NUREG-1437
Supplement 28

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 28

Regarding
Oyster Creek Nuclear Generating Station

Draft Report for Comment

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

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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 Draft 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 draft 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 preliminary 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 is 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 draft SEIS. For each applicable issue, the NRC staff concludes that the significance of the potential environmental impacts of renewal of the OL is SMALL. The NRC staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. The NRC staff determined that information provided during the scoping process did not identify any new issue that has a significant environmental impact.

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

Abstract

The NRC staff's preliminary 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.

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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 Plant*s (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 draft 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 1, of this draft SEIS.

The NRC staff will hold two public meetings in Toms River, New Jersey, in July 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 this draft SEIS. When the comment period ends, the NRC staff will consider and address all of the

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

comments received. These comments will be addressed in Appendix A, Part 2, of the final SEIS.

This draft SEIS includes the NRC staff's preliminary 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 preliminary 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 draft 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, neither the scoping process 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 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 draft SEIS because they are specifically related to refurbishment. 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 detail in this draft SEIS. Four 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 draft SEIS in relation to operation during the renewal term. For all 11 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.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted. Nevertheless, additional mitigation may be required by the State of New Jersey that would result in further 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.

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 preliminary 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 received during the scoping process.

Abbreviations/Acronyms

°	degree
µCi	microcurie(s)
µg	microgram(s)
µm	micrometer(s)
µSv	microsievert(s)
ac	acre(s)
AC	alternating current
ACC	averted cleanup and decontamination costs
AD	Anno Domini
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	averted offsite property damage costs
AOE	averted occupational exposure
AOSC	averted onsite costs
APE	averted public exposure
AQCR	Air Quality Control Region
ASME	American Society of Mechanical Engineers
ASMFC	Atlantic States Marine Fisheries Commission
ATWS	anticipated transient without scram
ATV	all-terrain vehicle
BA	Biological Assessment
BBNEP	Barnegat Bay National Estuary Program
BC	Before Christ
Bq	becquerel(s)
BO	Biological Opinion
Btu	British thermal unit(s)
BWR	boiling-water reactor
BWROG	Boiling-Water Reactor Owners Group
C	Celsius
CAA	Clean Air Act
CAFRA	Coastal Area Facility Review Act
CCC	Caribbean Conservation Corporation
CCW	component cooling water
CDF	core damage frequency or combined disposal facility

Abbreviations/Acronyms

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
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
d	day
DBA	design-basis accident
DC	direct current
DDT	dichloro-diphenyl-trichloroethane
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
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
EA	environmental assessment
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
ER	Environmental Report
ESA	Endangered Species Act
ESMP	Environmental Surveillance and Monitoring Program
Exelon	Exelon Corporation
F	Fahrenheit
FAA	Federal Aviation Administration
FES	Final Environmental Statement
FPRA	Fire Probabilistic Risk Assessment
FR	Federal Register
FSAR	Final Safety Analysis Report

ft	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
gpd	gallon(s) per day
gpm	gallon(s) per minute
GPU	General Public Utilities
GPUE	GPU Energy
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
ISLOCA	interfacing systems loss-of-coolant accident
ISRA	Industrial Site Recovery Act
ITS	Incidental Take Statement
J	joule(s)
JCP&L	Jersey Central Power & Light Company
kg	kilogram(s)
km	kilometer(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
mrad	millirad(s)
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 Electric 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
NJONLM	New Jersey Office of Natural Lands Management
NJPDES	New Jersey Pollutant Discharge Elimination System
NJWSA	New Jersey Water Supply Administration
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
NWPPC	Northwest Power Planning Council
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
PNNL	Pacific Northwest National Laboratory
ppm	part(s) per million
ppt	part(s) per thousand
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSD	Prevention of Significant Deterioration
RAI	request for additional information
REMP	radiological environmental monitoring program
RG	Regulatory Guide
RI	Remedial Investigation
ROI	region of interest

RPC	replacement power cost
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
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 draft plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the AmerGen license renewal application. This draft 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 draft 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 draft 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 preliminary 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 preparers of the supplement,

- A chronology of the NRC staff's environmental review correspondence related to this draft SEIS,

- The organizations contacted during the development of this draft SEIS,

- AmerGen's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and sent during the evaluation process),

- GEIS environmental issues that are not applicable to 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 draft 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.

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 draft SEIS sections where the analysis is presented. The draft 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* (Volume 70, page 54585 [70 FR 54585] [NRC 2005a]) on September 15, 2005. The NRC staff published a Notice of Intent to prepare an EIS and conduct scoping (70 FR 55635 [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 2006) dated February 21, 2006.

Comments that are applicable to this environmental review are presented in Part 1 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 draft 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 preliminary 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 will begin 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 will be held in Toms River, New Jersey, in July 2006. During these meetings, the NRC staff will describe the preliminary results of the NRC environmental review and answer 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.

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

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. "American 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). 2006. *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 the 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 the 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 the 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).

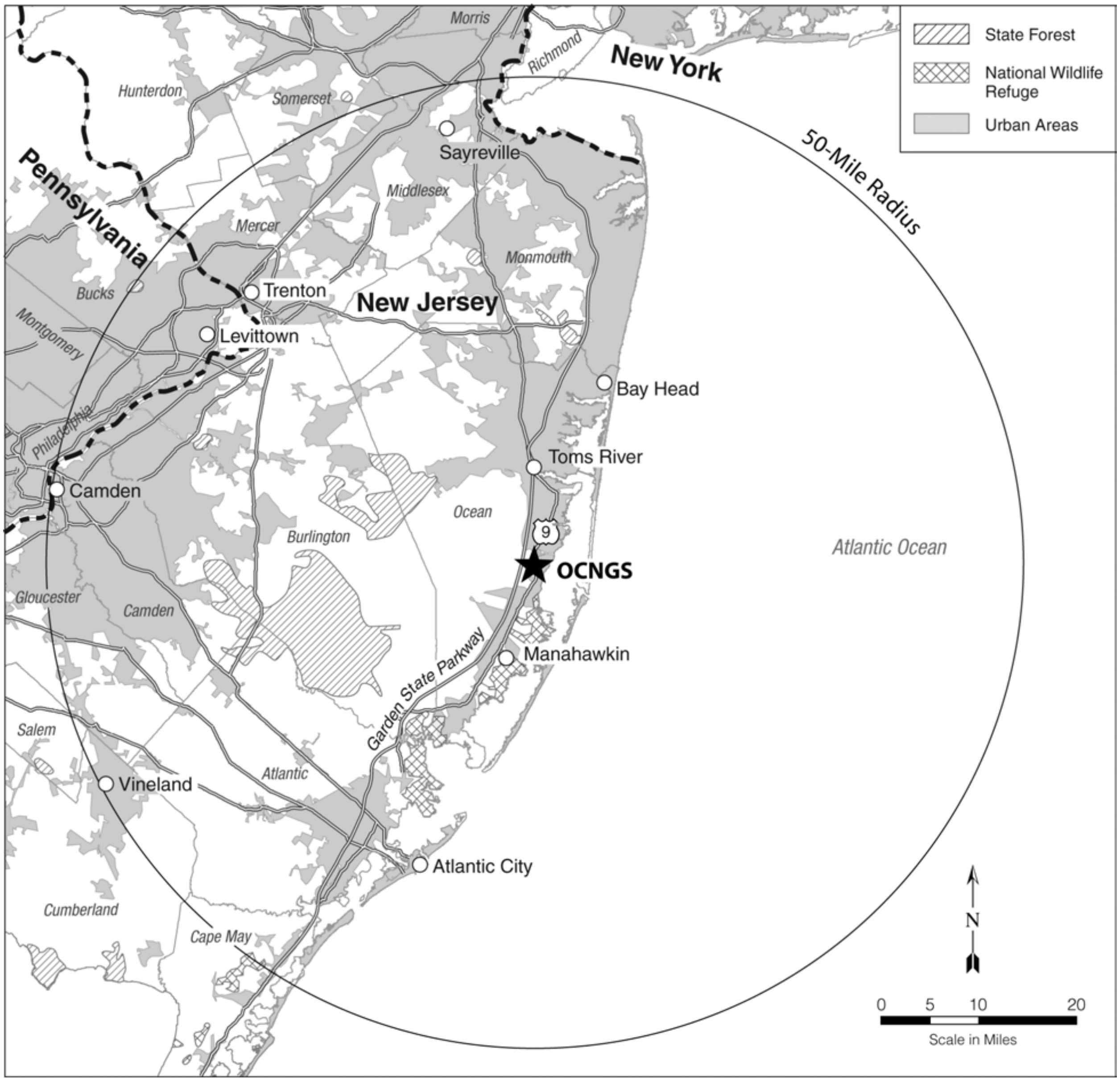

Figure 2-1. Location of Oyster Creek Nuclear Generating Station, 50-mi Region (Source: AmerGen 2005a)

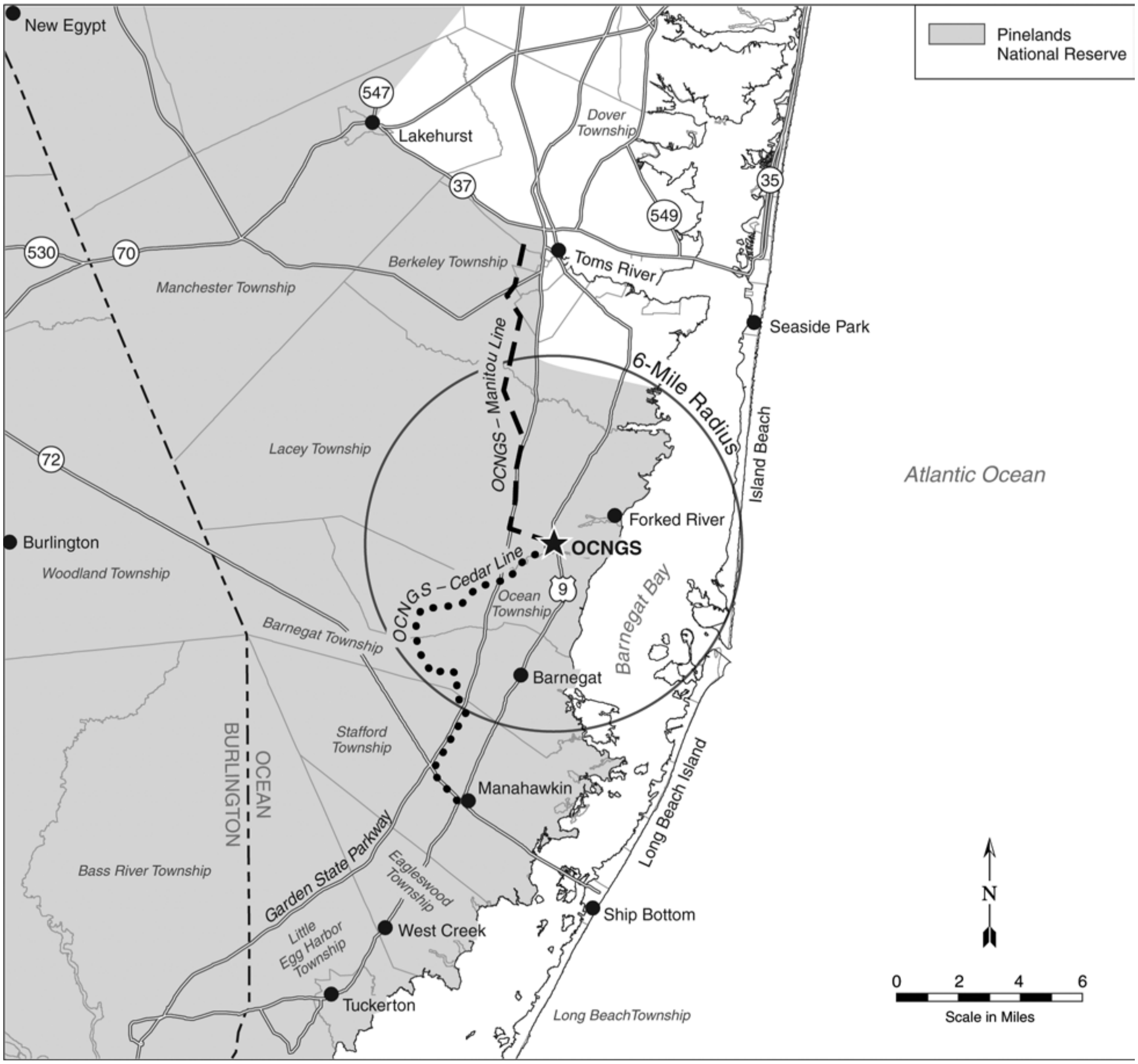

Figure 2-2. Location of Oyster Creek Nuclear Generating Station, 6-mi Region (Source: AmerGen 2005a)

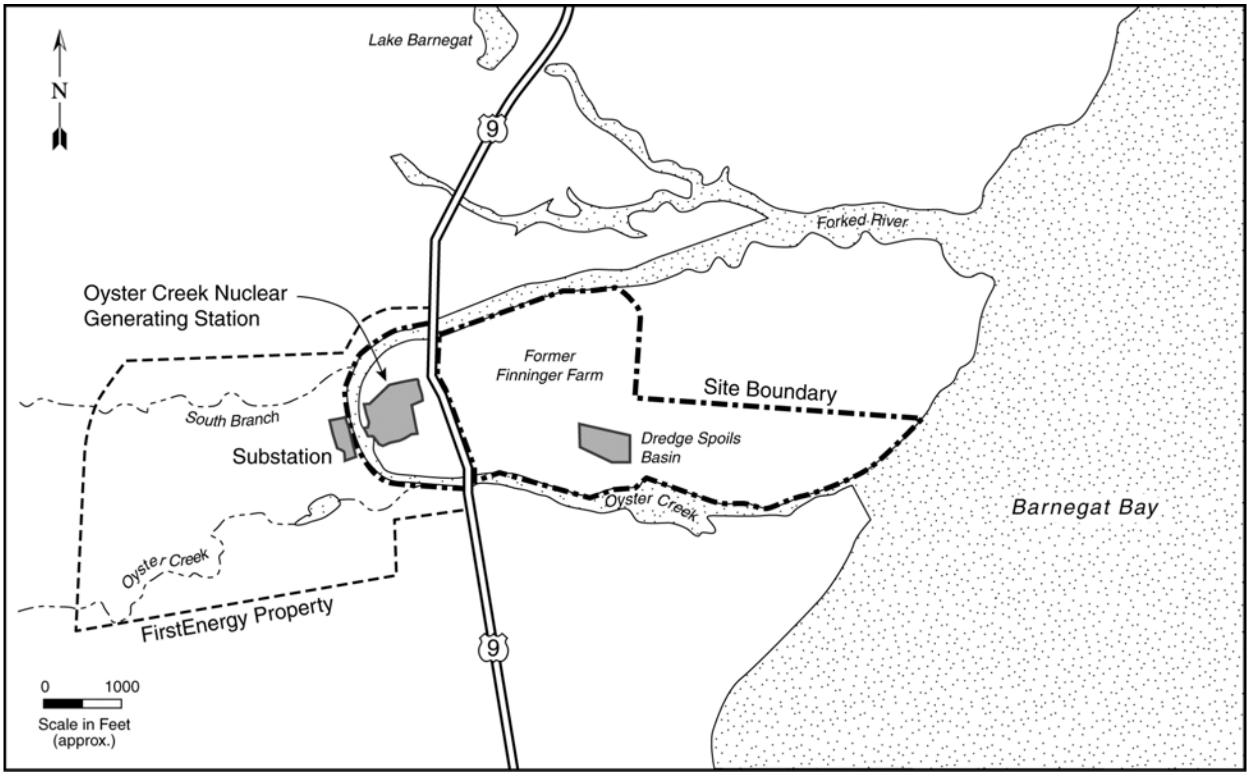

Figure 2-3. Oyster Creek Nuclear Generating Station Site Boundary
(Source: AmerGen 2005a)

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-megawatts-electric (MW[e]) dual-fired combustion turbine power plant that can provide emergency off-site 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 electric-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.

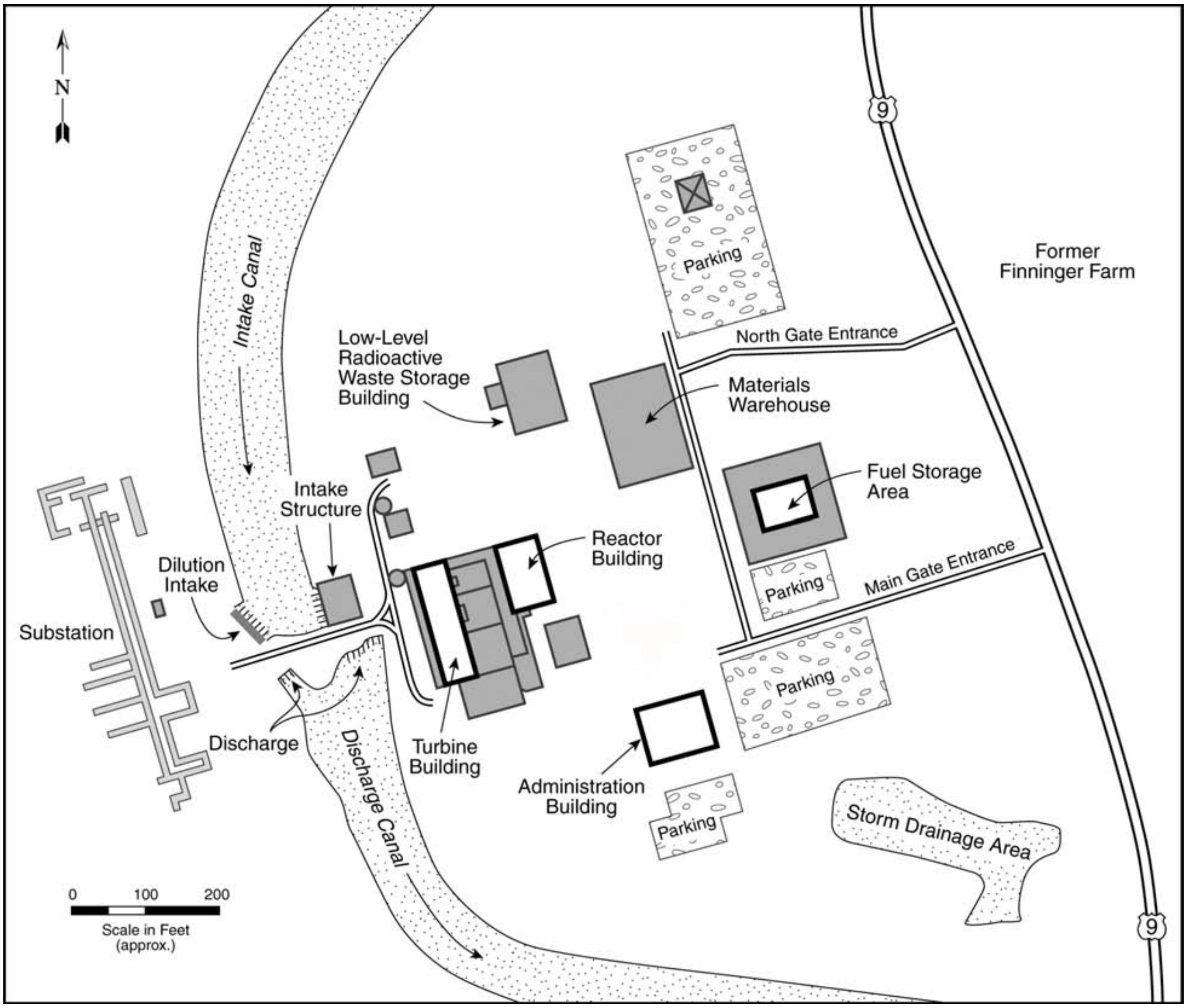

Figure 2-4. Oyster Creek Nuclear Generating Station Site Layout
(Source: AmerGen 2005a)

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 Zircalloy-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 the 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 hours 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-speed, 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-flow 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 one 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 EPA Phase II intake performance standards (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 Title 10, Part 20, of the *Code of Federal Regulations* (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. There are no releases to the environment from solid radioactive wastes created at OCNGS. 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 m3/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 include various solid waste, chemical waste, and sanitary waste.

Noncontaminated waste is collected inside the restricted area in designated containers located throughout the plant. Once filled, the containers are surveyed for the presence of loose surface contamination and are then transported to the clean material processing facility. Noncontaminated chemicals, paint, oil, fluorescent bulbs, and other items that have either been used or exceeded their useful shelf life are collected in a central collection area. The materials are received in various forms and are processed to meet all regulatory requirements prior to final disposition. Most items are packaged and shipped to vendors for processing offsite.

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.

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 interconnected to the grid through a 230-kV transmission system. The delivery of generated power 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 U.S. Environmental Protection Agency (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 the 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 the Forked River has been placed in a dredge spoils basin on the former Finninger Farm (Figure 2-3).

The nearest population center is the Forked River Beach housing development, located on the shoreline at the mouth of the 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 (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 to be inconsistent with New Jersey’s Coastal Zone Management Plan primarily because there was insufficient information in the January 21, 2005 application (NJDEP 2005i). Under the provisions of an 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 will resubmit its consistency certification at an appropriate time during the NRC review. Once NJDEP receives AmerGen’s consistency certification and necessary data and information, NJDEP’s six-month review period shall begin. As of the date of this draft SEIS, AmerGen has not resubmitted its certification of consistency to the NJDEP.

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 the Forked River was dredged in 1984 and 1997 (URSGWC 2000). Depth monitoring takes place every two 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 1963. Water naturally exits the pond by flowing over the dam. The pond 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. 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 five 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 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. 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. In July 2004, the EPA issued Phase II regulations for existing electric-generating plants. These regulations established performance standards with respect to Section 316(b) of the CWA. These regulations call for reducing the number of organisms impinged by the intake system by 80 to 95 percent of baseline, and reducing organisms entrained into the cooling system by 60 to 90 percent of baseline (EPA 2004). The draft 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 not be a feasible alternative for OCNGS then AmerGen is 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 criteria. 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 equalize the losses from entrainment and impingement. As of the date of publication of the draft SEIS, NJDEP has 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 during the period covered by the online system showed no violations. The system also includes Discharge Monitoring Report data since July 2000. 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.

Other NJPDES violations that occurred prior to the initiation of the online tracking system 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 the Forked River is administered by the U.S. Army Corps of Engineers (USACE) and a Coastal Area Facility Review under the New Jersey Coastal Zone Management Act. 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, the 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 one 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.

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 g/L was measured, which exceeds the State limit of 70 g/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 due to 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 g/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 0.42 pCi/g. A total of nine Forked River sediment cores were 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 eight 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

(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).

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 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

(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).

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 County (bordering Philadelphia) 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 one hour 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 one hour 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 the Forked River and to the south by Oyster Creek. Cooling water is withdrawn from the South Branch of the Forked River and discharged into Oyster Creek, which drains into Barnegat Bay.

Prior to the construction of OCNGS, the South Branch of the 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 the 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 the 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 the 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); references to specific chapters of the book are provided in this section. 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 the 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; they 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).

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, the New Jersey legislature passed an act in 1987 requiring 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 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 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 TEL levels, 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 contributes biocides (primarily chlorine and chloramine products) and, prior to the late

1980s when operational practices at the OCNGS essentially ended controlled releases of liquid radioactive waste discharges, low levels of radioactive isotopes, to Oyster Creek, and ultimately to 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 testing of 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 crab, marine snails, and sea stars (Table 2-3).

The Fishery Conservation and Management Act (FMCA) 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, and 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, and 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	–
Opsanus tau	oyster toadfish	resident	Sp, SN
Ophidion marginatum	striped cusk-eel	resident	MN
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, and 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/ 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 and 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 due to 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)

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; therefore, 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. The species was reported as present in Oyster Creek and the South Branch of the Forked River in the OCNGS Final FES (AEC 1974).

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 species is currently under status review to determine its eligibility for listing under the Endangered Species Act. The Atlantic States Marine Fishery Council (ASMFC) has developed a fishery management plan for this species, but EFH has not been identified in Barnegat Bay.

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 resilient to a variety of impacts, 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).

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 temperature and salinity; 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).

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, menhaden are 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 salinity ranging from 0.1 to 32.3 ppt (FWS/DOI/USACE 1989d).

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 2003 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). The MAFMC (2005) does not identify weakfish as a managed species; the ASMFC, however, has developed a 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 salinity ranging from 0 to 60 ppt (FWS/DOI/USACE 1989b).

Recent population trends for the 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 2003, 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 to 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 to 88 °F. Juveniles prefer a temperature range of 64 to 77 °F, and 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).

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 three years for males and six 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 with a length greater 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 three to five mg/L, and the apparent minimum dissolved oxygen level for adults appears to be three mg/L. Optimal salinity is approximately zero to three 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).

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; NMFS 2005a). However, MAFMC has not identified this striped bass as a federally 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).

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). EFH has been designated for bluefish in Barnegat Bay.

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).

Recent population trends for the winter flounder are not available for Barnegat Bay. A fisheries 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 is overfished, and that overfishing continues to occur (NMFS 2003). This conclusion was confirmed in 2005 by the ASMFC (2005c). Commercial landings 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). Winter flounder EFH has been designated 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).

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 pipfish 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 is one of the largest fisheries 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 two years, and generally live four 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 settlement to the bottom, juvenile blue crabs molt and 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).

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. There is also 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 uses. The MAFMC has not identified the blue crab as a managed species; therefore, no EFH has been designated for this species.

Shrimp

A variety of shrimp species is present in Barnegat Bay, including sand shrimp (*Crangon septemspinosa*), grass shrimps (*Palaemonetes vulgaris* and *P. pugio*), opossum shrimp (*Neomysis integer*), and mysid shrimp (*N. 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 impinged in the OCNGS cooling-water system. 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). 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. Clams become sexually mature at two or three 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 blooms (*Aureococcus anophagefferens*, *Nannochloris atomus*, and *Alexandrium fundyense*, respectively); 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).

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 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 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, 1982b) 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 the 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 the Forked River. *Toredo 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 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 submerged aquatic vegetation (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 (*Zostera marina*), *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 one or two meters 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.

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). 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 the 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* sp.) 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 threathened 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 reported fish or marine mammals considered threatened or endangered that have been observed in Barnegat Bay, the South Branch of the 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 Known to Occur or That 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
Chelonia mydas	green sea turtle	T	T
Dermochelys coriacea	leatherback sea turtle	E	E
Eretmochelys imbricata	hawksbill sea turtle	E	E
Lepidochelys kempii	Kemp’s ridley sea turtle	E	E

(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 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 two, three, or four 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 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 2005, seven loggerhead sea turtles (five alive, two dead) were removed from the OCNGS cooling-system trash bars. These impingements occurred in 1992, 1994, 1998, and 2000 (NRC 2005b). 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 Cheloniida) 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, 23 Kemp's ridley sea turtles have been impinged, and approximately 50 percent of the turtles 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 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 two to three 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 Caribbean Conservation Corporation (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 two 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; 4 green turtles have been impinged on the OCNGS trash racks since 1969 (3 alive and 1 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 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, saltwater 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 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 is also located on the Finninger Farm portion of the OCNGS site. Otherwise, the area functions as an undeveloped buffer area that is not planned for development during the license renewal period (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 the 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 the Forked River Wildlife Management Area for about 1 mi, and about 1.5 mi of the transmission line occurs within the northeastern corner of the 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 impact statement 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 the 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 sometimes congregate around the open water of the OCNGS thermal plume. 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.), scooters (*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 mink (*Mustela vison*), river otter (*Lontra canadensis*), 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 listed swamp pink (*Helonias bullata*), 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 listed species and the single candidate species for Federal listing that are reported from Ocean County are discussed below. No designated critical habitats for Federally listed species occur on either the OCNGS site or the associated OCNGS-to-Manitou transmission line corridor.

Seabeach Amaranth

The federally listed threatened seabeach amaranth (*Amaranthus pumilus*, family Amaranthaceae) 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.

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, and 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
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

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
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, airport 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, 2005f,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)

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 its habitat requirements, it is unlikely to occur on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

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 bog asphodel's habitat requirements, it is unlikely to occur on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

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 Knieskern beaked-rush's habitat requirements, it is unlikely to occur on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

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. Water depths rarely exceed 4 in. deep (NJDEP 2005e). As 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). In 2004, there were 48 eagle pairs during the nesting season, 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).

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 radiological environmental monitoring program (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).

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. All ESMP data are collected at and beyond the site boundaries of the nuclear generating stations. Samples are obtained for the determination of radioactivity in airborne and liquid effluents and in environmental samples such as crops, sediments and soils, and fish. Direct radiation exposure measurements are taken as well. 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 and Burlington 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.

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	6.0
Manahawkin	5.4
Others	19.0
Total Ocean County	80.6
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

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 (NJWSA) 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). All the water supply systems in the county have additional capacity to meet new water demands (AmerGen 2005a).

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 the 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

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	3.0	7.9
New Jersey American Water Company – Ocean City	Groundwater	2.8	12.2
Jackson Township MUA	Groundwater	2.5	11.0
Lakewood Township MUA	Groundwater	2.0	2.2
Manchester Township MUA	Groundwater	1.9	7.6
Lacey Township MUA	Groundwater	1.9	7.2
Stafford Township MUA	Groundwater	1.4	0.9
Crestwood Village Water Company	Groundwater	1.4	6.1
Little Egg Harbor	Groundwater	1.3	6.0
Point Pleasant	Groundwater	1.0	4.7
Long Beach Township	Groundwater	1.0	7.5

(a) MUA = Municipal Utilities Authority.
Source: AmerGen 2005a

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. 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 Highway 9, which have seen large increases in commuter and commercial traffic. One segment of 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).

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

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

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 Coastal Zone Management Act 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 Highway 9, the Garden State Parkway, Seaside Park, NJ, and the Barnegat Bay shoreline. The transmission lines connected to the OCNGS substation can also be readily seen from all directions, including from both 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 the 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 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

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

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 2005). People visiting summer homes and attendance at local colleges in the area also represent a substantial portion of the transient population in the area.

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 plays 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.

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

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	

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 local and county emergency management programs, public safety, local public schools, local government operations, local road maintenance, and the local 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

(a) 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 acres. 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 the 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 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 impact 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 the National Environmental Policy Act 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.

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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, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System."

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3.0 Environmental Impacts of Refurbishment

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

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

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

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

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this draft 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 draft 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).

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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

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

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, or the evaluation of other available information. Therefore, the NRC staff concludes that there are 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 additional plant-specific mitigation measures are not likely to 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:

- <u>Altered current patterns at intake and discharge structures</u>. 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, or the evaluation of other available information. 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 the Forked River. Station operation may contribute to the deposition of sediment in the canals. This issue is addressed in Section 4.7 of this Supplemental Environmental Impact Statement (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, or the evaluation of other available information. 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.

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

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

  The 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 of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

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

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

  The 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, or the evaluation of other available information. 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.

- Eutrophication. 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, or the evaluation of other available information, including plant monitoring data and technical reports. 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, or the 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). 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 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, or the evaluation of other available information, including the NJPDES permit for OCNGS, or discussion with the NJDEP. 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, or the evaluation of other available information, including the NJPDES permit for OCNGS, or discussion with the NJDEP. 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, or the evaluation of other available information. 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, or the evaluation of available information. 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, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no problems 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, or the evaluation of other available information, including the NJPDES permit for OCNGS. 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. 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 2006).

  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. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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.

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

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

The 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 of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

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

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

The single nuclear power plant referred to above is OCNGS. 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. 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. 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.

- <u>Noise</u>. 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, or the evaluation of other available information. 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.

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 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.

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

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. Entrainment of fish and shellfish into the cooling-water system is a potential adverse environmental impact.

On July 9, 2004, the EPA published a final rule in the *Federal Register* (69 FR 41575) 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 rule is Phase II in the EPA's development of 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 National Pollutant Discharge Elimination System (NPDES) permits, are designed to minimize the adverse environmental impacts, including entrainment losses, associated with the continued use of the intake systems. The new performance standards are designed to significantly reduce entrainment losses resulting from plant operation. Licensees are required to demonstrate compliance with the Phase II performance standards 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 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 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 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.

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 (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.

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) 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

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	5182	3299	5071	3106	10,253
Anchoa mitchilli	Bay anchovy larvae	6545	2543	6794	2607	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	3633	1227	4048	1157	7681
Crangon septemspinosa	Sand shrimp zoea	7225	1732	6383	1231	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	2099	1588	2231	1685	4330

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

associated with larvae, 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 had reviewed most of the information available to the staff. 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).

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).

Although 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 mortality for all life stages of fish and shellfish be reduced by 60 to 90 percent from the calculated baseline, although there is no clear definition of how the baseline is to be calculated.

In September 2005, after discussions and approval by NJDEP, the applicant began an intake sampling program for entrainment and 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, to reduce entrainment.

There is no evidence to suggest that past, current, or future entrainment of eggs, larvae, or juvenile forms of these species would destabilize or noticeably alter any important attribute of the resource. This conclusion was also reached by Kennish (2001), who stated that “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.” On the basis of a review of the available information, it is the NRC staff’s conclusion that the potential impacts of entrainment of fish and shellfish through the existing once-through cooling system during the renewal period would be SMALL. Regardless of the determination of impact, compliance with EPA's Phase II regulations may require modifications to the facility.

During the preparation of this SEIS, the NRC staff considered mitigation measures to reduce entrainment losses at OCNGS during a license renewal period. The staff evaluated two alternatives to the current 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. Impingement of fish and shellfish into the cooling-water system is a potential adverse environmental impact.

On July 9, 2004, the EPA published a final rule in the *Federal Register* (69 FR 41575) addressing cooling-water intake structures with flow levels exceeding a minimum threshold value of 50 million gpd at existing power plants. The rule is Phase II in the EPA's development of 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. The new performance standards are designed to significantly reduce impingement losses resulting from plant operation. Licensees are required to demonstrate compliance with the Phase II performance standards 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 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 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 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 made 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 and the cooler method was 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 for 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.

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

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.

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), it is likely that impingement was underestimated for the first 9 years of the study and overestimated for the last year of the study.

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 had reviewed most of the information available to the NRC staff. A summary of the conclusions associated with impingement impacts follows.

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,

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	3472
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	3952

(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

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 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.

As described above, Summers et al. (1989) identified a number of uncertainties associated with the sampling and data analyses that EA conducted during the demonstration study. For impingement, one of the most significant findings was that the screen mesh size (10.7 mm or 6.4 mm) of sampling equipment used to collect previously impinged organisms did not match the screen mesh size (9.5 mm) of the traveling screens used at the OCNGS circulating-water intake. During the 10-year study, the sampling-gear screen mesh size was larger than the traveling screen mesh for 9 study years and smaller for 1 study year. Summers et al. (1989) concluded that the impingement estimates were probably underestimated for nine 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."

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).

Although 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 impingement performance 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 the calculated baseline, though there is no clear definition of how the baseline is to be calculated.

There is no evidence to suggest that past, current, or future impingement of these species would destabilize or noticeably alter any important attribute of the resource. This conclusion was also reached by Kennish (2001), who stated, after reviewing 316(b) demonstration study data from 1975 to 1977 and 1984 to 1985, that "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." On the basis of a review of the available information, the NRC staff concludes that the potential impacts of impingement of fish and shellfish as a result of operation of the existing once-through cooling system during the renewal period would be SMALL.

Regardless of the determination of impact, compliance with the EPA's Phase II regulations may require modifications to the facility.

During the preparation of this SEIS, the NRC staff considered mitigation measures to reduce impingement losses at OCNGS during a license renewal period. The staff evaluated two alternatives to the current 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 No. NJ0005550 for OCNGS; and reviewed the proposed NJDEP draft permit and accompanying NJDEP fact sheet (NJDEP 2005). The fact sheet describes the principal facts and the significant legal and policy issues considered by NJDEP during the preparation of the draft permit that will govern activities at OCNGS until the permit expires on April 30, 2009 (the same date the current OL for OCNGS expires). Although 316(a) demonstration data presented in EA (1986) were reviewed, the staff's emphasis was placed on Versar's and NJDEP's 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 the 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 permit-related discharge requirements.

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

- Ambient water temperatures in the receiving waters shall not be raised by more than 2.2 °C (4 °F) from June through August, 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 the 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 the 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, as described in the NJDEP (2005) fact sheet.

The 316(a) demonstration study (EA 1986) estimated the recirculation of heated water by monitoring the 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 fully understand 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.

Interruption of the flow of heated water from the plant or failure of the dilution pump system resulted in a number of fish kills since OCNGS began operating in 1969. Fish kills are documented in the OCNGS Annual Environmental Monitoring Reports submitted to the NRC. Fish kills associated with thermal fluctuations from 1972 to 1982 are summarized in Kennish (2001). A review of this information shows that fish kills resulting in the death of more than 1000 fish occurred five times between January 29, 1972, and January 15, 1974. In all cases, thermal shock was the probable cause of death. From 1974 to 1982, the number and magnitude of fish kills was greatly reduced and appears to reflect procedural changes at OCNGS and upgrades to critical systems used to regulate thermal discharges. Fish kill information for 1999 to 2004 documented in OCNGS Annual Environmental Monitoring Reports (GPU Nuclear, Inc. 2000; AmerGen 2001a, 2002a, 2003a, 2004a, 2005b) shows that only one event has been documented in this time period. On September 23, 2002, 5876 fish were killed, of which 75 percent were striped bass, Atlantic menhaden (*Brevoortia tyrannus*), 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 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 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 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 NJDEP's fact sheet (2005).

On the basis of a review of the available information, including that provided by the applicant, the site visit, the State of New Jersey and its subcontractor (Versar, Inc.), and the 316(a) demonstration study presented in EA (1986), the NRC staff concludes that potential impacts on fish and shellfish due to heat shock during the renewal term would be SMALL. Although there have been significant fish kills since OCNGS began operation, the frequency and magnitude of the events have decreased. This is attributed to upgrades to critical systems used to regulate thermal discharges and additional monitoring requirements imposed by NJDEP following fish kill events.

Because the potential impacts to fish and shellfish due to heat shock during the renewal term were determined to be SMALL, additional mitigation was not considered. The staff evaluated two alternatives to the current station cooling system design. An analysis of the two alternatives 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 transmission system. 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

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

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 are 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 are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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, or its evaluation of other information. 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, or the evaluation of other information. 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, or the evaluation of other information. 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, or the evaluation of other information. 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, or the evaluation of other information. 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, or the evaluation of other information. 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, or the evaluation of other information. 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 is one Category 2 issue related to the transmission line, and another issue related to the transmission line is evaluated here. These issues are listed in Table 4-7 and are discussed in Sections 4.2.1 and 4.2.2.

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

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.

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

Table 4-8. 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

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, or the evaluation of other available information. 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, or the evaluation of other available information. 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, or the evaluation of other available information. Therefore, the NRC staff concludes that there are 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 are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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, or the evaluation of other available information. 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.

- Public services: education (license renewal term). 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, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on education during the renewal term beyond those discussed in the GEIS.

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

  > No significant impacts are expected during the license renewal term.

  The 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 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, or the evaluation of other available information. 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.

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.

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).

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.

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[(b)] if the

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(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).

(b) 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 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 1990 Census for low-income populations and the 2000 Census for minority populations (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 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

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with USCB guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2005b).

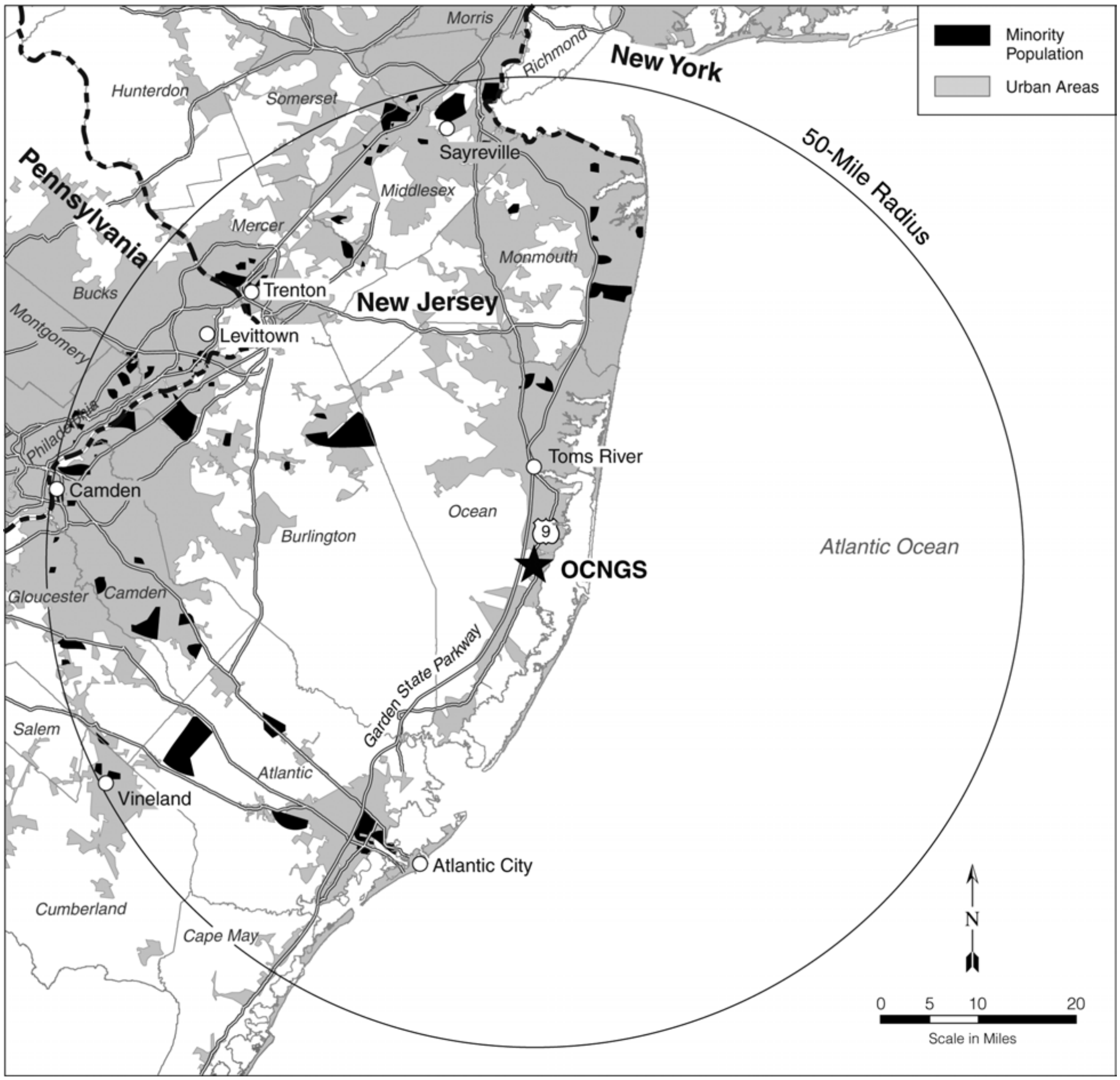

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 50 mi of the Oyster Creek Nuclear Generating Station Based on Census Block Group Data

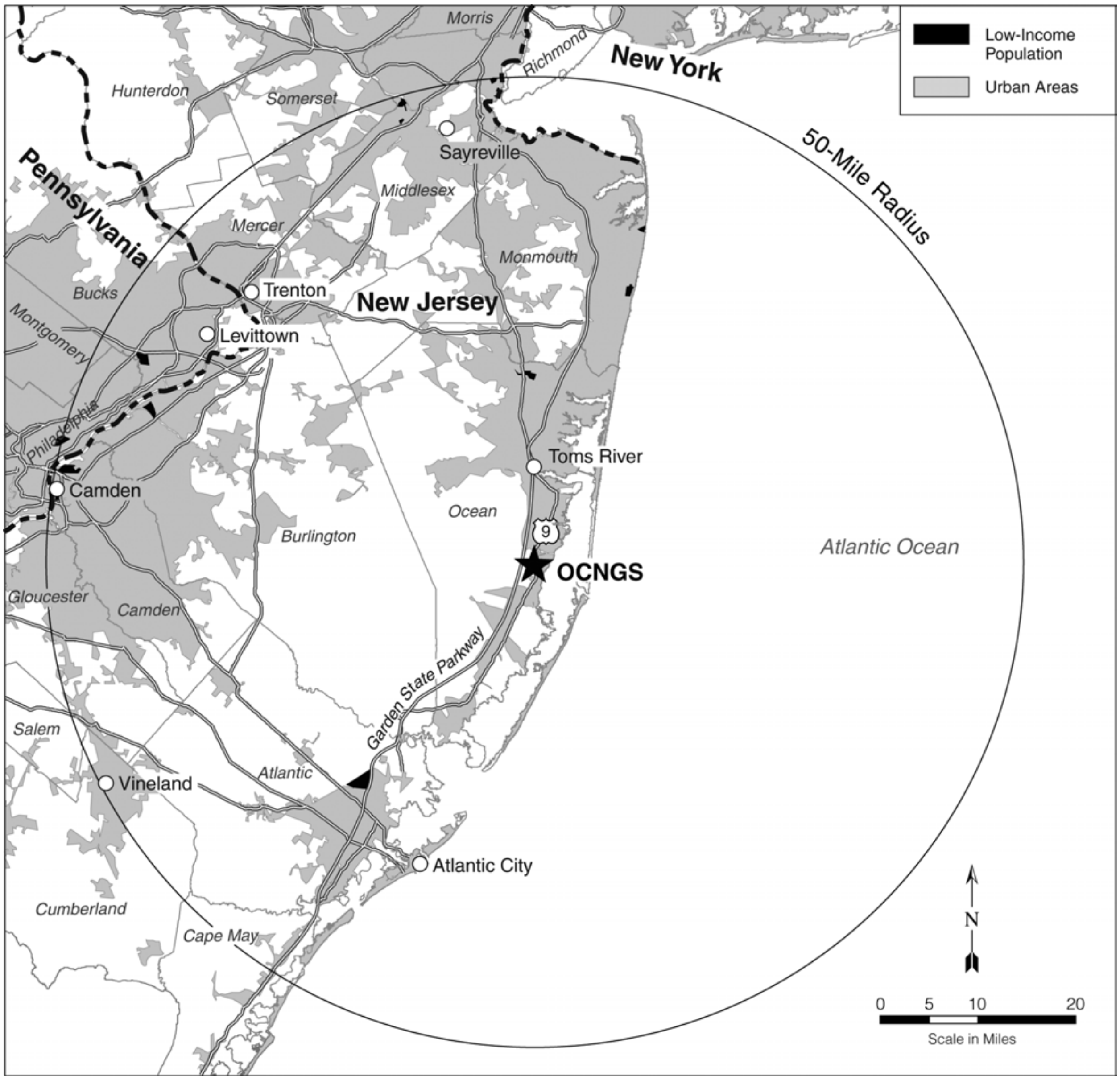

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 50 mi of the Oyster Creek Nuclear Generating Station Based on Census Block Group Data

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

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

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, or the evaluation of other available information. 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, or the evaluation of other available information. 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.

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

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 NRC had recently concluded an Endangered Species Act (ESA) Section 7 consultation with the NMFS regarding sea turtle impingement at the OCNGS intake (NMFS 2005). The NMFS plans to use the information in this SEIS to update its Biological Opinion (BO) and relate it to the license renewal term for continued operation of OCNGS.

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.

The primary threat of OCNGS operations to listed sea turtle species is impingement on the trash racks associated with the once-through cooling system. In 2004, OCNGS exceeded the incidental take limit for Kemp's ridley sea turtles, which resulted in a Section 7 consultation (NRC 2005c) with the NMFS. The Incidental Take Statement (ITS) in the NMFS BO (NMFS 2005) established specific take[(a)] limits for each species. These limits specify the number of individuals of each species that can be taken at OCNGS, and the number of allowed mortalities associated with these takes. Take limits established in the 2005 ITS are two loggerhead sea turtles (no more than one lethal), eight Kemp's ridley sea turtles (no more than four lethal), and one green sea turtle (no more than one lethal). 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 impinged on the trash racks associated with either the circulating-water or dilution-water intake systems.

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. If recovered turtles are comatose or appear dead, resuscitation is attempted. If resuscitation is unsuccessful, arrangements are made to send the turtle for necropsy. 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; recently, however, OCNGS procedures have been revised to correct these problems.

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 2005 are summarized in

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(a) Take is defined in ESA Section 3(19) as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct."

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

Table 4-13. Sea Turtles Impinged on Intake Trash Racks at OCNGS, 1969 to 2005

	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
Totals	5/2	12/11	3/1	20/14

Source: NRC 2005c

Kemp's ridley sea turtle captures began to occur at OCNGS. Green sea turtle captures began in 1999 (Table 4-13). Since 1992, 34 sea turtles have been captured, including 7 loggerhead sea turtles (5 alive, 2 dead), 23 Kemp's ridley (12 alive, 11 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 is 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.

Based on the 2005 consultation, the NRC staff has concluded that the impacts on threatened or endangered sea turtles from continued operation of OCNGS during the license renewal term would be SMALL, and that additional mitigation is not 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 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 accessed 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 that further mitigation would not be 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 the Forked River in the FESs for the Forked River Nuclear Station Unit 1 (AEC 1973) and for OCNGS (AEC 1974). American shad, considered a coolwater migrant of Barnegat Bay (Tatham et al. 1984), were not reported as being present in either Oyster Creek or the Forked River in either report. 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. Also, the fire pond dam would not hinder upstream migration of elvers.

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 the 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 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 pleasure boat use for people along the affected canals. Mitigation of this impact is beyond the scope of license renewal. The staff recommends that the homeowners work with the applicant to resolve this issue.

The NRC staff has identified a new issue that was not previously addressed in the GEIS related to essential fish habitat (EFH). The consultation requirements of Section 305(b) of the Fishery Conservation and Management Act (FCMA) provide that Federal agencies must 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 NMFS. The EFH Assessment to support this consultation is presented in Appendix E of this SEIS.

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 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 species distributions that are ecologically, commercially, or recreationally important. OCNGS is the largest point-source discharger in the Barnegat Bay estuary. However, impacts related to plant operations are localized and have less impact than those related to, for example, long-term regional land use changes. It is likely that plant operations contribute to some of the environmental concerns found in Barnegat Bay; the precise contribution, however, cannot be quantified without long-term studies of the estuary.

The 2005 State of the Estuary Report (BBNEP 2005) identified a variety of anthropogenic stressors to the 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 is causally linked to declines in SAV, and both phenomena may be responses to 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. 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 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. 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 the 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 Forked River and increased the flow of lower Oyster Creek with the discharge of heated cooling water containing biocides, trace metals, and other chemicals. These alterations resulted in habitat loss in the lower portions of both Oyster Creek and the Forked River, and long-term changes to the water quality (temperature, salinity, and chemical contamination) of those areas. For the most part, the remainder of the Oyster Creek and Forked River watersheds are undeveloped.

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 consultation with the FWS may result in a modification to this structure to allow for fish passage.

Maintenance dredging at OCNGS and dredging associated with local docks and marinas will continue to occur and contribute to cumulative impact. Runoff associated with U.S. Highway 9 and residences along the Forked River and Oyster Creek represents a potential ongoing impact, but the extent and magnitude are unknown. No other past, present, or future activities have been identified that could alter the physical and chemical condition of Oyster Creek and the Forked River.

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 information reviewed in EA (1986), Summers et al. (1989), BBNEP (2001), and Kennish (2001), there is no evidence to suggest that the operation of the OCNGS cooling-water system has significantly altered the marine and estuarine food web in Barnegat Bay or resulted in significant changes in phytoplankton or zooplankton species compositions, except in areas restricted to the Forked River and Oyster Creek.

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, 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. In its 2005 fact sheet accompanying the draft NJDEP permit, 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 (*Pseudopleuronectes americanus*), bay anchovy (*Anchoa mitchilli*)], sand shrimp (*Crangon septemspinosa*), opossum shrimp (*Neomysis integer*), blue crab (*Callinectes sapidus*), hard clam (*Mercenaria mercenaria*), eelgrass (*Zostera marina*), shipworms (Family Teredinidae), 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." This conclusion was supported by Kennish (2001), who stated "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 OCNGS on aquatic communities appear to be restricted to the discharge canal and Oyster Creek." Factors other than OCNGS operation also affect fish and shellfish populations in Barnegat Bay. For example, fishing pressure affects several bay stocks, such as winter flounder, which is overfished and depleted.

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. Recently, the NRC consulted with the NMFS to revisit the incidental take statement for sea turtles at OCNGS, given the increased prevalence of some species in coastal New Jersey waters and the exceedence of allowed takes of Kemp's ridley turtles in 2004. The results of the consultation produced a revised incidental take limit that is consistent with population abundances and designed to ensure that the species are protected.

Because the Barnegat Bay estuary is influenced by many controlling factors, the incremental contribution of OCNGS operations cannot be quantified precisely without additional investigation. It is likely, however, that OCNGS impacts are localized and have a minimal contribution to cumulative impact to the Barnegat Bay estuary. The NRC staff concludes that the cumulative impact of continued operation of the OCNGS once-through cooling system on aquatic resources in the Barnegat Bay estuary would be SMALL, and that no further mitigation would be warranted.

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 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 Radiological Impacts

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, 2002b, 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. Therefore, the staff concludes that future cumulative radiological impacts 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 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.

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 10 issues and environmental justice, the NRC staff concludes 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 Federally listed threatened and endangered species, the NRC staff's conclusion is that the impact resulting from license renewal would be SMALL and that further investigation is not warranted. 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.

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 result in significant cumulative impacts on potentially affected resources.

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."

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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, or the evaluation of other available information. Therefore, the NRC staff concludes that there are 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, the NRC regulatory requirements under 10 CFR Part 73 provide reasonable assurance that the risk from sabotage is SMALL. Furthermore, the NRC staff concluded that 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; 5.4; 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 (2005), the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there are 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 (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 1992) and Individual Plant Examination of External Events (IPEEE) (GPU 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 CCNGS 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.

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.

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.

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 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 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 fire 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."

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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

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

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, or the evaluation of other available information. Therefore, the NRC staff concludes that there are 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 are 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 are not likely to 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:

- <u>Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)</u>. 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, or the evaluation of other available information. 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.

- <u>Offsite radiological impacts (collective effects)</u>. 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, or the evaluation of other available information. 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.

- <u>Offsite radiological impacts (spent fuel and HLW disposal)</u>. 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.

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, or the evaluation of other available information. 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.

- Nonradiological impacts of the uranium fuel cycle. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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.

- 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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).

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U.S. Environmental Protection Agency (EPA). 2005. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada." *Federal Register*, Vol. 70, No. 161, pp. 49014–49068. Washington, D.C. (August 22, 2005).

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

U.S. Nuclear Regulatory Commission (NRC). 2005. "Implementation of a Dose Standard After 10,000 Years." *Federal Register*, Vol. 63, No. 173, pp. 53313–53320. Washington, D.C. (September 28, 2005).

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, or its evaluation of other available information. Therefore, the NRC staff concludes that there are 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 are SMALL, and additional plant-specific mitigation measures are not likely to 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 man-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, or the evaluation of other available information. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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, or the evaluation of other available information. 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.

- <u>Ecological resources</u>. 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, or the evaluation of other available information. 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.

- <u>Socioeconomic impacts</u>. 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, or its evaluation of other available information. 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."

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U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report,* "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, 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) a combination of generation and conservation measures. 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. 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 draft Supplemental Environmental Impact Statement (SEIS). Based on the NRC staff's review of the draft permit and discussions with the New Jersey Department of Environmental Protection (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 in 2005 (NJDEP 2005) that incorporated the U.S. Environmental Protection Agency's (EPA's) recently issued Phase II regulations for reducing impingement and entrainment losses at existing electric-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 call for reducing the number of organisms impinged at the intake structure by 80 to 95 percent of baseline, and reducing 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 a feasible alternative for OCNGS, AmerGen could implement another alternative, which is to "select, install, properly operate, and maintain a combination of design and construction technologies, operational

(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.

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 (PIC) which 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 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 restore wetlands. 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 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). 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.

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 two cooling towers 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 flow rate would be approximately 14,000 gpm, with 7000 gpm required for water lost to evaporation and drift and 7000 gpm required for water lost to blowdown. The blowdown water would be piped to the existing dilution pump structure and pumped through two of the three existing dilution pumps into the discharge canal. One dilution pump would remain in operation to dilute the blowdown.

AmerGen estimates that construction of the linear hybrid mechanical-draft cooling-tower system would take approximately two 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 megawatts electric (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.

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 SMALL 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).

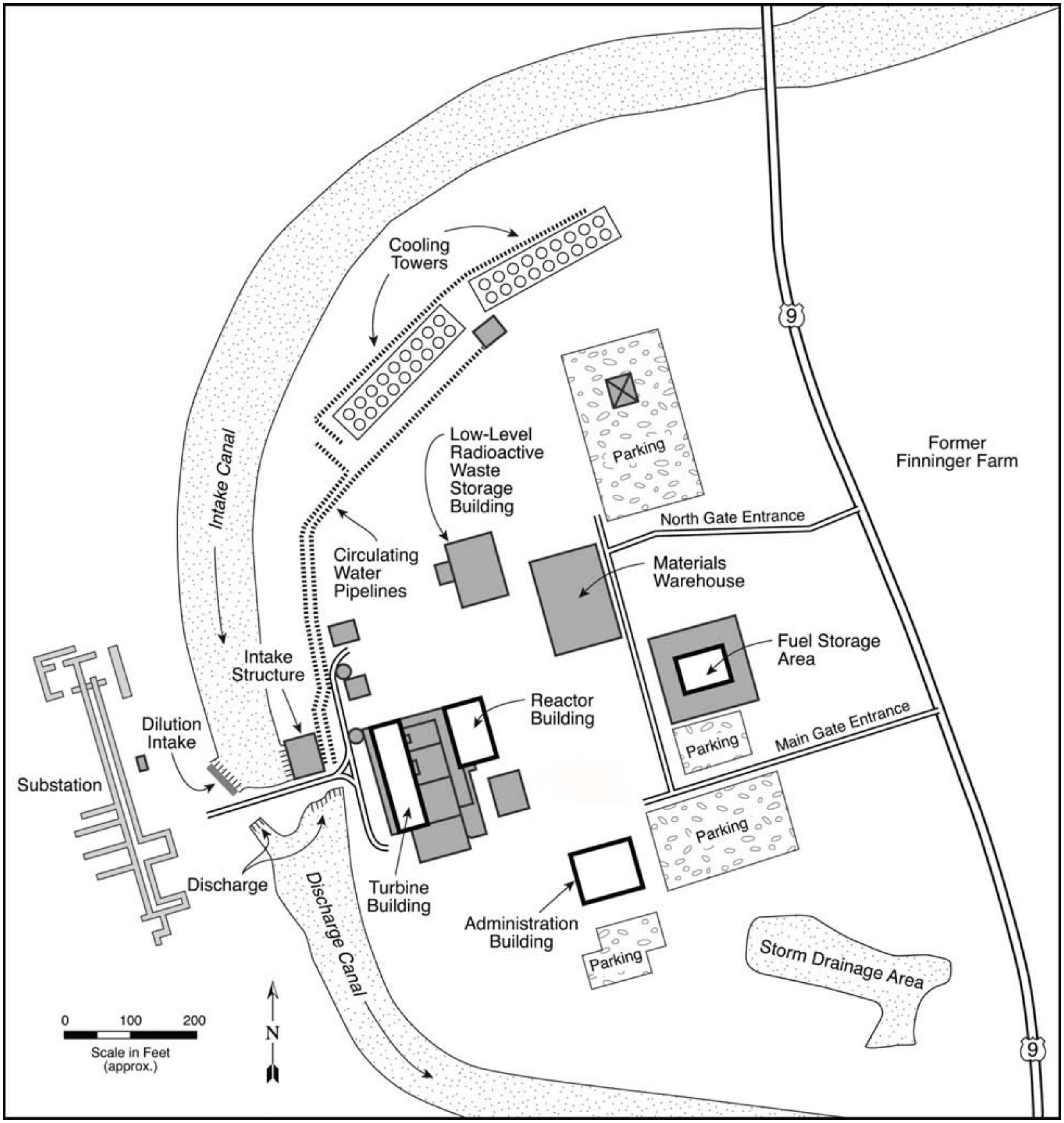

Figure 8-1. Potential Location and Configuration of a Linear Hybrid Mechanical-Draft Cooling Tower System at OCNGS

Construction of the cooling towers at the OCNGS 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 Renewal Act (CAFRA) limiting the percentage of impervious surface area for Lacey Township preclude the construction of the cooling basin and towers (AmerGen 2006).

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 to MODERATE	Would require disturbance of about 13.5 ac of previously disturbed land on the OCNGS site. Would 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 to 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	Impacts related to entrainment, impingement, cold shock, and heat shock would be less than 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 species adjacent to the cooling towers.	SMALL	No impacts on terrestrial ecology would result from modifications to the existing system at OCNGS. Short-term adverse impacts to 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	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. Water would not affect 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.
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 would be dependent on the location and size of the site chosen.

Table 8-1 (contd)

Impact Category	Closed-Cycle Cooling Alternative		Modified Existing Once-Through Cooling System with Restoration Alternative	
	Impact	**Comments**	**Impact**	**Comments**
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 affect significantly 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.

The NRC staff concludes that the impact on onsite land use of constructing and operating a closed-cycle cooling system at OCNGS would be SMALL to MODERATE, because of the impervious land cover restrictions.

The development of cooling towers could result in land-use changes offsite. These changes could come as a result of temporary increases in regional population during construction with direct and indirect employment job creation 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.

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 274,000 gpm (dilution and makeup water) would be withdrawn from the Forked River, representing a 70 percent reduction in water use relative to the existing once-through system. This would result in a substantial reduction in entrainment-related losses relative to the losses sustained by the current once-through cooling system.

Using full evaporative-mode cooling, approximately 14,000 gpm of makeup water would be withdrawn from the 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 the 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 the 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.

The NRC staff made the determination that the impacts of the existing once-through cooling system on aquatic resources would be SMALL. Operation of the closed-cycle cooling alternative would produce fewer impacts to the aquatic environment. 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. 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 parts per million (ppm) and about 0.5 to 0.6 ppm of chloride might be expected to be contributed by the operation of the plant’s saltwater cooling tower. 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 the OCNGS may result in a gradual change in some plant communities from salt-sensitive to salt-tolerant species (AEC 1973). Thus, the potential impact on vegetation from cooling-tower drift would likely be a small incremental increase over natural background concentrations (AEC 1974).

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 on site 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 amount to an estimated 7000 gpm, with makeup water taken from the intake canal (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 7000 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 the 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 the Forked River would decrease substantially.

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). Makeup water may need lime softening, resulting in a sludge that requires disposal (AmerGen 2006). 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 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

(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.

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 x 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 from both cooling towers (salt, other TSS, and TDS) 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[(a)] per hour (as provided at NJAC 7:27-6). Since the salt drift 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 Prevention of Significant Deterioration (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

(a) 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.”

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 mechanincal-draft towers are expected to be approximately 80 feet tall and would be visible from most directions, including from Highway 9, the Garden State Parkway, Seaside Park, NJ, 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, through which minority and low-income populations could be disproportionately high and adversely affected. 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 meet national performance standards for impingement and entrainment losses. 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 restoring wetlands 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. In describing this alternative, the NJDEP provided little information regarding operational or design changes that might be employed at OCNGS to reduce impingement and entrainment losses.

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 even 50 percent (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 damage to fish. 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 even 50 percent.

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 slightly 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 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 base. An increase in wetlands in the Barnegat Bay watershed could support increased populations of those species affected by OCNGS cooling-system operations and, thus, offset entrainment and impingement losses of those species.

In the draft NJPDES permit for OCNGS, the NJDEP estimated that a significant amount of wetlands would need to be restored to offset impingement and entrainment losses at OCNGS, but recognized that additional study would be needed before a final restoration requirement 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. 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.

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 viable retrofit technology to further reduce impingement and entrainment, there would be little change in the current impacts associated with continued operation of the existing cooling system. As presented in Sections 4.1, 4.6, and 4.8, the impacts of continued operation of the existing system would be SMALL. 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. This part of the site is mostly undisturbed and 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.

The 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.

Modifications to the cooling system are 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. The overall impacts associated with entrainment could be reduced somewhat 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 (1986), the organisms most commonly entrained include juvenile and adult opossum shrimp (*Neomysis integer*), hard clam (*Mercenaria mercenaria*) larvae, sand shrimp (*Crangon septemspinosa*) zoea, 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 smaller than those currently identified in Section 4.1.2 of this SEIS. It may be possible, however, to reduce slightly the overall impingement rates through flow reductions during periods when organisms susceptible to impingement are present in or near the intake canal. It might also be possible to increase survivorship of individuals once impinged through physical and operational changes to the screen wash system. Based on the 316(b) evaluation conducted by EA (1986), the organisms most commonly impinged include sand shrimp, blue crab (*Callinectes sapidus*), and bay anchovy (*Anchoa mitchilli*) (Table 4-5).

The current NPDES permit 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 of 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 mitigate impingement losses. 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 (*Pseudopleuronectes americanus*), 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.

The NRC staff concludes that the impacts on aquatic ecology of modifying and operating the once-through cooling system at OCNGS would continue to be SMALL as described in Sections 4.1.1, 4.1.2, and 4.1.3 of this SEIS. Slight reductions in impacts could occur as a result of modifying the existing system. The adverse impacts of initial restoration activities on aquatic ecology could range from SMALL to MODERATE. It is expected, over time, that the impacts will ultimately be SMALL and the estuary will benefit from the restoration activities.

<u>Terrestrial Ecology</u>. 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 system is not expected to generate significant amounts of 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 were 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.

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 whether the license is renewed or not 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

(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.

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 ecological impact of continued plant operation would be SMALL. Cessation of operations would be accompanied by a reduction in cooling-water flow and in the extent of the thermal plume from the plant. These changes would reduce environmental impacts on aquatic species, including threatened and endangered sea turtles. 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. Therefore, the NRC staff concludes that the ecological impact from shutdown of the plant would be SMALL.

- **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 reduction in cooling-water flow and in the amount of heat rejected to Barnegat Bay. The effects of operations on flow and salinity in Oyster Creek and the Forked River would also cease, and flow and salinity conditions more similar to preoperational conditions would be expected to become established. Therefore, the NRC staff concludes that the impact on surface-water use and quality from plant shutdown 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.

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.
Water use and quality – surface water	SMALL	Impact is expected to be SMALL because surface-water intake and discharges would be eliminated.
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.

- **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 2005 with Projections to 2025*, the EIA projects that more than 60 percent of new electric-generating capacity between 2004 and 2025 will be accounted for by combined-cycle,[a] distributed generation, or combustion turbine technology fueled by natural gas (EIA 2005). These technologies are designed primarily to supply peak and intermediate capacity; combined-cycle technology, however, can also be used to meet baseload[b] requirements. The EIA projects that coal-fired plants will account for nearly 33 percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements. Renewable energy sources, primarily wind, biomass, and geothermal, are projected by the EIA to account for the remaining 5 percent of new capacity. The EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. The EIA projects that combined-cycle plants will have the lowest levelized electricity costs for new plants in 2015, followed by wind generation and then coal-fired plants (EIA 2005). By 2025, coal-fired plants are projected to have the lowest costs, followed by gas combined-cycle plants and wind generation (EIA 2005).

(a) In a combined-cycle unit, hot combustion gas in a combustion turbine rotates the turbine to generate electricity. The hot exhaust from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

(b) A baseload plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation; that is, these units generally run near full load.

The EIA projects that oil-fired plants will account for very little new generation capacity in the United States between 2004 and 2025 because of higher fuel costs and lower efficiencies (EIA 2005).

The EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States between 2004 and 2025 because natural gas and coal-fired plants are projected to be more economical (EIA 2005). However, there has been an increased interest in constructing new nuclear power facilities, 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 a new reactor licensing program organization to prepare for and manage future reactor and site licensing applications (NRC 2001). In addition, the Energy Policy Act of 2005 (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.

- **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.

(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.

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.

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 onsite either at OCNGS or at an alternate 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.

(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.
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.

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**
1	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.
2	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.
3	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.

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 2001).

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 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 is 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 occurs. 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 color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting, provided that the lighting meets Federal Aviation Administration 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 Phase II performance standards of the EPA's 316(b) regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

Table 8-4. Summary of Environmental Impacts of Coal-Fired Plant Generation 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

Table 8-4. (contd)

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Transportation	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and archaeological resources	No change
Environmental justice	No change

8.3.2 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).

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.

  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.

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
1	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.
2 3	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.
4	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 Impact	OCNGS Site Comments	Alternate Site Impact	Alternate Site 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.

- **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 those 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 2001).

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 81.414). 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 (EPA 2000a). 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 Phase II performance standards of the EPA's 316(b) regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

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 advanced 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. Consideration of a new nuclear generating plant to replace OCNGS was not included in the AmerGen ER (AmerGen 2005).

Table 8-6. Summary of Environmental Impacts of Natural-Gas-Fired Plant Generation 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

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.

- **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 began. The impact would be greater than 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 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.

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 SMALL. Impact during operation would be MODERATE.
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.

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 consistent 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 Phase II performance standards of the EPA's 316(b) regulations to minimize adverse impacts associated with water withdrawal, and heated discharges would need to comply with 316(a) regulations.

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

8.3.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the OCNGS OL. It is unlikely, however, that sufficient baseload, firm power supply would be available to replace OCNGS capacity.

Imported power from Canada or Mexico is unlikely to be available for replacement of OCNGS capacity. In Canada, 60 percent of the country's electrical generation 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.

8.3.5 Other Alternatives

Other power-generation technologies considered by the NRC are discussed in the following paragraphs.

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). 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 not considered an economically feasible alternative to OCNGS license renewal.

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.

8.3.5.2 Wind Power

Wind power, by itself, is not a suitable alternative to replace the large baseload electrical generating capacity of OCNGS. As discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittency, and average annual capacity factors for wind plants are relatively low (on the order of 30 percent) (NRC 1996). Wind power, in conjunction with energy storage mechanisms, might serve as a means of providing baseload power. However, 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 indicates 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 2004a). 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).

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 largest available land-based turbine is used (currently, 1.5 MW), 427 turbines are estimated to be needed in land areas with a wind class of Class 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. 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 a baseload level of wind generation capacity. At an alternate site, this large amount of land required along the coastline could result in a LARGE environmental impact. Larger turbines could be used for offshore wind development where the wind class is greater, but even a 4-MW turbine (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. Consequently, the NRC staff concludes that locating a baseload, utility-scale wind energy facility on the OCNGS site or at an alternate site would not be economically feasible given the current state of wind generation technology.

8.3.5.3 Solar Power

Solar technologies use the sun's energy and light 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 by itself is not suitable for baseload capacity and is not a feasible alternative to license renewal of OCNGS. 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. Solar power, in conjunction with energy storage mechanisms, might serve as a means of providing baseload power. However, current energy storage technologies are too expensive to permit solar power to serve as a large baseload generator.

Therefore, solar power technologies (photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications because of high costs per kilowatt of capacity (NRC 1996).

Natural resources (e.g., wildlife habitat, land use, and aesthetics) can incur substantial impacts from construction of solar-generating facilities. 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. Neither type of solar electric system would fit at the OCNGS site, and both would have LARGE environmental impacts at an alternate site.

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). Because of the natural resource impacts (land and ecological), the area's relatively low rate of solar radiation, and high cost, solar power is not deemed a feasible baseload alternative to renewal of the OCNGS OL. Some solar power may be substituted for electric power in rooftop and building applications. Implementation of non-rooftop solar generation on a scale large enough to replace OCNGS would likely result in LARGE environmental impacts.

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 to replace the generating capacity of OCNGS (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). Replacement of OCNGS generating capacity would require flooding less than this amount of land. 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 not a feasible alternative to OCNGS OL renewal on its own. Any attempts to site hydroelectric facilities large enough to replace OCNGS would result in LARGE environmental impacts.

8.3.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation because of the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated in Figure 8.4 in the GEIS, geothermal electric-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 to serve as an alternative to OCNGS (DOE 2006b). The NRC staff concludes that geothermal energy is not a feasible alternative to renewal of the OCNGS OL.

8.3.5.6 Wood Waste

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. 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). The National Renewable Energy Laboratory (NREL) has estimated that 1100 kW(h) of electricity can be produced by 1 dry ton of wood residue. Therefore, approximately 0.88 TWh of electricity can 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.

While wood resources are available in New Jersey, wood energy is not considered a reasonable alternative to renewal of the OCNGS OL because of the disadvantages of low heat content, handling difficulties, and high transportation costs.

8.3.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the 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.

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).

Municipal solid waste combustion generates an ash residue that is buried in landfills. The ash residue 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. 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).

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), a much smaller capacity 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). Furthermore, 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. In addition, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be MODERATE, but still larger than the environmental effects of license renewal of OCNGS. Therefore, municipal solid waste would not be a feasible alternative to renewal of the OCNGS OL, particularly at the scale required.

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 do not offer a feasible alternative to renewal of the OCNGS OL.

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.

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 2004b). 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.

It is unlikely that the costs of existing fuel cell systems will drop below $1000/kW; therefore, the DOE has 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 2004c). 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 a feasible alternative to renewal of the OCNGS OL.

8.3.5.10 Delayed Retirement

Existing generating units slated for retirement would likely require major refurbishment to upgrade or replace plant components to meet current environmental regulations, such as those regarding air emissions. For this reason, delayed retirement of other AmerGen generating units would not be a feasible alternative to renewal of the OCNGS OL. AmerGen concluded in its ER (AmerGen 2005) that the environmental impacts of delayed retirement of non-nuclear generating sources would be similar to the impacts from the operation of coal-fired and natural-gas-fired plants. The NRC staff agrees that delayed retirement is not a feasible alternative to renewal of the OCNGS OL.

8.3.5.11 Utility-Sponsored Conservation

Market conditions that initially favored utility-sponsored conservation programs (i.e., DSM), including educational programs, energy efficiency programs, and load management programs, have changed significantly. The viability of new or expanded DSM programs has decreased in recent years because of increased competition in the electric utility industry, mandated energy efficiency standards, and years of customer education programs that have made efficiency the normal practice. 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). Although this program has resulted in peak demand reductions, and the environmental impacts of implementing a DSM program would be SMALL, implementation would not be able to realistically replace the 640 MW(e) of net generating capacity of OCNGS. Therefore, the conservation alternative by itself is not considered a reasonable alternative to renewing the OCNGS OL.

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 conceivable 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.

There are many possible combinations of 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.

The NRC staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with the proposed action.

Table 8-9. Summary of Environmental Impacts of Combination of 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
1	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.
2	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.
3	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.

8.4 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 all impact categories, except for 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 require the replacement 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. Alternative technologies are not considered feasible at this time, and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the OCNGS OL.

The NRC staff concludes that the alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

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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 draft 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 1, of this draft SEIS.

The NRC staff will hold two public meetings in Toms River, New Jersey, in July 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

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

this draft SEIS. When the comment period ends, the NRC staff will consider and address all comments received. Comments will be addressed in Appendix A, Part 2, of the final SEIS.

This draft SEIS includes the NRC staff's preliminary 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 draft SEIS also includes the staff's preliminary 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 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 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 draft 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 draft 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 draft SEIS. Four 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 draft SEIS in relation to operation during the renewal term. For all 11 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. 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. 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. Nevertheless, additional mitigation may be required by the state of New Jersey that would result in further 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.

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 in support of 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, and none warrants implementation of additional mitigation measures. 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 draft 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 will 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 are SMALL for all 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]). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

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 preliminary 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.

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

		License Renewal (Alternatives to the Existing Cooling System)			Coal-Fired Generation		Natural-Gas-Fired Generation		New Nuclear Generation		Combination of Alternatives	
Impact Category	License Renewal (Existing Cooling System)	Closed-Cycle Cooling	Modified Existing System with Restoration	No-Action Alternative (Denial of Renewal)	OCNGS Site	Alternate Site	OCNGS Site	Alternate Site	OCNGS Site	Alternate Site	OCNGS Site	Alternate Site
Land use	SMALL	SMALL to MODERATE	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	SMALL	SMALL	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[(a)]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL[(a)]	SMALL[(a)]	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) 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.

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).

Appendix A

Comments Received on the Environmental Review

Appendix A

Comments Received on the Environmental Review

Part I – Comments Received During Scoping

On September 22, 2005, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent in the *Federal Register* (Volume 70, page 55635) to notify the public of the NRC staff's intent to prepare a plant-specific supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, to support the renewal application for the Oyster Creek Nuclear Generating Station (OCNGS) operating license and to conduct scoping. The plant-specific supplement to the GEIS has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) guidance, and Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51). As outlined by NEPA, the NRC initiated the scoping process with the issuance of the *Federal Register* Notice. The NRC invited the applicant; Federal, State, and local government agencies; Native American Tribal organizations; local organizations; and individuals to participate in the scoping process by providing oral comments at the scheduled public meetings and/or by submitting written suggestions and comments no later than November 25, 2005.

The scoping process included two public scoping meetings that were held at the Quality Inn in Toms River, New Jersey, on November 1, 2005. More than 100 members of the public attended the meetings. Both sessions began with NRC staff members providing a brief overview of the license renewal process and the NEPA process. After the NRC's prepared statements, the meetings were open for public comments. Thirty-three attendees provided oral statements that were recorded and transcribed by a certified court reporter. The meeting transcripts are an attachment to the December 8, 2005, Scoping Meeting Summary. In addition to the comments received during the public meetings, three comment letters were received by the NRC in response to the Notice of Intent.

At the conclusion of the scoping period, the NRC staff and its contractors reviewed the transcripts and all letters to identify specific comments and issues. Each set of comments from a given commenter was given a unique identifier (Commenter ID), so that each set of comments from a commenter could be traced back to the transcript or letter by which the comments were submitted. Specific comments were numbered sequentially within each comment set. Several commenters submitted comments through multiple sources (e.g., afternoon and evening scoping meetings). All of the comments received and the NRC staff responses are included in the OCNGS Scoping Summary Report dated March 21, 2006.

Table A.1 identifies the individuals who provided comments applicable to the environmental review and the Commenter ID associated with each person's set(s) of comments. The individuals are listed in the order in which they spoke at the public meeting, and in alphabetical order for the comments received by letter or e-mail. To maintain consistency with the Scoping Summary Report, the unique identifier used in that report for each set of comments is retained in this appendix.

Specific comments were categorized and consolidated by topic. Comments with similar specific objectives were combined to capture the common essential issues raised by the commenters. The comments fall into one of the following general groups:

- Specific comments that address environmental issues within the purview of the NRC environmental regulations related to license renewal. These comments address Category 1 or Category 2 issues or issues that were not addressed in the GEIS. They also address alternatives and related Federal actions.

- General comments (1) in support of or opposed to nuclear power or license renewal or (2) on the renewal process, the NRC's regulations, and the regulatory process. These comments may or may not be specifically related to the OCNGS license renewal application.

- Questions that do not provide new information.

- Specific comments that address issues that do not fall within or are specifically excluded from the purview of NRC environmental regulations related to license renewal. These comments typically address issues such as the need for power, emergency preparedness, security, current operational safety issues, and safety issues related to operation during the renewal period.

Comments applicable to this environmental review and the NRC staff's responses are summarized in this appendix. The parenthetical alphanumeric identifier after each comment refers to the comment set (Commenter ID) and the comment number. This information, which was extracted from the OCNGS Scoping Summary Report, is provided for the convenience of those interested in the scoping comments applicable to this environmental review. The comments that are general or outside the scope of the environmental review for OCNGS are not included here. More detail regarding the disposition of general or inapplicable comments can be found in the Scoping Summary Report. The Agencywide Document Access and Management System (ADAMS) accession number for the Scoping Summary Report is ML060530691. This accession number is provided to facilitate access to the document through the Public Electronic Reading Room (ADAMS) (http://www.nrc.gov/reading-rm.html).

Table A-1. Individuals Providing Comments During Scoping Comment Period

Commenter ID	Commenter	Affiliation (If Stated)	Comment Source [(a)]
OS-A	Tom Jackson		Scoping Meeting
OS-B	Mike Mercurio	St. Francis Environmental Ministry	Scoping Meeting
OS-C	Ed Frydendahl		Scoping Meeting
OS-D	Don Warren		Scoping Meeting
OS-E	J. Simonair		Scoping Meeting
OS-F	Ed Stroup	International Brotherhood of Electrical Workers Local 1289	Scoping Meeting
OS-G	Bud Swenson	AmerGen Energy Company, LLC	Scoping Meeting
OS-H	Fred Polaski	Exelon	Scoping Meeting
OS-I	Tom Cervasio	EnviroWatch	Scoping Meeting
OS-J	Wayne Romberg		Scoping Meeting
OS-K	Judith Cambria		Scoping Meeting
OS-L	Bud Thoman	International Brotherhood of Electrical Workers Local 94	Scoping Meeting
OS-M	Chip Gerrity		Scoping Meeting
OS-N	Don Williams		Scoping Meeting
OS-O	Nancy Eriksen	Natural Resource Education Foundation	Scoping Meeting
OS-P	Paula Gotsch	Grandmothers, Mothers, and More for Energy Safety	Scoping Meeting
OS-Q	Suzanne Leta	New Jersey Public Interest Research Group	Scoping Meeting
OS-R	Kelly McNicholas	Sierra Club	Scoping Meeting
OS-S	Chris Tryon		Scoping Meeting
OS-T	Jay Vouglitois		Scoping Meeting
OS-U	Terry Matthews		Scoping Meeting
OS-V	Roberto Weinmann		Scoping Meeting
OS-W	Ed Hogan, Sr.	Concerned Citizens for America	Scoping Meeting
OS-X	Ed Hogan, Jr.	Concerned Citizens for America	Scoping Meeting
OS-Y	Rod Sterling		Scoping Meeting
OS-Z	David Most		Scoping Meeting
OS-AA	Peggi Sturmfels	New Jersey Environmental Federation	Scoping Meeting
OS-AB	Jeffrey Brown		Scoping Meeting
OS-AC	Jennifer M. Watley		Scoping Meeting
OS-AD	Ron Watson		Scoping Meeting
OS-AE	Donald Posey		Scoping Meeting
OS-AF	Judy Moken		Scoping Meeting
OS-AG	Diane Eleneski		Scoping Meeting
OS-AH	Jennifer Sampson, Nicole Simmons	Clean Ocean Action	Letter (ML053120157)
OS-AI	Bob Scro, Michael DeLuca	Barnegat Bay National Estuary Program	Letter (ML053220253)
OS-AJ	Clifford J. Day	U.S. Fish and Wildlife Service	Letter (ML053360432)

(a) The afternoon and evening transcripts can be found under accession number ML053400397.

Comments in this section are grouped in the following categories:

- A.1.1 Surface-Water Quality, Hydrology, and Use
- A.1.2 Aquatic Ecology
- A.1.3 Terrestrial Ecology
- A.1.4 Threatened and Endangered Species
- A.1.5 Air Quality
- A.1.6 Land Use
- A.1.7 Human Health
- A.1.8 Socioeconomics
- A.1.9 Alternate Energy Sources
- A.1.10 Postulated Accidents
- A.1.11 Uranium Fuel Cycle and Waste Management

A.1 Comments and Responses

A.1.1 Comments Concerning Surface-Water Quality, Hydrology, and Use

Comment: At other public meetings, some raised questions about our use of chlorine. We do use chlorine to keep the plant's condenser tubes clean and improve the efficiency of the plant. However, it's virtually nondetectable by the time it gets out of the condenser, and it certainly is not toxic to fish or any other living organisms. In addition, we are well below the allowable amounts of chlorine allowed by our discharge permits. (OS-G-9, OS-G-23)

Comment: The issue with chlorination, constantly dumping this chlorine. For the man to make a statement that chlorine is not toxic to fish, I've had an aquarium, and one of the first things you do in an aquarium is you dechlorinate the water before you put it in, or it will kill your fish. Granted, you can dilute it down to quantities that may be acceptable, but to say that it's not having an environmental impact is not – is not correct science. Because of this, this is why I'm focusing my environmental question on, again, the leakage from the plant and the radioactivity from this leakage from this plant. Without a closed-loop system, this extra contamination from Oyster Creek is ending up in our environment, because these leaks aren't all going into controlled areas. These leaks are going into the recirculating cooling-water area because of the design of the plant. So this is an environmental concern that I feel must be taken into consideration when deciding to issue an environmental permit for Oyster Creek in this licensing renewal. (OS-D-10)

Comment: We minimize the use of chlorine as a biocide. And by the way, all power plants that have once-through condensers use biocide. That's – I mean, all over the State, that's the way it is unless you've got a cooling tower. (OS-J-6)

Response: *The release of contaminants to surface-water bodies is a Category 1 issue that has been evaluated in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS). All effluent discharges are regulated under the provisions of the Clean Water Act and the implementing effluent guidelines, limitations, and standards established by the U.S. Environmental Protection Agency (EPA) and the States. Conditions of discharge for the Oyster Creek Nuclear Generating Station (OCNGS) are specified in its New Jersey Pollutant Discharge Elimination System (NJPDES) permit. The comment provides no new information and will not be evaluated further.*

Comment: The question is, it seems, that the flow of the Forked River may have changed the pattern under which sediments are deposited in the ground of the river and the adjacent lagoons that are along the Forked River. And I think there are navigational and recreational difficulties because of these deposits that don't allow you to get in and out unless you (inaudible) every time. So can something be done and it was done apparently by the plant 10 years ago. The question is, can this be repeated or can something be done about it? (OS-V-1)

Response: *The commenter suggests that station operation has resulted in an altered flow pattern in the Forked River that may be contributing to shoaling at the mouth of the finger canals. The impacts associated with alteration of current patterns due to station operation 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 the 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." Although the U.S. Nuclear Regulatory Commission (NRC) staff does not dispute the possibility that station operation is causing the shoaling and would also do so during the period of extended operation, the NRC staff finds that the GEIS broadly addressed this issue and finds that no new and significant information exists to suggest that the conclusion in the GEIS is no longer valid. In the past, the licensee has periodically dredged portions of the Forked River and Oyster Creek to maintain adequate depth. With respect to future remediation of the shoaling problem, the NRC staff believes that this is outside the scope of its National Environmental Policy Act (NEPA) of 1969 review; nonetheless, the phenomenon will be discussed in the Supplemental Environmental Impact Statement (SEIS).*

A.1.2 Comments Concerning Aquatic Ecology Issues

Comment: The second reason that we sample at Oyster Creek is to protect the environment. We sample the air and the water that leaves the plant to make sure that we have a minimum impact on the environment. We not only meet State and Federal regulations, but often we beat them. We're extremely proud of our record as a zero-release plant, and we continually improve our operating procedures as we discover new ways to be better environmental stewards. (OS-AC-2)

Comment: I know that the DEP [Department of Environmental Protection] has jurisdiction over their water discharge permit, and I don't know – actually, I'd like to ask how much jurisdiction the NRC [U.S. Nuclear Regulatory Commission] has over that, and whether you actually look at whether Oyster Creek is complying with the Clean Water Act, or if that is simply a matter for the DEP to consider, because it's unclear to me what is the truth in that. I mean, I know the DEP does, but I don't know what the NRC's role is in that. So just to be clear in terms of Oyster Creek's water impact into the local waterways, and to Barnegat Bay, that since Oyster Creek was built in 1969, the plant's operation has really resulted in very far-reaching and long-lasting environmental degradation to nearby waterways, including Forked River, Oyster Creek, and Barnegat Bay. And, unfortunately, as it stands right now, the DEP's draft water permit does let the plant off the hook, and I would hope that the NRC would not do the same, if you do have jurisdiction, any type of jurisdiction over this. (OS-Q-1)

Comment: Chlorine is injected through each of the circulating pumps daily to prevent and remove fouling organisms such as bacteria. Maximum chlorination occurs in the summer months when water temperatures peak and fish eggs and larvae are most abundant in the zooplankton and invertebrate and fish numbers peaks.

1) Chlorine directly kills phyto- and zooplankton entrained in the cooling system and can impact organisms residing in the discharge canal and surrounding waters.

   a) Chlorine begins to be lethal to marine organisms at 0.01 mg/L but tolerance is significantly lowered by high temperatures and physiological condition of the organisms.
   b) OCNGS [Oyster Creek Nuclear Generating Station] has a permitted daily maximum discharge limit of 0.20 mg/L of chlorine into the discharge canal, 20 times higher than the lethal limit of many estuarine organisms including striped bass, mummichogs and bunker. One chlorine related fish kill resulted in the death of 500 Atlantic menhaden in January of 1974.

2) Toxic residual organic compounds (chloramines) are a byproduct of chlorination, which persists in the canal and effluent resulting in long-term exposure to fish and other aquatic organisms residing in the canal and plume area.

3) Radionuclides are released from OCNGS and bioaccumulate throughout the estuarine food web. Reactor-released radionuclides (^{60}Co, ^{137}Cs, and ^{54}Mn) have been detected in water, bottom sediments, benthic marine algae, seagrass, hard clams, blue crabs, bunker, winter flounder, summer flounder, bluefish, and several other fish. Organisms collected near Oyster Creek had the highest levels of radionuclides but detectable levels were found

through out the bay. Recent sediments collected near the discharge canal contained levels of ^{60}Co that were up to 63 times higher than sediments collected at other locations within the Barnegat Bay-Little Egg Harbor estuary.

4) The current NJPDES [New Jersey Pollutant Discharge Elimination System] permit for OCNGS indicates a maximum daily limit of 15 ppm [parts per million] of PAHs [polycyclic aromatic hydrocarbons] can be discharged from 5 of their outfall pipes. The sources of this contaminant are not clear. (OS-AH-4)

Response: *The discharge of nonradioactive contaminants in the cooling water of the station, including chlorine and polycyclic aromatic hydrocarbons (PAHs), is limited by the NJPDES permit. Implementation of the Clean Water Act provisions is the responsibility of the EPA, and the EPA often delegates such authority to the State as is the case with New Jersey. The state of New Jersey, not the NRC, sets the limits of effluents according to the Clean Water Act. This issue was evaluated generically in the GEIS, and absent new and significant information, the NRC staff adopts the conclusions in the GEIS. With respect to nonradioactive contaminants, the comments provide no new information and will not be evaluated further.*

A comment was made concerning bioaccumulation of radionuclides in the estuarine food web. The NRC staff's review of the license renewal application includes an evaluation of offsite releases of radionuclides from OCNGS, including their movement through the food web. The results of this evaluation will be discussed in the SEIS.

Comment: At Oyster Creek we do everything we can to protect the Barnegat Bay. We have a constant focus on planning and executing our work to minimize the impact to the environment. On a day-to-day, hour-to-hour basis, we monitor water temperatures. We regularly take water samples to ensure compliance with regulations. We also coordinate any planned load reductions and shutdowns to avoid the risk to marine life. This practice is often costly, but it's essential to meet our commitment to the environment. Just this past weekend we performed a routine power reduction, and, due to our environmental team, there was no environmental impact. (OS-G-8, OS-G-22)

Comment: The employees at Oyster Creek – and there are about 450 of them – are highly trained and environmentally sensitive. We're a zero-discharge plant. We have modified their turbine cooling-water intake to be fish-friendly with soft sprays to return fish to the environment. Our intake screens are sized to be environmentally friendly. So we've changed some things over the years to make the plant more friendly to the environment. (OS-J-3)

Comment: Our startups and shutdowns, we have worked very hard in the last couple of years to do very slow startups and slow shutdowns, because that's environmentally friendly. And since we've started doing that, we've had no fish kills as a result. The fish don't like a fast change of temperature. (OS-J-5)

Comment: It's a well-known fact that the best fishing in the area, in Ocean County, is on Route 9 on the Oyster Creek discharge. You can go down there this afternoon and count the fishermen and count the fish they're getting. You know, I anchor my boat. I have an environmentally-friendly sailboat. We anchor it in Oyster Creek. We get blue shell crabs there. We swim there. You know, we feel good about it. (OS-J-8)

Comment: Oyster Creek is also involved in several environmental projects. Most recently, we purchased a boat for the Rutgers Extension Service Clam Restoration Project. The project team is working on reestablishing clam beds in the Barnegat Bay, and the boat will be used to more efficiently implement the restoration of the clam beds and other important environmental projects in the future. (OS-G-11, OS-G-25)

Comment: And anybody that's coming up with these cockeyed stories about, oh, they need water towers, no, they don't need water towers. The system they have is fine. The water flows in, and it flows out, and they do a good job. (OS-N-2)

Comment: I heard a couple of statements made tonight that I feel obligated to correct. One is that Oyster Creek is in violation of the Clean Water Act. That is simply not true. Oyster Creek could not operate today if it was in violation of the Clean Water Act. Oyster Creek currently operates under a New Jersey Pollutant Discharge Elimination System Permit that was issued by the New Jersey Department of Environmental Protection. That would not be possible if they were in violation of the Clean Water Act. That is a false statement.

Secondly, I heard someone say that there are far-reaching and long-lasting environmental degradation occurring due to the operation of the existing once-through cooling system. Well, there was a very thorough independent evaluation of this once-through cooling system that was done prior to the issuance of the permit that I referred to a second ago. The permit was issued in 1994. Before issuing the permit, the DEP hired an independent consultant called Versar to evaluate all of the studies, and there were some 20 years of intensive studies that were done on the cooling system at Oyster Creek. I know because I participated in many of them. If I wasn't actually doing the work, I participated in the design of the studies. I oversaw the hiring of the consultants. I looked over those – their shoulders as they did the work. I'm very familiar with this work. But it's not my opinion that's important. It's the opinion of the independent expert that was hired by the New Jersey Department of Environmental Protection prior to the issuance of the current permit. That independent consultant – Versar – was asked to determine if the existing once-through cooling system complied with Sections 316(a) and (b) of the Clean Water Act. Based upon the results of their review, Versar and the NJDEP, in the permit that they issue, concluded that the continued operation of the Oyster Creek Nuclear

Generating Station at the estimated levels of losses to representative important species populations – and these are the losses due to the impingement and entrainment that you heard people talk about. Continued operation at those levels of losses, without modification to the intake structures and/or operating practices – again, without modification to the intake structure, does not threaten the protection and propagation of balanced indigenous populations in Barnegat Bay. That's a direct quote from the DEP's independent consultant. It's not opinion. It's not AmerGen's or Exelon's opinion.

It's worth noting that Versar, the consultant that the DEP hired, was not shy about asking to have power plants modify their cooling-water intakes. As a matter of fact, a few months before they initiated the evaluation of Oyster Creek, they finished one up on the Salem nuclear generating station. And based upon the results of their evaluation of that cooling system, they called for a 50 percent reduction in cooling-water flow, which is essentially calling for backfitting, closed-cycle cooling. So they weren't afraid to say that Oyster Creek needed to modify their cooling system. But, in fact, they determined the opposite – that it didn't need to be modified. A couple of the other conclusions that they and the DEP came to, that I'd like to share with you, that are contrary to some of the assertions that were made tonight, include – and these are direct quotes. "The losses due to impingement at the Oyster Creek Nuclear Generating Station were of no consequence to the compliance determination." Losses due to impingement of no consequence to the compliance determination. Discharge effects, contrary to the fact that you heard that there is a thermal plume that goes all the way across the bay, causing all kinds of havoc, the DEP's independent consultant concluded, I quote, "Discharge effects are small and localized and have no adverse consequences to Barnegat Bay."

They go on to conclude, I quote, "Based on findings summarized in this report, balanced indigenous populations of Barnegat Bay are protected under Oyster Creek's current operations." I quote, "Plant-related losses at the Oyster Creek Nuclear Generating Station do not adversely impact spawning and nursery functions." I quote, "Plant-related losses at the Oyster Creek Nuclear Generating Station do not adversely affect the estuarine food web of Barnegat Bay." I quote, "Plant-related losses at the Oyster Creek Nuclear Generating Station do not adversely impact the beneficial uses of Barnegat Bay." This is contrary to the comment that I heard a few minutes ago that the alleged degradation of the bay is having a negative impact on the economy. These are not my conclusions. These are the conclusions of an independent expert hired by the Department of Environmental Protection. (OS-T-1, OS-T-2)

Comment: Now we're here to talk about the environment and I had addressed the DEP last week and I read a statement, but I'd like to get a little bit more informal as far as our screen-wash system that actually protects our marine life. I believe that we have a minimal effect on our marine life as far as impingement or entrainment on our screen-wash system. (OS-Z-3)

Comment: So my point being too is I'm a fisherman out in Barnegat Bay. I used to clam when I was a kid. And the only problem that I see out in Barnegat Bay is our limits. Now the state of

New Jersey limits our catch as far as striped bass. Now there was a low with striped bass I would say about 15 years ago, you couldn't barely catch a striped bass because they were pretty much fished out. Well, what happened is the State stepped in and they limited the catch limit. Well now if you look at the population in Barnegat Bay as far as our striped bass population, it's huge. I mean we're catching alligators out there and it's great. And our weakfish are the same.

So my point to the people that are saying that Oyster Creek has a negative effect on Barnegat Bay, I totally disagree with them because if that was a fact, they would never come back. Now as far as our clams, I used to clam for a living too. And I remember Cattrell's – remember Cattrell's in Waretown? Well, we used to go clamming and everybody knows where the batting ring is when baseball players put a batting ring on a bat to make it heavier. Well, these clams, you'd have to fit the clams through a batting ring and they would consider them a cherrystone. Well, when I was a kid, that's what we used to do to make a living. We used to actually clam, and we'd drop the clams off at Cattrell's and the clams used to fit through the batting ring and they were considered cherrystone. You'd get more money for cherrystones. But through the years, as our area has developed in Lacey Township, along with all our neighboring towns, the population has just exploded. So what happens to our clams? They get fished out. So we need time to let them reproduce, and I'm confident in time that our clam population will increase as well as our striped bass and our weakfish. (OS-Z-6)

Comment: In the environmental area, I'm proud to say that during the last refueling outage, we shut the plant down, performed the refueling, and restarted the plant with zero impact to the environment. And that's because of being good stewards of taking the time and getting the people involved from the chemistry organizations to the outside organizations to analyze the plant's impact to the environment and implementing that into the scheduling itself. So we took additional time to shut the plant down. We had people stationed out at the discharge canal and we had zero impact on the fish and the marine life out there. So that proves to me that Oyster Creek is a good steward, and it should be relicensed for another 20 years. (OS-AE-2)

Comment: Environmentally, I'm a local in Ocean County. I know firsthand people who fish right around the plant. They say they've never caught such big fish in their life, or crabs for that matter and none of them I've seen who I've known through the years and I've been here for years, none of them have come down with cancer, none of them are turning green and none of them are glowing in the dark. That's one thing I can say. And the gentleman from Forked River who's lived here for his life and he's in the Republican Party, he's told you that he sees more bass in the bay, that's probably due to conservation, but one thing you can say it's not because Oyster Creek is destroying those fish. If anything, it's helping those fish spawn. (OS-X-3)

Response: *The comments are, in general, supportive of the existing once-through cooling system of OCNGS, and no specific response is provided. The SEIS will address the impacts of the once-through cooling system as well as those associated with an alternative closed-cycle system.*

Comment: It's common knowledge that the state of New Jersey and the DEP is trying to force them to build a cooling tower. The cooling tower, according to my understanding, is not under the NRC, that you are actually reviewing it based on the approved method of operation. So the question is, is this cooling tower or what amounts to blackmail, they're asking for 3500 acres in order for the State to give them this water commitment separate from you? What impact does that have on your environmental statement? (OS-U-1)

Response: *The NRC's responsibility under NEPA is to provide a fair and comprehensive analysis of potential impacts related to the proposed action, to evaluate alternatives, and suggest mitigation if deemed necessary. Approval of a cooling-system design is the responsibility of the EPA, which has delegated that responsibility to the state of New Jersey. The NRC will evaluate the impacts of the existing once-through cooling system as well as those associated with an alternative closed-cycle cooling system, and an alternative that includes modifications to the existing system and wetland restoration.*

Comment: So even as of 1981, the technology that existed then, one of the areas from time to time was the water purification section – (inaudible) recovery towers, (inaudible) recovery towers, various aspects. And when the water was discharged into the (inaudible) River, which occurred in most of the (inaudible) – the by, the ocean – (inaudible) tanks (inaudible) clean water as of (inaudible). Now, we had found earlier, based on (inaudible), that both Federal and State organizations (inaudible) that the Hope Creek, New Jersey, atomic power plant (inaudible). And now (inaudible), we had a (inaudible) recovery time and (inaudible). I'm not aware of a fish kill at (inaudible) Creek. At the Oyster Creek facility, to my knowledge, (inaudible). But I'm aware of (inaudible) not one, but three massive fish kills. We have learned today that the Oyster Creek facility still does not have (inaudible). We have heard from two gentlemen – this surprised me – that they are environmentally conscious. They are conscious of (inaudible). The discharge site needs further work. We need a water cooler (inaudible) there on the discharge site. We do not need these fish kills anymore. Part of the renewal process for this license should be a consideration of a coolant tower should be built. (inaudible) one at Hope Creek. We need one at Oyster Creek. (OS-A-1)

Response: *Although, unfortunately, much of the comment was not captured in the transcript, the NRC staff believes that the commenter intended to express concern about fish kills that resulted from plant operations and to suggest that conversion to a closed-cycle cooling system using a cooling tower would be advisable. In the SEIS, the NRC staff will consider the effects of converting to a closed-cycle cooling system at OCNGS.*

Comment: Oyster Creek's present water and intake system destroys marine life. In the year 2002, the plant was fined $50,000 for killing 5,876 fish. If the Oyster Creek plant does not construct a cooling tower, the plant will continue to contribute to the loss of habitat in the remaining estuary, so, therefore, the plant should be shut down. (OS-I-6)

Comment: The point I'm trying to make here is they talk about the environmental impact. There's a tremendous environmental impact when Oyster Creek continues to operate every day. The fact that they are unwilling to spend the money for a cooling tower, which is exactly what it comes to – everybody has seemed to look at it, including the Environmental Protection Agency, and say this is the best alternative, yet Oyster Creek is looking for the cheaper way out. This is not true community concern. (OS-D-9)

Comment: And I do truly believe that the environmental impact on the aquatic life and overall – not just fish, all others, has been very, very devastating. And we are so overfishing as it is out there, once they get bigger that we need to be able to have as many possible make it to that point, and so they can become part of our food supply. So I'm very concerned about that. (OS-K-2)

Comment: I don't want to see any more fish kills. I saw enough of them. I saw striped bass three and four feet long when I lived in Lacey floating in that creek because of that plume that comes out of there, that hot water. We were told before by somebody from the plant that they add cool water to it. Again, my question to the people at AmerGen – four miles out in Barnegat Bay that plume continues to send warm water out into the bay. You can't tell me that that's not affecting the ecosystem and the environmental condition of Barnegat Bay. And I don't care what kind of an engineer you are, or where you went to school, or what you studied, I'm taking it from a fisherman and an environmentalist who says that warm water should not be shot out there. (OS-C-4)

Comment: The other thing that should be addressed is the fact that the coolant – the cooling of the water into Barnegat Bay can be very easily solved as heat recovery systems can be put in along the area, hydroponics, different areas. Forty years ago, we had a system – we had a bay that was full of life. Today it's – our oceans are 90 percent depleted. (OS-B-5)

Comment: You know, the once-through cooling system that was designed in the 1960s simply isn't sufficient to fix the problems that have been going on for so long in terms of intake and water discharge. You know, to describe – I don't know if anyone has done this yet, so I'm going to do this – I hopefully am not repeating what someone else has already said. But for the public's knowledge, I want to describe how the system works. Essentially, the heated water – excuse me, the – first, the system intakes water from Forked River to cool the reactor, and then the heated water, which is then called thermal pollution, is then discharged into Oyster Creek. And the plant actually intakes and discharges over 1.4 billion gallons of water every day. The water is taken in at a speed of about 1 to 2,000 cubic feet per second. That's actually the force of a medium-sized river. The chlorine levels in the water are also about 20 times the lethal level of many different types of aquatic life. And there are grates over the intake system, but because the water is flushed in at such a high speed, it creates a very – it's kind of like a giant sucking action, and that brings in an assortment of aquatic life. Some of it is small, some of it is larvae that flows right through the grate, and it's killed in the process of cooling the reactor. And that effect is called entrainment. And then, larger types of aquatic life – and those include sea bass, they include white perch, they also include endangered sea turtles. Although it's great to hear that you're looking at birds, that's an endangered species that, unfortunately, you do not address. Those creatures actually get pinned on the grate and often die from it and/or seriously injured, and that lethal effect is called impingement. So you have entrainment, where water is going through the system, and then you have impingement, when aquatic life is being impinged upon the grate.

So in addition to that, Oyster Creek's daily thermal pollution discharge often spreads a thermal plume, and that can be over a distance of four miles across the bay. It's actually the entire width of the bay. It creates a fry zone for young larvae, and the NRC has actually done studies and indicate that the thermal plume has increased the population of the tropical wood-boring species that, you know, serve kind of as aquatic termites in the area.

So, you know, all of these problems associated with Oyster Creek's water intake and discharge system actually put it in violation of the Clean Water Act, because that specific Act requires the plant to install modern technology that actually fixes the problem, and, fortunately for us, that technology is available. That technology is called a closed-cycle cooling system. There are different types of these types of systems. Oyster Creek will talk about how, you know, it will have more environmental problems than without it, but the reality is that we know – and the DEP has stated this several times – that, in fact, it won't result in any kind of environmental problems. In fact, it will really fix the root cause of the problem, because it actually reduces the amount of water going into a system and being discharged out to the system by over 95 percent. And that's actually the way to solve that particular problem involved with Oyster Creek's environmental record.

So we know, again, that reduces the discharge and intake by over 95 percent, and that actually would save over 13 million fish and shellfish annually, and an estimated tens of millions of additional larvae annually. Unfortunately, the DEP permit right now, it doesn't require the plant to install a closed-cycle cooling system only. Unfortunately, it gives Oyster Creek the option of restoration. If you're going to use restoration, you should use it as a penalty for violating the Clean Water Act for the past 35 years. You should not use it as an alternative to modern technology. That can actually solve the root cause of the problem.

And I would hope that the consideration of this particular issue, and of a closed-cycle cooling system, would be part of the NRC's environmental scoping record, and actually would look at the DEP's best professional judgment, which is stated, although it – although it allows for restoration, if you take a look at that permit, it says specifically that closed-cycle cooling will actually fix the problem. So that's the first thing I wanted to state on the record. (OS-Q-2)

Comment: In addition to that, I wanted to just again reinforce – I know you look at aquatic life and aquatic ecology. You want to make sure that you're looking very closely at Oyster Creek's intake and discharge. (OS-Q-12)

Comment: However, given our mission, Clean Ocean Action's current focus is on the marine degradations caused by the plant. An immediate and significant issue for the marine environment, linked to the re-licensing, is the renewal of the required pollution discharge permit. Oyster Creek Nuclear is currently operating under a New Jersey Pollution Discharge Elimination System permit (hereinafter "NJPDES permit") that expired in 1999 and has been "administratively extended" by the NJ Department of Environmental Protection (hereinafter "NJDEP"). This permit, originally issued in 1994, is outdated (to say the least) and results in significant harm to the marine environment. Fortunately, new Phase II regulations require implementation of the "best technology available to minimize the adverse environmental impact." Revising the plant's NJPDES permit to comply with Phase II regulations offers one of the most important opportunities to improve Barnegat Bay.

NJDEP is currently drafting a new NJPDES permit, which will implement the new Phase II regulations. This draft permit must be evaluated and viewed as an essential, rare opportunity to substantially improve the marine environment of Barnegat Bay. COA will analyze and comment on the permit application and will work to ensure that the new permit is consistent with federal and state laws, and adequately resolves OCNGS' current marine degradation issues, especially those related to the antiquated once-through cooling system. Put simply, once through cooling water systems cause substantial negative impacts to waterways. OCNGS' current cooling water intake structure causes severe adverse effects on the Barnegat Bay marine environment due to impingement, entrainment, thermal discharge, and chlorination. These impacts, which can be substantially minimized by installing a closed-cycle cooling system, are described below. From the outset, it is important to note, that an extensive scientific literature review has revealed that all available data on impingement and entrainment at the plant are the result of studies performed and/or funded by the Oyster Creek Nuclear Generating Station.

OCNGS currently operates using a once-through cooling system in which approximately 1.4 billion gallons of water passes through daily. OCNGS discharges more water into Barnegat Bay than any other industrial or commercial user. Water is drawn into the plant via the Forked River (Intake Canal) and released via Oyster Creek (Discharge Canal), which drains into Barnegat Bay. Both the river and creek were dredged and the flow of the southern portion of Forked River was actually reversed to accommodate the water needs of the plant. The activities of the plant change the salinity, water temperature and dissolved oxygen levels in and around the facility and release radionuclides that can be detected all the way up the food web.

Specific environmental impacts related to the intake and discharge canals follow. The intake canal produces significant flow velocities depending on the number of circulating pumps in operation. The consequence is both impingement and entrainment of aquatic organisms.

Impingements occur when organisms are too large to pass through the 9.5-mm screens and are trapped against the trash racks and intake screens from the force of the water being pumped from the intake canal.

1) Plant records indicate 32 impingement and 14 mortalities of endangered sea turtles since 1992. These data include the following species specific incidents:
   a) 21 impinged Kemp's Ridley Sea Turtles with 9 mortalities.
   b) 7 impinged Loggerhead Sea Turtles with 2 mortalities.
   c) 4 impinged Green Sea Turtles with 1 mortality.

   OCNGS exceeded their annual incidental take in 2004 when 8 juvenile Kemp's Ridley Sea Turtles were impinged and 3 were killed in the 3 month period from July 4 to September 23. An Incidental Take Assessment by the National Marine Fisheries authorized an annual limit of 4 Kemp's Ridley's (with no more than 3 mortalities), 5 Loggerheads (with no more than 2 mortalities) and 2 Green's (no more than 1 mortality).

2) A study conducted from September 1975 through August 1977 reported impingement of 13 million fish and invertebrates during this period.

3) A second study conducted from November 1984 through December 1985 reported impingement of 22 million fish and invertebrates (with 7 million impinged in December 1985 alone).

Entrainments occur when small organisms pass through the 9.5-mm screens and enter the cooling system. These smaller organisms generally consist of plankton and fish and invertebrates in the many early life stages. The facility increases water usage (and thus flow) during the summer months, which coincides with peak concentrations of eggs, larvae and plankton in the water column. A study conducted from September 1975 through August 1977 reported 9.19×10^{13} microzooplankton (<500 μm in size including several species of copepods and clam, snail, worm and barnacle larvae) and 4.24×10^{11} macrozooplankton (>500 μm in size including jellyfish, sand shrimp, grass shrimp, larvae of sandlance and American eels, eggs and larvae of winter flounder, and several crab species.) were entrained during this time period. Once entrained, the organisms are subjected to numerous and potentially fatal insults including:

1) Thermal shock from the sudden increase in water temperature (12–13 °C).
2) Shear and pressure forces from high water velocity and trapped air.
3) Mechanical stress from contact with machinery, pumps, etc.
4) Lethal levels of chlorine injected daily into the condenser section to reduce biofouling.

The once-through cooling system used by OCNGS results in an increase in water temperature (between 22-33 °F) between the intake and discharge canals. Water temperature in the discharge canal can reach 110 °F, which affects the behavior, physiology and habitat utilization of aquatic organisms in the area. The elevated temperature in the discharge canal and surrounding waters induces behavioral changes that have been documented in important managed species such as bluefish, fluke, winter flounder, and tautogs. Some of these behavioral changes include:

1) Avoidance of parts or all of Oyster Creek by certain species during summer and early fall.

2) Attraction to parts or all of Oyster Creek during winter when they should have migrated out of the area due to cold temperatures. Failure to migrate can lead to large-scale mortality (due to thermal shock) when the plant experiences a planned or emergency shut down.
   a) Records from January 1972 through December 1982 reported 2,404,496 fish were killed due to thermal shock including Atlantic menhaden, bay anchovy, bluefish, striped bass and weakfish.
   b) An emergency shutdown on January 21, 2000 caused a 17 °F drop in the water temperature in the discharge canal in 15 minutes. The rapid drop in temperature to 32 °F resulted in the death of about 3500 fish including 2980 striped bass.
   c) An emergency shutdown on November 11, 2001 caused a 70 °F drop in the water temperature in the discharge canal in 15 minutes. The rapid drop in temperature to 48 °F resulted in the death of about 1407 fish.
   d) A scheduled shutdown on September 23, 2002 caused the water in the discharge canal to increase to 101 °F in less than an hour and resulted in the death of about 6000 fish. AmerGen recently reached about a $1 million dollar settlement over this incident.

3) Metabolic rate of organisms increases with increased temperatures resulting in decreased growth and survival, especially during summer months when ambient water temperatures are at their peak.

4) High water temperature decreases oxygen solubility in water and increases Biological Oxygen Demand (“BOD”) resulting in dangerously low dissolved oxygen concentrations in the water.

5) Tropical/subtropical invasive species are able to thrive in the surrounding warm water plume. Two exotic shipworms (*Teredo barschi* and *T. furcifera*) have benefitted from the elevated temperatures with an increase in growth rate and length of breeding season along with reduced winter mortality, which lead to a population increase that has created problems for boat owners in the vicinity of the plume. (OS-AH-2)

Comment: Detectable Impacts of the OCNGS on the Aquatic Community

1) Reduced phytoplankton abundance at the mouth of Oyster Creek compared to other areas in the estuary. These impacts include lower diversity, a 30 percent decrease in gross productivity, a 20 percent decrease in net productivity and a 17.7 percent drop in biomass.

2) Changes in zooplankton abundance with some organisms showing increased abundance at the mouth of Oyster Creek than in the discharge canal (barnacle and polychaete larvae) while others showed a decrease in abundance (rotifers, snail larvae).

3) Reduced ichthyoplankton abundance in Oyster Creek compared to Forked River including eggs, larvae and juveniles of bay anchovy and goby and pipefish larvae.

4) The overall production loss of sand-shrimp due to impingement and entrainment associated mortality resulted in a direct population loss of 16.6 percent and an estimated annual net predator loss of 7,483 kg associated with the reduced forage production.

5) Economic loss of about 1 percent of potential hard clam fishery.

The above individual impacts need to be examined from an ecosystem perspective, including cumulative effects, to fully appreciate the overall effect of OCNGS on the surrounding habitat. Ecosystems level impacts include:

1) Impacts at the base of the food web (phytoplankton, zooplankton and ichthyoplankton) affect higher trophic levels with reduced prey availability and/or changes in preferred prey type.

2) Impacts on sensitive life stages such as eggs, larvae and spawning adults have obvious population-level effects.

3) Changes in water quality and temperature induce physiological stress to organisms that utilize the surrounding habitat. Physiological stress can confound the effects of other insults present in the Barnegat Bay estuary such as eutrophication and contaminant exposure.

4) Peak abundance of organisms coincides with increased water usage and chlorination by OCNGS, thus maximizing their impact on the aquatic community.

Because of the numerous adverse impacts cited above, OCNGS' antiquated once-through cooling system must be replaced with a closed-cycle cooling system for OCNGS to continue operations. The abuse of the Forked River and Barnegat Bay waters must be eliminated. (OS-AH-5)

Comment: Under new EPA regulations, OCNGS will be required to comply with Phase II regulations upon the imminent renewal of its NJDPES permit. Since OCNGS' NJPDES permit expired in 1999, the renewal of its permit will hinge on compliance with Phase II regulations.

Phase II Regulations implement Section 316(b) of the Clean Water Act (CWA). Section 316(b) of the CWA requires that the "location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact" (emphasis added).

Phase II Regulations mandate that OCNGS upgrade its system to meet specific performance standard requirements. The performance standards require a decrease in fish mortality due to impingement by 80-95 percent and a reduction in entrainment by 60-90 percent (depending on total capacity utilization rates)." An existing facility may choose one of five compliance alternatives for establishing the best technology available for minimizing adverse environmental impacts at the site.

COA finds, and strongly urges, that OCNGS install a closed-circuit-cooling system because such systems are the "best technology available for minimizing adverse environmental impacts." Any other option simply does not reflect the best technology available for minimizing adverse environmental impacts. Habitat restoration or reductions in the performance standards due to a cost-benefit analysis are particularly inadequate alternatives. In fact, a study of the restoration project at Salem Nuclear Power Plant has shown that such restoration projects do not offset the loss due to the impingement and entrainment of marine organisms. Meeting the best technology available requirement is not only the law, but is also sound and reasonable.

It is also important to note that it is highly unlikely that OCNGS would be located where it is today if it were to comply with current siting laws. The Nuclear Regulatory Commission laws now state that "special precautions should be planned if a reactor is to be located at a site where a significant quantity of radioactive effluent might accidentally flow into nearby streams or rivers or might find ready access to underground water tables." However, special precautions were not taken to ensure against such accidents during the siting of OCNGS.

In short, COA will be urging the NJDEP, as it drafts the NJPDES permit for OCNGS, to mandate the installation of a closed-cycle cooling system as a matter of law, good governance, and good neighbor policy.

1) The law requires implementation of the "best technology available for minimizing adverse environmental impact."

2) Good governance requires protection of public resources and the quality of life.

3) A good neighbor enhances a neighborhood's resources and the quality of life. (OS-AH-6)

Comment: During the past 35 years of operation at the OCNGS, there have been significant concerns regarding impingement, entrainment, and thermal impacts on estuarine and marine life. As a result, the Science and Technical Advisory Committee (STAC) of the BBNEP [Barnegat Bay National Estuary Program] convened a meeting on November 1, 2005, and drafted a number of recommendations for submission to the NRC regarding the OCNGS.

1. An independent, scientific body (similar to the National Academy of Science) must be assembled to coordinate and oversee surveys and studies on the impacts of the OCNGS on the Barnegat Bay/Little Egg Harbor estuary.

2. The NRC must require the OCNGS to focus on remediation of its direct impacts on estuarine and marine organisms in the Barnegat Bay/Little Egg Harbor estuary.

3. There have been very few studies of biotic communities in central Barnegat Bay during the past 25-30 years. Additional studies must be conducted in the Barnegat Bay/Little Egg Harbor to accurately assess the impacts of entrainment, impingement, and thermal discharges on estuarine and marine organisms.

4. The use of wetlands restoration as a mitigation measure must not be implemented in place of remediation efforts targeting bay populations and communities of organisms.

Based on the ongoing effects of the OCNGS on the estuarine ecosystem, the NJDEP and the NRC must mandate the implementation of the best available technology for intake structure design and operation of the OCNGS to mitigate impingement and entrainment losses. Section 316(b) of the Clean Water Act requires that the “location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.” This is the position endorsed by the BBNEP and its partners.

The BBNEP strongly recommends that the permit include a condition that charges the BBNEP with the role of the independent scientific body whose purpose is to coordinate research efforts in the Barnegat Bay relating to the effects of the OCNGS. The BBNEP’s Comprehensive Conservation and Management Plan (CCMP) recognizes the need for such an entity. Action Item 5.15 of the CCMP charges the BBNEP with establishing this technical group for the examination and coordination of data in order to understand OCNGS’s role in the overall ecological health of the bay.

Program partners agree that the BBNEP can and should have the lead role in coordinating and overseeing much-needed surveys and studies regarding OCNGS’s effects on the Bamegat Bay ecosystem.

In conclusion, the position of the BBNEP is that regardless of the option pursued by the NRC regarding Oyster Creek’s license renewal, without question, the OCNGS absolutely must be required to conduct detailed, comprehensive studies of the communities of bay organisms to determine what the overall impact of the power plant is on Barnegat Bay. (OS-AI-1)

Comment: The applicant has identified its preferred alternative as renewal of its operating license for an additional 20 years, without any plant modifications. The Service recommends that the applicant re-consider in its alternatives analysis the value to the aquatic environment of constructing a closed-loop cooling system or the employment of other project features (see below) that are designed to avoid or minimize adverse impacts to the aquatic environment. For example, the use of a closed-loop system would reduce intake cooling water volumes, when compared to the preferred alternative, by 90 percent (see the applicant's Environmental Report page 7-19). Such an alternative would avoid many of the adverse environmental impacts that are currently occurring to the aquatic biota of Barnegat Bay (i.e., entrapment, entrainment, and thermal impacts).

The continued operation of the Oyster Creek Nuclear Generating Station poses individual and cumulative impacts on the human environment. The continued use of 1.25 billion gallons of water per day from Barnegat Bay represents an adverse impact to the bay's aquatic biota. The Service does not concur with the applicant's conclusion that the impacts associated with its proposed 20-year license renewal would be small and do not warrant mitigation (see page 6-4 or the applicant's Environmental Report). The intake velocities for plant cooling may approach 5.0 feet per second (fps). These velocities exceed the 0.5 fps criteria established for intake structures by the State (New Jersey Division of Fish, Game and Wildlife, undated). The U.S. Environmental Protection Agency's (EPA) establishment of a 0.5 fps velocity for all new cooling water intake structures that draw from rivers, streams, or ocean waters of the United States (40 CFR Part 125.84 [b][2]) is consistent with the State's requirements. Velocities of intake water that exceed 0.5 fps promote adverse impacts to aquatic resources due to entrapment or entrainment.

The Service recommends that the Draft EIS also include consideration of the following project features as a means to avoid or minimize impacts to the aquatic environment: placement of additional screening/netting or other project features (e.g., bubble or sound deterrent systems) in the intake canal closer to Barnegat Bay; employment of flow reduction options during low peak demands; construction of a large water impoundment or recirculation structure on the Finninger's Farm to supplement the plant's cooling water needs; or a combination of any of the above. (OS-AJ-5)

Response: *The comments, in general, express concern over the impacts on aquatic organisms resulting from the operation of the existing OCNGS once-through cooling system. To operate the station, AmerGen must comply with the Clean Water Act and associated requirements imposed by the State as part of its NJPDES permitting system. OCNGS cannot operate without a valid NJPDES permit. On July 19, 2005, the New Jersey Department of Environmental Protection (NJDEP) issued for comment a draft NJPDES permit for OCNGS.*

The draft permit affords AmerGen two options for demonstrating compliance with the EPA's Phase II regulations found at Title 10, Part 125, Section 125.94(a), of the Code of Federal Regulations (*40 CFR 125.94(a)) for the Clean Water Act, Section 316(b). One option is to reduce intake flow to a level commensurate with the use of a closed-cycle cooling system. The second option is to reduce impingement and entrainment mortality of all life stages of fish and shellfish to the EPA performance standards of 40 CFR 125.94b(1) and (2). The State also has suggested that wetlands restoration is one means of meeting the performance standards. The SEIS for license renewal at OCNGS will evaluate the effects of the existing once-through cooling system as well as the impacts of an alternative closed-cycle cooling system. These evaluations will address impacts related to impingement and entrainment of organisms, cold shock, radiological releases to the aquatic environment, the thermal plume, and other potential or actual impacts. Any impact on Federally protected species also will be addressed in the SEIS. The ongoing NJPDES permitting process will ultimately determine the compliance action taken by OCNGS to meet requirements of the Clean Water Act.*

Comment: The NRC's Draft EIS should document the adverse cumulative impacts that are occurring to the bay's aquatic biota from thermal impacts (cold-water shock and heated water, as discussed below) and from entrapment or entrainment from passing through the circulation and dissipation pumps. Because the data discussed in the applicant's Environmental Report are dated, it is difficult to ascertain the present level of cumulative adverse impacts. In addition, the NRC must consider the cumulative effects on the bay's aquatic environment due to other actions such as mortality from recreational and commercial fishing. Without more relevant biological data on species use of the project area, the Service must conclude that cumulative impacts to the environment are more than minimal. Without meaningful biological data, the NRC's Draft EIS should also conclude that cumulative adverse impacts would continue to occur with the applicant's preferred alternative (license renewal), warranting substantial measures for compensatory mitigation. (OS-AJ-6)

Response: *The SEIS will include a discussion of the cumulative impacts of the cooling system at OCNGS.*

Comment: Earlier this afternoon, a man who is a former employee of the plant talked about the 1994 Versar report regarding Oyster Creek's water intake and discharge. I wanted to state for the record that that report has been discredited and if you take a close look at both what the DEP has said in public, in addition to the draft water permit for the plant, they clearly state that the best available technology is a closed-cycle cooling system that would again reduce the plant's intake and discharge by over 95 percent. (OS-Q-7)

Comment: Now a few minutes ago, the representative from NJPIRG [New Jersey Public Interest Research Group] made a statement that the Versar report has been discredited. Well, I wish she had stayed around because I would very much like to know how the Versar report was discredited. Who discredited it and where did they discredit it? It was a scientific report. It can't be discredited just by stating that it's discredited. So you can be assured that I will be sending her a letter to get that information, and I'll share with as many of you as I possibly can when I get it. I think the reason she would like it to be discredited is not only because of the conclusion that I just read to you, but they came up with some other significant conclusions regarding the impacts of Oyster Creek. (OS-T-3)

Response: *The comment refers to a report prepared by J.K. Summers et al. of Versar, Inc. entitled* Technical Review and Evaluation of Thermal Effects Studies and Cooling Water Intake Structure Demonstration of Impact for the Oyster Creek Nuclear Generating Station *dated May 1989. The report was prepared by Versar for the NJDEP to summarize the findings and conclusions of Versar's review and evaluation of the OCNGS 316 (Section 316 of the Clean Water Act) demonstration and to make recommendations that would assist the NJDEP in making a Section 316 decision for the OCNGS. As part of the environmental review for the OCNGS license renewal application, the NRC staff will consider the Versar report and its findings.*

Comment: When an agency is evaluating reasonable significant adverse effects on the human environment in an EIS, and information is incomplete or unavailable, the agency shall determine the reasonableness of including that information in an EIS (40 CFR Part 1502.22).

The Service recommends that the NRC postpone the issuance of its Draft EIS (June 2006) until additional ongoing biological studies (which began recently) are completed and information is available to assess plant operational effects on fish and wildlife resources. The results of these studies are essential for assessing potential adverse environmental impacts to the aquatic environment. The overall cost of obtaining this information is not exorbitant, as defined in 40 CFR Part 1502.22 (a) and is necessary to fulfill NEPA [National Environmental Policy Act of 1969] responsibilities to adequately assess individual and cumulative impacts (see cumulative effects discussion below). Information from the biological studies will yield, at a minimum, biomass losses of finfish and crustaceans from the applicant's plant operation and projected adverse impacts to the aquatic environment if the license is renewed.

The applicant's Environmental Report uses biological data derived from a 12-year period (1965 to 1977), to describe aquatic biota found in the project area; however, the age of the data (28 years) limits its value for assessing current and reasonably foreseeable future impacts. The applicant's assertion that the impacts of entrainment of fish and shellfish are "small" (page 4-9) cannot be supported adequately with data that are most likely outdated. In addition, the assertion that impacts are small appears to contradict later statements in the applicant's Environmental Report that numerous unavoidable adverse impacts to the aquatic environment are occurring (page 6-5).

The plant utilizes 1.25 billion gallons of water each day for cooling. Water from Barnegat Bay enters the Forked River, passes through several small, mesh screens and large circulating or dissipating pumps, is heated upwards of 24 degrees Fahrenheit as it passes through the heat dissipation chamber, and is then released into Oyster Creek, eventually flowing back into the bay. This cooling water entraps and entrains an unknown amount of aquatic biota, including egg, larvae, juvenile, and adult finfish and crustaceans. The NJDEP (2005) reported that the Forked River drainage area provides habitat for river herring. The same report indicated that the Upper Branch of the Forked River had a herring spawning run, which no longer exists due to the combined effects of pollution, habitat displacement, man-made water course blockages, and over-fishing. Although not mentioned in the NJDEP report, it appears that Oyster Creek, just south of the Forked River drainage area, may have also lost a herring spawning run after a dam was build on the creek in the 1960s for the purpose of storing water for fire fighting capability at the nuclear plant. The proximity of the Forked River to the plant cooling intake structures makes it likely that any egg larvae or young-of-the-year herring originating from Forked River will pass through the plant's cooling system and be killed before entering Barnegat Bay.

Significant population changes have also occurred to several commercial and recreationally important finfish and shellfish species found in Barnegat Bay since the conclusion of the 12-year biological sampling study in 1977. The population of the hard clam (*Merceneria mercenaria*) and winter flounder (*Pseudopleuronectes americanus*) have dropped precipitously and the localized effects of the intake of over 1 billion gallons of water per day on these two species are unknown. In addition, the Atlantic Coast population of the striped bass (*Marone saxitilis*) has risen sharply from the mid-1980s. Striped bass and other marine species are known to utilize the intake and discharge areas of the project, but the extent of their use is unknown. The economic value of recreational fishing in New Jersey is high (see discussion on public access and recreation below). The effect of the discharge of hot water is unknown on recreational sport fish and other aquatic species. In addition, there have been several confirmed large fish kills due to cold water shock from winter plant closings. The NRC Draft EIS should document these fish kills and discuss the cumulative impacts of these kills in view of the data and available information concerning the aquatic biota that is entrapped on the cooling water intake structures or entrained in the heat dissipation chamber.

Because of the concerns outlined above, the Service [U.S. Fish and Wildlife Service] recommends expansion of the current biological sampling study to a minimum of 3 years. A 3-year study would allow the NRC to more adequately determine what effects, if any, the plant's operation is having on aquatic biota. Obtaining this information does not appear to be cost prohibitive. The Service also recommends review of the current sampling method by the NJDEP, NMFS [National Marine Fisheries Service], Service, and other interested parties to ensure that information gathered will be adequate for assessing impacts to aquatic biota associated with plant operation. The Service also recommends collection of biological data for the life of the license in order to demonstrate that adverse impacts remain minimal over time.

The license should contain conditions to require additional mitigation (see the discussion of mitigation below) should post-license data analysis confirm that additional or unforeseen adverse impacts are occurring. (OS-AJ-7)

Response: *The NRC staff recognizes that the amount and quality of data available for NEPA evaluations sometimes falls short of ideal, but believes that there is sufficient information available to perform an assessment of the impacts of license renewal at OCNGS. The assessment presented in the SEIS will be based on the best available information, drawing from a variety of sources, including data collected by AmerGen, the NJDEP, other governmental agencies, independent researchers, and others. If new and significant information becomes available in the future that demonstrates a significant impact on the aquatic environment as a result of continued station operation, the NRC staff expects the NJDEP to require modifications to the cooling system necessary to protect the resource through the NJPDES permitting process.*

Comment: The CEQ [Council on Environmental Quality] requires inclusion of means to mitigate adverse environmental impacts in the EIS discussion of environmental consequences, if not covered in the description of the proposed action or alternatives (40 CFR Part 1502.16[h]). In addition, a mitigation plan (when necessary) is generally required prior to project authorization by the NJDEP. Therefore, the Service recommends that the NRC develop a mitigation plan for the proposed license renewal and discuss the plan in the Draft EIS. The mitigation plan should be developed in consultation with the NMFS, Service, and NJDEP and identify proposed means to avoid, minimize, and compensate (in that order) all adverse environmental effects on fish and wildlife resources. Consistent with the Service's Mitigation Policy, all in-kind options should be exhausted before considering out-of-kind mitigation. For example, the Service is aware that the NJDEP is considering restoration of several large wetland areas as potential mitigation. Although the Service encourages wetland restoration in most cases, this should only be employed as out-of-kind mitigation after the applicant has exhausted other direct compensatory options for adverse impacts to aquatic organisms (i.e., the removal of fish blockages for river herring or the development of long-term hard clam or other finfish or shellfish restoration projects).

During the October 11-13 interagency scoping meeting, the Service learned that a dam and pond were constructed just below the headwaters of Oyster Creek to store water for fire fighting capability at the plant. From a review of pre-1969 construction aerial photographs of the pond, 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. The Service can assist the NRC in identifying other potential fish ladder projects as potential mitigation for the preferred alternative. (OS-AJ-9)

Response: *In Chapter 4 of the SEIS, the NRC staff will present an evaluation of the impacts of license renewal at OCNGS. If it is determined that the impacts of license renewal are not small (as defined in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B), the NRC staff will recommend mitigation to reduce the severity of those impacts. The installation of a fish ladder on the small onsite reservoir located on Oyster Creek was discussed with the licensee and will be addressed in the SEIS.*

A.1.3 Comments Concerning Terrestrial Ecology Issues

Comment: We are a staunch protector of the South Jersey wildlife and natural resources. We support the New Jersey Audubon Society. We've donated a significant amount of money to the organization in recognition for the society's efforts to help rescue and clean waterfowl impacted by the recent oil spills in the Delaware River. (OS-G-12, OS-G-26)

Comment: We also do bird surveys, and we do mammal surveys out at Oyster Creek. That information is given to the DEP, and it's compiled, and we work with the DEP if we need to. We also sponsor bluebird trails. Bluebirds are no longer threatened, but they were at one time, so 10 years ago we put up a bluebird trail and we monitor that to make sure that we were able to bring that population back, which we did, not singlehandedly but we had Ocean County put up bluebird trails. We have wood duck trails, and we have a peregrine falcon tower at the plant. (OS-O-4)

Response: *The comments are, in general, supportive of the licensee's current programs to protect terrestrial resources. No specific response is provided. The impacts of license renewal on terrestrial resources will be discussed in Chapter 4 of the SEIS.*

Comment: I remember when I first moved into my home in Sunrise Beach in Lacey Township, I took my brine tank from my saltwater conditioner and I threw it out on my driveway and some went on my grass. Well, I didn't realize that the salt would kill my grass. Well, the next morning, I woke up my whole lawn was dead. So I suggest don't ever put salt on any plant life. (OS-Z-5)

Response: *The comments are noted. The effects of salt drift from a cooling tower will be addressed in the alternatives section (Chapter 8) of the SEIS.*

Comment: The Service also recommends that the Draft EIS reflect that the Conectiv 230-kV transmission line is active. The applicant's Environmental Report on page 3-6 states that the line has not been constructed. (OS-AJ-4)

Response: *The SEIS will provide a description of the current status of the Conectiv transmission line.*

Comment: The applicant does not propose any new construction activities with the license renewal. However, during the inter-agency meetings noted above, the Service learned that a substantial amount of previously contaminated dredged material, stored in a confined disposal facility (CDF) just east of the plant on the Finninger's Farm property, may require remediation and/or removal to an approved upland facility. A site visit revealed that the farm consists of several abandoned fields; an early successional forest, including some maritime forest species; and pockets of both tidal and non-tidal wetlands. These -types of vegetative cover provide valuable habitats for upland wildlife species. New construction activities (e.g., clearing and grubbing of upland vegetation, upgrading roads, or the construction of an offloading barge facility in Oyster Creek) would be expected if the CDF requires remediation or removal and would impact terrestrial species that utilize the farm. Therefore, the Service recommends clarifying any activities proposed on the Finninger's Farm in the Draft EIS, including construction methods for any remediation of the CDF. (OS-AJ-8)

Response: *The need for remediation of the dredge spoils pile on the Finninger Farm portion of the OCNGS site has not been determined. Should it be determined that remediation is necessary or desired, that action would be subject to a separate environmental review and is not a part of the license renewal process. The current status of the spoils pile will be discussed in the SEIS.*

Comment: The Service also recommends that, in association with implementing best management practices (BMPs), the NRC include provisions to control the spread of invasive species, such as *Phragmites australis* in the transmission line right-of-ways and the CDF on the Finninger's Farm.

A draft Management Plan by the Chesapeake Bay Program's *Phragmites australis* Working Group (2003) includes recommendations to curb the spread of *Phragmites* through federal and state permit conditions, in order to help achieve a long-term goal of no net gain in *Phragmites* acreage. The Service has subsequently recommended initiation of a similar planning effort to control *Phragmites* in the Hackensack Meadowlands in Bergen and Hudson Counties, pursuant to Executive Order 13122 and under the auspices of the National Invasive Species Council. The Service recommends a similar program in the project area, including the two power line right-of-ways maintained by Conectiv and FirstEnergy and the CDF, with participation of the NRC. In the interim, the Service recommends that any federal authorization resulting in wetland disturbance (e.g., power line right-of-way maintenance, dredging, or excavation of the CDF) include conditions requiring: (1) BMPs to prevent the introduction or spread of invasive species, such as avoiding creation of elevated berms and the spread or burial of *Phragmites* rhizomes; (2) 2 to 5 years of post-construction monitoring to detect the introduction or spread of invasive species, and (3) control efforts, if *Phragmites* or another invasive species are detected (to include re-grading or hydrologic corrections for any construction-related disturbances that promote the spread of *Phragmites*, if other control methods [i.e., herbicides] prove insufficient in the long-term). (OS-AJ-11)

Response: *At this time, there are no planned activities associated with license renewal that would result in the disturbance of wetlands on the OCNGS site or within the transmission line corridor associated with OCNGS. The assessment presented in the SEIS will include an evaluation of the vegetation-management protocols on the site and within associated transmission corridors. This assessment will address the effects of existing protocols on the spread of invasive species and will suggest mitigation if impacts are determined not to be small.*

A.1.4 Comments Concerning Threatened and Endangered Species

Comment: Our employees are trained to do their jobs with environmental protection in mind. One practice that we are particularly proud of is our commitment to protect sea turtles that become caught in our intakes. We have specific procedures in place for the safe return of all sea turtles to their natural environment. Our operators are trained to identify, to remove, and, if need be, resuscitate those turtles. When a sea turtle is found, our operators contact the Brigantine Marine Mammal Stranding Center, which recovers the sea turtle, gives it a checkup, rehabilitates it if necessary, and releases it back to the sea. We also partner with Drexel University to track the number of sea turtles that are rescued from our intake canal. Oyster Creek has modified its intake structures to significantly reduce the impact on aquatic life. Fish and crabs caught in our intake screens are gently returned to the discharge canal, and we pump cool water from the intake canal to the discharge canal, diluting the warmer water coming out of the plant. (OS-G-10, OS-G-24)

Comment: We have a program that trains our operators to rescue sea turtles, and I think you heard about that earlier. When we're unsuccessful, it's generally because that sea turtle got to us injured. Boat propeller is the most frequent injury that we see. And, obviously, when it gets to us cut open from the boat propeller, it's hard to resuscitate them. (OS-J-4)

Comment: If there's a problem with an endangered species, for example, or a threatened species, such as an osprey or – we get seals, we get all kinds of terrapins – we stop work and take care of that animal, whether it's calling other regulatory agencies, if it's calling the DEP to come in and help us, that's what we do. (OS-O-6)

Response: *The comments are noted. They are, in general, supportive of the licensee's activities related to threatened and endangered species. No specific response is provided. The impacts of license renewal on threatened and endangered species will be presented in Chapter 4 of the SEIS.*

Comment: When Oyster Creek was found to be noncompliant with the turtle kills for their intake, speaking of environmental issues, they petitioned to have it increased – the amount that they could kill increased. This is not responsible to the community. This is not responsible to the environment. (OS-D-5)

Comment: Plant records indicate 32 impingement and 14 mortalities of endangered sea turtles since 1992. These data include the following species specific incidents:

5. 21 impinged Kemp's Ridley Sea Turtles with 9 mortalities.
6. 7 impinged Loggerhead Sea Turtles with 2 mortalities.
7. 4 impinged Green Sea Turtles with 1 mortality.

OCNGS exceeded their annual incidental take in 2004 when 8 juvenile Kemp's Ridley Sea Turtles were impinged and 3 were killed in the 3 month period from July 4 to September 23. An Incidental Take Assessment by the National Marine Fisheries authorized an annual limit of 4 Kemp's Ridley's (with no more than 3 mortalities), 5 Loggerheads (with no more than 2 mortalities) and 2 Green's (no more than 1 mortality). (OS-AH-3)

Comment: AmerGen has submitted an application to the Nuclear Regulatory Commission (NRC) to continue operation of its Oyster Creek Nuclear Generating Station for an additional 20 years (the applicant's preferred alternative). The nuclear plant has been in operation since 1969, and its license is due to expire on April 9, 2009. On October 11 through 13, 2005, the Service attended several interagency scoping meetings with the applicant, the NRC, and representatives from the New Jersey Department of Environmental Protection (NJDEP) to discuss the project, current adverse impacts to fish and wildlife resources, and potential plant modifications and other mitigative measures that could offset these impacts. Currently, the power plant withdraws approximately 1.25 billion gallons of water per day from Barnegat Bay to aid in cooling the nuclear reactor. The intake of cooling water entrains and entraps an unknown quantity of aquatic biota from Barnegat Bay. Prior to the scoping meetings, the Service concluded with AmerGen on January 25, 2005 that the continued operation of the plant until 2029 would not adversely affect federally listed threatened and endangered species under Service jurisdiction.

As discussed in the Service's January 25, 2005 letter to AmerGen, except for an occasional transient bald eagle (*Haliaeetus leucocephalus*), no other federally listed or proposed threatened or endangered species under the Service jurisdiction are known to occur within the project area. Therefore, the Service concluded that the proposed project would not adversely affect federally listed species under Service jurisdiction.

Due to the recent nesting successes of bald eagles in New Jersey, a possibility exists that a pair of eagles could nest on or adjacent to the project area in New Jersey during the NRC's regulatory review or during the life of the renewed license (if approved). The NRC and

AmerGen were notified at the above scoping meetings of the possibility of future eagle nesting. Should nesting occur in the project area during the NRC re-licensing process or during the life of any renewed license, additional consultation pursuant to Section 7 of the ESA [Endangered Species Act] would be necessary. We recommend that the NRC obtain a status update of the bald eagle prior to its approval of any license renewal.

The Service also recommended (not required) in its January 25 letter, that AmerGen retain a qualified botanist to conduct a survey to determine the presence of any rare plants, including the federally listed Knieskern's beaked-rush (*Rhynchospora knieskernii*) and swamp pink (*Helonias bullata*), and the federal candidate bog asphodel (*Narthecium americanum*) in the project area.

These species have been documented within 1.5, 2.8, and 1.3 miles (respectively) of the project area. Since re-licensing is not expected to impact project area wetlands, the Service recommended, rather than required, a botanical survey. To date, the Service is unaware of any botanical survey conducted in the project area. Surveys for the above species would be necessary if any project alternatives or mitigative measures were to involve project area wetlands that might support these species.

No further consultation pursuant to Section 7(a) (2) of the ESA is required with the Service at this time. If project plans change (e.g., to involve project area wetlands) or if new information is obtained that indicates the occurrence of a federally listed species at the proposed project site(s), this determination may be reconsidered. The Service provides the above determination with respect to federally listed or proposed threatened or endangered flora and fauna under the Service jurisdiction only. The proposed project is located on Barnegat Bay and may affect federally listed marine turtles. Principal responsibility for threatened and endangered marine species is vested with the National Marine Fisheries Service (NMFS). We understand that the NRC has begun formal Section 7 consultation with the NMFS. This consultation should be completed prior to the NRC's issuance of the Draft EIS. (OS-AJ-1)

Response: *The comments are noted. The comments relate to the impacts of OCNGS operations on threatened and endangered species and will be considered in the preparation of the SEIS.*

Comment: The Service recommends that the NRC and the applicant continue working with the NJDEP to protect State-listed species and to obtain any other recommendations to modify plant operations to protect resources of State concern. Any mitigation plans should be developed prior to completing the Draft EIS. In addition, any botanical surveys conducted in the project area should include State-listed species. (OS-AJ-2)

Response: *The comment is noted. The comment relates to the impacts of OCNGS operations on State-listed threatened and endangered species. The occurrence of State-listed species on the OCNGS site and associated transmission lines will be presented in Chapter 2 of the SEIS.*

A.1.5 Comments Concerning Air Quality Issues

Comment: They love to say that they don't produce fossil fuels, yet the material that they use, the fuel has to be mined. There's a tremendous amount of fossil fuels that are used in the production to get a plant running and to keep it running. (OS-D-6)

Comment: And stop – it is disingenuous for nuclear people to keep comparing the CO_2 [carbon dioxide] that comes from coal, as if that was the option we're all headed for. And in terms of the CO_2, they are saying that now nuclear is so – you know, that it's going to make our air in New Jersey better, and I said this at another meeting – there are three of the worst coal producers – coal-fed plants in the Midwest that have no safety equipment on them whatsoever in terms of getting the CO_2 out of their refuse there, that go to serve the uranium processing people. So that – and that CO_2 comes from Ohio and Kentucky, and wherever those plants are, right into New Jersey. So we don't need to keep saying that nuclear energy does not produce CO_2, because that's disingenuous. (OS-P-2)

Comment: Oyster Creek provides a tremendous environmental benefit to the community. Oyster Creek represents 20 percent of JCP&L's [Jersey Central Power & Light Company's] electricity needs. Not only do we produce 9 percent of New Jersey's electricity, but we also do this with virtually no greenhouse emissions. Each year we operate Oyster Creek avoids some 7-1/2 million metric tons of carbon dioxide that would have been produced in coastal New Jersey by replacement of a coal plant. That replacement plant would produce carbon emissions equivalent to two million cars, nearly half of all the cars in New Jersey now. The clean air benefits of nuclear power production are of critical importance to New Jersey, the United States, and the world as we look for solutions to the greenhouse gas impacts. (OS-G-6, OS-G-20)

Comment: Oyster Creek, as a nuclear facility, is capable of producing power for over 6000 homes in New Jersey, day or night, wind or no wind, while it produces zero carbon emissions. In fact, we avoid the generation of carbon emissions equivalent to half the cars driven in New Jersey on a given day. (OS-J-2)

Comment: I am for it because of the simple reason that carbon emissions present more of a threat to human life on this planet right now, because of the fact of the amount that we're putting in. The United States puts 2.5 billion tons of carbon just from electric power generation through coal-fired plants. So if you really want to point a finger at what's causing environmental impacts, it's pointed to the coal industry, not to the nuclear regulatory area. (OS-B-6)

Comment: And when you look at, when it comes to diversifying in our fuel mix, because obviously we have to worry about the quality of air in New Jersey, we have predominant winds that blow from the west to the east. We have a lot of coal plants out there. Unfortunately, New Jersey's quality of air is pretty poor, which contributes to childhood diseases such as asthma. So my point being is we have five million cars too, also in the state of New Jersey. So how do we offset that? Well, Oyster Creek doesn't put off an effluent which really contributes positively to our environment. (OS-Z-2)

Response: *Nuclear power contributes substantially fewer carbon dioxide (CO_2) emissions to the atmosphere than fossil-fuel-based energy production methods. CO_2 emissions from various sources of energy will be discussed in the alternatives section (Chapter 8) of the SEIS.*

Comment: So as far as building a cooling tower, when you think about a cooling tower at Oyster Creek, personally, I don't think it's a viable issue. Environmentally, we don't even know the negative effect that a cooling tower could bring to Lacey Township, between all the salinity that pumps out of the stack. (OS-Z-4)

Comment: A cooling tower is a whole different issue around economic investment and whether or not it's the right thing to do. I know as a resident, I don't want a cooling tower. I'm going to have salt spray all over my car and my house, and so on. That's enough for me or my neighbors. (OS-J-7)

Response: *The NRC staff will discuss the impacts associated with closed-cycle cooling, including cooling-tower drift, in the alternatives section (Chapter 8) of the SEIS.*

A.1.6 Comments Concerning Land-Use Issues

Comment: Federal law requires that licensees operating near the coast must adhere to State environmental rules. Oyster Creek does not, so, therefore, the plant should be shut down. (OS-I-5)

Response: *The NRC staff is unaware of any continuing noncompliance with State environmental regulations. The SEIS will address recent past compliance with State requirements.*

Comment: We've also donated land from our Finninger Farm property across the street from the power plant to Lacey Township for preservation. (OS-O-2)

Response: *The comment is noted. The comment does not relate to an impact on the environment, and, therefore, will not be evaluated in the SEIS.*

Comment: Recreational fishing is a $35 billion industry for the nation, with approximately 900,000 New Jersey recreational anglers expending nearly $700 million annually for fishing tackle and other related purchases (U.S. Fish and Wildlife Service and U.S. Census Bureau, 2002). A key component to these economic benefits is unimpeded public access. A federal excise tax is collected from manufacturers of fishing equipment, as well as a portion of the federal fuel tax that is attributed to motorboat usage. Revenue is passed on to participating states. Since 1950, the Service's Federal Aid in Sport Fish Restoration Program has provided funds to state fish and wildlife agencies. The funding is used to restore, conserve, manage, and enhance fish species that are sought by recreational anglers, fund educational programs to enhance the public's understanding of aquatic resources and recreational fishing, and to promote the development of responsible attitudes and ethics toward the aquatic environment.

Currently, recreational anglers fish in areas downstream of the hot water effluent in Oyster Creek. However, the public access points in this area are limited to the State Route 9 Bridge and several small shoreline areas. The Service recommends that the NRC work closely with the applicant, the NJDEP, and interested recreational fishing organizations to develop a comprehensive public access plan that would better address the recreational needs in the project area. A recreational use and access plan would be consistent with public access policies and regulations (Coastal Zone Management Act of 1972 (86 Stat. 1280; 16 U.S.C. 1451-1464). The Service is available to assist in the development of a public access plan. (OS-AJ-10)

Response: *Although the NRC staff agrees with the U.S. Fish and Wildlife Service that development of a recreational use and access plan would likely benefit anglers and address recreational needs in the area, the requirement to develop such a plan is outside the scope of the NEPA-mandated environmental review for license renewal. The comment will not be evaluated further.*

A.1.7 Comments Concerning Human Health Issues

Comment: We are asked to renew the license for AmerGen, so that they can continue because they're a business. And I understand they want to continue, because they're a business, but we're a community, and we have an obligation to the community. I'm a health care provider in this community, and my obligation is to the children of this community. And this is the reason why I'm here. This is the reason why I spend my days off to come here, because if I'm working in a hospital, if I can save one person's life in a year, to me that's an incredible accomplishment. Shutting this plant down has the potential to save hundreds of thousands of lives in this community for generations and generations to come. This child here was not born at the time the Chernobyl accident happened. This child was born years later, and this is the legacy of nuclear power. This is what happens. This plant, on a daily basis, when everything is working fine, is releasing radiation into the environment. It's releasing it in particulate form. It's contamination that stays in the environment, and it's not like going and getting an X-ray at the doctor's office where you get zapped one time and then it's gone. This stuff goes into your body, it's built into your bones in the form of strontium-90, it goes in your muscle – and cesium-137. And the science has proven to show this. There's a condition called Chernobyl heart, which develops in children having so much cesium in their heart muscle that they actually develop birth defects. (OS-D-8)

Comment: And I certainly do not want my grandchildren or great-grandchildren to look anything like the picture that the gentleman showed earlier. (OS-K-6)

Comment: I hope this takes a full environmental review. I am sorry I missed your presentation and look forward to hearing more than that. But this needs to be broader than just whether fish die, which is something we clearly are concerned about. It needs to look at the environmental health of people who are affected in the communities as well. (OS-R-7)

Comment: So in addition to daily radioactive emissions, whether or not you consider the Tooth Fairy Study as part of it, I just want to make sure you're really taking a close look at daily emissions. And in addition to that, that's why we're talking about waste issues and security issues, it's because those fall under the general scope of radiation protection. (OS-Q-13)

Comment: The Chemistry Department samples, analyzes, and trends parameters for many of the plant systems. However, as I see it, there are three main reasons that we take the thousands of samples that we do. The first is to protect the public. Almost 80 percent of Oyster Creek's employees live and raise their families in Ocean County. So for us, the public has names and faces. The public is our families, our friends, and our neighbors. There's nothing that we take more seriously than our obligation to protect those that we care about. (OS-AC-1)

Comment: Now there's about 100 or 105 of these plants around the country. None of them have been built since 1977 or so and they were all built in about a 10-year window there. So let's just say the average one is 30 years of age and there's about a 100 of them. That's 3000 operating years of nuclear power stations. And yet, all over the country there's not a single proven cluster of cancer, leukemia, birth defects, or anything else.

At that point in time, people should begin to look at this and say this is safe and clean. Your fears should be put aside. And also, I have to say that the NRC, it's not the same as talking to the IRS or the Department of Justice. The stakes are pretty high here. What is it that they're going to be paid off with for being corrupt? And it just doesn't make any sense. They have to breathe the same air we do. At a certain point in time this ought to be satisfied. I feel people are alarmed by this, they seem to worry about it day in and day out. And I abhor a lot of politicians who further these fears because it looks like they're fighting for their constituents.

I'm standing up for this thing. I have no training in nuclear science, engineering. And I rely upon certain people that do have the training, as we all do throughout our lives. You go to a physician. He tells you that you need this pill or that pill. You're relying upon his training. I have expertise in certain areas and I expect people when they hire me to rely upon me in areas that I have expertise in. So of course, we have to rely upon these people, and I don't believe that they have performed in any way that would bring any doubt upon their character or their ability and I hope that you people will, in fact, find some solace in this and satisfaction that there just isn't anything to base this on. (OS-Y-2)

Response: *The comments are noted. The assessment of human health impacts in the SEIS will determine if the facility is currently limiting and will continue to limit radiological releases to within Federal limits, which are considered protective of the public. Absent new and significant information that would lead the NRC staff to conclude that future operation would result in routine radiological releases in excess of the Federal limits, the NRC staff will not evaluate the effects of low-level ionizing radiation on members of the public. The NRC staff concluded generically in the GEIS that "the significance of radiation exposures to the public attributed to the operation after license renewal would be small." The comments provide no new and significant information and, therefore, will not be evaluated further.*

Comment: In 1976, I was teaching school with another teacher and the area around the plant had to go for tests within a mile and a half. They were being treated with leukemia and this was affecting people. In Vanderbilt and I questioned about it, you know, and everything, the teacher said that the plant was built in 1967 and at the time there was no regulatory data supporting when the plant was built or any type of data regarding requirements, etcetera.

When I started doing the research on it at the time, the plant was supposed to come up for renewal and it kept on coming up for renewal, and I couldn't believe this and what happens is there's a loophole in the clause that grandfathers any previous data does not have to comply with the present data of what has to go into the plant. And when I heard this, you know, and everything, it was really questionable. So I started doing some research about it. And Vanderbilt University, the edu, says the RPHP [Radiation and Public Health Project] research associates from Vanderbilt did a study on it and they said that they had the four nuclear plants in New Jersey listed, and it said they've had considerable radioactivity to the local environment, raising the question of whether local residents have been harmed. And then it goes on with the study. And it says about the research group has investigated this issue as documented facts that suggest such harm is occurring. A number of these findings have been published in peer-reviewed medical journals. Radioactive emissions, the Oyster Creek reactor began operations on May 3, 1969 making it the oldest of the 103 U.S. reactors still in operation. Now this is – I got this off the web in 2001. So you know. The Salem and Hope Creek reactors – it goes on and on. And it says "Oyster Creek emitted 77.0 curies of airborne radioactivity in the period from 1970 to 1993, the largest amount of any U.S. reactors."

And it keeps on going. And it talks about the similarity of the average concentration of radioactive strontium-90 in 222 New Jersey baby teeth is relatively constant after 1980 and then it keeps on going down and it says "Ocean and Monmouth County children, under age 5, is 32.4 percent greater than the U.S. rate and 30.6 percent greater than any other New Jersey counties. Ocean and Monmouth lie directly downwind of the Oyster Creek reactor."

And then it keeps on going down and it says "Cancer mortality in Ocean and Monmouth County children under age 10 was 43.9 percent since the early 1980s, compared to the decline, 35.3 percent and 23.4 percent in the nation and the rest of New Jersey."

And then it keeps on going down about the different kinds of cancers, leukemia, Hodgkin's disease and non-Hodgkin's lymphoma, and multiple myeloma.

And the report keeps on going on and I'm sure if you want to contact the university or whatever, Vanderbilt will still have the report on file and this by the Ph.D. Jay M. Gould, Ph.D., Director; Ernest J. Sternglass, Ph.D., two scientists; Jerry Brown, Ph.D.; Joseph Mangano, MPH, MBA; William McDonnel, MA; Marsha Marks and so on. (OS-AF-1)

Response: *The NRC staff acknowledges that past radiological emissions from OCNGS, particularly in the 1970s, were significantly higher than current levels. The NRC staff's analysis is focused on impacts occurring during the license renewal period. The NRC staff concluded generically in the GEIS that "the significance of radiation exposure to the public attributable to the operation after license renewal would be small." Absent new and significant information that would lead the NRC staff to conclude that future operations during the license renewal period would result in routine radiological releases in excess of Federal limits, the NRC staff will not evaluate the effects of past releases of low-level ionizing radiation on the public. The comment provides no new and significant information and, therefore, will not be evaluated further.*

Comment: My question is, I understand in our previous conversation, that you will be relying on existing studies. Will the Tooth Fairy be part of that review or is any kind of radiation exposure currently part of the environmental review for the plant? (unidentified speaker)

Response: *In 2000, a report entitled* Strontium-90 in Deciduous Teeth as a Factor in Early Childhood Cancer *was published by the Radiation and Public Health Project. The report alleges that there has been an increase in cancer incidence due to strontium-90 released from nuclear power facilities. Elevated levels of strontium-90 in deciduous (baby) teeth were claimed in the report as evidence for the increase in childhood cancer. This study has been largely discredited by the scientific community for a number of reasons, including lack of controls, small sample sizes, and the lack of environmental sampling and analysis (see http://www.nrc.gov/*

reading-rm/doc-collections/fact-sheets/tooth-fairy.html). The assessment of human health impacts in the SEIS will determine if the facility is currently limiting and will continue to limit radiological releases to within Federal limits, which are considered protective of the public. The comment provides no new and significant information and, therefore, will not be evaluated further.

A.1.8 Comments Concerning Socioeconomic Issues

Comment: In addition, Oyster Creek employees are community-minded and generous. Oyster Creek has the largest employee-run United Way campaign in Ocean County. This past year our employees raised more than $180,000 for the United Way. Our employees are involved in the American Red Cross, Juvenile Diabetes Research Foundation, and the American Cancer Society. They are Little League coaches, Girl and Boy Scout leaders, volunteer EMTs and firefighters, and PTA members. We support a variety of family and youth organizations and activities in local communities, and have donated to – land to the community for recreational use. (OS-G-5, OS-G-19)

Comment: Our employees are also involved in many environmental activities in the area, including the World Series of Birding, aiding the Cape May Observatory, and Ocean Nature and Conservation Society, and also the Barnegat Bay Estuary. (OS-G-13, OS-G-27)

Comment: Oyster Creek has donated thousands of dollars to the New Jersey Audubon. (OS-O-1)

Comment: Oyster Creek also supports me and two other members to be on the World Series of Birding every year, which is quite expensive. It's $2000 just to sponsor us to go out and bird, and find all the endangered and threatened species around Ocean County and the state of New Jersey. (OS-O-3)

Response: *The comments are noted. The comments relate to socioeconomic issues and, in general, are supportive of license renewal for OCNGS. The comments provide no new and significant information, and, therefore, will not be evaluated further.*

Comment: Additionally, there are several environmental aspects of this plant, as Suzanne Leta went on, about the cooling towers. We also support only the option of installing cooling towers at this plant and oppose the mitigation factor of wetlands restoration. Tourism is the third largest industry in the state of New Jersey, and Barnegat Bay heavily contributes to that. We need to be looking at what those factors are in determining what the harm is on Barnegat Bay by this plant, and how that's negatively impacting not just the environment but also the economy of the state of New Jersey in terms of the degradation that this plant causes to that important estuary. (OS-R-3)

Response: *The commenter expressed concern that continued operation of OCNGS during the license renewal period may adversely affect Barnegat Bay, which supports a large recreational tourism industry in the State. The NJDEP has the responsibility of implementing the provisions of the Clean Water Act with respect to OCNGS continued operation. The NRC staff is confident that the NJPDES permit issued by the State will adequately protect Barnegat Bay. The comment provides no new and significant information and, therefore, will not be evaluated further.*

Comment: More than 450 families, not including our security personnel, depend on our plant for their livelihood. Of these 450 employees, approximately 250 are members of the International Brotherhood of Electrical Workers, Local 1289. These are good, high-paying jobs with excellent benefits. Our employees are highly skilled and dedicated, and I'm proud to work with them. When I first came to Oyster Creek, a local resident told me, "Run Oyster Creek safely. Do a good job, and, most importantly, keep that plant open, because a lot of my neighbors work there." (OS-G-2, OS-G-16)

Comment: Oyster Creek strengthens our community in so many ways. We are a significant employer and a public – and a positive economic force in the local area. The operation of Oyster Creek adds $52 million to Ocean County. We spend $7.7 million on goods in Ocean County and pay $9.2 million in sales and local taxes every year. We contribute $234 million to Ocean County's domestic product annually, if we value the electrical production that's considered. And we have led the way to $33 million in increased output in Ocean County and $46-1/2 million more in economic output in New Jersey itself every year. (OS-G-4, OS-G-18)

Comment: So what I'm saying here is I don't want to hear that we've got to have this power plant, it's safe and it's good and it's producing a lot of jobs, because the people of Lacey Township are not going to see any difference in their tax structure if that thing closed tomorrow. The reason for that is because the tax law was passed many, many years ago that said if Oyster Creek closes, it does not have an impact on the taxes of Lacey. Let's close it, and let's get it done now. (OS-C-7)

Comment: In addition to that, I took a look at what you do review in terms of the general scoping. The first is you look at, it's called socioeconomics and environmental justice and that is a really, I think a very important part of thinking about environmental health and public health and so I know you look at the evacuation plan annually which I understand. Unfortunately, it does not look at the plan 20 years out and so when you're thinking about socioeconomics and environmental justice you must consider what the population is going to look like 20 years down the line because there are excellent estimates that the census has and if you looked and talked to the towns, that information is available and it will change and it is changing right now. (OS-Q-11)

Comment: However, the other thing you have to take into consideration is you're also going to be probably getting rid of $52 million worth of revenue for Ocean County and it may even cost more. Because if you're hooked up, those houses that are receiving that energy from Oyster Creek, if they get hooked onto the power grid, then they're going to be paying more money for that energy, even if they seem to think it's more environmentally sound. But that's not – that might be a Tooth Fairy issue, actually. Not only will we be paying more for that energy, you probably – it might actually depress the economy a little bit because then there's all these other service industries that are connected to all that. It's something to keep in mind. (OS-X-2)

Response: *The comments are noted and will be considered in the preparation of the SEIS.*

A.1.9 Comments Concerning Alternate Energy Sources

Comment: And I have a question for AmerGen. In 10 years, let's say this plant did become unsafe to operate, I'm sure that they would start taking steps into shutting it down. Now my question to AmerGen would be and you've seen the advertisements on the TV, this new power plant company that's floating around, I believe they're out of Canada, and they're advocating new nuclear power plants. Would AmerGen consider building another plant on that site? I for one would be in favor of it. And I believe that is the future. Coal, fossil fuels, they're not going to last us. Look at what happened with Katrina. The pipelines shut down for a couple of days. Gas went up from $1.90 a gallon to $3 and something a gallon. We can't live with that forever. But nuclear power plants is – maybe not the total solution, but it's the answer today until something else comes along. (OS-U-4)

Response: *Chapter 8 (alternatives) in the SEIS will discuss the relative impacts of alternatives on license renewal, including the impacts of replacing OCNGS generation with a new nuclear facility.*

Comment: When you look at other alternative energies, in the case of wind, solar, and conservation, they can easily make up for it. A gentleman before asked about why Germany had switched. Germany has switched because of safety concerns and because Europe is finding that alternative energies are actually filling the gap. The technology has come of age, and it is working. (OS-D-7)

Comment: Now, we get to this person that was talking about the reactor. It's clean, it's safe, but no carbon. But you've got 3 percent energy and 90 percent waste, nuclear waste, which is worse. What they should be doing is cutting down on some of the – you know, some of the energy we use. (OS-E-5)

Comment: We also took a look at part of our review and alternatives if Oyster Creek would not have its license renewed and another source of electric generation would have to be installed either here onsite or someplace else to generate 600 megawatts of electricity, and concluded that any other means of generating 600 megawatts would have more of an impact on the environment than continued operation of Oyster Creek. I think one thing we need to keep in mind, though, here is that whatever we do, whether it's generating electricity, driving a car, building a new home, building a new industry, a new plant someplace for people to work, it all has impacts on the environment. And our charge in this is to make sure that we are assessing that and minimizing the impact on the environment to take all of that into consideration. We did that in our review, and we concluded that the impact on the environment of continuing to operate Oyster Creek is the best alternative for continued generation of 600 megawatts. (OS-H-4, OS-H-9)

Comment: That nuclear power – any nuclear power is outdated technology. It's finished. Wind and solar are the new modern technologies. They are clean, they are safe, they are not going to hurt us, even if something goes wrong. The plant has lived out its 40-year life span. Now is the time to let it die. (OS-S-2)

Comment: Then in the future there are definitely ways that we can replace the plant with clean and safe and non-air-pollution-emitting energy generation. The primary source of that is energy conservation and efficiency. I want to give one primary example and that example is an Appliance Efficiency Standards Act that was actually passed this summer, and that act actually puts eight energy-efficient appliances into the market in New Jersey and it actually saves about 300 megawatts of electricity by 2010 across the state. That's about half of what Oyster Creek provides and that's eight appliances only. So I want to make sure that when we're talking about – I know that in this environmental review, part of the review is to take a look at what happens if this plant is not, if the license is not extended and I want to make sure that part of that scope is to look at other clean and renewable alternatives to Oyster Creek because I think that is a critical part that may be missing, unfortunately. (OS-Q-10)

Comment: So I'm just saying to everybody, there are alternatives coming up. At the present time, dark matter is being researched, dark energy. It still has not been containable though yet. So I'm saying to everybody there is future yes. (OS-AF-2)

Response: *The comments are noted. The comments relate to alternative energy development and conservation. Alternatives will be considered in Chapter 8 (alternatives) of the SEIS; they include conservation (demand-side management) and renewable energy sources such as wind and solar energy.*

A.1.10 Comments Concerning Postulated Accidents

Comment: And what we're talking about here is if there is a problem with that plant, and we get a very significant release of radiation, and the consequences of that radiation are Chernobyl children. These are the children of Chernobyl. These are not statistics. These are people's children. If an accident happens at Oyster Creek, these are going to be the children of our community. These are going to be the children of our community for generations to come.

I also have another picture here. This is the Davis-Besse reactor that was being inspected regularly by the NRC and by the licensee in Ohio. As anybody can see looking at this picture, severe corrosion is occurring on this. However, they didn't seem to think this was a problem and allowed the plant to continue to operate. This is a plant is now old at Oyster Creek. So I think you can understand why the community here has quite a few reservations about the inspection that's going on right now at Oyster Creek. With that said, I'd like to go back to the original question that I asked at the first meeting. And considering how much – the length of time it's been since then, and nobody has gotten back to me about this question, I would hope that you would have the information to answer this question now, because this is not a question that has come to you out of the blue. This is a question that was asked before, and I was told that I would be given an answer.

The question I have is that on March 1st, after restoring the main transformer and restoring the main generator to service at Oyster Creek, a power ascension was in progress when an error resulted in the loss of multiple reactor recirculation pumps, which led an operator to manually scram the reactor. I'd like to add that this was not done very well. It was not controlled well. The water level was not controlled well, and as you go on later in this report that was the conclusion of the NRC inspector. It was also noted that the plant had been overpressurized. And one of the specific questions that I was asking was how many times – from documentation that I've read, it was overpressurized 10 times, the actual reactor vessel. I was asking how many times it had actually been overpressurized, so I was hoping somebody had an answer to that question for me. (OS-D-1)

Response: *The environmental review does consider postulated plant accidents that might occur at OCNGS during the license renewal term. As a result, the impacts of accidents are considered within the scope of the environmental review for license renewal and will be addressed in the SEIS.*

With respect to a Chernobyl-type accident at a U.S. nuclear power plant, U.S. reactors have different plant designs, larger shutdown margins, robust containment structures, and operational controls to protect them against the combination of errors that led to the accident at Chernobyl. Although the NRC has always acknowledged the possibility of major accidents, its regulatory requirements provide adequate protection, subject to continuing vigilance, including review of new information that may suggest weaknesses. Assessments in light of Chernobyl have indicated that the causes of the accident have been adequately dealt with in the design of U.S. commercial reactors. A Chernobyl-like accident is outside the scope of license renewal for U.S. commercial reactors and will not be evaluated in the SEIS.

The reactor vessel head corrosion event at the Davis-Besse Nuclear Plant is an operational issue and is also outside the scope of license renewal. The event has had, and continues to have, a significant effect on both the NRC and reactor licensees. The corrosion was discovered by the licensee during an NRC-required inspection resulting from safety concerns related to reactor vessel head nozzle circumferential cracking. Since the discovery of the reactor vessel head corrosion event at Davis-Besse, the NRC has significantly increased the oversight of licensee reactor vessel head activities and other activities that may affect the condition of the reactor vessel head. Almost immediately after the discovery, the NRC strengthened reactor vessel head inspections with the imposition of inspection requirements by order. The immediate initiatives by the NRC staff provide assurance that any further corrosion events will be identified early and corrected. The NRC also formed a Lessons Learned Task Force (LLTF) to carefully review the Davis-Besse incident and make recommendations for improvement. The LLTF has made recommendations for improvements in reactor vessel inspection requirements, inspection program management and inspector qualification, handling of operating experience information, and research activities relating to leakage detection methodologies. The NRC is confident that the implementation of the LLTF recommendations will preclude any future recurrence of reactor vessel head corrosion similar to that at Davis-Besse.

Reactor overpressurization events are also outside the scope of the environmental review for license renewal. The event referred to at OCNGS actually involved an excessive reactor cooldown that occurred following an automatic reactor scram due to a low water level condition on November 15, 2000. During scram recovery, the reactor experienced an initial cooldown rate of 111 degrees (Fahrenheit) per hour, which exceeded the technical specification (TS) limit of 100 degrees per hour. The TS bases consider 10 cooldowns exceeding 300 degrees per hour to be acceptable during the lifetime of the facility to ensure calculation assumptions used to determine reactor vessel component fatigue limits. AmerGen's records indicate that OCNGS has no occurrences of cooldowns exceeding the 300 degrees per hour limit. OCNGS has exceeded the 100 degree cooldown rate twice in the plant's history, on December 29, 1972, and again on November 15, 2000. The comment will not be evaluated further.

Comment: And the second question that I had is they put out this report to talk about normal boiler loss of approximately three-quarters of a gallon per minute. Now, my question is: if you've got a reactor that's leaking, and it's considered a normal part of its operation, releasing three-quarters of a gallon per minute, where is this water going? What kind of corrosion is it producing? How is this realistically being monitored? And not just with visual inspections.

As we can see from Davis-Besse, it didn't work, because that reactor was so corroded through it was basically an act of God that kept it from going critical. How is this corrosion being monitored effectively? And not just with visual inspections, but actual testing of materials.

And also, where is this water going? Where is this being admitted? Where is this radiation going? I mean, I know it's part of normal operation of a nuclear reactor to be releasing radioactivity into the environment, and I'm concerned that this is not being properly monitored and checked. (OS-D-2)

Response: *Leakage from the reactor coolant system is an operational issue and is outside the scope of license renewal. The leakage rate from the reactor coolant system is limited by a TS to 5 gallons per minute (gpm) for "unidentified" leakage and 20 gpm for "identified" leakage. The allowed leakage rates are based on the predicted and experimentally observed behavior of cracks in pipes and on the ability to make up coolant system leakage in the event of a loss of offsite power.*

The dry-well floor drain sump and equipment drain tank provide the primary means of leak detection and collection. Identified leakage is that from valves and pumps in the reactor system and from reactor vessel head flange gasket. Leakage through seals of this equipment is piped to the dry-well equipment drain tank. Leakage from other sources is classified as unidentified leakage and is collected in the dry-well sump.

Reactor coolant system leakage is continuously monitored and is trended to ensure that unidentified leakage is identified, analyzed, and corrected in a timely manner. The amount of leakage is determined by recording the amount of liquid pumped out of the dry-well equipment drain tank and the dry-well sump. This liquid waste is sent to the radioactive waste processing system where it is filtered and recycled for use as makeup water for the plant. Any release to the environment would be monitored and included in the Annual Radioactive Effluent Release Report. The comment will not be evaluated further.

Comment: Actually, I'd like to start by clarifying a couple of things. The first thing I was clarifying is the gentleman stated before that there are no Chernobyl-style plants operating in the United States. Although this is true with the graphite reactor, the one that they were operating was closed down. The point is not the type of reactor. The point is the type of accident that can come from it, and that type of accident is a massive radiation release. And these are the – this is what is going to cause a Chernobyl-like incident. It's not necessarily a fire, but if Oyster Creek – because of its age, does have a catastrophic release of radiation, the plant in Chernobyl is only two years old. Oyster Creek has far more radiation there. So even a significant percentage of that would be catastrophic to the environment. (OS-D-3)

Comment: I think when we talk about environmental effects, the big environmental effect that scares me, and should scare all of us, is what happens if it really goes wrong. And it worries me terribly that we're taking an old, obsolete plant and saying, "Let's put 20 more years on it." (OS-K-3)

Response: *The environmental review does consider postulated plant accidents that might occur during the license renewal term. It also includes a review of the alternatives to mitigate* *severe accidents if this has not previously been evaluated for the applicant's plant. 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, evaluated, and, if appropriate, implemented. As a result, the impacts of accidents are considered within the scope of the environmental review for license renewal and will be addressed in the SEIS.*

Comment: How does that accident mitigation – how does that play into the environmental scoping process? (OS-Q-5)

Response: *An analysis of severe accident mitigation alternatives (SAMAs) is included as part of the environmental review of the application for license renewal if it had not been considered earlier for the facility. The SAMA review is an evaluation of alternatives to mitigate severe accidents. Severe accidents are those that could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. The NRC staff reviews and evaluates SAMAs to ensure that changes that could improve severe accident safety performance are identified and evaluated. Potential improvements could include hardware modifications, changes to procedures, and changes to the training program.*

In some cases, SAMAs may have already been evaluated by the NRC staff in a previous EIS, supplement, or environmental assessment (EA) written for a facility before the applicant applied for license renewal. In such cases, the evaluation does not have to be repeated for that particular facility, according to NRC regulations in 10 CFR 51.53. However, if the NRC staff has not previously evaluated SAMAs for an applicant's plant in an EIS, a supplement, or an EA, the license renewal applicant is required to consider alternatives to mitigate severe accidents as part of the license renewal application. AmerGen has submitted a SAMA evaluation for OCNGS as part of its license renewal application.

The outcome of the SAMA analysis is a list of plant improvements that meet the criteria of being cost-beneficial, provide a significant reduction in total risk, and are associated with aging effects during the period of extended operation.

In some cases, however, the review leads to a determination that there are no specific SAMA candidates that are cost-beneficial. This may be the case where there is a low residual level of risk and where the applicant has, in fact, already implemented many plant improvements. In other cases, a SAMA that is potentially cost-beneficial may not relate to adequately managing the effects of aging during the period of extended operation. Such SAMAs need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

A.1.11 Comments Concerning Uranium Fuel Cycle and Waste Management

Comment: The second question is: what are the requirements of nuclear regulatory as far as encasing the spent fuel rods? Are there specific things at Yucca Mountain that they are required to do, which is we can't – and I understand a lot of the points of spent fuel rods is not in – is the transportation of those to Yucca Mountain. What are the regulations for encasement? (OS-B-2)

Response: *Requirements for dry cask storage and transportation are outside the scope of license renewal. During dry cask storage and transportation, spent nuclear fuel must be "encased" in NRC-approved casks. An NRC-approved cask is one that has undergone a technical review of its safety aspects and been found to meet all of the NRC's requirements. These requirements are specified in 10 CFR Part 72 for storage casks and 10 CFR Part 71 for transportation casks. Regulations that govern disposal of high-level radioactive waste in a potential geologic repository at Yucca Mountain, Nevada, are provided in 10 CFR Part 63. The comment provides no new and significant information and, therefore, will not be evaluated further.*

Comment: I'd like to know how many spent fuel rods are now stored onsite, and how many are we generating in a yearly process? (unidentified speaker)

Response: *Although outside the scope of license renewal, at the time of the scoping meetings, there were 976 spent fuel assemblies loaded in 16 dry storage casks at the OCNGS site, and 1992 assemblies stored in the spent fuel pool. OCNGS is on a 24-month refueling cycle, with about 180 spent fuel assemblies discharged to the pool during each refueling. Each assembly weighs approximately 600 lb, and of that weight about 500 lb is actual uranium fuel.*

Comment: Presently, there is no permanent safe storage of nuclear waste, so rather than continue to produce this toxic by-product, the plant should be shut down. (OS-I-3)

Comment: Furthermore, please add to the record that the Federal Government should not subsidize the new construction of nuclear plants until the problem of safe storage of nuclear waste is solved, an issue not covered by the new energy bill passed by the Congress. (OS-I-8)

Comment: The particular concern – and this is not just here in this area, but having read about it in the newspapers – is our utter and complete failure after all of these years to come up with any solution, reasonable solution, to what to do with the rods that are left, the things that are so completely contaminated, so heavily contaminated. And we kept hearing – you know, I'm not young, so I've been hearing for years and years and years how they're going to solve this problem. Well, we're no closer to it now than we were 30, 40, 50 years ago. And what we are a lot closer to is all, and I mean all, those rods that are right up the road apiece. And so I am very frightened about those. We keep adding more and more to them with no – no – nothing in sight of getting rid of them. (OS-K-4)

Comment: Our number one problem is not radiation from the atomic power plant. It's how to get rid of – we have to get the Federal Government to start moving on disposal of the fuel rods. That is a major priority that's the Federal Government's responsibility that they should take on, not these people. (OS-B-4)

Comment: You can mount this under a fault, and those tanks will only hold highly radioactive radiation for 10,000 years, at most. So some of this radiation doesn't go away for billions of years. Then, you've got the radiation, you've got the – it's really hot stuff, this radiation. If they ever lose water from it – I'm telling you what is going to happen here. You know this. You know it, and you speak it, because you're dealing with a genocide. You don't understand. (OS-E-1)

Comment: Our biggest concern right now is that the NRC refuses to look at the solid waste problem and the evacuation problem as a legitimate concern within the scoping process. They keep saying that that's an everyday issue. We say that's an everyday issue that every day they don't take care of. So, therefore, it's a now issue, yes, but it's an ongoing issue that isn't being taken care of.

In terms of the nuclear waste, if anything should be considered in an environmental scoping meeting, it's that waste that is not being disposed of, that is dangerous as it sits there now. Even going to the casks, the cement casks, no one really knows how those will hold up. There is talk that 300 years they will probably start leaking.

In terms of Yucca Mountain, even if they ever do open that up, which it looks like they won't, there will be so much nuclear waste at all of the plants that we don't even know if ours will get there. A nuclear waste dump in New Jersey, which is what we're talking about, is what will happen – it is that way now, and it will continue to get worse the more we make. How can an industry claim to be moral and community-oriented when they produce a deadly substance where there is no known disposal for anywhere on this earth? No one can find it.

Somebody asked the reason that Germany is getting off nuclear, or wants to get off nuclear, as the U.K. would like to, too, since they had that terrible accident at the nuclear processing plant. The reason they're getting off it is because there is no place to dispose of this stuff. They are finding out that renewable energy is getting cheaper and cheaper, when you consider the billions of dollars that go into subsidizing the nuclear energy field. (OS-P-1)

Comment: I think there are clear problems involved with the way that the NRC looks at license extensions, and, number one, they don't take a look at waste. You think of it as an ongoing issue. But there's going to be 20 more years of it. And looking that far into the future, unfortunately, is not part of that process. (OS-Q-3)

Comment: And when they get to Yucca Mountain, they put the high, long-lived radiation, they put that in Yucca Mountain in carbon steel – in tanks that last 10,000 years, they say. And then, they say it could deteriorate in 300 years, and it doesn't go away. So you keep on putting more fuel rods there, more radiation. Where are you going to put it? As soon as they go there, if they go there – they probably will – they have to already make a – already did make plans with the Indian reservations there to put it in the land there. Radiation doesn't go away. It decays. It has to decay to go away into another element, and some of that could be short-lived, some of that could be billions of years. And you're going to be sick, and your children are going to be sick. (OS-E-3)

Comment: I wanted to ask about two things and because when I spoke in July, August, I'm sorry, the months are going into each other, there was a concern for me about the spent fuel rods. And at that particular meeting the NRC said that they felt that the – based upon what was happening with Yucca Mountain that these rods could stay where they were. I want to know what is the Federal plan or the NRC's plan and how is it justified that more of these fuel rods can be generated when the existing rods are still there and with the burgeoning population and all of these other things, we don't have a plan. And do you have a foreseeable plan? Do you have an idea how many years the rods that are already there going to be there and generating more. What's that going to create in terms of what I would have a real concern about? (OS-AA-2)

Comment: How can they use Yucca Mountain when Nevada doesn't want those – if they don't want –. (unidentified speaker)

Response: *The safety and environmental effects of long-term storage of spent fuel onsite have been evaluated by the NRC, and as set forth in the Waste Confidence Rule (Federal Register, Volume 40, page 34658 [49 FR 34658], 55 FR 38474, and 64 FR 68005), the NRC generically determined that such storage could be accomplished without significant environmental impact. In the Waste Confidence Rule, the Commission determined that spent fuel can be stored onsite for at least 30 years beyond the licensed operating life, which may include the term of a renewed license. At or before the end of that period, the fuel would be moved to a permanent repository. The GEIS is based upon the assumption that storage of the spent fuel onsite is not permanent. The SEIS regarding license renewal for OCNGS will be based on the same assumption.*

The Commission has determined that the comprehensive regulatory controls that are in place and the low public doses that have been incurred ensure that the radiological impacts on the environment will remain small during the term of a renewed license. The Commission also *concluded that there is reasonable assurance that sufficient low-level waste disposal capacity will be available when needed for facilities during the license renewal period as well as during decommissioning. The comments provide no new information and, therefore, will not be evaluated further.*

Appendix B

Contributors to the Supplement

Appendix B

Contributors to the Supplement

The overall responsibility for the preparation of this supplement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC). The supplement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations, Argonne National Laboratory, Pacific Northwest National Laboratory, and Information Systems Laboratories, Inc.

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(a) Argonne National Laboratory is operated for the U.S. Department of Energy by The University of Chicago.
(b) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.
(c) Information Systems Laboratories, Inc., is located in Rockville, Maryland.

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to the AmerGen Energy Company, LLC Application for License Renewal of Oyster Creek Nuclear Generating Station

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to the AmerGen Energy Company, LLC Application for License Renewal of Oyster Creek Nuclear Generating Station

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and AmerGen Energy Company, LLC (AmerGen), and other correspondence related to the NRC staff's environmental review, under Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), of AmerGen's application for renewal of the Oyster Creek Nuclear Generating Station (OCNGS) operating license. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, and are available electronically from the Public Electronic Reading Room found on the Internet at the following web address: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to the NRC's Agencywide Document Access and Management Systems (ADAMS), which provides text and image files of NRC's public documents in the Publicly Available Records (PARS) component of ADAMS. The ADAMS accession numbers for each document are included below.

July 22, 2005	Letter from AmerGen to NRC, forwarding the application for renewal of the operating license for OCNGS, requesting an extension of the operating license for an additional 20 years (Accession No. ML053050477).
July 29, 2005	Letter from NRC to AmerGen, "Receipt and Availability of the License Renewal Application for the Oyster Creek Nuclear Generating Station" (Accession No. ML052100022).
September 9, 2005	Letter from NRC to AmerGen, transmitting "Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Application from AmerGen Energy Company, LLC, for Renewal of the Operating License for the Oyster Creek Nuclear Generating Station" (Accession No. ML052520034).

September 16, 2005	Letter from NRC to AmerGen, forwarding the *Federal Register* Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping in Support of the Review of the License Renewal Application (Accession No. ML052590296).
October 12, 2005	Letter from NRC to Mr. Clifford Day, U.S. Fish and Wildlife Service (FWS), New Jersey Field Office, “Request for List of Protected Species Within the Area Under Evaluation for the Oyster Creek Nuclear Generating Station License Renewal” (Accession No. ML052870166).
October 12, 2005	Letter from NRC to Ms. Patricia A. Kurkul, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service, Northeast Regional Office, “Request for List of Protected Species and Essential Fish Habitat Within the Area Under Evaluation for the Oyster Creek Nuclear Generating Station License Renewal” (Accession No. ML052870502).
October 12, 2005	Letter to Mr. Robert Chicks, President, Stockbridge-Munsee Community, inviting participation in the scoping process related to NRC’s environmental review of the license renewal application for Oyster Creek Nuclear Generating Station (Accession No. ML052900227).
October 12, 2005	Letter to Mr. Brice Obermeyer, Native American Graves Protection and Repatriation Act (NAGPRA) Director, The Delaware Tribe, inviting participation in the scoping process related to NRC’s environmental review of the license renewal application for Oyster Creek Nuclear Generating Station (Accession No. ML052870572).
October 12, 2005	Letter to Ms. Tamara Francis, NAGPRA Director, Delaware Nation of Western Oklahoma, inviting participation in the scoping process related to NRC’s environmental review of the license renewal application for Oyster Creek Nuclear Generating Station (Accession No. ML052870571).
October 12, 2005	Letter to The Honorable Mark Gould, Tribal Chairman, Nanticoke Lenni-Lenape Indians of New Jersey, inviting participation in the scoping process related to NRC’s environmental review of the license renewal application for Oyster Creek Nuclear Generating Station (Accession No. ML052870563).

October 12, 2005	Letter to The Honorable Joe Brooks, Chief, Delaware Tribe of Indians, inviting participation in the scoping process related to NRC's environmental review of the license renewal application for Oyster Creek Nuclear Generating Station (Accession No. ML052870553).
November 9, 2005	Letter to AmerGen from NRC, "Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives (SAMAs) for Oyster Creek Nuclear Generating Station" (Accession No. ML053130387).
November 15, 2005	Letter from Barnegat Bay National Estuary Program to NRC regarding environmental review of Oyster Creek Nuclear Generating Station (Accession No. ML053220253).
December 8, 2005	"Summary of Public Scoping Meetings Regarding the Review of Oyster Creek Nuclear Generating Station License Renewal Application" (Accession No. ML053430247).
December 8, 2005	Letter to AmerGen from NRC, "Request for Additional Information (RAI) Regarding the Environmental License Renewal Review for the Oyster Creek Nuclear Generating Station" (Accession No. ML053430198).
January 9, 2006	Letter from AmerGen to NRC "Response to NRC Request for Additional Information Related to Severe Accident Mitigation Alternatives (SAMA) for Oyster Creek Generating Station" (Accession No. ML060130238).
January 30, 2006	Letter from New Jersey State Representatives L.T. Connors, Jr., C.J. Connors, and B.E. Rumpf to NRC regarding constituent's concerns about fish kills (Accession No. ML060730108).
February 21, 2006	Letter from NRC to AmerGen, "Issuance of Environmental Scoping Summary Report Associated with the Staff's Review of the Application by AmerGen for Renewal of the Operating License for the Oyster Creek Nuclear Generating Plant" (Accession No. ML060530691).
March 2, 2006	Letter from AmerGen to NRC, "Correction of Minor Errors in the Oyster Creek Generating Station License Renewal Application" (Accession No. ML060660177).

March 8, 2006	Letter from AmerGen to NRC, "Response to NRC Request for Additional Information Regarding the Environmental License Renewal Review for the Oyster Creek Generating Station" (Accession No. ML060720126).
March 13, 2006	Letter from NRC to L.T. Connors, Jr. regarding constituent's concerns about fish kills (Accession No. ML060720453).
March 15, 2006	Letter from AmerGen to NRC, "Clarifications to Responses to NRC Request for Additional Information Related to Severe Accident Management (sic) Alternatives (SAMA) for Oyster Creek Generating Station" (Accession No. ML060760379).

Appendix D

Organizations Contacted

Appendix D

Organizations Contacted

During the course of the U.S. Nuclear Regulatory Commission staff's independent review of environmental impacts from operations during the renewal term, the following Federal, State, regional, local, and Native American Tribal agencies were contacted:

Barnegat Bay National Estuary Program, Toms River, New Jersey.

Delaware Nation of Western Oklahoma, Anadarko, Oklahoma

Delaware Tribe of Indians, Bartlesville, Oklahoma

Lacey Township, New Jersey

Nanticoke Lenni-Lenape Indians, Bridgeton, New Jersey

National Marine Fisheries Service, Gloucester, Massachusetts

New Jersey Department of Environmental Protection, Trenton, New Jersey

New Jersey Department of Environmental Protection, Bureau of Nuclear Engineering, Trenton, New Jersey

New Jersey Department of Environmental Protection, Endangered and Non-game Species Program, Trenton, New Jersey

New Jersey Department of Environmental Protection, Historic Preservation Office, Trenton, New Jersey

New Jersey Pinelands Commission, New Lisbon, New Jersey

Ocean County, Department of Planning, Toms River, New Jersey

Stockbridge-Munsee Community, Bowler, Wisconsin

The Delaware Tribe, Emporia, Kansas

U.S. Fish and Wildlife Service, Pleasantville, New Jersey

Appendix E

AmerGen Energy Company, LLC's
Compliance Status and Consultation Correspondence

Appendix E

AmerGen Energy Company, LLC's Compliance Status and Consultation Correspondence

Correspondence received during the process of evaluation of the application for renewal of the license for Oyster Creek Nuclear Generating Station (OCNGS) is identified in Table E-1. Copies of the correspondence are included at the end of this appendix.

The licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities for OCNGS are listed in Table E-2.

Table E-1. Consultation Correspondence

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission (P.T. Kuo)	New Jersey State Historic Preservation Officer (D. Guzzo)	October 12, 2005
U.S. Nuclear Regulatory Commission (P.T. Kuo)	U.S. Fish and Wildlife Service (C. Day)	October 12, 2005
U.S. Nuclear Regulatory Commission (P.T. Kuo)	National Marine Fisheries Service (P. Kurkul)	October 12, 2005
U.S. Nuclear Regulatory Commission (P.T. Kuo)	Stockbridge-Munsee Community (R. Chicks)	October 12, 2005[a]
New Jersey State Historic Preservation Officer (D. Fimbel)	U.S. Nuclear Regulatory Commission (P.T. Kuo)	November 2, 2005
U.S. Fish and Wildlife Service (C. Day)	U.S. Nuclear Regulatory Commission (M. Lesar)	November 23, 2005

(a) Similar letters were sent to four other Native American Tribes listed in Appendix C.

Table E-2. Federal, State, Local, and Regional Licenses, Permits, Consultations, and Other Approvals for Oyster Creek Nuclear Generating Station

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NRC	10 CFR Part 50	Operating license, Oyster Creek Nuclear Generating Station	DPR-16	04/09/69	04/09/09	Authorizes operation of OCNGS.
DOT	49 USC 5108	Registration	052804 700 004MO	05/28/04	06/30/07	Authorizes hazardous materials shipment.
FWS	Section 7 of the Endangered Species Act (16 USC 1536)	Consultation	NA	NA	NA	Requires a Federal agency to consult with the FWS regarding whether a proposed action will affect endangered or threatened species.
NMFS	Endangered Species Act (16 USC 1531-1544)	Incidental Take Permit – Sea Turtles	NA	Ongoing	Ongoing	Possession and disposition of impinged or stranded sea turtles.
NJDEP, Division of Parks and Forestry	Section 106 of the National Historic Preservation Act (16 USC 470f)	Consultation	NA	NA	NA	The National Historic Preservation Act requires Federal agencies to take into account the effect of any undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places.
NJDEP, Land Use Regulations	Federal Coastal Zone Management Act (16 USC 1452 et seq.)	Certification	NA	NA	NA	Requires applicant to prove certification to Federal agency issuing the license that license renewal would be consistent with the Federally approved State Coastal Zone Management program. Based on its review of the proposed activity, the State must concur with or object to the applicant's certification.
NJDEP	Clean Water Act, Section 401 (33 USC 1341)	Certification	NA	NA	NA	State issuance of NPDES permit constitutes 401 certification.

Table E-2. (contd)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NJDEP	Clean Water Act (33 USC 1251 et seq.); NJ Statutes Annotated (NJSA) Water Pollution Control Act 58:10A et seq.; and NJ Administrative Code (NJAC) 7:14 et seq.	New Jersey Pollutant Discharge Elimination System Permit – surface water	NJ0005550	10/24/94	Remains in effect pending State action on current application	Wastewater (industrial surface water, thermal surface water, and stormwater runoff) discharges to Oyster Creek, Forked River, and South Branch of the Forked River.
NJDEP	Clean Water Act (33 USC 1251 et seq.); NJSA 58:10A et seq.; NJAC 7:14A et seq.	New Jersey Pollutant Discharge Elimination System Permit – groundwater	NJ101966	02/20/04	02/20/09	Wastewater (percolation lagoon, underground injection, dredge spoils) to groundwater.
NJDEP	Coastal Area Facility Review Act (NJSA 13:19-1 et seq.); Waterfront Development Act (NJSA 12:5-3); Wetlands Act (NJSA 13:9A-1 et seq.)	Certification	NA	NA	NA	Compliance with coastal zone management rules, freshwater wetlands protection rules, and Coastal Permit Program rules.
NJDEP	Water Supply Management Act (NJSA 58:1A et seq.)	Water Use Registration	11108W	07/25/01	NA	Registers two wells with collective diversions of less than 100,000 gallons per day.
NJDEP	NJAC 7:7A	Freshwater Wetlands Statewide General Permit	1500-02-0004.1	06/04/02	06/04/07	Remove vegetation from fire pond.
NJDEP	Chapter 251, Soil Erosion and Sediment Control Act, PL 195	Certificate	SCD 1302	07/09/05	01/09/09	Soil Erosion Control and Sediment Control Plan for upland dredge disposal site.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP970001	09/08/97	09/08/07	Air emissions for DL-42 boiler and DL-68 boiler.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP970002	10/09/02	10/09/07	Emergency Fire Diesel 1-2.
NJDEP	Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP970003	11/14/97	11/14/07	#1 Boiler.

Table E-2. (contd)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP970005	01/08/03	01/08/08	Forked River Emergency Fire Diesel.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP970006	10/31/02	10/29/07	Dirty Oil Lube Tank.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP960005	03/23/04	03/23/09	Aboveground Gasoline Storage Tank.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP960006	07/10/04	07/10/09	Emergency Generator 1.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP960007	07/10/04	07/10/09	Emergency Diesel Generator 2.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP960008	06/26/96	06/26/06	Grit Blaster.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP020001	07/29/02	07/28/07	Emergency Fire Diesel 1-1.
NJDEP	NJAC 7:14B	Certificate to operate	GEN000001	07/18/05	07/18/10	Emergency Generator 2.
NJDEP	Clean Water Act (33 USC 1251 et seq.); Clean Air Act (42 USC 7401 et seq.); Resource Conservation and Recovery Act (42 USC 6901 et seq.); Water Pollution Control Act (NJSA 48:10A et seq.); Industrial Site Recovery Act (NJSA 26:2C-1 et seq. and NJAC 7:14B)	Registration	UST 000002	08/24/04	08/24/09	Underground Storage Tank – Emergency Spill Tank.

Table E-2. (contd)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NJDEP	NJAC 7:18 et seq.	Laboratory certification	15304	06/30/05	06/30/06	State-certified laboratory to perform listed analyses.
NJDOT	Fish and Game, Wild Birds and Animals	License	H-205	01/31/06	01/31/07	Oyster Creek Helistop.
NJDEP	Clean Air Act (42 USC 7401 et seq.); Air Pollution Control Act (NJSA 26:2C-9.2)	Certificate to operate	PCP960004	02/13/06	02/13/11	Emergency Diesel Generator Fuel Oil Storage Tank.
SCDHEC	South Carolina Radioactive Waste Transportation and Disposal Act (Act No. 429)	South Carolina Radioactive Waste Transport Permit	0043-29-04	12/31/05	–	Transportation of radioactive waste into the state of South Carolina.
VDEP	Virginia Department of Emergency Management Title 44, Code of Virginia, Chapter 3.3, Section 44–146.3	Virginia Registration to Transport Hazardous Radioactive Materials	AO-S-063006	05/27/04	06/30/06	Transport of hazardous radioactive materials.
TDEC	Tennessee Department of Environment and Conservation Rule 1200-2-10.32	Tennessee Radioactive Waste License-for-Delivery	T-NJ001-L04	12/31/05	–	Transportation of radioactive waste into the state of Tennessee.
NJDEP	40 CFR 266 Subpart N, NJAC 7:26G	Conditional Exemption	NA	NA	NA	Storage and treatment of low-level mixed waste.
Ocean County Utilities Authority	NA	Agreement	NA	NA	NA	OCNGS provides continuous radiation monitoring of discharges of OCNGS wastewater to publicly owned treatment facility.

Table E-2. (contd)

–	=	date not given
CFR	=	Code of Federal Regulations
DOT	=	U.S. Department of Transportation
FWS	=	U.S. Fish and Wildlife Service
NA	=	not applicable
NJAC	=	New Jersey Administrative Code
NJDEP	=	New Jersey Department of Environmental Protection
NJDOT	=	New Jersey Department of Transportation
NJSA	=	New Jersey Statutes Annotated
NMFS	=	National Marine Fisheries Service
NPDES	=	National Pollutant Discharge Elimination System
NRC	=	U.S. Nuclear Regulatory Commission
OCNGS	=	Oyster Creek Nuclear Generating Station
PL	=	Public Law
SCDHEC	=	South Carolina Department of Health and Environmental Control
TDEC	=	Tennessee Department of Environment and Conservation
USC	=	United States Code
VDEP	=	Virginia Department of Environmental Protection

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 12, 2005

Ms. Dorothy Guzzo
State Historic Preservation Officer
Historic Preservation Office
P.O. Box 404
Trenton, NJ 08625-0404

SUBJECT: OYSTER CREEK NUCLEAR GENERATING STATION LICENSE RENEWAL REVIEW (TAC NO. MC7625) (HPO-J2004-7021)

Dear Ms. Guzzo:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating license for Oyster Creek Nuclear Generating Station (OCNGS), which is located in Lacey Township in Ocean County, New Jersey. The nearest major metropolitan areas to OCNGS include Newark, New Jersey, approximately 60 miles to the north; Atlantic City, New Jersey, approximately 35 miles to the south; and Philadelphia, Pennsylvania, approximately 60 miles west of the OCNGS site. OCNGS is owned and operated by AmerGen Energy Company, LLC (AmerGen). The application for renewal was submitted by AmerGen on July 22, 2005, pursuant to the requirements of Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54). The NRC has established that, as part of the review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) augmenting its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, the NRC regulation that implements the National Environmental Policy Act (NEPA) of 1969, as amended. In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and archaeological resources.

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff has determined that the area of potential effect (APE) for a license renewal action is the area at the power plant site and its immediate environs that may be impacted by post-license-renewal land-disturbing operations or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license-renewal land-disturbing operations or projected refurbishment activities, specifically related to license renewal, may have a potential effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest.

While preparing its application, AmerGen contacted your office by letter dated October 7, 2004. In that letter, AmerGen stated that it has no plans to alter current operations or engage in any land-disturbing activities during the license renewal period, and therefore, it does not expect the operation of OCNGS through the license renewal term to affect adversely cultural or historic resources at the plant or its immediate environs. Your office responded by letter dated October 15, 2004, stating that no historic properties listed on or eligible to be listed on the National Register of Historic Places would be affected by the proposed action.

D. Guzzo - 2 -

On November 1, 2005, the NRC will conduct two public scoping meetings at the Quality Inn located at 815 Route 37 in Toms River, New Jersey. You and your staff are invited to attend. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is June 2006. If you have any questions or require additional information, please contact the NRC's Senior Environmental Project Manager, Dr. Michael Masnik, at 301-415-1191 or by e-mail at MTM2@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-219

cc: See next page

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 12, 2005

Mr. Clifford Day, Administrator
New Jersey Field Office
U.S. Fish and Wildlife Service
927 N. Main Street
Heritage Square, Building D
Pleasantville, New Jersey 08232

SUBJECT: REQUEST FOR LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR THE OYSTER CREEK NUCLEAR GENERATING STATION LICENSE RENEWAL (TAC NO. MC7625)

Dear Mr. Day:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by AmerGen Energy Company, LLC (AmerGen) for the renewal of the operating license for the Oyster Creek Nuclear Generating Station (OCNGS). OCNGS is a single-unit nuclear plant located in Lacey Township in Ocean County, New Jersey. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

AmerGen stated that it has no plans to alter current operations over the license renewal period, and that OCNGS operating under a renewed license would use existing plant facilities and transmission lines and would not require additional construction or disturbance of new areas. Any maintenance activities would be limited to previously disturbed areas.

OCNGS is situated on approximately 800 acres of land in the coastal pine barrens of New Jersey approximately 9 miles south of Toms River, New Jersey. The property is on the western shore of Barnegat Bay. East of U.S. Highway 9 the northern site boundary is the South Branch of Forked River, and the southern site boundary is Oyster Creek. West of U.S. Highway 9 the site boundary is defined by the manmade intake and discharge canals (See Enclosed Maps).

OCNGS employs a once-through heat dissipation system designed to remove waste heat from the condensers. The circulating water system includes the intake canal, an intake structure divided into two bays, circulating water pumps, condensers, dilution pumps, discharge pipes, and discharge canal. The purpose of the dilution pumps is to decrease the attractiveness of the heated discharge to migratory marine species during the spring and fall, and to reduce thermal stress on organisms in the discharge canal during the summer. 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. Barnegat Bay is the plant's cooling water source and heat sink. Cooling water is drawn from Barnegat Bay through the South Branch of Forked River and into a

150-foot-wide intake canal dredged to a depth of 10 feet. The circulating water is returned to the 150-foot-wide discharge canal and from there flows to Oyster Creek and back to Barnegat Bay. Depths in the South Branch of the Forked River, canals, and lower reaches of Oyster Creek are maintained by periodic dredging.

The transmission lines in the scope of NRC's environmental review for license renewal are those that were originally constructed for the specific purpose of connecting the plant to the transmission system. A single 230-kilovolt transmission line was built to connect OCNGS to the electric grid. It is a double circuit line hung on a single set of towers that runs 11.1 miles from the OCNGS 230 kilovolt Substation to the Manitou Substation near Toms River. Beyond the OCNGS substation transformer-side disconnects, the line is owned and operated, and corridor easements held, by FirstEnergy, an Ohio utility. The transmission line corridor is 240-feet-wide and approximately parallels the New Jersey State Parkway, occupying about 320 acres. The corridor passes through land that is primarily pine forest and swamp forest. Approximately 1 mile of the line passes through Double Trouble State Park. The line is in Ocean County and crosses numerous county roads and the New Jersey 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 after OCNGS is decommissioned. The transmission line and site boundary are identified in the enclosed maps.

The U.S. Fish and Wildlife Service and the State of New Jersey were involved in the siting of the new transmission line south of OCNGS owned by Connectiv. This new line is outside the scope of NRC's license renewal review.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of OCNGS and its associated transmission line right-of-way. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act.

The NRC staff plans to two public NEPA scoping meetings on November 1, 2005, at the Quality Inn located at 815 Route 37 in Toms River, New Jersey. You and your staff are invited to attend the public meetings. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Your office will also receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is June 2006.

C. Day -3-

If you have any questions concerning OCNGS, the license renewal application, or other aspects of this project, please contact the NRC's Senior Environmental Project Manager, Dr. Michael Masnik, at (301) 415-1191 or by e-mail at MTM2@nrc.gov.

Sincerely,

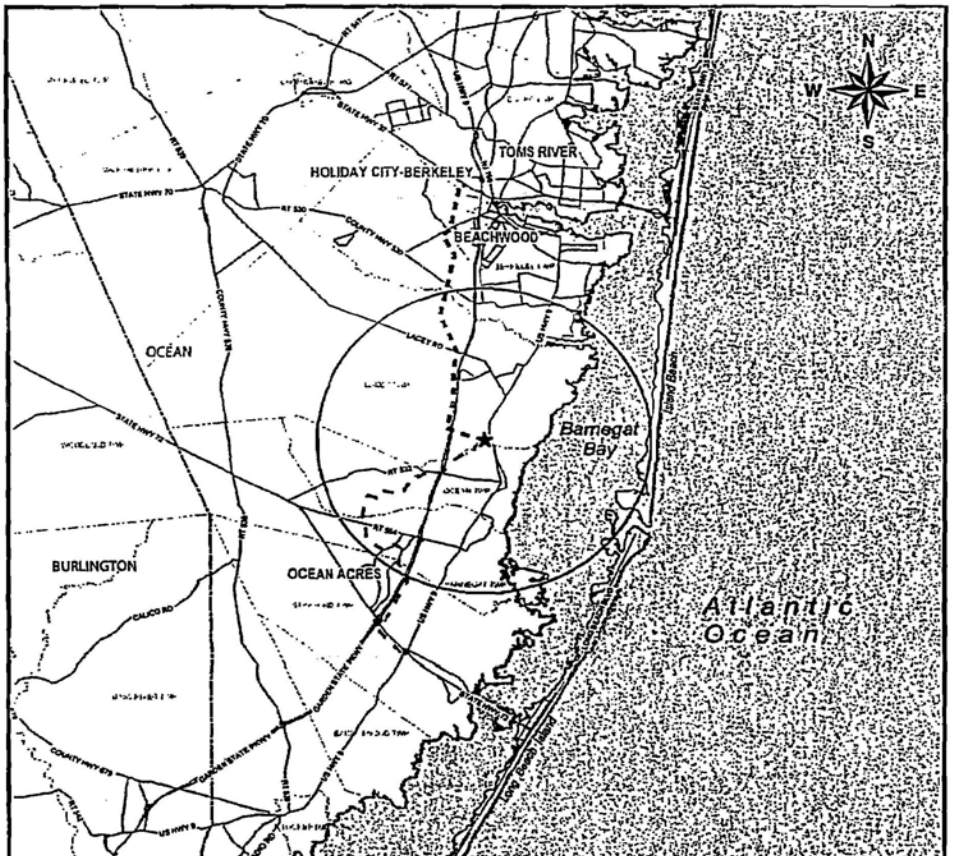
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-219

Enclosures: As stated

cc w/encl.: See next page

Environmental Report
Section 2.1 Figures



LEGEND
- ★ Oyster Creek
- 6 Mile Radius
- Transmission Line
- Proposed Transmission Line Route (Northern Phase)

0 1 2 3 4 5 6 Miles
Scale is approximate.

FIGURE 2-2
6-Mile Vicinity Map

Page 2-40 *Oyster Creek Generating Station License Renewal Application*

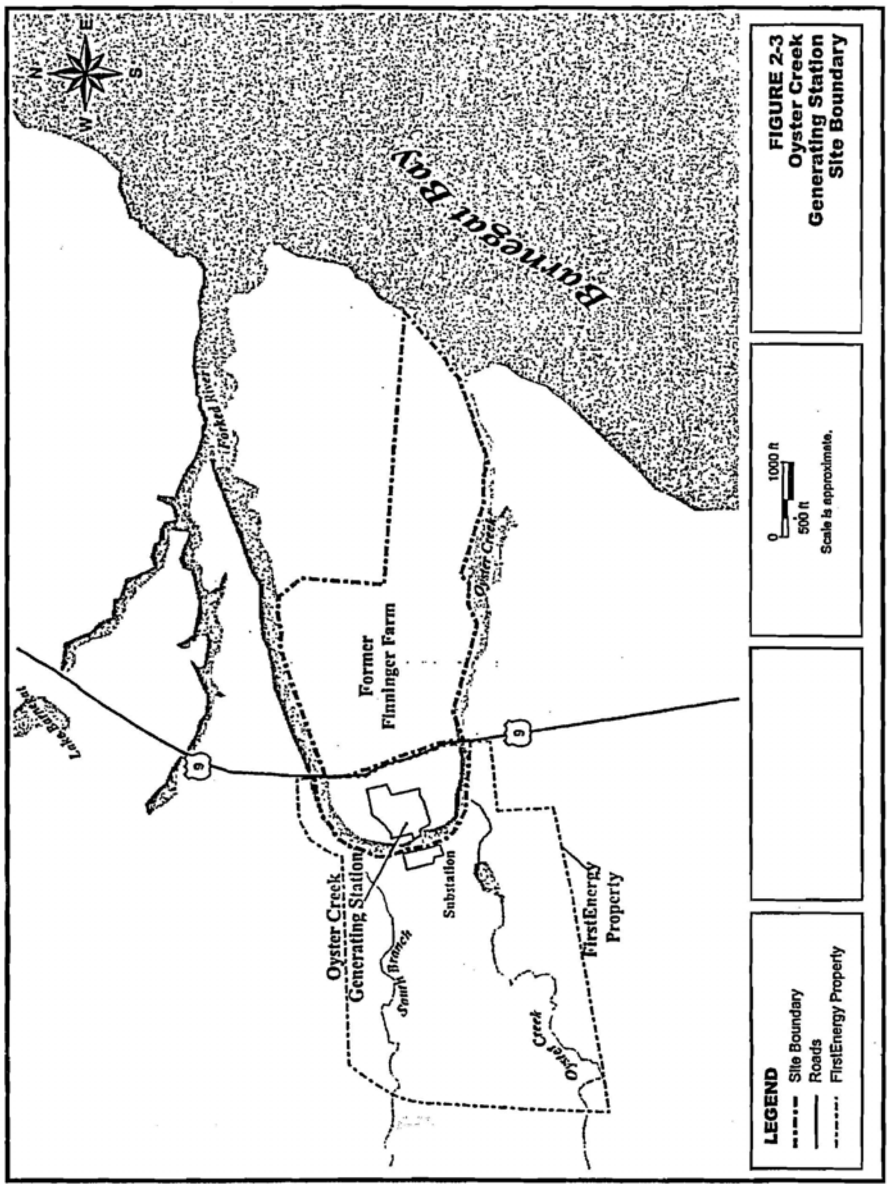


FIGURE 2-3 Oyster Creek Generating Station Site Boundary

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 12, 2005

Patricia A. Kurkul, Regional Administrator
NOAA's National Marine Fisheries Service
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 09130-2298

SUBJECT: REQUEST FOR LIST OF PROTECTED SPECIES AND ESSENTIAL FISH HABITAT WITHIN THE AREA UNDER EVALUATION FOR OYSTER CREEK NUCLEAR GENERATING STATION LICENSE RENEWAL

Dear Ms. Kurkul:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by AmerGen Energy Company, LLC (AmerGen) for the renewal of the operating license for the Oyster Creek Nuclear Generating Station (OCNGS). OCNGS is a single-unit nuclear plant located in Lacey Township in Ocean County, New Jersey. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of the National Environmental Policy Act (NEPA) of 1969, as amended. The SEIS includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to marine resources and habitat. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, the Fish and Wildlife Coordination Act of 1934, as amended, and the Sustainable Fisheries Act of 1996.

AmerGen stated that it has no plans to alter current operations over the license renewal period and that OCNGS operating under a renewed license would use existing plant facilities and transmission lines and would not require additional construction or disturbance of new areas. Any maintenance activities would be limited to previously disturbed areas.

OCNGS is situated on approximately 800 acres of land in the coastal pine barrens of New Jersey approximately 9 miles south of Toms River, New Jersey. The property is on the western shore of Barnegat Bay. East of U.S. Highway 9 the northern site boundary is the South Branch of Forked River, and the southern site boundary is Oyster Creek. West of U.S. Highway 9 the site boundary is defined by the manmade intake and discharge canals (See Enclosed Maps).

OCNGS employs a once-through heat dissipation system designed to remove waste heat from the condensers. The circulating water system includes the intake canal, an intake structure divided into two bays, circulating water pumps, condensers, dilution pumps, discharge pipes, and discharge canal. The purpose of the dilution pumps is to decrease the attractiveness of the heated discharge to migratory marine species during the spring and fall, and to reduce thermal stress on organisms in the discharge canal during the summer. 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. Barnegat Bay is the plant's cooling water source and heat sink. Cooling water is drawn from Barnegat Bay through the South Branch of Forked River and into a

150-foot-wide intake canal dredged to a depth of 10 feet. The circulating water is returned to the 150-foot-wide discharge canal and from there flows to Oyster Creek and back to Barnegat Bay. Depths in the South Branch of the Forked River, canals, and lower reaches of Oyster Creek are maintained by periodic dredging.

The transmission lines in the scope of NRC's environmental review for license renewal are those that were originally constructed for the specific purpose of connecting the plant to the transmission system. A single 230-kilovolt transmission line was built to connect OCNGS to the electric grid. It is a double circuit line hung on a single set of towers that runs 11.1 miles from the OCNGS 230 kilovolt Substation to the Manitou Substation near Toms River. Beyond the OCNGS substation transformer-side disconnects, the line is owned and operated, and corridor easements held, by FirstEnergy, an Ohio utility. The transmission line corridor is 240 feet wide and approximately parallels the New Jersey State Parkway, occupying about 320 acres. The corridor passes through land that is primarily pine forest and swamp forest. Approximately 1 mile of the line passes through Double Trouble State Park. The line is in Ocean County and crosses numerous county roads and the New Jersey 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 after OCNGS is decommissioned. The transmission line and site boundary are identified in the enclosed maps.

To support the SEIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of endangered, threatened, candidate, and proposed species, and designated and proposed critical habitat under the jurisdiction of the National Marine Fisheries Service that may be in the vicinity of the OCNGS site and its transmission line corridors. The most recent formal consultation for the continued operation of OCNGS was completed on September 22, 2005. However, this letter requesting consultation relates specifically to the NRC's review of AmerGen's license renewal application for OCNGS.

In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act. Also in support of the SEIS preparation and to ensure compliance with Section 305 of the Magnuson-Stevens Fishery Conservation and Management Act, the NRC requests a list of essential fish habitat that has been designated in the vicinity of the OCNGS site and its associated transmission line corridors.

The NRC staff plans to hold two public NEPA scoping meetings on November 1, 2005, at the Quality Inn located at 815 Route 37 in Toms River, New Jersey. You and your staff are invited to attend the public meetings. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Your office will also receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is June 2006.

P. Kurkul - 3 -

If you have any questions concerning OCNGS, the license renewal application, or other aspects of this project, please contact the NRC's Senior Environmental Project Manager, Dr. Michael Masnik, at 301-415-1191 or by e-mail at MTM2@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-219

Enclosures: As stated

cc w/encls.: See next page

Environmental Report
Section 2.1 Figures

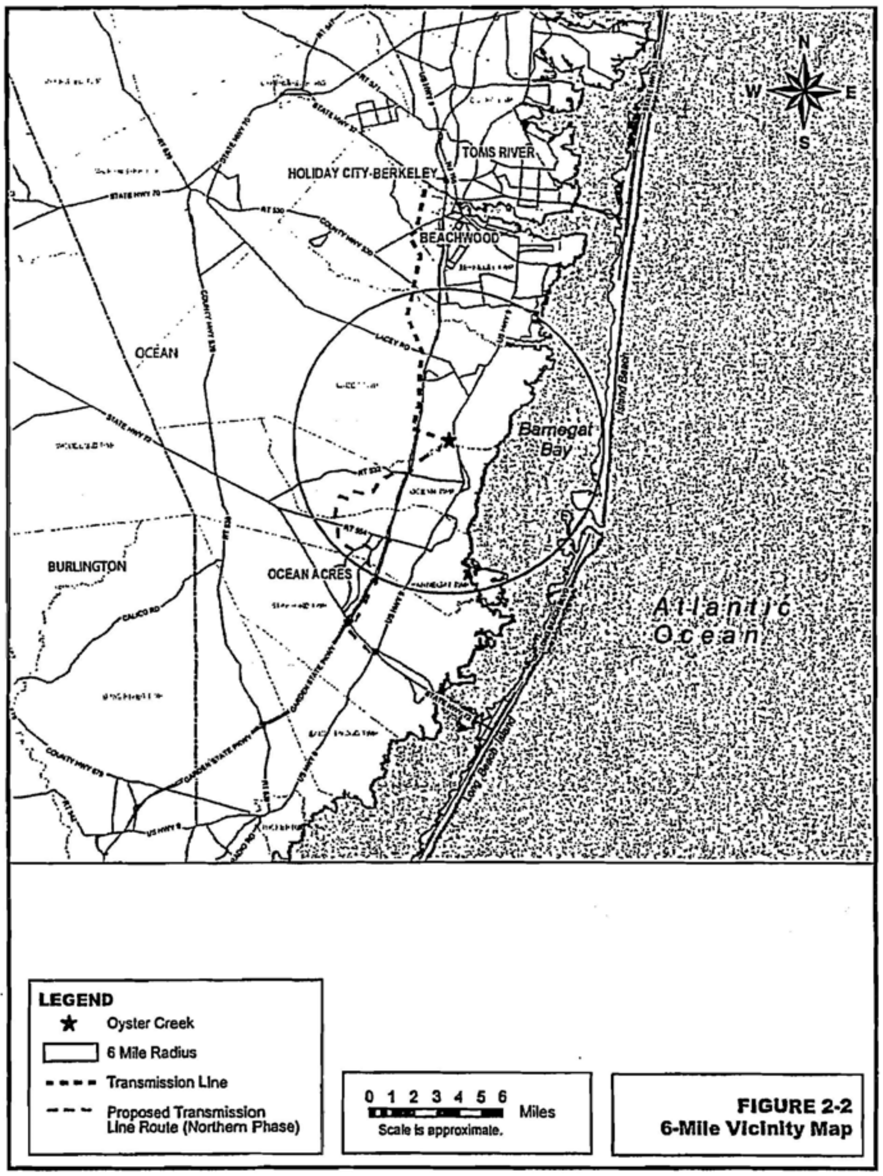
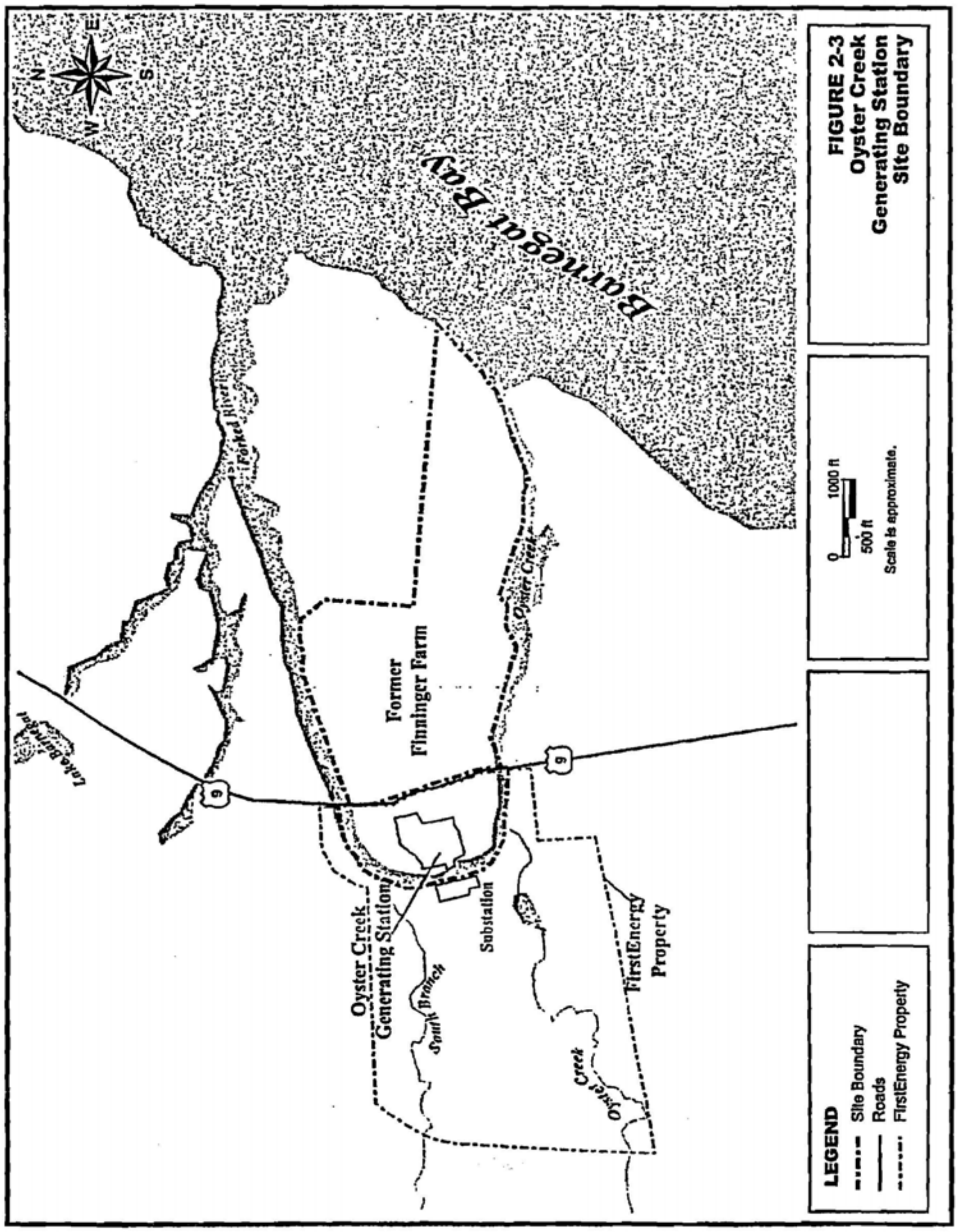


FIGURE 2-2
6-Mile Vicinity Map

Page 2-40 *Oyster Creek Generating Station License Renewal Application*

Environmental Report
Section 2.1 Figures



Oyster Creek Generating Station
License Renewal Application
Page 2-41

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 12, 2005

Mr. Robert Chicks
President, Stockbridge-Munsee Community
N8476 Mo He Con Nuck Road
Bowler, WI 54416

SUBJECT: REQUEST FOR COMMENTS CONCERNING THE OYSTER CREEK NUCLEAR GENERATING STATION APPLICATION FOR OPERATING LICENSE RENEWAL (TAC NO. MC7625)

Dear Mr. Chicks:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from AmerGen Energy Company, LLC (AmerGen) for the renewal of the operating license for the Oyster Creek Nuclear Generating Station (OCNGS), located in Lacey Township in Ocean County, New Jersey. OCNGS is in close proximity to lands that may be of interest to the Stockbridge-Munsee Community. As described below, the NRC process includes an opportunity for public and inter-governmental participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to Title 10 of the *Code of Federal Regulations* Part 51.28(b) (10 CFR 51.28(b)), the NRC invites the Stockbridge-Munsee Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, with the requirements of the National Environmental Policy Act of 1969, as amended.

Under NRC regulations, the original operating license for a nuclear power plant has a term of up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating license for OCNGS will expire on April 9, 2009. AmerGen submitted its application for renewal of the OCNGS operating license on July 22, 2005.

The NRC is gathering information for an OCNGS site-specific supplement to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437. The supplement will contain the results of the review of potential environmental impacts on the area surrounding the OCNGS site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues, among others, and will contain a recommendation regarding the environmental acceptability of the license renewal action.

The NRC will hold two public scoping meetings for the preparation of the OCNGS Supplemental Environmental Impact Statement (SEIS) on November 1, 2005, at the Quality Inn located at 815 Route 37 in Toms River, New Jersey. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. To be considered, comments must be provided either at the transcribed public meetings or in writing. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during informal discussions. The application is electronically available for inspection from the Publicly

R. Chicks - 2 -

Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS) under Accession Number ML052080172. ADAMS is accessible at www.nrc.gov/reading-rm/adams.html and provides access through the NRC's Public Electronic Reading Room link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-800-397-4209, 301-415-4737, or by e-mail at pdr@nrc.gov. In addition, the application can be viewed on the Internet at www.nrc.gov/reactors/operating/licensing/renewal/applications/oystercreek.html.

A paper copy of the application can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, 20852-2738 and at the Lacey Public Library located at 10 East Lacey Road, Forked River, NJ 08731. The GEIS, which assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site, can also be found on the NRC's website or at the NRC's PDR.

Please submit any written comments that the Stockbridge-Munsee Community may have on the scope of the environmental review by November 25, 2005. Comments should be submitted by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington D.C. 20555-0001. At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and mail a copy to you.

The NRC will issue the draft SEIS for public comment (anticipated publication date June 2006), and will hold another set of public meetings in the site's vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final SEIS for OCNGS is planned for February 2007. If you need additional information regarding the environmental review process, please contact Dr. Michael Masnik, Senior Environmental Project Manager, at 301-415-1191 or by e-mail at mtm2@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-219

cc: See next page

From: "Deborah Fimbel" <Deborah.Fimbel@dep.state.nj.us>
To: <MTM2@nrc.gov>
Date: 11/2/05 3:50PM
Subject: Oyster Creek Nuclear Generating Station license renewal and invitation to public scoping meeting

Dr. Masnik -

Our Office administrator, Dorothy Guzzo, has received a letter from Pao-Tsin Kuo inviting us to join you at the November 1st, 2005 public scoping meeting in Toms River, NJ for the Oyster Creek Nuclear Generating Station license renewal. As noted in the letter, Ms. Guzzo responded on October 15th, 2004 that the project re-licensing will not impact historic and archaeological properties. Therefore, we will not consult further at this time.

We are aware that limited off-site new activities may potentially become part of the project, and that there may be modification to on-site facilities as well. If project activities beyond re-licensing do occur, we look further to further consultation under Section 106 of the National Historic Preservation Act.

Thank you for the invitation to the public scoping meeting. If you have nay questions, please contact me. Deborah Fimbel

Deborah Rinker Fimbel
Principal Historic Preservation Specialist
Historic Preservation Office NJDEP
501 East State Street P.O. Box 404
Trenton, New Jersey 08625-0404
(609) 984-6019 FAX (609) 984-0578
Deborah.Fimbel@dep.state.nj.us
www.state.nj.us/dep/hpo

2005 Conference of the Council for
Northeast Historical Archaeology
Cities Built on Commerce & Industry
October 20-23, 2005 in Trenton, NJ

For additional information, please see
http://www.smcm.edu/Academics/soan/cneha/home.htm

United States Department of the Interior

FISH AND WILDLIFE SERVICE

In Reply Refer to:

New Jersey Field Office
Ecological Services
927 North Main Street, Building D
Pleasantville, New Jersey 08232
Tel: 609/646 9310
Fax: 609/646 0352
http://njfieldoffice.fws.gov

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RULES AND DIRECTIVES BRANCH USNRC

Michael T. Lesar, Chief
Rules and Directives Branch
Division of Administrative Services
Office of Administration
Mailstop T-6D59, U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Lesar:

The U.S. Fish and Wildlife Service (Service) has reviewed the Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) and to conduct a scoping process for the license renewal of the AmerGen Energy Company, LLC (AmerGen) (applicant) Oyster Creek Nuclear Generating Station, in the Township of Forked River, Ocean County, New Jersey. The project is located on the South Branch of the Forked River and on Oyster Creek, two waterways that discharge into Barnegat Bay. The following comments also reflect an assessment of a report entitled "Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station" (undated).

INTRODUCTION

AmerGen has submitted an application to the Nuclear Regulatory Commission (NRC) to continue operation of its Oyster Creek Nuclear Generating Station for an additional 20 years (the applicant's preferred alternative). The nuclear plant has been in operation since 1969, and its license is due to expire on April 9, 2009. On October 11 through 13, 2005, the Service attended several interagency scoping meetings with the applicant, the NRC, and representatives from the New Jersey Department of Environmental Protection (NJDEP) to discuss the project, current adverse impacts to fish and wildlife resources, and potential plant modifications and other mitigative measures that could offset these impacts. Currently, the power plant withdraws approximately 1.25 billion gallons of water per day from Barnegat Bay to aid in cooling the nuclear reactor. The intake of cooling water entrains and entraps an unknown quantity of aquatic biota from Barnegat Bay. Prior to the scoping meetings, the Service concluded with AmerGen on January 25, 2005 that the continued operation of the plant until 2029 would not adversely affect federally listed threatened and endangered species under Service jurisdiction.

TSP Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = M. Masnik (MTM2)

AUTHORITY

The following comments on the proposed activity are provided pursuant to the National Environmental Policy Act of 1969 (83 Stat. 852; 42 U.S.C. 4321 *et seq.*) (NEPA), Migratory Bird Treaty Act of 1918 (40 Stat. 755, as amended; 16 U.S.C. 703-712), and Section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) (ESA), and do not preclude future comments pursuant to the NEPA on a Draft EIS or to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*) regarding review for federal permit or license. The following comments are consistent with the intent of the Service's Mitigation Policy (Federal Register Vol. 46, No. 15, Jan. 23, 1981), which emphasizes that avoidance and minimization precede compensation, which is to be considered for unavoidable adverse impacts to fish and wildlife resources and supporting ecosystems.

GENERAL COMMENTS

The Service appreciates the opportunity to participate in the early planning of this project. The above-referenced 3-day interagency meetings allowed the regulatory and resource agencies and the applicant to discuss impacts to fish and wildlife resources. The Service offers the following comments and concerns to assist in project planning and for use in the NRC's NEPA document (EIS). These comments also reflect an assessment of the applicant's Environmental Report. The Service recommends that the following concerns, including the development of a mitigation plan, be resolved prior to completing the Draft EIS.

SPECIFIC COMMENTS

1. Federal Listed Species

As discussed in the Service's January 25, 2005 letter to AmerGen, except for an occasional transient bald eagle (*Haliaeetus leucocephalus*), no other federally listed or proposed threatened or endangered species under the Service jurisdiction are known to occur within the project area. Therefore, the Service concluded that the proposed project would not adversely affect federally listed species under Service jurisdiction.

Due to the recent nesting successes of bald eagles in New Jersey, a possibility exists that a pair of eagles could nest on or adjacent to the project area in New Jersey during the NRC's regulatory review or during the life of the renewed license (if approved). The NRC and AmerGen were notified at the above scoping meetings of the possibility of future eagle nesting. Should nesting occur in the project area during the NRC re-licensing process or during the life of any renewed license, additional consultation pursuant to Section 7 of the ESA would be necessary. We recommend that the NRC obtain a status update of the bald eagle prior to its approval of any license renewal.

The Service also recommended (not required) in its January 25 letter, that AmerGen retain a qualified botanist to conduct a survey to determine the presence of any rare plants, including the federally listed Knieskern's beaked-rush (*Rhynchospora knieskernii*) and swamp pink (*Helonias bullata*), and the federal candidate bog asphodel (*Narthecium americanum*) in the project area.

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These species have been documented within 1.5, 2.8, and 1.3 miles (respectively) of the project area. Since re-licensing is not expected to impact project area wetlands, the Service recommended, rather than required, a botanical survey. To date, the Service is unaware of any botanical survey conducted in the project area. Surveys for the above species would be necessary if any project alternatives or mitigative measures were to involve project area wetlands that might support these species.

No further consultation pursuant to Section 7(a) (2) of the ESA is required with the Service at this time. If project plans change (*e.g.*, to involve project area wetlands) or if new information is obtained that indicates the occurrence of a federally listed species at the proposed project site(s), this determination may be reconsidered. The Service provides the above determination with respect to federally listed or proposed threatened or endangered flora and fauna under the Service jurisdiction only. The proposed project is located on Barnegat Bay and may affect federally listed marine turtles. Principal responsibility for threatened and endangered marine species is vested with the National Marine Fisheries Service (NMFS). We understand that the NRC has begun formal Section 7 consultation with the NMFS. This consultation should be completed prior to the NRC's issuance of the Draft EIS.

2. State Listed Species

The Service recommends that the NRC and the applicant continue working with the NJDEP to protect State-listed species and to obtain any other recommendations to modify plant operations to protect resources of State concern. Any mitigation plans should be developed prior to completing the Draft EIS. In addition, any botanical surveys conducted in the project area should include State-listed species.

3. National Environmental Policy Act

a. Project Purpose and Need

Under the NEPA, "purpose" and "need" are closely linked but subtly different. "Need" may be thought of as the problem and "purpose" as an intention to solve the problem. Clear statements of purpose and need are the basis for (1) identifying reasonable and practicable alternatives, (2) analyzing those alternatives in depth, and (3) selecting the preferred alternative.

The Service requests that the NRC demonstrate a public need for the continued operation of the Oyster Creek Nuclear Generation Station. Specifically, we request additional information on the current and projected electrical needs of the applicant's service area and whether other alternative sources of electricity are available, that could meet this need. The Service understands that the electrical transmission capability in New Jersey is deficient but growing and that the importation of electricity from other Northeast states and Canada could meet the public's need without the continuation of the Oyster Creek nuclear power facility. The Service has also obtained information from Conectiv Power, owner of one of the transmission lines that terminates at the applicant's substation, that "there is very significant electric generation available from existing power plants to meet that growth" (ENSR International, 2004). It appears that transmission capability and not generation is the most critical component to meeting the public's need for electricity. In addition, the applicant states in its

3

Environmental Report (page 7-11) that the "construction of new transmission lines could be required to ensure system reliability."

The NRC Draft EIS should discuss the interrelationship between available transmission capability and electrical generation. This discussion should include several new transmission line upgrades recently constructed or planned in New Jersey and other sources of generated electricity from the Northeast that could meet the current and projected public need. The Service also recommends that the Draft EIS reflect that the Conectiv 230-kV transmission line is active. The applicant's Environmental Report on page 3-6 states that the line has not been constructed.

b. Alternatives Analysis

The applicant has identified its preferred alternative as renewal of its operating license for an additional 20 years, without any plant modifications. The Service recommends that the applicant re-consider in its alternatives analysis the value to the aquatic environment of constructing a closed-loop cooling system or the employment of other project features (see below) that are designed to avoid or minimize adverse impacts to the aquatic environment. For example, the use of a closed-loop system would reduce intake cooling water volumes, when compared to the preferred alternative, by 90 percent (see the applicant's Environmental Report page 7-19). Such an alternative would avoid many of the adverse environmental impacts that are currently occurring to the aquatic biota of Barnegat Bay (*i.e.*, entrapment, entrainment, and thermal impacts).

The continued operation of the Oyster Creek Nuclear Generating Station poses individual and cumulative impacts on the human environment. The continued use of 1.25 billion gallons of water per day from Barnegat Bay represents an adverse impact to the bay's aquatic biota. The Service does not concur with the applicant's conclusion that the impacts associated with its proposed 20-year license renewal would be small and do not warrant mitigation (see page 6-4 or the applicant's Environmental Report). The intake velocities for plant cooling may approach 5.0 feet per second (fps). These velocities exceed the 0.5 fps criteria established for intake structures by the State (New Jersey Division of Fish, Game and Wildlife, undated). The U.S. Environmental Protection Agency's (EPA) establishment of a 0.5 fps velocity for all new cooling water intake structures that draw from rivers, streams, or ocean waters of the United States (40 CFR Part 125.84 [b][2]) is consistent with the State's requirements. Velocities of intake water that exceed 0.5 fps promote adverse impacts to aquatic resources due to entrapment or entrainment.

The Service recommends that the Draft EIS also include consideration of the following project features as a means to avoid or minimize impacts to the aquatic environment: placement of additional screening/netting or other project features (*e.g.*, bubble or sound deterrent systems) in the intake canal closer to Barnegat Bay; employment of flow reduction options during low peak demands; construction of a large water impoundment or recirculation structure on the Finnengar's Farm to supplement the plant's cooling water needs; or a combination of any of the above.

c. Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations for implementing NEPA define cumulative impacts as "the impact on the environment which results from the incremental impact of the action when

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added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR Part 1508.7).

The NRC's Draft EIS should document the adverse cumulative impacts that are occurring to the bay's aquatic biota from thermal impacts (cold-water shock and heated water, as discussed below) and from entrapment or entrainment from passing through the circulation and dissipation pumps. Because the data discussed in the applicant's Environmental Report are dated, it is difficult to ascertain the present level of cumulative adverse impacts. In addition, the NRC must consider the cumulative effects on the bay's aquatic environment due to other actions such as mortality from recreational and commercial fishing. Without more relevant biological data on species use of the project area, the Service must conclude that cumulative impacts to the environment are more than minimal. Without meaningful biological data, the NRC's Draft EIS should also conclude that cumulative adverse impacts would continue to occur with the applicant's preferred alternative (license renewal), warranting substantial measures for compensatory mitigation.

d. Aquatic Impacts

When an agency is evaluating reasonable significant adverse effects on the human environment in an EIS, and information is incomplete or unavailable, the agency shall determine the reasonableness of including that information in an EIS (40 CFR Part 1502.22).

The Service recommends that the NRC postpone the issuance of its Draft EIS (June 2006) until additional ongoing biological studies (which began recently) are completed and information is available to assess plant operational effects on fish and wildlife resources. The results of these studies are essential for assessing potential adverse environmental impacts to the aquatic environment. The overall cost of obtaining this information is not exorbitant, as defined in 40 CFR Part 1502.22 (a) and is necessary to fulfill NEPA responsibilities to adequately assess individual and cumulative impacts (see cumulative effects discussion below). Information from the biological studies will yield, at a minimum, biomass losses of finfish and crustaceans from the applicant's plant operation and projected adverse impacts to the aquatic environment if the license is renewed.

The applicant's Environmental Report uses biological data derived from a 12-year period (1965 to 1977), to describe aquatic biota found in the project area; however, the age of the data (28 years) limits its value for assessing current and reasonably foreseeable future impacts. The applicant's assertion that the impacts of entrainment of fish and shellfish are "small" (page 4-9) cannot be supported adequately with data that are most likely outdated. In addition, the assertion that impacts are small appears to contradict later statements in the applicant's Environmental Report that numerous unavoidable adverse impacts to the aquatic environment are occurring (page 6-5).

The plant utilizes 1.25 billion gallons of water each day for cooling. Water from Barnegat Bay enters the Forked River, passes through several small, mesh screens and large circulating or dissipating pumps, is heated upwards of 24 degrees Fahrenheit as it passes through the heat dissipation chamber, and is then released into Oyster Creek, eventually flowing back into the bay. This cooling water entraps and entrains an unknown amount of aquatic biota, including

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egg, larvae, juvenile, and adult finfish and crustaceans. The NJDEP (2005) reported that the Forked River drainage area provides habitat for river herring. The same report indicated that the Upper Branch of the Forked River had a herring spawning run, which no longer exists due to the combined effects of pollution, habitat displacement, man-made water course blockages, and over-fishing. Although not mentioned in the NJDEP report, it appears that Oyster Creek, just south of the Forked River drainage area, may have also lost a herring spawning run after a dam was build on the creek in the 1960s for the purpose of storing water for fire fighting capability at the nuclear plant. The proximity of the Forked River to the plant cooling intake structures makes it likely that any egg larvae or young-of-the-year herring originating from Forked River will pass through the plant's cooling system and be killed before entering Barnegat Bay.

Significant population changes have also occurred to several commercial and recreationally important finfish and shellfish species found in Barnegat Bay since the conclusion of the 12-year biological sampling study in 1977. The population of the hard clam (*Merceneria mercenaria*) and winter flounder (*Pseudopleuronectes americanus*) have dropped precipitously and the localized effects of the intake of over 1 billion gallons of water per day on these two species are unknown. In addition, the Atlantic Coast population of the striped bass (*Marone saxitilis*) has risen sharply from the mid-1980s. Striped bass and other marine species are known to utilize the intake and discharge areas of the project, but the extent of their use is unknown. The economic value of recreational fishing in New Jersey is high (see discussion on public access and recreation below). The effect of the discharge of hot water is unknown on recreational sport fish and other aquatic species. In addition, there have been several confirmed large fish kills due to cold water shock from winter plant closings. The NRC Draft EIS should document these fish kills and discuss the cumulative impacts of these kills in view of the data and available information concerning the aquatic biota that is entrapped on the cooling water intake structures or entrained in the heat dissipation chamber.

Because of the concerns outlined above, the Service recommends expansion of the current biological sampling study to a minimum of 3 years. A 3-year study would allow the NRC to more adequately determine what effects, if any, the plant's operation is having on aquatic biota. Obtaining this information does not appear to be cost prohibitive. The Service also recommends review of the current sampling method by the NJDEP, NMFS, Service, and other interested parties to ensure that information gathered will be adequate for assessing impacts to aquatic biota associated with plant operation. The Service also recommends collection of biological data for the life of the license in order to demonstrate that adverse impacts remain minimal over time. The license should contain conditions to require additional mitigation (see the discussion of mitigation below) should post-license data analysis confirm that additional or unforeseen adverse impacts are occurring.

e. <u>Terrestrial Impacts</u>

The applicant does not propose any new construction activities with the license renewal. However, during the inter-agency meetings noted above, the Service learned that a substantial amount of previously contaminated dredged material, stored in a confined disposal facility (CDF) just east of the plant on the Finnenger's Farm property, may require remediation and/or removal to an approved upland facility. A site visit revealed that the farm consists of several abandoned fields; an early successional

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forest, including some maritime forest species; and pockets of both tidal and non-tidal wetlands. These types of vegetative cover provide valuable habitats for upland wildlife species. New construction activities (*e.g.*, clearing and grubbing of upland vegetation, upgrading roads, or the construction of an offloading barge facility in Oyster Creek) would be expected if the CDF requires remediation or removal and would impact terrestrial species that utilize the farm. Therefore, the Service recommends clarifying any activities proposed on the Finnenger's Farm in the Draft EIS, including construction methods for any remediation of the CDF.

f. <u>Mitigation</u>

The CEQ requires inclusion of means to mitigate adverse environmental impacts in the EIS discussion of environmental consequences, if not covered in the description of the proposed action or alternatives (40 CFR Part 1502.16[h]). In addition, a mitigation plan (when necessary) is generally required prior to project authorization by the NJDEP. Therefore, the Service recommends that the NRC develop a mitigation plan for the proposed license renewal and discuss the plan in the Draft EIS. The mitigation plan should be developed in consultation with the NMFS, Service, and NJDEP and identify proposed means to avoid, minimize, and compensate (in that order) all adverse environmental effects on fish and wildlife resources. Consistent with the Service's Mitigation Policy, all in-kind options should be exhausted before considering out-of-kind mitigation. For example, the Service is aware that the NJDEP is considering restoration of several large wetland areas as potential mitigation. Although the Service encourages wetland restoration in most cases, this should only be employed as out-of-kind mitigation after the applicant has exhausted other direct compensatory options for adverse impacts to aquatic organisms (*i.e.*, the removal of fish blockages for river herring or the development of long-term hard clam or other finfish or shellfish restoration projects).

During the October 11-13 interagency scoping meeting, the Service learned that a dam and pond were constructed just below the headwaters of Oyster Creek to store water for fire fighting capability at the plant. From a review of pre-1969 construction aerial photographs of the pond, 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. The Service can assist the NRC in identifying other potential fish ladder projects as potential mitigation for the preferred alternative.

OTHER SERVICE CONCERNS

1. Public Access and Recreation

Recreational fishing is a $35 billion industry for the nation, with approximately 900,000 New Jersey recreational anglers expending nearly $700 million annually for fishing tackle and other related purchases (U.S. Fish and Wildlife Service and U.S. Census Bureau, 2002). A key component to these economic benefits is unimpeded public access. A federal excise tax is collected from manufacturers of fishing equipment, as well as a portion of the federal fuel tax that is attributed to motorboat usage. Revenue is passed on to participating states. Since 1950, the Service's Federal Aid in Sport Fish Restoration Program has provided funds to state fish and wildlife agencies. The funding is used to restore, conserve, manage, and enhance fish species that are sought by recreational anglers, fund educational programs to enhance the public's understanding of aquatic resources and recreational

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fishing, and to promote the development of responsible attitudes and ethics toward the aquatic environment.

Currently, recreational anglers fish in areas downstream of the hot water effluent in Oyster Creek. However, the public access points in this area are limited to the State Route 9 Bridge and several small shoreline areas. The Service recommends that the NRC work closely with the applicant, the NJDEP, and interested recreational fishing organizations to develop a comprehensive public access plan that would better address the recreational needs in the project area. A recreational use and access plan would be consistent with public access policies and regulations (Coastal Zone Management Act of 1972 (86 Stat. 1280; 16 U.S.C. 1451-1464). The Service is available to assist in the development of a public access plan.

2. Best Management Practices

The Service also recommends that, in association with implementing best management practices (BMPs), the NRC include provisions to control the spread of invasive species, such as *Phragmites australis* in the transmission line right-of-ways and the CDF on the Finnengar's Farm.

A draft Management Plan by the Chesapeake Bay Program's *Phragmites australis* Working Group (2003) includes recommendations to curb the spread of *Phragmites* through federal and state permit conditions, in order to help achieve a long-term goal of no net gain in *Phragmites* acreage. The Service has subsequently recommended initiation of a similar planning effort to control *Phragmites* in the Hackensack Meadowlands in Bergen and Hudson Counties, pursuant to Executive Order 13122 and under the auspices of the National Invasive Species Council. The Service recommends a similar program in the project area, including the two power line right-of-ways maintained by Conectiv and FirstEnergy and the CDF, with participation of the NRC. In the interim, the Service recommends that any federal authorization resulting in wetland disturbance (*e.g.*, power line right-of-way maintenance, dredging, or excavation of the CDF) include conditions requiring: (1) BMPs to prevent the introduction or spread of invasive species, such as avoiding creation of elevated berms and the spread or burial of *Phragmites* rhizomes; (2) 2 to 5 years of post-construction monitoring to detect the introduction or spread of invasive species, and (3) control efforts, if *Phragmites* or another invasive species are detected (to include re-grading or hydrologic corrections for any construction-related disturbances that promote the spread of *Phragmites,* if other control methods [*i.e.*, herbicides] prove insufficient in the long-term).

SUMMARY AND RECOMMENDATIONS

The Draft EIS should thoroughly address the purpose and need for the proposed action, alternatives and project viability. In addition, fish and wildlife issues must be adequately addressed pursuant to the NEPA, in determining direct, indirect and cumulative adverse impacts to fish and wildlife resources, and mitigation for unavoidable adverse impacts must be developed. In summary, the Service recommends that the NRC:

1. Obtain a status update of the bald eagle prior to any license renewal and conclude consultation with the NMFS regarding listed species under NMFS jurisdiction.

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2. Conduct a survey to determine the presence of any federally listed or other rare species of plants, especially if any project area wetlands are evaluated as potential mitigation sites.

3. Continue coordinating with the NJDEP to protect State-listed species, and to obtain any other recommendations to modify plant operations to protect resources of State concern. Include State-listed species in any botanical surveys of the project area.

4. Provide further clarification regarding the need for the project in view of improved electrical transmission capacity in the Northeast and Canada. Include a discussion on the interrelationship between available transmission and electrical generation capability throughout the Northeast.

5. Confirm in the Draft EIS that the Conectiv 230-kV transmission line was constructed.

6. Evaluate other alternatives to obtain cooling water for the nuclear reactor, including the use of a closed-loop cooling system and constructing a large water impoundment or recirculating structure on Finnengar's Farm. Evaluate measures to minimize adverse impacts from the preferred alternative, reducing the need for cooling water during low peak usage, using additional fish screening closer to Barnegat Bay, and using bubble or sound deterrent systems to eliminate impacts to aquatic organisms.

7. Document in the Draft EIS all aquatic biota mortality attributable to plant operation, including but not limited to organisms entrapped, passing through the cooling chamber or dissipation pumps, or killed by thermal shock.

8. Postpone the issuance of the Draft EIS until completion of a 3-year biological study. Existing biological data are outdated and no longer reliable for assessing individual or cumulative adverse impacts to the aquatic environment. Please submit the aquatic biota sampling protocols to the Service, NMFS, and NJDEP for review. As noted, the sampling period should be expanded to 3 years.

9. Clarify statements made in the applicant's Environmental Report that impacts to the aquatic environment are small. The same report notes that unavoidable adverse impacts are occurring.

10. Collect biological data for the life of any approved license to demonstrate that future potential adverse impacts are no more than minimal.

11. Discuss the removal of contaminated dredged material from the CDF found on the Finnengar's Farm and specify any activities proposed.

12. Develop a mitigation plan with the Service, NMFS, and NJDEP to compensate for unavoidable adverse impacts prior to completion of the Draft EIS and for unforeseen impacts that may develop over the term of the license if renewed.

13. Develop a public access plan to address the recreational needs in the project area.

14. Develop BMPs for all construction activities and include provisions to control the spread of invasive species and monitoring with remedial provisions to ensure success.

The Service appreciates the opportunity to comment on the NOI and the applicant's Environmental Report. We recommend that the NRC continue close coordination with the Service and the NJDEP to ensure that fish and wildlife concerns are comprehensively addressed during preparation of the Draft EIS. Please keep us informed of your actions regarding the development of the Draft EIS. Mr. John Staples or Mr. Steve Mars of my staff are available to answer any questions on the content of this letter. They are available at (609) 646-9310, extensions 12 and 23, respectively.

Sincerely,

Clifford G. Day

Clifford G. Day
Supervisor

REFERENCES

Chesapeake Bay *Phragmites australis* Working Group. 2003. Common reed (*Phragmites australis*) in the Chesapeake Bay: a draft bay-wide management plan. U.S. Department of the Interior, Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, Maryland. 30 pp. (Available online at http://www.chesapeakebay.net/pubs/calendar/1NISW 2-10-3 Report 4 5129.pdf.)

ENSR International. 2004. Environmental Assessment prepared for the U.S. Fish and Wildlife Service for Land Exchange with Conectiv Power Delivery involving the Edwin B. Forsythe National Wildlife refuge, Galloway Township, Atlantic County, New Jersey. ENSR International Langhorn, Pennsylvania. 53pp. + Appendices.

New Jersey Department of Environmental Protection. 2005. Locations of anadromous American shad and river herring during their spawning period in New Jersey's freshwaters including known migratory impediments and fish ladders. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Bureau of Freshwater Fisheries, Sicklerville, New Jersey.

New Jersey Division of Fish, Game, and Wildlife. Undated. Basic criteria for intake structures. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Bureau of Freshwater Fisheries, Trenton, New Jersey.

U.S. Fish and Wildlife Service and U.S. Census Bureau. 2002. 2001 National survey of fishing, hunting, and wildlife-associated recreation. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. and U.S. Department of Commerce, Census Bureau, Washington D.C. p.120 of 170 pp. (Available online at http://www.census.gov/prod/2002pubs/FHW01.pdf.)

AmerGen
An Exelon Company

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, AND AMERGEN ENERGY COMPANY LLC
REGARDING THE COASTAL ZONE MANAGEMENT ACT REVIEW FOR RENEWING THE OPERATING LICENSE FOR THE OYSTER CREEK NUCLEAR GENERATING STATION

PURPOSE

The New Jersey Department of Environmental Protection (NJDEP), and AmerGen Energy Company LLC (AmerGen) (collectively, the parties) hereby enter into this memorandum of understanding (MOU) concerning an application filed with the Nuclear Regulatory Commission (NRC) by AmerGen, seeking to renew the operating license for its Oyster Creek Nuclear Generating Station located within the coastal zone of the State of New Jersey.

STATEMENT OF FACTS

The parties agree to the following facts:

1. On January 21, 2005, AmerGen submitted to NJDEP a consistency certification under the Coastal Zone Management Act (CZMA) federal consistency provision (16 U.S.C. § 1456(c)(3)(A)) and National Oceanic and Atmospheric Administration's (NOAA's) regulations (15 C.F.R. part 930, subpart D);

2. On August 19, 2005, NJDEP objected to AmerGen's CZMA consistency certification based upon a lack of information. AmerGen must file its notice of appeal of NJDEP's August 19, 2005, objection with the Secretary by September 19, 2005;

3. Pursuant to the recently enacted Energy Policy Act of 2005 (Pub. L. No. 109-58), the Secretary of Commerce (Secretary) must use NRC's and NJDEP's decision records as the initial record to decide AmerGen's CZMA appeal. At the present time, NRC is in the initial stages of reviewing AmerGen's application to renew its operating license, and will be gathering additional technical and environmental information as part of its review that will be included as part of the record of its decision;

4. Under 15 C.F.R. § 930.51(f), federal consistency applies only to active applications. AmerGen filed its consistency certification six months before filing its application to renew its operating license with NRC on July 22, 2005; and

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5. Under 16 U.S.C. § 1456(c)(3)(A) and 15 C.F.R. § 930.57(a), an applicant provides in the application to the federal licensing agency a consistency certification. This does not require the applicant to provide a consistency certification at the time the application is submitted; rather, the applicant (in this case AmerGen) provides the consistency certification when the applicant has the necessary data and information required by the CZMA and NOAA's regulations and at an appropriate time during the federal licensing agency's process (in this case NRC's process).

AGREEMENTS

Based upon the above statement of facts, the parties agree to the following:

1. AmerGen hereby withdraws its consistency certification, dated January 21, 2005, from NJDEP's consideration;

2. NJDEP hereby withdraws its consistency objection, dated August 19, 2005. NJDEP believes it will need the information described in NJDEP's August 19 objection letter, to respond to any consistency certification resubmitted by AmerGen under paragraph 3, below. AmerGen expresses no opinion regarding NJDEP's need for the information;

3. AmerGen shall resubmit to NJDEP its CZMA consistency certification and necessary data and information, pursuant to 15 C.F.R. part 930, subpart D, at an appropriate time during the NRC's review process;

4. Once NJDEP receives AmerGen's consistency certification and necessary data and information under paragraph 3 pursuant to 16 U.S.C. § 1456(c)(3)(A) and 15 C.F.R. part 930, subpart D, NJDEP's six-month review period shall begin;

5. If NJDEP objects to AmerGen's resubmitted consistency certification, AmerGen may file an appeal with the Secretary within the time frames established by NOAA's CZMA regulations;

6. The CZMA review prompted by AmerGen's consistency certification dated January 21, 2005, is hereby superseded by any subsequent review that shall occur once AmerGen resubmits its consistency certification as envisioned in paragraph 3. NJDEP and AmerGen shall retain all rights under the CZMA relative to this subsequent consistency certification; and

7. This MOU may be executed in counterparts.

SIGNATURES FOR MOU BETWEEN NJDEP AND AMERGEN REGARDING THE CZMA REVIEW FOR RENEWING THE OPERATING LICENSE FOR THE OYSTER CREEK NUCLEAR GENERATING STATION

______________________________ __________
For NJDEP Date
Mark Mauriello
Director, Land Use Regulation Program

______________________________ __________
For AmerGen Date
Pam Cowan
Director, Licensing and Regulatory Affairs
AmerGen Energy Company LLC

STATEMENT BY NOAA:

While NOAA is not a party to this MOU, it has no objections to its terms. Since both AmerGen's consistency certification and NJDEP's objection have been withdrawn, that proceeding has terminated. If a new consistency certification is submitted by AmerGen, and NJDEP issues an objection, the CZMA and NOAA regulations would allow AmerGen to file an appeal with the Secretary in that new proceeding.

For Joel La Bissonniere 9/19/05
Date
Assistant General Counsel
NOAA Office of General Council for Ocean Services

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SIGNATURES FOR MOU BETWEEN NJDEP AND AMERGEN REGARDING THE CZMA REVIEW FOR RENEWING THE OPERATING LICENSE FOR THE OYSTER CREEK NUCLEAR GENERATING STATION

Mark N. Mauriello 9/19/05
For NJDEP Date
Mark Mauriello
Director, Land Use Regulation Program

For AmerGen Date
Pam Cowan
Director, Licensing and Regulatory Affairs
AmerGen Energy Company LLC

STATEMENT BY NOAA:

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Joel La Bissonniere Date
Assistant General Counsel
NOAA Office of General Council for Ocean Services

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SIGNATURES FOR MOU BETWEEN NJDEP AND AMERGEN REGARDING THE CZMA REVIEW FOR RENEWING THE OPERATING LICENSE FOR THE OYSTER CREEK NUCLEAR GENERATING STATION

______________________________ ________
For NJDEP Date
Mark Mauriello
Director, Land Use Regulation Program

______________________________ 9/19/05
For AmerGen Date
Pam Cowan
Director, Licensing and Regulatory Affairs
AmerGen Energy Company LLC

STATEMENT BY NOAA:

While NOAA is not a party to this MOU, it has no objections to its terms. Since both AmerGen's consistency certification and NJDEP's objection have been withdrawn, that proceeding has terminated. If a new consistency certification is submitted by AmerGen, and NJDEP issues an objection, the CZMA and NOAA regulations would allow AmerGen to file an appeal with the Secretary in that new proceeding.

______________________________ 9/19/05
for Joel La Bissonniere Date
Assistant General Counsel
NOAA Office of General Council for Ocean Services

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ESSENTIAL FISH HABITAT ASSESSMENT
FOR RENEWAL OF THE OYSTER CREEK NUCLEAR GENERATING STATION OPERATING LICENSE

1.0 INTRODUCTION

The Magnuson-Stevens Fishery Conservation and Management Act, (FCMA) which was reauthorized and amended by the Sustainable Fisheries Act of 1996, sets forth the essential fish habitat (EFH) provisions designed to protect important habitats of Federally managed marine and anadromous fish species. The Act requires the eight regional fishery management councils to describe and identify EFH in their respective regions, to specify actions that would conserve and enhance EFH, and to minimize the adverse effects of fishing on EFH. Pursuant to the Act, Congress has defined EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity”. Federal agencies that fund, permit, or undertake activities that may adversely affect EFH are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH, and respond in writing to NMFS’s conservation recommendations. For the purpose of consultation, an adverse effect includes any impact that reduces the quality and/or quantity of EFH. The consultation document must include the following information:

- A description of the proposed action;

- An analysis of the potential adverse effects of the action on EFH and the managed species;

- The Federal agency’s conclusions regarding the effects of the action on EFH; and

- Proposed mitigation, if applicable.

On July 22, 2005, the U.S. Nuclear Regulatory Commission (NRC) received an application from AmerGen Energy Company, LLC (AmerGen), for renewal of the operating license (OL) of the Oyster Creek Nuclear Generating Station (OCNGS), which expires on April 9, 2009. As part of the application, AmerGen submitted an Environmental Report (ER) (AmerGen 2005a) prepared in accordance with the requirements of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51).

On September 22, 2005, the NRC staff published (NRC 2005a) a Notice of Intent to prepare a plant-specific supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996,1999). During the development of the Supplemental Environmental Impact Statement (SEIS), the NRC staff visited the site, met with members of Federal and State regulatory agencies, spoke to local citizens, interviewed individuals who had conducted environmental research in Oyster Creek, Forked River, or Barnegat Bay, and reviewed a variety of technical reports, journal articles, and other relevant information to determine whether license renewal would result in adverse environmental impacts. This information and other sources relevant to EFH issues were consulted during the development of this document. This EFH assessment has been developed to fulfill the NRC requirement under the FCMA for the OCNGS license renewal review.

2.0 PROPOSED FEDERAL ACTION

The proposed Federal action is renewal of the OL for OCNGS, a nuclear power plant that is located in eastern New Jersey adjacent to Barnegat Bay. OCNGS is a single-unit plant with a boiling-water reactor and steam turbine manufactured 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 cooling system that draws cooling water from Barnegat Bay via the Forked River and a man-made intake canal, and discharges heated water back to Barnegat Bay via a discharge canal and Oyster Creek. The current OL for OCNGS expires on April 9, 2009. By a letter dated July 22, 2005, AmerGen submitted an application (AmerGen 2005b) to the NRC to renew the OL for an additional 20 years of operation (i.e., until April 9, 2029). Details concerning the renewal of the OL can be found on the NRC website (NRC 2006a).

3.0 ENVIRONMENTAL SETTING

OCNGS is located in eastern New Jersey, approximately 60 mi south of Newark, 35 mi north of Atlantic City, and 50 mi east of Philadelphia, Pennsylvania (Figure 1). The nearest major water body is Barnegat Bay, a protected estuary on the central New Jersey coast (Figure 2). OCNGS is bounded on the north by the South Branch of the Forked River and on the south by Oyster Creek (Figure 3). 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. Depths range from 3 to 23 ft, with the greatest depths associated with the Intracoastal Waterway, a dredged channel running parallel to the U.S. eastern seaboard (Chizmadia et al. 1984; BBNEP 2002). The total quantity of water associated with 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, the barrier islands to the east, and Manahawkin Causway 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 Little Egg Inlet. There is also an entrance to Barnegat Bay via Barnegat Inlet, a narrow navigable passage to the Atlantic Ocean through the barrier islands located to the southeast of Oyster Creek. The configuration of the Barnegat Inlet jetty system and the entrance channel have undergone extensive modifications by the U.S. Army Corps of Engineers, and a major

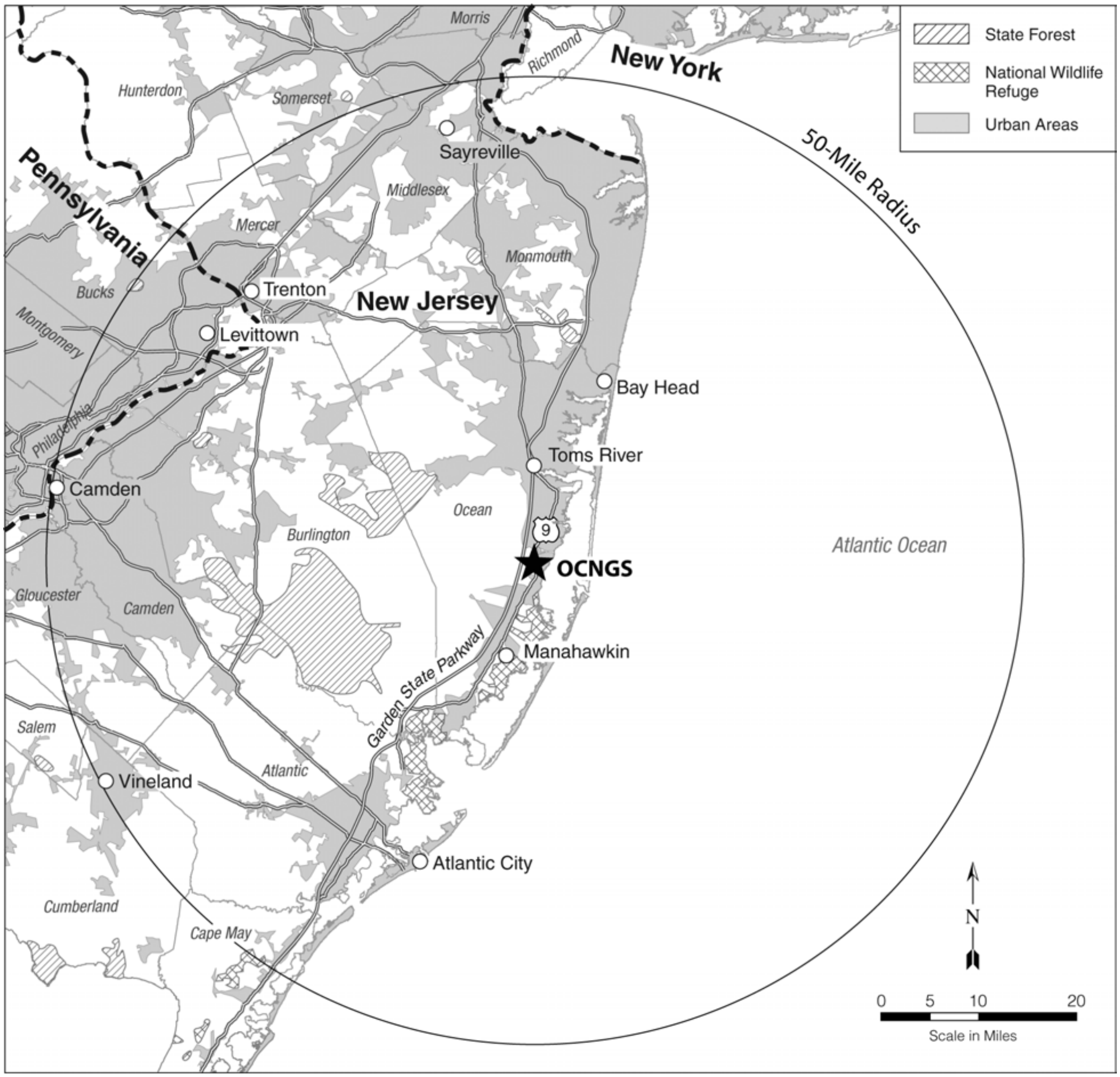

Figure 1. Location of Oyster Creek Nuclear Generating Station, 50-mi Region (Source: AmerGen 2005a)

program was initiated in 1988 to realign the south jetty and dredge accumulated sediments from the channel to improve navigation (Seabergh et al. 2003). Because of the limited connection of Barnegat Bay to the Atlantic Ocean, tides in the bay are attenuated relative to the open ocean. Complete turnover of the 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;

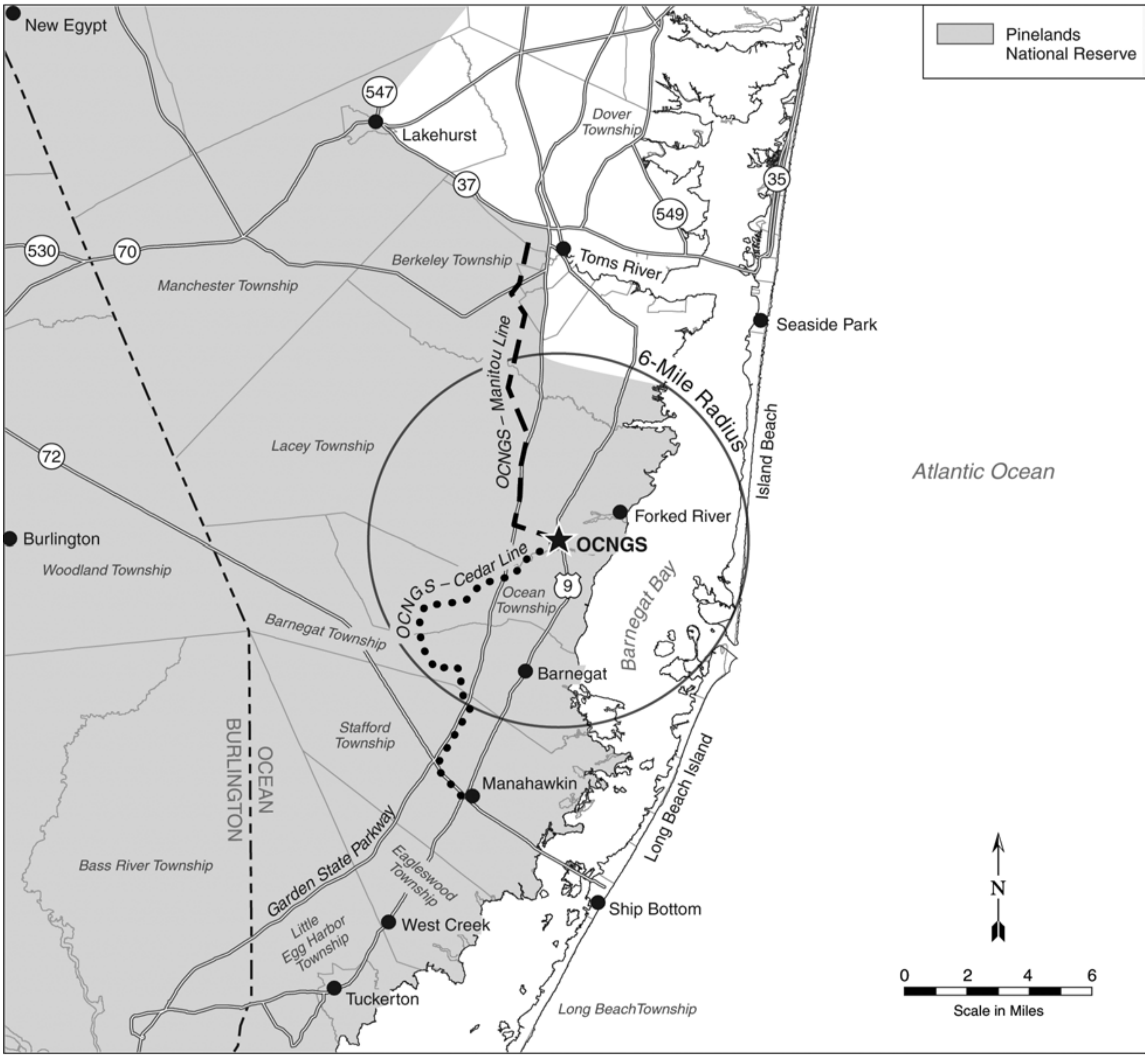

Figure 2. Location of Oyster Creek Nuclear Generating Station, 6-mi Region (Source: AmerGen 2005a)

Guo et al. 2004). Salinity ranges from approximately 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 34.9 °F (1.6 °C) in winter to 73.4 °F (23.0 °C) in summer (Chizmadia et al. 1984; BBNEP 2001).

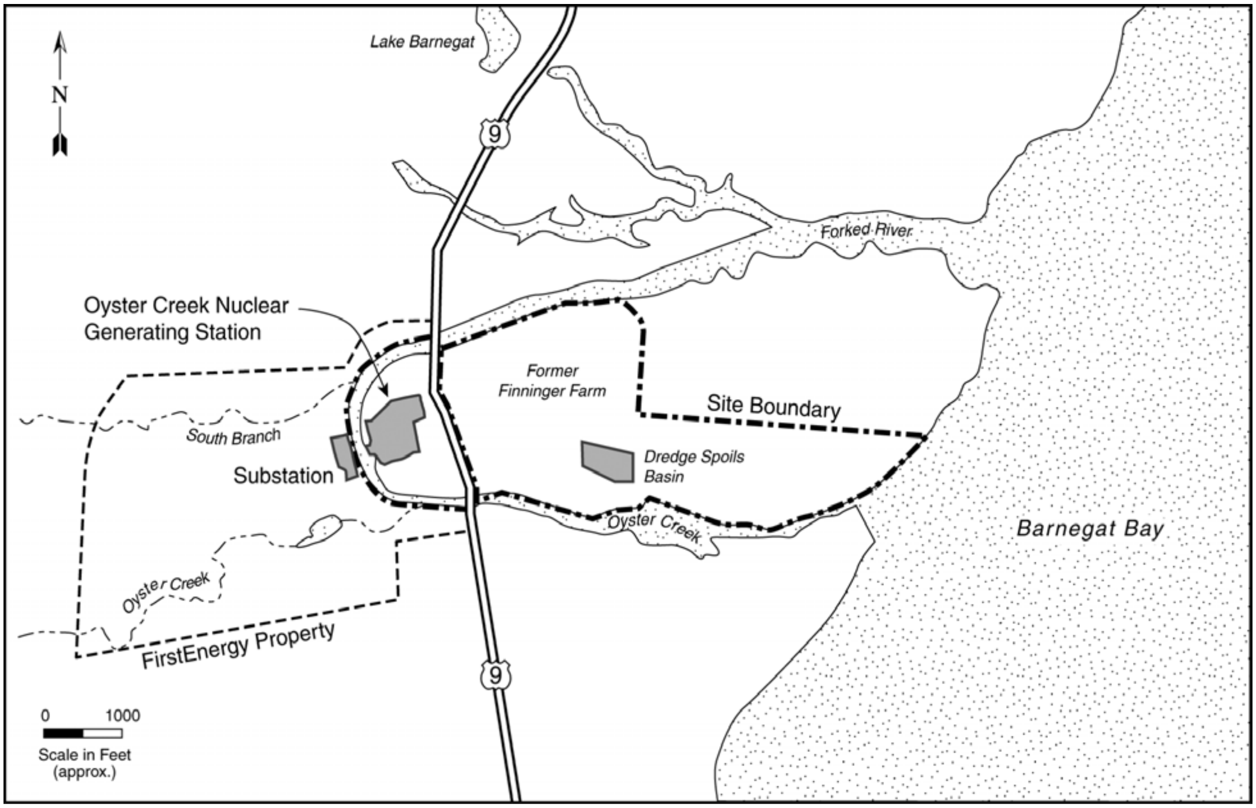

Figure 3. Oyster Creek Nuclear Generating Station Site Boundary
(Source: AmerGen 2005a)

The substrate of Barnegat Bay is typical of a shallow estuary. Central portions of the bay are composed primarily of fine to medium sand, with muddier sand present closer to the western shore. The intertidal areas adjacent to the mouths of Forked River and Oyster Creek are primarily sandy mud (Chizmadia et al. 1984). The barrier islands and mainland shores of Barnegat Bay support a network of salt marshes and other coastal wetlands 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 Atlantic Coast (GLCF 2005). The cause of the observed losses is not known, but it is assumed to be a combination of sea level rise and hydrologic changes that result in an inadequate supply of sediment required for marsh maintenance (Hartig and Gornitz 2001).

4.0 PLANT COOLING-WATER SYSTEM DESCRIPTION

OCNGS has a once-through cooling system that uses water from Barnegat Bay. Cooling water is withdrawn from the bay via the South Branch of the Forked River, then through a 150-ft-wide

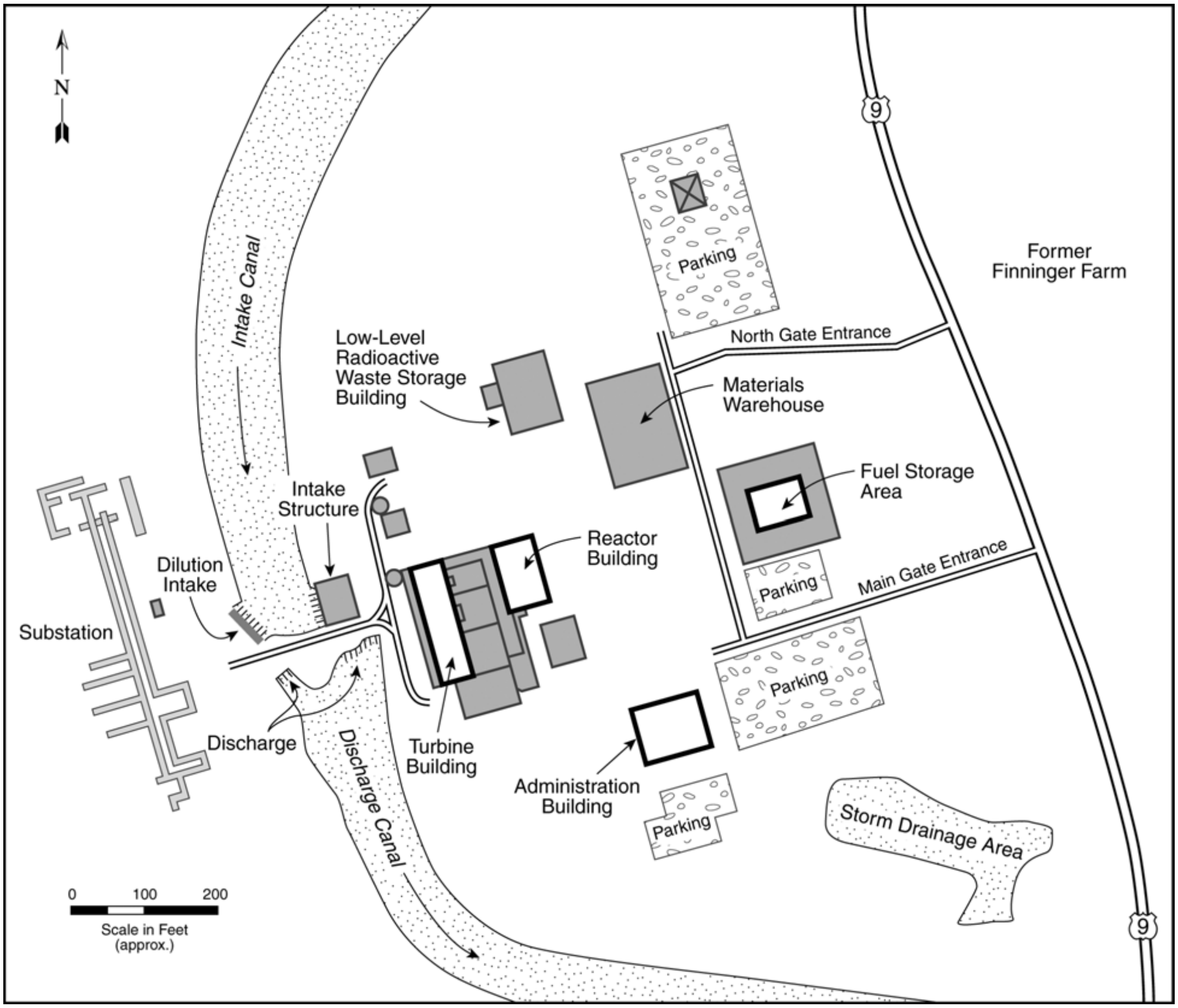

Figure 4. Oyster Creek Nuclear Generating Station Site Layout
(Source: AmerGen 2005a)

intake canal to the intake structure. 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. Three dilution pumps move water from the intake canal directly into the discharge canal to lower the temperature of the station cooling water in the discharge canal. Details on the circulating-water system are presented below. Unless otherwise noted, the discussion of the circulating-water system was obtained from the Updated Final Safety Analysis Report (AmerGen 2003), the Final Environmental Statement for OCNGS operations (AEC 1974), or the ER (AmerGen 2005a).

The intake structure has two bays, each equipped with a trash rack, a 3/8-in.-mesh traveling screen, a screen-wash system, two service-water pumps, two emergency service-water pumps, and two circulating-water pumps. Each of the four circulating-water pumps located in the intake structure can provide up to 115,000 gallons per minute (gpm) of cooling water to the condensers. In addition to the circulating water system OCNGS has a separate service water system that provides cooling water to the reactor building and turbine building heat exchangers. 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 racks are composed of nearly vertical steel bars on 3-in. centers, with effective openings of 2.5 in. After passing through the trash racks, water passes through 3/8-in.-mesh traveling screens equipped with Ristroph buckets. A low-pressure screen wash washes off impinged aquatic organisms and debris into the Ristroph buckets. The Ristroph buckets empty into a flume that conveys the fish and shellfish to the head of the discharge canal in the area of the dilution pump discharge (NJDEP 2005a).

Each bay of the intake structure has a service-water pump with a capacity of 6000 gpm, a second service-water pump with a capacity of 2000 gpm, two emergency service-water pumps each with a capacity of 4150 gpm, and a screen-wash pump with a 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.

Three dilution water pumps (low-speed, axial flow pumps with 7-ft impellers, each rated at 260,000 gpm) are located on the western side of the intake canal and are protected by trash racks. Because the dilution pump intakes lack traveling screens, fish may be drawn through the pumps. No impingement or entrainment safeguards are present; however, AmerGen contends that the 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 water, 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 covered in the New Jersey Pollutant Discharge Elimination System (NJPDES) permit, which allows only two of the three pumps to operate concurrently during normal operations. During a station shutdown, dilution pumps are operated 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 structure as needed to prevent icing.

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 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 hours per day of chlorination for the entire condensor (NJDEP 2005a).

5.0 POTENTIAL IMPACTS OF PLANT OPERATION ON BIOTA AND HABITAT

The cooling-water system associated with OCNGS utilizes water from Forked River and Barnegat Bay and may affect EFH in the following ways:

- Impingement of juvenile or adult forms of fish and shellfish;
- Entrainment of eggs or larvae of fish and shellfish, or of phytoplankton and zooplankton that form the basis of the nearshore marine food webs; and
- Discharge of heated cooling water containing biocides or other chemicals into Oyster Creek and Barnegat Bay

These impacts are discussed in this section.

5.1 IMPINGEMENT

At maximum flow, with all circulating and dilution pumps operating, the OCNGS cooling-water system requires approximately 1.25 million gpm. However, the licensee normally does not operate more than two dilution pumps at a time so total plant flow is typically less than one million gpm. At this flow rate, the velocity in the intake and discharge canals is typically less than 2.0 ft/s, but the flow is sufficient to result in impingement of fish and shellfish on the traveling screens associated with the cooling-water intake system.

Impingement mortality studies were conducted between 1965 and 1977 on a variety of fish and shellfish species, including bay anchovy (*Anchoa mitchilli*), Atlantic silverside (*Menidia menidia*), winter flounder (*Pseudopleuronectes americanus*), Atlantic menhaden (*Brevoortia tyrannus*), sand shrimp (*Crangon septemspinosa*), and blue crab (*Callinectes sapidus*). Winter flounder exhibited the highest survival after impingement (77 to 93 percent), and bay anchovy exhibited the lowest survival (4 to 19 percent) (Summers et al. 1989).

5.2 ENTRAINMENT

During normal operations, a variety of organisms are entrained, including eggs and larvae of fish and shellfish occurring in Barnegat Bay or Forked River, and phytoplankton and zooplankton that contribute to the marine-estuarine food web in Barnegat Bay. The number and variety of entrained organisms vary seasonally and annually. The most commonly entrained organisms include juvenile and adult opossum shrimp (*Neomysis integer*); zoea, juvenile, and adult sand shrimp; eggs and larvae of the bay anchovy; and larvae of winter flounder.

5.3 THERMAL RELEASES

The discharge of heated water into Oyster Creek creates elevated temperatures (>86 °F [30 °C]) in the discharge canal and produces a thermal plume in Barnegat Bay that varies in extent and magnitude based on plant operation characteristics, ambient air and water temperatures, and hydrodynamic characteristics associated with wind and tide. These thermal emissions have the potential to affect food web dynamics, alter fish behavior, or produce acute or chronic impacts on temperature-sensitive species.
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The NJDEP fact sheet (NJDEP 2005a) identified the following thermal surface-water quality standards applicable to OCNGS operations:

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

Interruption of the flow of heated water from the plant, or failure of the dilution pump system, has resulted in a number of fish kills since OCNGS began operating in 1969. Fish kills associated with thermal fluctuations from 1972 to 1982 are summarized in Kennish (2001). Additional details on fish kills related to thermal fluctuations at OCNGS are provided in Section 4 of Supplement 28 to the GEIS (NRC 2006b).

6.0 POTENTIAL EFFECTS OF THE PROPOSED ACTION ON DESIGNATED ESSENTIAL FISH HABITAT OF MANAGED SPECIES

6.1 EVALUATION OF SPECIES REQUIRING EFH CONSULTATION

During the development of this EFH assessment, NMFS websites (NMFS 2006a,b,c) were consulted to develop an initial list of candidate fish species that would be considered for EFH consultation. Because Barnegat Bay encompasses four different 10-minute × 10-minute grids for EFH habitats in addition to the Barnegat Bay complex (Table 1), the initial candidate species list includes organisms living in nearshore estuarine and oceanic habitats (Table 2). During the initial review of life history and EFH requirements for each candidate species, some species or life stages were eliminated from further consideration based on salinity or depth requirements, or life history information that suggested that the appearance of some species or life stage is unlikely in Barnegat Bay, Oyster Creek, or Forked River (Table 3). Table 4 gives the final list of species and life stages that were evaluated in this EFH assessment.

Table 1. Essential Fish Habitat Areas Associated with Barnegat Bay

North	East	South	West	Web Address
40° 10.0'N	74° 0.00'W	40° 00.0'N	74° 10.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/40007400.html
40° 00.0'N	74° 0.00'W	39° 50.0'N	74° 10.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/39507400.html
39° 50.0'N	74° 10.0'W	39° 40.0'N	74° 20.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/39407400.html
39° 40.0'N	74° 10.0'W	39° 30.0'N	74° 20.0'W	http://www.nero.noaa.gov/hcd/STATES4/new_jersey/39307410.html
Barnegat Bay, New Jersey				http://www.nero.noaa.gov/hcd/nj1.html

6.2 SPECIES DESCRIPTIONS AND IMPACT DETERMINATION

EFH requirements for the relevant species and life stages presented in Table 4 are discussed in this section. Species descriptions include, if available, information on fish abundance patterns in Barnegat Bay, common depth distributions, migratory and spawning habits, tolerance and preference ranges for temperature and salinity, habitat needs, and information on food preferences. For each species and life stage, OCNGS operations were evaluated to determine whether they resulted in (1) no adverse impact, (2) minimal adverse impact, or (3) substantial adverse impact on EFH. These impact categories follow the standard used by

Table 2. Initial List of Candidate Species and Life Stages Considered for Inclusion in EFH Assessment

		Life Stage				
Scientific Name	**Common Name**	**Egg**	**Larvae**	**Juvenile**	**Adult**	**Spawning Adult**
Carcharhinus obscurus	dusky shark		◆[a]			
Carcharhinus plumbeus	sandbar shark		◆[a]	◆	◆	
Centropristis striata	black sea bass			◆	◆	
Clupea harengus harengus	Atlantic sea herring			◆	◆	
Gadus morhua	Atlantic cod				◆	
Galeocerdo cuvier	tiger shark		◆[a]	◆		
Glyptocephalus cynoglossus	witch flounder	◆				
Hippoglossoides platessoides	American plaice			◆	◆	
Leocoraja erinacea	little skate			◆	◆	
Leucoraja ocellata	winter skate			◆	◆	
Limanda ferruginea	yellowtail flounder	◆	◆			
Lophius americanus	monkfish	◆	◆			
Merluccius bilinearis	whiting	◆	◆	◆	◆	
Paralichthys dentatus	summer flounder		◆	◆	◆	
Peprilus triacanthus	Atlantic butterfish			◆		
Pomatomus saltatrix	bluefish			◆	◆	
Pseudopleuronectes americanus	winter flounder	◆	◆	◆	◆	◆
Rachycentron canadum	cobia	◆	◆	◆	◆	
Raja eglanteria	clearnose skate			◆	◆	
Scomberomorus cavalla	king mackerel	◆	◆	◆	◆	
Scomberomorus maculatus	Spanish mackerel	◆	◆	◆	◆	
Scophthalmus aquosus	windowpane flounder	◆	◆	◆	◆	◆
Spisula solidissima	surf clam			◆	◆	
Stenotomus chrysops	scup			◆	◆	
Urophycis chuss	red hake	◆	◆	◆		
Zoarces americanus	ocean pout	◆		◆	◆	

(a) Neonates and/or early-stage juveniles.

Table 3. Species and Life Stages Eliminated from Consideration in EFH Assessment and Rationale for Elimination

Common Name	Life Stages Eliminated from EFH Assessment	Rationale for Elimination
American plaice	All life stages	Salinity and depth requirements not present in Barnegat Bay
Atlantic butterfish	All life stages	Depth requirements not present in Barnegat Bay
Atlantic cod	All life stages	Salinity and depth requirements not present in Barnegat Bay
Atlantic sea herring	All life stages	Salinity and depth requirements not present in Barnegat Bay
Black sea bass	Adults (juveniles retained)	Depth requirements not present in Barnegat Bay
Bluefish	Adults (juveniles retained)	Salinity requirements not present in Barnegat Bay
Cobia	All life stages	Salinity requirements not present in Barnegat Bay
King mackerel	All life stages	Salinity requirements not present in Barnegat Bay
Monkfish	All life stages	Depth requirements not present in Barnegat Bay
Ocean pout	All life stages	Salinity requirements not present in Barnegat Bay
Red hake	Juveniles (eggs and larvae retained)	Salinity requirements not present in Barnegat Bay
Spanish mackerel	All life stages	Salinity requirements not present in Barnegat Bay
Summer flounder	Larvae (juveniles and adults retained)	Depth requirements not present in Barnegat Bay
Whiting	All life stages	Depth requirements not present in Barnegat Bay
Witch flounder	All life stages	Salinity and depth requirements not present in Barnegat Bay
Yellowtail flounder	All life stages	Salinity and depth requirements not present in Barnegat Bay

Table 4. Species and Life Stages Included in EFH Consultation

Common Name	Egg	Larvae	Juvenile	Adult	Spawning Adult
	Life Stage				
Black sea bass			◆		
Bluefish			◆		
Clearnose skate			◆	◆	
Dusky shark		◆[(a)]			
Little skate			◆	◆	
Red hake	◆	◆			
Sandbar shark		◆[(a)]	◆	◆	
Scup			◆	◆	
Summer flounder			◆	◆	
Surf clam			◆	◆	
Tiger shark		◆[(a)]	◆		
Windowpane flounder	◆	◆	◆	◆	◆
Winter flounder	◆	◆	◆	◆	◆
Winter skate			◆	◆	

(a) Neonates and/or early-stage juveniles.

the Northeast Regional Office of the NMFS. To determine impact level, OCNGS monitoring data, scientific journal articles or technical reports, and other relevant information were reviewed.

Black Sea Bass (*Centropristis striata*)

Barnegat Bay is considered EFH for juvenile black sea bass. The shallow depth of Barnegat Bay prevents it from meeting EFH criteria for black sea bass adults. Juveniles enter the estuary in late spring and early summer after settlement has occurred in coastal waters, and move to warmer offshore or southern waters during the winter months. Juvenile young-of-the-year (YOY) are tolerant of temperatures of 43-86 °F (6 to 30 °C) and salinities of 8 to 38 ppt, but prefer temperatures of 63-77 °F (17 to 25 °C) and salinities of 18 to 20 ppt. In winter, juvenile black sea bass require water temperatures higher than 41 °F (5 °C) and prefer salinities of approximately 18 to 20 ppt (NMFS 1999a). The EFH of juvenile black sea bass includes shallow, hard-bottom substrates with structure present to provide protection and refuge. Suitable habitat includes oyster or mussel beds, seagrass beds, piers, wharves, artificial reefs, and cobble and shoal areas (NMFS 2006a,b,c). Juveniles do not prefer open areas, unvegetated sandy intertidal areas, or beaches. Juvenile black sea bass are diurnal, visual predators, and their diet consists of small benthic crustaceans, polychaetes, sand shrimp, amphipods, and shrimp. There is also no evidence that entrainment of prey items (e.g., sand shrimp) has significantly disrupted the population of juvenile black sea bass in Barnegat Bay. Reported losses of seagrass habitat in Barnegat Bay appear to be related to increased urbanization and possibly to alterations to Barnegat Inlet that have changed the salinity and resulted in the proliferation of algal blooms that can kill seagrass or limit light penetration and productivity (McLain and McHale 1996; BBNEP 2001; Gastrich et al. 2004). This species is not commonly impinged on OCNGS traveling screens, nor has it been identified in episodic fish kills associated with the thermal plume. Although prey items are entrained or impinged in the OCNGS cooling system, there is no indication that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on juvenile black sea bass EFH.

Bluefish (*Pomatomus saltatrix*)

Barnegat Bay is considered EFH for juvenile and adult bluefish, although adults are generally not found in the bay because they require oceanic (>35 ppt) salinity. According to the NMFS (1999b), juvenile bluefish distribution over the continental shelf has not been documented; thus, it is unclear whether this life stage is estuarine-dependent. Juveniles have been observed in all estuaries within the Middle Atlantic Bight from May through October. As water temperatures cool during the autumn and winter, juveniles and adults move south. Optimum conditions for pelagic juveniles (summer cohort) include temperatures of 59 to 68 °F (15 to 20 °C) and salinities of 31 to 36 ppt. Summer cohort juveniles prefer temperatures of 68 to 86 ° F (20 to 30 °C) and salinities of 23 to 33 ppt. Bluefish are known to be voracious predators and appear to eat whatever prey items are abundant, including small fish, polychaetes, and crustaceans. It is likely that the juvenile summer-spawned cohort uses Barnegat Bay as a nursery area (Tatham et al. 1984). Although juvenile bluefish are among the species that have been killed by thermal shock associated with OCNGS operations (Kennish 2001), the number of fish kills has declined dramatically over the past decade because of improved procedures. There is no evidence that large numbers of juvenile bluefish are impinged on the OCNGS cooling system traveling screens, nor is there evidence that entrainment or impingement of prey items at OCNGS has resulted in a detectable disruption of the food web in Barnegat Bay (EA 1986; Summers et al. 1989). It appears that OCNGS operations would likely have a minimal adverse effect on bluefish EFH.

Clearnose Skate (*Raja eglanteria*)

On the basis of the distribution patterns described by NMFS (2006c), Barnegat Bay may provide EFH for juvenile and adult clearnose skates. Little information is available to determine whether juveniles and adults frequent Barnegat Bay. However, there is some evidence that they enter the coastal waters of New Jersey during the spring and early summer and move offshore and southward as the water cools during the autumn and winter (NMFS 2003a). Tatham et al. (1984) considered the clearnose skate as a local marine stray in Barnegat Bay. Clearnose skates occur over a relatively large temperature range (48 to 86 °F [9 to 30 °C]) and have been found in water with salinity ranging from 6 to greater than 35 ppt (NMFS 2003a). The optimum temperature for both juveniles and adults appears to be approximately 48 to 68°F (9 to 20 °C), and the optimum salinity appears to range from 31 and 35 ppt. Skates are often found on soft-bottom habitats along the continental shelf and have been caught in water depths ranging from approximately 1 to 300 m; they are most common in waters ranging from about 5 to 20 m. Juveniles and adults generally move inshore and northward during the spring and early summer, and offshore and southward during the autumn and early winter. Juvenile and adult clearnose skates are not commonly impinged on the OCNGS traveling screens, nor is there evidence to suggest that clearnose skates make significant use of the estuary for reproduction or nursery activities. It is also unlikely that OCNGS operations have adversely affected EFH for this species because the operational impacts on nearshore sediments are generally restricted to Oyster Creek and Forked River (EA 1986; Summers et al. 1989). Although prey items are entrained or impinged in the OCNGS cooling system, there is no indication that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on EFH for adult or juvenile clearnose skates.

Dusky Shark (*Carcharhinus obscurus*)

According to the NMFS (2006c), Barnegat Bay is designated as EFH for dusky shark neonates and early-stage juveniles. Shallow bays and estuaries are used as nursery areas for young sharks. After giving birth, females leave the estuary (FMNH 2006a). Adults are considered highly migratory (NMFS 2006d) and generally move north during the summer and south during the winter. Adults avoid low-salinity conditions and rarely enter estuaries. This species was not identified in Barnegat Bay by Tatham et al. (1984). EFH for neonates and early-stage juveniles is considered to be shallow coastal waters, inlets, and estuaries to depths of approximately 25 m (NMFS 2006d), and it appears that the young sharks are tolerant of both temperature and salinity extremes common to estuaries. Because recently born sharks are approximately one m in length, their diet is assumed to be similar to adults and includes a variety of fish and invertebrates occurring near the bottom. This species was not commonly impinged (EA 1986; Summers et al. 1989), and dusky sharks have not been found in OCNGS fish kills. Although prey items are entrained or impinged in the OCNGS cooling system, there is no indication that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on EFH for neonates and early-stage juveniles.

Little Skate (*Leocoraja erinacea*)

On the basis of the distribution patterns presented in NMFS 2006c, Barnegat Bay likely contains EFH for juvenile and possibly adult little skates. Adults and juveniles generally move into shallow coastal areas and estuaries during the spring and summer, and into deeper water during the winter. They may also leave estuaries for deeper waters during warm summer months (NMFS 2003b). Juvenile skates are generally found in water depths ranging from 1 to 400 m, but are most common in depths of 5 to 8 m. They are able to tolerate temperatures ranging from 32 to 45 °F (0 to 7 °C) in the winter and 57 to 72 °F (14 to 22 °C) in the summer, and salinity ranging from approximately 15 to 35 ppt. Adults and juveniles collected from the New York Bight were found at a mean temperature of 47 °F (8.5 °C) and a mean salinity of 32 ppt (NMFS 2003b). Preferred prey items for adult and juvenile little skates include decapod crustaceans and amphipods. Fish and squid are also eaten. On the basis of studies of the OCNGS once-through cooling system, entrainment of early life stages of fish and invertebrates has not adversely affected the prey items of Barnegat Bay that could potentially support juvenile and adult skates, nor is this species commonly impinged on the traveling screens associated with the cooling-water intakes. Although fish kills due to thermal fluctuations have occurred, little skate was not among the species killed. OCNGS operations would likely have a minimal adverse effect on EFH for juvenile and adult little skate.

Red Hake (*Urophycis chuss*)

Barnegat Bay is considered EFH for eggs and larvae of the red hake. Red hake are demersal fish common along the New Jersey coastline. Spawning adults are known to frequent coastal ports, and spawning occurs from about April to November at temperatures between 41 and 50 ° F (5 and 10 °C) (NMFS 1999c). Eggs are about 0.6 to 1.0 mm in diameter and float near the water surface. EFH for red hake eggs includes surface waters of the middle Atlantic region at sea surface temperatures below 50 °F (10 °C) and salinities of less than 25 ppt. Eggs are usually observed from May to November, with peak densities during June and July (NMFS 2006a,c). Temperature dependent hatching occurs at temperatures ranging from 37 to 45 °F (3 to 7 °C). Larvae of red hake are less than 2.0 mm at hatching and dominate the ichthyoplankton during the late summer months in the Middle Atlantic Bight (NMFS 1999c). EFH for larval red hake includes surface waters of the middle Atlantic region at depths less than 200 m, temperatures less than 66 °F(19 °C), and salinities greater than 0.5 ppt. Larvae are observed from May to December, with peak densities in September and October (NMFS 2006b). Larvae are nocturnal feeders that prey upon copepods and other microcrustaceans. On the basis of results of the 316(b) demonstration study at OCNGS (EA 1986; Summers et al. 1989), eggs and larvae of red hake were not identified in entrainment samples at OCNGS, nor is there evidence that entrainment or thermal fluctuations associated with the facility have resulted in a detectable disruption of food web dynamics in the estuary with respect to the presence and abundance of microcrustacean prey items. OCNGS operations would likely have a minimal adverse effect on EFH for red hake eggs and larvae.

Sandbar Shark (*Carcharhinus plumbeus*)

Barnegat Bay is considered EFH for neonate, juvenile, and adult sandbar sharks. Sandbar sharks are bottom-dwelling and represent one of the most numerous shark species in the western Atlantic. EFH requirements for neonates and early juveniles (90 cm or less) include shallow coastal waters at depths reaching 25 m, and nursery areas generally located in shallow coastal waters with temperatures higher than 70 °F (21 °C) and salinities greater than 22 ppt (NMFS 2006b). EFH for late-stage juveniles and subadults (91 to 179 cm) is identified in coastal and pelagic waters near Barnegat Inlet that range in depth from 25 to 200 m (NMFS 2006c). EFH for adult sandbar sharks (>179 cm) includes shallow coastal areas to a depth of 50 m. Temperature and salinity preferences for various life stages are assumed to be typical of estuaries. Sandbar sharks are opportunistic feeders, and prey items commonly include small fish, molluscs, and crustaceans. Some of these prey are commonly impinged at OCNGS. The sandbar shark was not identified as a common species in Barnegat Bay by Tatham et al. (1984), juveniles and adults are not routinely impinged on the OCNGS traveling screens (EA 1986; Summers et al. 1989), and this species has not been found in OCNGS fish kills (Kennish 2001). OCNGS operations would likely have a minimal adverse effect on EFH for this species.

Scup (*Stenotomus chrysops*)

Barnegat Bay contains EFH for the both juvenile and adult scup. Scup are considered a temperate species, with a range extending from Massachusetts to South Carolina, and are common in the summer and early fall in coastal estuaries containing both open and structured environments (NMFS 1999d). Tatham et al. (1984) considered scup a local marine stray in Barnegat Bay. Juveniles are found in water depths ranging from intertidal to approximately 39 m; they prefer water temperatures of approximately 61 to 70 °F (16 to 22 °C), but are found in water with temperatures higher than 45 °F (7 °C) in winter. Juveniles in estuaries are found at salinities greater than 15 ppt; those in coastal environments are found at salinities exceeding 30 ppt. The primary prey items for juveniles include small benthic invertebrates, fish eggs, and larvae. EFH for juvenile scup includes the demersal waters over the continental shelf and estuaries where juvenile scup are abundant. In estuaries like Barnegat Bay, juveniles are commonly found in sandy and muddy environments, near mussel and eelgrass beds where water temperatures are higher than 45 °F (7 °C) and salinities are greater than 15 ppt. In summer, adult scup are found in water depths of approximately 2 to 38 m, at temperatures ranging from 45 to 77 °F (7 to 25 °C), and at salinities greater than 15 ppt. In winter, adults are generally found offshore in water depths ranging from 38 to 185 m, water temperatures higher than 45 °F (7 °C), and salinities exceeding 30 ppt (NMFS 2006b). Adult scup feed on small benthic invertebrates and small fish. EFH for adult scup is similar to that described for juveniles. Fish kills at OCNGS have included scup, but fewer than 10 individuals were killed per event. Previous studies and the conclusions of Kennish (2001) indicate that there is no evidence that OCNGS operations have resulted in detectable changes in scup prey populations. On the basis of work by Tatham et al. (1984), scup were not abundant in Barnegat Bay during the 1980s, nor were they commonly entrained at OCNGS (EA 1986; Summers et al. 1989). OCNGS operations would likely have a minimal adverse effect on EFH for scup juveniles and adults.

Summer Flounder (*Paralichthys dentatus*)

Barnegat Bay is considered EFH for summer flounder juveniles and adults. Summer flounder are common in coastal and estuarine waters from Nova Scotia to Florida; the highest abundances are associated with waters of the Middle Atlantic Bight (NMFS 1999e). Tatham et al. (1984) considered this species a warmwater migrant in Barnegat Bay. Summer flounder exhibit a strong seasonal migration pattern that finds them in shallow coastal and estuarine waters during the spring and summer, and in deeper offshore waters during the fall and winter. EFH for juveniles includes demersal waters over the continental shelf, and estuaries where juveniles have been observed. Nursery habitat used by juvenile flounder in Barnegat Bay includes salt marsh creeks, seagrass beds, mudflats, and open bay areas. Preferred water temperature is higher than 37 °F (3 °C), and preferred salinities range from 10 to 30 ppt. EFH for adult summer flounder includes demersal waters over the continental shelf at water depths to 152 m and coastal systems similar to Barnegat Bay (NMFS 2006c). Juvenile and adult summer flounder are opportunistic feeders; juveniles appear to prefer crustaceans and polychaetes, while larger individuals appear to prefer crustaceans and fish. The primary impacts of OCNGS operations on summer flounder EFH are expected to be impingement of juveniles and adults on OCNGS traveling screens, and impacts associated with the OCNGS thermal discharges. Annual summer flounder impingements ranged from 1308 to 4266 individuals. This represented less than 0.2 percent of the total number of individual fish impinged during that period and was considered inconsequential by EA (1986), given the number of fish caught by recreational anglers during that period. Fish kills associated with thermal fluctuations at OCNGS did not include summer flounder (Kennish 2001). Also, there is no evidence to suggest that the operation of the facility has significantly affected the prey of this species (EA 1986; Summers et al. 1998). Thus, OCNGS operations would likely have a minimal adverse effect on EFH for this species.

Surf Clam (*Spisula solidissima*)

The coastal region adjacent to Barnegat Bay is considered EFH for juvenile and adult surf clams. Both adults and juveniles are found along the Atlantic Coast from the Gulf of St. Lawrence to Cape Hatteras, from the beach zone to a water depth of approximately 60 m

(FWS/DOI/USACE 1983; Weinberg 2000; NJDEP 2005b). The species prefers oceanic salinities (>32 ppt) and temperatures ranging from 59 to 86 °F (15 to 30 °C). Both juveniles and adults are filter-feeders, and their diet consists of a variety of algae associated with the sediment surface and the water column. EFH for juveniles and adults includes substrates to a depth of one m below the water-sediment interface in waters from the eastern edge of Georges Bank and the Gulf of Maine through the Atlantic Exclusive Economic Zone, in areas that encompass the top 90 percent of all ranked 10-minute squares for the areas where surf clams were caught during the Northeast Fisheries Science Center surf clam and ocean quahog dredge surveys (NMFS 2006c). Because surf clams are known to burrow in medium to coarse sand and gravel substrates, they may occur in Barnegat Bay near the Barnegat Inlet. It is unlikely that OCNGS operations impact the EFH or food supply of surf clams because they are generally found in coastal rather than estuarine waters. Surf clam larvae have not been reported in OCNGS entrainment samples, and hydrodynamic modeling indicates that the OCNGS thermal plume does not extend to Barnegat Inlet (EA 1986). Although the number of surf clams appears to have decreased since 1996, a variety of factors are likely responsible for the decline, including a change in ambient water temperature due to a warm water intrusion over the mid-Atlantic shelf. This intrusion may be responsible for the mortality of larger clams, and the gradual northward shift of the population (Weinberg 2000). In conclusion, no adverse effect on surf clam EFH is expected from continued OCNGS operations.

Tiger Shark (*Galeocerdo cuvier*)

Barnegat Bay is considered EFH for neonate and juvenile tiger sharks (NMFS 2006b). This species is common throughout the world in temperate waters and exhibits a high tolerance for many different kinds of marine habitats, including rivers, estuaries, harbors, and other nearshore locations where there are numerous prey items (FMNH 2006b). Adults migrate north from tropical to temperate waters during the summer months and return to the tropics during the winter. Mating occurs between March and May, and young are born between April and June of the following year. EFH for neonates and juveniles includes shallow coastal waters to a depth of 200 m from Cape Canaveral, Florida, to offshore Montauk, Long Island, New York (NMFS 2006c). Adults are known to feed on a variety of fish and invertebrates, and it is assumed that juveniles share this characteristic. Juveniles are not routinely impinged on the traveling screens associated with the circulating-water cooling system, nor is there evidence to suggest that plant operations have significantly affected prey populations (Kennish 2001). OCNGS operations would likely have a minimal adverse effect on EFH of the tiger shark.

Windowpane Flounder (*Scophthalmus aquosus*)

Barnegat Bay is considered EFH for all life stages of the windowpane flounder, including spawning adults (NMFS 2006b). This species occurs in estuaries, nearshore waters, and waters associated with the continental shelf along the Atlantic Coast from the Gulf of

St. Lawrence to Florida, and is most abundant in water depths of two m or less (NMFS 1999f). Eggs are buoyant and are typically found in surface waters, with greatest abundance between May and October. Larvae are approximately 2 mm long at hatching, and metamorphose into juvenile forms when they reach a length of approximately 5.5 mm; they settle to the bottom when they reach a total length of approximately 10 mm (Bigelow and Schroeder 1953). Juveniles typically reach a size range of 11 to 19 cm about 4 months after spawning, and the total length of adults is about 46 cm (NMFS 1999f). Adults generally spawn from February to December, with peak spawning occurring in May in the middle-Atlantic region (NMFS 2006a). Juvenile and adult windowpane flounder feed on small crustaceans (mysid shrimp and decapods) and larval forms of fish.

EFH for eggs includes surface waters extending from the Gulf of Maine to Cape Hatteras. Optimum water temperatures are less than 68 °F (20 °C) and water depths of less than 70 m (NMFS 2006c). EFH for larvae is similar to that described for eggs. EFH for juvenile windowpane flounder includes mud or fine-grained sand substrates with water temperatures below 77 °F (25 °C), depths of 1 to 100 m, and salinities between 5.5 and 36 ppt (NMFS 2006c). EFH for adults is similar to that described for juveniles, with water temperatures below 81 °F (27 °C). Spawning adults in the mid-Atlantic region prefer habitats with mud or fine-grained sand, water temperatures below 70 °F (21 °C), salinities ranging from 5.5 and 36 ppt, and water depths ranging from 1 to 75 m. The peak spawning period is May (NMFS 2006c).

Because all life stages of windowpane flounder could occur in Barnegat Bay, it is possible that OCNGS activities could adversely affect EFH for this species. Tatham et al. (1984) considered the windowpane flounder a local marine stray and did not consider it to be an abundant species based on trawl studies in the study area from 1975 to 1978, nor was it designated as a species that uses the estuary for spawning or as a nursery area. On the basis of commercial landing data for this species for the state of New Jersey provided by the NMFS (2005), commercial landings of windowpane flounder during the Tatham et al. study period ranged from 0 to 0.6 metric tons, and were less than 4.5 metric tons from 1971 to 1996. This could account for the low abundances of this species in Barnegat Bay. Commercial landings in New Jersey increased dramatically after 1996, peaking at 51 metric tons in 2001. Commercial landings of windowpane flounder have declined since 2001 and accounted for 16.9 metric tons in 2004 (NMFS 2005).

The results of studies conducted at OCNGS between 1965 and 1977 suggest that eggs and larvae of windowpane flounder are not commonly entrained, and there was no evidence of significant impingement of this species during that time (EA 1986; Summers et al. 1989). In addition, this species has not been found in fish kills resulting from OCNGS operations (Kennish 2001). Unfortunately, most of the relevant information collected to determine potential OCNGS impacts occurred during a period of low abundance of this species (NMFS 2005).

Detailed abundance, entrainment, and impingement data are not available for Barnegat Bay during years when commercial landings were at historical highs (1997 to 2004). Therefore, it is not possible to quantify EFH impacts for this species during that period. Despite this, it appears likely that the general conclusions stated in EA (1986), Summers et al. (1989), and Kennish (2001) are still valid. All three sources concluded that the operation of OCNGS did not result in a discernable effect on invertebrate or fish communities in Barnegat Bay. OCNGS operations are expected to result in a minimal adverse effect on EFH for windowpane flounder eggs, larvae, juveniles, adults, and spawning adults.

Winter Flounder (*Pseudopleuronectes americanus*)

Barnegat Bay is considered EFH for all lifestages of the winter flounder, including spawning adults. Winter flounder represent a valuable recreational and commercial resource along the Atlantic Coast; this species is ubiquitous in inshore areas from Massachusetts to New Jersey (NMFS 1999g). Winter flounder eggs are adhesive and occur in clusters. Larval forms are initially planktonic and begin to settle to the bottom when they reach a length of approximately 9 to 13 mm. In New Jersey waters, YOY and juvenile winter flounder are found in shallow water, where they may grow from 0.23 to 0.47 mm per day (NMFS 1999g). Adults can grow to a length of 58 cm and may live up to 15 years. Adults enter nearshore estuaries and rivers during the fall and early winter and spawn in late winter and early spring. After spawning, adults typically leave inshore areas. Winter flounder larvae eat small planktonic organisms (copepods, eggs, and phytoplankton); juveniles and adults are opportunistic feeders, and their diets include polychaetes and crustaceans. EFH for winter flounder eggs consists of bottom habitats with sand, muddy sand, and gravel substrates; a depth range of 0.3 to 4.5 m, an optimum temperature range of 37 to 41 °F (3 to 5 °C), and a preferred salinity range of 10 to 32 ppt (NMFS 1999g; NMFS 2006a). EFH for larvae includes shallow (1 to 4.5 m) inshore areas with a fine sand to gravel substrate, temperatures of 36 to 59 °F (2 to 15 °C), and a salinity range of 3.2 to 30 ppt. YOY and juveniles prefer a habitat consisting of mud or sand (with shell fragments) and water depths ranging from approximately 0.5 to 27 m. Preferred temperatures range from 36 to 84 °F (2 to 29 °C) for YOY and from 50 to 77 °F (10 to 25 °C) for juveniles. Preferred salinity ranges are approximately 23 to 33 ppt for YOY and 19 to 21 ppt for juveniles. Adult winter flounder are typically found in 1 to 30 m of water with a mud, sand, or large cobble substrate. The preferred water temperature range is 54 to 59 ° F (12 to 15 °C), and the preferred salinity range is 15 to 33 ppt.

OCNGS operations have the potential to adversely affect EFH for all life stages of winter flounder because all stages could occur in Barnegat Bay. Tatham et al. (1984) considered the winter flounder a resident species in Barnegat Bay that made significant use of the estuary for spawning and as a nursery area; the years of study (1975 to 1978) reflected a period when commercial landings in New Jersey waters ranged from 47.7 to 92.7 metric tons. These data appear to reflect a low point in the population based on data from 1979 to 2004, when catches usually exceeded 100 metric tons and were greater than 200 metric tons for seven years during that period (NMFS 2005). Winter flounder larvae represented between 1 and 10 percent of the annual OCNGS entrainment measured in studies from 1975 to 1981 (Summers et al. 1989). Juvenile and adult opossum shrimp represented the largest percentage of organisms entrained during that period (49 to 91 percent). The total number of entrainment losses for winter flounder larvae for 1975 to 1976, 1977 to 1978, and 1980 to 1981 was 4330 million organisms (Summers et al. 1989). Opossum shrimp entrainment losses during this same period were 209,889 million organisms (Summers et al. 1989). Winter flounder are also impinged on the OCNGS traveling screens. Annual impingement of winter flounder from 1975 to 1985 ranged from 8908 individuals in 1975 to 1976, to more than 148,000 individuals from 1978 to 1979), and the average annual impingement was estimated (EA 1986) to be 38,866 individuals during that period. These totals represented less than 1.5 percent of the total impingements observed at the facility during the study period (sand shrimp and blue crab accounted for the majority of the impingements) and less than 1 percent of the total population in Barnegat Bay during that time. It is likely the winter flounder impingement losses are actually lower than those described in EA (1986) because they did not reflect the high survival observed in impinged organisms (77 to 94 percent) (Summers et al. 1989). Although thermal fluctuations associated with OCNGS operations have caused significant fish kills, winter flounder have not been among the affected species (Kennish 2001).

On the basis of the results of OCNGS studies (EA 1986; Summers et al. 1989) and the results reported in Kennish (2001), OCNGS operations have not resulted in discernable changes in invertebrate or fish communities in Barnegat Bay. OCNGS does not appear to adversely affect winter flounder egg EFH, since the eggs are demersal, adhesive, and occur in clusters. OCNGS operations would likely have a minimal adverse effect on EFH for larvae, juveniles, adults, and spawning adults of the winter flounder.

Winter Skate (*Leucoraja ocellata*)

On the basis of the distribution patterns described in NMFS (2006c), Barnegat Bay may provide EFH for both juvenile and adult winter skate. This species is common along the Atlantic Coast, with a range extending from the Gulf of St. Lawrence to Cape Hatteras. The population center is believed to be on Georges Bank (NMFS 2003c). EFH for juvenile and adult winter skates includes sand- and gravel-bottom substrates at depths of up to 300 m. During the spring, juveniles are found in water temperatures ranging from 34 to 54 °F (1 to 12 °C), with the majority occurring in temperatures of 39 to 41 °F (4 to 5 °C) and a salinity range of 32 to 33 ppt. During the fall, juveniles occur in water temperatures ranging from 41 to 70 °F (5 to 21 °C), with peak abundances observed at 59 °F (15 °C) and in salinities of 32 and 33 ppt (NMFS 2003c). Adult winter skates are found year round at temperatures ranging from 36 to 52 °F (2 to 11 °C) and depths ranging from 31 to 60 m. Adults are typically found at salinities ranging from 30 to 36 ppt. Juvenile and adult winter skates are bottom feeders and preferred prey include polychaetes and crustaceans. Crustaceans are believed to make up more than 50 percent of their diet (NMFS 2003c). Because this species generally occurs in water with salinities greater than 32 ppt, it is not likely that this species spends a significant amount of time in the western portion of Barnegat Bay. However, it may frequent the eastern portion where higher salinity exists near the Barnegat Inlet. Tatham et al. (1984) did not identify winter skate as a common species in Barnegat Bay, nor are juveniles or adults routinely impinged on OCNGS traveling screens (EA 1986; Summers et al. 1989). This species was not identified in OCNGS fish kills (Kennish 2001). Current OCNGS operations may entrain or impinge some winter skate prey, but there is no evidence that prey populations have been measurably affected. OCNGS operations would likely have a minimal adverse effect on winter skate EFH for juveniles and adults.

7.0 MITIGATION MEASURES

Three categories of impacts related to OCNGS operations that could influence EFH are: (1) release of heated cooling water containing biocides or other chemicals; (2) entrainment of eggs, larvae, or phytoplankton and zooplankton in the water column; and (3) impingement of juveniles or adults. These operations are regulated under a NJPDES permit that is currently under review for extension to April 30, 2009. The NJDEP developed a fact sheet (NJDEP 2005a) that describes the agency’s assessment of impacts and potential mitigation alternatives that may be necessary to comply with Phase II requirements of Section 316(b) of the Clean Water Act.

The existing dilution-pump system was designed to mitigate thermal effects in the discharge canal, Oyster Creek, and Barnegat Bay. Water at ambient temperature is pumped directly from the intake canal to the discharge canal where it mixes with the heated discharged water. The dilution water serves to reduce the temperature of the discharged circulation water immediately. Such temperature reduction greatly reduces any potential thermal effects on EFH in the discharge canal, Oyster Creek, and Barnegat Bay.

The NJDEP has granted OCNGS a variance from thermal surface-water quality standards for heat and temperature pursuant to Section 316(a) of the Clean Water Act. This variance was granted based on the assessment by Summers et al. (1989) that the operation of OCNGS did not appear to produce long-term population or ecosystem level impacts. Thus, the draft NJPDES permit does not require additional mitigation measures for thermal discharges beyond those already stipulated in the existing permit, which include temperature monitoring at various locations near OCNGS and plant shutdown restrictions during December, January, February, and March to reduce the possibility of fish kills related to cold shock.

Current mitigation measures also are in place to reduce effects of impingement on EFH in Barnegat Bay, Forked River, and the intake canal. In 1984, the circulating-water intake was fitted with 3/8-in.-mesh traveling screens with Ristroph buckets and a screen-wash and fish-return system. Impinged organisms are washed into or fall into the buckets; the buckets deliver the organisms into the fish-return system, which transports them to the discharge canal where the dilution water enters the canal. Such mitigation measures greatly reduce the effects of impingement on EFH, including various life stages of prey species, in the Barnegat Bay system.

The fact sheet also addresses the impacts of entrainment and impingement by evaluating the potential losses of representative important species using three population models: equivalent adult model, production foregone model, and spawning/nursery area of consequence model. Although the NJDEP acknowledged the conclusion of Summers et al. (1989) that OCNGS operations 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 trigger the 2004 EPA Phase II Section 316(b) requirements. The NJDEP went 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 National entrainment performance standard requires that entrainment mortality for all life stages of fish and shellfish be reduced by 60 to 90 percent from the calculated baseline, though there is no guidance on how the baseline is to be calculated. Impingement mortality is to be reduced by 80 to 90 percent from the calculated baseline. In addition to compliance with these performance standards, the NJDEP has indicated that AmerGen should initiate a wetlands restoration and enhancement program, within the Barnegat Bay estuary, to offset any residual impingement and entrainment losses at the facility. If such mitigation were to occur, it is likely that the potential impact of OCNGS activities on EFH would be further reduced during the license renewal period.

8.0 CONCLUSION

The expected impacts of OCNGS operations on EFH is summarized in Table 5. Because OCNGS operates a once-through cooling system, it has the potential to create a substantial adverse impact on EFH due to the withdrawal of water from the Forked River and Barnegat Bay. However, the general lack of interaction between EFH species and the facility, as well as current mitigation measures in place at OCNGS, reduce the potential adverse effect on EFH. OCNGS operations do not have an adverse effect on the food web in Barnegat Bay. The NRC staff concludes that license renewal for OCNGS for an additional 20 years of operation would result in a minimal adverse effect on EFH.

Table 5. Impacts of OCNGS Operations on EFH

Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
Black sea bass	Juveniles	Shallow water hard substrate with refuge. Temperatures of 17 to 25°C, and salinity of 18 to 22 ppt.	**Minimal Adverse Effect**. Probably does not frequent nearshore areas near OCNGS and not commonly impinged. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Bluefish	Juveniles	Habitat requirements not specified. Summer cohort temperatures of 20 to 30°C, and salinity of 31 to 36 ppt.	**Minimal Adverse Effect**. Not commonly impinged. Some documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Clearnose skate	Juveniles	Soft-bottom substrate. Temperatures of 9 to 20°C, and salinity of 31 to 35 ppt.	**Minimal Adverse Effect**. Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Same as juveniles	**Minimal Adverse Effect**. Same as juveniles.
Dusky shark	Neonates and juveniles	Shallow coastal waters to 25 m. Temperature of about 19°C, and salinity of >30 ppt.	**Minimal Adverse Effect**. Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Little skate	Juveniles	Shallow coastal water and estuaries (5 to 8 m). Temperatures of 0 to 7°C (winter), and 14 to 22°C (summer). Salinity of 15 to 35 ppt.	**Minimal Adverse Effect**. Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Same as juveniles.	**Minimal Adverse Effect**. Same as juveniles.
Red hake	Eggs	Surface waters of mid-Atlantic region. Temperature of <10°C, and salinity of <25 ppt.	**No Adverse Effect.** Not commonly entrained.
	Larvae	Surface waters of mid-Atlantic region. Temperature of <19°C, and salinity of >0.5 ppt.	**Minimal Adverse Effect.** Not commonly entrained. Prey items are entrained at OCNGS, but prey population size not affected.

Table 5. (contd)

Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
Sandbar shark	Neonates and juveniles	Shallow coastal waters (25 to 200 m). Temperature of >21°C, and salinity of >22 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged, no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Shallow coastal waters (<50 m). Temperature and salinity similar to coastal estuaries with oceanic influence.	**Minimal Adverse Effect.** Same as juveniles.
Scup	Juveniles	Sandy or muddy habitat. Temperature of >7°C, and salinity of >15 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. Some documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Same as juveniles.	**Minimal Adverse Effect.** Same as juveniles.
Summer flounder	Juveniles	Coastal estuaries with seagrass, mudflats, or open areas. Temperature of >3°C, and salinity 10 to 30 ppt.	**Minimal Adverse Effect.** Some annual impingement mortality, but no observed population impacts. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adults	Demersal waters over continental shelf, oceanic conditions.	**Minimal Adverse Effect.** Same as juveniles.
Surf clam	Juveniles	Coastal water in medium and coarse sand/gravel at water depths to 60 m.	**No Adverse Effect.** Limited distribution in Barnegat Bay. Prey abundance probably not influenced by operations.
	Adults	Same as juveniles.	**No Adverse Effect.** Same as juveniles.
Tiger shark	Neonates and juveniles	Shallow coastal waters to a depth of 200 m.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
Windowpane flounder	Eggs	Surface water with temperatures <20°C.	**Minimal Adverse Effect.** Limited distribution in Barnegat Bay. Eggs not commonly entrained.

Table 5. (contd)

	Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
1		Larvae	Same as eggs.	**Minimal Adverse Effect.** Limited distribution in Barnegat Bay. Larvae not commonly entrained. Prey items are entrained at OCNGS, but prey population size not affected.
2		Juveniles	Mud or fine-grained sand habitat at depths of 1 to 100 m. Temperature of <25°C, and salinity of 5.5 to 36 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
3		Adults	Mud or fine-grained sand habitat at depths of 1 to 75 m. Temperature of <26.8°C, and salinity of 5.5 to 36 ppt.	**Minimal Adverse Effect.** Same as juveniles.
4		Spawning adults	Mud or fine-grained sand habitat at depths of 1 to 75 m. Temperature of <21°C, and salinity of 5.5 to 36 ppt.	**Minimal Adverse Effect** Same as juveniles.
5	Winter flounder	Eggs	Sand, muddy sand, and gravel habitat with depths of 0.3 to 4.5 m. Temperatures of 3 to 5°C, and salinity of 10 to 32 ppt.	**No Adverse Effect** Eggs demersal and adhesive. Not reported from entrainment samples.
6		Larvae	Shallow (1 to 4.5 m) inshore areas with fine sand to gravel substrate. Temperatures of 3 to 5°C, and salinity of 10 to 32 ppt.	**Minimal Adverse Effect.** Some annual entrainment loss. No documented thermal shock mortality. Prey items entrained at OCNGS, but prey population size not affected.
7		Juveniles	Mud or sand habitat with shell hash. Water depths of 0.5 to 27 m, temperatures of 2 to 29°C, and salinity of 19 to 33 ppt.	**Minimal Adverse Effect.** Some annual impingement loss, but no documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
8		Adults	Mud, sand, or large cobble substrate, depths of 1 to 30 m. Temperatures of 12 to 15°C, and salinity of 15 to 33 ppt.	**Minimal Adverse Effect.** Same as juveniles.
9		Spawning adults	Same as adults.	**Minimal Adverse Effect.** Same as juveniles.

Table 5. (contd)

Species	Life Stage	EFH Description	Expected Effect of OCNGS Operations on EFH
Winter skate	Juveniles	Sand and gravel substrates to 300 m. Springtime temperatures of 4 to 5°C, and salinities of 28 to 32 ppt. Fall temperatures of 5 to 21°C, with peak abundance at 15°C, and salinities of 31 to 35 ppt.	**Minimal Adverse Effect.** Not common in Barnegat Bay or commonly impinged. No documented thermal shock mortality. Prey items are entrained or impinged at OCNGS, but prey population size not affected.
	Adult	Sand and gravel substrates to 300 m. Springtime temperatures of 4 to 5°C and salinities of 28 to 32 ppt. Fall temperatures of 5 to 21°C, with peak abundance at 15°C and salinities of 31 to 35 ppt.	**Minimal Adverse Effect.** Same as juveniles.

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Appendix F

Generic Environmental Impact Statement Environmental Issues Not Applicable to Oyster Creek Nuclear Generating Station

Appendix F

Generic Environmental Impact Statement Environmental Issues Not Applicable to Oyster Creek Nuclear Generating Station

Table F-1 lists those environmental issues listed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, 1999)[(a)] and Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, Table B-1, that are not applicable to Oyster Creek Nuclear Generating Station (OCNGS) because of plant or site characteristics.

Table F-1. GEIS Environmental Issues Not Applicable to OCNGS

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Altered thermal stratification of lakes	1	4.2.1.2.2; 4.4.2.2	OCNGS does not use surface water from lakes.
Water-use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow)	2	4.3.2.1; 4.4.2.1	The OCNGS cooling system does not use cooling ponds or cooling towers.
AQUATIC ECOLOGY (FOR ALL PLANTS)			
Premature emergence of aquatic insects	1	4.2.2.1.7, 4.4.3	OCNGS is located on an estuary and cooling water is too saline to support aquatic insects.

(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 F-1. (contd)

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING-TOWER-BASED HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	1	4.3.3	OCNGS does not use a cooling tower.
Impingement of fish and shellfish	1	4.3.3	OCNGS does not use a cooling tower.
Heat shock	1	4.3.3	OCNGS does not use a cooling tower.
GROUNDWATER USE AND QUALITY			
Groundwater-use conflicts (potable and service water, and dewatering; plants that use >100 gpm)	2	4.8.1.1; 4.8.2.1	OCNGS does not use >100 gpm of groundwater.
Groundwater-use conflicts (plants using cooling towers withdrawing makeup water from a small river)	2	4.8.1.3; 4.4.2.1	OCNGS does not use a cooling tower.
Groundwater-use conflicts (Ranney wells)	2	4.8.1.4	OCNGS does not use Ranney wells.
Groundwater-quality degradation (Ranney wells)	1	4.8.2.2	OCNGS does not use Ranney wells.
Groundwater-quality degradation (cooling ponds in salt marshes)	1	4.8.3	OCNGS does not use a cooling pond.
Groundwater-quality degradation (cooling ponds at inland sites)	2	4.8.3	OCNGS does not use a cooling pond.

TERRESTRIAL RESOURCES

Table F-1. (contd)

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
Cooling-tower impacts on crops and ornamental vegetation	1	4.3.4	OCNGS does not use a cooling tower.
Cooling-tower impacts on native plants	1	4.3.5.1	OCNGS does not use a cooling tower.
Bird collisions with cooling towers	1	4.3.5.2	OCNGS does not use a cooling tower.
Cooling pond impacts on terrestrial resources	1	4.4.4	OCNGS does not use a cooling pond.
HUMAN HEALTH			
Microbial organisms (occupational health)	1	4.3.6	OCNGS does not use a cooling tower.
Microbial organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river).	2	4.3.6	This issue is related to heat-dissipation systems that are not installed at OCNGS.

F.1 References

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Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives for Oyster Creek Nuclear Generating Station in Support of License Renewal Application

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives for Oyster Creek Nuclear Generating Station in Support of License Renewal Application

G.1 Introduction

AmerGen Energy Company, LLC (AmerGen), submitted an assessment of severe accident mitigation alternatives (SAMAs) for Oyster Creek Nuclear Generating Station (OCNGS) as part of the Environmental Report (ER) (AmerGen 2005). This assessment was based on the most recent OCNGS Probabilistic Risk Assessment (PRA) available at that time, a plant-specific offsite consequence analysis performed with the MELCOR Accident Consequence Code System 2 (MACCS2) computer code, and insights from the OCNGS Individual Plant Examination (IPE) (GPU 1992) and Individual Plant Examination of External Events (IPEEE) (GPU 1995). In identifying and evaluating potential SAMAs, AmerGen considered SAMAs that addressed the major contributors to core damage frequency (CDF) and large early release frequency (LERF) at OCNGS, as well as SAMA candidates for other operating plants that have submitted license renewal applications. AmerGen identified 136 potential SAMA candidates. This list was reduced to 37 unique SAMA candidates by eliminating SAMAs that are not applicable to OCNGS because of design differences, required extensive changes that would involve implementation costs known to exceed any possible benefit, have already been implemented, are of low benefit, or are addressed by a similar SAMA. AmerGen assessed the costs and benefits associated with each of the potential SAMAs and concluded that several of the candidate SAMAs evaluated would be cost-beneficial.

On the basis of a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to AmerGen by letter dated November 9, 2005 (NRC 2005). Key questions concerned changes to the Level 1 and Level 2 PRA model since the IPE, the PRA self-assessment performed in 2004, the multiplier used to account for external events, the reanalysis of the fire risk subsequent to the IPEEE; clarification/information on several specific candidate SAMAs, and the evaluation of combinations of potentially cost-beneficial SAMAs. AmerGen submitted additional information by letters dated January 9, 2006 (AmerGen 2006a), and March 15, 2006 (AmerGen 2006b). In the responses, AmerGen provided a listing of the major modifications made to the Level 1 model since the IPE, a description of the current Level 2 model, a description and summary results of the self-assessment, justification for the use of the multiplier for external events, information regarding the updated fire PRA, specific requested information for the SAMAs of interest, and the results of combining selected potentially cost-beneficial SAMAs. AmerGen's responses addressed the NRC staff's concerns.

An assessment of SAMAs for OCNGS is presented below.

G.2 Estimate of Risk for OCNGS

AmerGen's estimates of offsite risk at OCNGS are summarized in Section G.2.1. The summary is followed by the NRC staff's review of AmerGen's risk estimates in Section G.2.2.

G.2.1 AmerGen's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the OCNGS Level 1 and 2 PRA model, which is an updated version of the IPE (GPU 1992), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the SAMA analysis. The SAMA analysis is based on the most recent OCNGS Level 1 and 2 PRA model, referred to as the 2004B PRA model. The scope of the OCNGS PRA does not include external events.

The baseline CDF for the purpose of the SAMA evaluation is approximately 1.1×10^{-5} per year. The CDF is based on the risk assessment for internally initiated events. AmerGen did not include the contribution from external events within the OCNGS risk estimates; however, it did account for the potential risk reduction benefits associated with external events by doubling the estimated benefits for internal events. AmerGen also utilized a recently completed fire PRA to assess the risk reduction for several fire-related SAMAs. This is discussed further in Sections G.2.2 and G.6.2.

Table G-1 provides the breakdown of the CDF by initiating event. As shown in this table, events initiated by loss of offsite power (LOOP) 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).

The current OCNGS Level 2 PRA model represents a significant change from the somewhat simplistic analysis that was utilized in the IPE. This update is a full Level 2 model that is stated to meet standard industry practice. The Level 1 results are initially characterized by 13 accident sequence functional classes. A separate containment event tree is used for each of the Level 1 accident classes to describe the response of the containment. The linked Level 1/Level 2 end states are then grouped into release categories based on magnitude and timing of the expected releases. The resulting release categories are then reduced to 10 consequence categories for use in consequence analyses. The fission product release fractions are obtained from the

Table G-1. 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

results of analyses of representative sequences for each consequence category by using version 4.0.5 of the Modular Accident Analysis Program (MAAP). The results of the Level 2 PRA are a set of consequence categories with their respective frequency and release characteristics. The results of this analysis for OCNGS are provided in Tables F-6 and F-7 of the ER (AmerGen 2005).

The offsite consequences and economic impact analyses use the MACCS2 code to determine the offsite risk impacts on the surrounding environment and public. Input for these analyses includes plant-specific and site-specific values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within a 50-mi radius) for the year 2029, emergency response evacuation modeling, and economic data. The magnitude of the onsite impacts (in terms of cleanup and decontamination costs and occupational dose) is based on information provided in NUREG/BR-0184 (NRC 1997a).

In its 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 G-2. 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 G-2. 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.

G.2.2 NRC Staff's Review of AmerGen's Risk Estimates

AmerGen's determination of offsite risk at OCNGS is based on the following four major elements of analysis:

- The Level 1 and 2 risk models that form the basis for the 1992 IPE submittal (GPU 1992) and the external events analyses of the 1995 IPEEE submittal (GPU 1995),
- The major modifications to the IPE model that have been incorporated into the OCNGS PRA,
- The recent reassessment of the fire portion of the IPEEE, referred to as the Fire PRA (FPRA), and
- The MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PRA model into offsite consequence measures.

Each of these analyses was reviewed to determine the acceptability of AmerGen's risk estimates for the SAMA analysis, as summarized below.

The NRC staff's review of the OCNGS IPE is described in an NRC report dated August 2, 1994 (NRC 1994). On the basis of a review of the IPE submittal, the staff concluded that the IPE submittal met the intent of Generic Letter (GL) 88-20; that is, the IPE was of adequate quality to be used to look for design or operational vulnerabilities. The NRC staff did note, however, that the OCNGS IPE's lack of treatment of preinitiators in the human reliability analysis might limit the IPE's usefulness in other applications. This deficiency was resolved in subsequent PRA updates. The IPE did not identify any severe accident vulnerabilities associated with either core damage or poor containment performance.

Although no vulnerabilities were identified, 15 modifications to the plant, procedures, and training were identified that had either been implemented, were to be implemented, or were being considered at the time of the completion of the IPE process. Eight of the improvements have not been completed and have been included as candidate SAMAs in the current evaluation (AmerGen 2005).

Several revisions have been made to the IPE model since its submittal. A comparison of the internal events CDF between the IPE and the 2004B PRA model indicates an increase of approximately 6.8×10^{-6} per year in the total CDF (from 3.69×10^{-6} per year to 1.05×10^{-5} per year). The increase is mainly attributed to many modeling and data changes that have been incorporated since the IPE was submitted. A summary listing of those changes that resulted in the greatest impact on the internal events CDF was provided in the ER (AmerGen 2005) and further discussed in response to an RAI (AmerGen 2006a). Table G-3 summarizes the major changes.

The IPE CDF value for OCNGS was the lowest CDF value reported in the IPE for boiling-water reactor (BWR) 1/2/3 plants. Figure 11.2 of NUREG-1560 shows that the IPE-based total internal events CDF for BWR 1/2/3 plants ranges from 3×10^{-6} to 5×10^{-5} per year (NRC 1997a). It is recognized that other plants have updated the values for CDF subsequent to the IPE submittals because of modeling and hardware changes. The current internal events CDF results for OCNGS are reasonably consistent with that for plants of similar vintage and characteristics.

The NRC staff considered the peer review performed for the OCNGS PRA, and the potential impact of the review findings on the SAMA evaluation. In the ER, AmerGen described the previous peer reviews, the most significant of which was the Boiling-Water Reactor Owners Group (BWROG) Peer Review of the 1992 PRA model (i.e., the IPE) conducted in 1997. The BWROG review concluded that the OCNGS PRA can be effectively used to support applications involving relative risk significance. AmerGen stated that all Level A (important and necessary to address before the next regular PRA update) and Level B (important and necessary to address, but disposition may be deferred until the next PRA update) facts and observations from the peer review have been resolved by model changes. AmerGen further stated that no outstanding model issues exist outside the normal PRA maintenance program, and that none are known to have the potential to impact the SAMA conclusions.

In the ER and subsequent responses to RAIs (AmerGen 2006a,b), AmerGen describes the self-assessment process of the OCNGS PRA model and documentation performed in 2004. This review of the 2001 PRA, against the American Society of Mechanical

Table G-3. OCNGS PRA Historical Summary

PRA Version	Summary of Changes from Prior model	CDF (per year)
1992	IPE submittal	3.69×10^{-6}
2001A	Resolution of peer review comments	6.27×10^{-6}
	Inclusion of internal flooding	
	Data update	
	Level 2 reassessment with simplified large early release frequency (LERF) model	
2004B	Conversion from RISKMAN to CAFTA software platform	1.05×10^{-5}
	Addition of AC and DC initiating events	
	Addition of more detailed modeling of extreme weather and impact on AC power	
	Addition of recirculation pump seal leakage scenario	
	Addition of induced LOOP events for transients and LOCAs	
	Utilized updated plant-specific failure data	
	Extensive human reliability analysis (HRA) reassessment	
	Revised/updated common cause failure calculations	
	Updated and more detailed ATWS analysis	
	LERF model upgraded to full Level 2 model	

Engineers (ASME) PRA Standard (ASME 2003) and Regulatory Guide (RG) 1.200 (NRC 2004a), identified a number of items for updating. Changes required to meet Capability Category II of the ASME Standard were then incorporated into the 2004A model. Subsequently, the 2004A model was completely reassessed against the same requirements. AmerGen indicated that most of the "gaps" relative to the requirements have been addressed as part of the current update (i.e., the 2004B update), and that none of the remaining items are judged to affect the SAMA evaluation.

The NRC staff concludes that the Level 1 PRA model is of sufficient quality to support the SAMA evaluation because (1) the OCNGS Level 1 internal events PRA model has been both peer reviewed and subjected to an extensive self-assessment process; (2) the review findings have been resolved or judged to have no adverse impact on the SAMA evaluation; and (3) AmerGen has satisfactorily addressed NRC staff questions regarding the PRA.

As indicated above, the current OCNGS PRA (2004B) does not include external events. In the absence of such an analysis, AmerGen used the OCNGS IPEEE to identify the highest risk accident sequences and potential means of reducing the risk posed by those sequences. In addition, subsequent to the ER submittal, a FPRA has been completed. In response to NRC staff RAIs (NRC 2005, 2006), AmerGen described the use of the IPEEE and updated fire analyses to support the identification and evaluation of potential SAMAs related to external events (AmerGen 2006a,b).

The OCNGS IPEEE was submitted in December 1995, in response to Supplement 4 of GL 88-20 (GPU 1995). GPU Nuclear, Inc., did not identify any fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events related to seismic, fire, or other external events. In a letter dated February 8, 2001, the NRC staff concluded that the submittal met the intent of Supplement 4 to GL 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities (NRC 2001).

The seismic PRA performed for the initial OCNGS IPEEE submittal resulted in a seismic CDF of 3.6×10^{-6} per year. The seismic model was modified significantly as a result of the NRC IPEEE review and subsequently yielded a total seismic CDF of 4.7×10^{-6} per year. The dominant contributors to this value are failure of the turbine building and the reactor building since their failures lead directly to core damage. The seismic IPEEE assumed that all relays that did not meet USI A-46 requirements would be replaced. The NRC staff Safety Evaluation Report (SER) for USI A-46 (NRC 2000) accepted the A-46 resolution. In response to an RAI, AmerGen confirmed that all relays that did not meet A-46 requirements have been replaced or otherwise shown to be acceptable (AmerGen 2006a).

The OCNGS IPEEE fire analysis consisted of a FPRA based on Electric Power Research Institute's (EPRI's) Fire Induced Vulnerability Evaluation (FIVE) methodology (supplemented by an existing fire hazards analysis) and the IPE internal events PRA models. An initial qualitative screening phase was utilized to screen out fire areas based on a lack of risk-significant components or lack of a demand for a reactor trip. Quantitative screening of fire areas was then employed to screen out areas where the conservatively determined (neglecting fire suppression and conservatively estimating fire propagation) CDF is less than 1×10^{-6} per year. This was then followed by a detailed analysis that included the consideration of fire suppression, fire propagation, and fire severity factor. Eight fire areas required detailed analysis.

Based on the IPEEE, Table G-4 gives the fire areas with frequencies greater than 1×10^{-6} per year that were considered to be the dominant contributors, comprising more than 80 percent of the estimated total fire CDF.

Table G-4. Significant Fire Areas for OCNGS

Fire Area	Description	CDF (per year)
OB-FZ-4	Lower cable spreading room	8.6×10^{-6}
OB-FZ-6A	480-VAC switchgear room	5.1×10^{-6}
TB-FZ-11D	Turbine building basement	1.9×10^{-6}

The resulting total fire CDF from the IPEEE was estimated as 1.9×10^{-5} per year (NRC 2001).

Subsequent to the ER submittal, AmerGen completed a FPRA for OCNGS (AmerGen 2006a). The FPRA includes a comprehensive reanalysis of the entire plant and indicates a fire CDF of 9.4×10^{-6} per year. AmerGen stated that the reanalysis applied accepted industry methods (as documented in the EPRI Fire PRA Implementation Guide and modified by NRC generic RAIs and responses) and incorporated updated fire frequency values and fire-induced spurious actuation probabilities (AmerGen 2006b). A comparison of the results from the FPRA with those from the IPEEE was provided in response to RAIs (AmerGen 2006a,b) and is summarized below. Included are the dominant contributors to the IPEEE, as listed above, and the areas from the FPRA that have a CDF contribution of more than approximately 2.7×10^{-7} per year (which corresponds to an averted cost risk of approximately $50,000). The major reason for the reduction in fire CDF is stated to be attributable to the more detailed treatment of fire ignition sources and incorporation of alternate mitigation measures involving the remote shutdown panel for fire area OB-FZ-4.

As Table G-5 indicates, the overall fire CDF from the IPEEE is conservative.

The IPEEE analysis of other external events (GPU 1995) followed the screening specified in Supplement 4 to GL 88-20 (NRC 1991) and did not identify any unduly significant sequences or vulnerabilities. The plant design was reviewed to determine if it met 1975 Standard Review Plan design criteria for high winds, floods, and other external events. If it met these criteria and a walkdown did not identify any unique vulnerabilities, then the CDF from the external hazard was considered to be less than 1×10^{-6} per year. If it did not meet the criteria, then additional analysis was performed to evaluate the specific concern. Since tornadoes were not part of the design basis for OCNGS, high winds and tornadoes could not be screened out. Further analysis summarized in the IPEEE SER (NRC 2001) indicated that the CDF due to high winds and tornadoes is less than 1×10^{-6} per year.

Based on the IPEEE results, the external events CDF (fire: 1.9×10^{-5} per year, seismic: 4.7×10^{-6} per year) is approximately 2.3 times the internal events CDF (1.05×10^{-5} per year). AmerGen argued that, in addition to the fire risk being conservatively estimated, a SAMA derived to address the internal events risk profile will have a less profound impact on the

Table G-5. Comparison of FRPA and IPEEE Core Damage Frequencies

		CDF (per year)	
Fire Area	**Description**	**IPEEE**	**FPRA**
OB-FZ-6A	"A" 480-VAC switchgear room	5.1×10^{-6}	3.1×10^{-6}
OB-FZ-8C	A and B batt room, tunnel and elec tray room	4.6×10^{-7}	2.1×10^{-6}
TB-FZ-11E	Condenser bay	Screened	6.0×10^{-7}
TB-FA-3A	4169-VAC switchgear 1C vault	Screened	5.1×10^{-7}
OB-FZ-5	Control room	3.3×10^{-7}	4.3×10^{-7}
MT-FA-12	Main transformer and condensate storage tank	Screened	3.9×10^{-7}
OB-FZ-4	Cable spreading room	8.6×10^{-6}	3.9×10^{-7}
OB-FZ-10A	Monitoring and change room	Screened	3.8×10^{-7}
TB-FA-3B	4169-VAC switchgear 1D Vault	Screened	3.3×10^{-7}
TB-FZ-11D	Turbine building basement, south end	1.9×10^{-6}	6.2×10^{-8}

external event risk profile, and that assuming a one-to-one correspondence will overestimate the external events benefit. Therefore, in the ER, AmerGen doubled the benefit that was derived from the internal events model to account for the contribution from external events. This doubling was not applied to those SAMAs that specifically addressed external events risk (i.e., SAMAs 67, 124, 125, 130, and 134). Doubling the benefit for these SAMAs is not appropriate since these SAMAs are specific to external event risks and would not have a corresponding benefit on the risk from internal events.

As discussed above, in response to staff RAIs, AmerGen provided the results of an updated FPRA (AmerGen 2006b). The CDF from the FPRA, combined with the IPEEE seismic CDF, yields a total external events CDF of 1.41×10^{-5} per year or approximately 1.3 times the internal events CDF. The total CDF is approximately 2.3 times the CDF internal events. In the discussion provided in the response to RAIs, AmerGen argues that since seismic risk is only marginally impacted by SAMAs intended to mitigate the risk from internal events, the seismic risk should not be included in the total mitigated risk. If seismic is not included, the external events CDF for the purposes of SAMA evaluations is approximately 0.9 times the internal events CDF, or the total CDF is approximately 1.9 times the internal events CDF.

On the basis of the above, the NRC staff concludes that the applicant's use of a multiplier of 2 to account for external events is reasonable for the purposes of the SAMA evaluation.

The NRC staff reviewed the general process used by AmerGen to translate the results of the Level 1 PRA into containment releases, as well as the results of this Level 2 analysis. AmerGen characterized the releases for the spectrum of possible radionuclide release scenarios by using a set of release categories defined based on the timing and magnitude of the release. The frequency of each release category was obtained from the quantification of a linked Level 1/Level 2 model that effectively evaluates a containment event tree for each Level 1 accident sequence. The process for assigning accident sequences to the various release categories and the dominant accident sequences for each release category is described in the ER (AmerGen 2005). The release categories were then reduced to 10 consequence categories by combining several of the low and very low release categories. The fission product release fractions for each consequence category were obtained from the results of analyses of representative sequences for each category by using version 4.0.5 of MAAP. The frequencies and fission product release characteristics for each of the release and consequence categories are presented in Tables F-6, F-6a, and F-7 of the ER (AmerGen 2005).

While the IPE Level 2 analysis was reviewed by the NRC and found to be consistent with the intent of the IPE program (NRC 1994), the current Level 2 analysis is a significant modification of the earlier analysis. In response to RAIs, AmerGen described the development of the current model, the reviews performed, and the experience and qualifications of the team that prepared it. The IPE Level 2 model was upgraded in 2003 to a “LERF only” model. This model was included within the PRA self-assessment performed in 2004. The results of this self-assessment against the requirements of the ASME PRA Standard and RG 1.200 were then used to upgrade the 2003 model, while at the same time expanding the scope of the model to treat the spectrum of radionuclide releases. The upgraded Level 2 model was incorporated into the 2004A PRA model and then reassessed against the above requirements. The NRC staff notes that the team that developed the Level 2 model has considerable experience in Level 2 PRA analysis and has been involved in developing industry standards for such analyses. The staff concludes that the process used for determining the consequence category frequencies and source terms is reasonable and appropriate for the purposes of the SAMA analysis.

As indicated in the ER, the reactor core radionuclide inventory used in the consequence analysis is based on a plant-specific ORIGEN 2.1 calculation and corresponds to best estimate, end-of-cycle values for a 24-month fuel cycle. All releases were modeled as occurring at ground level with a thermal content the same as ambient. AmerGen assessed the impact of alternative assumptions (i.e., elevated releases for selected consequence categories). The results of this sensitivity study showed that the 50-mi population dose and offsite economic risks would increase by less than 1 percent.

The NRC staff reviewed the process used by AmerGen to extend the containment performance (Level 2) portion of the PRA to an assessment of offsite consequences (essentially a Level 3 PRA). This included consideration of the major input assumptions used in the offsite consequence analyses. The MACCS2 code was utilized to estimate offsite consequences. Plant-specific inputs to the code include the source terms for each consequence category and the reactor core radionuclide inventory (both discussed above), site-specific meteorological data, projected population distribution within a 50-mi radius for the year 2029, emergency evacuation modeling, and economic data. This information is provided in Appendix F of the ER (AmerGen 2005).

AmerGen used site-specific meteorological data processed from hourly measurements for the 2003 calendar year as input to the MACCS2 code. The hourly data were collected from the onsite meteorological tower. Small data voids (less than six consecutive hours) were filled using interpolation between data points. Larger data voids were filled using data from the previous hours or days. Data from 2000 and 2001 were also considered, but 2003 data were found to be the most complete and resulted in the highest population dose risk and offsite economic cost risk. Data for 2003 were subsequently used in base case MACCS2 risk calculations. (Data for 2002 were not readily available because of modifications to the collection system implemented in mid-2002.) The NRC staff considers use of the 2003 meteorological data in the SAMA analysis to be reasonable.

The population distribution the applicant used as input to the MACCS2 analysis was estimated for the year 2029, using SECPOP2000 (NRC 2003), U.S. Census block-group level population data (USCB 2000), and population growth rate estimates. The 1990 and 2000 census data were used to estimate an annual average population growth rate for each of the 50-mi-radius rings. The annual growth rate estimate for each ring was applied uniformly to all sectors in the respective ring. The NRC staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending out 10 mi from the plant. It was assumed that 95 percent of the population would move at an average speed of approximately 1.3 mph, with a delayed start time of 30 minutes after a General Emergency has been declared (AmerGen 2005). This assumption is conservative relative to the NUREG-1150 study (NRC 1990) that assumed evacuation of 99.5 percent of the population within the emergency planning zone. The evacuation assumptions and analysis are deemed reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data were provided from SECPOP2000 (NRC 2003) by specifying the data for each of the counties surrounding the plant, to a distance of 50 mi. Generic economic data were revised from the MACCS2 sample problem when better information was available (e.g., per diem living expenses, relocation costs, and value of farm and nonfarm wealth). These values were updated to the year 2000 by using the Consumer Price Index ratio.

The NRC staff concludes that the methodology AmerGen used to estimate the offsite consequences for OCNGS provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by AmerGen.

G.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by AmerGen are discussed in this section.

G.3.1 Process for Identifying Potential Plant Improvements

AmerGen's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- Review of the most significant basic events from the OCNGS 2004B Level 1 and 2 PRA,

- Review of Phase II SAMAs from license renewal applications for five other U.S. nuclear sites,

- Review of potential plant improvements identified in the OCNGS IPE and IPEEE,

- Review of dominant fire areas and SAMAs that could potentially reduce the associated fire risk, and

- Input from OCNGS system managers during the PRA update process and the development of the SAMA list.

On the basis of this process, an initial set of 136 candidate SAMAs was identified. (The ER states that 138 SAMAs were identified; however, two were listed as Not Used.) In Phase I of the evaluation, AmerGen performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- The SAMA is not applicable at OCNGS because of design differences;

- The SAMA requires extensive changes that would involve implementation costs known to exceed any possible benefit (a screening value of $4.46 million, which represents the dollar value associated with completely eliminating all internal and external event severe accident risk at OCNGS, was used to support this determination);

- The SAMA has already been implemented at OCNGS;

- The implementation cost obviously exceeds the benefit, or the benefit is negligible; or

- The SAMA has been addressed by a similar SAMA.

Based on this screening, 99 SAMAs were eliminated, leaving 37 for further evaluation. The remaining SAMAs are listed in Table F-16 of the ER (AmerGen 2005). A detailed evaluation was performed for each of the 37 remaining SAMA candidates, as described in Sections G.4 and G.6 below. To account for the potential impact of external events, the estimated benefits based on internal events were multiplied by a factor of 2 (except for those SAMAs specific to external events, since those SAMAs would not have a corresponding benefit on the risk from internal events).

G.3.2 Review of AmerGen's Process

AmerGen's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events, but also included explicit consideration of potential SAMAs for seismic, fire, and high wind events. The initial list of SAMAs generally addressed the accident sequences considered to be important to CDF from functional, initiating event, and risk reduction worth (RRW) perspectives at OCNGS, and included selected SAMAs from other plants.

AmerGen provided a tabular listing of the PRA basic events sorted according to their RRW (AmerGen 2005). SAMAs impacting these basic events would have the greatest potential for reducing risk. AmerGen used a RRW cutoff of 1.01, which approximately corresponds to a 1 percent change in CDF given 100 percent reliability of the event. This equates to an averted cost risk (benefit) of approximately $45,000 (after the benefits are doubled to account for external events). AmerGen also provided and reviewed the LERF-based RRW events down to an RRW of 1.01. AmerGen correlated the top Level 1 and 2 events with the SAMAs evaluated in the ER and showed that all of the significant basic events are addressed by one or more SAMAs (AmerGen 2005). Based on this information, the NRC staff concludes that the set of SAMAs evaluated in the ER addresses the major contributors to CDF and offsite dose.

Although the IPE did not identify any vulnerabilities, 15 modifications to the plant, procedures, and training were identified that had either been implemented, were to be implemented, or were being considered at the time of the completion of the IPE process. Eight of the improvements have not been completed and were included as candidate SAMAs in the current evaluation.

AmerGen identified OCNGS-specific candidate SAMAs for external events by using the OCNGS IPEEE (as well as the recently completed FPRA.) A total of 14 SAMAs were identified to address external events and were included as candidate SAMAs in the Phase I analysis. These included 11 seismic-related SAMAs and 3 fire-related SAMAs. In addition, two SAMAs related to high wind events were identified and included based on input from OCNGS system managers. Of these SAMAs, five were retained for more detailed evaluation in the Phase II analysis, specifically, two seismic-related SAMAs (67 and 124), one fire-related SAMA (125), and two high-wind-related SAMAs (130 and 134).

The NRC staff notes that the set of SAMAs submitted is not all inclusive, since additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

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. This search included reviewing insights from the plant-specific risk studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its PRA personnel.

G.4 Risk Reduction Potential of Plant Improvements

AmerGen evaluated the risk reduction potential of the 37 remaining SAMAs that were applicable to OCNGS. The changes made to the model to quantify the impact of the SAMAs are detailed in Section F.6 of Appendix F to the ER (AmerGen 2005). The SAMA evaluations were performed by using realistic assumptions with some conservatism.

AmerGen used model requantification to determine the potential benefits. The CDF and population dose reductions were estimated by using the 2004B model version of the OCNGS PRA. Table G-6 lists the assumptions considered to estimate the risk reduction for each of the evaluated SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk. The estimated benefits reported in Table G-6 reflect the combined benefit in both internal and external events. The determination of the benefits for the various SAMAs is further discussed in Section G.6.

For those SAMAs that specifically address external events (i.e., SAMAs 67, 124, 125, 130, and 134), the reduction in CDF and population dose were calculated as discussed below.

SAMAs 67 and 124 involve modifying the condensate storage tank and reinforcing a block wall to increase their capability in seismic events. For these SAMAs, a seismic baseline risk (CDF,

Table G-6. SAMA Cost-Benefit Screening Analysis for OCNGS

SAMA[a]	Assumptions	% Risk Reduction: CDF	% Risk Reduction: Population Dose	Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
7. Enhance alternate injection reliability. Provide hard pipe cross-connection between emergency service water (ESW) and core spray.	Failure probability of 1×10^{-2} assigned to represent operator action and additional equipment operation that could prevent the modification from functioning.	3	4	174,000	240,000	500,000
10. Install alternate path to the torus hard pipe vent via the wet well using a rupture disk.	**Operator actions and AC and DC power associated with venting removed from model.**	**16**	**19**	**788,000**	**1,088,000**	**1,000,000**
18. Improve ability to cool residual heat removal (RHR) heat exchangers through procedure and hardware modifications to allow manual alignment of the fire protection system.	Change model logic such that failure of service water AND failure of fire water, in addition to ESW pumps required for failure of containment spray heat exchangers.	0.5	0.3	8,000	10,000	265,000
20. Reopen main steam isolation valves (MSIVs) to restore main condenser as a heat sink.	Operator error of 0.1 assumed for reopening of spuriously closed steam line.	0.4	0.3	4,000	6,000	400,000
23. Enable manual bypass of explosive valves via installation of a bypass line and manual valve.	Operator error of 0.01 assumed for use of new bypass valve.	0.7	1	42,000	58,000	150,000

Table G-6. (contd)

SAMA[a]	Assumptions	% Risk Reduction: CDF	% Risk Reduction: Population Dose	Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
25. Install bypass switch to enable quick bypassing of low-pressure permissive for core spray.	Operator error of 0.01 assumed for operator action to bypass the permissive.	0.3	0.3	4,000	6,000	50,000
67. Strengthen seismic capability of the condensate storage tank (CST).	Factor of 5 reduction in CST seismic failure contribution to seismic core damage frequency (CDF).	251	251	139,000	190,000	1,000,000
84. Enable manual operation of all containment vent valves via local controls.	Operator error of 0.01 assumed as alternate if support systems fail.	2	2	80,000	110,000	150,000
88. Modify procedure(s) to specify a control band for containment venting.	Reduction by factor of 10 in operator error for failure to control venting.	0.1	0	0	0	50,000
89. Improve procedure(s) for aligning shutdown cooling (SDC) given high dry well pressure	Operator error requantified considering time available to align SDC increased from 3 hours to 19 hours.	~0	~0	0	0	50,000

Table G-6. (contd)

SAMA[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
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.	**Added gates for divisions of core spray and containment spray that are potentially available with the new cross-tie. Operator error of 0.1 assumed for action to align the new cross-tie.**	**3**	**3**	**118,000**	**162,000**	**90,000**
92. Modify procedure to eliminate flow restriction and maximize control rod drive (CRD) flow.	Model revised to allow credit for CRD for all events except loss-of-coolant accident (LOCAs).	2	0.6	36,000	50,000	100,000
94. Modify Emergency Operating Procedures (EOPs) to provide a crew action to align fire protection for reactor pressure vessel (RPV) injection.	Operator errors associated with aligning fire protection system reevaluated considering 5-minute increase to cognitive time window.	0.2	0	0	0	50,000
95. Modify procedure(s) to include a caution that containment spray should not be secured if being utilized for accident mitigation.	No penalty is included in the Probabilistic Risk Assessment (PRA) for associated error of commission, thus no benefit calculated.	~0	~0	0	0	50,000

Table G-6. (contd)

SAMA[a]	Assumptions	% Risk Reduction: CDF	% Risk Reduction: Population Dose	Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
99. Modify procedures and training to operate the isolation condensers (ICs) with no support systems available.	**Factor of 10 reduction in operator error associated with opening IC when DC power is unavailable.**	**16**	**16**	**674,000**	**928,000**	**150,000**
100. Modify the circuit to allow the combustion turbines (CTs) to also supply the "A" bus directly.	Added gates for divisions of core spray and containment spray that are potentially available with the new connection. Also a revised model for increased feedwater system availability (0.01) and heat removal paths (0.1).	4	4	146,000	204,000	500,000
101. Provide a procedure for determining RPV level using fuel zone level indicators with standby liquid control operating.	Factor of 3 reduction in operator errors associated with lowering level to control power for an anticipated transient without scram (ATWS).	0.2	0	0	0	50,000
102. Revise AWTS EOP to provide RPV level correction based on power.	Factor of 3 reduction in operator errors associated with lowering level to control power for an ATWS.	0.2	0	0	0	50,000

Table G-6. (contd)

SAMA[a]		Assumptions	% Risk Reduction		Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
			CDF	Population Dose			
104.	Develop loss of circulating water abnormal operating procedure to include guidance to allow condensate and feedwater to be adequately protected.	Added credit for cooling condensate pumps by service water as a backup to circulating water. No operator actions modeled.	3	0.8	44,000	60,000	250,000
106.	Revise procedure to provide direction for cooldown following loss of reactor building closed cooling water by reducing RPV pressure.	Assumed a 10% reduction in seal LOCA probability.	0.7	0.6	34,000	46,000	50,000
107.	Modify the spill valve air supply to be fitted with air accumulators.	Reduced probability of losing CST inventory on loss of instrument air from 0.1 to 0.001.	0.1	0	0	0	250,000
108.	Relocate reference leg instrument penetration closer to top of active fuel and recalibrate.	Reduced operator errors to adequately control water level while using either condensate pumps or fire protection or core spray systems following an ATWS.	~0	~0	0	0	1,000,000

Table G-6. (contd)

SAMA[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
109/125A. Provide portable battery charger capable of supplying 125-V DC buses.	**Combined operator error and equipment failure probability of 0.1 in added credit for non-LOCA loss of AC power sequences.**	**16[b] 54[c]**	**16[b] 59[c]**	**674,000 3,390,000**	**930,000 4,680,000**	**75,000**
110. Delete high dry well pressure signal from shutdown cooling isolation.	Same as SAMA 89.	~0	~0	0	0	75,000
111. Provide alternate dry well spray injection source, e.g., emergency service-water cross-tie, service-water cross-tie, diesel fire pump cross-tie.	Credit given for use of fire protection system in case of failure of each set of containment spray pumps.	~0	~0	0	0	500,000
112. Ensure high reliability of the cooling-water intake structure via surveillance and active programs.	Loss of intake structure initiating event frequency reduced by approximately a factor of 5.	0.8	0.3	8,000	10,000	1,000,000
124. Reinforce block wall 53.	Seismic CDF contribution from block wall failure eliminated. Release parameters based on modified Individual Plant Examination of External Events (IPEEE) seismic Class distribution.	15[d]	151[d]	84,000	115,000	150,000

Table G-6. (contd)

SAMA[a]	Assumptions	% Risk Reduction: CDF	% Risk Reduction: Population Dose	Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
125B. Add a bus cross-tie circuit breaker to Bus 1B2.	**Eliminates fire risk of Area OB-FZ-6A based on Fire Probabilistic Risk Assessment (FPRA) results.**	**15[e]**	**12[e]**	**445,000**	**611,000**	**100,000**
125C. Relocation of relief valve cables, circuitry, and components, as well as other modifications, to ensure one train of core spray remains unaffected by fire.	Eliminated dominant contributors to fire risk remaining after implementation of SAMAs 109/125A and 125B.	29[f]	17[f]	397,000	540,000	750,000
127. Increase operator training on systems and operator actions determined to be important in the PRA.	**Not modeled.**	**Not estimated**	**Not estimated**			**50,000**
128. Institute a program to reduce IC biofouling.	Reduce biofouling basic events by an order of magnitude.	~0	~0	14,000	20,000	200,000
129. Improve internal flooding procedures.	Reduce all internal flood initiating events except "Fire Protection Spray of Buses 1A, 1B" by a factor of 2.	4	1	56,000	78,000	100,000

Table G-6. (contd)

SAMA[a]	Assumptions	% Risk Reduction: CDF	% Risk Reduction: Population Dose	Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
130. Increase CT building integrity to withstand higher winds.	**Assumed factor of 20 reduction in extreme weather loss of offsite power (LOOP), which also causes failure of CT.**	**30**	**34**	**747,000**	**1,032,000**	**600,000**
132. Modify procedures to allow switching of the CTs to OCNGS while running.	**Probability of spurious trip of running CT assumed to be 0.5.**	**1**	**1**	**46,000**	**64,000**	**50,000**
133. Increase the hot well makeup capability to allow condensate/feedwater to be beneficial over a wide range of LOCA conditions.	Remove from model failure of feedwater due to insufficient makeup capability.	1	2	72,000	100,000	250,000
134. Increase fire pump building integrity to withstand higher winds.	**Assumed factor of 20 reduction in extreme weather LOOP, which also causes failure of fire pump building.**	**16**	**19**	**438,000**	**606,000**	**150,000**
136. Provide alternate power to condensate transfer pumps.	Add gates for alternate AC power supplies to individual condensate transfer pump models.	0.2	0	0	0	100,000

Table G-6. (contd)

SAMA[a]	Assumptions	% Risk Reduction		Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate ($)	Cost ($)
		CDF	Population Dose			
138. Protect transformers from explosive failure.	LOOP frequency increased by 1×10^{-2} per year to incorporate impact of postulated transformer explosions.	8[g]	9[g]	446,000	616,000	780,000

(a) SAMAs in bold are potentially cost-beneficial when either a 7 percent or 3 percent real discount rate is used in the NRC staff's analysis.
(b) Value based on doubling of internal events benefits, as reported in ER Section F.6.23 (AmerGen 2005) for SAMA 109.
(c) Value based on modified base PRA that incorporates the dominant fire risk contributors from the FPRA update, as reported in ER Section F.6.28 for SAMA 125A.
(d) Values represent the reduction in seismic risk. Risk from internal and fire events is assumed to be unchanged.
(e) Value based on updated FPRA results, as described in AmerGen's response to RAI followup questions (AmerGen 2006b).
(f) Benefit is based on prior implementation of SAMAs 109/125A and 125B.
(g) Impact of transformer explosion not in current PRA. Risk reduction of SAMA is, therefore, equal to risk increase when it is added to the model.

population dose, and offsite economic cost risk) was developed from the IPEEE Level 1 seismic results, and release parameters based on IPEEE seismic accident class distribution, and release characteristics were estimated based on the current Level 2 model. The contribution to seismic CDF from each of the failures addressed by the SAMAs was then estimated from the IPEEE and used with the seismic baseline risk to estimate the averted cost risk. These SAMAs were assumed to have no additional benefits in internal events.

SAMA 125 was subsequently separated into three specific SAMAs that address fire risk contributors: SAMA 125A involves providing portable battery chargers capable of supplying 125-V DC buses, SAMA 125B involves adding a circuit breaker related to fire area OB-FZ-6A, and SAMA 125C involves rerouting of cable in dominant fire areas. To determine the benefit of these modifications, a new baseline risk was determined by incorporating the two dominant fire areas from the FPRA reanalysis into the internal events PRA. The benefits of the SAMA 125 modifications were then determined by making appropriate changes to this new baseline risk model and reevaluating the risk. The evaluations for each SAMA are discussed below.

- SAMA 125A – This SAMA involves providing a portable battery charger capable of supplying 125-V DC buses in order to preserve isolation condenser and electromagnetic relief valve operability along with adequate instrumentation. The same plant change was identified as SAMA 109, based on internal event considerations. SAMA 109 and 125A represent the same physical modification evaluated by using two different approaches. The first approach is based on a doubling of benefits from the internal events PRA to account for external events, and results in an estimated benefit of $674,000 based on a 7 percent discount rate. The second approach is based on the use of the modified baseline risk model, which incorporates the two dominant fire areas from the FPRA reanalysis, and results in an estimated benefit of $3.4 million based on a 7 percent discount rate. The latter value is considered the best value to use for the benefit of SAMAs 109/125A.

  The NRC staff notes that SAMA 109 was singled out for reevaluation by using the revised fire model because it was designed to deal with station blackout sequences; these types of sequences dominate both the internal event risk and the fire risk. Other internal event SAMAs were reviewed by AmerGen to identify similar circumstances and found not to be applicable, or to be less beneficial than SAMA 109.

- SAMA 125B – This SAMA involves the installation of an additional circuit breaker on Bus 1B2 in order to reduce a failure mode applicable to fires in the “A” 480-VAC switchgear room. The estimated benefit for SAMA 125B reported in the ER is based on an assumption that SAMA 109/125A has already been implemented (i.e., the residual risk after implementing SAMA 109/125A was used as the baseline for determining the further benefit of SAMA 125B.) In response to an RAI, AmerGen provided an estimate of the benefits associated with SAMA 125B without credit for prior implementation of SAMA 109/125A (AmerGen 2006b). This estimate was based on the result of the FPRA. The averted cost risk for SAMA 125B (without credit for implementation of SAMA 109/125A) is approximately $445,000, based on a 7 percent discount rate.

- SAMA 125C – This SAMA involves the relocation of relief valve cables, circuitry, and components to allow credit for depressurization and core spray as a backup to the isolation condenser. In addition, other modifications would be required to ensure that at least one train of core spray remains unaffected by the postulated fire event. The risk after incorporation of SAMAs 109/125A and 125B was used as the baseline to evaluate SAMA 125C. The averted cost risk for SAMA 125C (with credit for prior implementation of SAMAs 109/125A and 125B) is approximately $397,000 based on a 7 percent discount rate. AmerGen did not provide an estimate for the implementation of SAMA 125C alone on the basis that the costs, competing risks, and expected benefit associated with this SAMA would make it undesirable. In a follow-up RAI response, AmerGen indicated that if SAMA 125B is not implemented for fire area OB-FZ-6A, then SAMA 125C should be considered in place of SAMA 125B (AmerGen 2006b).

SAMAs 130 and 134 involve modifications to the combustion turbine building and fire pump building to address high wind events. For these SAMAs, the internal events model includes the impact of failure of the building due to high winds by taking no credit for these components/structures for those Loss of Offsite Power events that are due to extreme winds. The benefit of strengthening these structures to withstand higher wind speeds was estimated by reducing the probability that extreme winds would fail these structures. Since these SAMAs would not have any impact on risk from other external events, the factor of 2 multiplier for external events was not applied. In response to an NRC RAI, AmerGen discussed the implications of changes in the wind hazard curve suggested by an NRC RAI on the IPEEE, and provided additional benefit estimates based on an alternative wind hazard curve. The NRC staff believes that the original assessment of the benefits of SAMAs 130 and 134, as provided in the ER, are appropriate.

The NRC staff has 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 staff based its estimates of averted risk for the various SAMAs on AmerGen's risk reduction estimates.

G.5 Cost Impacts of Candidate Plant Improvements

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 cost estimates provided in the ER did not account for inflation.

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 staff reviewed the costs and found them to be consistent with estimates provided in support of other plants' analyses.

The NRC staff concludes that the cost estimates provided by AmerGen are sufficient and appropriate for use in the SAMA evaluation.

G.6 Cost-Benefit Comparison

AmerGen's cost-benefit analysis and the NRC staff's review are described in the following sections.

G.6.1 AmerGen's Evaluation

The methodology used by AmerGen was based primarily on NRC's guidance for performing cost-benefit analysis, that is, NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997b). The guidance involves determining the net value for each SAMA according to the following formula:

Net Value = (APE + AOC + AOE + AOSC) – COE

where,

APE = present value of averted public exposure ($),
AOC = present value of averted offsite property damage costs ($),
AOE = present value of averted occupational exposure costs ($),
AOSC = present value of averted onsite costs ($), and
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. AmerGen's derivation of each of the associated costs is summarized below.

NUREG/BR-0058 has recently been revised to reflect the agency's 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 2004b). AmerGen provided both sets of estimates (AmerGen 2005).

Averted Public Exposure (APE) Costs

The APE costs were calculated by using the following formula:

APE = Annual reduction in public exposure (Δ person-rem/year)
× monetary equivalent of unit dose ($2000 per person-rem)
× present value conversion factor (10.76 based on a 20-year period with a 7 percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997b), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, which assumes elimination of all severe accidents due to internal events, AmerGen calculated an APE of approximately $775,000 for the 20-year license renewal period.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated by using the following formula:

AOC = Annual CDF reduction
× offsite economic costs associated with a severe accident (on a per-event basis)
× present value conversion factor.

For the purposes of initial screening, which assumes all severe accidents due to internal events are eliminated, AmerGen calculated an annual offsite economic risk of about $118,000 based on the Level 3 risk analysis. This results in a discounted value of approximately $1,270,000 for the 20-year license renewal period.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated by using the following formula:

AOE = Annual CDF reduction
× occupational exposure per core damage event
× monetary equivalent of unit dose
× present value conversion factor.

AmerGen derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997b). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated by using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $2000 per person-rem, a real discount rate of 7 percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents due to internal events are eliminated, AmerGen calculated an AOE of approximately $4000 for the 20-year license renewal period.

Averted Onsite Costs (AOSC)

The AOSC include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. AmerGen derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997b).

AmerGen divided this cost element into two parts: the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and the Replacement Power Cost.

Averted cleanup and decontamination costs (ACC) were calculated by using the following formula:

ACC = Annual CDF reduction
× present value of cleanup costs per core damage event
× present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $\$1.1 \times 10^9$ (discounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents due to internal events are eliminated, AmerGen calculated an ACC of approximately $124,000 for the 20-year license renewal period.

Long-term replacement power costs (RPC) were calculated using the following formula:

RPC = Annual CDF reduction
× present value of replacement power for a single event
× factor to account for remaining service years for which replacement power is required
× reactor power scaling factor

AmerGen based its calculations on the value of 630 megawatts electric (MW[e]). Therefore, AmerGen applied power scaling factors of 630 MWe/910 MWe to determine the replacement power costs. For the purposes of initial screening, which assumes all severe accidents due to internal events are eliminated, AmerGen calculated the AOSC to be approximately $182,000.

By using the above equations, AmerGen estimated the total present dollar value equivalent associated with completely eliminating severe accidents due to internal events at OCNGS to be about $2,231,000. To account for additional risk reduction in external events, AmerGen doubled this value (to $4,462,000) to provide the modified maximum averted cost risk (MMACR), which represents the dollar value associated with completely eliminating all internal and external event severe accident risk at OCNGS.

<u>AmerGen's Results</u>

If the implementation costs for a candidate SAMA were greater than the MMACR of $4,462,000, then the SAMA was screened from further consideration. A more refined look at the costs and benefits was performed for the remaining SAMAs. If the implementation costs for a candidate SAMA exceeded the calculated benefit, the SAMA was considered not to be cost-beneficial. In the baseline analysis contained in the ER (using a 7 percent discount rate), AmerGen identified seven potentially cost-beneficial SAMAs. On the basis of an analysis using a 3 percent real discount rate, as recommended in NUREG/BR-0058 (NRC 2004b), two additional SAMA candidates were determined to be potentially cost-beneficial. The potentially cost-beneficial SAMAs are:

- SAMA 10 – install alternate path to the torus hard pipe vent via the wet well using a rupture disk (cost-beneficial at 3 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-V AC 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,

- SAMA 132 – modify procedures to allow switching of the combustion turbines to OCNGS while running (cost-beneficial at 3 percent discount rate), 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.

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 SAMA candidates (beyond those identified in the 3 percent discount rate case) were determined to be potentially cost-beneficial (SAMAs 84, 106, 124, 125C, 129, and 138). The potentially cost-beneficial SAMAs are discussed in more detail in Section G.6.2.

G.6.2 Review of AmerGen's Cost-Benefit Evaluation

The cost-benefit analysis performed by AmerGen was based primarily on NUREG/BR-0184 (NRC 1997b) and was executed consistent with this guidance.

To account for external events, AmerGen multiplied the internal event benefits by a factor of 2 for each SAMA, except those SAMAs that specifically address external events (i.e., SAMAs 67, 124, 125, 130, and 134). Doubling the benefit for these SAMAs is not appropriate since these SAMAs are specific to external events and would not have a corresponding benefit in risk from internal events. Given that the CDF from internal fires and other external events as reported by AmerGen is less than the CDF for internal events, the NRC staff agrees that the factor of 2 multiplier for external events is reasonable.

AmerGen considered the impact that possible increases in benefits from analysis uncertainties would have on the results of the SAMA assessment. Currently, an uncertainty distribution is not available for the SAMA PRA model. Therefore, AmerGen reviewed the point estimate and 95th percentile CDFs for several SAMA submittals. The factor by which the 95th percentile CDFs are greater than the point estimate CDFs ranged from 2.35 to 2.45 (AmerGen 2005). AmerGen reexamined the initial set of SAMAs to determine if any additional Phase I SAMAs would be retained for further analysis if the benefits were increased by a factor of 2.5. No additional Phase I SAMAs were identified. AmerGen also considered the impact on the Phase II screening if the benefits were increased by a factor of 2.5 (in addition to the factor of 2 multiplier already included in the baseline benefit estimates to account for external events). Six additional SAMAs (beyond the nine SAMAs identified above) could be cost-beneficial. These additional SAMAs are SAMAs 84, 106, 124, 125C, 129, and 138.

AmerGen recognized that a combination of lower-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. Based on this, 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:

- 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 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,

- SAMA 125B – add a bus cross-tie circuit breaker to Bus 1B2 to reduce the impact of fires in the 480-V AC switchgear room, and

- SAMA 127 – increase operator training on the systems and operator actions determined to be important from the PRA.

AmerGen concluded that if the above 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, which are only cost-beneficial at the upper bound (95th percentile), do not appear to have competing effects and 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 2006a). With the exception of SAMAs 84 and 138, these SAMAs remained individually cost-beneficial at the upper bound. Two of these SAMAs (10 and 125C) have large implementation costs (approximately $1 million); however, the upper bound net values are also large (approximately $200,000 to $800,000). The other four SAMAs (99, 129, 132, and 124) have lower implementation costs ($50,000 to $150,000), but also have lower net values ($60,000 to $90,000).

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.

G.7 Conclusions

AmerGen compiled a list of 136 SAMAs based on a review of the most significant basic events from the plant-specific PRA, Phase II SAMAs from license renewal activities for other plants, insights from the plant-specific IPE and IPEEE, review of dominant fire areas, and input from OCNGS systems managers. A qualitative screening removed SAMA candidates that (1) were not applicable at OCNGS because of design differences, (2) required extensive changes that would involve implementation costs known to exceed any possible benefit (i.e., more than $4.46 million), (3) had already been implemented at OCNGS, (4) had a negligible benefit, or (5) had been addressed by a similar SAMA. Ninety-nine SAMAs were eliminated, leaving 37 for further evaluation.

For the remaining SAMA candidates, a more detailed design and cost estimates were developed as shown in Table G-6. The cost-benefit analyses showed that seven of the SAMA candidates were potentially cost-beneficial in the baseline analysis. AmerGen performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment. As a result, seven additional SAMAs were identified as potentially cost-beneficial. AmerGen evaluated the impact of implementing four potentially cost-beneficial SAMAs. The evaluation indicated that the remaining three SAMAs that were determined to be 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.

The NRC staff reviewed the AmerGen 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 events PRA, the likelihood of there being cost-beneficial enhancements in this area was minimized by inclusion of several candidate SAMAs related to external events, insights from the FPRA, and inclusion of a multiplier to account for external events.

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 the identified, potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the staff concludes that further evaluation of these SAMAs by AmerGen is warranted. 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.

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10. SUPPLEMENTARY NOTES

Docket No. 50-219

11. ABSTRACT *(200 words or less)*

This Supplement Environmental Impact Statement (SEIS) has been prepared in response to an application submitted to the NRC by AmerGen Energy Company, LLC, to renew the Operating License for Oyster Creek Nuclear Generating Station for an additional 20 years under 10CFR Part 54. This SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action.

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 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.)*	
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