restoration of wetlands to compensate for OCNGS impacts could require acquisition of substantial amounts of land within the Barnegat Bay watershed (NJDEP 2005). The exact acreage and location of lands to be designated in the restoration program are not known, but land acquisition is likely to proceed incrementally.

Modification of the existing once-through cooling system is likely to employ a small number of workers, with no new workers likely to be required once modifications are complete (AmerGen 2006). During modification, a small number of additional jobs would be created indirectly in the economy of the surrounding region. Compared with total employment in the economy surrounding the plant, increases in direct and indirect employment in the region would be small and would have no effect on land use.

Modification of the existing cooling system at the site would increase the value of OCNGS property, producing a small increase in property tax revenues for Lacey and Ocean Townships during plant operation. Compared with the existing property tax base, however, increases in property taxes as a result of the modifications are likely to be small and not likely to produce any impacts on offsite land use.

Changes in land designation under the restoration program could have an impact on land use in the Barnegat Bay area, depending on the location of specific land parcels and the pace of restoration. Depending on the location and size of the area to be restored, the impact on offsite land use could range from SMALL to MODERATE. Overall, the NRC staff concludes that the impact on offsite land use of the modification of the existing cooling system with restoration alternative at OCNGS would be SMALL to MODERATE.

- **Ecology**

Aquatic ecology. Because extensive plant modifications are not anticipated under this alternative, onsite construction-related impacts are expected to be minimal. During restoration activities, short-term impacts could occur if modifications to nearshore areas are required to reestablish hydraulic connectivity. These impacts could include the removal of dikes or other nearshore obstructions, dredging or filling activities, and restoration actions associated with upland sites that influence adjacent nearshore environments. Potential nearshore impacts include increased turbidity, changes in nutrient or dissolved oxygen concentrations in the water, short-term impacts associated with changes to current patterns, water temperature, and salinity. It is likely that the impacts associated with these activities can be reduced through the use of silt fences or other physical barriers, or by timing construction activities to occur when the least amount of impact on important resources is expected.

Entrainment impacts associated with modifications to the existing once-through cooling system would be expected to be somewhat smaller than those identified in Section 4.1.1 of this SEIS if flow reductions or plant shutdowns are employed during the spring and early summer when the eggs and larvae of many species are present in the water column. Based on the 316(b) evaluation conducted by EA Engineering Science and Technology, Inc. (EA 1986), the organisms most commonly entrained include juvenile and adult opossum shrimp (*Neomysis integer*), hard clam (*Mercenaria mercenaria*) larvae, sand shrimp zoea, larvae of the winter flounder, and eggs or early developmental stages of other species (Table 4-3).

Impingement impacts associated with modifications to the existing system would be expected to be somewhat smaller than those currently identified in Section 4.1.2 of this SEIS if flow reductions or plant shutdowns occur during periods when organisms susceptible to impingement are present in or near the intake canal. It might also be possible to increase survivorship of impinged individuals through physical and operational changes to the screen wash system. Based on the 316(b) evaluation conducted by EA (1986), the organisms with the highest impingement mortality include bay anchovy, Atlantic menhaden, and Atlantic silverside (Table 4-4).

The current NPDES permit (NJDEP 1994) prohibits OCNGS from scheduling routine shutdowns during the months of December through March to reduce the possibility of cold shock. OCNGS is also prohibited from scheduling routine maintenance that would result in a violation of thermal limitations during the months of June through September. With modifications to the existing once-through cooling system, the extent and magnitude of the thermal plume may be reduced during specific times of the year if additional flow reductions or shutdowns are scheduled to reduce further the thermal, entrainment, or impingement impacts associated with plant operation.

As discussed above, it is not possible to determine the overall impacts or positive environmental benefits of restoration until (1) the site or sites are identified, (2) the goals for the restoration are clearly stated, (3) a detailed restoration and monitoring plan is developed, (4) the restoration is initiated, and (5) the success of the restoration is evaluated based on the results of long-term monitoring. Although the overall goals of the restoration program may vary by site, it is assumed that the programs would be designed to improve the estuarine food webs adversely affected by entrainment or impingement, and to improve the survivability of species and life stages adversely affected by OCNGS operations. Based on the information provided by the NJDEP (NJDEP 2005), the largest impacts of OCNGS operations appear to be associated with the loss of opossum shrimp, sand shrimp, hard clam, bay anchovy, winter flounder, and blue crab due to entrainment or impingement impacts. It is assumed that restoration activities would be employed to mitigate the losses of these and other species as well.

Modification of the existing once-through cooling system could result in a reduction in cooling-system-related losses, especially those resulting from impingement. However, these reductions would not result in substantial differences in impacts relative to those under the existing once-through cooling system, and are not expected to result in significant changes to aquatic resources in central Barnegat Bay. It is likely that near-field effects (i.e., those in Oyster Creek, Forked River, and adjacent areas of Barnegat Bay) and far-field effects (those in central Barnegat Bay) would be comparable to those occurring under existing operations. Therefore, the NRC staff concludes that the impacts of operations would be SMALL if populations in the Bay are comparable to those found in the 1970s and 1980s, but could be MODERATE if populations in the Bay have noticeably changed.

The adverse impacts of initial restoration activities on aquatic ecology could range from SMALL to MODERATE because of temporary disturbance or disruptions of existing biological communities. It is expected, over time, that the impacts will ultimately be SMALL, and that the estuary will benefit from the restoration activities.

Terrestrial ecology. The restoration of wetlands would potentially increase wildlife diversity and provide high-quality foraging and nesting habitat for wildlife, especially birds. Some short-term, localized impacts on ecological resources could occur during the initial stages of wetland restoration (e.g., habitat disruption and disturbance of wildlife). These would occur from the need to (1) establish the hydrologic regime (e.g., install water-flow control structures, remove dikes or berms, remove drainage tiles or ditches, and create channels or basins), (2) prepare the soil (e.g., grading and recontouring, removal of contaminated sediments, or replacement of sediments), and (3) planting of native wetland and upland species (Hlohowskyj et al. 2003). Prior to planting, there may be the need to remove invasive non-native plant species through the use of herbicides, prescribed burns, and/or biocontrol. Also, periodic maintenance (e.g., prescribed burns, herbicide application, and additional plantings) could be required to maintain the desired mix of native plant species (Hlohowskyj et al. 2003). This would cause short-term impacts similar to those that would occur during wetland restoration.

The NRC staff concludes that the adverse impact on terrestrial ecology of wetland restoration would be SMALL to MODERATE in the short-term, but would be SMALL over the long-term. Short-term adverse terrestrial ecological impacts would occur during initial wetland restoration and periodic maintenance activities. However, restoring wetland areas could provide long-term benefits to the Barnegat Bay estuary.

- **Water Use and Quality**

Possible modifications to the operation of the existing once-through cooling system would not significantly affect usage or quality of surface water or groundwater.

During initial restoration activities, temporary impacts on surface water could result from the erosion of exposed and excavated soils. This erosion could be a significant source of turbidity to adjacent surface waters, but the impact level would depend on factors such as soil characteristics, slope, and the area of land affected. The land-use history of the areas to be restored could affect the potential impact on surface water, since soil contaminated from past industrial practices could become exposed. Use of best management practices to control erosion would prevent most impacts related to ground disturbance. Periodic maintenance of restored wetlands would not be expected to have an adverse impact on water resources, because little land disturbance would be expected, and herbicide use and prescribed burning would be conducted by qualified licensed applicators.

On the basis of these considerations, the NRC staff concludes that the impact of the modified existing once-through cooling system with restoration alternative on surface-water and groundwater use and quality would be SMALL.

- **Air Quality**

Relatively minor construction-related impacts are anticipated with the modified existing once-through cooling system with restoration alternative. Modifications to the existing cooling system are not expected to require extensive construction activities or ground disturbance, and operation of the system would not produce a change in emissions from those produced by operation of the existing system as described in Section 2.2.4 of this SEIS. Because wetland restoration activities could include grading and excavation of soils, use of earthmoving equipment could generate some fugitive dust and engine exhaust. Air quality impacts of these activities are expected to be minimal and would not result in exceedance of national or State standards for criteria pollutants.

The application of herbicides to remove invasive, non-native plant species would be conducted by licensed applicators using methods that would reduce or eliminate drift. Controlled applications, in the absence of high winds, should minimize the unintended spread of herbicides to downwind offsite locations. Prescribed burning would generate some smoke over short periods, but burns would be performed under controlled conditions to minimize offsite impacts.

The NRC staff considers the air quality impacts of the modified existing once-through cooling system with restoration alternative to be SMALL.

- **Waste**

Modification of the existing once-through cooling system could generate small amounts of waste related to cooling-system modifications. Little, if any, ground-disturbing activities and associated waste are expected to be needed for system modification. Any waste materials generated would be recycled or disposed of properly offsite. Operation of the modified system is not expected to generate significant amounts of additional waste.

Restoration activities could produce some waste, including removed plant materials, excavated soils, dredged sediments, potentially contaminated soils, and other materials that must be removed from the area to be restored. The amount of waste involved would depend on the size and location of the area to be restored and site-specific conditions that cannot be determined until a specific restoration plan has been developed and approved. It is unlikely that restoration-related wastes would pose a significant problem.

On the basis of these considerations, the NRC staff concludes that waste-related impacts associated with the modified existing once-through cooling system with restoration alternative would be SMALL.

- **Human Health**

Construction activities associated with the modified existing once-through cooling system with restoration alternative are expected to be less extensive than under the closed-cycle cooling-tower system alternative. As described in Section 8.1.2.1, possible plant modifications include modification of intake structures, pumping rates, and optimization of dilution pump operations to reduce entrainment and impingement losses for targeted species. Consequently, human health impacts associated with cooling-system modifications are expected to be SMALL.

Restoration of wetlands could include activities such as installation of structures that control the inflow and outflow of water, the removal of dikes or berms that prevent flooding, the removal of drainage tiles or ditches that drain water away from a site, and the creation of channels or basins. These activities could include the use of heavy construction equipment. During such activities, there would be a relatively slight risk to workers from typical construction incidents and accidents. However, the occurrence of such events would be mitigated by the use of proper industrial hygiene practices, worker safety requirements, and training.

The restoration of wetlands would also likely involve the use of herbicides, prescribed burning, biocontrol, or a combination of techniques. These activities also pose a potential risk to human health, primarily to those directly involved in the activity. Human health risks associated with these activities would be mitigated by the use of licensed applicators and the use of proper industrial hygiene practices, worker safety requirements, and training.

Overall, human health impacts associated with activities for this alternative are expected to be SMALL.

- **Socioeconomics**

Cooling-system modification and restoration activities are likely to employ a small number of workers. A small number of additional jobs could be created indirectly in the economy of the surrounding region. Compared with total employment in the region, increases in direct and indirect employment would be small. Additionally, as few of the additional workers are likely to migrate into the area from elsewhere, the projected small increase in employment would not affect housing and public services. Increases in traffic associated with the increase in plant employment on U.S. Highway 9 would also be SMALL. No additional permanent employees are likely to be needed to operate the modified system or maintain restored areas.

Changes in land designation under the restoration program could have an impact on property values, employment, and tax revenues in the Barnegat Bay area. The level of impact would depend on the location, size, and characteristics of the area to be restored.

The NRC staff concludes that the impact of the modification of the existing once-through cooling system with restoration alternative on socioeconomics would be SMALL.

- **Aesthetics**

Construction activities associated with the modification of the existing cooling system at OCNGS could have an impact on the visual environment and on noise if these modifications change the visual character at the power plant location, or if construction activities markedly add to local noise levels. The site currently hosts a number of large industrial buildings, and because many of the cooling-system modifications are likely to be associated with existing structures, modifications to the plant are not expected to change the character of the local visual environment. Construction activities would likely produce low levels of noise associated with the operation of construction machinery and construction traffic entering and leaving the site. Operations of the modified system are not expected to change noise levels on or off the OCNGS site.

Restoration activities could produce short-term impacts on visual aesthetics until initial restoration activities are complete. Once restored wetlands are established, long-term benefits are anticipated.

The NRC staff concludes that the impact of the modified existing once-through cooling system with restoration alternative on visual aesthetics and noise would be SMALL.

- **Historic and Archaeological Resources**

The OCNGS site has not been surveyed for historic and archaeological resources, and the potential exists for resources to be present within the site boundaries. However, modification of the existing once-through cooling system would not require new land disturbance and would not require an archaeological survey within the site. No impacts on historic and archaeological resources are anticipated from construction or operation of the modified once-through cooling system.

Archaeological surveys to identify and evaluate historic and archaeological resources in areas identified for restoration would be required prior to initiation of ground-disturbing activities. The archaeological surveys would have to be conducted by qualified archaeologists in consultation with the New Jersey SHPO and appropriate Native American Tribes, as required under Section 106 of the NHPA. Many shell midden sites occur adjacent to wetland areas, and such sites may be encountered during surveys. Sites that are determined to be eligible would require mitigation prior to initiating restoration actions. Mitigation, including avoidance, data recovery, or other options, would be determined in consultation with the SHPO and Native American Tribes. The impact of restoration on historic and archaeological resources could range from SMALL to MODERATE, depending on the locations chosen for restoration, the number of sites recorded in those locations, whether the recorded sites are significant (i.e., eligible for listing on the NRHP), and the ability to avoid or mitigate significant sites through data recovery or other means.

- **Environmental Justice**

Modification to the existing once-through cooling system at OCNGS and restoration of wetlands could have an impact on environmental justice if environmental impacts of modifications affected minority and low-income populations in a disproportionately high and adverse manner.

Based on staff guidance (NRC 2004), air, land, and water resources within 50 mi of the OCNGS site were examined. Within that area, a few potential environmental impacts could affect human populations; all of these would be considered SMALL for the general population. The staff found no unusual resource dependencies or practices on land that would be a candidate for restoration, such as subsistence agriculture, hunting, or fishing, through which minority and low-income populations could be disproportionately highly and adversely affected. The NRC staff concludes that the environmental justice impacts of the modified existing once-through cooling system with restoration alternative are expected to be SMALL.

8.2 No-Action Alternative

NRC regulations implementing the National Environmental Policy Act (NEPA), 10 CFR Part 51, Subpart A, Appendix A(4), specify that the no-action alternative be discussed in an NRC EIS. For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the OCNGS OL, and AmerGen would then cease plant operations by the end of the current OL and initiate decommissioning of the plant. AmerGen eventually would be required to shut down OCNGS and to comply with NRC decommissioning requirements in 10 CFR 50.82, whether or not the OL is renewed. If the OCNGS OL is renewed, shutdown of the unit and decommissioning activities would not be avoided, but would be postponed for up to an additional 20 years.

Table 8-2. Summary of Environmental Impacts of the No-Action Alternative

Impact Category	Impact	Comment
Land use	SMALL	Impact is expected to be SMALL because plant shutdown would not be expected to result in changes to onsite or offsite land use.
Ecology	SMALL	Impact is expected to be SMALL because aquatic impacts would be reduced from current levels, and terrestrial impacts are not expected because there would not be any changes in transmission line right-of-way maintenance practices. Cessation of operations would initially result in degradation of existing conditions in the lower portions of Oyster Creek and Forked River because of changes in flow rate, salinity, and temperature.
Water use and quality – surface water	SMALL	Impact is expected to be SMALL because surface-water intake and discharges would be eliminated. Cessation of operations would initially result in degradation of existing conditions in the lower portions of Oyster Creek and Forked River because of changes in flow rate, salinity, and temperature.
Water use and quality – groundwater	SMALL	Impact is expected to be SMALL because groundwater use would decrease.
Air quality	SMALL	Impact is expected to be SMALL because emissions related to plant operation and worker transportation would decrease.
Waste	SMALL	Impact is expected to be SMALL because generation of high-level waste would stop, and generation of low-level and mixed waste would decrease.
Human health	SMALL	Impact is expected to be SMALL because radiological doses to workers and members of the public, which are within regulatory limits, would be further reduced.
Socioeconomics	SMALL	Impact is expected to be SMALL because the loss of overall employment and tax revenues would be small.
Transportation	SMALL	Impact is expected to be SMALL because the decrease in employment would reduce traffic.
Aesthetics	SMALL	Impact is expected to be SMALL because plant structures would remain in place.
Historic and archaeological resources	SMALL	Impact is expected to be SMALL because shutdown of the plant would not result in land disturbance.
Environmental justice	SMALL	Impact is expected to be SMALL because the loss of overall employment would be small.

The environmental impacts associated with decommissioning under a license renewal or the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the license renewal GEIS (NRC 1996), Chapter 7 of this SEIS, and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those that would occur after 40 years of operation.

Impacts from the decision to permanently cease operations are not considered in NUREG-0586, Supplement 1.[a] Therefore, immediate impacts that occur between plant shutdown and the beginning of decommissioning are considered here. These impacts would occur when the unit shuts down regardless of the action taken on license renewal, and are discussed below with the results presented in Table 8-2. Plant shutdown would result in a net reduction in power production capacity. The power not generated by OCNGS during the license renewal term would likely be replaced by (1) power purchased from other electricity providers, (2) generation alternatives other than OCNGS, (3) demand-side management (DSM) and energy conservation, or (4) some combination of these options. The environmental impacts of these options are discussed in Section 8.3.

- **Land Use**

  In Chapter 4, the NRC staff concluded that the impact of continued plant operation on land use would be SMALL. Onsite land use would not be affected immediately by the cessation of operations. Plant structures and other facilities are likely to remain in place until decommissioning. The transmission line associated with the project is expected to remain in service after the plant stops operating. As a result, maintenance of the transmission line right-of-way will continue as before. Therefore, the NRC staff concludes that the impact on land use from plant shutdown would be SMALL.

- **Ecology**

  In Chapter 4, the NRC staff concluded that the impact of plant operation during the renewal period on Oyster Creek, Forked River, and adjacent portions of Barnegat Bay would continue to occur. Far-field impacts on central Barnegat Bay could be SMALL or MODERATE, depending on the current species composition and abundance of aquatic organisms. Cessation of operations would result in the elimination of cooling-water flow and the elimination of the OCNGS thermal plume. These changes would reduce environmental impacts on aquatic species in Barnegat Bay, including threatened and endangered sea turtles.

(a) Appendix J of NUREG-0586, Supplement 1, discusses the socioeconomic impacts of plant closure. The results of the analysis in Appendix J, however, were not incorporated into the analysis presented in the main body of the NUREG.

The construction and operation of OCNGS altered the ecosystems in the lower portions of both Oyster Creek and Forked River as well as created new aquatic habitat in the intake and discharge canals. Over time, these altered environments have reached equilibrium and now provide suitable habitat for a variety of species. Permanent cessation of OCNGS operations could result in destruction or alteration of these existing habitats and lead to a degradation of the current environment in the lower portions of both Oyster Creek and Forked River because of the accompanying changes in flow rate, salinity, and temperature. With the elimination of circulating water and dilution pump operation, flow in the intake and discharge canals would be wholly dependent on creek and river flow inputs and tidal fluctuations. It is possible that these areas would become stagnant and experience increased siltation and low dissolved oxygen events, with the latter being most pronounced during the warmer summer months. The current high levels of shoreline development along Forked River and Oyster Creek could contribute to poor water quality once the flushing nature of the station flow is eliminated. However, the NRC staff concludes that there would be no adverse effects of the no-action alternative on central Barnegat Bay.

The transmission line associated with OCNGS is expected to remain in service after OCNGS stops operating. As a result, maintenance of the right-of-way and subsequent impacts on the terrestrial ecosystem would continue as before.

In conclusion, the NRC staff has determined that the ecological impact from shutdown of the plant would be SMALL and that some benefits would accrue in Barnegat Bay.

- **Water Use and Quality – Surface Water**

In Chapter 4, the NRC staff concluded that the impact of continued plant operation on surface-water use and quality would be SMALL. When the plant stops operating, there would be an immediate reduction in the consumptive use of water because of the significant reduction in thermal additions to Oyster Creek and Barnaget Bay, thereby reducing evaporation from those water bodies. The effects of operations on flow and salinity in Oyster Creek and Forked River would also cease. Cessation of OCNGS operations would eliminate the reverse flow situation in Forked River and result in greatly reduced flow in Oyster Creek. These changes in flow would produce accompanying changes in salinity and temperature. With the elimination of circulating water and dilution pump operation, flow in the intake and discharge canals would be wholly dependent on creek and river flow inputs and tidal fluctuations. It is possible that these areas would become stagnant and experience increased siltation and low dissolved oxygen events, with the latter being most pronounced during the warmer summer months. The current high levels of shoreline development could contribute to poor water quality once the flushing nature of the station flow is eliminated. However, the NRC staff concludes that there would be no adverse effects of the no-action alternative on water use and quality in central Barnegat Bay, and that, overall, the impacts of the no-action alternative on surface water resources would be SMALL.

- **Water Use and Quality – Groundwater**

  In Chapter 4, the NRC staff concluded that the impact of continued plant groundwater use on groundwater availability and quality would be SMALL. When the plant stops operating, there would be a reduction in the use of well water because reactor makeup water would no longer be required and there would be reduced potable water consumption and sanitary use as the size of the plant staff decreases. Therefore, the NRC staff concludes that the impact on groundwater use and quality from shutdown of the plant would be SMALL.

- **Air Quality**

  In Chapter 4, the NRC staff concluded that the impact of continued plant operation on air quality would be SMALL. When the plant stops operating, there would be a reduction in emissions from activities related to plant operation, such as the use of diesel generators and worker transportation. Therefore, the NRC staff concludes that the impact on air quality from shutdown of the plant would be SMALL.

- **Waste**

  The impacts of radioactive waste generated by continued plant operation are discussed in Chapter 6. The impact of low-level and mixed waste from plant operation is characterized as SMALL. When OCNGS stops operating, it would stop generating high-level waste (HLW), and the generation of low-level and mixed waste associated with plant operation and maintenance would be reduced. Therefore, the NRC staff concludes that the impact of waste generated after shutdown of the plant would be SMALL.

- **Human Health**

  In Chapter 4, the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL. After the cessation of operations, the amount of radioactive material released to the environment in gaseous and liquid forms would be reduced. Therefore, the NRC staff concludes that the impact of shutdown of the plant on human health would be SMALL. In Chapter 5, the NRC staff concluded that the impacts of accidents during operation would be SMALL. After shutdown, the variety of potential accidents at the plant would be reduced to a limited set associated with fuel handling and storage. Therefore, the NRC staff concludes that the impact of potential accidents following shutdown of the plant would be SMALL.

- **Socioeconomics**

  In Chapter 4, the NRC staff concluded that the socioeconomic impact of continued plant operation would be SMALL. There would be immediate socioeconomic impacts associated with the shutdown of the plant because of the reduction in the staff at the plant. There may also be an immediate reduction in property tax revenues for Ocean County, but this is anticipated to be small. The overall impact would depend on the state of the economy, the net change in workforce at the plant, and the changes in local government tax receipts. Appendix J of Supplement 1 to NUREG-0586 (NRC 2002) shows that the overall socioeconomic impact of plant closure plus decommissioning could be greater than SMALL. However, the NRC staff concludes that the socioeconomic impact of OCNGS shutdown would be SMALL because of the relatively small employment loss compared with total employment in the economy of the surrounding area. Impacts also could be offset if new power-generating facilities are built at or near the current site.

- **Transportation**

  In Chapter 4, the NRC staff concluded that the impact of continued plant operation on transportation would be SMALL. Cessation of operations would be accompanied by a reduction of traffic in the vicinity of the plant. Most of the reduction would be associated with a reduction in the plant workforce, but there also would be a reduction in shipment of material to and from the plant. Therefore, the NRC staff concludes that the impact of plant closure on transportation would be SMALL.

- **Aesthetics**

  In Chapter 4, the NRC staff concluded that the aesthetic impact of continued plant operation would be SMALL. Plant structures and other facilities are likely to remain in place until decommissioning. Therefore, the NRC staff concludes that the aesthetic impact of plant closure would be SMALL.

- **Historic and Archaeological Resources**

  In Chapter 4, the NRC staff concluded that the impacts of continued plant operation on historic and archaeological resources would be SMALL. Onsite land use would not be affected immediately by the cessation of operations. Plant structures and other facilities would likely remain in place until decommissioning. The transmission line associated with the project is expected to remain in service after the plant stops operating. As a result, maintenance of the transmission line right-of-way would continue as before. Therefore, the NRC staff concludes that the impact on historic and archaeological resources from plant shutdown would be SMALL.

- **Environmental Justice**

  In Chapter 4, the NRC staff concluded that the environmental justice impact of continued operation of the plant would be SMALL. Continued operation of the plant would not have a disproportionately high and adverse impact on minority and low-income populations. Shutdown of the plant also would not have disproportionately high and adverse impacts on minority and low-income populations resulting from the loss of employment opportunities at the site or from secondary socioeconomic impacts (e.g., loss of patronage at local businesses because the loss would be very minor in the context of the regional economy). The NRC staff concludes that the environmental justice impact of plant shutdown is expected to be SMALL. Any impact would be offset if new power-generating facilities are built at or near the current site. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of this impact.

8.3 Alternative Energy Sources

This section discusses the environmental impacts associated with developing alternative sources of electric power to replace the power generated by OCNGS, assuming that the OL for OCNGS is not renewed. The order of presentation of alternative energy sources does not imply which alternative would be most likely to occur or to have the least environmental impacts.

The following power-generation alternatives are considered in detail:

- Coal-fired plant generation at the OCNGS site and at an alternate site (Section 8.3.1),

- Natural-gas-fired plant generation at the OCNGS site and at an alternate site (Section 8.3.2), and

- New nuclear power plant generation at the OCNGS site and at an alternate site (Section 8.3.3).

The alternative of purchasing power from other sources to replace power generated at OCNGS is discussed in Section 8.3.4. Other power-generation alternatives and conservation alternatives considered by the NRC staff and found not to be reasonable replacements for OCNGS are discussed in Section 8.3.5. Section 8.3.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. In its *Annual Energy Outlook 2006 with Projections to 2030*, the EIA projects that more than 57 percent of new electricity-generating capacity between 2006 and 2030 will be coal-fired plants (EIA 2006). The amount of electricity produced by coal-fired plants will rise slowly in the near future but will grow considerably compared with other types of plants because of reliability and rising natural gas prices. Natural-gas-fired plants accounted for 18 percent of the total supply in 2004, but the EIA predicts their contribution to decline to 17 percent by 2030 (EIA 2006). A slight rise in the percentage of natural-gas-fired plants in the near term is predicted because of new, more efficient technologies; the rising cost of natural gas, however, will eventually reduce this share. Renewable fuel technologies such as wind, solar, and hydropower provided 9 percent of the total electricity consumed in 2004, and this is expected to rise to only 9.4 percent by 2030 (EIA 2006). Of the renewable fuels, hydropower provides the most power at 6.8 percent in 2004 and is expected to fall to 5.1 percent in 2030 (EIA 2006). The drop in hydropower is due to the lack of new locations for development. The share of power resulting from other renewable sources of power is expected to rise from 2.2 percent in 2004 to 4.3 percent in 2030 because of technological advances and State and Federal support (EIA 2006).

Nuclear plants currently provide 20 percent of the power in the United States (EIA 2006). By 2030, nuclear power is expected to drop to only 15 percent of the total power produced in the United States (EIA 2006). There has been an increased interest in constructing new nuclear power facilities partly due to Energy Policy Act of 2005 (EPACT) tax incentives and as evidenced by the certification of four standard nuclear power plant designs and recent activities involving the review of other plant designs and potential sites (see Section 8.3.3). The NRC has also established an Office of New Reactors to prepare for and manage future reactor and site licensing applications (NRC 2006). In addition, the EPACT contains provisions to ensure that nuclear energy continues to be a major component of the nation's energy supply. This Act also establishes a production tax credit for new nuclear power facilities. Therefore, despite the EIA projection, a new nuclear plant alternative for replacing power generated by OCNGS is considered in this SEIS.

OCNGS has a net electrical capacity of 640 MW(e) (Section 2.1.2; AmerGen 2005). For the coal- and natural-gas-fired plant alternatives, the NRC staff assumed construction of a 600-MW(e) plant, which is consistent with AmerGen's Environmental Report (ER) (AmerGen 2005). This assumption will understate the environmental impacts of replacing the 640 MW(e) from OCNGS by about 7 percent. The applicant did not identify any specific alternate sites in the ER for the coal-fired or natural-gas-fired plants; however, it was assumed that a suitable location could be found in the region. For the new nuclear power plant alternative, the NRC staff assumed the same capacity as OCNGS. Therefore, this SEIS evaluates both the OCNGS site and an alternate site for the analysis of environmental impacts for the new nuclear power plant alternative.

8.3.1 Coal-Fired Plant Generation

The coal-fired plant alternative is analyzed for a generic alternate site. Unless otherwise indicated, the assumptions and numerical values used are from the AmerGen ER (AmerGen 2005). The NRC staff reviewed the information in the AmerGen ER and compared it with environmental impact information in the GEIS for license renewal. Although the OL renewal period is only 20 years, the impact of operating a coal-fired plant for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant). The NRC staff assumed that the OCNGS plant would remain in operation while the alternative coal-fired plant was constructed.

The NRC staff assumed the construction of one standard 600-MW(e) unit for a total capacity of 600 MW(e) as a potential replacement for OCNGS. The coal-fired plant would consume approximately 1.9 million tons/yr of pulverized bituminous coal with an ash content of approximately 9.5 percent (AmerGen 2005). AmerGen assumes a heat rate[(a)] of 10,200 Btu/kWh and a capacity factor[(b)] of 0.85 in its ER (AmerGen 2005).

In addition to the impacts discussed below for a coal-fired plant at an alternate site, impacts would occur offsite as a result of the mining of coal and limestone. Impacts of mining operations would include an increase in fugitive dust emissions; surface-water runoff; erosion; sedimentation; changes in water quality; disturbance of vegetation and wildlife; disturbance of historic and archaeological resources; changes in land use; and impacts on employment.

The magnitude of these offsite impacts would largely be proportional to the amount of land affected by mining operations. In the GEIS, the NRC staff estimated that approximately 22,000 ac would be affected by the mining of coal and the disposal of the waste needed to support a 1000-MW(e) coal-fired plant during its operational life (NRC 1996). Proportionally less land would be affected by a 600-MW(e) plant. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for OCNGS. In the GEIS, the NRC staff estimated that approximately 1000 ac would be affected for mining the uranium and processing it during the operating life of a nuclear power plant.

8.3.1.1 Coal-Fired Plant with a Closed-Cycle Cooling System

In this section, the NRC staff evaluates the impacts of a coal-fired plant located at OCNGS and at an alternate site that uses a closed-cycle cooling system. The impacts of a coal-fired plant using a once-through cooling system are considered in Section 8.3.1.2 of this SEIS.

The overall impacts of the coal-fired plant alternative are discussed in the following sections and summarized in Table 8-3. The magnitude of impacts for an alternate site would depend on the characteristics of the particular site selected.

(a) Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (Btus) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of the fuel burned for electric generation by the resulting kWh generation.

(b) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

- **Land Use**

  For siting a coal-fired plant at OCNGS, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction and land disturbance that would be required. Specifically, the NRC staff assumed that a coal-fired plant at OCNGS would use the existing switchyard, offices, parking areas, and transmission line right-of-way. Land that has been previously disturbed would be used to the extent practicable.

  In its ER, AmerGen estimated that 524 ac of land would be needed for construction of a coal-fired plant at OCNGS. This estimate includes 171 ac for power block and coal storage, 180 ac for a new rail spur, and 173 ac for waste disposal (AmerGen 2005).[a] AmerGen assumed use of the existing once-through cooling system for a coal-fired plant at the OCNGS site; the NRC staff, however, evaluated closed-cycle cooling (see Section 8.3.1.2 and Table 8-3 of this SEIS for a discussion of the impacts of a coal-fired plant using a once-through cooling system). Additional land would likely be required for construction of cooling towers.

(a) The amount of land needed for waste disposal during 20 years of operation (the length of the OCNGS license renewal period) is half of the 173 ac presented here; 173 ac is the area needed for 40 years of operation – the typical life of a coal-fired plant.

Table 8-3. Summary of Environmental Impacts of a Coal-Fired Plant Using Closed-Cycle Cooling at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land use	SMALL to LARGE	Impact would depend on the degree to which previously disturbed lands were utilized. Uses approximately 524 ac for power block, waste disposal, and rail spur; additional land would be needed for cooling-tower construction. Additional offsite land-use impacts from coal and limestone mining.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Uses approximately 1020 ac for plant, offices, parking, and waste disposal. Additional land (amount dependent on site chosen) would be needed for a rail spur and a transmission line. Same offsite impacts for mining as for a coal-fired plant at the OCNGS site.
Ecology	SMALL to LARGE	Impact would depend on the characteristics of land to be developed. Uses developed and undeveloped areas at current OCNGS site, plus undeveloped land offsite for rail spur. Impact on terrestrial ecology from cooling-tower drift is expected. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission line and rail spur routes. Impact on terrestrial ecology from cooling-tower drift. Some impingement and entrainment of aquatic organisms.
Water use and quality – surface water	SMALL	Impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.

Table 8-3. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for potable water.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the aquifers.
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be MODERATE. Impact of operations on air quality during operations would be MODERATE with the following emissions expected: Sulfur oxides • 2796 tons/yr Nitrogen oxides • 469 tons/yr Particulates • 89 tons/yr of total suspended particulates • 20 tons/yr of PM_{10} Carbon monoxide • 469 tons/yr Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials – mainly uranium and thorium.	MODERATE	Potentially the same impact as a coal-fired plant at the OCNGS site, although pollution-control standards may vary, depending on location. Impact during construction would be SMALL. Impact during operation would be MODERATE.
Waste	MODERATE	Waste would be generated and removed during construction. During operation, total waste volume would be about 331,000 tons/yr of ash and scrubber sludge, requiring approximately 173 ac for disposal during the 40-year life of the plant.	MODERATE	Same impact as a coal-fired plant at the OCNGS site. Waste disposal constraints may vary.
Human health	SMALL	Impact is uncertain, but considered SMALL in the absence of more quantitative data.	SMALL	Same impact as a coal-fired plant at the OCNGS site.

Table 8-3. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Socioeconomics	MODERATE	During construction, impact would be MODERATE. Up to 400 workers during the peak period of the 5-year construction period, followed by a reduction in the current OCNGS workforce of 470 to 170 workers; tax base preserved. Impact during operation would be SMALL.	SMALL to LARGE	Construction impact would depend on location, but could be LARGE if the plant is located in a rural area. Up to 400 workers during the peak period of the 5-year construction period. Operation would result in a workforce of 170 full-time employees, which is a net loss of approximately 300 jobs, if the site is located in Ocean County. Ocean County's tax base would experience a loss and an additional reduction in employment if the alternate site is not located within the county. Employment impacts could be offset by other economic growth in the area.
Transportation	MODERATE to LARGE	Transportation impact associated with construction would be MODERATE, as 470 OCNGS workers and 400 construction workers would be commuting to the site. Impact during operation would be SMALL, as the workforce would be reduced to 170 workers. For rail transportation of coal and lime over a distance of 15 mi, the impact is considered MODERATE to LARGE.	MODERATE to LARGE	Transportation impact associated with 400 construction workers would be MODERATE. Impact associated with 170 plant workers during operation would be SMALL. For rail transportation of coal and lime, the impact is considered SMALL to LARGE, depending on location.

Table 8-3. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Aesthetics	MODERATE	Aesthetic impact due to the addition of plant units, cooling towers, plume stacks, coal piles, and rail spur is considered MODERATE. Intermittent noise from construction, commuter traffic, and waste disposal; continuous noise from cooling towers and mechanical equipment; and rail transportation of coal and lime would result in MODERATE noise impacts.	MODERATE to LARGE	Impact would depend on the characteristics of the site, but would be similar to those for a coal-fired plant at the OCNGS site. The impact could range from MODERATE to LARGE. Additional impact would result from construction and operation of the new transmission line and rail spur. Depending on the location of the site chosen, this impact could be LARGE.
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate the potential impact of construction on cultural resources.	SMALL to MODERATE	Impact would depend on the characteristics of the alternate site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new plant construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impact on housing could occur during construction; loss of 300 operating jobs could reduce employment prospects for minority and low-income populations. Impact could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impact would depend on population distribution and makeup at the site.

The GEIS estimates that approximately 1700 ac would be needed for a 1000-MW(e) coal-fired plant (NRC 1996). This estimate would be scaled down for the 600-MW(e) capacity of the proposed coal-fired plant alternative (i.e., 1020 ac) at an alternate site. Additional land might be needed for transmission lines and rail spurs, depending on the location of the alternate site relative to the nearest intertie connection and rail line.

Approximately 180 ac would be needed for a rail spur connection from Toms River, New Jersey, to OCNGS, assuming a 100-ft-wide corridor and approximately 15 mi of rail. Similar acreage would be needed for a rail spur if an alternate site is located within 15 mi of the nearest railway connection. Additional land would likely be needed at an alternate site for a transmission line to connect to the existing grid.

The waste produced by the coal-fired plant would be disposed of at the power plant site and would account for approximately 173 ac of land area over the 40-year plant life.

The NRC staff concludes that at OCNGS, the impact on land use of a coal-fired plant with a closed-cycle cooling system would be SMALL to LARGE, depending on the amount of previously disturbed lands that would be developed. This alternative would also result in MODERATE to LARGE land-use impacts at an alternate site, depending particularly on the location and length of the transmission line and rail spur.

- **Ecology**

Locating a coal-fired plant at OCNGS would impact ecological resources because of the need for more than 524 ac of land for power block construction, coal storage, waste disposal, rail spur construction, and cooling-tower construction. This land requirement includes both developed and undeveloped land at the OCNGS site.

Ecological impacts related to the development of previously disturbed land would be minimal. Development of previously undisturbed lands could result in impacts on threatened or endangered species, wildlife habitat destruction, habitat fragmentation, reduced productivity, and local reductions in biological diversity. The magnitude of these impacts would depend on the current ecological condition of the land. Cooling-tower drift could result in impacts on terrestrial ecology, especially nearby vegetation. The use of cooling towers to replace once-through cooling would reduce thermal discharge and the entrainment and impingement of aquatic organisms. The NRC staff concludes that the ecological impacts of a new coal-fired plant with a closed-cycle cooling system at the OCNGS site would be SMALL to LARGE, depending on the amount of previously disturbed land that is used.

Locating a coal-fired plant at an alternate site would result in construction and operational impacts. Approximately 1020 ac of land would be converted to industrial use. Even assuming siting at a previously disturbed area, the impacts would affect ecological resources. Impacts could include impacts on threatened and endangered species, wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface-water body could cause entrainment and impingement of fish and other aquatic organisms, and result in adverse impacts on aquatic resources. If needed, construction and maintenance of a transmission line and a rail spur also would have ecological impacts. There would be some additional impact on terrestrial ecology from drift from the cooling towers. Overall, the ecological impacts of constructing a coal-fired plant with a closed-cycle cooling system at an alternate site are considered to be MODERATE to LARGE and would probably be greater than those associated with construction of a coal-fired plant at the OCNGS site.

- **Water Use and Quality**

Surface water. At the OCNGS site, replacement of the existing once-through cooling system with a closed-cycle system would result in a reduction in cooling-water demands. Plant discharge would consist of cooling-tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides. Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by the NJDEP. There would be consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation may occur during construction. Impacts on water quality are possible offsite from coal mining operations. The NRC staff considers the impacts of a new coal-fired plant with a closed-cycle cooling system located at the OCNGS site on surface-water use and quality to be SMALL.

At an alternate site, the impact on surface-water use and quality would depend on the volume of water needed for cooling makeup water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the state of New Jersey. The impacts would be SMALL to MODERATE and dependent on the receiving body of water.

Groundwater. The OCNGS currently uses groundwater for both reactor makeup water and potable water, and it is assumed that groundwater would continue as the source of potable water if a coal-fired plant were constructed at the OCNGS site. Impacts on groundwater use and quality of a coal-fired plant with a closed-cycle cooling system at the OCNGS site would be SMALL. Impacts on groundwater use and quality of a coal-fired plant at an alternate site would be SMALL to MODERATE, depending on the volume of groundwater withdrawn and characteristics of the aquifer.

- **Air Quality**

The air quality impacts of coal-fired generation differ considerably from those of nuclear generation due to emissions of SO_x, NO_x, particulate matter, CO, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

A new coal-fired plant located in New Jersey would likely need a PSD permit and an operating permit under the CAA. The plant would need to comply with the new-source performance standards for such plants as set forth in 40 CFR Part 60, Subpart D(a). The standards establish limits for particulate matter and opacity (40 CFR 60.42(a)), SO_2 (40 CFR 60.43(a)), and NO_x (40 CFR 60.44(a)).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the CAA. Portions of New Jersey have been classified as attainment or unclassified for criteria pollutants (40 CFR 81.331). In the posted amendment to that classification, dated April 30, 2004, there are several instances of nonattainment for ozone, including Ocean County (EPA 2004b).

Section 169A of the CAA establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The EPA issued a new regional haze rule in 1999 (*Federal Register*, Volume 64, page 35714 [64 FR 35714]; July 1, 1999 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a coal-fired plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Brigantine National Wildlife Refuge, located about 20 mi south of OCNGS, is a Class I area where visibility is an important value (40 CFR 81.414). Air quality in this area could be affected by a coal-fired plant at the OCNGS site and at an alternate site if the site chosen were located within 62 mi of the wildlife refuge.

In 1998, the EPA issued a rule requiring 20 eastern states, including New Jersey, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone (40 CFR 50.9).

The total amount of NO_x that can be emitted by each of the 20 states in the 2007 ozone season (May 1 to September 30) is presented in 40 CFR 51.121(e). For New Jersey, the amount is 330,836 tons/yr (EPA 2001b).

Anticipated impacts for particular pollutants that would result from a coal-fired plant at the OCNGS site or at an alternate site are as follows:

Sulfur oxides. A new coal-fired power plant would be subject to the requirements in Title IV of the CAA. Title IV was enacted to reduce SO_2 and NO_x emissions, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. The EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal-fired plant alternative than the proposed action.

AmerGen estimates that by using wet limestone flue gas desulfurization to minimize SO_x emissions (95 percent removal), the total annual stack emissions would be approximately 2796 tons of SO_x (AmerGen 2005).

Nitrogen oxides. Section 407 of the CAA establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new-source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain NO_x (expressed as nitrogen dioxide [NO_2]) in excess of 200 ng/J (1.6 lb/MWh) of gross energy output, based on a 30-day rolling average.

AmerGen estimates that by using NO_x burners with overfire air and selective catalytic reduction (SCR) (95 percent reduction), the total annual NO_x emissions for a new coal-fired power plant would be approximately 469 tons (AmerGen 2005). This level of NO_x emissions would be greater than that under the proposed action.

Particulate matter. AmerGen estimates that the total annual stack emissions would include 89 tons of filterable total suspended particulates and 20 tons of particulate matter (PM_{10}) (40 CFR 50.6). Fabric filters (99.9 percent removal) would be used for control (AmerGen 2005). Particulate emissions would be greater under the coal-fired plant alternative than under the proposed action.

The construction of a coal-fired plant would generate fugitive dust. In addition, exhaust emissions would come from vehicles and motorized equipment used during the construction process.

Carbon monoxide. AmerGen estimates that the total CO emissions would be approximately 469 tons/yr (AmerGen 2005). This level of emissions would be greater than that under the proposed action.

Hazardous air pollutants, including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). The EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. The EPA found that coal-fired power plants emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000a). The EPA concluded that mercury is the hazardous air pollutant of greatest concern. The EPA found that (1) there is a link between the burning of coal and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000a). Accordingly, on March 15, 2005, the EPA issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants (EPA 2005).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 ppm. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that in 1982, a typical coal-fired plant released about 5.2 tons of uranium and 12.8 tons of thorium (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

Carbon dioxide. A coal-fired plant would also have unregulated carbon dioxide (CO_2) emissions that could contribute to global warming. The level of emissions from a coal-fired plant would be greater than that under the proposed action.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts could be substantial. The GEIS also mentioned global warming from unregulated CO_2 emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the products of coal combustion. The NRC staff concludes that appropriate characterization of air impacts from coal-fired generation at the OCNGS site would be MODERATE.

Siting a coal-fired power plant at an alternate site would not significantly change air quality impacts from those described for a coal-fired plant at the OCNGS site, although it could result in installing more or less stringent pollution control equipment to meet local applicable requirements. Therefore, the NRC staff concludes that the impact on air quality would be MODERATE.

- **Waste**

Waste would be generated during construction activities. During operations, coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. One 600-MW(e) coal-fired plant would generate approximately 331,000 tons of this waste annually for 40 years (AmerGen 2005). The ash and scrubber sludge would be disposed of onsite, accounting for approximately 173 ac of land area over the 40-year plant life. Waste impacts on groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occur. Disposal of the waste could noticeably affect land use and groundwater quality; however, with appropriate management and monitoring, the impact is expected to be SMALL to MODERATE. After closure of the waste site and revegetation, the land could be available for other uses.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (EPA 2000b). The EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could be dangerous to human health and the environment under certain conditions; (2) the EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and (4) the EPA identified gaps in State oversight of coal combustion wastes. Accordingly, the EPA announced its intention to issue regulations for disposal of coal combustion waste under Subtitle D of the Resource Conservation and Recovery Act.

For all of the preceding reasons, the impact from waste generated from burning coal at either the OCNGS site or at an alternate site is considered MODERATE.

- **Human Health**

Worker risks associated with coal-fired plants result from fuel and limestone mining, from fuel and lime transportation, and from disposal of coal combustion waste. In addition, there are public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal-fired plant alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In the GEIS, the NRC staff stated that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but it did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the EPA and State agencies, establish air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As discussed previously, the EPA has recently concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, the NRC staff expects that the human health impact from radiological doses and inhalation of toxins and particulates generated by burning coal would be SMALL, whether at the OCNGS site or at an alternate site.

- **Socioeconomics**

Construction of a coal-fired plant and associated facilities would take approximately 5 years. The NRC staff assumed that construction would take place while OCNGS continues operation and would be completed by the time OCNGS permanently ceases operations. Estimates presented in the GEIS indicate that the workforce would be expected to vary between 720 and 1500 workers during the 5-year construction period for a 600-MW(e) coal-fired plant (NRC 1996). However, AmerGen estimates approximately 400 workers during the peak construction period. These workers would be in addition to the approximately 470 workers employed at OCNGS. During construction, the surrounding communities would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other nearby locations, including areas like Atlantic City, Newark, and Philadelphia. After construction, the local communities would be impacted by the loss of the construction jobs, although this loss would be possibly offset by other growth currently being projected for the area. Impacts on socioeconomics of operation of a coal-fired plant would be SMALL.

Construction of a replacement coal-fired power plant at an alternate site would impact the communities around OCNGS as they would experience the impact of the loss of jobs at OCNGS. The communities around the new site would have to absorb the impacts of a temporary workforce (approximately 400 workers at the peak of construction) and a permanent workforce of approximately 170 workers. In the GEIS, the NRC staff stated that socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction workforce would need to move to the area to work. Alternate sites would need to be analyzed on a case-by-case basis, and socioeconomic impacts could range from SMALL to LARGE.

- **Transportation**

  Approximately 400 construction workers would be commuting to the OCNGS site over the 5-year construction period for a coal-fired plant. The addition of these commuters to the 470 OCNGS workers also commuting to the site during this period could affect traffic loads on nearby existing highways. Transportation-related impacts during this period of overlap at the OCNGS site are expected to be MODERATE. Impacts during operation of a coal-fired plant at the OCNGS site would be SMALL, because the new plant workforce would be reduced to 170 workers and OCNGS would have ceased operation. Transportation-related impacts associated with a coal-fired plant at an alternate site would be dependent on the site location. The impacts on transportation associated with 400 commuting construction workers would likely be MODERATE. Transportation impacts related to the commuting of an estimated 170 workers during operations would likely be SMALL.

  At the OCNGS site or at an alternate site, coal and lime would probably be delivered by rail. At the OCNGS site, the delivery of coal and lime over a distance of 15 mi is considered a MODERATE to LARGE impact. At an alternate site, impacts associated with rail transportation would depend on the site location and distance to the existing rail line. Impacts associated with rail transportation at an alternate site could range from SMALL to LARGE.

- **Aesthetics**

  The coal-fired plant could be as much as 200 ft tall with cooling towers, stack, and coal piles visible in daylight hours. The exhaust stack could be as much as 650 ft high. The plant and associated stack would also be visible at night because of outside lighting. Visual impacts of a new coal-fired plant could be mitigated by landscaping and selecting a color for buildings that is compatible with the environment. Visual impact at night could be mitigated by reduced use of lighting, provided that the lighting meets FAA requirements (FAA 2000), and appropriate use of shielding. There could be a significant impact if construction of a new transmission line and/or rail spur is needed. Overall, the addition of a coal-fired plant and the associated stacks at the OCNGS site is expected to result in a MODERATE impact. A coal-fired plant at an alternate site would likely have a MODERATE to LARGE aesthetic impact, depending on the site location chosen.

  A coal-fired plant would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations, such as cooling towers. Intermittent sources include the equipment related to coal handling, solid waste disposal, transportation related to coal and lime delivery, use of outside loudspeakers, and the commuting of plant employees. These impacts are considered to be MODERATE.

Noise impacts associated with rail delivery of coal and lime to a plant at the OCNGS site or at an alternate site would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the many residents likely to be within hearing distance of the rail route, the impact of noise on residents in the vicinity of the facility and the rail line are considered MODERATE.

The aesthetic impact associated with the construction and operation of a new transmission line and rail spur at an alternate site could be LARGE, depending on the location of the site chosen. Overall, the NRC staff concludes that the aesthetic impact associated with locating a coal-fired plant at the OCNGS site would be MODERATE and, at an alternate site, MODERATE to LARGE.

- **Historic and Archaeological Resources**

Before construction or any ground disturbance at the OCNGS site or at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Other lands, if any, that are acquired to support the plant would also likely need an inventory of cultural resources to identify and evaluate existing historic and archaeological resources and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Historic and archaeological resources must be evaluated on a site-specific basis. The impacts can generally be effectively managed under current laws and regulations, and as such, the categorization of impacts at the OCNGS site or at an alternate site could range from SMALL to MODERATE, depending on what resources are present, and whether mitigation is necessary.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the OCNGS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of OCNGS would result in a decrease in employment of approximately 470 operating employees, possibly offset by general growth in the area. Following construction, it is possible that the ability of local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, the impact is expected to be SMALL. Projected economic growth in the area and the ability of minority and low-income populations to commute to other jobs outside the area could mitigate any adverse effects.

The environmental justice impact at an alternate site would depend on the site chosen and the nearby population distribution, and could range from SMALL to MODERATE.

8.3.1.2 Coal-Fired Plant with a Once-Through Cooling System

This section discusses the environmental impacts of constructing and operating a coal-fired plant using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are similar to the impacts for a coal-fired plant using the closed-cycle system. However, there are minor differences in impacts between the closed-cycle and once-through cooling systems. Table 8-4 summarizes these differences. The design and operation of the intake would need to comply with EPA's 316(b) Phase I or II regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

8.3.2 Natural-Gas-Fired Plant Generation

The environmental impacts of the natural-gas-fired plant alternative are examined in this section for both the OCNGS site and an alternate site. The NRC staff assumed that the plant would use a closed-cycle cooling system (Section 8.3.2.1). In Section 8.3.2.2, the NRC staff also evaluated the impacts of once-through cooling.

The existing switchyard, offices, and transmission line would be used for the gas-fired alternative at the OCNGS site. For purposes of analysis, AmerGen estimates that approximately 2 mi of buried gas supply pipeline would need to be constructed to connect to the existing pipeline at the Forked River gas plant (AmerGen 2005).

If a new natural-gas-fired plant were built at an alternate site in New Jersey to replace OCNGS, construction of a new natural gas supply pipeline and a new transmission line could be needed. In the GEIS, the NRC staff estimated disturbance of up to 2500 ac for construction of a 60-mi transmission line to an alternate site (NRC 1996).

Table 8-4. Summary of Environmental Impacts of a Coal-Fired Plant Using Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land use	Impact may be less (e.g., through elimination of cooling towers) or greater (e.g., if a reservoir is required).
Ecology	Impact would depend on ecological conditions in areas to be developed. Possible impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock. No impact on terrestrial ecology from cooling-tower drift.
Water use and quality – surface water	Greater water withdrawal rates leading to possible water-use conflicts; thermal load higher on receiving body of water than with closed-cycle cooling; no discharge of cooling-tower blowdown.
Water use and quality – groundwater	No change
Air quality	No change
Waste	No change
Human health	No change
Socioeconomics	No change
Transportation	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and archaeological resources	No change
Environmental justice	No change

The NRC staff assumed that a replacement natural-gas-fired plant would use combined-cycle technology (AmerGen 2005). In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

AmerGen assumed two standard-sized 300-MW(e) units with a total capacity of 600 MW(e), as the gas-fired plant alternative at OCNGS (AmerGen 2005). This capacity is approximately equivalent to the OCNGS total net capacity of 640 MW(e). AmerGen estimates that the plant would consume approximately 38.4 billion ft^3 of gas annually (AmerGen 2005).

Unless otherwise indicated, the assumptions and numerical values used are from the AmerGen ER (AmerGen 2005). The NRC staff reviewed this information and compared it with environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating a natural-gas-fired plant for 40 years is considered (as a reasonable projection of the operating life of a natural-gas-fired plant).

8.3.2.1 Natural-Gas-Fired Plant with a Closed-Cycle Cooling System

The overall impacts of a natural-gas-fired plant with a closed-cycle cooling system are discussed in the following sections and summarized in Table 8-5. The extent of impacts at an alternate site would depend on the characteristics of the selected location of the plant site.

- **Land Use**

  For siting a natural-gas-fired plant at OCNGS, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the NRC staff assumed that a natural-gas-fired plant would use the existing switchyard, offices, and transmission line. Much of the land that would be used has been previously disturbed. At OCNGS, the staff assumed that approximately 40 ac would be needed for the plant and associated infrastructure. (However, additional land would also be needed for construction of cooling towers for a closed-cycle cooling system.) There would be an additional impact of up to approximately 12 ac for construction of a gas pipeline. Approximately 40 ac of already developed land at the OCNGS site is available (AmerGen 2005).

  For construction at an alternate site, the NRC staff assumed in the GEIS that 110 ac would be needed for a 1000-MW(e) plant and associated infrastructure (NRC 1996). This estimate would be scaled down for the 600-MW(e) capacity of the gas-fired plant alternative considered here (i.e., 66 ac). The additional amount of land impacted by the construction of a new transmission line and a gas pipeline is dependent on the site location chosen. The NRC staff assumed in the GEIS that approximately 2500 ac would be impacted for construction of a 60-mi transmission line (NRC 1996).

  Regardless of where a gas-fired plant is built, additional land (approximately 3600 ac) would be required for natural gas wells and collection stations (NRC 1996). Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for OCNGS. In the GEIS (NRC 1996), the NRC staff estimated that approximately 1000 ac would be affected by the mining and processing of uranium during the operating life of a nuclear power plant.

Table 8-5. Summary of Environmental Impacts of a Natural-Gas-Fired Plant Using Closed-Cycle Cooling at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Land use	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. Uses approximately 40 ac for plant site. Additional impact of up to approximately 12 ac for construction of 2 mi of underground gas pipeline. Additional land needed for cooling towers.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Uses approximately 66 ac for power block, cooling towers, offices, roads, and parking areas. Additional land would be needed for a new transmission line (amount dependent on site chosen) and for construction and/or upgrade of a gas pipeline.
Ecology	SMALL to MODERATE	Impact would depend on the characteristics of the land to be developed. Uses developed areas at current OCNGS site, reducing impacts on ecology. Impacts could occur with construction of a gas pipeline. Impact on terrestrial ecology from cooling-tower drift. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission and pipeline routes. Impact on terrestrial ecology from cooling-tower drift. Some impingement and entrainment of aquatic organisms.
Water use and quality – surface water	SMALL	Impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in any streams crossed during pipeline construction.	SMALL to MODERATE	Impact would depend on volume of water withdrawn and discharged and characteristics of surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in streams crossed during pipeline construction.

Table 8-5. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for potable water use.	SMALL to MODERATE	Impact would depend on the location of the site, the volume of water withdrawn and discharged, and characteristics of the aquifer.
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be SMALL. Impact of operations on air quality during operations would be MODERATE with the following emissions expected: Sulfur oxides • 42 tons/yr Nitrogen oxides • 135 tons/yr Carbon monoxide • 28 tons/yr PM_{10} particulates • 24 tons/yr Some hazardous air pollutants.	MODERATE	Same emissions as a natural-gas-fired plant at the OCNGS site, although pollution-control standards may vary depending on location. Impacts during construction would be SMALL. Impacts during operation would be MODERATE.
Waste	SMALL	Waste would be generated and removed during construction. Minimal waste from fuel consumption during operation.	SMALL	Same impact as a natural-gas-fired plant at the OCNGS site. Waste disposal constraints may vary.
Human health	SMALL	Human health risks associated with gas-fired plants may result from NO_x emissions, which are regulated. Impacts are expected to be SMALL.	SMALL	Same impact as a natural-gas-fired plant at the OCNGS site.

Table 8-5. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Socioeconomics	MODERATE	During construction, impact would be MODERATE. Up to 360 additional workers during the peak of the 3-year construction period, followed by a reduction of the current OCNGS workforce from 470 to 24. Ocean County would experience a reduced demand for goods and services as well as a loss in its tax base and employment, but this would be potentially offset by projected economic growth in the area. Impact during operation would be SMALL.	MODERATE	Construction impact would depend on location, but could be MODERATE if the location is in a rural area. Up to 360 additional workers during the peak of the 3-year construction period. Ocean County would experience a loss in its tax base and employment if the plant is built outside of the county, but this would be potentially offset by projected economic growth in the area. Impact during operation would be SMALL.
Transportation	MODERATE	Transportation impact associated with construction workers would be MODERATE, as 470 OCNGS workers and 360 construction workers would be commuting to the site. Impact during operation would be SMALL as the number of commuters would be reduced to 24.	MODERATE	Transportation impact associated with 360 construction workers would be MODERATE. Impact during operation would be SMALL as the number of commuters would be reduced to 24.
Aesthetics	SMALL to MODERATE	SMALL to MODERATE aesthetic impact due to visibility of plant units, exhaust stacks, cooling towers and plumes, and gas compressors. Intermittent noise from construction and continuous noise from cooling towers and mechanical equipment would result in SMALL to MODERATE impact.	SMALL to MODERATE	Impact would depend on the characteristics of the site, but would be similar to those for a natural-gas-fired plant at the OCNGS site with additional impact from the new transmission line and gas pipeline. The impact could range from SMALL to MODERATE.

Table 8-5. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate the potential impact of new plant construction.	SMALL to MODERATE	Impact would depend on the characteristics of the alternate site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new plant construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; the loss of 446 operating jobs at OCNGS could reduce employment prospects for minority and low-income populations. Impact could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impact would depend on population distribution and makeup at site.

Overall, the NRC staff concludes that land-use impact for a gas-fired plant at the OCNGS site would be SMALL to MODERATE given the availability of previously developed and disturbed land that could be used for the plant site, the use of existing transmission systems, and the proximity of an existing gas pipeline. Impacts on land use at an alternate site could be greater, depending on the site chosen and the land requirements for a new transmission line and new gas pipeline, and are characterized as MODERATE to LARGE.

- **Ecology**

At the OCNGS site, there would be ecological impacts related to possible habitat loss and to cooling-tower drift associated with siting of a gas-fired plant. There also would be ecological impacts associated with bringing a new underground gas pipeline to the OCNGS site. Impacts due to habitat loss could be reduced through the use of previously impacted land. Ecological impacts at an alternate site would depend on the nature of the land converted for the plant and the possible need for a new gas pipeline and/or transmission line. Construction of the transmission line and construction and/or upgrading of the gas pipeline to serve the plant would be expected to have ecological impacts. Ecological impacts on the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. The use of cooling makeup water from a nearby surface-water body could cause entrainment and impingement of fish and other aquatic organisms, and result in adverse impacts on aquatic resources. However, rates of entrainment and impingement would be greatly reduced from current levels associated with operation of the existing once-through cooling system.

Overall, the NRC staff concludes that ecological impact of a gas-fired plant at the OCNGS site would be SMALL to MODERATE given the availability of previously developed and disturbed land that could be used for the plant site, the use of the existing transmission system, and the proximity of an existing gas pipeline. Impact at an alternate site could be greater, depending on the site chosen and the land requirements for a new transmission line and new gas pipeline, and are characterized as MODERATE to LARGE.

- **Water Use and Quality**

Surface water. Each of the natural-gas-fired units would include a heat-recovery boiler, using a portion of the waste heat from the combustion turbines to generate additional electricity. The net result would be an overall reduction in the amount of waste heat rejected from the plant, with an associated reduction in the amount of cooling water required by the plant. Thus, the cooling-water requirements for the natural-gas-fired combined-cycle units would be much less than the requirements for conventional steam-electric generators, including the existing nuclear unit. Plant discharge would consist mostly of cooling-tower blowdown, with the discharge having a higher temperature and increased concentration of dissolved solids, relative to the receiving body of water, and intermittent low concentrations of biocides (e.g., chlorine). In addition to the cooling-tower blowdown, treated process waste streams and sanitary wastewater might also be discharged. All discharges would be regulated by the NJDEP. There would be consumptive use of water due to evaporation from the cooling towers. Overall, the surface-water impacts of operation under the natural-gas-fired plant alternative at the OCNGS site are considered SMALL.

A natural-gas-fired plant at an alternate site is assumed to use surface water for cooling makeup water and discharge. Intake and discharge would involve relatively small quantities of water compared with the coal-fired plant alternative. The impact on surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Discharges would be the same as those described above for a gas-fired plant at the OCNGS site. Intake from and discharge to any surface body of water would be regulated by the NJDEP. The impact would be SMALL to MODERATE.

Water-quality impacts from sedimentation during construction were characterized in the GEIS as SMALL (NRC 1996). The NRC staff also noted in the GEIS that operational water-quality impacts would be similar to, or less than, those from other generating technologies.

Groundwater. Any groundwater withdrawal would require a permit from the local permitting authority. OCNGS currently uses groundwater for potable water, and this practice would likely continue under the gas-fired plant alternative. Impacts on groundwater use and quality would be considered SMALL. Impacts on groundwater at an alternate site would depend on the volume of water needed and characteristics of the groundwater source. The NRC staff concludes that impacts at an alternate site would be SMALL to MODERATE, depending on site-specific conditions.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired plant alternative would release similar types of emissions, but in lesser quantities than the coal-fired plant alternative.

A new gas-fired plant located in New Jersey would likely need a PSD permit and an operating permit under the CAA. A new combined-cycle natural gas power plant would also be subject to the new-source performance standards for such units at 40 CFR Part 60, Subparts D(a) and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x.

In 1998, the EPA issued a rule requiring 20 eastern states, including New Jersey, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard (40 CFR 50.9) for ozone. The total amount of NO_x that can be emitted by each of the 20 states in the 2007 ozone season (May 1 to September 30) is presented in 40 CFR 51.121(e). For New Jersey, the amount is 330,836 tons/yr (EPA 2001b).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated attainment or unclassified under the CAA. Portions of New Jersey have been classified as attainment or unclassified for criteria pollutants (40 CFR 81.331). In the posted amendment to that classification dated April 30, 2004, there are several instances of nonattainment for ozone, including Ocean County (EPA 2004b).

Section 169A of the CAA establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The EPA issued a new regional haze rule in 1999 (64 FR 35714; July 1,1999 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a natural-gas-fired plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Brigantine National Wildlife Refuge, located about 20 mi south of OCNGS, is a Class I area where visibility is an important value (40 CFR 81.420). Air quality in this area could be affected by a natural-gas-fired plant at the OCNGS site and at an alternate site, if the site chosen were located within 62 mi of the wildlife refuge.

AmerGen projects the following emissions for the natural-gas-fired plant alternative (AmerGen 2005):

- Sulfur oxides – 42 tons/yr
- Nitrogen oxides – 135 tons/yr
- Carbon monoxide – 28 tons/yr
- PM_{10} particulates – 24 tons/yr

A natural-gas-fired plant would also have unregulated CO_2 emissions that could contribute to global warming.

In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). The EPA found that natural-gas-fired power plants emit arsenic, formaldehyde, and nickel. Unlike coal- and oil-fired plants, the EPA did not determine that emissions of hazardous air pollutants from natural-gas-fired power plants should be regulated under Section 112 of the CAA.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. Air emissions would likely be the same at OCNGS or at an alternate site. The overall air quality impact for a new natural-gas-fired plant sited at OCNGS or at an alternate site is considered MODERATE.

- **Waste**

  There would be spent SCR catalyst from NO_x emissions control and small amounts of solid waste products (i.e., ash) from burning natural gas fuel. In the GEIS, the NRC staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Natural gas combustion results in very few by-products because of the clean nature of the fuel. Waste-generation impacts would be so minor that they would not noticeably alter any important resource attribute. Construction-related debris would be generated during construction activities.

  Overall, the waste impacts associated with the natural-gas-fired plant alternative would be SMALL for a plant sited at OCNGS or at an alternate site.

- **Human Health**

  In Table 8-2 of the GEIS, the NRC staff identified cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contributes to health risks. Nitrogen oxide emissions from any gas-fired plant would be regulated. For a plant sited in New Jersey, NO_x emissions would be regulated by the NJDEP. Overall, the impact on human health of the natural-gas-fired plant alternative sited at OCNGS or at an alternate site is considered SMALL.

- **Socioeconomics**

  Construction of a natural-gas-fired plant would take approximately 3 years. Peak employment would be approximately 360 workers (AmerGen 2005). The NRC staff assumed that construction would take place while OCNGS continues operation and would be completed by the time it permanently ceases operations. During construction, the communities surrounding the OCNGS site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other parts of Ocean County or from other nearby counties. After construction, the communities would be impacted by the loss of jobs. The current OCNGS workforce (approximately 470 workers) would decline through a decommissioning period to a minimal maintenance size. The gas-fired plant would introduce a replacement tax base at OCNGS or at an alternate site and approximately 24 new permanent jobs. This would represent a net loss of 446 jobs at the OCNGS site.

  In the GEIS (NRC 1996), the NRC staff concluded that socioeconomic impacts from constructing a natural-gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology. Compared with the coal-fired and nuclear plant alternatives, the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operations workforce would mitigate socioeconomic impacts. The loss of 446 permanent jobs (up to 470 jobs if an alternate site is not located in Ocean County) may be partially tempered by the projected economic growth of the area. For these reasons, socioeconomic impacts associated with construction and operation of a natural-gas-fired power plant would be MODERATE and SMALL, respectively, for siting at OCNGS or at an alternate site.

- **Transportation**

  Transportation impacts associated with construction and operating personnel commuting to a natural-gas-fired plant would depend on the population density and transportation infrastructure in the vicinity of the site. The impacts can be classified as MODERATE for construction and SMALL for operation at OCNGS or at an alternate site.

- **Aesthetics**

  For a natural-gas-fired plant, the turbine buildings (approximately 100 ft tall) and exhaust stacks (approximately 125 ft tall), and cooling towers and plumes would be visible during daylight hours from offsite. The gas pipeline compressors also would be visible. Noise and light from the plant would be detectable offsite. Intermittent noise from construction and continuous noise from cooling towers and mechanical equipment would result in SMALL to MODERATE impact. Overall, the aesthetic impacts associated with construction and operation of a natural-gas-fired plant at the OCNGS site are categorized as SMALL to MODERATE.

  At an alternate site, the buildings, cooling towers, cooling-tower plumes, and the associated transmission line and gas pipeline compressors would be visible offsite. There would also be a visual impact from a new transmission line. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Noise impacts would be similar to those described for the OCNGS site. Overall, the aesthetic impacts associated with an alternate site are categorized as SMALL to MODERATE and would depend on the characteristics of the area to be developed. Depending on the site chosen, the greatest contributor to aesthetic impact would be the new transmission line.

- **Historic and Archaeological Resources**

  Before construction or any ground disturbance at OCNGS or at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Other lands, if any, that are acquired to support the plant would also likely need an inventory of cultural resources to identify and evaluate existing historic and archaeological resources and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Historic and archaeological resources must be evaluated on a site-specific basis. The impacts can generally be effectively managed under current laws and regulations, and as such, the categorization of impacts ranges from SMALL to MODERATE, depending on what resources are present and whether mitigation is necessary.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a new natural-gas-fired plant were built at the OCNGS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of OCNGS would result in a decrease in employment of approximately 470 operating employees, partially offset by the 24 workers required for operation of the new plant, and possibly by general growth in the area. Following construction, it is possible that the ability of local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, environmental justice impacts are expected to be SMALL. Projected economic growth in the area and the ability of minority and low-income populations to commute to other jobs outside the area could mitigate any adverse effects.

Environmental justice impact at an alternate site would depend upon the site chosen and the nearby population distribution; therefore, impacts could range from SMALL to MODERATE.

8.3.2.2 Natural-Gas-Fired Plant with a Once-Through Cooling System

This section discusses the environmental impacts of constructing and operating a natural-gas-fired plant using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are similar to the impacts for a natural-gas-fired plant using the closed-cycle system. However, there are minor differences between the closed-cycle and once-through cooling systems. Table 8-6 summarizes these differences. The design and operation of the intake would need to comply with the EPA's 316(b) Phase I or II regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

Table 8-6. Summary of Environmental Impacts of a Natural-Gas-Fired Plant Using Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land use	Impact may be less (e.g., through elimination of cooling towers) or greater (e.g., if a reservoir is required).
Ecology	Impact would depend on the ecological conditions in areas to be developed. Potential impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock. No impact on terrestrial ecology from cooling-tower drift.
Water use and quality – surface water	Greater water withdrawal rates leading to possible water-use conflicts, thermal load higher on receiving body of water than with closed-cycle cooling; no discharge of cooling-tower blowdown.
Water use and quality – groundwater	No change
Air quality	No change
Waste	No change
Human health	No change
Socioeconomics	No change
Transportation	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and archaeological resources	No change
Environmental justice	No change

8.3.3 Nuclear Power Plant Generation

Since 1997, the NRC has certified four new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the 1300-MW(e) U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the 1300-MW(e) System 80+ Design (10 CFR Part 52, Appendix B), the 600-MW(e) AP600 Design (10 CFR Part 52, Appendix C), and the 1117- to 1154-MW(e) AP1000 design (10 CFR Part 52, Appendix D). All these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to the NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent escalation in prices of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint. In addition, System Energy Resources, Inc., Exelon Generation Company, LLC, and Dominion Nuclear

North Anna, LLC, have recently submitted applications for early site permits for new advanced nuclear power plants under the procedures in 10 CFR Part 52, Subpart A (SERI 2003; Exelon 2003; Dominion 2003). Consequently, construction of a new nuclear power plant at either the OCNGS site or at an alternate site is considered in this section. The NRC staff assumed that the new nuclear plant would have a 40-year lifetime. Impacts of a new nuclear generating plant to replace OCNGS were not included in the AmerGen ER (AmerGen 2005) because AmerGen did not judge it likely that an Advanced Nuclear Reactor could be licensed, constructed, and on-line in time for the expiration of the current OCNGS OL.

The NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs, sited at OCNGS or at an alternate site. In the GEIS, the NRC estimated that for a 1000-MW(e) reactor, 500 to 1000 ac would be required for construction (NRC 1996). The impacts shown in Table S-3 were adjusted to reflect the replacement of 640 MW(e) generated by OCNGS. The environmental impacts associated with transporting fuel and waste to and from a light-water-cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52.

The summary of the NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a new nuclear power plant. Additional environmental impact information for a new nuclear power plant using closed-cycle cooling is presented in Section 8.3.3.1, and using once-through cooling is presented in Section 8.3.3.2.

8.3.3.1 New Nuclear Plant with a Closed-Cycle Cooling System

The overall impacts of a new nuclear plant are discussed in the following sections and are summarized in Table 8-7. The extent of impacts at an alternate site would depend on the location of the site that is selected.

In addition to the impacts discussed below, impacts would occur offsite as a result of uranium mining. Impacts of mining would include an increase in fugitive dust emissions, surface-water runoff, erosion, sedimentation, changes in water quality, disturbance of vegetation and wildlife, disturbance of historic and archaeological resources, changes in land use, and impacts on employment.

The magnitude of these offsite impacts would be largely proportional to the amount of land affected by mining. However, there would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel at OCNGS.

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant Using Closed-Cycle Cooling at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Land use	MODERATE to LARGE	Impact would depend on the degree to which previously disturbed lands were utilized. Requires approximately 320 to 640 ac for the plant. Additional offsite land use impacts from uranium mining.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Impact would be generally the same as a new nuclear plant at the OCNGS site plus additional land for a transmission line.
Ecology	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed. Uses developed and undeveloped areas at current OCNGS site and possibly additional undeveloped land adjacent to the site. Impact on terrestrial ecology from cooling-tower drift. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission line route. Impact on terrestrial ecology from cooling-tower drift. Some impingement and entrainment of aquatic organisms.
Water use and quality – surface water	SMALL	Impact on surface water would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released.
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for reactor makeup water and potable water use.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged and the characteristics of the aquifer.

Table 8-7. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be MODERATE. Emissions from diesel generators and possibly other sources during operation would be similar to current OCNGS operation, and their impact on air quality would be SMALL.	MODERATE	Same impacts as a new nuclear plant at the OCNGS site. Impact during construction would be MODERATE. Impact during operation would be SMALL.
Waste	SMALL	Waste would be generated and removed during construction. Waste impacts for an operating nuclear power plant are presented in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impact as a new nuclear plant at the OCNGS site.
Human health	SMALL	Human health impacts for an operating nuclear power plant are presented in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impact as a new nuclear plant at the OCNGS site.
Socioeconomics	MODERATE	During construction, impact would be MODERATE. Up to 1600 workers during peak period of the 6-year construction period. Operating workforce assumed to be similar to OCNGS; tax base preserved. Impacts during operation would be SMALL.	MODERATE to LARGE	Construction impact would depend on location, but could be LARGE at a rural location. Ocean County would experience a loss in its tax base and employment if the chosen site is located outside of the county, but possibly offset by economic growth in the area.
Transportation	MODERATE to LARGE	Transportation impact associated with 1600 construction workers in addition to 470 OCNGS workers would be MODERATE to LARGE. Transportation impact of commuting personnel would be SMALL.	MODERATE to LARGE	Impact would depend on the location of the site. Transportation impacts of 1600 construction workers could be MODERATE to LARGE. Transportation impacts of 470 commuting personnel could be SMALL to MODERATE.

Table 8-7. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Aesthetics	SMALL to MODERATE	Aesthetic impact due to the addition of cooling towers and other structures would be SMALL to MODERATE. Intermittent noise from construction and commuter traffic and continuous noise from cooling towers and mechanical equipment could result in impacts ranging from SMALL to MODERATE.	SMALL to MODERATE	Impact would depend on the characteristics of the site but would be similar to those for a new nuclear plant at the OCNGS site. Additional visual impacts would occur from the new transmission line that would be needed.
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction.	SMALL to MODERATE	Impact would depend on the characteristics of the alternative site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. SMALL impact on housing could occur during construction. Employment impacts would be similar to the current operation of OCNGS and are expected to be SMALL.	SMALL to LARGE	Impacts would vary, depending on population distribution and makeup at the site.

- **Land Use**

The existing facilities and infrastructure at the OCNGS site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the NRC staff assumed that a new nuclear power plant would use the existing switchyard, offices, and transmission line rights-of-way. Much of the land that would be used has been previously disturbed. A new nuclear power plant at the OCNGS site would alter approximately 320 to 640 ac of land (NRC 1996).

The impact of a new nuclear plant on land use at the existing OCNGS site is best characterized as MODERATE to LARGE, because the existing site may not be large enough to accept the additional land requirements for construction. Additional land may have to be obtained outside of the existing boundaries, or OCNGS might have to be dismantled before new construction begins. The impact would be greater than it would be under the proposed action.

Land-use impacts at an alternate site would be similar to siting at OCNGS except for the land needed for a transmission line to connect to the grid. The amount of land needed for the transmission line would depend upon the location of the alternate site. In addition, it may be necessary to construct a rail spur to an alternate site to bring in equipment during construction. Depending particularly on transmission line routing, siting a new nuclear plant at an alternate site would result in MODERATE to LARGE land-use impacts.

- **Ecology**

Locating a new nuclear power plant at the OCNGS site would alter ecological resources because of the need to convert about 320 to 640 ac of land to industrial use. Some of this land, however, would have been previously disturbed.

Siting a new nuclear plant at OCNGS would have a MODERATE to LARGE ecological impact that would be greater than that under the proposed action. Development of previously undisturbed lands could result in impacts on threatened or endangered species, wildlife habitat destruction, habitat fragmentation, reduced productivity, and local reductions in biological diversity. The magnitude of the impact would depend on the characteristics of the land to be developed. Cooling-tower drift could result in impacts on terrestrial ecology, especially nearby vegetation. The use of cooling towers to replace once-through cooling would reduce thermal discharge and the entrainment and impingement of aquatic organisms.

At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would affect ecological resources. Impacts could include impacts on threatened and endangered species, wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface-water body could have adverse aquatic resource impacts. Impacts on terrestrial ecology could result from cooling-tower drift. Construction and maintenance of a transmission line, if needed, would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE and would depend on the ecological conditions at the site and the amount of land to be developed.

- **Water Use and Quality**

  Surface water. A new nuclear plant at the OCNGS site would require the construction of cooling towers for a closed-cycle cooling system. The use of a closed-cycle cooling system would reduce impacts on surface water relative to the existing once-through system at OCNGS. Plant discharge would consist mostly of cooling-tower blowdown, with the discharge having a higher temperature and increased concentration of dissolved solids, relative to the receiving body of water, and intermittent low concentrations of biocides (e.g., chlorine). In addition to the cooling-tower blowdown, treated process waste streams and sanitary wastewater might also be discharged. All discharges would be regulated by the state of New Jersey through a NJPDES permit. Surface-water impacts are expected to be SMALL.

  At an alternate site, the impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the NJDEP. The impacts would be SMALL to MODERATE, and their magnitude would depend on the characteristics of the surface-water body used as the source of cooling water.

  Groundwater. The NRC staff assumed that a new nuclear power plant located at OCNGS would continue the current practice for OCNGS of using groundwater for reactor makeup water and potable water (see Section 2.2.2). Use of groundwater for a nuclear power plant sited at an alternate site would require a permit from the local permitting authority. Overall, the impacts on groundwater use and quality from a closed-cycle new nuclear plant at the OCNGS site are considered SMALL. Impacts from a similar plant at an alternate site are considered to be SMALL to MODERATE, depending on the volume of groundwater used and characteristics of the aquifer.

- **Air Quality**

  Construction of a new nuclear plant sited at OCNGS or at an alternate site would result in fugitive dust emissions during the 6-year construction period. Exhaust emissions would also be produced by vehicles and motorized equipment used during the construction process. Air quality impacts from construction could be MODERATE. An operating nuclear plant would have minor air emissions associated with diesel generators and other minor intermittent sources and would be similar to the current impacts associated with operation of OCNGS (i.e., SMALL).

- **Waste**

  The waste impacts associated with operation of a nuclear power plant are presented in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Construction-related waste would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts are considered SMALL.

  Siting a new nuclear power plant at a site other than OCNGS would not alter waste generation. Therefore, the impacts would be SMALL.

- **Human Health**

  Human health impacts for an operating nuclear power plant are presented in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Overall, human health impacts are considered SMALL.

  Siting the replacement nuclear power plant at a site other than OCNGS would not alter human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

  For the construction of a new nuclear power plant, the NRC staff assumed a construction period of 6 years and a peak workforce of 1600 (NRC 1996). Additional land may have to be acquired to construct a new nuclear plant at the OCNGS site, or OCNGS might have to be decommissioned and dismantled before construction began. During construction, the communities surrounding the OCNGS site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other parts of Ocean County or from other nearby counties.

  A new nuclear plant is assumed to have an operating workforce comparable to the 470 workers currently working at OCNGS. The new nuclear plant would provide a new tax base to offset the loss of tax base associated with decommissioning of OCNGS. For these reasons, the NRC staff concludes that the socioeconomic impacts for a replacement nuclear plant constructed at OCNGS would be MODERATE during construction and SMALL during operation.

  If a new nuclear power plant were constructed at an alternate site, the communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 1600 workers at the peak of construction) and a permanent workforce of approximately 470 workers. In the GEIS (NRC 1996), the NRC staff indicated that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work. Alternate sites would need to be analyzed on a case-by-case basis, and impacts could range from MODERATE to LARGE, depending on the socioeconomic characteristics of the area around the site.

- **Transportation**

During the 6-year construction period, up to 1600 construction workers and 470 OCNGS workers would be commuting to the OCNGS site. The addition of the construction workers could place significant traffic loads on existing highways. Such impact would be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of OCNGS and are considered SMALL.

Transportation-related impacts associated with commuting construction workers at an alternate site are site dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL to MODERATE, and would depend on the characteristics of the transportation system and population in the vicinity of the site.

- **Aesthetics**

The containment buildings for a new nuclear power plant sited at OCNGS and other associated buildings would likely be visible in daylight hours over many miles. Mechanical-draft towers could be up to 100 ft high and would also have an associated noise impact and condensate plumes. The replacement nuclear plant would also likely be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is compatible with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed. The aesthetic impact due to the addition of cooling towers and other structures would be SMALL to MODERATE.

Intermittent noise impacts from construction and commuter traffic are likely. Continuous noise from a new nuclear plant would potentially be audible offsite in calm wind conditions or when the wind is blowing in the direction of the listener. Noise impacts from a new nuclear plant would be similar to those from the existing OCNGS unit. Mitigation measures, such as reduced or no use of outside loudspeakers, could be employed to reduce noise impacts to levels that would range from SMALL to MODERATE.

At an alternate site, there would be an aesthetic impact from the buildings, cooling towers, and the plume associated with the cooling towers. There could also be a significant aesthetic impact associated with construction of a new transmission line. The length of the transmission line would depend upon the location of the plant. Noise and light from the plant would be detectable offsite. The impact of noise and light would be less if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating a new nuclear plant at an alternate site can be categorized as SMALL to MODERATE. Depending on the location chosen, the greatest contributor to this categorization could be the aesthetic impact of the new transmission line.

- **Historic and Archaeological Resources**

  Before construction or any ground disturbance at OCNGS or at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Other lands, if any, that are acquired to support the plant would also likely need an inventory of cultural resources to identify and evaluate existing historic and archaeological resources and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Historic and archaeological resources must be evaluated on a site-specific basis. The impacts can generally be effectively managed under current laws and regulations, and as such, the categorization of impacts ranges from SMALL to MODERATE, whether at the OCNGS site or an alternate site, depending on what resources are present and whether mitigation is necessary.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a new nuclear plant were built at the OCNGS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations. After completion of construction, it is possible that the ability of the local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. Overall, impacts are expected to be SMALL. Projected economic growth in the area and the ability of minority and low-income populations to commute to other jobs outside the Ocean County area could mitigate any adverse effects.

  The environmental justice impact at an alternate site would depend upon the site chosen and the nearby population distribution, and could range from SMALL to LARGE.

8.3.3.2 New Nuclear Plant with a Once-Through Cooling System

This section discusses the environmental impacts of constructing and operating a new nuclear power plant using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are similar to the impacts for a nuclear power plant using a closed-cycle system. However, there are minor differences between the closed-cycle and once-through cooling systems. Table 8-8 summarizes these differences. The design and operation of the intake would need to comply with the EPA's 316(b) Phase I or II regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

8.3.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the OCNGS OL. Imported power from Canada or Mexico is unlikely to be available for replacement of OCNGS capacity. In Canada, 60 percent of the country's electricity-generating capacity is derived from renewable energy sources, principally hydropower (EIA 2004). Canada plans to expand hydroelectric capacity, including large-scale projects (EIA 2004). Canada's nuclear generation is projected to increase from 10,000 MW in 2001 to 15,200 MW in 2020 before reaching a forecasted decline to 12,400 MW in 2025 (EIA 2004). The EIA projected that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 38.4 billion kWh in 2001 to 47.2 billion kWh in 2010 and then gradually decrease to 15.2 billion kWh in 2025 (EIA 2004). Consequently, it is unlikely that electricity imported from Canada or Mexico would be able to replace OCNGS capacity.

If power to replace OCNGS capacity were to be purchased from sources within the United States or a foreign country, the power-generation technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased electrical power alternative to renewal of the OCNGS OL. Thus, the environmental impacts of imported power would still occur but would be located elsewhere within the region, nation, or another country. In addition, there could be environmental impacts associated with the possible construction of new transmission lines.

8.3.5 Other Alternatives

Other power-generation technologies considered by the NRC are discussed in the following paragraphs.

Table 8-8. Summary of Environmental Impacts of a New Nuclear Power Plant Using Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land use	Impact may be less (e.g., through elimination of cooling towers) or greater (e.g., if a reservoir is required).
Ecology	Impact would depend on the ecological conditions in areas to be developed. Possible impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock. No impact on terrestrial ecology from cooling-tower drift.
Water use and quality – surface water	Greater water withdrawal rates leading to possible water-use conflicts, thermal load higher on receiving body of water than with closed-cycle cooling; no discharge of cooling-tower blowdown.
Water use and quality – groundwater	No change
Air quality	No change
Waste	No change
Human health	No change
Socioeconomics	No change
Transportation	No change
Aesthetics	Less aesthetic impact because cooling towers are not used.
Historic and archaeological resources	No change
Environmental justice	No change

8.3.5.1 Oil-Fired Plant Generation

The EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States between 2005 and 2025 because of higher fuel costs and lower efficiencies (EIA 2004). AmerGen has several oil-fired units in the Pennsylvania, New Jersey, and Maryland area. These units produce less than 2 percent of AmerGen's total power (AmerGen 2005).

Construction and operation of an oil-fired plant would have environmental impacts. For example, in Section 8.3.11 of the GEIS, the NRC staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac of land for the facility and additional land for an oil pipeline (NRC 1996). In addition, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those of a coal-fired plant.

Oil-fired generation is more expensive than nuclear or coal-fired generation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its use for electricity generation. For these reasons, oil-fired generation is unlikely to replace the electricity-generating capacity of OCNGS.

8.3.5.2 Wind Power

Wind power, by itself, would not be able to replace the 640-MW(e) baseload electrical generating capacity of OCNGS. As discussed in Section 8.3.1 of the GEIS, wind is not continuously available, resulting in average annual capacity factors for wind plants that are relatively low (on the order of 30 percent) (NRC 1996) as compared with other conventional baseload facilities. Wind power, only in conjunction with energy storage mechanisms or other sources of electric generation, might serve as a means of providing baseload power. Current energy storage technologies are too expensive for wind power to serve as a large baseload generator.

The New Jersey coast, including Ocean County, has marginal-to-fair wind power potential. The annual wind power estimates for the New Jersey coast indicate a rating of Class 2 and some Class 3, increasing to Classes 4 and 5 offshore (DOE 2006a). However, the wind power class attenuates rapidly to Class 1 (poor) inland from the coastline. Areas designated Class 3 or greater are suitable for most wind energy applications (DOE 2004). Land-use conflicts, such as urban development, farmland, and environmentally sensitive areas, also minimize the amount of land suitable for wind energy applications (PNL 1986).

Currently, commercially available wind turbines range in capacity from 1 to 3600 kW (3.6 MW, offshore only), with rotor diameters exceeding 200 ft. The magnitude of environmental impact would vary with the size, height, and location of the turbine(s). DOE's National Renewable Energy Laboratory (NREL) estimates that the footprint of a 1.5-MW wind turbine is between 0.25 and 0.5 ac. In addition, a spacing interval of 5 to 10 turbine rotor diameters between wind turbines is typically maintained to prevent interferences between turbines (NREL 2006). Five turbine rotor diameters would be suitable for optimal wind conditions, increasing to 10 depending on the amount of wind turbulence and other potential topographic disturbances. Land disturbance during construction to install the turbine is estimated to be between 1 to 3 ac per turbine related to grading the site for installation, laydown areas for equipment and materials, and staging areas for construction equipment used to hoist the turbines and their towers into place. The area surrounding the turbine is then reclaimed after construction is completed. These estimates do not include land used for substations, control buildings, access roads, and other related facilities. Assuming the most common commercially available land-based turbine is used (1.5 MW[a]), 427 turbines are estimated to be needed in land areas with a wind class of 3 or greater to produce 640 MW(e), using the NREL's Wind Farm Area Calculator (NREL 2006). Assuming a rotor diameter of roughly 200 ft for a 1.5-MW turbine, the total acreage for a wind farm with 427 turbines in optimal wind conditions could require more than 2,000 ac; 213.5 ac would be dedicated to the turbine footprint (assuming approximately 0.5 ac per turbine base), and the remaining land between turbines could be available for other uses, such as grazing or agricultural land. In a linear configuration, these turbines would require at least 427,000 ft (80 mi) of coastline. In comparison, the New Jersey coast is approximately 150 mi long. These numbers do not take into account the low annual capacity factor of approximately 30 percent that is associated with wind energy.

The current OCNGS site is too small to support 640 MW(e) of baseload wind generation capacity. At an alternate site, this large amount of land required along the coastline could have significant environmental impacts. Larger turbines could be used for offshore wind development where the wind class is greater. A wind farm of 4-MW turbines (the largest currently available turbine for offshore use is 3.6 MW) would require about 160 turbines, with greater spacing required between turbines because of the greater rotor lengths, to produce 640 MW(e). Although impacts would depend on the site chosen, common issues of concern include visual impacts, noise, potential interferences with aircraft operations, and bird and bat collisions. For these reasons, wind power by itself is unlikely to replace the electricity-generating capacity of OCNGS.

8.3.5.3 Solar Power

Solar technologies use the sun's heat and light energy to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. In the GEIS, the NRC staff noted that by its nature, solar power is intermittent. Therefore, solar power is not suitable for baseload capacity by itself. The average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 to 40 percent. New Jersey receives between approximately 3.0 to 4.5 kWh of solar radiation per square meter per day, compared with 6 to 8 kWh of solar radiation per square meter per day in areas of the southwestern United States, such as Arizona and California, which are most promising for solar technologies (DOE 2006b). Solar power, only in conjunction with energy storage mechanisms or other generation sources, might serve as a means of providing baseload power. While energy storage systems like battery banks may be feasible for small applications, current energy storage technologies are too expensive to permit solar power facilities to serve as large baseload generation sources by themselves.

(a) 1.8-MW and 2.3-MW turbines have recently been made available with approximately 300-ft rotor diameters. The size of the construction footprint of these turbines is not known at this time.

Natural resources (e.g., wildlife habitat, land use, and aesthetics) can incur substantial impacts from construction of concentrated solar-generating facilities on a greenfield site. As stated in the GEIS, land requirements are high – 35,000 ac per 1000 MW(e) for photovoltaic and approximately 14,000 ac per 1000 MW(e) for solar thermal systems. A concentrated solar electric system capable of generating 640 MW(e) could not fit on the OCNGS site, and both could have significant environmental impacts at an alternate site. However, smaller distributed photovoltaic arrays may be placed on rooftops and other disturbed areas with less environmental impact.

8.3.5.4 Hydropower

There are no remaining sites in the New Jersey market region that would be environmentally suitable for a hydroelectric facility with 640 MW(e) of electricity-generating capacity (INEEL 1998). In Section 8.3.4 of the GEIS, the NRC staff points out that hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses.

The NRC staff estimated in the GEIS that land requirements for hydroelectric power are approximately 1 million ac per 1000 MW(e). Therefore, replacement of OCNGS generating capacity would require approximately 640,000 ac. Construction of hydroelectric facilities large enough to replace OCNGS would likely result in significant environmental impacts. Because of the lack of suitable sites in New Jersey and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace OCNGS, the NRC staff concludes that hydropower is unlikely to replace the 640 MW(e) of electricity-generating capacity provided by OCNGS.

8.3.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where it is available. Geothermal technology is limited by the geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated in Figure 8.4 in the GEIS, geothermal electricity-generating plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. There is no feasible location in New Jersey for geothermal capacity sufficient to generate 640 MW(e) (DOE 2006b). The NRC staff concludes that geothermal energy is unlikely to replace the 640 MW(e) of electricity-generating capacity provided by OCNGS.

8.3.5.6 Wood Waste

States with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan use wood waste to generate electricity. Electric power is generated in these states by the pulp, paper, and paperboard industries that consume wood and wood waste for energy; these industries benefit from the use of waste materials that could otherwise represent a disposal problem.

DOE estimates that New Jersey has some resources for wood fuels consisting of urban, mill, and forest residues; approximately 800,181 dry tons/yr are available in New Jersey (Walsh et al. 2000). NREL has estimated that 1100 kWh of electricity can be produced by 1 dry ton of wood residue. Therefore, approximately 880,200 MWh of electricity could be generated from wood residue in New Jersey (NREL 2004).

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment. Operation of a wood-burning facility could have environmental impacts on air quality, transportation, aesthetics, and other resources.

While wood resources are available in New Jersey, wood energy is unlikely to replace the 640 MW(e) of electricity-generating capacity provided by OCNGS.

8.3.5.7 Municipal Solid Waste

Municipal waste combustors incinerate nonhazardous solid waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2004c). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (EIA 2001). Mass-burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion.

Estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant should be approximately the same as that for a coal-fired plant. Municipal solid waste combustion generates an ash residue that is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace, which must be disposed of in landfills. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters or scrubbers (EIA 2001). Waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal) as a coal-fired plant of similar size. Therefore, constructing and operating a waste-fired plant would likely have significant impacts.

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills; (2) the 1994 Supreme Court decision *(C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (EIA 2001). The EIA projects an increase in electricity generation from municipal solid waste and landfill gas by 7 billion kWh to 29 billion kWh in 2025; however, no new capacity is expected (EIA 2005).

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of unfavorable economics, particularly with electricity prices declining in real terms. U.S. electricity prices in 2002 dollars are expected to decline by 8 percent between 2002 and 2008 and remain stable until 2011 (EIA 2004). Prices are expected to increase by 0.3 percent per year from 2011 until 2025, following the trend of the generation component of electricity price (EIA 2004).

Currently, there are approximately 89 waste-to-energy plants operating in the United States. These plants generate approximately 2500 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2004), considerably less than that needed to replace the 640 MW(e) of OCNGS.

The initial capital costs for municipal solid waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste (NRC 1996). Therefore, municipal solid waste is unlikely to replace the 640 MW(e) of electricity-generating capacity provided by OCNGS.

8.3.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for power generation, including burning crops, converting crops to a liquid fuel such as ethanol, and converting crops or wood waste to gaseous fuel. In the GEIS, the NRC staff points out that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as OCNGS. For these reasons, such fuels are unlikely to replace 640 MW(e) of electricity-generating capacity provided by OCNGS.

8.3.5.9 Fuel Cells

Fuel cells work without combustion and its environmental impacts. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and CO_2. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen. Hydrogen may also be generated by electrolysis using electricity.

Phosphoric acid fuel cells are generally considered first-generation technology. These fuel cells are commercially available at a cost of approximately $4000 to $4500/kW of installed capacity (DOE 2006c). Higher-temperature second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

Because of cost issues, the DOE formed the Solid State Energy Conversion Alliance (SECA), with the goal of producing new fuel cell technologies at a cost of $400/kW or lower by 2010 (DOE 2006d). Fuel cells have the potential to become economically competitive if SECA can reach its goal. For comparison, the installed capacity cost for a natural-gas-fired, combined-cycle plant is about $500 to $600/kW (Northwest Power Planning Council 2000). At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Consequently, fuel cells are not likely to replace the 640 MW(e) of electricity-generating capacity provided by OCNGS.

8.3.5.10 Delayed Retirement

Existing generating units slated for retirement could be used for longer periods, thus reducing the need to construct or operate other facilities to replace OCNGS capacity. This would likely require major refurbishment, including upgrading or replacing plant components to meet current environmental regulations, such as those regarding air emissions. The environmental impacts of delayed retirement of non-nuclear-generating facilities would be similar to or greater than the impacts from the operation of coal-fired and natural-gas-fired plants described in SEIS Sections 8.3.1 and 8.3.2. Delayed retirement is not likely to replace the 640 MW(e) of electricity-generating capacity provided by OCNGS.

8.3.5.11 Conservation Measures

Government, nonprofit, and utility-sponsored conservation programs (i.e., DSM), including educational programs, energy efficiency programs, and load management programs, have the potential to reduce consumer demand for electricity and allow current consumer needs to be met with less electric generation. Consumers may also choose to implement measures to reduce their demand in order to lower their electric bills or the environmental impacts associated with electrical production. The environmental impacts of conservation measures are typically low, and often beneficial when demand on facilities with significant environmental impacts is reduced.

New Jersey has a Clean Energy Program and other energy efficiency incentives and programs for use of energy-efficient appliances, incentives (sales tax exemptions) for use of cogeneration power, transportation initiatives, a greenhouse gas initiative, and updated mandatory energy codes for new building construction (Alliance to Save Energy 2006). This program has resulted in some peak demand reductions. However, the NRC staff concludes that conservation measures alone would not be able to realistically replace the 640 MW(e) of net generating capacity of OCNGS in the near future.

8.3.5.12 Tidal and Ocean Energy

Tidal power is a relatively new technology that can be used to produce electricity in areas with large tidal ranges, or relatively large tidal flow volumes and current speeds. Tidal energy emits no pollutants and operates at predictable output levels, though most designs currently in use rely on dams or impoundments across tidal rivers, creeks, or other estuarine habitats. They can reduce tidal fluxes, as well as tidal ranges, with uncertain effects on estuarine organisms. The largest of these dam-type installations has a maximum capacity of 240 MW.

Barnegat Bay is an area of low tidal ranges – less than one foot throughout most of the bay, up to 2.59 feet at Barnegat Inlet (NOAA 2006a) – while tidal flows through Barnegat Inlet range from 1.28 meters per second to 3.61 meters per second (NOAA 2006b). Most of Barnegat Bay is shallow, averaging 4.6 feet (Guo et al. 2004), and Barnegat Inlet is also shallow: it is dredged to 8 feet, with a 10 foot depth at the outer bar (USACE 2006). Though now mitigated by frequent dredging and shoreline stabilization, the Inlet regularly migrated prior to hard stabilization in the late 1930's (NOAA 2006c). It is also currently used as a passageway for watercraft.

New, lower-impact approaches to tidal energy that rely on in-stream generators akin to wind-power turbines may have lower impacts than older, dam-style designs, but they require sufficient water for submersion, as well as additional overhead clearance for watercraft when placed in navigable channels. Thus, they are not likely candidates for power generation in Barnegat Bay or Barnegat Inlet.

In addition, wave energy is another not-yet-mature technology for electricity generation from the ocean. Pilot projects off of New Jersey, Hawaii, and other locations have established the validity of the concept, though it has not yet been implemented in utility-scale installations.

8.3.6 Combination of Alternatives

Even though individual alternatives to OCNGS might not be sufficient on their own to replace OCNGS capacity because of the small size of the resource or lack of cost-effective opportunities, it is possible that a combination of alternatives might be cost-effective. As discussed previously, OCNGS has a combined net electrical capacity of 640 MW(e). For the coal- and natural-gas-fired plant alternatives, the use of standard-sized units as potential replacements for OCNGS were assumed for purposes of the analyses.

8.3.6.1 Combination of Conventional Energy Alternatives

There are many possible combinations of conventional energy alternatives. Table 8-9 presents the environmental impacts of one assumed combination of alternatives consisting of 530 MW(e) of combined-cycle natural-gas-fired plant generation using closed-cycle cooling, a DSM reduction in peak electric demand of 40 MW(e), and 70 MW in purchased power. The NRC staff considered a natural-gas-fired plant over a coal-fired plant because a comparison of the impacts indicates that a coal-fired plant would have greater impacts than a similar-sized gas-fired plant (see Tables 8-3 and 8-5). Also, the footprint of the natural-gas-fired plant is smaller and could be easily accommodated within previously disturbed portions of the OCNGS site. The impacts are based on the assumptions for constructing and operating a natural-gas-fired plant, as discussed in Section 8.2.2, adjusted for the reduced capacity. Energy reduction savings associated with DSM would result in no addition to the environmental impacts listed in Table 8-9 for a natural-gas-fired plant.

Operation of a new natural-gas-fired plant would result in increased emissions (compared with the proposed action) and other environmental impacts. Environmental impacts related to the number of acres of land disturbed and air emissions are scaled based on the reduced amount of electricity produced. However, the number of workers was not likewise scaled. Conservatively, the number of workers for a 600-MW(e) plant, as used in Table 8-5, is also used here for a 530-MW(e) natural-gas-fired-plant. The environmental impacts of power generation associated with power purchased from other generators would still occur, but would be located elsewhere in the region, nation, or another country (Canada) as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-9.

Table 8-9. Summary of Environmental Impacts of Combination of Conventional Energy Alternatives at the OCNGS Site and at an Alternate Site

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Land use	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. Uses 32 ac for plant site. Additional impact of up to approximately 12 ac for construction of a 2-mi underground gas pipeline.	MODERATE to LARGE	Impact would depend on the characteristics of the alternate site. Uses 58 ac for power block, offices, cooling towers, roads, and parking areas. Additional land needed for a new transmission line (amount dependent on site chosen) and for construction and/or upgrade of a gas pipeline.
Ecology	SMALL to MODERATE	Impact would depend on the characteristics of land to be developed. Uses developed areas at current OCNGS site, thereby reducing impacts on ecology. Impacts could occur with construction of a gas pipeline. Impacts on terrestrial ecology from cooling-tower drift are expected. Impact on aquatic ecology would be reduced from current levels because surface-water intake and thermal discharge would be reduced.	MODERATE to LARGE	Impact would depend on the characteristics of the land to be developed, surface-water body used for intake and discharge, and transmission and pipeline routes.
Water use and quality – surface water	SMALL	Impact would be reduced from current level. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in streams crossed during pipeline construction.	SMALL to MODERATE	Impact would depend on volume of water withdrawn and discharged and characteristics of surface-water body. Cooling-tower blowdown containing increased dissolved solids and intermittent low concentrations of biocides, as well as wastewater, would be released. Temporary erosion and sedimentation could occur in streams crossed during pipeline construction.

Table 8-9. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Water use and quality – groundwater	SMALL	Impact would be similar to current OCNGS operations if groundwater continues to be used for potable water.	SMALL to MODERATE	Impact would depend on the location of the site, volume of water withdrawn and discharged, and the characteristics of the aquifer.
Air quality	MODERATE	Impact from fugitive dust and emissions from vehicles and equipment during construction would be SMALL. Impact of operations on air quality would be MODERATE with the following emissions expected: Sulfur oxides • 37 tons/yr Nitrogen oxides • 119 tons/yr Carbon monoxide • 172 tons/yr PM_{10} particulates • 22 tons/yr Some hazardous air pollutants.	MODERATE	Same emissions as a natural-gas-fired plant at the OCNGS site, although pollution control standards may vary depending on location.
Waste	SMALL	Minimal waste product from fuel consumption. Waste would be generated and removed during construction.	SMALL	Same impact as a natural-gas-fired plant at the OCNGS site. Waste disposal constraints may vary.
Human health	SMALL	Human health risks associated with natural-gas-fired plants may be attributable to NO_x emissions, which are regulated. Impacts considered SMALL.	SMALL	Same impacts as a natural-gas-fired plant at the OCNGS site.

Table 8-9. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to MODERATE	During construction, impact would be SMALL to MODERATE. Up to 360 additional workers during the peak of the 3-year construction period, followed by a reduction in the current OCNGS workforce from 470 to 24. Ocean County would experience reduced demand for goods and services as well as a loss in its tax base and employment, but this would be potentially offset by projected economic growth in the area. Impact during operation would be SMALL.	SMALL to MODERATE	Construction impact would depend on location, and likely be SMALL, but could be MODERATE if the location is in a rural area. 360 additional workers during the peak of the 3-year construction period. Ocean County would experience a loss in its tax base and employment if a plant were constructed outside of the county, but this would be potentially offset by projected economic growth in the area.
Transportation	MODERATE	Transportation impact associated with construction workers would be MODERATE as 470 OCNGS workers and up to 360 construction workers would be commuting to the site. Impact during operation would be SMALL as the number of commuters would be reduced to 24.	MODERATE	Transportation impact associated with 360 construction workers and 24 plant workers would be MODERATE and SMALL, respectively.
Aesthetics	SMALL to MODERATE	SMALL to MODERATE aesthetic impact due to visibility of plant units, exhaust stacks, cooling towers, plumes, and gas compressors. Intermittent noise from construction and continuous noise from cooling towers and mechanical equipment would occur.	SMALL to MODERATE	Impact would depend on the characteristics of the site, but would be similar to those for a natural-gas-fired plant at the OCNGS site, with additional impact from the new transmission line and gas pipeline.

Table 8-9. (contd)

Impact Category	OCNGS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Historic and archeological resources	SMALL to MODERATE	Impact would depend on the degree to which previously disturbed lands were utilized. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction on cultural resources in undeveloped areas.	SMALL to MODERATE	Impact would depend on the characteristics of the alternate site. A cultural resource inventory would be needed to identify, evaluate, and mitigate potential impacts of new construction.
Environmental justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing could occur during construction; loss of 446 operating jobs at OCNGS could reduce employment prospects for minority and low-income populations. Impact could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impact would depend on population distribution and makeup at the site. Some impact on housing could occur during construction.

8.3.6.2 Combination of Renewable Energy Alternatives

On the basis of public comments on the draft SEIS, the NRC staff evaluated a combination of alternatives that employs only renewable energy alternatives. While there are many possible combinations of renewable alternatives, for the purpose of providing a baseline comparison, the NRC evaluated a combination that includes 200-MW wind power, 200-MW solar power, 40-MW DSM reduction in peak electric demand, and 200-MW purchased renewable energy (assumed to be hydroelectric power purchased from Canada). The wind power capacity evaluated would require a minimum of 134 1.5-MW turbines on land (occupying an estimated 600 ac) or 50 4-MW turbines offshore). The solar power capacity evaluated would require a minimum of 2800 ac for solar thermal energy or 7000 ac for photovoltaic energy. Wind and solar technologies could employ systems to store electricity for periods of peak demand to compensate for periods of intermittency (periods of little or no wind or sunlight).

It should be noted that the acreage estimate for wind power is a conservative estimate, and significant additional acreage (up to approximately 1400 ac) could be required to provide 200 MW because the capacity factor of wind is estimated to be on the order of 30 percent; the 25 percent capacity factor of solar has been factored into the above estimate of area, which was determined based on information provided in the GEIS (NRC 1996). Thus, for the all-renewable-energy combination of alternatives, a minimum of 3400 ac (approximately 5 mi^2) would be needed for a land-based system. These estimates do not include installation of new transmission capacity, which would be needed.

This combination of alternatives could have significant environmental impacts during construction (wind turbine installation and construction of a solar power plant). Less land disturbance would result if rooftops were used throughout the local communities for solar applications. Depending on site locations, installation of wind turbines, solar panels, and associated facilities, including transmission systems, could have potentially LARGE impacts associated with land disturbance. Land disturbance could result in impacts on land use, terrestrial ecology, aquatic ecology (including offshore impacts if offshore wind turbines are used), and archaeological sites (onshore and offshore [e.g., shipwrecks]). Construction impacts on air quality, water quality, and noise could be MODERATE depending on location and construction practices. Local impacts during operation likely would be SMALL for wind, solar, DSM, and purchased power in most environmental areas. Impacts would depend on the site chosen, but common concerns regarding wind power that could cause MODERATE impacts include visual impacts, potential interferences with radar and aircraft, and bird and bat collisions.

The NRC staff concludes that the environmental impacts of a combination of renewable energy options could vary from SMALL to LARGE depending on the location, size, and number of facilities (with land disturbance during construction having the largest impact in most cases).

8.4 Summary of Alternatives Considered

Two alternatives to the existing OCNGS once-through cooling system were considered: (1) a closed-cycle system using linear multicelled hybrid mechanical-draft cooling towers, and (2) modifications to the existing once-through cooling system coupled with restoration of wetlands to offset impingement and entrainment losses at the facility. The closed-cycle cooling system alternative would significantly reduce entrainment and impingement losses from current levels, but could produce some impacts on onsite land use, air quality (salt drift, emissions from fossil-fuel-fired plants needed to offset the energy penalty of the cooling system), visual aesthetics (visible plume under certain atmospheric conditions), and noise that could reach MODERATE levels. Modifications to the existing system coupled with wetland restoration could offset impacts of the once-through cooling system, but restoration activities could produce some adverse impacts on land use, ecological resources (short term), and historical and archaeological resources that could reach MODERATE levels. The magnitude of impacts would depend on the location and size of the area to be restored.

The environmental impacts of the proposed action, renewal of the OCNGS OL, would be SMALL for most impact categories, except for potentially MODERATE impacts to aquatic resources and collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal. Collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal were not assigned a single significance level but were determined by the Commission to be Category 1 issues nonetheless. Alternatives to the proposed action that were evaluated include license renewal with implementation of alternatives to the existing once-through cooling system (discussed in Section 8.1), the no-action alternative (discussed in Section 8.2), new-generation alternatives (from coal, natural gas, and nuclear discussed in Sections 8.3.1 through 8.3.3, respectively), purchased electrical power (discussed in Section 8.3.4), alternative technologies (discussed in Section 8.3.5), and a combination of alternatives (discussed in Section 8.3.6).

The no-action alternative would have SMALL impacts in all categories and would likely require the replacement of 640 MW(e) of electrical-generating capacity by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) power-generation alternatives other than OCNGS, or (4) some combination of these options. For each of the new-generation alternatives (coal, natural gas, and nuclear), the environmental impacts would be greater than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of OCNGS. The impacts of purchased electrical power (imported power) would still occur, but would occur elsewhere. Individual alternative technologies for baseload generation by themselves are not considered likely at this time. A combination of generation and conservation options could potentially be implemented with a level of impact similar to or greater than those associated with renewal of the OCNGS OL, depending on a number of variables, including the number, size and location of wind, solar, and other generation sources.

The NRC staff concludes that the alternative actions, including the no-action alternative, may have environmental effects ranging from SMALL in all categories to MODERATE or LARGE significance in some impact categories.

8.5 References

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 50. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR Part 81. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

Alliance to Save Energy. 2006. "New Jersey Statewide EE Policies: State Energy Efficiency Index." Available URL: http://www.ase.org/content/artcle/detail/2573 (Accessed February 7, 2006).

AmerGen Energy Company, LLC (AmerGen). 2005. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Nuclear Generating Station.* Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

AmerGen Energy Company, LLC. 2006. Letter from M.P. Gallagher, AmerGen Energy Company, LLC, Forked River, New Jersey, to U.S. Nuclear Regulatory Commission, Document Control Desk, Rockville, Maryland. Subject: "Response to NRC Request for Additional Information Regarding the Environmental License Renewal Review for the Oyster Creek Generating Station (TAC No. MC7625)." (March 8, 2006).

Barnegat Bay National Estuary Program (BBNEP). 2002. "Comprehensive Conservation and Management Plan." May 2002. Available URL: http://www.bbep.org/ccmp.htm (Accessed March 21, 2006).

C & A Carbone, Inc. v. Town of Clarkstown, New York, 511 U.S. 383 (U.S. Supreme Court 1994).

Coastal Area Facility Review Act (CAFRA). N.J.S.A. 13:19

Clean Air Act (CAA). 42 USC. 7401, et seq.

Dominion Nuclear North Anna, LLC (Dominion). 2003. Letter from D.A. Christian, Dominion, to J.E. Dyer, U.S. Nuclear Regulatory Commission. Subject: "North Anna Early Site Permit Application." (September 25, 2003).

EA Engineering Science and Technology, Inc. (EA). 1986. *Entrainment and Impingement Studies at the Oyster Creek Nuclear Generating Station, 1984–1985.* Sparks, Maryland.

Energy Policy Act of 2005 (EPACT). 42 USC 20.

Electric Power Research Institute, Inc. (EPRI). 1987. *User's Manual: Cooling Tower Plume Prediction Code (Rev. 1)*. EPRI Report No. CS-3403-CCM. Palo Alto, California. (September).

Energy Information Administration (EIA). 2001. *Renewable Energy 2000: Issues and Trends*. DOE/EIA-0628(2000). Washington, D.C.

Energy Information Administration (EIA). 2004. *Annual Energy Outlook 2004 with Projections to 2025*. DOE/EIA-0383(2004). Washington, D.C.

Energy Information Administration (EIA). 2005. *Annual Energy Outlook 2005 with Projections to 2025*. DOE/EIA-0383(2005). Washington, D.C.

Energy Information Administration (EIA). 2006. *Annual Energy Outlook 2006 with Projections to 2030*. DOE/EIA-0383(2006). Washington, D.C.

Exelon Generation Company, LLC (Exelon). 2003. Letter from M.C. Kray, Exelon, to U.S. Nuclear Regulatory Commission. Subject: "Early Site Permit Application." (September 25, 2003).

Federal Aviation Administration (FAA). 2000. "Obstruction Marking and Lighting." Advisory Circular AC 70/7460-1K. Available URL: http://www.faa.gov/ats/ata/ai/circV.pdf (Accessed November 10, 2005).

Gabbard, A. 1993. "Coal Combustion: Nuclear Resource or Danger." Oak Ridge National Laboratory Review. Oak Ridge, Tennessee. Summer/Fall 1993. Available URL: http://www.ornl.gov/ORNLReview/rev26-34/text/colmain.html (Accessed April 6, 2006).

Guo,Qizhong, Norbert P. Psuty, George P. Lordi, Scott Glenn, Matthew R. Mund, and Mary Downes Gastrich. 2004. "Research Project Summary: Hydrographic Study of Barnegat Bay." (July 2004). Available URL: http://www.state.nj.us/dep/dsr/coastal/hydrographic.pdf (Accessed October 26, 2006).

Hlohowskyj, I., J. Hayse, R. Van Lonkhuyzen, J. Veil, and W. Vinikour. 2003. *Enhancement Strategies for Mitigating Potential Operational Impacts of Cooling Water Intake Structures: Approaches for Enhancing Environmental Resources*. EPRI Report No. 1007454, Palo Alto, California. (June 2003).

Idaho National Engineering and Environmental Laboratory (INEEL). 1998. *U.S. Hydropower Resource Assessment for New Jersey.* DOE/ID-10430(NJ). Idaho Falls, Idaho. (February 1998).

Integrated Waste Services Association. 2004. *Waste-to-Energy: Clean, Reliable, Renewable Power.* Fact Sheet. Washington, D.C. (June 2004).

Lauver, T.A., C.R. Curtis, G. Patterson, and L.W. Douglass. 1978. *The Effects of Saline Cooling Tower Drift on Seasonal Variations of Sodium and Chloride Concentrations in Native Perennial Vegetation*. Presented at a Symposium on Environmental Effects of Cooling-Tower Emissions. Water Resources Research Center, University of Maryland, College Park, Maryland. (May 1978).

McCormick, R.W., D.C. Wolf, G. McClung, and J.E. Foss. 1978. *Movement of NaCl Through Three Soil Profiles and Its Effect on Soil Chemical Properties.* Presented at a Symposium on Environmental Effects of Cooling-Tower Emissions. Water Resources Research Center, University of Maryland, College Park, Maryland. (May 1978).

Micheletti, W.C., et al. 2002. *Proceedings of the Workshop on Electric Utilities and Water: Emerging Issues and R&D Needs*. Pittsburgh, Pennsylvania. (July).

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

National Oceanic and Atmospheric Administration (NOAA). 2006a. "2006 Water Level Tidal Predictions." Available URL: http://tidesandcurrents.noaa.gov/tides06/ (Accessed October 25, 2006).

National Oceanic and Atmospheric Administration (NOAA). 2006b. "2006 Tidal Current Predictions." Available URL: http://tidesandcurrents.noaa.gov/currents06/ (Accessed October 25, 2006).

National Oceanic and Atmospheric Administration (NOAA). 2006c. "Beach Nourishment: A Guide for Local Government Officials: Effects of Navigation Channel Construction and Maintenance on Coastal Processes." Available URL: http://www.csc.noaa.gov/beachnourishment/html/geo/channels.htm (Updated August 23, 2006; Accessed October 26, 2006).

National Renewable Energy Laboratory (NREL). 2004. “Biomass and Biofuels.” Available URL: http://www.nrel.gov/gis/il_biomass.html (Accessed June 16, 2004).

National Renewable Energy Laboratory (NREL). 2006. "Wind Farm Area Calculator." Available URL: www.nrel.gov/analysis/power_databook_3ed/calc_wind.php (Accessed April 14, 2006).

New Jersey Administrative Code NJAC 7:27-6. Title 7, Chapter 27, Subchapter 6, Section 6.1, “Definitions.”

New Jersey Administrative Code NJAC 7:27-18. Title 7, Chapter 27, Subchapter 18, Section 18.7, “Determination of a Net Emission Increase or a Significant Net Emission Increase.”

New Jersey Department of Environmental Protection (NJDEP). 1994. "New Jersey Pollutant Discharge Elimination System Permit Number NJ0005550."

New Jersey Department of Environmental Protection (NJDEP). 2005. “Fact Sheet on the New Jersey Pollutant Discharge Elimination System (NJPDES) Surface Water Renewal Permit Action for Oyster Creek Facility.” Available URL: http://www.state.nj.us/dep/dwq/pdf/oysterck_factsh.pdf (Accessed December 20, 2005).

Northwest Power Planning Council. 2000. *Northwest Power Supply Adequacy/Reliability Study Phase I Report.* Paper No. 2000-4. (March 6, 2000).

Pacific Northwest Laboratory (PNL). 1986. *Wind Energy Resource Atlas of the United States, The Great Lakes Region.* DOE/CH 10093-4. Solar Energy Research Institute, Golden, Colorado (October 1986).

Resource Conservation and Recovery Act of 1976 (RCRA). 42 USC 6901, et seq.

Roschow, J.J. 1978. *Compositional, Structural, and Chemical Changes to Forest Vegetation from Fresh Water Wet Cooling-Tower Drift*. Presented at a Symposium on Environmental Effects of Cooling Tower Emissions. Water Resources Research Center, University of Maryland, College Park, Maryland. (May 1978).

Summers, J.K., A.F. Holland, S.B. Weisberg, L.C. Wendling, C.F. Stroup, R.L. Dwyer, M.A. Turner, and W. Burton. 1989. *Technical Review and Evaluation of Thermal Effects Studies and Cooling Water Intake Structure Demonstration of Impact for the Oyster Creek Nuclear Generating Station. Revised Final Report.* Prepared by Versar, Inc., Columbia, Maryland, for the New Jersey Department of Environmental Protection, Division of Natural Resources. (May 1989).

Systems Energy Resources, Inc. (SERI). 2003. Letter from W.A. Eaton, SERI, to U.S. Nuclear Regulatory Commission. Subject: "Grand Gulf Site, Early Site Permit Application." (October 16, 2003).

Szabo, Z. 1998. "The Economics and the Future of Water Conserving Power Plant Cooling." *Energy and Technology: Sustaining World Development into the Next Millenium, Conclusions and Recommendations.* 19th World Energy Congress. Houston, Texas. (September).

Talbot, J.J. 1979. "A Review of Potential Biological Impacts of Cooling Tower Salt Drift," *Atmospheric Environment*, Vol. 13, 395–405.

U.S. Army Corps of Engineers (USACE). 2006. "Project Factsheet: Barnegat Inlet, Ocean County, NJ." (September 2006). Available URL: http://www.nap.usace.army.mil/cenap-dp/projects/factsheets/NJ/Barnegat%20Inlet.pdf (Accessed October 26, 2006).

U.S. Atomic Energy Commission (AEC). 1973. *Final Environmental Statement Related to the Forked River Nuclear Station Unit 1, Jersey Central Power and Light Company.* Docket No. 50-363. Directorate of Licensing. Washington, D.C.

U.S. Department of Energy (DOE). 2004. "U.S. Wind Energy Resource Map." Available URL: http://www.eere.energy.gov/windandhydro/wind_potential.html?print (Accessed May 13, 2004).

U.S. Department of Energy (DOE). 2006a. "New Jersey Wind Activities." Available URL: http://www.eere.energy.gov/windandhydro/windpoweringamerica/astate_template.asp?stateab=NJ (Accessed February 7, 2006).

U.S. Department of Energy (DOE). 2006b. "Alternative Energy Resources in New Jersey." Available URL: http://www.eere.energy.gov/states/alternatives/resources_nj.cfm (Accessed February 7, 2006).

U.S. Department of Energy (DOE). 2006c. "Phosphoric Acid Fuel Cells." Available URL: http://www.eere.energy.gov/hydrogenandfuelcells/fuelcells/fc_types.html#phosphoric (Accessed October 19, 2006).

U.S. Department of Energy (DOE). 2006d. "Fuel Cells Powering America." Available URL: http://www.netl.doe.gov/technologies/coalpower/distgen/pdf/SECA%20Brochure%208_29_06.pdf (Accessed October 19, 2006).

U.S. Environmental Protection Agency (EPA). 1995a. "AP 42, Fifth Edition, Volume I, Section 13.4, Miscellaneous Sources, Wet Cooling Towers." Washington, D.C. January.

Available URL: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s04.pdf (Accessed March 27, 2006).

U.S. Environmental Protection Agency (EPA). 1995b. "SCREEN3 Model User's Guide." EPA-454/B-95-004. Washington, D.C. September. Available URL: http://www.epa.gov/scram001/userg/screen/screen3d.pdf (Accessed March 27, 2006).

U.S. Environmental Protection Agency (EPA). 1998. "Revision of Standards of Performance for Nitrogen Oxide Emissions from New Fossil-Fuel Fired Steam Generating Units; Revisions to Reporting Requirements for Standards of Performance for New Fossil-Fuel Fired Steam Generating Units, Final Rule." *Federal Register*, Vol. 63, No. 179, pp. 49442–49455. Washington, D.C. (September 16, 1998).

U.S. Environmental Protection Agency (EPA). 1999. "Regional Haze Regulations, Final Rule." *Federal Register*, Vol. 64, No. 126, pp. 35714–35717. Washington, D.C. (July 1, 1999).

U.S. Environmental Protection Agency (EPA). 2000a. "Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units." *Federal Register*, Vol. 65, No. 245, pp. 79825–79831. Washington, D.C. (December 20, 2000).

U.S. Environmental Protection Agency (EPA). 2000b. "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels." *Federal Register*, Vol. 65, pp. 32214–32237. Washington, D.C. (May 22, 2000).

U.S. Environmental Protection Agency (EPA). 2001a. *Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities*. Chapter 3. EPA-821-R-01-036. (November).

U.S. Environmental Protection Agency (EPA). 2001b. "About the Emissions by Category Report – Criteria Air Pollutants." Air Data. Available URL: http://www.epa.gov/air/data/help/hemcatrep.html (Accessed February 27, 2006).

U.S. Environmental Protection Agency (EPA). 2004a. "National Pollutant Discharge Elimination System – Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities." *Federal Register*, Vol. 69, No. 131, pp. 41576–41693. Washington, D.C. (July 9, 2004).

U.S. Environmental Protection Agency (EPA). 2004b. "Designation of Areas for Air Quality Planning Purposes." *Federal Register*, Vol. 69, p. 23921. Washington, D.C. (April 30, 2004).

U.S. Environmental Protection Agency (EPA). 2004c. "Municipal Solid Waste." Available URL: http://www.epa.gov/epaoswer/non-hw/muncpl/facts.htm.

U.S. Environmental Protection Agency (EPA). 2005. "Mercury – Controlling Power Plant Emissions: Overview." Available URL: http://www.epa.gov/mercury/control_emissions/index.htm (Accessed December 15, 2005).

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

U.S. Nuclear Regulatory Commission (NRC). 2002. *Final Generic Environmental Impact Statement on Decommissioning Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*. NUREG-0586, Vols. 1 and 2. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004. "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues." Appendix D to NRC Office Instruction LIC-203, Rev 1. Office of Nuclear Reactor Regulation. Washington, D.C. (May 24, 2004).

U.S. Nuclear Regulatory Commission (NRC). 2005. Letter from M. Masnik, U.S. Nuclear Regulatory Commission, Rockville, Maryland, to C.N. Swensen, AmerGen Energy Company, LLC, Forked River, New Jersey. Subject: "Request for Additional Information (RAI) Regarding the Environmental License Renewal Review for the Oyster Creek Nuclear Generating Station (TAC No. MC7625)." (December 8, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2006. "Proposed Reorganization of The Office of Nuclear Reactor Regulation." SECY-06-0144. (July 21, 2006).

Walsh, M.E., et al., 2000. "Biomass Feedstock Availability in the United States: 1999 State Level Analysis." Available URL: http://bioenergy.ornl.gov/resourcedata/index.html (Accessed December 16, 2005).

9.0 Summary and Conclusions

By letter dated July 22, 2005, AmerGen Energy Company, LLC (AmerGen), submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Oyster Creek Nuclear Generating Station (OCNGS) for an additional 20-year period (AmerGen 2005a). If the OL is renewed, State regulatory agencies and AmerGen 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 OL is not renewed, then the plant must be shut down at or before the expiration of the current OL, which expires on April 9, 2009.

Section 102 of the National Environmental Policy Act (NEPA) directs that an Environmental Impact Statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51). Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 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 Plant*s (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a]

Upon acceptance of the AmerGen 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 (*Federal Register*, Volume 70, page 55635 [70 FR 55635] [NRC 2005]) on September 22, 2005. The NRC staff visited the OCNGS site in October 2005 and held public scoping meetings on November 1, 2005, in Toms River, New Jersey (NRC 2006). The NRC staff reviewed the AmerGen Environmental Report (ER) (AmerGen 2005b) and compared it with the GEIS, consulted with other agencies, and 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* (NRC 2000). The NRC staff also considered the public comments received during the scoping process for preparation of this Supplemental Environmental Impact Statement (SEIS) for OCNGS. 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.

The NRC staff held two public meetings in Toms River, New Jersey, on July 12, 2006, to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments on

---

(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.

the draft SEIS. When the comment period for the draft SEIS ended, the NRC staff considered and addressed all comments received. Comments are addressed in Appendix A, Part II, of this SEIS.

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

The NRC 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 NRC 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 storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).[(a)]

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 the 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 NRC staff analysis in the GEIS shows the following:

(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 [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.

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

(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations – generic determination of no significant environmental impact."

Subpart A, Appendix B. The NRC staff also determined that information provided during the public comment period did not identify any new issue that requires site-specific assessment.

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 NRC staff's consideration of all 92 environmental issues identified in the GEIS. The NRC 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 OL for OCNGS) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the OCNGS site or at some other unspecified location. In addition, the NRC staff evaluated alternatives to the once-through cooling-water system currently used at OCNGS.

9.1 Environmental Impacts of the Proposed Action – License Renewal

AmerGen and the NRC staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither AmerGen nor the NRC 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, AmerGen, nor the NRC staff has identified any new issue applicable to OCNGS that has a significant environmental impact. Therefore, the NRC staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to OCNGS.

AmerGen's license renewal application presents an analysis of the Category 2 issues that are applicable to OCNGS. The NRC staff has reviewed the AmerGen analysis for each issue and has conducted an independent review of each issue plus environmental justice and chronic effects from electromagnetic fields. Six Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at OCNGS. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. AmerGen (AmerGen 2005b) 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 OCNGS for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the final environmental statement related to operation of OCNGS (AEC 1974).

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 this SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For nine Category 2 issues and environmental justice, the NRC staff concludes that the potential environmental impacts would be of SMALL significance in the context of the standards set forth in the GEIS. For two Category 2 issues (entrainment of fish and shellfish in early life stages and impingement of fish and shellfish), the NRC staff determined that the impacts of OCNGS operations during the license renewal term could be MODERATE if species composition and abundance of aquatic organisms have changed substantially from the 1970s and 1980s when the last studies of the effects of OCNGS operations were conducted. Also, the NRC staff found that impacts on Federally protected sea turtles would be SMALL during the proposed renewal period. If the NRC renews the OCNGS license, the renewed license would contain requirements consistent with the Incidental Take Statement in the 2006 Biological Opinion. In addition, the NRC 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 NRC staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for OCNGS and the plant improvements already made, the NRC staff concludes that several SAMAs are potentially cost-beneficial. However, none of these SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. For most issues, 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. Additional mitigation may be required by the state of New Jersey that would reduce losses to aquatic organisms related to cooling-system operation.

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 OCNGS license renewal impacts are deemed to be SMALL, the NRC staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources. For aquatic resources, cumulative impacts would likely be SMALL but could be MODERATE.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted for a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance for most impact areas. Impacts on aquatic resources related to operation of the existing once-through cooling system would likely be SMALL but could be MODERATE depending on the condition of the ecosystem in the central Barnegat Bay. The adverse impacts of likely alternatives if OCNGS ceases operation at or before the expiration of the current OL would not be smaller than those associated with continued operation of this unit, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of OCNGS during the current license period was made when the plant was built. The resource commitments considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. OCNGS replaces a portion of the fuel assemblies in its unit during every refueling outage, which occurs on a 24-month cycle.

The likely power-generation alternatives if OCNGS ceases operation on or before the expiration of the current OL would require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the OCNGS site was set when the plant was approved and construction began. That balance is now well-established. Renewal of the OL for OCNGS and continued operation of the plant would not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the OL would lead to shutdown of the plant and would alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the OCNGS site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OL for OCNGS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at OCNGS. Chapters 4 through 7 discuss environmental issues associated with renewal of the OL. Environmental issues associated with alternatives to the once-through cooling system currently in use at OCNGS, the no-action alternative, and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OL), alternatives to the existing once-through cooling system, the no-action alternative (denial of the application), alternatives involving nuclear, coal-, or gas-fired power generation at the OCNGS site and at an unspecified alternate site, and a combination of alternatives are compared in Table 9-1. Closed-cycle cooling systems are assumed for all power-generation alternatives.

Substitution of once-through cooling for the closed-cycle cooling system in the evaluation of the nuclear and gas- and coal-fired generation alternatives would result in somewhat greater environmental impacts in some impact categories.

Table 9-1 shows that the significance of the environmental effects of the proposed action would be SMALL for most impact categories (except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned [see Chapter 6], and except for impacts on aquatic resources that could be MODERATE). The alternative actions (except for the no-action alternative) may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance, especially during construction.

9.3 NRC Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996, 1999), (2) the AmerGen ER (AmerGen 2005b), (3) consultation with Federal, State, and local agencies, (4) the NRC staff's own independent review, and (5) the NRC staff's consideration of public comments received, the

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Power Generation Using Closed-Cycle Cooling, Except as Otherwise Specified

Impact Category	License Renewal (Existing Cooling System)	License Renewal (Alternatives to the Existing Cooling System)		No-Action Alternative (Denial of Renewal)	Coal-Fired Generation		Natural-Gas-Fired Generation		New Nuclear Generation		Combination of Conventional Energy Alternatives	
		Closed-Cycle Cooling	Modified Existing System with Restoration		OCNGS Site	Alternate Site	OCNGS Site	Alternate Site	OCNGS Site	Alternate Site	OCNGS Site	Alternate Site
Land use	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE
Ecology	SMALL to MODERATE[(a)]	SMALL	SMALL TO MODERATE[(a)]	SMALL	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE
Water use and quality – surface water	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water use and quality – groundwater	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Air quality	SMALL	MODERATE	SMALL	SMALL	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Waste	SMALL	SMALL	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Human health	SMALL[(b)]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL[(b)]	SMALL[(b)]	SMALL	SMALL
Socioeconomics	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL to LARGE	MODERATE	MODERATE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Transportation	SMALL	SMALL	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE	MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE	MODERATE
Aesthetics	SMALL	SMALL to MODERATE	SMALL	SMALL	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Historic and archaeological resources	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to LARGE	SMALL	SMALL to MODERATE

(a) Impacts on aquatic resources would be small if species composition and abundance of aquatic organisms are comparable to those in the 1970s and 1980s when studies of the effects of OCNGS operations were last conducted. Impacts could be moderate if species composition and abundance have changed substantially.
(b) Except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a significance level was not assigned. See Chapter 6 for details.

recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for OCNGS are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

9.4 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."

AmerGen Energy Company, LLC (AmerGen). 2005a. *License Renewal Application, Oyster Creek Generating Station, Docket No. 50-219, Facility Operating License No. DPR-16*. Forked River, New Jersey. (July 22, 2005).

AmerGen Energy Company, LLC (AmerGen). 2005b. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

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

U.S. Atomic Energy Commission (AEC). 1974. *Final Environmental Statement Related to Operation of Oyster Creek Nuclear Generating Station*, *Jersey Central Power and Light Company*. Docket No. 50-219. Directorate of Licensing, Washington, D.C.

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

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2005. "AmerGen Energy Company, LLC, Oyster Creek Nuclear Generating Station; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, Vol. 70, No. 183, pp. 55635–55637. Washington, D.C. (September 22, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2006. *Environmental Impact Statement Scoping Process: Summary Report – Oyster Creek Generating Station, Ocean County, New Jersey*. Washington, D.C. (February 21, 2006).

NRC FORM 335 (9-2004) NRCMD 3.7

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG-1437, Vol. 1, Supp. 28

2. TITLE AND SUBTITLE

Generic Environmental Impact Statement for License Renewal of Nuclear Plants
Supplement 28
Regarding Oyster Creek Nuclear Generating Station
Final Report - Main Report

3. DATE REPORT PUBLISHED

MONTH	YEAR
January	2007

4. FIN OR GRANT NUMBER

5. AUTHOR(S)

6. TYPE OF REPORT

Technical

7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION - NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

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

9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Same as 8 above

10. SUPPLEMENTARY NOTES

Docket Number 50-219

11. ABSTRACT *(200 words or less)*

This final supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the Nuclear Regulatory Commission (NRC) by AmerGen Energy Company, LLC (AmerGen) to renew the operating license for the Oyster Creek Nuclear Generating Station (Oyster Creek) for an additional 20 years under 10 CFR Part 54. This final 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 available for reducing or avoiding adverse impacts.

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for Oyster Creek are not so great that preserving the option of license renewal for energy-planning decision makers would be unreasonable. This recommendation is based on the following: (1) the analysis and findings in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437); (2) the Environmental Report submitted by AmerGen; (3) consultation with other Federal, State, Tribal, and Local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Oyster Creek Nuclear Generating Station
Supplement to the Generic Environmental Impact Satement
GEIS
National Environmental Policy Act
NEPA
License Renewal

13. AVAILABILITY STATEMENT

unlimited

14. SECURITY CLASSIFICATION

(This Page) unclassified

(This Report) unclassified

15. NUMBER OF PAGES

16. PRICE