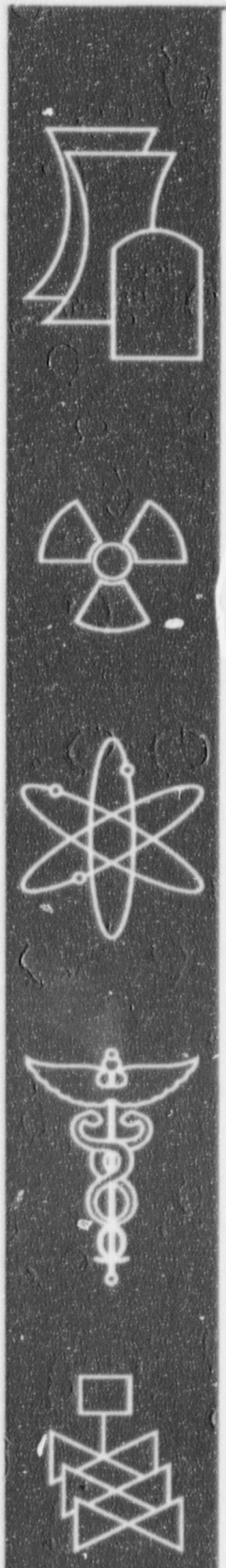
NUREG-1437
Supp. 2



Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 2

Oconee Nuclear Station

Draft Report for Comment

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NUREG-1437
Supp. 2

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 2

Oconee Nuclear Station

Draft Report for Comment

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



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TO: Addressees for NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," Supplement 2, Oconee Nuclear Station

This draft supplement documents the NRC staff's review of the environmental issues at the Oconee Nuclear Station in support of Duke Energy Corporation's application for license renewal of Oconee Nuclear Station, Units 1, 2, and 3. The draft supplement was prepared in accordance with 10 CFR 51.71. This supplemental environmental impact statement includes the 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 alternatives available for reducing or avoiding adverse impacts. It also includes the staff's preliminary recommendation regarding the proposed action.

Please provide any comments you may have on the draft supplement no later than August 16, 1999. Written comments may be sent via mail to:

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Please feel free to contact Mr. James H. Wilson at 301-415-1108 if you have questions.

Sincerely,



David B. Matthews, Director
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental effects of renewing nuclear power plant operating licenses for a 20-year period in the *Generic Environmental Impact Statement for Renewal of Nuclear Plants* (GEIS), NUREG-1437, and codified the results in 10 CFR Part 51. The GEIS identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 68 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 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 Duke Energy Corporation (Duke) to renew the operating licenses for Oconee Nuclear Station (ONS) Units 1, 2, and 3 for an additional 20 years under 10 CFR Part 54. This SEIS includes the 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 alternatives available for reducing or avoiding adverse effects. It also includes the staff's preliminary recommendation regarding the proposed action.

Neither Duke nor the staff have identified significant new information for any of the 68 issues for which the GEIS reached generic conclusions and which apply to the ONS. Therefore, the staff concludes for these issues, that the impacts of renewing the ONS operating licenses will not be greater than the impacts identified in the GEIS. For each of these issues, the GEIS conclusion is that the impact is of small significance (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and from spent fuel, which were not assigned a single significance level) and that additional mitigation measures are likely not to be sufficiently beneficial to be warranted.

Each of the remaining 24 issues that applies to the ONS is addressed in this SEIS. For each applicable issue, the staff concludes that the significance of the potential environmental effects of renewal of the operating license is small. The staff also concludes that additional mitigation measures are likely not to be sufficiently beneficial as to be warranted.

Based on the analysis and findings in the GEIS, the Environmental Report submitted by Duke, consultation with other Federal and State agencies, and its own independent review, the staff's preliminary recommendation is that the adverse environmental impacts of license renewal for the Oconee Nuclear Station Units 1, 2 and 3 are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

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RCRA	Resource Conservation and Recovery Act
REMP	radiological environmental monitoring program
SAMA	Severe Accident Mitigation Alternative
SCDHEC	South Carolina State Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCR	selective catalytic reduction
SCSHPO	South Carolina State Historic Preservation Office
SEIS	supplemental environmental impact statement
SGTR	steam generator tube rupture
SRM	staff requirements memorandum
SSF	standby shutdown facility
UFSAR	Updated Final Safety Analysis Report

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Executive Summary

By letter dated July 7, 1998, Duke Energy Corporation (Duke) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the Oconee Nuclear Station (ONS), Units 1, 2, and 3 operating licenses for an additional 20-year period. If the operating licenses are renewed, Federal (other than NRC) agencies, 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. If the operating licenses are not renewed, the plant will be shut down at or before the expiration of the current operating licenses on February 6, 2013, for Unit 1; October 6, 2013, for Unit 2; and July 19, 2014, for Unit 3.

Under the National Environmental Policy Act (NEPA), an environmental impact statement (EIS) is required for major Federal actions significantly affecting the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. 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 operating license; 10 CFR 51.95(c) states that the EIS prepared at the operating license renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437.

Upon acceptance of the Duke application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping. The staff visited the ONS site in October 1998 and held public scoping meetings on October 19, 1998, in Clemson, South Carolina. The staff reviewed the Duke environmental report (ER) and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in the draft *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, NUREG-1555, Supp. 1.

This supplemental EIS (SEIS) includes the 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 alternatives available for reducing or avoiding adverse effects. It also includes the staff's preliminary recommendation regarding the proposed action.

The Commission has adopted the following definition 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 Commission, in 10 CFR 51.95, has also provided the criterion to be used in evaluating the environmental impacts, as follows:

> ... 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.

The statement of purpose and need and the evaluation criterion both implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether ONS continues to operate beyond the period of the current operating licenses.

The GEIS contains the results of a systematic evaluation of the consequences of renewing an operating license and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using a three-level standard of significance—small, moderate, or large—based on Council on Environmental Quality guidelines. These significance levels are defined 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.

For 68 of the 92 issues considered in the GEIS, the analysis in the GEIS has shown:

(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 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.

These 68 issues were identified in the GEIS as Category 1 issues. In the absence of significant new information, the staff will rely on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in Appendix B to 10 CFR 51, Subpart A.

Of the 24 issues not meeting the criteria set forth above, 22 were identified 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 also be addressed in a plant-specific supplement to the GEIS. Information on chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared or at the time this document was prepared.

This SEIS evaluates all 92 environmental issues considered in the GEIS. The SEIS considers the environmental impacts associated with alternatives to license renewal and compares the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that are considered include the no-action alternative (not renewing the ONS operating licenses) and alternative methods of power generation. Among the alternative methods of power generation, coal-fired and gas-fired generation appear the most likely if the power from ONS is replaced. These alternatives are evaluated assuming that the replacement power generation plant is located at either the ONS site or an unspecified "greenfield" site.

Duke and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Duke nor the staff is aware of any significant new information related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither Duke nor the staff has identified any new issue applicable to the ONS that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all 68 Category 1 issues.

The staff has reviewed the Duke analysis for each Category 2 issue and has conducted an independent review of each issue. Five Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at ONS. Four additional Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. Duke has stated that their evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications necessary to support the continued operation of ONS beyond the end of the existing operating licenses. 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 (FES) for ONS.

The remaining 13 Category 2 issues, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. For all issues, the staff concludes that the potential environmental effects are of SMALL significance in the context of the GEIS. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for ONS, the staff concludes that none of the candidate SAMAs are cost beneficial.

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

In the event that the ONS operating licenses are not renewed and the plants cease operation at or before the expiration of their current operating licenses, the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of ONS. The impacts may, in fact, be greater in some areas.

The staff's preliminary recommendation is that the adverse environmental impacts of license renewal for Oconee Nuclear Station Units 1, 2, and 3 are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable, based on (1) the analysis and findings in the GEIS, (2) the ER submitted by Duke, (3) consultation with other Federal, State, and local agencies, and (4) its own independent review.

Abbreviations/Acronyms

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ALI	annual limits on intake
AOC	averted offsite property damage costs
AOE	averted occupational exposure
AOSC	averted onsite costs
APE	averted public exposure
BWST	borated water storage tank
CCW	condenser cooling water
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
COE	cost of enhancement
CRAC	Calculations of Reactor Accident Consequences
DO	dissolved oxygen
DOC	Department of the Census
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
Duke	Duke Energy Corporation
EC	effluent concentration
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESRP	Environmental Standard Review Plan for License Renewal
EWST	elevated water storage tank
FERC	Federal Energy Regulatory Commission
FES	final environmental statement
FR	Federal Register
FSAR	Final Safety Analysis Report
ft	feet
FWPCA	Federal Water Pollution Control Act (also known as the Clean Water Act)
FWS	U.S. Fish and Wildlife Service
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
gpd	gallons per day
gpm	gallons per minute
ha	hectare
HE	high energy

HLW	high-level waste
HPI	high pressure injection
HPSW	high pressure service water
HVAC	heating, ventilation, and air conditioning
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination for External Events
IRP	Integrated Resource Plan
ISFSI	Independent Spent Fuel Storage Installation
km	kilometer
kV	kilovolt
LOCA	loss of coolant accident
LWR	light-water reactors
m	meter
MACCS	Melcor Accident Consequence Code System
mi	mile
MTHM	metric tonnes of heavy metal
MTU	metric ton of uranium
MW	megawatt
MW(e)	megawatts electric
MW(t)	megawatts thermal
MWd/MTU	megawatt-days per metric ton of uranium
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NESC	National Electric Safety Code
NIEHS	National Institute of Environmental Health Sciences
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRR	Nuclear Reactor Regulation
ODCM	Offsite Dose Calculation Manual
ONS	Oconee Nuclear Station
PDS	plant damage states
PRA	Probabilistic Risk Assessment
PSI	pollutant standards index
RAI	request for additional information
RCM	reactor coolant makeup

1.0 Introduction

Duke Energy Corporation (Duke)[a] holds operating licenses DPR-38, DPR-47, and DPR-58 issued by the U.S. Nuclear Regulatory Commission (NRC) for the Oconee Nuclear Station (ONS) Units 1, 2, and 3 in northwestern South Carolina. These operating licenses will expire in 2013 for Units 1 and 2 and in 2014 for Unit 3. By letter dated July 7, 1998, Duke submitted an application to the NRC to renew the ONS operating licenses for an additional 20 years under Title 10 of the Code of Federal Regulations (CFR) Part 54. Duke is a *licensee* for the purposes of its current operating licenses and an *applicant* for the renewal of the operating licenses.

The National Environmental Policy Act (NEPA) requires an environmental impact statement (EIS) for major Federal actions significantly affecting the quality of the human environment. As provided in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996), under NRC's environmental protection regulations in 10 CFR Part 51 implementing NEPA, renewal of a nuclear power plant operating license is identified as a major Federal action significantly affecting the quality of the human environment. Therefore, an EIS is required for a plant license renewal review. The EIS requirements for a plant-specific license renewal review are specified in 10 CFR Part 51. Pursuant to 10 CFR 54.23 and 51.53(c), Duke submitted an environmental report (ER) (Duke 1998) in which Duke analyzed the environmental impacts associated with the proposed action, considered alternatives to the proposed action, and evaluated any alternatives for reducing adverse environmental effects.

As part of NRC's evaluation of the application for license renewal, the NRC staff is required under 10 CFR Part 51 to prepare an EIS for the proposed action, issue the statement in draft form for public comment, and issue a final statement after considering public comments on the draft. This report is the plant-specific supplement to the GEIS (supplemental environmental impact statement [SEIS]) for the Duke license renewal application. The staff will also prepare a separate safety evaluation report in accordance with 10 CFR Part 54.

The following sections in this introduction describe the background and the process used by the staff to assess the environmental impacts associated with license renewal, describe the proposed Federal action, discuss the purpose and need for the proposed action, and present the status of compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 and 4 discuss the potential environmental impacts of plant refurbishment and plant operation during the renewal term, respectively. Chapter 5 contains an evaluation of potential environmental impacts of plant accidents and includes consideration of severe accident mitigation alternatives (SAMAs). Chapter 6 discusses the uranium fuel cycle and solid waste management, and Chapter 7 discusses decommissioning. The alternatives to license renewal are considered in Chapter 8. Finally, Chapter 9 summarizes the findings of the prior chapters, draws conclusions related to the adverse impacts that cannot be avoided

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(a) Duke Energy Corporation has held the license for the ONS Unit 1, 2, and 3 since September 16, 1997. Before that date, Duke Power Company held the license. Duke Power Company remains a division of Duke Energy Corporation.

(the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and the irreversible or irretrievable commitments of resources), and presents the preliminary recommendation of the staff with respect to the proposed action. Additional information is included in Appendices. Appendix A is reserved for comments on this draft supplement to the GEIS. Appendix B lists preparers of this supplement, and Appendix C lists the chronology of correspondence between NRC and Duke with regard to this supplement. The remaining appendices are identified in subsequent sections.

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. The GEIS serves as the principal reference for all 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 analytical approach (1) described the activity that affects the environment, (2) identified the population or resources that is affected, (3) assessed the nature and magnitude of the impact on the affected population or resource, (4) characterized the significance of the effect for both beneficial and adverse effects, (5) determined whether the results of the analysis applied to all plants, and (6) considered whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The standard of significance was established using the Council on Environmental Quality regulations (40 CFR 1508.27) for assessing environmental issues as small, moderate, or large. These significance levels are defined 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 assigned a significance level to each environmental issue. In assigning these levels, it was assumed that ongoing mitigation measures would continue.

The GEIS included 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 characteristic.

(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 not likely 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 of Category 1, and therefore, additional plant-specific review for these issues is required.

As set forth in the GEIS, the staff assessed 92 environmental issues and determined that 68 qualified as Category 1 issues, 22 qualified as Category 2 issues, and two issues were not categorized. The latter two issues, environmental justice and chronic effects of electromagnetic fields, will be addressed in a plant-specific analysis. A summary of the findings for all 92 issues is listed in Table 9.1 of the GEIS and is codified in 10 CFR Part 51, Subpart A, Appendix B Table B-1.

License Renewal Evaluation Process

An applicant seeking a renewal of its operating license is required to submit an ER as part of its application. This ER must provide an analysis of the issues listed as Category 2 in 10 CFR Part 51, Subpart A, Appendix B, Table B in accordance with 10 CFR 51.53(c)(3)(ii). The ER must include a discussion of actions to mitigate adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action. Certain issues, including the need for power, the economic benefits and costs of the proposed action, economic benefits and costs of alternatives to the proposed action, and other issues not related to the environmental effects of the proposed action need not be considered. In addition, the ER need not discuss any aspect of the storage of spent fuel. The ER is not required to contain an analysis of any Category 1 issues unless there is significant new information on a specific issue. New and significant information is (1) information that identifies a significant environmental issue not covered in the GEIS and codified in10 CFR Part 51, Subpart A, Appendix B or (2) information that was not considered in the analyses summarized in the GEIS and which leads to an impact finding different from that codified in 10 CFR Part 51.

In preparation for submission of its application to renew the ONS operating licenses, Duke developed a process to ensure that new and significant information regarding the environmental impacts of license renewal for ONS was properly reviewed before submitting the ER and to ensure that new and significant information related to renewal of the ONS licenses will be identified, reviewed, and addressed during the period of NRC review. Duke reviewed the Category 1 issues appearing in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 to verify that the conclusions of the GEIS remained valid with respect to ONS. This review was performed by personnel from Duke's Group Environmental Health and Safety and the Oconee station personnel. Duke has committed to repeating this review process at 1-year intervals until a determination on the Oconee license renewal application is made. Duke also committed to including discussions with South Carolina Department of Health and Environmental Control (SCDHEC), the South Carolina Department of Natural Resources (SCDNR), and the U.S. Fish and Wildlife Service (FWS) as part of the review process and making revisions to the ER if new issues are identified that were not included in the GEIS or if changes to conclusions made in the ER are required.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (ESRP), NUREG-1555, Supplement 1 (February 1999 pre-publication copy) (NRC 1999b). The search for new information includes review of an applicant's ER and process for discovering and evaluating the significance of new information, review of records of public meetings and correspondence, review of environmental quality standards and regulations, and review of the technical literature. Any new information discovered by the staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of the issue that are not affected by the new information.

The discussion of the environmental issues considered in the GEIS that are applicable to ONS is found in Chapters 3 through 7. 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 10 CFR Part 51, Subpart A, Appendix B, followed by the staff's review steps 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 describe the analysis required and the SEIS sections where the analysis is presented. The SEIS sections discussing the Category 2 issues listed immediately follow the table.

The NRC prepares an independent analysis of the environmental impacts of license renewal as well as a comparison of these impacts to the environmental impacts of alternatives. The evaluation of Duke's license renewal application began with publication of a notice of acceptance for docketing (63 FR 42885, August 11, 1998). The staff published a notice of intent to prepare an EIS and conduct scoping (63 FR 50257, September 21, 1998). Two public scoping meetings were held on October 19, 1998, in Clemson, South Carolina. Comments received during the scoping meeting were summarized in the *Environmental Impact Statement Scoping Process, Oconee Nuclear Station, Summary Report*, January 1999 (NRC 1999a).

The staff conducted a site visit at ONS on October 19 through 22, 1998, performed a review of the comments received during scoping, and consulted with state, regional, and local agencies. A list of the organizations consulted is provided in Appendix D of this document. Other documents related to ONS were also reviewed and are referenced.

The ESRP provides guidance for the staff review and for the preparation of the SEIS. Because the ESRP was under development at the time of the Duke application, a draft of the ESRP was used during the review of the ER. The staff issued Requests for Additional Information (RAI) to Duke by letters dated December 29, 1998 (NRC 1998a and NRC 1998b). Duke provided its responses in a letter dated March 4, 1999 (Duke 1999). The staff reviewed this information and incorporated it into its analysis. The results of the staff's evaluation are contained in this SEIS. The SEIS presents an analysis that considers and weighs the environmental effects of the license renewal, the environmental impacts of alternatives to license renewal, and alternatives available for avoiding adverse environmental effects. A preliminary recommendation on whether the adverse impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable is provided in Chapter 9, Summary and Conclusions.

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) and in accordance with §51.23(b).[a]

(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."

This SEIS is being released in draft form for public comment as required in 10 CFR 51.73. Comments received during the comment period will be considered. The disposition of the comments will be addressed in Appendix A to the final SEIS.

1.1 The Proposed Federal Action

The proposed Federal action is renewal of the operating licenses for ONS Units 1, 2, and 3. ONS is located in Oconee County, South Carolina, approximately 13 km (8 mi) northeast of Seneca, South Carolina. The plant has three pressurized light-water reactors, each with a design rating for net electrical power output of 887 megawatts (MW). Plant cooling is provided by a once-through heat dissipation system into Lake Keowee which, along with the Keowee Hydroelectric station, was constructed at approximately the same time as the ONS. ONS produces electricity to supply the needs of more than 730,000 homes. The current operating licenses for Unit 1 expires on February 6, 2013, for Unit 2 on October 6, 2013 and for Unit 3 on July 19, 2014. By letter dated July 7, 1998, Duke submitted an application to renew these operating licenses for an additional 20 years of operation (i.e., until February 6, 2033, for Unit 1, October 6, 2033, for Unit 2, and July 19, 2034, for Unit 3).

1.2 Purpose and Need for the Action

Although a licensee must have a renewed license to operate a plant beyond the term of the existing operating license, 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 licensed, 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 Commission has adopted the following definition of purpose and need 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.

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, as amended, 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 operating license is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant's license.

1.3 Compliance and Consultations

Duke is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. Duke provided a list of the status of authorizations from Federal, state, and local authorities for current operations as well as environmental approvals and consultations associated with ONS license renewal. Authorizations most relevant to the proposed license renewal action are summarized in Table 1-1. The full list of authorizations provided by Duke is included as Appendix E.

The staff reviewed the list and has consulted with the appropriate Federal, State, and local agencies to identify any significant environmental issues of concern to the reviewing agencies. Agency interactions identified no new and significant environmental issues. The staff has also not identified any new and significant environmental issues.

Table 1-1. Federal, State, and Local Authorizations

Agency	Authority	Requirement	License Permit Number	Permit Expiration or Consultation Date	Activity Covered
NRC	Atomic Energy Act, 10 CFR Part 50	Operating license	DPR-38, DPR-47, DPR-58	Expires February 6, 2013, October 6, 2013, and July 19, 2014	Operation of ONS Units 1, 2, and 3
FERC	Federal Power Act, Section 4(e)	Associated hydro project	FERC Project No. 2503	Expires 2016	License for Keowee Dam and Hydro station
FWS	Endangered Species Act, Section 7	Consultation	NA	Consultation initiated June 23, 1998	Operation during the renewal term
SCDHEC	Clean Air Act, Section 112	Air quality permit	1820-0041	April 22, 2002	Air quality permit
SCDHEC	Safe Drinking Water Act, 42 U.S.C. 1412	Water quality	202098AI and 204558	In compliance	ONS has two permits for drinking water wells in protected area
SCDHEC	RCRA-subtitle 1	Permit	06673,11174, 11843	Issued January 1, 1982, November 3, 1988 November 3, 1989	Underground storage tanks
SCDHEC	FWPCA Section 402	State discharge permit	SCR000000	Issued October 1, 1992 in compliance	General storm water permit
SCDHEC	FWPCA Section 402	Water quality	SCR00[illegible]15	Expired[(a)]	Discharges of process waste water (NPDES permit)
SCSHPO	National Historic Preservation Act, Section 106	Consultation	NA	Letter from Duke requesting consultation dated September 30, 1997	Operation during the renewal term

EPA - U.S. Environmental Protection Agency
FERC - Federal Energy Regulatory Commission
FWPCA - Federal Water Pollution Control Act (also known as the Clean Water Act)
FWS - U.S. Fish and Wildlife Service
NPDES - National Pollutant Discharge Elimination System
RCRA - Resource Conservation and Recovery Act
SCDHEC - South Carolina Department of Health and Environmental Control
SCSHPO - South Carolina State Historic Preservation Office
NA - Not applicable

(a) Section 2.2.3.

1.4 References

10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR 51.23, "Temporary Storage of spent fuel after cessation of reactor operation - generic determination of no significant environmental impact."

10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR 51.23, "Temporary Storage of spent fuel after cessation of reactor operation - generic determination of no significant environmental impact."

10 CFR 51.53, "Postconstruction environmental reports."

10 CFR 51.73, "Request for comments on draft environmental impact statement."

10 CFR 51.95, "Postconstruction environmental impact statements."

10 CFR Part 51, Subpart A, Appendix B, Table B-1, "Environmental effect of renewing the operating license of a nuclear power plant."

10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR 54.23, "Contents of application - environmental information."

40 CFR 1508/27, "Terminology and index - Significantly."

63 FR 42885, "Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of Licenses Nos. DPR-38, DPR-47 and DRP-55," August 11, 1998.

63 FR 50257, "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." September 21, 1998

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

Duke Energy Corporation. 1998. *Application for Renewed Operating Licenses - Oconee Nuclear Station, Units 1, 2 and 3.* Volume IV, Environmental Report.

Duke Energy Corporation, 1999. Letter from M. S. Tuckman, Duke Energy Corporation to U.S. Nuclear Regulatory Commission. Subject: License Renewal-Response to Requests for Additional Information, Oconee Nuclear Station. Dated March 4, 1999.

Endangered Species Act, as amended, 16 USC 1531 et seq.

Federal Water Pollution Control Act (FWPCA), as amended, 33 USC 1251 et seq. (also known as the Clean Water Act).

National Historic Preservation Act, as amended, 16 USC 470 et seq.

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

U.S. Nuclear Regulatory Commission (NRC). 1998a. Letter from U.S. NRC to William R. McCollum, Duke Energy Corporation. Subject: Request for Additional Information for the Review of the Oconee Nuclear Station Units 1, 2, and 3. Environmental Report Associated with License Renewal-Environmental. Dated December 29, 1998.

U.S. Nuclear Regulatory Commission (NRC). 1998b. Letter from U.S. NRC to William R. McCollum, Duke Energy Corporation. Subject: Request for Additional Information for the Review of the Oconee Nuclear Station Unit Nos. 1, 2 & 3 Environmental Report Associated with License Renewal - SAMA. Dated December 29, 1998.

U.S. Nuclear Regulatory Commission (NRC). 1999a. *Environmental Impact Statement Scoping Process: Summary Report - Oconee Nuclear Station Units 1, 2 and 3, Oconee County, South Carolina.* Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999b. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal,* NUREG-1555, Supplement 1. Washington, D.C.

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

The Oconee Nuclear Station (ONS) is located near State Highways 130 and 183 on Lake Keowee in eastern Oconee County, South Carolina, approximately 13 km (8 mi) northeast of Seneca, South Carolina. The site is within 40 km (25 mi) of the boundaries of the States of North Carolina and Georgia, as shown in Figure 2-1. ONS is a three unit plant. Each unit is equipped with a nuclear steam supply system manufactured by Babcock and Wilcox that uses a pressurized light-water reactor and once-through cooling with water from Lake Keowee. The electricity generated is transferred to the switchyards located at the ONS site. Each unit has a design rating for net electrical power output of 887 megawatts electric (MW(e)). Each unit is rated at 846 MW(e) net power. This provides a combined station total of 2538 MW(e) net power. The amount of electricity produced by ONS can supply the needs of more than 730,000 homes. Descriptions of the plant and its environs follow in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

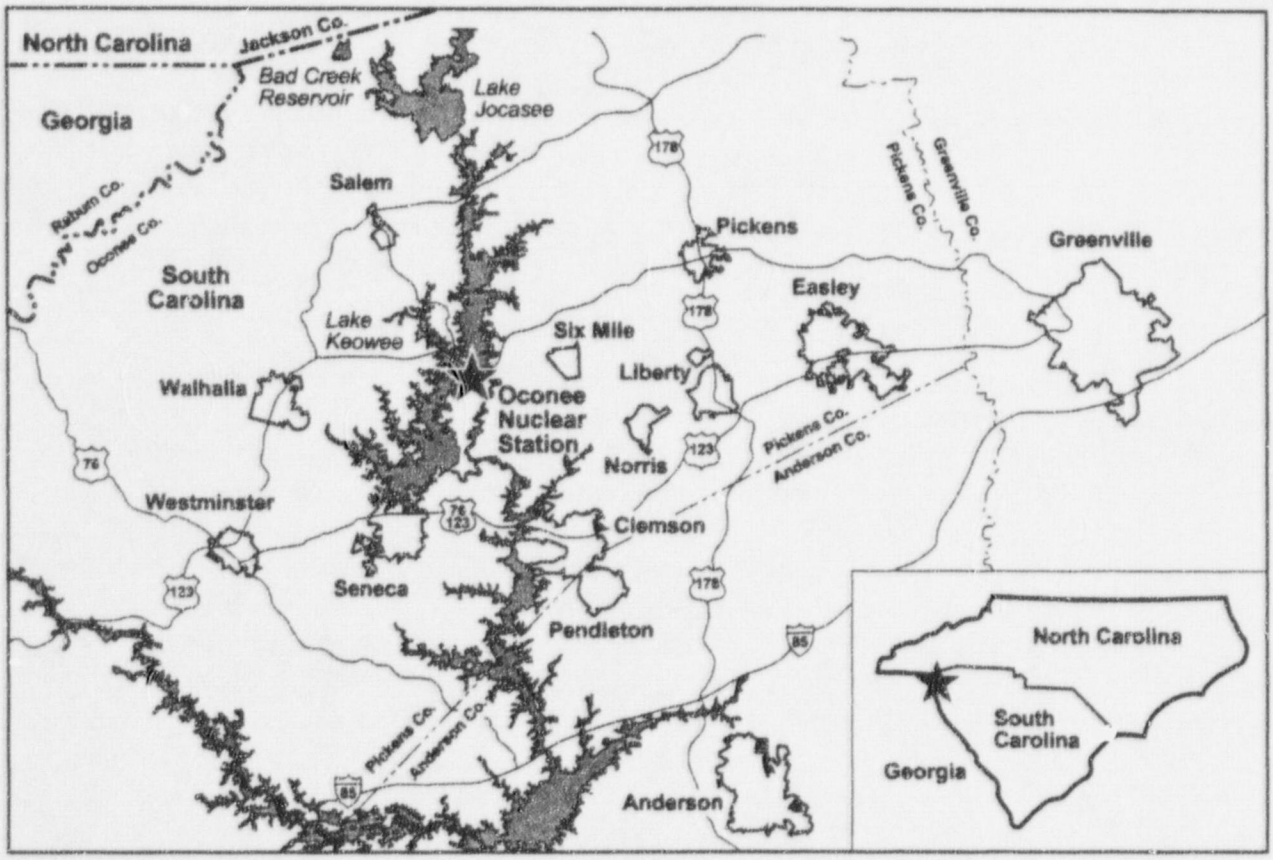


Figure 2-1. Location of Oconee Nuclear Station

2.1 Plant and Site Description and Renewal Term Plant Operation

ONS is located on 210 ha (510 acres) in a rural part of northwestern South Carolina. Figure 2-1 shows the location of ONS in relationship to the tri-state area (northwest South Carolina, northeast Georgia, and southwest North Carolina). The site is surrounded by an exclusion area of 1.6 km (1 mi) radius as shown in Figure 2-2. All land is owned by Duke in full except for a small rural church lot, a highway right-of-way, and approximately 4 ha (9.9 acres) included in the Hartwell Reservoir project.

The region surrounding ONS was identified by the Generic Environmental Impact Statement (GEIS) as having a medium population density. Approximately 1700 persons comprise the non-outage work force at ONS. There are 1350 Duke employees normally on site. The remainder of the 1700 persons are contract or vendor workers. The plant is located near the cities of Seneca, Walhalla, Clemson, and Central South Carolina. The nearest town is Six Mile, located 6 km (4 mi) east northeast. The majority of the land area is forest, with pasture, cropland, and residential development each contributing significant proportions of land-use. The land within 8 km (5 mi) of the plant is primarily forest.

The property consists of rolling hills, with surface elevations ranging from about 210 m to 273 m (700 ft to 900 ft) within the region. The area is well drained by several intermittent streams flowing away from the center of the site in a radial pattern. The site lies within the drainage area of the Little and Keowee Rivers, which flow southerly into the Seneca River and subsequently discharge into the main drainage course of the Savannah River. The average annual rainfall at the site area is approximately 135 cm (53 in.).

ONS is part of Duke's integrated energy producing area called the Keowee-Toxaway complex. ONS was constructed as a part of the Keowee-Toxaway Project (FERC Project #2503). This project also included the construction of Lake Keowee, Lake Jocassee, and the associated hydroelectric stations. Construction of the project occurred between 1968 and 1974. The Keowee-Toxaway Complex is located in the upper Savannah River drainage basin. It consists of the three-unit ONS, the Keowee Hydroelectric Station (a two-unit conventional hydroelectric facility), the Jocassee Hydroelectric Station (a four-unit pumped storage hydroelectric facility) and the Bad Creek Pumped Storage Project (a four-unit pumped storage hydroelectric facility). The Jocassee Hydroelectric Station can operate in a generating mode or in a pumping mode to store water for later generation of electric power. In the generating mode, electricity is generated by allowing water to flow from Lake Jocassee (upper pond) into Lake Keowee (lower pond). In the pumping mode, water is pumped into Lake Jocassee from Lake Keowee for generation of electricity at a later time. The Bad Creek Pumped Storage Facility uses Lake Jocassee as the lower pond, and the Bad Creek Reservoir serves as the upper pond. Figure 2-3 illustrates the location of ONS in relationship to the rest of the Keowee Toxaway project and the Bad Creek project.

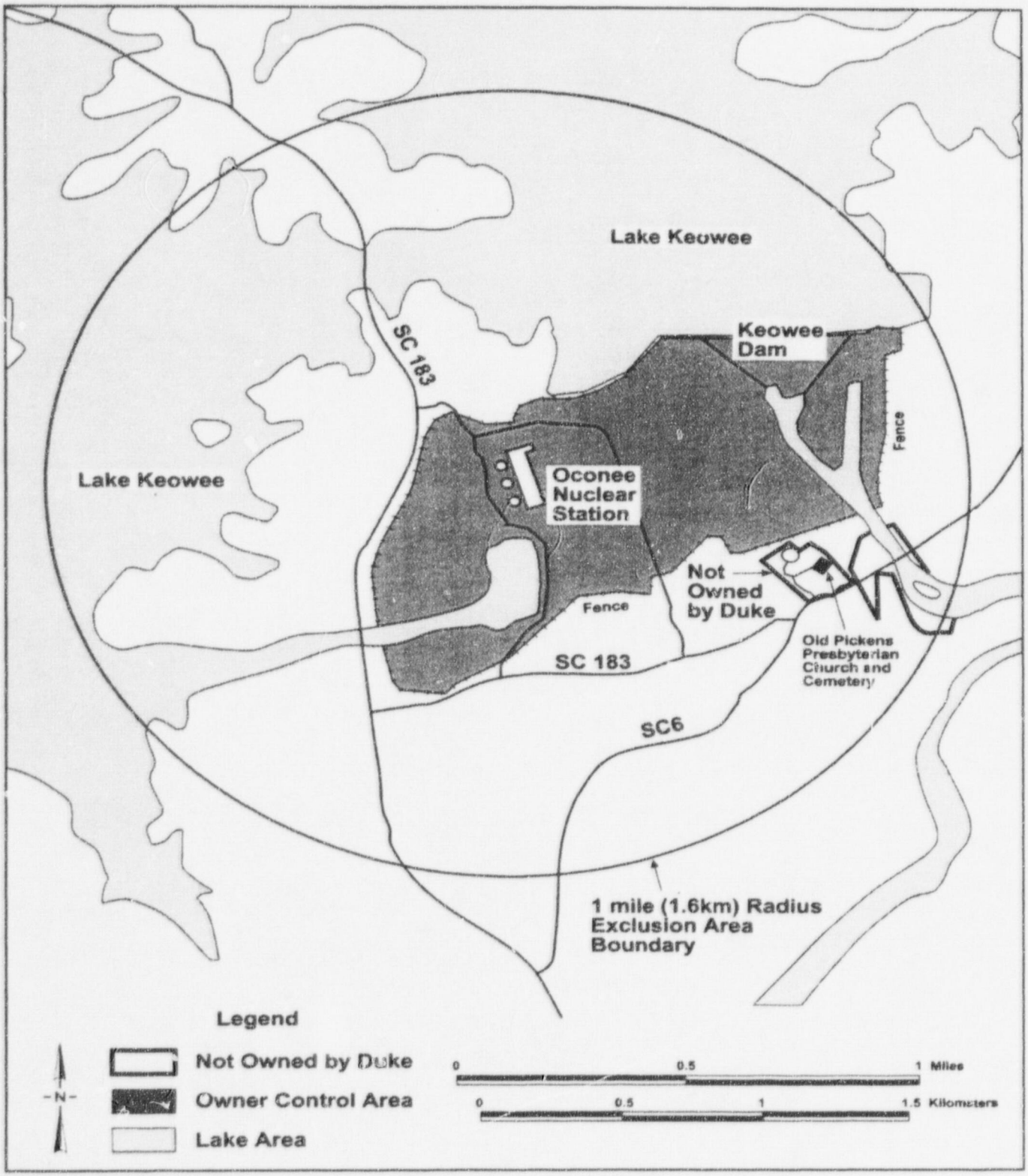


Figure 2-2. Oconee Nuclear Station - One-Mile Exclusion Area

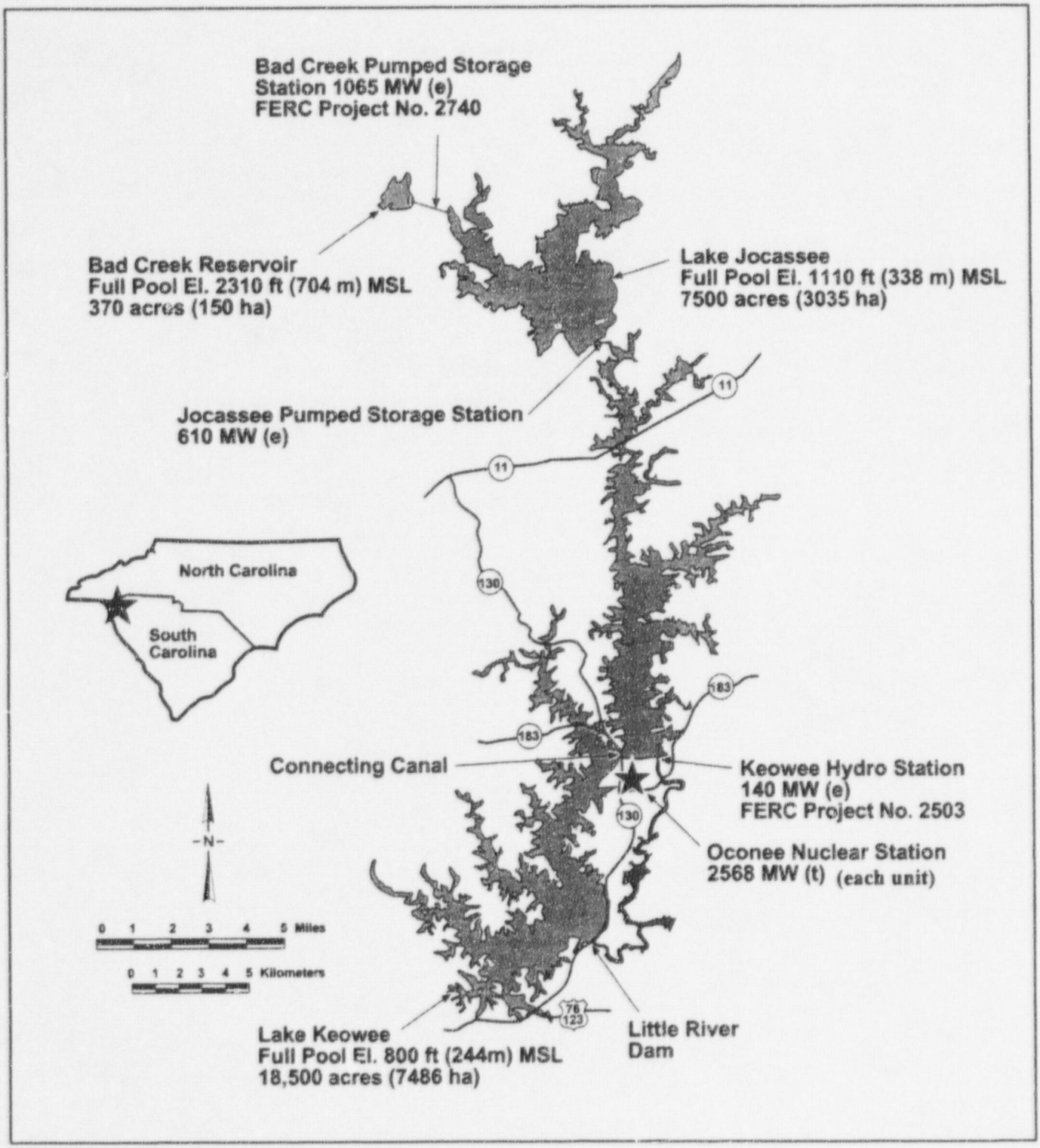


Figure 2-3. Location of Oconee Nuclear Station Relative to Other Parts of Keowee-Toxaway Project (Jocassee Pumped Storage Station and Keowee Hydro Station)

ONS is on the shores of Lake Keowee, which is located immediately north and west of the site. Lake Keowee was formed by damming the water of the Little River and the Keowee River above the Hartwell Reservoir. Hartwell Reservoir, an Army Corps of Engineers' reservoir, is located south and downstream of the site. Lake Jocassee is approximately 17.5 km (11 mi) to the north. Keowee Lake covers about 7490 ha (18,500 acres) and has 480 km (300 mi) of shoreline, which is developed with both permanent and vacation residences, along with campgrounds, boat launch areas, marinas, golf courses and some small retail establishments. The volume of Lake Keowee is $1.175 \times 10^{+9}$ m^3 (952,300 acre ft). The mean depth is 16 m (52 ft) with a maximum depth of 43 m (141 ft). In addition to uses for the needs of the nuclear and hydroelectric power plants, Lake Keowee is used as a source of municipal drinking water by Greenville and Seneca and is extensively used for recreation by fishermen, swimmers, skiers, and boaters.

2.1.1 External Appearance and Setting

The station is sited within a forested valley and is only visible from the neighboring highways in a few locations. The most obvious view is one of the water tower. ONS consists of three cylindrical concrete reactor building structures, approximately 38 m (125 ft) in diameter and about 61 m (200 ft) high. A turbine building and an auxiliary building are shared among the three units. Switchyards are located near the turbine building. Various other office buildings and facilities are located at ONS to support the station. Figure 2-4 shows the general features of the ONS site. Figure 2-5 presents an aerial view of the facility showing the three cylindrical reactor buildings.

Duke has an independent spent fuel storage installation (ISFSI) located on the site that has a license separate from the operating license. Duke was issued a Materials License (No. SNM-2503) for the ISFSI on January 29, 1990, with an expiration date of January 31, 2010. The ISFSI is outside the scope of this review.

The Old Pickens Presbyterian Church and Cemetery are located to the southeast of ONS on a small parcel of land that is not owned by Duke. The church is the only building remaining from the original Pickens town site. A Visitor's Center on a hill just above the site displays "The Story of Energy," which describes how sources of energy are found in nature and converted into electricity by Duke's generating facilities. There is also a lakeside picnic area and landscaped grounds.

The site's geological setting is in the southeastern Piedmont physiographic province, and the site is underlain by crystalline rocks (AEC 1972). This northeastward-trending belt of ancient metamorphic rocks extends northward from Alabama east of the Appalachians, and in South Carolina, it crosses the state from the fall line on the east to the Blue Ridge and Appalachian Mountains on the west. These rocks are generally recognized as being divided into four parallel northeast-southwest-trending belts in the Carolinas. From southeast to northwest, these are the Carolina slate belt, the Charlotte belt, the Kings Mountain belt, and the Inner Piedmont belt. The site is in the northwestern Inner Piedmont belt.

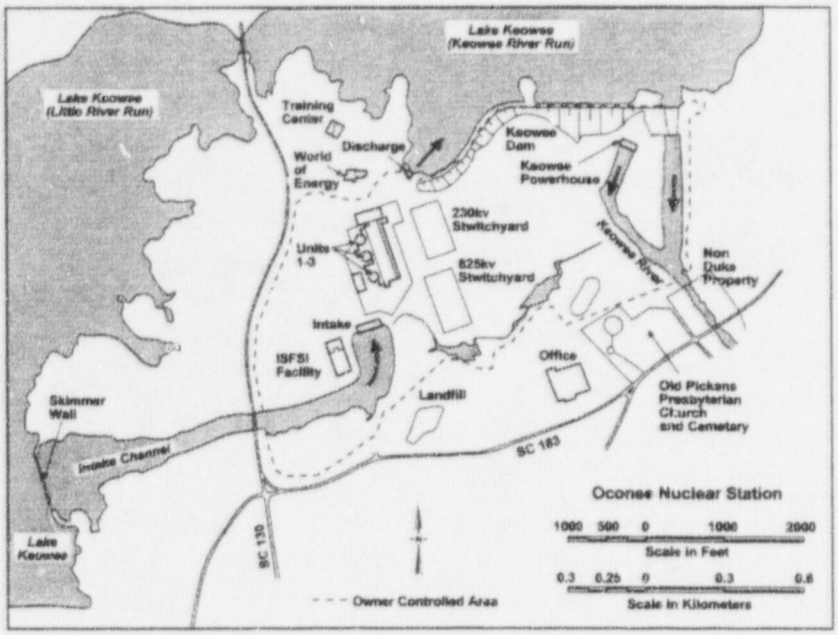


Figure 2-4. Oconee Nuclear Station Layout

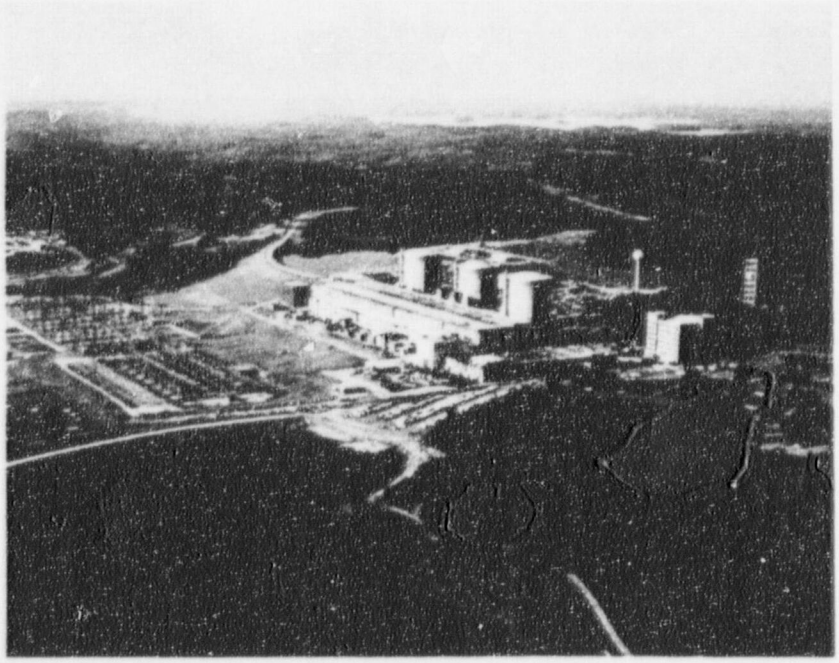


Figure 2-5. Oconee Nuclear Station (aerial photo)

The rocks are geologically ancient and complex. These rocks were folded and metamorphosed when the Appalachian Mountains were formed during the Appalachian Revolution, some 270 million years ago. Faults and other lines of weakness dating from this Revolution may serve to locate present-day minor crustal movements that produce small earthquakes, and their location is of some importance. The most important is the Brevard fault zone that passes 17.5 km (11 mi) northwest of the site. The design criteria for the Station took this fault zone into account. Small earthquakes have been detected along this zone with intensities of IV to VI. Using this scale of intensities, V and VI represent disturbances that can dislodge plaster, etc.; X, XI, and XII represent disturbances that are severely damaging (AEC 1972).

In addition to the Brevard fault, there are fault zones 48 km (30 mi) to 320 km (200 mi) southeast where quake intensities of VII or VIII have been recorded. But because of their distance, these zones are of slight importance for ONS (AEC 1972).

ONS is in the drainage basins of the Little and Keowee Rivers, which receive the runoff of surface water and groundwater from the site. The residual soil in the area is comparatively impermeable, particularly in late winter and early spring when the soil is saturated, and much of the precipitation goes into direct surface runoff. The residual soils do accept some water, and the area is underlain by a water table that is a subdued replica of the topography. Groundwater is not an important source of water supply in the area; all neighboring towns obtain their municipal supplies from above-ground sources.

The rate of movement of the groundwater was calculated to be 45 m to 76 m (150 ft to 250 ft) per year (AEC 1972). The residual soil has excellent ion exchange properties.

2.1.2 Reactor Systems

ONS is a three-unit plant. Each unit is a pressurized light-water reactor, with a nuclear steam supply system manufactured by Babcock and Wilcox. Each unit has a design rating for net electrical power output of 887 MW(e), and is operated at a maximum core thermal power output level of 2568 MW(t). The turbines are manufactured by General Electric Company. Each turbine is a tandem, compound, six-flow exhaust, indoor unit.

ONS fuel is slightly enriched (3.7 percent by weight)[a] uranium dioxide in the form of pellets contained in zirconium alloy fuel rods (tubes fitted with welded end caps).

(a) Naturally occurring uranium contains several forms of uranium, including approximately 0.7 percent uranium-235, the form that a nuclear reactor uses. The nuclear fuel manufacturing process removes some of the other forms, resulting in a slightly higher percentage ("enrichment") of uranium-235.

Duke can operate ONS at a maximum fuel burnup[a] rate of 62,000 megawatt days per metric ton uranium (MWd/MTU).

Reactor containment structures are designed with engineered safety features to protect the public and plant personnel from accidental release of radioactive fission products, particularly in the unlikely event of a loss of coolant accident (LOCA). These safety features function to localize, control, mitigate, and terminate such events to limit exposure levels below applicable dose guidelines. The reactor is controlled using a combination of chemical controls (boric acid dissolved in coolant water) and solid absorber material (tubes of boron carbide).

2.1.3 Cooling and Auxiliary Water Systems

ONS is equipped with a once-through heat dissipation system that withdraws cooling water from the Little River arm of Lake Keowee, from underneath a skimmer wall. The discharge for the cooling water is located on the Keowee River arm of the lake just above the Lake Keowee dam. The Keowee River and the Little River basins are connected by a canal, approximately 31 m (100 ft) wide and 12 m (40 ft) deep (illustrated in Figure 2.2). It is nearly 3.2 km (2 mi) by lake from the point of discharge to the mouth of the intake canal. A natural cove was deepened and extended to within a few hundred feet of the power plant as part of the project when initially licensed. Across the mouth of the cove, a skimmer wall was constructed extending from above the surface of the lake (normally 244 m (800 ft)) above mean sea level) down to an elevation of 223 m (735 ft). This wall ensures that cooler water from near the bottom of the lake enters the intake canal. Further into the intake cove is a submerged dam, or weir, with its crest at 233 m (770 ft) above mean sea level. The purpose of this dam is to retain enough water in the intake canal to provide ample condenser cooling for an orderly shutdown of the plant in the event that one of the Lake Keowee dams or dikes fails, and the lake drains. The distance from the weir to the intake structures is nearly 1.2 km (0.75 mi). Figure 2-4 shows the water flow for the plant and illustrates the location of the skimmer wall, intake structure, submerged dam, and the outfall for the once-through cooling system.

Each generating unit has three separate water loops. The primary coolant loop is a closed piping system— pressurized water in the system is circulated through the reactor and transfers heat from the reactor to the steam generator. The secondary loop is also a closed system—water from this system is converted into steam (in the steam generators) that is used to drive the turbine. The third loop is an open system—water from the Little River arm of Lake Keowee is used to cool the spent steam in the secondary loop, and then it is returned to the Keowee River arm of Lake Keowee. The principal components of the third cooling loop are the skimmer wall, intake structure, circulating water pumps, condensers, and discharge conduits.

(a) "Burn-up" is the length of use of, or total energy generated by, the nuclear fuel and is measured as megawatt-days per metric ton uranium.

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

ONS uses liquid, gaseous, and solid radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes that are the by-products of the ONS operation. These systems reduce radioactive liquid, gaseous, and solid effluents before they are released to the environment. The ONS waste processing systems meet the design objectives of 10 CFR Part 50, Appendix I, and control the processing, disposal, and release of radioactive liquid, gaseous, and solid wastes. Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive wastes in light-water reactors (LWRs). Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods, but small quantities escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system also is responsible for coolant contamination.

Non-fuel 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 design and operations modifications and routine maintenance activities. Solid wastes may be shipped to a waste processor for volume reduction before disposal or may be sent directly to the licensed burial site. Spent resins, filters, and evaporator concentrates are dewatered and stored or packaged for shipment to an offsite processing or disposal facility.

Fuel rods that have exhausted a certain percentage of their fuel and that are removed from the reactor core for disposal are called spent fuel. ONS currently operates on an 18-month refueling cycle for all three units. Spent fuel is stored onsite either in a spent fuel pool in the Auxiliary Building or in dry storage at the ONS ISFSI. ONS also temporarily stores mixed waste onsite. This storage is governed by the Atomic Energy Act for radioactive material and the Resource Conservation and Recovery Act for hazardous waste, consistent with NRC and EPA requirements (42 USC 2011-2259; 42 USC 6901).

The systems used for processing—liquid waste processing, gaseous waste processing, solid waste processing, and nonradioactive waste systems—are discussed in the following sections.

The Offsite Dose Calculation Manual (ODCM) provides the methodology and parameters used to calculate potential offsite doses due to radioactive liquid and gaseous effluents and to ensure compliance with the dose limitations of the Selected Licensee Commitments (Section 16.11 Radiological Effluents Control of the Updated Final Safety Analysis Report (UFSAR)). These dose limits require:

1) The concentration of radioactive liquid effluents released from the site to the unrestricted area will be limited to ten times the effluent concentration (EC) levels of 10 CFR Part 20, Appendix B, Table 2.

2) The exposures to any individual member of the public from radioactive liquid effluents will not result in doses greater than the design objectives of 10 CFR Part 50, Appendix I.

3) The dose rate at any time at the site boundary from radioactive gaseous effluents will be limited to (a) less than or equal to 5 mSv/yr (500 mrem/yr) to the whole body and less than or equal to 30 mSv/yr (3000 mrem/yr) to the skin for noble gases and (b) less than or equal to 15 mSv/yr (1500 mrem/yr) to any organ for iodine-131 and 133, tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days.

4) The exposure to any individual member of the public from radioactive gaseous effluents will not result in doses greater than the design objectives of 10 CFR Part 50, Appendix I.

5) The dose to any individual member of the public from the nuclear fuel cycle will not exceed the limits of 40 CFR Part 190 and 10 CFR Part 20.

2.1.4.1 Liquid Waste Management Systems and Effluent Controls

Radioactive liquid wastes from the operation of ONS are accumulated in storage tanks based on the waste source and process train. These wastes are collected in the Auxiliary Building and transferred to the Radwaste Facility for processing by filtration or demineralization or both. The Auxiliary Building processes high-activity wastes, low-activity wastes and miscellaneous wastes from the Radwaste Facility. There is also an Interim Radwaste Building that can process liquid wastes, but it is not currently in use.

ONS liquid wastes are disposed of by one of the following three methods based on the concentration of radioactive material in the waste:

- Collected, sampled, and analyzed (diluted to meet the permissible concentration limits for discharge) and then discharged directly to the tailrace of the Keowee Hydroelectric plant.

- Processed by filtration or demineralization or both, collected, sampled, and analyzed with the filters and or resins and then packaged and shipped to an approved licensed burial ground.

- Processed by filtration or demineralization or both, collected, sampled, and analyzed with the filters and or resins and then packaged and shipped to an offsite vendor waste processor.

The liquid waste holdup capacity for the three units is 28,343 m^3 (944,773 ft^3) per year. The actual liquid waste generated is reported in the Oconee Annual Effluent Report.

The ODCM prescribes the effluent release rate that will ensure that the concentration of radioactive liquid effluents released from the site to the unrestricted area is less than ten times the effluent concentrations of 10 CFR Part 20, Appendix B. In addition, the ODCM provides calculations for the radiation monitor alarm/trip set points that define the relationship between the measured effluent activity, the maximum allowable effluent activity, and the effluent flowrate needed to ensure that the instantaneous release rate is not exceeded and thereby the Selected Licensee Commitments are met.

2.1.4.2 Gaseous Waste Management Systems and Effluent Controls

Radioactive gaseous wastes at ONS are created by the evolution of gases in liquid wastes stored in tanks. The wastes are monitored and released at a permissible rate prescribed by the ODCM. Units 1 and 2 share a Gaseous Waste Disposal System, and Unit 3 has a separate system that can be interconnected to the Unit 1 and 2 system. The purposes of the Gaseous Waste Disposal Systems are: 1) to maintain a non-oxidizing cover gas of nitrogen in tanks and equipment that may contain radioactive gas, 2) to holdup gas for decay, and 3) to release the gases under controlled conditions.

The gaseous wastes are to be released in the following ways depending on the source, quantities, and concentration of radioactive material: 1) release of Auxiliary Building ventilation air and Reactor Building purges into the unit vents, 2) release of Reactor Building purges through high efficiency particulate and charcoal iodine filters to the unit vents, 3) release of waste gas directly or through high efficiency particulate and charcoal iodine filters to the unit vents, 4) diversion of gaseous radioactive waste to waste gas tanks with controlled release after sampling and analysis through the waste gas system high efficiency particulate and charcoal iodine filters to the unit vents, and 5) release of Radwaste Facility heating, ventilation, and air conditioning (HVAC) and process exhaust.

The ODCM prescribes the effluent release rate to ensure that releases are less than the Selected Licensee Commitments. In addition, the ODCM provides the calculational methodology for the radiation monitor alarm/trip set points, which defines the relationship between the measured effluent activity, the maximum allowable effluent activity, and the effluent flowrate needed to ensure that the instantaneous release rate is not exceeded, and thereby the Selected Licensee Commitments are met.

2.1.4.3 Solid Waste Processing

Solid waste is packaged in containers to meet the applicable requirements of 10 CFR Parts 61 and 71 for transportation and disposal. There are no releases to the environment from radioactive solid wastes created at ONS. NRC and the state of South Carolina have approved the disposal of slightly contaminated materials within the Company Controlled Area. For each onsite disposal, the waste is analyzed and confirmed to have acceptably low radionuclide concentrations, following the approval process described in 10 CFR 20.2002.

There are approximately 150 shipments made from ONS each year. About 120 are radioactive material shipments (contaminated parts, tools, equipment, sources, etc.) and 30 radwaste shipments (dry active waste, dewatered resins, irradiated hardware, etc.). The radwaste shipments may be shipped to a waste processor to reduce the volume before disposal or may be sent directly to a licensed burial site.

From year to year, the volume of radioactive contaminated waste generated will vary, but averages about 750 m^3 (25,000 ft^3) per year. ONS has been aggressively reducing volume and minimizing waste for several years and plans to continue to do so in the future.

2.1.5 Nonradioactive Waste Systems

The primary nonradioactive chemical wastes produced by ONS are from reactor coolant feedwater, steam generator feedwater, water treatment demineralizers, and deborating demineralizers. Laundry and cleaning detergents are also considered nonradioactive chemical wastes. Most wastes are neutralized and sent to the holding pond, eventually being discharge to the tailrace of the Keowee Hydroelectric Station. Sanitary wastes are chlorinated before discharge to the Keowee River downstream from the Keowee Hydroelectric station.

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear power plant. Some of the maintenance activities conducted at ONS include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and public 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 replacement of a major component. Scheduled refueling outages commonly have a duration of 45 to 55 days for a single unit. An additional 800 to 900 workers are onsite during a typical outage. Scheduled refueling outages for ONS occur on 18-month intervals for all three units.

Duke performed an aging management review and developed an integrated plant assessment for managing the effects of aging on systems, structures and components in accordance with 10 CFR Part 54. The integrated plant assessment identified several activities that must necessarily be conducted during the period of extended operation. These activities include inspections and replacement of certain components. The licensee indicated that replacing these components and conducting additional inspections are within the bounds of normal plant operations. Therefore, Duke expects to conduct these activities during plant operation or normal refueling and other outages, but plans no outages specifically for the purpose of refurbishment. Duke has no plans to add additional full-time persons (non-outage workers) at the plant during the period of the extended license.

2.1.7 Power Transmission System

The ONS FES (AEC 1972) lists the transmission lines shown in Table 2-1 as being "attributable to the (Oconee) nuclear station". These lines account for 528 km (330 mi) of lines and about 3120 ha (7800 acres) of land in the rights-of-way. Figure 2-6 illustrates the location of these transmission lines.

These transmission lines were constructed concurrently with the construction of Oconee and the Keowee-Toxaway project and at a time that the Duke transmission system was being expanded in the Piedmont area. These lines are owned and operated by Duke Electric Transmission, a division of Duke Energy separate from Duke Power (Duke 1998a). The applicant indicated that the transmission lines will remain in service following the termination of operation and the decommissioning of Oconee, unless business needs require otherwise. The applicant stated that the 525 kV and the 230 kV lines from the Oconee substation provide an outlet for the 1675 MW of electrical power at the Jocassee and Bad Creek Pumped Storage Hydro plants, and a source of power when these units are in pump mode. In addition, Duke stated that three of the lines were energized before initial ONS startup. These lines are also used for tie-ins to the Virginia-Carolinas subregion of the Southeastern Electric Reliability Council as well as for connections to Georgia and Florida. Duke (1998a) proposed that the transmission lines that should be considered to connect the plant to the transmission system are only those lines from the Oconee Turbine Building to the 230 kV and the 525 kV switchyards. However, as provided in 10 CFR 51.53(c)(3)(ii)(H), the scope of the review of transmission lines for the Category 2 issue concerning electric shock is the set of transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system. The NRC staff has determined that the scope of the review of transmission lines for the Category 2 issue concerning threatened or endangered species should be identical to the scope of review for electric shock (NRC 1999b). As stated above, the ONS FES indicates that all the transmission lines listed in Table 2-1 were "attributable to [ONS]." Accordingly, the staff has determined that all these lines were constructed for the specific purpose of connecting ONS to the transmission system and determined that all of the transmission lines discussed in the FES should be evaluated.

Table 2-1. Transmission Lines from Oconee Nuclear Station

Destination	Double or Single	kV	Distance (mi)	Width of Right-of-way (ft)	Date Line was Energized
Tiger	d	230	53	150	November 1, 1973
Central (2)	d	230	9	270	October 31, 1970
Site H (McGuire)	s	525	130	200	July 2, 1974
Newport	s	525	110	200	April 1, 1973
N. Greenville	d	230	28	200	January 1, 1970



Figure 2-6. Transmission Lines Attributable to the Oconee Nuclear Station in the Final Environmental Statement (AEC 1972)

2.2 Plant Interaction with the Environment

Subsections 2.2.1 through 2.2.8 provide general descriptions of the environment as background information and detailed descriptions where needed to support analysis of potential environmental impacts of refurbishment and operation during the renewal term as discussed in Chapters 3 and 4. Subsection 2.2.9 describes the historical and archaeological resources in the area, and 2.2.10 describes possible impacts on other Federal project activities.

2.2.1 Land Use

ONS is located in the northwest corner of South Carolina. The station is in the eastern portion of Oconee County. It is approximately 13 km (8 mi) northeast of the city of Seneca, the largest city in

Oconee County. Lake Keowee occupies the area immediately north and west of the station. Lake Keowee covers approximately 7500 ha (18,500 acres) and was created by dams on the Lower Keowee and Little River.

The total area occupied by the station is 210 ha (510 acres). Forests cover the majority of the land area in the region surrounding ONS. The topography of the immediate area is undulating to rolling. Surface elevations range from approximately 210 m (700 ft) to 275 m (900 ft).

Oconee County is predominantly rural. The county's major population centers and developed areas are concentrated in the east central portion of the county around the municipalities of Walhalla, Westminster, and Seneca. Walhalla is the county seat for Oconee County. Table 2-2 shows a breakdown of land use in Oconee County in 1994. The amount of developed land is increasing with time.

The land occupied by the station is an unincorporated portion of Oconee County. There are no zoning or land-use restrictions imposed by Oconee County in the unincorporated portions of the county.

Table 2-2. Land Use in Oconee County in 1994 (Talbert & Bright 1996)

Land Use	Hectares	(Acres)	% of Total
Farming	97,700	(241,300)	56.3
Residential	5,700	(14,100)	3.3
Government Owned	41,000	(101,200)	23.6
Other (commercial and industrial)	9,500	(23,500)	5.5
Water Bodies	19,700	(48,600)	11.3
Total	173,600	(428,700)	100

2.2.2 Water Use

Water from Lake Keowee (8.3×10^6 m^3/d [2200 million gpd]) provide once-through condenser cooling water (CCW) for ONS (see Section 2.1.3), serves as the lower pond for the Jocassee Pumped Storage Station, and furnishes energy to drive the Keowee Hydroelectric Station. Water from the Seneca water treatment plant (1200 m^3/d [0.3 million gpd]) is used for potable water. Treated waste water (51 m^3/d [0.01 million gpd]) from the plant's liquid rad waste system is diluted and returned to the Keowee dam tailrace. Treated water (5300 m^3/d [1.4 million gpd]) from the sewage treatment system, the chemical treatment system, the landfill leachate collection system, chemical treatment ponds, storm water runoff, and the turbine building sump are returned to the Keowee River at a location below the tailrace. Figure 2.7 illustrates the water flow for the plant.

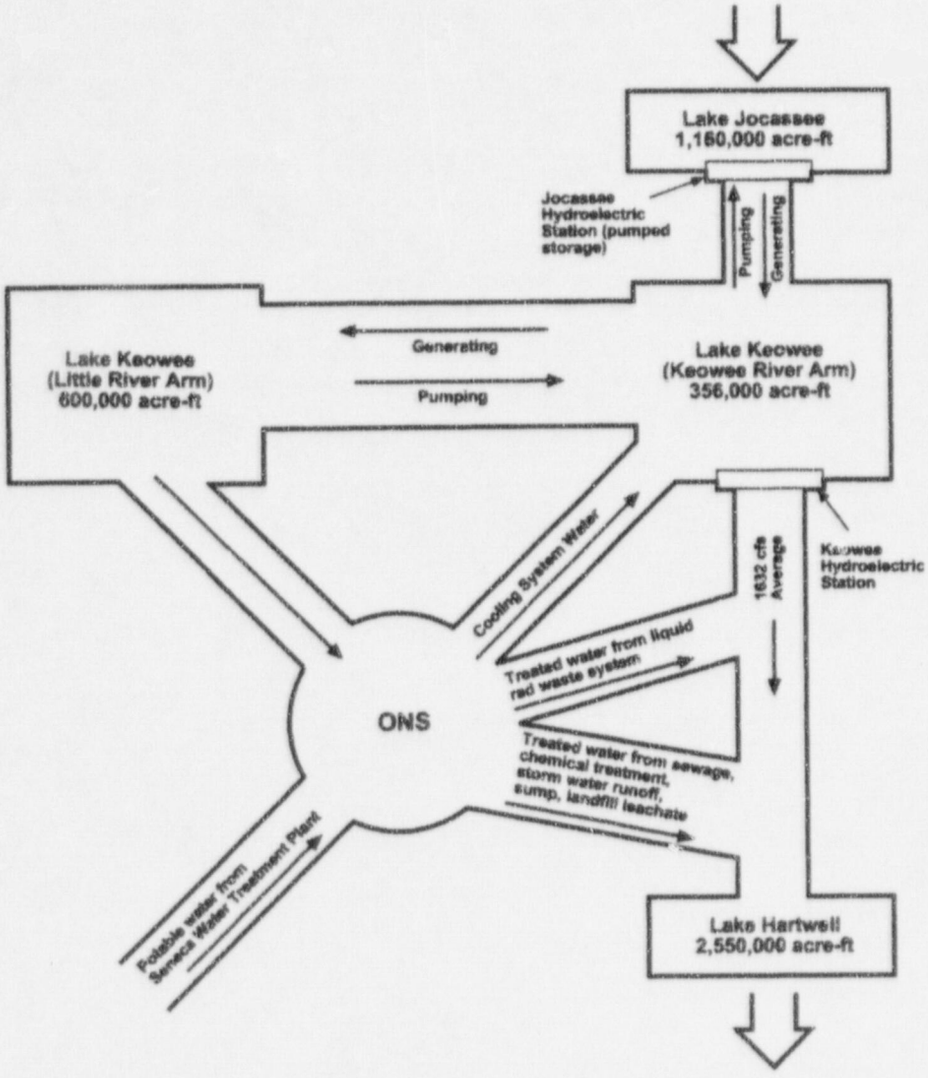


Figure 2-7. Oconee Nuclear Station - Water Flow Diagram

In addition to serving the needs of the nuclear and hydroelectric power plants, Lake Keowee is used as a source of municipal drinking water for the cities of Greenville and Seneca. Lake Keowee experiences extensive recreational use by fishermen, boaters, skiers, and swimmers.

ONS has permits from the state of South Carolina for four groundwater wells. One of these wells has a pumping capacity of 0.0019 m^3/s (30 gpm) and is used to supply drinking water and a restroom facility at the station baseball field. The other three groundwater wells are used for supplying irrigation water for landscaping at the site during the summer months (June through September). The estimated combined pumping rate for all four groundwater wells at Oconee is less than 0.068 m^3/s (100 gpm).

2.2.3 Water Quality

The concentrations in Lake Keowee of all minerals are very low, with total dissolved solids of less than 25 mg/liter (0.00021 pounds/gallon). Water clarity is generally very high. Dissolved oxygen concentrations in the surface waters are adequate, and algae are never present in nuisance concentrations. Due to low nutrient content of its waters, Lake Keowee has a relatively low standing crop (pounds per acre) of fish.

SCDHEC, as part of the Clean Lakes program, monitors the water quality and use of lakes in the State. These results are published in *Watershed Water Quality Assessment, Savannah and Salkehatchie Basins, Technical Report No. 003-97.* In this document, SCDHEC reported that

- Eutrophication assessments indicate that Lake Keowee is the least eutrophic large lake in South Carolina, characterized by very low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended. Aquatic life uses are not supported in Lake Keowee due to occurrences of copper in excess of the aquatic life acute standards, including a high concentration of copper measured in 1995, compounded by a significant increasing trend in pH. A significant increasing trend in dissolved oxygen concentration and a significant decreasing trend in five-day biochemical oxygen demand suggest improving conditions for these parameters. Recreational uses are fully supported at this site.

Pursuant to the Federal Water Pollution Control Act (FWPCA), also known as the Clean Water Act, the water quality of plant effluent discharges is regulated through the National Pollutant Discharge Elimination System (NPDES). The SCDHEC is the agency delegated by the EPA to issue the NPDES permit. The current permit (SC0000515) was issued on November 1, 1993, and expired September 30, 1998. The permit is currently being renewed. A toxicity compliance issue is currently outstanding and must be completed before final approval and issuance of the NPDES permit (SCDHEC 1999). Any new regulations promulgated by EPA or the SCDHEC would be included in future permits.

2.2.4 Air Quality

ONS is located on the eastern slope of the Appalachian Mountains at an elevation of about 240 m (800 ft) mean sea level. The climate of the region is generally mild. Climatological records for Greenville-Spartanburg, South Carolina (NOAA 1998), which should be representative of the site, show normal daily maximum temperatures ranging from about 10°C (50°F) in January to about 31°C (88°F) in July; normal daily minimum temperature range from about -1°C (30°F) in January to about 20°C (68°F) in July. Precipitation, which averages about 130 cm (51 inches) per year, is spread rather uniformly through the year. Monthly average wind speeds range from 2.7 m/s (6.1 mph) to 3.75 m/s (8.4 mph), with the highest speeds during the winter and lowest speeds during the summer. The influence of the Appalachian Mountains is seen in the prevailing wind directions, which are west southwest and northeast. Section 2.3 of the ONS updated final safety analysis report UFSAR (Duke 1998b) contains a more detailed description of the climate of the region and site.

Climatological records also show that the area is subject to occasional storms, including destructive winds. In most years, one or more tropical storms affect the site; however, ONS is sufficiently far inland that the winds associated with these storms are below hurricane force. Tornadoes are infrequent in this region and are generally small when they occur.

For about two-thirds of the year, the region is under the influence of the Bermuda high pressure system. High pressure systems are typically associated with low winds and increased potential for air pollution problems. As indicated in 40 CFR 81.334, 40 CFR 81.341, and the 1997 South Carolina Air Quality Annual Report (SCDHEC 1998) South Carolina and North Carolina are in attainment of the National Air Quality Standards. The only non-attainment area in Georgia is an ozone non-attainment area in the Atlanta region (40 CFR 81.311). The Pollutant Standards Index (PSI) is an air quality index developed by the EPA in cooperation with the Council on Environmental Quality. For the 1997, the average PSI for the Spartanburg, Greenville, Anderson metropolitan area was 48, which is associated with *Good* air quality (SCDHEC 1998). The daily PSIs for 211 days were in the *Good* range, and the remaining daily PSIs were in the *Moderate* range. The days with *Moderate* PSIs resulted from ozone formation.

The EPA has published revisions to the ground-level ozone and particulate matter standards. Although collection of monitoring data to determine compliance with the revised standards has not been completed, the state of South Carolina has indicated a concern about meeting the revised standards in some parts of the state, including Oconee County (SCDHEC 1998).

The Oconee site is within 100 km (62 mi) of the Great Smoky Mountains National Park and Shining Rock Wilderness Area Class I Areas for the Prevention of Significant Deterioration. As a result of the proximity of the Oconee Site to these Class I areas, future industrial development at the site will be subject to strict Federal standards for pollution control (SCDHEC 1998).

2.2.5 Aquatic Resources

Lake Keowee serves the needs of the local nuclear and hydroelectric power plants and is also used as a source of municipal drinking water by the cities of Greenville and Seneca, South Carolina. It is used extensively by fishermen, boaters, skiers, and swimmers, and its banks are developed with vacation and permanent residences, campgrounds, boat launch areas, marinas, golf courses, and small retail establishments.

Algae have never been present in nuisance concentrations, and, because of the low nutrient content of the water, Lake Keowee has a relatively low standing crop of fish. A creel census conducted in 1973 indicated that largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), and crappie (*Pomoxis*, spp.) were the most important recreational species in Lake Keowee (Edwards et al. 1976). Data on angler effort and harvest rates collected over a period from 1974 to 1993 (Barwick et al. 1995) confirmed that largemouth bass remained the most important sportfish in the reservoir and that sunfish (*Lepomis* spp., including bluegill) and crappie were the only other species that contributed in a significant way to the reservoir's sport fishery.

The U.S. Fish and Wildlife Service (FWS), in a letter dated April 17, 1998, provided a list of the Federally endangered and threatened species that potentially occur in Oconee County, South Carolina. No federally listed aquatic species were identified for Oconee County. However, the bog turtle *(Clemmys muhlenbergii)* occurs in neighboring Pickens County and was listed as a threatened species due to similarity of appearance to the northern population of the same species. A survey conducted during June 1998 by Dr. L.L. Gaddy (Duke 1998a) found no Federal or state listed threatened or endangered aquatic species present within a 1.6-km (1-mi) radius of ONS, Unit 2's reactor building. This includes the owner-controlled areas as well as additional lands along the Keowee River and along Lake Keowee. No State-ranked aquatic species listed as occurring in Oconee or Pickens Counties have been identified as occurring on or in the immediate vicinity of ONS.

The importance of fishery resources to the local community has promoted a partnership between Duke and SCDNR. Recently, SCDNR and Duke Power Company signed a Memorandum of Understanding (Keowee-Toxaway Fisheries Resources 1996) and developed a 10-year work plan to enhance communication between the two groups and provide for continued research, management, and enhancement of the fisheries resources in the watershed.

2.2.6 Terrestrial Resources

The vegetation in the vicinity of ONS has been variously described as part of the oak-pine-hickory biome of the eastern deciduous forest (Greller 1988) or as part of the southern mixed forest province (Bailey 1976, 1980). Much of the Piedmont region near ONS was cleared and converted to cotton production during the late 1800s, and then abandoned in the 1930s. Most of the existing forested areas in the vicinity of ONS consequently represent second growth forests. The various pine species, such as loblolly (*Pinus taeda*), shortleaf (*P. echinata*), and Virginia (*P. virginiana*) pines, are the dominant conifers. Common hardwoods include red and white oaks (*Quercus rubra*, *Q. alba*), hickory (*Carya sp.*), and tulip poplar (*Liriodendron tulipifera*), among others. The under story is dominated by shrubs such as dogwood (*Cornus florida*), mountain laurel (*Kalmia latifolia*), and redbud (*Cercis canadensis*), as well as many species of herbs and grasses.

White-tailed deer (*Odocoileus virginianus*), black bear (*Ursus americanus*), raccoon (*Procyon lotor*), rabbits (*Sylvilagus floridanus*), squirrels (*Sciurus carolinensis* and *Tamiasciurus hudsonicus*), beavers

(*Castor canadensis*), muskrats (*Ondatra zibethica*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), opossums (*Didelphis marsupialis*), skunks (*Mephitus mephitus* and *Spilogale putorius*), river otters (*Lutra canadensis*), mink (*Mustela vison*).and various mice, voles, and shrews are wildlife species found in the project area. The white-tailed deer is the most popular game species, and black bear are hunted in the areas to the west of ONS.

The turkey (*Meleagris gallopavo*), bobwhite quail (*Colinus virginianus*), and mourning dove (*Zenaida macroura*), are the most common game birds. Many species of songbirds inhabit the area, including the eastern bluebird (*Sialia sialis*), red-eyed vireo (*Vireo olivaceus*), cardinal (*Cardinalis cardinalis*), tufted titmouse (*Parus bicolor*), woodthrush (*Hylocichla mustelina*), summer tanager (*Piranga rubra*), blue-gray gnatcatcher (*Polioptila caerulea*), hooded warbler (*Wilsonia citrina*), and Carolina wren (*Thryothorus ludovicianus*). The box turtle (*Terrapene carolina*), common garter snake (*Thamnophis sirtalis*), timber rattlesnake (*Crotalus horridus*), and assorted frogs, toads, and salamanders comprise the herpetofauna.

Extensive areas of ONS are protected or managed as upland natural areas, wetlands, or wildlife areas. In support of the environmental report, Duke funded a survey of all lands within a 1.6-km (1-mi) radius of the plant site. This survey, which was conducted in May and June 1998, identified several areas that retain characteristics of mature upland forests that the applicant has designated as protected natural areas. Wetlands were also identified during this survey, and these are managed as sensitive environmental areas. The applicant has a program of wildlife enhancement in unused portions of the plant site that was designed in partnership with the South Carolina Wildlife Federation, the SCDNR, and the National Wild Turkey Federation. This program has established semi-natural meadows, enhanced wetland native plants, placed wood duck and bluebird nesting boxes, and developed a butterfly garden.

The field survey also included an inventory of endangered, threatened, and otherwise noteworthy plant and animal species within a 1.6 km (1 mi) radius of ONS. No federally listed, proposed, or candidate threatened or endangered species were identified during the onsite survey. However, three state-listed plant species and one plant species not previously known in South Carolina (Table 2-3) were identified. The populations of these four species were all confined to "natural areas" located toward the periphery of the survey area, well away from areas used for normal plant operations. Three additional state-listed plant and one animal species have been reported from the general area in the past, but were not located within the 1.6 km (1 mi) radius of ONS during this survey (Table 2-3).

During the spring of 1998, Duke contacted the FWS and the SCDNR to request information about threatened or endangered species that potentially could occur in the vicinity of the ONS. The staff contacted the FWS during the spring of 1999 to request similar information concerning the ONS related transmission lines. The FWS identified nine species that have been reported to occur within either Pickens or Oconee counties, South Carolina and eight additional species reported from the other counties crossed by the transmission lines (Table 2-4). None of the species listed in Table 2-4 are known to inhabit the immediate vicinity of the ONS.

Federally listed species that have been occasionally sighted near ONS include the threatened bald eagle (*Haliaeetus leucocephalus*) and the endangered peregrine falcon (*Falco peregrinus*). Bald eagles are occasional visitors near the ONS site, but are not known to nest or to reside near the site for significant time periods. Bald eagles are known to be more numerous and spend more time in the vicinity of the Jocassee and Bad Creek Reservoirs. Peregrine falcons are occasional transients near ONS. Attempts have been made to introduce individuals near the Jocassee dam, but they are not known to reside near ONS.

Table 2-3. Endangered, Threatened, and South Carolina State Listed Plant and Animal Species Found on or Historically Occurring in the Vicinity of the Oconee Nuclear Station

Scientific Name	Common Name	State Status[a]	Occurrence[b]
	ANIMALS		
Sigmora robusta	a centipede	SC	Historical
	PLANTS		
Carex laxiflora	Loose-flowered sedge	SR	Present
Carex prasina	Drooping sedge	SC	Present
Echinacea laevigata	Smooth coneflower	FE, SC	Historical
Nestronia umbellula	Indian olive	SC	Present
Orobanche uniflora	One-flowered broomrape	SC	Historical
Pachysandra procumbens	Allegheny spurge	SC	Historical
Viola tripartita	Three-parted violet	SC	Present

(a) FE = Federally endangered, SC = Species of Concern in South Carolina, SR = new state record for species.

(b) Historical = species have been reported from the general area in the past but were not located within the one-mile radius of ONS during the applicant's survey; Present = species was found within a one-mile radius of ONS.

Transmission lines associated with the ONS extend through a number of additional counties in both South Carolina and North Carolina. The FWS provided the staff information about threatened and endangered species that may occur in these counties. This list is summarized in Table 2-4.

Examination of the National Heritage Databases from South Carolina and North Carolina indicates that three plant species listed in Table 2-4 may occur within or near the transmission line rights-of-way. The bunched arrowhead occurs in the corridors located northwest of Greenville, South Carolina and in the corridors located northeast of Traveler's Rest, South Carolina. The dwarf-flowered heartleaf occurs near corridors northeast of Traveler's Rest and also between Landrum, South Carolina and the McGuire substation. Schweinitz's sunflower is known to occur near the Newport and McGuire substation at the far eastern end of the ONS related transmission system.

Table 2-4. Federally Listed Threatened or Endangered Species Known or Potentially Occurring Near the ONS or in Counties Crossed by Transmission Lines Associated with the ONS.

Species	Common Name	Status[a]	COUNTY												
			Greenville, SC	Spartanburg, SC	Anderson, SC	Laurens, SC	Union, SC	York, SC	Rutherford, NC	Cleveland, NC	Gaston, NC	Lincoln, NC	Oconee, SC	Pickens, SC
ANIMALS														
Halieeatus leucocephalus	Bald eagle	T			X			X					X	X
Falco peregrinus anatum	Peregrine falcon	E	X						X				X	X
Picoides borealis	Red-cockaded woodpecker	E				X								
Myotis sodalis	Indiana bat	E							X				X	
Clemmys muhlenbergii	Bog turtle	T'	X								X			X
PLANTS														
Sisyrinchium dichotomum	White irisette	E	X						X					
Hexastylus naniflora	Dwarf-flowered heartleaf	T	X	X				X	X	X		X		X
Helianthus schweinitzii	Schweinitz's sunflower	E						X			X			
Rhus michauxii	Michaux's sumac	E										X		
Echinacea laevigata	Smooth coneflower	E			X								X	X
Helonius bullata	Swamp pink	T	X											
Isotria medeoloides	Small whorled pogonia	T	X										X	
Sagittaria fasciculata	Bunched arrowhead	E	X											
Sarracenia rubra ssp. *jonesii*	Mountain sweet pitcher plant	E	X											X
Amphianthus pusillus	Little amphianthus	T						X						
Gymnoderma lineare	Rock gnome lichen	E	X						X					
Trillium persistens	Persistent trillium	E											X	
Isoetes malanospora	Black-spored quillwort	E												X

(a) E = Endangered, T = Threatened, T* = threatened due to similarity of appearance

2.2.7 Radiological Impacts

Since 1969, Duke has conducted a radiological environmental monitoring program (REMP) around ONS. The radiological impacts to workers, the public, and the environment have been carefully monitored, documented, and compared to the appropriate standards. The purposes of the REMP are to

- verify that radioactive materials and ambient radiation levels attributable to plant operation are within the limits contained in the Selected Licensee Commitments and the Environmental Radiation Protection standards as stated in 40 CFR Part 190, *Environmental Radiation Protection Standards for Nuclear Power Operations*

- detect any measurable buildup of long-lived radionuclides in the environment

- monitor and evaluate ambient radiation levels

- determine whether any statistically significant increase occurs in the concentration of radionuclides in important pathways.

These releases are summarized in the annual reports titled "Oconee Nuclear Station Units 1, 2, and 3 Annual Radiological Environmental Operating Report" and the annual Effluent Release Reports, and includes the results of the monitoring for the ISFSI. The limits for all radiological releases are specified in the Selected Licensee Commitments, and these limits are designed to meet Federal standards and requirements. The REMP includes monitoring of the aquatic environment (Lake Keowee, aquatic organisms, shoreline sediment), atmospheric environment (air particulates and iodine), terrestrial environment including vegetation, and direct radiation.

Review of historical data on releases and the resultant dose calculations revealed that the doses to maximally exposed individuals in the vicinity of ONS were fractions of the limits specified in the Environmental Protection Agency's environmental radiation standards 40 CFR Part 190 as required by 10 CFR 20.1301(d). For 1997, dose estimates were calculated based on actual 1997 liquid and gaseous effluent release data (Duke Power 1997). Calculations were performed using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM.

A review of whole body and organ doses (Duke Power 1997) revealed the following results: the total body dose estimate to an adult from environmental measurements was 0.0014 mSv/yr (0.14 mrem/yr), and the total body dose estimate from all effluent release pathways was 0.00615 mSv/yr (0.615 mrem/yr). The critical pathway for both of these estimates was from fish consumption. Cesium-137 was the major contributing radionuclide. These doses, which are representative of the doses from the past five years, are provided to demonstrate that the impact to the environment from releases from ONS is small.

The applicant does not anticipate any significant changes to the radioactive effluent releases or exposures from ONS operations during the renewal period and, therefore, the impacts to the environment are not expected to change.

2.2.8 Socioeconomic Factors

The staff reviewed the applicant's environmental report, and information obtained from several county staff members, local real estate agents/appraisers, and social services providers during the October 1998 site visit. The following information describes the economy, population, and communities near ONS.

2.2.8.1 Housing

Between 1970 and 1990, total housing units in Oconee County increased from 14,032 to 25,983 (DOC. 1991; U.S. Bureau of the Census 1988). Approximately 146 new households, or one percent of the growth in households may be attributed to ONS employment (NEC 1996). A total of 891 ONS employees currently live in Oconee County (as of January 1999). As of January 1999, 515 ONS employees live in Pickens County and 161 live in Anderson (see Table 2-5). County growth has continued since 1990. Based on the estimates in the GEIS (NRC 1996) of 2,300 direct employment in 1990, immigrant ratio of 16.4 percent, and indirect employment multiplier of 0.41, ONS may have accounted for 3,243 direct and indirect jobs in Oconee, Pickens, and Anderson counties, 378 households, and less than two percent of the housing growth from 1970 to 1990. Between 1980 and 1990, the number of housing units in the Tri-County (Oconee, Pickens, and Anderson) area increased approximately 22.5 percent to a total of 122,602 units (Knight 1998a). Table 2-6 provides the number of housing units and housing unit vacancies by county in the Tri-County area for the years 1970 to 1996.

Since 1990, Oconee County population has continued to increase from 57,494 at the 1990 Census to 64,059 in 1998 (Table 2-7). Pickens County increased in population from about 93,894 in 1990 to 104,318 in 1998 (Table 2-7). About 4,000 units were added to the Oconee County housing stock between 1990 and 1996, as the county became a more popular bedroom community, recreation area, and second home and retirement community, and as manufacturing jobs were added (Table 2-6). The east end of Pickens County increasingly became a bedroom community for Greenville. At the 1990 Census about 10,700 Pickens County residents per day commuted to Greenville County (Knight 1997), and this number likely has increased. Clemson University is a major employer in Pickens County, with 7,156 jobs in 1997 (Knight 1997). Anderson County increased in population from 145,177 at the 1990 Census to 160,791 in 1998 (South Carolina Statistical Abstract (South Carolina Office of Research and Statistical Services 1998), due largely to growth in branch plant manufacturing. In 1997 Anderson County employed 15,800 in major manufacturing facilities, compared with 8,400 in Oconee County and 6,800 in Pickens County (Knight 1997). Oconee County added 4,017 housing units between 1990 and 1996; Pickens County added 4,835 housing units over the same period; while Anderson County added 6,947 units (Table 2-6). Housing availability in the Tri-County area is not limited by growth-control measures. With a 1996 vacancy rate of approximately ten percent, over 14,300 units are available for occupancy in the three closest counties (Bureau of Census 1996).

Table 2-5. Employee Residence Information, Oconee Nuclear Station, January 1999

County and Selected Cities	Duke and Contractor Employees
Oconee County	891
Salem	50
Seneca	454
Tamassee	19
Walhalla	138
West Union	75
Westminister	125
Other Cities and Towns	30
Pickens County	515
Central	102
Clemson	45
Easley	127
Liberty	68
Pickens	83
Six Mile	79
Other Towns and Cities	11
Anderson County	161
Anderson	88
Belton	13
Pendleton	20
Other Towns and Cities	40
Greenville County	35
Other Counties	29
North Carolina	49
Georgia	65
Other States	40
Total	1785

Source: Duke (1999)

Table 2-6. Housing Units and Housing Units Vacant (Available) by County 1970-1996

	1970	1980	1990	1996
	OCONEE COUNTY			
Housing Units	14032	20226	25983	30000
Occupied Units	12764	17373	22358	25200
Vacant Units	1268	2853	3625	4800
	PICKENS COUNTY			
Housing Units	18673	28469	35865	40700
Occupied Units	17274	25986	33422	38200
Vacant Units	1399	2483	2443	2500
	ANDERSON COUNTY			
Housing Units	35981	51369	60753	67700
Occupied Units	33277	46944	55481	60700
Vacant Units	2704	4375	5264	7000

Source: 1990 Census of Housing, file STF1A, Table H2; Reference 1 (DOC. 1991); 1988 City and County Data Book; South Carolina Statistical Abstract (South Carolina Office of Research and Statistical Services 1998).

Table 2-7. Population Growth in Oconee, Pickens, and Anderson Counties, South Carolina (1970-1998)

	Oconee County		Pickens County		Anderson County	
	Population	Annual Growth %	Population	Annual Growth %	Population	Annual Growth %
1970	40,728	--	59,956	--	105,474	--
1980	48,611	1.8	79,292	2.8	133,235	2.4
1990	57,494	1.7	93,896	1.7	145,177	0.9
1998	64,059	1.4	107,087	1.7	160,791	1.3

Sources: U.S. Bureau of the Census, County Population Estimates for July 1, 1998 and Population Change for July 1, 1997 to July 1, 1998, Population Estimates Program Population Division, March 12, 1999; Knight 1998a.

2.2.8.2 Public Services

- **Water Supply**

Potable water used in Oconee County is from both subsurface and surface sources and is used primarily for domestic and industrial uses. The county has four privately owned water systems, five municipal water systems, and a single sewer commission that serves the incorporated towns in the county and some selected rural areas. Table 2.8 shows source and capacity information on selected water supply systems in communities near ONS, as well as the area served by each. Both Seneca and Greenville are served with surface water from Lake Keowee, which is very high quality and has low concentrations of minerals and nutrients. Large areas of Oconee County are not served by public water supplies. According to the Oconee Community Facilities Plan, some supplies are threatened by incompatible development, including septic tanks around lakes and sedimentation and erosion from land-clearing activities. Both Seneca and Walhalla (which draws water from Coneross Creek, above Lake Keowee) have identified current plant capacity as inadequate for meeting future water demand. Seneca is searching for a location for a new treatment plant to meet future demand, while Walhalla is expected to construct a new treatment plant in the next five years, drawing on Lake Jocassee (reducing its need to depend on the limited capacity of Coneross Creek).

Table 2-8. Major Public Water Supply Systems in Oconee County in 1997

Water System	Source	Maximum Daily Consumption	Average Daily Consumption	Area Served
Salem Water Department	Two wells on SC Highway 130	Unavailable	Unavailable	City Limits
Seneca Light and Power	Lake Keowee	5.914 million gallons	4.406 million gallons	City of Seneca, with lines 16 km (10 mi) north and south
Walhalla Water Department	Coneross Creek	2.2 million gallons	1.42 million gallons	Walhalla city limits, Town of West Union, Surrounding area
Westminster Commission of Public Works	Chauga River	3.62 million gallons	2.314 million gallons	Unavailable, but generally along US 123 and US 76
Pioneer Water Systems	Seneca and Westminster systems	Unavailable	Unavailable	South portion of county, including Fair Play and Townville

Source: Oconee County Planning Commission 1997.

Availability of adequate wastewater collection is considered to be a current constraint on development in both Oconee and Pickens County. Public wastewater collection is provided in Oconee County by the municipalities of Seneca, Walhalla, and Westminster, while water treatment is provided by the Oconee County Sewer Authority (Oconee County Planning Commission 1997). Private treatment operators serve Chickasaw Point, Keowee Key, and Newry. The Authority operates the Coneross Waste Treatment Plant, which was expanded in capacity to 0.4 m^3/s (7.8 million gpd). Average daily volume is only 0.14 m^3/s (3 million gpd). While the difference allows considerable excess capacity for economic development within the area served by the system, there are large portions of the county not served, and there are institutional constraints that make serving the I-85 corridor a problem in Oconee County. Pickens County has limited excess capacity, and this constrains the county's ability to absorb or recruit manufacturing. Current excess capacity has been only about 0.02 m^3/s (500,000 gpd) and a current $12 million upgrade is expected to primarily replace older, environmentally unacceptable capacity, expanding excess capacity to 0.04 m^3/s (800,000 gpd).

- **Education**

In 1996, there were approximately 49,600 students enrolled in schools in the Oconee-Pickens-Anderson County area (Knight 1997). Enrollment totals for the public schools were 10,056 in Oconee County, 26,187 in Anderson County, and 13,353 in Pickens County. Oconee County has 11 public elementary schools, four middle schools, four high schools, and four private schools. In Anderson County, there are 27 public elementary, 11 middle/junior high schools, nine high schools, and five private schools. Pickens County has 15 public elementary schools, five middle schools, five high schools, and eight private schools. Pickens and Anderson Counties have some post-secondary capability. Anderson County has Tri-County Technical College (enrollment 3,250), Forrest Junior College (enrollment 899), and Anderson College (a private, four-year university with an enrollment of 245). Pickens County has Clemson University, with 16,526 enrollment, and Soutnern Wesleyan University, with an enrollment of 1,298. Economic development also benefits from the presence of technical college and university education in nearby Greenville, especially Greenville Tech.

The area has comparatively low student/teacher ratios, despite also having relatively low property taxes. For 1996, student/teacher ratios were 14.8/1 in Oconee County, 16.9/1 in Pickens County, and varied from 15.4/1 to 18.5/1 among the five school districts in Anderson County (Knight 1997). Property tax rates in 1997 were $1.99/$1,000 in Oconee County (Knight 1998b) , $2.04/$1,000 in Pickens County, and $2.24/$1,000 in Anderson County (an average of the range among 31 districts of $1.95 to $2.64)[a]. Reflecting population growth, during the 1996-97 school year, the Oconee School District opened two new elementary schools, Fair Oak and Orchard Park, with a combined enrollment of over 1,100 students (Oconee County Planning Commission 1997). Fair Play Elementary School was closed and replaced by Fair Oak. All schools in the county except West Oak and Seneca High Schools received some expansion or upgrade. These two schools had received upgrades in recent years.

(a) Personal contact, Hara T. Knight, South Carolina Appalachian Council of Governments, March, 1999.

- **Transportation**

Oconee County is served by I-85 at its southeast corner, plus U.S. highways 76 and 123 and State highways 28 and Scenic 11. ONS is on a two-lane highway with service to the site being convenient from four main directions. Highway access remains adequate for the time being, but population growth in the county may create crowded conditions in the future, particularly at selected intersections.

Pickens County is not served by the Interstate Highway system, but has ready access to the I-85 corridor via U.S. 76 , 123, and 178. State Highways 8, 96, 135, 137, 124, and Scenic 11 complete the major road net. Highway 123 runs the length of Pickens County from east to west with four lane service to Greenville. State Highway 133 (which runs north-south on the east side of Lake Keowee) and State Highway 183 from Pickens serve as a commuting highways from Pickens County to ONS. Although several of the residential communities on both sides of Lake Keowee have long, narrow access roads, none of these roads has been identified as seriously bottlenecked.

The period from 1995 to 2015, has been projected by the State of South Carolina to be one of moderate population growth (1.1 percent per year). Oconee County is projected to grow at about the same rate as the state during that period, while Pickens and Anderson Counties are expected to grow at about 0.9 percent per year. At these rates, Oconee County would increase its current population by about 50 percent at the end of the license renewal period (see Section 2.2.8.1 and Knight 1998a). Significant upgrading of most arterial links and main highways is likely to be required to accommodate such growth. The population of the other two counties would grow by about 40 percent and also likely would require highway upgrades.

2.2.8.3 Offsite Land Use

Oconee and Pickens Counties both have land use plans, but neither has zoning regulations (Talbert & Bright, Inc. 1996; interview with Pickens County Director of Planning, October 22, 1998). Industrial development is concentrated in the I-85, S.C. Route 123, Route 28, and Route 76 corridors in the two counties and in Anderson County. There are some restrictions on building practices, but these are not extensive. Industrial development has been limited in Pickens County by lack of sewer and water infrastructure. Oconee County has been relatively selective about the industry they target. They also have a sanitary landfill that is nearly at capacity and may constrain growth if it is not replaced (Oconee County Planning Commission 1997).

The continued availability of ONS and the associated tax base is an important feature in Oconee County's ability to continue to invest in infrastructure and to draw industry and new residents. In 1998-1999 the Oconee County Operational Budget was $26.2 million and the school operating budget $41.1 million, for a total of $67.4 million. Duke will pay $22.3 million in taxes on ONS in 1998-1999, or

roughly a third of the county combined operational and school budget.[a] In Pickens County, continued presence of the plant will have less influence on development or land use, since the plant does not directly contribute to the tax base of the county. There is relatively little impact on land use in Anderson County from Oconee-related population. Duke helps with industrial recruiting in all three counties.

2.2.8.4 Visual Aesthetics and Noise

From the air, the principal visual features of the ONS region are Lakes Keowee, Jocasee, and Hartwell and the countryside, which is generally wooded or in small farms. The position of the plant relative to Lake Keowee is such that the ONS is only visible from the water within the first 1.6 km (1 mi) to the north. Further north, islands and the topography of the shoreline render the plant invisible. From the lake, the shoreline appears mostly wooded with upscale housing developments and boat launches.

Scenic resources inland from the lake have changed since ONS construction due to population growth. This growth has resulted in housing and some roadside development supplanting agricultural and wooded areas. However, South Carolina Highway 130, which follows the east side of Lake Keowee south of the plant and follows the west side of the lake to the north of the plant, mainly affords attractive views of the lake and surrounding hilly, wooded countryside with interspersed development and occasional agricultural lands. This is the main access route to the plant from either north or south. The view on South Carolina Highway 183 coming from either the east or west shows mainly woods and fields and does not show ONS until the traveler is within a hundred yards of the plant gate.

Because of woods and topography, noise from the ONS is generally not an issue. The only sounds heard offsite are the plant loudspeakers, which can be heard nearby on the lake.

2.2.8.5 Demography

The update to Duke's Final Safety Analysis Report (Duke 1998b) refers to Duke's emergency response plan which had an estimated resident population as 65,423 within 16 km (10 mi) of ONS for the year 1990. This is only slightly different than Duke's current estimate of 64,405 (Duke 1999a). Seasonal resident population adds another 6,694, transient summer weekend visitors add 8,636 more, and on Clemson football weekends, there may be over 75,000 visitors to the area.

Tables 24.1 through 24.5 in Duke (1999a) estimated resident population for 1990 and each decade through the proposed ONS license renewal term (2010, 2020, 2030). The 2010 projections represent estimated population near the first year of license renewal for Unit 1 (2013), and the projections for the year 2030 represent populations after the end of the renewal term (2034 for Unit 3). Near the end of the license renewal term (2030), the population within 80 km (50 mi) of ONS is expected to be approximately 1.3 million, as compared with 990,000 in 1990 (Duke 1998b).

(a) Letter to Michael J. Scott, Staff Scientist, Pacific Northwest National Laboratory from Phyllis E. Lombard, Finance Director, Oconee County, October 22, 1998.

Data for 1990 are based on the 1990 Census of Population. Future population estimates were developed by combining information that was available from the 1990 Census[a] and resident population projections found in the GEIS, Vol. 2, page A-46.

The 1990 resident population distribution (by distance and directions) is found in Table 24.1 of Duke (1999a). Populations for the sectors[b] were calculated using population values at the census block level, the smallest enumeration level used by the Census Bureau. Census blocks whose geographic centroid was located within a sector were considered to lie within that sector. For each sector that is located within 80 km (50 mi) of the plant, the population numbers for the blocks within each sector were summed to give a total for that sector.

The projected population within the sectors for the years 2000, 2010, 2020, and 2030 was calculated by increasing the 1990 population for each sector by the percentage increases between the respective periods.

The projected 1990 population within 80 km (50 mi) of the Oconee Nuclear Station from the GEIS, is 990,000 persons. The 1990 Census Bureau data for the year 1990 indicated 1,021,226 people living within 80 km (50 mi) of the plant. This difference (3.2 percent) was considered to be small. Therefore, Duke (1999a) used the predicted total population values found in the GEIS for the 80 km (50 mi) radius around the plant to extrapolate the 1990 population distribution data forward in time for the years 2010 and 2030. The total resident population within the 80 km (50-mi) radius for the year 2020 (not listed in the GEIS) was determined by using linear interpolation between the population totals for the years 2010 and 2030. This same procedure was applied by the staff to Duke's estimates to obtain the population by sector within 16 km (10 mi).

- **Resident Population Within 16 km (10 mi)**

The estimated resident population within 16 km (10 mi) of the ONS for the years 1990, 2010, 2020, and 2030 is listed in Tables 2-9 through 2-12. Figure 2-8 illustrates the 10-mile radius from ONS.

Between 1970 and 1990, the population within 16 km (10 mi) of ONS increased about 70 percent, from 37,831 (AEC 1972) to 64,405 (Duke 1999a). Current projections indicate that by the year 2010, the population within 16 km (10 mi) will be 73,789 (obtained from the FSAR [Duke 1998b]), which is about

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(a) US Census Bureau C90STF3A

(b) A sector is identified by a combination of its compass direction and the distance of its outer edge from the plant. For instance, the sector that is between 11.25 and 33.75 degrees and 64 km (40 mi) and 80 km (50 mi) from a plant is identified as NNE50.

Table 2-9. Es. ıated Population Distribution in 1990 Within 16 km (10 mi) of ONS

Sector	0 to 1 Miles	1 to 2 Miles	2 to 3 Miles	3 to 4 Miles	4 to 5 Miles	5 to 10 Miles	Total
N	0	0	0	8	3	143	154
NNE	0	0	30	64	9	186	288
NE	0	13	44	192	222	1,351	1,823
ENE	2	0	39	206	387	1,599	2,233
E	6	23	123	167	229	2,128	2,676
ESE	0	12	38	121	436	2,768	3,375
SE	0	103	158	84	144	6,825	7,314
SSE	0	0	0	0	105	14,858	14,963
S	0	8	6	0	202	3,823	4,038
SSW	0	5	5	4	86	10,989	11,090
SW	0	26	3	145	120	2,916	3,210
WSW	0	0	44	277	114	2,858	3,294
W	0	43	34	176	142	4,192	4,587
WNW	0	16	38	66	67	1,227	1,415
NW	0	14	62	661	35	1,514	2,285
NNW	0	40	110	364	140	1,007	1,660
Total	8	302	735	2,535	2,440	58,384	64,405

Source: U.S. Census Bureau - 1990 Census, File C90STF3A (DOC, 1991)

Table 2-10. Estimated Population Distribution in 2010 Within 16 km (10 mi) of ONS

Sector	0 to 1 Miles	1 to 2 Miles	2 to 3 Miles	3 to 4 Miles	4 to 5 Miles	5 to 10 Miles	Total
N	0	0	0	9	3	164	176
NNE	0	0	34	73	10	213	330
NE	0	15	51	220	254	1,548	2,089
ENE	2	0	45	236	443	1,831	2,558
E	7	26	141	192	262	2,438	3,066
ESE	0	14	43	139	500	3,171	3,867
SE	0	117	181	96	165	7,820	8,380
SSE	0	0	0	0	120	17,023	17,143
S	0	9	7	0	231	4,379	4,626
SSW	0	6	6	5	98	12,591	12,706
SW	0	30	4	166	137	3,342	3,678
WSW	0	0	51	318	131	3,274	3,774
W	0	50	39	202	163	4,802	5,255
WNW	0	19	44	75	77	1,406	1,621
NW	0	16	71	758	40	1,735	2,618
NNW	0	45	126	417	160	1,153	1,902
Total	9	346	842	2,905	2,796	66,891	73,789

Source: Computed from Table 2-14.

Table 2-11. Estimated Population Distribution in 2020 Within 16 km (10 mi) of ONS

Sector	0 to 1 Miles	1 to 2 Miles	2 to 3 Miles	3 to 4 Miles	4 to 5 Miles	5 to 10 Miles	Total
N	0	0	0	9	4	174	187
NNE	0	0	36	78	11	226	350
NE	0	16	54	234	270	1,641	2,214
ENE	3	0	48	250	470	1,941	2,711
E	7	27	149	203	278	2,584	3,249
ESE	0	14	46	147	530	3,361	4,098
SE	0	124	192	102	175	8,288	8,881
SSE	0	0	0	0	127	18,041	18,168
S	0	9	7	0	245	4,641	4,903
SSW	0	6	6	5	104	13,344	13,466
SW	0	32	4	176	145	3,541	3,898
WSW	0	0	54	337	139	3,470	4,000
W	0	53	41	214	173	5,090	5,570
WNW	0	20	47	80	81	1,490	1,718
NW	0	17	75	803	42	1,839	2,775
NNW	0	48	134	442	170	1,223	2,016
Total	10	367	892	3,079	2,963	70,893	78,204

Source: Computed from Table 2-15.

Table 2-12. Estimated Population Distribution in 2030 Within 16 km (10 mi) of ONS

Sector	0 to 1 Miles	1 to 2 Miles	2 to 3 Miles	3 to 4 Miles	4 to 5 Miles	5 to 10 Miles	Total
N	0	0	0	10	4	184	198
NNE	0	0	38	82	11	238	369
NE	0	17	57	247	285	1,733	2,338
ENE	3	0	51	264	496	2,050	2,864
E	8	29	158	214	294	2,730	3,433
ESE	0	15	48	156	560	3,550	4,329
SE	0	131	203	107	185	8,755	9,382
SSE	0	0	0	0	134	19,060	19,194
S	0	10	8	0	259	4,904	5,180
SSW	0	7	7	5	110	14,097	14,226
SW	0	33	4	186	154	3,741	4,118
WSW	0	0	57	356	147	3,666	4,225
W	0	56	43	226	183	5,377	5,884
WNW	0	21	49	84	86	1,574	1,815
NW	0	17	79	848	44	1,942	2,931
NNW	0	51	141	466	179	1,291	2,129
Total	11	388	942	3,252	3,130	74,893	82,615

Source: Computed from Table 2-16.

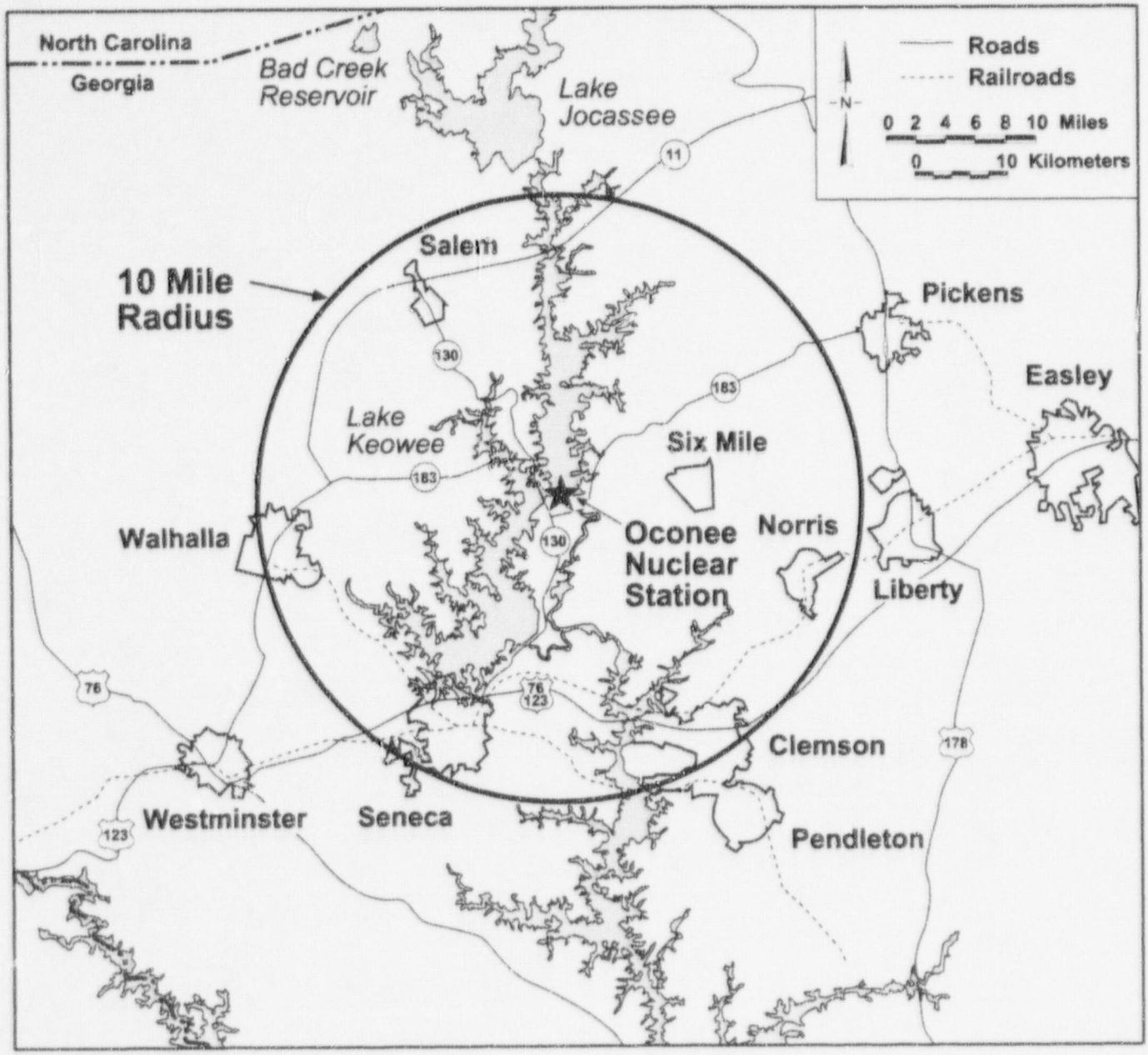


Figure 2-8. Oconee Nuclear Station - 16-km (10-mi) Radius

39 percent higher than projected in the original FES (AEC 1972). The higher growth within the 16-km (10-mi) radius is primarily related to rapid population growth in Oconee County. Between 1980 and 1990, Oconee County grew half again as fast as the State (1.7 percent per year vs. 1.1 percent per year). According to agency projections, it is expected to grow at about the same rate as the state through the year 2015 (Knight 1998a). Factors stimulating growth in Oconee County include proximity to high-quality recreation and to Greenville. To these factors one could add relatively easy commutes

to metropolitan areas (45 minutes to 1-hour commute by car), less development and lower taxes than those areas, and less stringent land use, zoning, and development regulations compared with some surrounding counties.

- **Resident Population Within 80 km (50 mi)**

The estimated resident population distribution within 80 km (50 mi) of ONS for the years 1990, 2010, 2020, and 2030 is shown in Tables 2-13 through 2-16. Figure 2-9 illustrates the 80-km (50-mi) radius from ONS.

Between 1970 and 1990, the population within 80 km (50 mi) of ONS increased approximately 36 percent, from about 730,000 (AEC 1972) to about 1,020,000 (Table 2-14). Current population projections in the environmental report (ER) (Duke 1998a) indicate that by the year 2010, the population within 80 km (50 mi) will be approximately 1,170,000.

Table 2-17 lists the age distribution of Oconee County in 1990 compared to the United States population.

- **Transient Population**

The transient population in the vicinity of ONS can be identified as daily or seasonal. Daily transients are associated with places where a large number of people gather regularly, such as local businesses, industrial facilities, and schools. Seasonal transients result from the use of weekend recreational areas such as Lakes Keowee, Jocasee, and Hartwell. It is estimated that seasonal transients increase the population within 16 km (10 mi) of ONS by approximately 10 percent during the summer months (Oconee Nuclear Station Emergency Response Plan, Duke 1999b). The daily and seasonal population associated with selected industry and recreation within 16 km (10 mi) of the station is listed in Table 2-18.

It should be noted that on most weekdays, a significant portion of the resident population is absent from Oconee County during daytime hours. According to the 1990 Census of Population, 25 percent of employed County residents (about 6,700 people) commuted to jobs outside of Oconee County while over 4,200 commuted into the county (Talbert & Bright 1996). With increased numbers of in-movers to the County, the number of commuters likely has increased, although no post-1990 numbers are available.

2.2.9 Historical and Archaeological Resources

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

Table 2-13. Estimated Population Distribution in 1990 Within 80 km (50 mi) of ONS

Sector	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Total
N	154	355	2,557	444	22,328	25,838
NNE	288	547	6,285	18,676	26,660	52,456
NE	1,823	4,692	4,331	4,631	41,165	56,642
ENE	2,233	13,845	34,721	46,169	36,182	133,150
E	2,676	29,511	112,819	117,286	30,134	292,426
ESE	3,375	5,678	25,609	14,078	12,455	61,195
SE	7,314	5,916	36,445	12,423	11,055	73,153
SSE	14,963	11,038	38,834	9,191	2,715	76,741
S	4,038	3,363	6,624	9,659	13,001	36,685
SSW	11,090	5,290	7,450	10,407	9,024	43,261
SW	3,210	6,814	8,155	5,772	6,847	30,798
WSW	3,294	4,722	13,914	13,605	20,881	56,416
W	4,587	3,070	2,403	3,427	3,540	17,027
WNW	1,415	1,017	4,945	3,116	4,151	14,644
NW	2,285	579	2,678	14,770	5,142	25,454
NNW	1,660	354	1,946	7,872	13,508	25,340
Total	**64,405**	**96,791**	**309,716**	**291,526**	**258,788**	**1,021,226**

Source: U.S. Census Bureau - 1990 Census, File C90STF3A (DOC 1991).

Table 2-14. Estimated Population Distribution in 2010 Within 80 km (50 mi) of ONS

Sector	0-10 Miles	10-20. Miles	20-30 Miles	30-40 Miles	40-50 Miles	Total
N	176	407	2,930	509	25,591	29,602
NNE	330	627	7,201	21,397	30,544	60,098
NE	2,089	5,376	4,962	5,306	47,162	64,894
ENE	2,558	15,862	39,779	52,895	41,453	152,548
E	3,066	33,810	129,255	134,372	34,524	335,027
ESE	3,867	6,505	29,340	16,129	14,269	70,110
SE	8,380	6,778	41,754	14,233	12,666	83,810
SSE	17,143	12,646	44,491	10,530	3,111	87,921
S	4,626	3,853	7,589	11,068	14,895	42,029
SSW	12,706	6,061	8,535	11,923	10,339	49,563
SW	3,678	7,807	9,343	6,613	7,844	35,285
WSW	3,774	5,410	15,941	15,587	23,923	64,635
W	5,255	3,517	2,753	3,926	4,056	19,508
WNW	1,621	1,165	5,665	3,570	4,756	16,777
NW	2,618	663	3,068	16,922	5,891	29,162
NNW	1,902	406	2,229	9,019	15,476	29,032
Total	**73,788**	**110,892**	**354,836**	**333,996**	**296,489**	**1,170,000**

Source: Duke 1999a.

Table 2-15. Estimated Population Distribution in 2020 Within 80 km (50 mi) of ONS

Sector	0-10 Miles	10-20. Miles	20-30 Miles	30-40 Miles	40-50 Miles	Total
N	187	431	3,105	539	27,111	31,373
NNE	350	664	7,631	22,677	32,371	63,693
NE	2,214	5,697	5,259	5,623	49,984	68,776
ENE	2,711	16,811	42,159	56,060	43,933	161,674
E	3,249	35,833	136,988	142,412	36,590	355,071
ESE	4,098	6,894	31,095	17,094	15,123	74,305
SE	8,881	7,183	44,252	15,084	13,423	88,824
SSE	18,168	13,403	47,153	11,160	3,297	93,181
S	4,903	4,083	8,043	11,728	15,786	44,544
SSW	13,466	6,423	9,046	12,636	10,957	52,529
SW	3,898	8,274	9,902	7,009	8,314	37,396
WSW	4,000	5,734	16,895	16,520	25,354	68,502
W	5,570	3,728	2,918	4,161	4,298	20,675
WNW	1,718	1,235	6,004	3,784	5,040	17,781
NW	2,775	703	3,252	17,934	6,244	30,907
NNW	2,016	430	2,363	9,558	16,402	30,769
Total	**78,202**	**117,526**	**376,065**	**353,979**	**314,227**	**1,240,000**

Source: Duke 1999a.

Table 2-16. Estimated Population Distribution in 2030 Within 80 km (50 mi) of ONS

Sector	0-10 Miles	10-20. Miles	20-30 Miles	30-40 Miles	40-50 Miles	Total
N	198	455	3,280	570	28,642	33,144
NNE	369	702	8,062	23,957	34,199	67,289
NE	2,338	6,019	5,556	5,941	52,805	72,659
ENE	2,864	17,760	44,539	59,224	46,413	170,801
E	3,433	37,856	144,721	150,451	38,655	375,116
ESE	4,329	7,284	32,851	18,059	15,977	78,499
SE	9,382	7,589	46,751	15,936	14,181	93,839
SSE	19,194	14,159	49,815	11,790	3,483	98,441
S	5,180	4,314	8,497	12,390	16,677	47,058
SSW	14,226	6,786	9,557	13,350	11,576	55,494
SW	4,118	8,741	10,461	7,404	8,783	39,507
WSW	4,225	6,057	17,848	17,452	26,786	72,369
W	5,884	3,938	3,083	4,396	4,541	21,842
WNW	1,815	1,305	6,343	3,997	5,325	18,785
NW	2,931	743	3,435	18,947	6,596	32,652
NNW	2,129	454	2,496	10,098	17,328	32,505
Total	**82,617**	**124,161**	**397,295**	**373,961**	**331,966**	**1,310,000**

Source: Duke 1999a.

Table 2-17. Estimated Age Distribution of Population in 1990[a]

Year and Age Group	Oconee County, South Carolina		United States	
	Number	Percent	Number	Percent
1990: Under 5	3,573	6.2	19,512,000	7.6
5-19	12,106	21.1	53,523,000	21.0
20-44	21,241	36.9	101,416,000	39.8
45-64	12,666	22.0	48,348,000	19.0
65 and Over	7,908	13.8	32,283,000	12.7
Total	57,494	100.0	255,082,000	100.0

(a) U.S. Bureau of the Census 1990, File STFIA (DOC 1991).

Table 2-18. Transient Population Within 16 km (10 mi) of ONS

Direction	Seasonal Resident Population	Winter Weekday	Winter Weeknight	Summer Weekend	Clemson Football Weekend
N	25	20	0	392	20
NNE	39	0	0	0	0
NE	235	0	0	0	0
ENE	229	0	0	0	0
E	272	0	0	0	0
ESE	300	210	90	90	90
SE	491	468	322	2,515	378
SSE	738	1,486	1,294	1,133	73,688
S	383	100	60	60	0
SSW	848	597	447	797	457
SW	318	1,002	335	3,300	235
WSW	453	1,420	120	169	169
W	517	275	127	122	122
WNW	215	0	0	0	0
NW	715	0	8	0	50
NNW	687	8	0	0	8
Offsite	6,465	5,586	2,803	8,578	75,217
ONS		1395	698	698	698
Total		6,981	3,501	9276	75,915

Source: Oconee Nuclear Station Emergency Response Plan (Duke 1999b), Revision 99-01, Figures J-3B to J-4E.

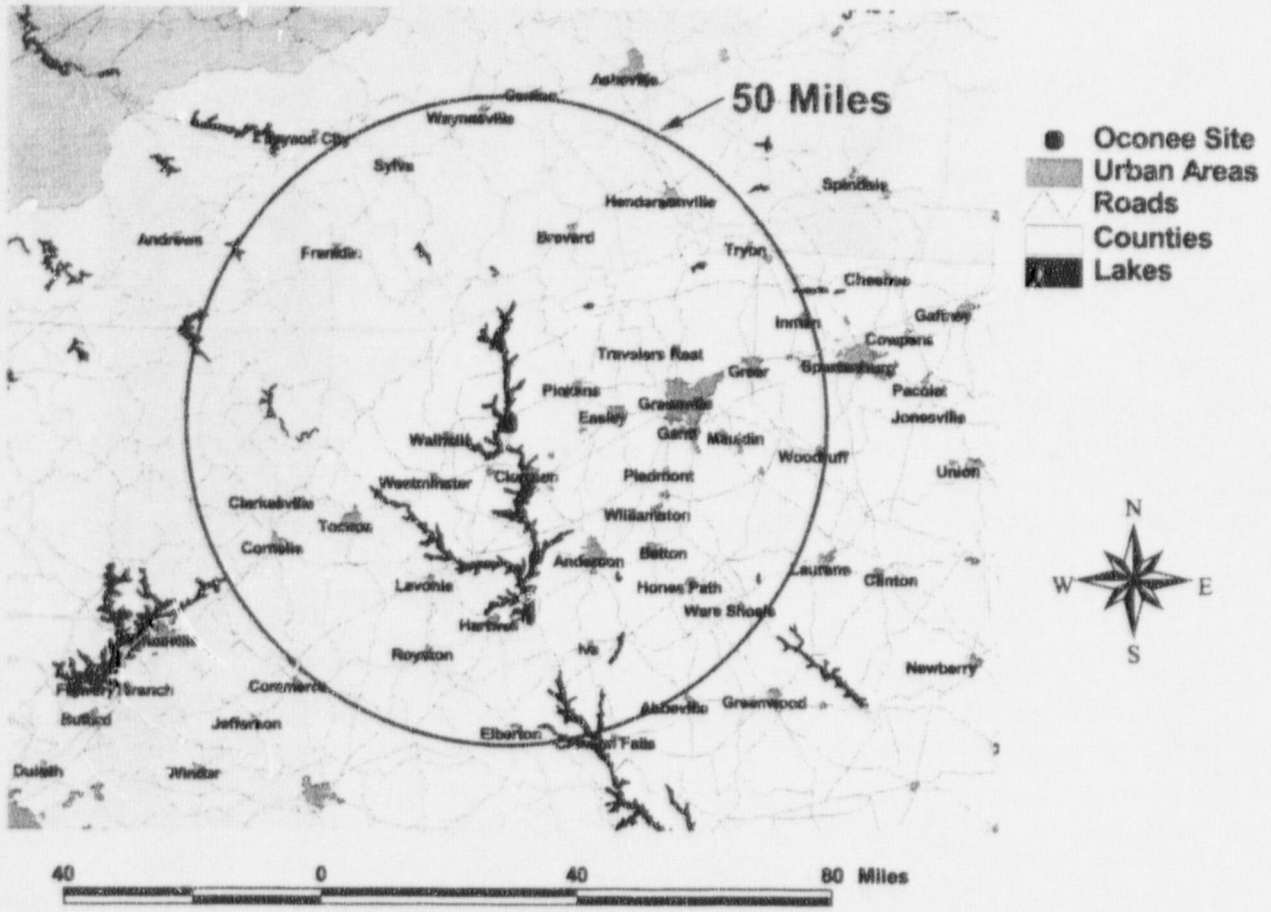


Figure 2-9. Oconee Nuclear Station - 80-km (50-mi) Radius

2.2.9.1 Cultural Background

The area around ONS is rich in prehistoric and historic Native American and historic Euroamerican cultural resources. This part of northwestern South Carolina has an archaeological sequence that extends back to about 10,000 B.C., although human use of the area was probably limited until about 4000 to 5000 B.C. when numerous small campsites are evident in the record. By 1000 B.C., archaeological data suggest a shift from scattered campsites to a more sedentary settlement and a subsistence system that was concentrated on ravine settings. By A.D. 1000, the archeological evidence for ancestral Cherokee culture is present, beginning with the regional Pisgah Phase (A.D. 1000 to 1500) and the following contact period Qualla Phase (A.D. 1500 to 1850) (Dickens 1976; Keel 1976). Pisgah villages included upright wooden post houses encircled by a palisade. These villages were commonly located in the larger alluvial valleys where soils were suitable for horticulture. This general village pattern continued into the Early Qualla Phase with the Late Qualla being characterized by the Europeanization of Native American technology, economy, and settlement patterns after A.D. 1820.

The Cherokee were first noted in the written record by Spanish explorers in 1540. During the Qualla historic period, the Cherokee Indian cultural group has been divided into three subgroups, based on cultural, linguistic, and environmental distinctions (Dickens 1979). Of these subgroups, the Lower Cherokee grouping occupied the foothills of the Appalachian Mountains near the upper reaches of the Savannah River system. The Keowee River valley, which includes ONS and the associated reservoir, was one of the principal ravine settings for Lower Cherokee settlements of this period. Other Lower Cherokee villages are documented from historical written references in this part of North Carolina (Sheriff 1994; Ross 1980). During the 18th century, Keowee was the most important of these villages (Harmon 1986). The Cherokee village of Keowee, which is today located beneath the waters of Lake Keowee about 8 km (5 mi) north of ONS, was partially excavated during a pre-impoundment archaeological project sponsored by Duke in 1966-68. Also investigated by this project was Fort Prince George, a garrison constructed across the river from Keowee Village by the British Government in 1753 to protect the Lower Cherokee from French intrusions into the area and to secure trade relations between the British and the Cherokees (Hembree and Jackson 1998; Williams 1998).

The Cherokee Indian presence throughout their former extensive homelands came to a close in the late 1700s through a series of treaties with the Colonies and the United States, culminating with the well documented removal of the Cherokee and other southeastern tribes to Indian Territory in the West (Perdue and Green 1995). The part of South Carolina including the Oconee project area was included in a land cession treaty completed in May of 1777 (Royce 1884). A small number of Cherokee in North Carolina avoided the removal actions and today are recognized as the Eastern Band of Cherokee Indians, with their tribal headquarters at Cherokee, North Carolina, some 80 km (50 mi) north of ONS. Cherokees removed to the West are today known as the Cherokee Nation of Oklahoma.

Following the 1777 treaty, northwestern South Carolina was immediately occupied by land-hungry white settlers. The first deeds in the Keowee River valley date to 1784; by the turn of the century, most of the land along the Keowee and adjacent valleys had been deeded. Hembree and Jackson (1998) document the historical development of the Keowee River valley from initial settlement through construction of Duke's Keowee-Toxaway Project that transformed the entire river valley.

2.2.9.2 Historical and Archaeological Sites at ONS

Archaeological

As noted above, archaeological investigations were conducted throughout the Keowee-Toxaway Project area, basically the Keowee River valley from the present Keowee Dam and ONS north to include the inundated portion of Lake Keowee. This effort was conducted by personnel from the South Carolina State Department of Archaeology during which 39 archaeological sites were recorded. Of this total, nine of the sites were archaeologically tested, and significant excavations were completed at six sites, including Keowee Indian village and Fort Prince George (Beuschel, no date). Although final reports of these activities were not issued following the fieldwork, recent documents have provided some detail (Harmon 1986; Williams 1998). Information gained about both the Cherokee occupation and the British operation of Fort Prince George is also presented in the interpretive displays at the Keowee-Toxaway State Park.

Archaeological site file searches at the South Carolina Department of Archives and History and the Institute of Archaeology and Anthropology, University of South Carolina, reveal the presence of four recorded Native American sites within a 1.6-km (1-mi) radius of ONS. Two of these sites (38OC104 and 105) were recorded during a field survey of the Oconee-Bad Creek 500 kV transmission line (Brockington 1978). Both of these archaeological sites, located northwest of the ONS, are low-density lithic tool scatter sites and were evaluated as not possessing characteristics that would make them eligible for the National Register of Historic Places. The other two archaeological sites (38OC225 and 38PN51) are located southwest of the plant, along Highway 183 with one being on either side of the bridge that crosses the Keowee River below the dam. Each of these sites is also categorized as a nondescript lithic scatter.

Historical

The pre-inundation archaeological project focused solely on the prehistoric and early historic Cherokee sites and Fort Prince George. The architecture and archaeology of historic Euroamerican period settlements in the overall project area were not documented and evaluated, including the Old Pickens townsite at the location of ONS. A number of cemeteries in the valley were relocated before inundation. Additionally, many historic structures were relocated by Duke, including residences, a girl's camp, two sawmills, and a covered wooden bridge.

The original town of Pickens on the west bank of the Keowee River was active between 1828 and 1868 as the courthouse town of Pickens District, which then included present-day Oconee and Pickens Counties (Hembree and Jackson 1998; Holder 1991). In 1868, the Keowee River was designated as the boundary line between the two newly formed counties. In response to this division, a new town, also called Pickens, was established about 24 km (15 mi) northeast to be the seat of Pickens County. Most of the buildings in the original town of Pickens were torn down or dismantled and moved to the new town of Pickens or to Walhalla, the new county seat of Oconee County.

The original townsite apparently included much of what became ONS. According to Hembree and Jackson (1998), "The Pickens townsite stretched from the bank of the Keowee, along what is now the Pickens-Walhalla Highway [Highway 183], west across the Duke construction and maintenance shops, and north over the site of the nuclear plant."

Today, the only standing structure at the Old Pickens townsite is a one story brick building built in 1849-51, commonly known as the "Old Pickens Presbyterian Church." A cemetery with over 200 marked graves surrounds the church, including the original cemetery associated with the church and relocated graves from 14 family or other cemeteries that were moved to Old Pickens in the late 1960s before Lake Keowee was filled. A complete listing of tombstone inscriptions from the original and relocated cemeteries is found in the Pendleton Chapter of South Carolina Genealogical Society (1983-84). The Old Pickens Presbyterian Church was nominated for inclusion in the National Register of Historic Places in 1994 and listed in 1996 (Sherard 1994).

No other historic period sites are currently recorded at ONS. While no historic structures are present, there is potential for either surface or buried historic archaeological remains (e.g., artifact scatters,

privies, and refuse dumps) that could exist in areas that have not received substantial soil disturbance. Any such remains could have been associated either with the Old Pickens townsite, with nearby homesteads along the river, or along Highways 183 and 130. According to the Keowee-Toxaway Project description (Duke 1971), 17 houses were relocated in connection with development of ONS.

Hembree and Jackson (1998), for example, illustrate a historic two-story home, known in the 1800s as the Pleasant Alexander House, that once stood in the Oconee project area on the west bank of the Keowee River. During dam construction in the 1960s, Duke used the house as an office, after which it was moved to High Falls County Park where it continues to serve as park offices. In a 1968 aerial photograph of the ONS construction site, the house is clearly evident on the west bank, just below the damsite (Hembree and Jackson 1998). In the same view, two other then extant historic houses can be seen along the north side of Highway 183, along the southern edge of the plant site. At the same location near the current access road into the plant from Highway 183, there is a small fenced cemetery on the knoll above the road. This cemetery has not been recorded and is not included in the listing of Oconee County historic cemeteries (Pendleton Chapter of South Carolina Genealogical Society (1983-84). Household artifacts in the vicinity of this cemetery indicate that a house was probably at one time associated with the graves.

2.2.10 Related Federal Project Activities

The Federal Power Commission, now the Federal Energy Regulatory Commission (FERC), issued a license (FERC Project No. 2503) to Duke Power Co. on September 1, 1966, for the construction of the Keowee hydroelectric station and the Jocassee pumped storage project. Lake Keowee, from which the ONS draws cooling water, is formed by dams on the Keowee River and Little River. The Keowee hydroelectric station is located at the dam on the Keowee River. The station serves as the onsite emergency electric power source for ONS. The license for the Keowee and Jocassee hydroelectric projects will expire in the year 2016. Under current FERC rules, Duke will need to file a notice of intent with FERC by the year 2011 declaring whether it intends to seek a new license for the Keowee and Jocassee hydroelectric projects. At least 2 years before the license expires, Duke will need to file an application for a new license (relicense). FERC procedures for processing a new license are similar to those for an original license.

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

The staff determined that there were no Federal project activities in the vicinity of ONS that could result in cumulative environmental impacts or that would make it desirable for another Federal agency to become a cooperating agency for preparation of the SEIS. The Natural Resources Conservation Service (NRCS), a division of the U.S. Department of Agriculture, was the only Federal agency to participate in the scoping process. NRCS submitted a letter stating that it has partnered with Duke in planning, implementing, and promoting environmental stewardship such as the cooperative work to prevent and control soil erosion at work sites in the South Carolina mountains and foothills.

2.3 References

10 CFR Part 20, "Standards for protection against radiation."

10 CFR 20.1301, "Dose limits for individual members of the public."

10 CFR 20.2002, "Method for obtaining approval of proposed disposal procedures."

10 CFR Part 20, Appendix B, Table 2, "Annual limits on intake (ALIs) and derived air concentrations (DACs) of radionuclides for occupational exposure; effluent concentrations; concentrations for Release to Sewerage."

10 CFR Part 50, Appendix I, "Numerical guides for design objectives and limiting conditions for operation to meet the criterion 'as low as is reasonably achievable' for radioactive material in light-water-cooled nuclear power reactor effluents."

10 CFR 54.21, "Contents of application -- technical information."

10 CFR Part 61, "Licensing requirements for land disposal of radioactive waste."

10 CFR Part 71, "Packaging and transportation of radioactive material."

40 CFR 81.311, "Georgia."

40 CFR 81.334, "North Carolina."

40 CFR 81.341, "South Carolina."

40 CFR Part 190, "Environmental radiation protection standards for nuclear power operations."

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3.0 Environmental Impacts of Refurbishment

Environmental issues associated with refurbishment activities were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*, NUREG-1437 (NRC 1996). The GEIS included 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 were then assigned a Category 1 or a Category 2 designation. Category 1 issues are those that the GEIS defines as having met 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 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 did not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for 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.

The potential environmental effects of refurbishment actions would be identified and the analysis would be summarized within this section if such actions were planned. Duke indicated that it has performed an evaluation of structures and components pursuant to 10 CFR 54.21 to identify activities that are necessary to continue operation of ONS 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 Exhibit A of the Oconee Application for Renewed Operating Licenses (Duke 1998). However, Duke stated that the replacement of these components and the additional inspection activities are within the bounds of normal plant component replacement and inspections; and therefore, are not expected to affect the environment outside the bounds of plant operations as evaluated in

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

the final environmental statement (FES) (AEC 1972). In addition, Duke's evaluation of structures and components as required by 10 CFR 54.21 did not identify any major plant refurbishment activities or modifications necessary to support the continued operation of Oconee beyond the end of the existing operating licenses. Therefore, refurbishment is not considered within the scope of the SEIS.

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 (non-attainment 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	3.7.4.1	I
Offsite land use	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	

3.1 References

10 CFR 54.21, "Contents of application - technical information."

10 CFR Part 51, Subpart A, Appendix B, Table B-1, "Environmental effect of renewing the operating license of a nuclear power plant."

Duke Energy Corporation 1998. Application for Renewed Operating Licenses, Oconee Nuclear Station Units 1, 2, and 3. Volume IV - Environmental Report.

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

4.0 Environmental Impacts of Operation During the Renewal Term

Environmental issues associated with refurbishment activities were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*, NUREG-1437 (NRC 1996a). The GEIS included 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 were then assigned a Category 1 or a Category 2 designation. Category 1 issues are those that the GEIS defines as having met 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 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 did not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

This chapter addresses those issues related to operation during the renewal term that are listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to ONS. Section 4.1 addresses the Category 1 issues applicable to the ONS once-through cooling system, while Category 2 issues applicable to the ONS cooling system are discussed at greater length in Sections 4.1.1 through 4.1.5. Section 4.2 addresses Category 1 issues related to transmission lines and land use, while Category 2 issues are discussed in Sections 4.2.1 and 4.2.2. Section 4.3 addresses the radiological impacts of normal operation. There are no Category 2 issues related to radiological impacts of normal operation. Section 4.4 addresses the Category 1 issues related to the socioeconomic impacts of normal operation during the renewal term. Category 2 socioeconomic issues are discussed in Sections 4.4.1 through 4.4.6. Section 4.5 addresses the Category 1 issues related to groundwater use and quality. Category 2 groundwater use and quality issues are discussed in Sections 4.5.1 and 4.5.2. Section 4.6 discusses the impacts of renewal -term operations on threatened and endangered species, a Category 2 issue. Section 4.7 addresses new information that was raised during the scoping period. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.8. Finally, Section 4.9 lists the references for Chapter 4.

4.1 Cooling System

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to ONS cooling system operation during the renewal term are listed in Table 4-1. Duke stated in its

Table 4-1. Category 1 Issues Applicable to the Operation of the ONS Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Altered thermal stratification of lakes	4.2.1.2.2; 4.4.2.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2.
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in waste water	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water-use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11; 4.4.3
HUMAN HEALTH	
Microbial organisms	4.3.6
Noise	4.3.7

environmental report (ER) (Duke 1998a) that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

- Altered current patterns at intake and discharge structures: Based on information in the GEIS, the Commission found: "Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information including reports of studies of Lake Keowee. Therefore, the staff concludes that there are no impacts of altered current patterns during the renewal term beyond those discussed in the GEIS.

- Altered thermal stratification of lakes: Based on information in the GEIS, the Commission found: "Generally, lake stratification has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information, including reports of studies of Lake Keowee performed for the South Carolina Department of Health and Environmental Control (SCDHEC). Therefore, the staff concludes that there are no impacts of altered thermal stratification of Lake Keowee 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: "These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water: Based on information in the GEIS, the Commission found: "Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of scouring during the renewal term beyond those discussed in the GEIS.

- Eutrophication: Based on information in the GEIS, the Commission found: "Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information including plant monitoring data and technical reports. Therefore, the staff concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides: Based on information in the GEIS, the Commission found: "Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER and the ONS NPDES permit, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills: Based on information in the GEIS, the Commission found: "Effects are readily controlled thorough the NPDES permit, and modifications, if needed, and are not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, the National Pollutant Discharge Elimination System (NPDES) permit for ONS, or through the site visit, scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- Discharge of other metals in waste water: Based on information in the GEIS, the Commission found: "These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.' The staff has not identified any significant new information in its review of the Duke ER, the NPDES permit for ONS, or through the site visit, scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of discharges of other metals in waste water 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: "These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipating systems." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no water-use conflicts 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: "Accumulation of contaminants has been a concern at a few nuclear power plants, but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those

of another metal. It is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton: Based on information in the GEIS, the Commission found: "Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, scoping process, and its independent evaluation of available information including reports by Hudson and Nichols (1978) and Duke (1977). Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock: Based on information in the GEIS, the Commission found: "Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information including Barwick et al. (1995). Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish: Based on information in the GEIS, the Commission found: "Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER or through the site visit, the scoping process, and its independent evaluation of available information including information from Oliver and Hudson (1987). Therefore, the staff concludes that there are no impacts of thermal plumes during the renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms: Based on information in the GEIS, the Commission found: "Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information including pre- and post-operational reports by Oliver and Hudson (1987), Barwick (1984), and Barwick et al. (1995). Therefore, the staff concludes that there are no impacts on the distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- Premature emergence of aquatic insects: Based on information in the GEIS, the Commission found: "Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license

renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information, including pre- and post-operational studies reported by Oliver and Hudson (1987). Therefore, the staff concludes that there are no impacts of premature emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas bubble disease): Based on information in the GEIS, the Commission found: "Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen (DO) in the discharge: Based on information in the GEIS, the Commission found: "Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information including pre- and post-operational studies conducted by Oliver and Hudson (1987) and the 316(a) demonstration report (Duke 1995). Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses: Based on information in the GEIS, the Commission found: "These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms: Based on information in the GEIS, the Commission found: "Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information including the 316(a) demonstration report

(Duke 1995). Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Microbiological organisms (occupational health): Based on information in the GEIS, the Commission found: "Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of microbiological organisms during the renewal term beyond those discussed in the GEIS.

- Noise: Based on information in the GEIS, the Commission found: "Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

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

Table 4-2. Category 2 Issues Applicable to the Operation of the ONS Cooling System During the Renewal Term

ISSUE -- 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) subparagraph	SEIS Section
Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.4.3	B	4.1.1
Impingement of fish and shellfish	4.2.2.1.3; 4.4.3	B	4.1.2
Heat shock	4.2.2.1.4; 4.4.3	B	4.1.3
Microbiological organisms (human health)	4.3.6	G	4.1.4

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For plants with once-through cooling systems, entrainment of fish and shellfish in early life stages into cooling water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment prior to license renewal.

The staff reviewed NPDES Permit #SC0000515 (that governs the release of effluents by Oconee Nuclear Power Station into the receiving waters of Lake Keowee). The current permit was issued on November 1, 1993 and expired September 30, 1998. Duke Energy has applied to renew its NPDES permit. A toxicity compliance issue is currently outstanding and must be completed before final approval and issuance of the NPDES permit (SCDHEC 1999).

The EPA-issued NPDES permit effective February 18, 1975, required Oconee to implement a program to monitor entrainment through plant intake structures in accordance with Section 316(b) of the Federal Water Pollution Control Act (FWPCA), also known as the Clean Water Act. Rates of entrainment were studied and summarized in a letter report to the EPA on March 24, 1976 (letter from W.D. Adair, 1976 in Duke 1999a). The summary report, which Duke considers its 316(b) demonstration, indicated that no fish eggs or larvae were collected after extensive sampling that began in May 1973.

While no formal record of acceptance by the EPA of this 316(b) demonstration has been identified, the EPA did issue a modified NPDES permit on August 30, 1976, that deleted requirements to monitor entrainment through plant intake structures (Duke 1998a). No further studies or analyses were required in subsequent NPDES permits.

However, while the EPA was reviewing the 316(b) demonstration report, Duke was conducting additional larval entrainment studies weekly from March through August 1976 to document the efficiency of the skimmer wall to reduce entrainment of larval fish (Olmsted and Adair 1981). Standing crops of fish larvae in the intake canal and in Lake Keowee were compared to numbers of fish larvae entrained under the skimmer wall and through the condensers. Overall, the density of fish larvae entrained was always less than 1 percent of that noted in concurrent lake sampling at ONS. The difference in larvae densities between the lake and intake canal was attributed to the skimmer wall's depth being below the thermocline during the spawning season. Thus, this study served to reinforce the results of the 316(b) demonstration.

On March 2, 1979, the staff issued Amendments to the Licenses for Oconee Units 1, 2, and 3 that deleted the aquatic surveillance and special studies programs because the Environmental Impact Appraisal performed for this amendment concluded the impact of Oconee on the aquatic environment was within the bounds of the final environmental statement (FES) and that the special study programs were no longer necessary (letter from R.W. Reid, March 1979 in Duke 1999a).

The staff has reviewed the available information relative to potential impacts of the cooling water intake system's entrainment of fish and shellfish in early life stages. Based on this review, the staff has concluded that the potential impacts are SMALL, and mitigation is not warranted.

4.1.2 Impingement of Fish and Shellfish

For plants with once-through cooling systems, impingement of fish and shellfish on debris screens of cooling water systems associated with nuclear power plants is considered a Category 2 issue,

requiring a site-specific assessment before license renewal. Impingement of shellfish is not an issue because there is no significant population of endemic shellfish species in the vicinity of ONS (Duke 1999b).

The staff reviewed NPDES Permit #SC0000515 which was issued on November 1, 1993 and expired on September 30, 1998 (as discussed in Section 4.1.1). This permit governs the release of effluents by Oconee Nuclear Power Station into the receiving waters of Lake Keowee.

An early EPA-issued NPDES permit effective February 18, 1975 required Oconee to implement a program to monitor impingement of fish on plant intake structures in accordance with Section 316(b) of the Clean Water Act. Rates of impingement were studied and summarized in a letter report to the EPA on March 24, 1976 (letter from W.D. Adair, 1976 in Duke 1999a). The summary report indicated that

> ...impingement of game and sport fish has been low. Small bluegill and yellow perch were the fishes most commonly impinged prior to the introduction of threadfin shad into Lake Keowee. Since threadfin have become established, we have a situation which is typical of cooling reservoirs in the southeastern U.S. Threadfin comprise the majority of those fish impinged (over 90 percent on most occasions) and contribute most to seasonal trends – i.e., high impingement rates in winter and low in summer. In view of the species and number of fishes affected it is doubtful that impingement at Oconee exerts any significant impact on resident fish populations of Lake Keowee.

These findings on impingement were drawn largely from a study conducted by Duke (Edwards et al., 1976) that determined the number of finfish impinged on stationary screens at Oconee Nuclear Station between July 1974 and May 1975. Six screens (two screens per unit and 25 percent of total screen area) were removed and inspected at 2-week intervals. Over the entire study period 241,697 fish were collected on representative screens.

Overall, species composition found impinged during the study included threadfin shad, *Dorosoma petenense* (49.3 percent), yellow perch, *Perca flavescens* (2.5 percent), and bluegill, *Lepomis macrochirus* (1.4 percent), even though threadfin shad were only introduced to Lake Keowee in February 1974 and did not show up in impingement samples until November 1974. Many fish collected during the study were unidentifiable (46.8 percent) but suspected to be almost entirely threadfin shad (Duke 1998a, Attachment B) and the remainder were miscellaneous species that comprised an insignificant portion of the impingement samples.

SCUBA divers inspected all 24 species at ONS between September 16 and 19, 1974 to ensure that impingement rates were similar for all screens and that subsampling at representative screens from each unit was realistic for estimating total impingement. Significant differences among screens was not apparent (Duke 1998a, Attachment B). Electrofishing, gill-net, and cove rotenone data were used to compare species composition throughout the lake to species found on intake screens. All species collected on the intake screens were represented in field collection samples, but 33 species collected in the field were not observed on intake screens. This suggests that susceptibility to impingement was, in part, species specific.

Impacts from impingement are determined relative to recreationally or commercially important species. A creel census conducted in 1973 indicated that largemouth bass *(Micropterus salmoides)*, bluegill, and crappie (*Pomoxis* spp.) were the most important sport fish taken from Lake Keowee. Data on angler effort and harvest rates collected over a period from 1974 to 1993 (Barwick et al. 1995) confirmed that largemouth bass remained the most important sportfish in the reservoir and that sunfish (*Lepomis* spp., including bluegill) and crappie were the only other species that contributed in a significant way to the reservoir's sport fishery. Cove samples conducted from 1972 to 1993 indicated that these species were also the most common sportfish in the reservoir (Duke 1995). Occasional impingement of these species is not expected to produce population-level effects. Again, only 1.4 percent of fish impinged in the 1974-75 study (Edwards et al. 1976) were bluegill. Other sunfish species, largemouth bass, and crappie were included in the "miscellaneous" category that made up less than 0.3 percent of the total fish impinged. Threadfin shad, which were the most frequently impinged species (49.3 percent), are a forage fish species and are not considered important by either recreational or commercial standards, although they were impinged in large numbers.

Over the years, NPDES permits issued to Duke for ONS gradually reduced requirements for evaluating impingement because research indicated that important aquatic species were not being adversely impacted. Although the 316(b) demonstration was not formally approved, the EPA issued a modified NPDES permit on August 30, 1976 that deleted requirements to monitor impingement through plant intake structures (Duke 1998a). No further studies or analyses were required in subsequent NPDES permits. On March 2, 1979, the staff issued Amendments to the Licenses for Oconee Units 1, 2, and 3 that deleted the aquatic surveillance and special studies programs because the Environmental Impact Appraisal performed for this amendment concluded the impact of Oconee on the aquatic environment was within the bounds of the FES and that the special study programs were no longer necessary (letter from R.W. Reid, March 1979 in Duke 1999a).

Although special studies were no longer required, additional impingement studies were performed from January through March 1990 (Barwick 1990). During this period of weekly sampling, only three fish species were found in impingement samples, none of which are considered important sportfish species. Threadfin shad comprised 91.5 percent of the total fish impinged, blueback herring *(Alosa aestivalis)* comprised 8.4 percent, and yellow perch comprised 0.1 percent. The numbers of fish impinged were 2.6 times the number of impinged fish that were reported by Edwards et al. (1976) and were estimated to represent 11.1 percent of the pelagic fish population in the Keowee Reservoir. Although threadfin shad are not commercially or recreationally important, the high rate of impingement merits some discussion. Mobile hydroacoustic surveys conducted during spring and fall 1989, 1990, 1996, and fall 1997 show a pattern in threadfin shad population dynamics that helps explain the high percentage of impinged fish (Duke 1999a).

Table 4-3 (Duke 1999a) shows the fluctuation in pelagic fish populations (approximately 51 percent threadfin shad and 49 percent blueback herring) between spring and fall surveys.

The estimated numbers of small pelagic fish are always lower in spring than fall, following a period of high winter mortality. Blueback herring are not overly susceptible to cold temperatures, but threadfin shad become stressed at temperatures less than 10°C (50°F) and exhibit complete mortality at 4°C

(39°F) (Griffith 1978). Areas of Keowee Reservoir often drop below 10°C (50°F) during the winter, severely weakening large numbers of threadfin shad that die or become stressed and unable to resist intake currents. According to the seasonal study conducted by Edwards et al. (1976), 88 percent of all threadfin shad impingement at Oconee occurred between January and March. However, as indicated by the hydroacoustic survey results showing seasonal population fluctuations, threadfin shad have a high fecundity and generally expand their population considerably by fall so long as an adequate number of spawners survived the winter. Edwards et al. (1976) concluded that "the impingement of threadfin shad at (Oconee) does not appear to be a major cause of mortality but is rather an indication of natural mortality of the species".

Based on these data, the staff has reviewed the available information relative to potential impacts of the cooling water intake system on the impingement of fish and shellfish, and concludes that the potential impacts are SMALL, and mitigation is not warranted.

4.1.3 Heat Shock

For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal.

Table 4-3. Fluctuation in Pelagic Fish Populations Between Spring and Fall Surveys

Numbers of Small Pelagic Fish (millions)	Date of Mobile Hydroacoustic Survey
3.0	March 1989
4.9	November 1989
2.6	March 1990
14.1	November 1990
12.5	March 1996
28.2	November 1996
3.7	November 1997

The staff reviewed NPDES Permit #SC0000515 which was issued on November 1, 1993 and expired on September 30, 1998 (as discussed in Section 4.1.1). This permit governs the release of effluents by Oconee Nuclear Power Station into the receiving waters of Lake Keowee.

The staff also reviewed the results of a 316(a) demonstration that Duke submitted in January 1995 (Duke 1999a). Based on the study, the SCDHEC granted a 316(a) variance. Duke submitted a reapplication in April 1998 and supporting documentation in May 1998 to the SCDHEC requesting a continuation of the variance.

ONS complies with State standards and has an approved NPDES permit and 316(a) variance. Under such circumstances, pursuant to 10 CFR 50.51(c)(3)(ii)(B), no further assessment of heat shock is required. Thus, the staff concludes that potential heat shock impacts resulting from operation of the plant's cooling water discharge system to the aquatic environment on or in the vicinity of the site are SMALL and mitigation is not warranted.

4.1.4 Microbiological Organisms

For plants discharging cooling water to cooling ponds, lakes, canals, or small rivers, the effects of microbiological organisms on human health are listed as a Category 2 issue and require plant-specific evaluation before license renewal.

ONS has a once-through cooling system that uses Lake Keowee as the cooling source. The Keowee and Little Rivers were impounded to form Lake Keowee. Combined, these two rivers have a flow rate that is lower than the 9×10^{12} m^3 per year (3.15×10^{12} ft^3 per year) specified in 10 CFR 51.53(c)(3)(ii)(G) as being a concern from the standpoint of the potential for enhancement of the presence of thermophylic microorganisms such as *Naegleria fowleri*, which could be a potential health concern for members of the public swimming in the cooling source (Duke 1998a).

Although Lake Keowee is a popular site for water-based recreational activities including swimming and water skiing, these activities are dispersed throughout the lake, rather than being concentrated in specific areas such as near the plant. In addition, the nearest private pier located on the Keowee River arm of the lake is 1300 m (4200 ft) from the discharge structure.

In a letter included with the Environmental Report (Duke 1998a), the State Toxicologist at the SCDHEC indicated that there "seems to be no significant threat to off-site persons near such heated recreational waters [from operation of ONS] ."

Thus, although there is a potential for deleterious thermophylic microorganisms to be associated with the cooling system, the results of analyses and evaluations, including the results of consultation with the State Public Health Department, indicate that the impact of deleterious microbiological organisms during continued operation of the plant during the renewal term are SMALL, and mitigation is not warranted.

4.2 Transmission Lines

The FES discussed five transmission lines with a total length of 528 km (330 mi) that connect the plant to the Duke Energy Transmission System. They were constructed concurrently with the construction of Oconee and the Keowee-Toxaway Project and connect both Oconee and the Keowee-Toxaway Project hydro-plants to the Duke Energy Transmission System.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to the ONS transmission lines are listed in Table 4-4. Duke stated in its ER that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the GEIS concluded that the impacts are SMALL and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-4. Category 1 Issues Applicable to the ONS Transmission Lines During the Renewal Term

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

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

- Power line right-of-way management (cutting and herbicide application): Based on information in the GEIS, the Commission found: "The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, consultation with the FWS and SCDNR, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of power line right-of-way management during the renewal term beyond those discussed in the GEIS.

- Bird collisions with power lines: Based on information in the GEIS, the Commission found: "Impacts [of bird collisions with power lines] are expected to be of small significance at all sites." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information including the status of the Duke monitoring program, Duke efforts to document collisions, and Duke efforts to protect species nesting on the power lines. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock): Based on information in the GEIS, the Commission found: "No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Floodplains and wetland on power line right-of-way: Based on information in the GEIS, the Commission found: "Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS), and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts on floodplains and wetland on power line right-of-way during the renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines: Based on information in the GEIS, the Commission found: "Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- Power line right-of-way (land use): Based on information in the GEIS, the Commission found: "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 staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, consultation with FWS, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of restriction on use of power line right-of-ways during the renewal term beyond those discussed in the GEIS.

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

4.2.1 Electromagnetic Fields - Acute Effects

The GEIS analysis for electric shock from transmission lines was unable to reach a conclusion on the significance of the electric shock potential because for earlier licensed plants, electric shock was not

addressed, some plants may have chosen to upgrade the voltage line, and land use may have changed. It is stated in 10 CFR 51.53(c)(3)(ii)(H) that if the transmission system does not meet the recommendations of the National Electric Safety Code, an assessment of the potential shock hazard must be provided by the applicant.

In the ER, Duke stated that the transmission lines that connect Units 1 and 2 to the 230 kV switching station and the lines that connect Unit 3 to the 525 kV switching station meet the vertical clearance requirement specified in the 1997 Edition of the National Electric Safety Code (NESC 1997). Duke states further that the transmission lines constructed concurrently with the Oconee and the Keowee-Toxaway Project are part of the Duke Energy Transmission System. These transmission lines were constructed to the standards of the National Electric Safety Code, 6th edition, published in November 1961. According to the ER, there have been no upgrades in line voltage on these transmission lines since they were constructed. Duke reviewed the vertical clearances of the 528 km (330 mi) of transmission lines attributed to Oconee in the FES (AEC 1972) using the 1997 Edition of the National Electric Safety Code and determined that all clearances exceeded the minimum requirements of the 1997 NESC (Duke 1999a).

Table 4-5. Category 2 Issues Applicable to the ONS Transmission Lines During the Renewal Term

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

Based on the above, the staff concludes that the impact of the potential for electrical shock is SMALL and mitigation is not warranted.

4.2.2 Electromagnetic Fields - Chronic Effects

The chronic effects of electromagnetic fields from power lines were given a finding of "not applicable" rather than a Category 1 or 2 designation until a scientific consensus is reached on the health implications of these fields.

The GEIS states that the maximum measured magnetic field strengths beneath 500-kV lines often average about 7×10^{-6} telsa (70 milligauss). During peak electricity use, the field strength may peak at 14×10^{-5} telsa (140 milligauss). 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). Epidemiological and experimental evidence are still inconclusive.

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 ONS with regard to radiological impacts are listed in Table 4-6. Duke stated in its ER that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the GEIS concluded that the impacts are SMALL and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

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

- Radiation exposures to public (license renewal term): Based on information in the GEIS, the Commission found: "Radiation doses to the public will continue at current levels associated with normal operations." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term): Based on information in the GEIS, the Commission found: "Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-7. Duke stated in its ER (Duke 1998) that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

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

- Public services: public safety, social services, and tourism and recreation: Based on information in the GEIS, the Commission found: "Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term): Based on information in the GEIS, the Commission found: "Only impacts of small significance are expected." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term): Based on information in the GEIS, the Commission found: "No significant impacts are expected during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term): Based on information in the GEIS, the Commission found: "No significant impacts are expected during the license renewal term." The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

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

4.4.1 Housing Impacts During Operations

In determining housing impacts, the applicant chose to follow Appendix C of the GEIS (NUREG-1437), which presents a population characterization method that is based on two factors, "sparseness" and "proximity" (GEIS Section C.1.4). Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80.5 km (50 mi). Each factor has categories of density and size (GEIS Table C.1), and a matrix is used to rank the population category

Table 4-8. 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	--	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
ENVIRONMENTAL JUSTICE			
Environmental Justice	Not addressed		4.4.6

as low, medium, or high (GEIS, Figure C.1). ONS was selected by the NRC to be evaluated as a potential socioeconomic case study site. The results of this evaluation, published in the GEIS, classifies the current ONS population as "medium" (GEIS Table C.2).

As described in Section 2.2.8, the Tri–County (Oconee, Pickens, and Anderson) area around ONS is not subject to growth control measures that effectively limit housing development, although Oconee County in particular is attempting to steer the growth toward the center of the county, where the infrastructure is most completely developed. In 10 CFR Part 51, Subpart A, Appendix B, Table B-1, NRC concluded that impacts on housing availability are expected to be of small significance at plants located in a "medium" population area where growth control measures are not in effect. ONS is located in a medium population area and is not located in an area where growth control measures limit housing development, so housing impacts would be expected to be small, even if there were plant-related increases in population.

Small impacts result when no discernable change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion occurs. Although significant housing impacts are expected in all three counties as a result of population growth, it will be difficult to discern the impact from license renewal activities. Although the GEIS assumed an additional staff of 180 permanent workers during the license renewal period, Duke, in the ER, indicated that they "have not identified any increases in staffing related to license renewal-related programs." The staff has reviewed the available information relative to housing impacts. Based on this review, the staff has concluded that the impact on housing during the license renewal period is SMALL, and 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 capital facilities. Impacts are considered moderate if overtaxing 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, absent new significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies. The staff believes that, in view of the expected population increase in the three counties, there may be reason to add significant public services and infrastructure other than water supply during the next 40 years. None of the increase would be due to the impact of additional ONS workers because no need for additional workers has been identified.

Analysis of impacts to the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the plant's permitted withdrawal rate and the plant's actual use of water. The applicant does not expect plant demand to have a direct effect on water resources.

As described in Section 2.2.8, Walhalla and Seneca in eastern Oconee County have some water plant capacity problems, but only Walhalla is actually limited by the water source (Coneross Creek). Walhalla is expected to construct a new water treatment plant on Lake Jocassee. Seneca draws from

Lake Keowee, which is considered adequate. Because ONS obtains its water from an adequate renewable surface water source and there is no increase in population expected as a result of the renewal of the ONS operating license, there is no impact expected from license renewal on water supplies. The staff concludes that the impact on water supply is SMALL and that mitigation is not warranted.

4.4.3 Offsite Land Use During Operations

Land use in the vicinity of a nuclear power plant may change as a result of plant-related population growth. It is noted in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that significant changes in land use may be associated with population and tax revenue changes resulting from license renewal. However, Section 3.7.5 of the GEIS notes that if the plant-related increase in population is less than 5 percent of the study area's total population and if plant total tax payments are small relative to the community's total revenue, new population-driven and tax-driven land-use changes during the plant's license renewal term would be small, especially if the community has pre-established patterns of development and has provided adequate public services to support and guide development.

The analysis of offsite land use during the renewal term has two components, population-driven changes in offsite land use and tax-driven changes in offsite land use. No plant-related, population-driven changes in land use are expected during the license renewal term, because no increase in employment is expected.

Oconee County is the only jurisdiction that taxes ONS directly, and it is the principal jurisdiction that receives direct tax revenue as a result ONS's presence. Because there are no major refurbishment activities and no new construction as a result of the license renewal, no new sources of plant-related tax payments are expected that could significantly influence land use in Oconee County. However, continued operation of the plant would provide a significant continuing source of tax revenues to Oconee County. As discussed in Section 2.8, the applicant is expected to pay $22.3 million in property taxes to Oconee County in 1998-99. This payment represented about one-third of the county budget and has a substantial, positive impact on the fiscal condition of Oconee County.

The staff has determined that the significance of project-related tax payments are moderate if the payments to a jurisdiction are between 10 and 20 percent of the total tax revenue of the jurisdiction, and large if the percentage is greater than 20 percent (GEIS). Using these criteria, ONS tax payments, representing around 33 percent of the total Oconee County budget, are of large significance. If the tax-related revenues are medium to large relative to the jurisdiction's total revenue, tax-driven land-use

changes would most likely be moderate if the community has no pre-established patterns of development (i.e., land use plans or controls), or has not provided adequate public services to guide land-use changes in the past (GEIS). The staff defined the magnitude of land-use changes as follows:

- SMALL - Very little new development and minimal changes to the area's land use pattern.
- MODERATE - Considerable new development and some changes to land-use patterns.
- LARGE - Large-scale new development and many changes to land-use patterns.

The County has experienced significant population growth and moderate land-use changes. The growth is not directly related to the presence of the ONS. Other factors, such as development of Lake Keowee recreational property, industrial growth, proximity to Greenville and Anderson, and less stringent land-use, zoning, and development regulations compared to surrounding counties clearly play a role. However, the county has not adopted land codes or ordinances nor does it enforce a minimum housing code (Talbert & Bright 1996). However, the County has well established patterns of development and has public services in place to support development, which is being directed toward the center of the county. In combination, these two factors would be expected to result in SMALL land-use impacts from ONS-related taxes.

Continuation of Oconee County's tax receipts from ONS keeps tax rates below what they otherwise would have to be to fund the County's government and also provides for a higher level of public infrastructure and services than otherwise would be possible. This enhances the county's attractiveness as a place to live and tends to accelerate the conversion of open space to residential and commercial uses. On the other hand, the presence of Duke's real estate arm as a major landowner has provided a considerable degree of discipline on development in the county.

Based on this review of the issues, the staff concludes that the net impact of plant-related population increases and tax receipts is likely to be SMALL. While the tax receipts are large enough to result in moderate impacts on land use, Oconee County has a conservative approach to providing water and sewer that limits upgrades and could slow future economic development except in areas already served. In addition, while the relatively low taxes and high levels of public service afforded by ONS-related tax receipts tend to draw population growth to the County, these same receipts make possible formal tax relief programs that favor open space or land-use control programs, if such programs are deemed necessary in the future. Additional mitigation does not appear to be warranted.

4.4.4 Public Services: Transportation Impacts During Operations

There is significant population growth expected in all three counties in the study area by the year 2034, as was discussed in Section 2.2.8 of this report. However, none of this expected growth will be due directly to increases in employment at ONS. It may be argued that the industrial tax base afforded by ONS makes the county a more affordable and pleasant place to live and indirectly increases population, but even this indirect impact is likely to be fairly small and difficult to predict. Future general

population increase likely will degrade the highway level of service at choke points, but the magnitude of impact of ONS on this service degradation is likely to be SMALL and not require mitigation.

4.4.5 Historical and Archaeological Resources

Since the Duke license renewal application (Duke 1998a) covering an additional 20 years of operation of the ONS does not include plans for future land disturbances or structural modifications beyond routine maintenance activities at the plant, there would be no identifiable adverse effects to known historical and archaeological resources. Consultation between the license renewal applicant and the South Carolina State Historic Preservation Office resulted in a determination by the State office that no known historical properties included in or eligible for inclusion in the National Register of Historic Places would be affected by the proposed action.

Continued operation of the power plant and protection of the natural landscape and vegetation within the site boundaries would have a beneficial effect in that known or undiscovered resources would receive *de facto* protection for the term of the license renewal period, being located in an undisturbed area with secured access. Duke has assisted in conservation and security of the adjacent National Register property, the Old Pickens Church and cemetery. This assistance will continue to enhance long-term preservation of that property.

Because there is a possibility that undiscovered and/or unrecorded prehistoric and historic period archaeological sites could exist in the 206-ha (510-acre) plant site, additional care must be taken during normal operational or maintenance conditions to ensure that cultural resources are not inadvertently impacted. These activities may include not only operation of the plant itself, but also land management-related actions such as recreation, wildlife habitat enhancement, or maintaining/upgrading access roads throughout the plant site.

The staff concludes that impacts on historical and archaeological resources is SMALL, and mitigation is not needed.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy in which Federal actions should not result in disproportionately high and adverse impacts on low-income or minority populations. Executive Order 12898 (26 FR 7629) directs Federal executive agencies to consider environmental justice under NEPA, and the Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice under NEPA (CEQ 1997). The Commission has committed to undertake environmental justice reviews. Specific guidance is provided in Attachment 4 to NRR [Nuclear Reactor Regulation] Office Letter No. 906, Revision 1: *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues* (NRC 1996b).

The scope of the review as defined in NRR Office Letter No. 906, Rev. 1 (NRC 1996b) should include an analysis of impacts on low-income and minority populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and any

additional information pertaining to mitigation. The descriptions to be provided by this review should be of sufficient detail to permit subsequent staff assessment and evaluation of specific impacts, in particular whether these impacts are likely to be disproportionately high and adverse, and to evaluate the significance of such impacts.

Air, land, and water resources within about 80 km (50 mi) of ONS were examined. Within that area, there are a few potential environmental impacts that could affect human populations; all of these were considered SMALL. These include

- groundwater use conflicts
- electric shock
- microbial organisms
- accident scenarios.

To decide whether any of these impacts could be disproportionate, the staff examined the geographic distribution of minority and low-income populations recorded during the 1990 Census (DOC 1991), supplemented by field inquiries to the local planning departments in Oconee, Pickens, and Anderson Counties, and to social service agencies in the three counties. The staff focused this portion of the review on the geographic areas most likely to experience the impacts discussed above, i.e., the three closest surrounding counties. This area is referred to as the study area.

Generally speaking, minority populations are a small, dispersed, and declining proportion of the study's area's population. Figure 4-1, taken from the 1990 Census (DOC 1991) shows the geographic

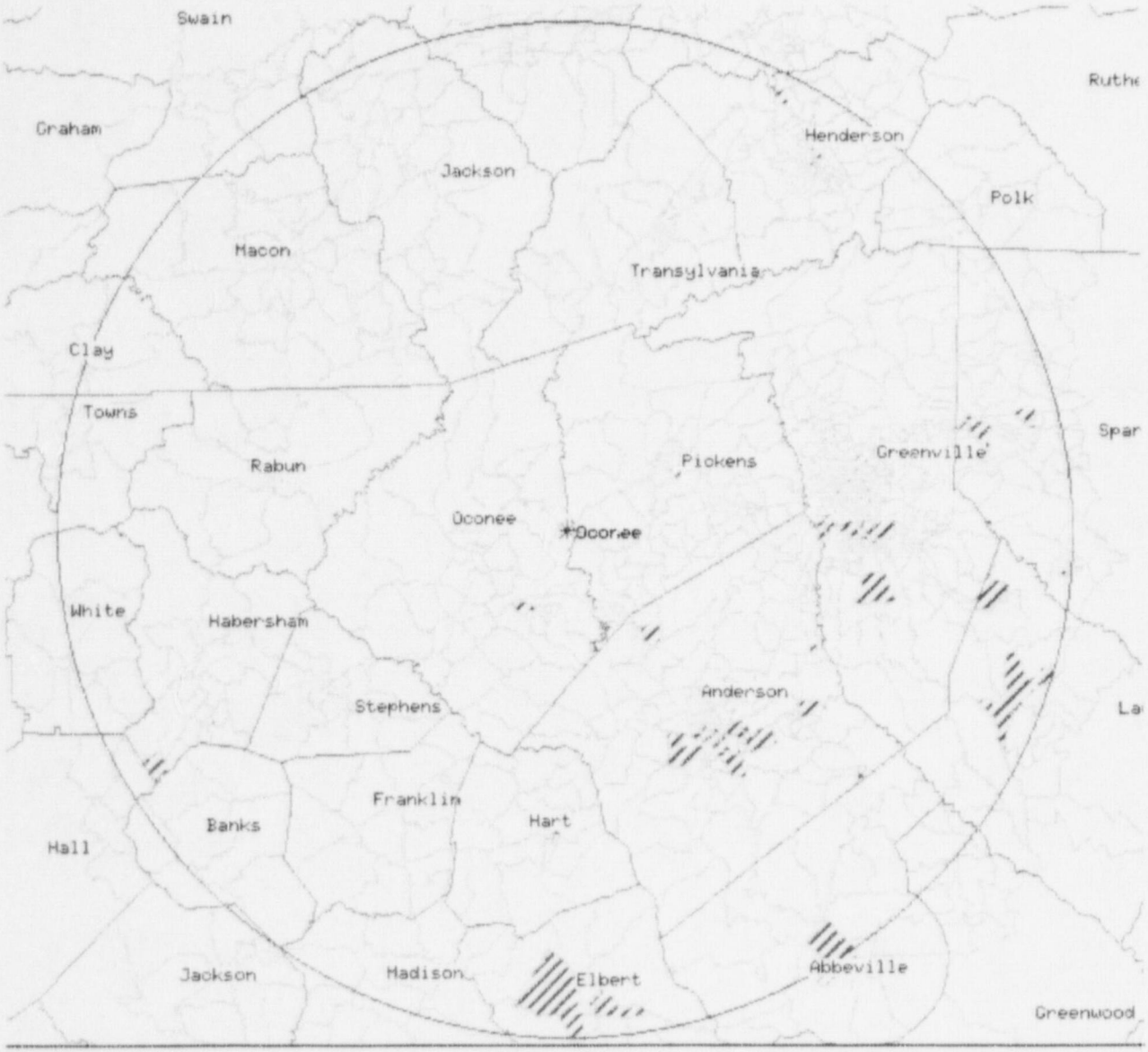


Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of ONS

distribution of minority populations within the 80 km (50 mi) radius of the plant. A minority population is defined to exist if the percentage of minorities within the census blocks exceeds the percentage of minorities in the entire state of South Carolina by 10 percent, or if the percentage of minorities within the census block is at least 50 percent. For census blocks within the states of Georgia or North Carolina, the percentage of minorities is compared to the percentage of minorities in the respective state. Minority populations are located primarily in Greenville and Anderson. However, there are a few scattered census block groups that showed significant concentration of minority individuals in the Seneca and Clemson areas. Figure 4-1 indicates that minority populations in general are either relatively well-mixed into the majority population, or concentrations of minority individuals are too small to be caught in the census detail. This is consistent with the results of field interviews.

Figure 4-2, also taken from the 1990 Census (DOC 1991) shows the geographic distribution of low-income populations within the 80 km (50 mi) radius of the plant. The cross-hatched census blocks show areas where the percentage of households below the poverty level is 10 percent or more greater than the percentage of households below the poverty level in the entire state of South Carolina for those census blocks within the state of South Carolina. It also includes census blocks where the percentage of households below the poverty level exceeds 50 percent. For census blocks within the states of Georgia or North Carolina, the percentage of households below the poverty level is compared to the percentage of households below the poverty level in the corresponding state. The largest concentrations of low-income populations within the 80 km (50 mi) radius are located in North Carolina. There are some small groups scattered throughout the three-county area although none is within 16 km (10 mi) of ONS. Some of these individuals are known to be ex-sharecroppers effectively engaged in subsistence agriculture. The 1990 Census (DOC 1991) shows concentrations of low-income population at Seneca, Easley, and Clemson, the latter partly due to a large university student population. Low-income housing tends to be concentrated in the Seneca and Clemson area.

Examination of the various environmental pathways by which low-income and minority populations could be disproportionately affected reveals no unusual resource dependencies or practices through which these populations could be disproportionately affected. Specifically, no pathways were found through which subsistence agriculture was significantly affected. In general, the prevailing atmospheric transport direction from the ONS site are toward the northeast, thus missing the most of the census blocks showing minority and low-income populations. Therefore, the impact is SMALL, and no special mitigation actions are warranted.

4.5 Groundwater Use and Quality

A Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, is applicable to ONS groundwater use and quality and is listed in Table 4-9. Duke stated in its ER that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review.



Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of ONS

Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS. For these issue, the GEiS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-9. Category 1 Issue 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	
Ground-water use conflicts (potable and service water; plants that use <100 gpm).	4.8.1.1

A brief description of the staff's review and the GEIS conclusions, as codified in 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: "Plants using less than 100 gpm are not expected to cause any groundwater use conflicts." As discussed in Section 2.2.2, ONS's groundwater use is less than 0.068 m^3/s (100 gpm). The staff has not identified any significant new information in its review of the Duke ER, or through the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

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

4.6 Threatened or Endangered Species

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

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they would be adversely affected. Consultation under Section 7 of the Endangered Species Act was initiated by Duke during April 1998 with a request for information to FWS concerning species potentially occurring near ONS. The FWS identified (FWS 1998a) nine listed species known to occur in either Oconee or Pickens Counties and one species that could possibly occur in those counties (see Section 2.2.6). Subsequent to that letter, Duke performed a survey of all of the land within 1.6 km (1 mi) of ONS during May and June of 1998. No Federally listed, proposed, or candidate threatened or endangered species were identified during that survey. The results of the survey were documented for the FWS and the South Carolina Department of Natural Resources (SCDNR) (Duke 1998b; Duke 1998c).

The FWS concurred with Duke's determination that the proposed action will have no effect on listed or proposed endangered or threatened species (FWS 1998). The SCDNR also concurred with the findings presented in the report submitted by Duke (SCDNR 1998).

Table 4-10. 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 Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Sections
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

Four plant species of concern to the SCDNR were identified within the surveyed area (see Section 2.2.6, Table 2-3). These species were all confined to "natural areas" located toward the periphery of ONS, well away from areas used for normal plant operations.

Based on its review of the applicant's report and their independent analysis, the FWS[a] and the SCDNR concluded that continued operation of the plant under license renewal will have no effect on listed or proposed endangered or threatened species within the immediate vicinity of the ONS.

Federally-listed species are known to occur near the transmission line rights-of-way attributable to the ONS (see Section 2.2.6). Of these, the dwarf-flowered heartleaf and the bunched arrowhead occur within or very near the rights-of-ways of the McGuire 525 Kv line and the Tiger 230 Kv lines respectively.

The staff has initiated the consultation process (NRC 1999) with the FWS relative to potential impacts to listed and proposed threatened or endangered species or critical habitats from continued operation and maintenance of the transmission system. In its preliminary analysis with respect to the Federally-listed species known to occur near the transmission line rights-of-way, the staff considered the infrequent need for maintenance, Duke's maintenance practices, and Duke's procedures for conducting surveys of sensitive habitats prior to initiation of maintenance activities. Based on the available information concerning the species distributions and the operational and maintenance activities, it is the staff's preliminary determination that the impact would be SMALL and further mitigation is not warranted.

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

The staff has not identified new and significant information on environmental issues related to operation during the renewal term listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The staff reviewed the discussion of environmental impacts associated with operation during the renewal term in

(a) U.S. Fish and Wildlife Service. 1998. Letter dated August 4, 1998, from the Acting Field Supervisor for the Charleston Field Office to Duke Power indicating that continued operation or refurbishment of ONS will have no effect on listed or proposed endangered or threatened species.

the GEIS and has conducted its own independent review, including the public scoping meetings, to identify issues with significant new information. Processes for identification and evaluation of new information are described in Section 1.0 under License Renewal Evaluation Process.

4.8 Summary of Impacts of Operations During the Renewal Term

Neither Duke nor the staff is aware of significant new information related to any of the applicable Category 1 issues associated with the ONS operation during the renewal term. Consequently, the 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 "plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation."

Plant-specific environmental evaluations were conducted for 13 Category 2 issues applicable to ONS operation during the renewal term and for environmental justice. For 12 issues, the staff concluded that the potential environmental impact of renewal term operations of ONS would be of SMALL significance in the context of the standards set forth in the GEIS, and that mitigation would not be warranted. Relative to threatened and endangered species, the staff's preliminary determination is that the impact resulting from license renewal would be SMALL and further mitigation is not warranted.

In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies that there are adverse effects from electromagnetic fields.

4.9 References

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5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents that might occur during the license renewal term were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996). The GEIS included 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. Category 1 issues are those that the GEIS defines as having met 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)

(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 did not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

This chapter addresses the postulated plant accidents in Section 5.1 and the Severe Accident Mitigation Alternatives (SAMAs) analysis in Section 5.2.

5.1 Postulated Plant Accidents

A Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, is applicable to ONS postulated accidents and is listed in Table 5-1. Duke stated in its environmental report (ER) (Duke 1998a) that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS. For this issue, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for the issue follows.

Design-Basis Accidents: Based on information in the GEIS, the Commission found: "The NRC staff has concluded that the environmental impacts of design basis accidents are of small significance for all plants." The staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, or in its independent evaluation of the available information. Therefore, the staff concludes that there are no impacts of design-basis accidents beyond those discussed in the GEIS.

A Category 2 issue related to postulated accidents that is applicable to ONS is discussed in Table 5-2.

Severe Accidents: Based on information in the GEIS, the Commission found the following:

> 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.

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 Sections
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 staff has not identified any significant new information with regard to the consequences from severe accidents in its review of the Duke ER, the Duke Final Safety Analysis Report (FSAR) (Duke 1998b), the site visit, the scoping process, or in its independent evaluation of the available information. Therefore, the 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 staff has reviewed SAMAs for ONS. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

In 10 CFR 51.53(c)(3)(ii)(L), it is required that license renewal applicants provide a consideration of alternatives to mitigate severe accidents if the staff has not previously considered 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 design changes with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for ONS, therefore, the remainder of Chapter 5.0 addresses those alternatives.

5.2.1 Introduction

Duke submitted an assessment of SAMAs for ONS as part of the Environmental Report (Duke 1998a). This assessment was based on Revision 2 of the ONS Probabilistic Risk Assessment (Duke 1997a). Revision 2 constitutes a full-scope Level 3 Probabilistic Risk Assessment (PRA) with the analysis of both internal and external events; the internal events analysis is an updated version of the Individual Plant Examination (IPE) model (Duke 1990), whereas the external events analysis is the same as the Individual Plant Examination for External Events (IPEEE) model (Duke 1995). In identifying and evaluating potential SAMAs, Duke took into consideration the insights and recommendations from earlier risk studies as well as several more recent risk studies. Duke concluded that none of the candidate SAMAs evaluated were cost effective for ONS.

Based on a review of the SAMA assessment, NRC issued a request for additional information (RAI) to Duke by letter dated December 29, 1998 (NRC 1998). Major issues concerned the process used by the license renewal applicant to identify potential SAMAs, the implementation status of numerous enhancements identified in previous studies, and the inclusion of averted onsite costs (AOSC) in Duke's value impact analysis. Duke submitted additional information by letter dated March 4, 1999 (Duke 1999) clarifying the SAMA identification process, the disposition of previously identified design enhancements, and the impact of AOSC on the cost-benefit analysis. This response provided additional clarification regarding the staff's concerns and reaffirmed that none of the SAMAs would be cost-beneficial even when averted onsite costs are included.

The staff's assessment of SAMAs for ONS is presented below.

5.2.2 Estimate of Risk for ONS

Duke's estimates of the offsite risk at ONS are summarized below. The summary is followed by the staff's review of Duke's risk estimates.

5.2.2.1 Duke Risk Estimates

The ONS PRA model, which forms the basis for the SAMA analysis, is a Level 3 risk analysis, i.e., it includes the treatment of core damage frequency, containment performance, and offsite consequences. The model, which Duke refers to as PRA, Revision 2, consists of an internal events portion, based on an updated version of the IPE (Duke 1990) and an external events portion, based on the current version of the IPEEE (Duke 1995). The calculated total core damage frequency for internal and external events in Revision 2 is 8.9E-5 per year.

Since the ONS PRA is a "living" PRA, the original version of the IPE is being continuously updated to reflect various design and procedural changes, such as those related to the improvements identified in the IPE, to incorporate comments from the "peer review certification" and to reflect up-to-date operational experience. A comparison of risk profiles between the original IPE PRA (which was reviewed by the staff) and the current version (internal events portion of PRA, Revision 2) indicated that there are no significant differences that could change the results of the SAMA analysis by impacting the approach used to identify potential SAMAs or the assessed risk reductions.

Since the issuance of the ONS PRA, Revision 2, report, the total core damage frequency has been recalculated. An IPEEE supplemental report (Duke 1997b) further evaluated the relay chatter issue and updated the seismic core damage frequency (CDF) to be 3.5E-5 per year. A high pressure injection (HPI) reliability study performed in response to an operational event (Duke 1997c) resulted in an updated core damage frequency of 4.3E-5 per year for all events, excluding seismic. Thus, by removing conservative assumptions related to the original seismic analysis and the HPI system, the net effect of these two studies would be to reduce the total CDF for ONS to 7.8E-5 per year. Despite the availability of these later studies, the results of the ONS PRA, Revision 2, were used as the basis for the SAMA analysis since the later studies did not include Level 2 and Level 3 calculations and because the net impact of the changes was a small decrease in CDF.

Since Duke's PRA is based on ONS Unit 3, the licensee performed an analysis to determine the applicability of the PRA results to Units 1 and 2 and submitted the analysis as part of the IPE. This analysis concluded that inter-unit differences do not have a significant impact on the PRA results. Most mechanical and electrical systems of Units 1 and 2 are redundant and diverse from those of Unit 3. Those systems and structures that are shared affect all three Units in a similar fashion during a severe accident scenario. Because civil structures of Units 1 and 2 are similar to those of Unit 3, external events impact structures and components similarly for each Unit. Therefore, the results and insights of the ONS PRA are applicable to all three units.

The Level 2 (also called containment performance) portion of the ONS PRA, Revision 2, model, including the plant damage state descriptors, the Containment Event Tree, and the source term binning and

containment release categories, is essentially the same as the IPE Level 2 analysis. The offsite (or Level 3) consequence analyses were carried out using the NRC-developed Calculations of Reactor Accident Consequences Version 2 (CRAC2) code, and site-specific data for meteorology, population, and evacuation modeling.

Duke estimated the total CDF for internally- and externally-initiated events to be 8.9E-5 per year based on Revision 2 of the ONS PRA. The breakdown of the CDF is provided in Table 5-3. External event initiators represent about 71 percent of the total CDF and are dominated by seismic (44 percent of total CDF) and tornado initiators (16 percent of total CDF). External flood and fire initiators together account for about 11 percent of the total CDF. Internal event initiators represent about 29 percent of the total CDF and are dominated by internal flood (11 percent of total CDF), transient (9 percent of total CDF), and loss of coolant accident initiators (8 percent of total CDF). Remaining contributors together account for less than 2 percent of total CDF.

Table 5-3. ONS Core Damage Frequencies

Initiating Event	Frequency (per year)	% of Total CDF (Int+Ext)
EXTERNAL INITIATORS		
Seismic	3.9E-5	44
Tornado	1.4E-5	16
External Flood	5.9E-6	6
Fire	4.5E-6	5
Total External	**6.3E-5**	**71**
INTERNAL INITIATORS		
Internal Flood	9.5E-6	11
Transients	8.2E-6	9
LOCAs* (small, medium, large)	6.8E-6	8
RPV Rupture	1.0E-6	1
Steam Generator Tube Rupture	4.1E-7	<1
ATWS	1.7E-7	<1
Interfacing systems LOCA	6.9E-9	<1
Total Internal	**2.6E-5**	**29**
Total CDF (Internal + External)	**8.9E-5**	**100**

*LOCA = loss of coolant accident.

Duke estimated the dose to the population within 80 kilometers (50 miles) of the ONS site from all initiators (internal and external) to be 4.92 person-rem per year (Duke 1999). The breakdown of the total population dose by containment end-state is summarized in Table 5-4. Of the total risk from all initiators, about 80 percent is due to external events. Interfacing system LOCA, containment isolation failure, and late containment failure dominate external event risk (Column 3 of Table 5-4) and total risk from all initiators (Column 4 of Table 5-4) with nearly equal contributions from each. Early containment failure accounts for approximately 10 percent of the total risk from all initiators, with the majority of this contribution coming from external events. Only about 20 percent of the total risk from all initiators is due to internal events, with the majority of this risk from late containment failure (Column 2 of Table 5-4). All other internal event contributors combined account for less than 10 percent of the total risk from all initiators.

Table 5-4. Breakdown of Population Dose by Containment End-State (Total Dose = 4.92 person-rem per year)

Containment End-State	% of Total Dose Internal Initiators	% of Total Dose External Initiators	% of Total Dose All Initiators
Steam Generator Tube Rupture	2.7	<0.1	2.8
Interfacing System LOCA	0.8	24.4	5.2
Containment Isolation Failure	0.5	22.0	22.5
Early Containment Failure	3.7	6.5	10.2
Late Containment Failure	9.4	22.8	32.2
Basemat Melt Through	2.2	4.6	6.8
No Containment Failure	<0.1	0.2	0.3
Total	**19.3**	**80.7**	**100**

5.2.2.2 Review of Duke's Risk Estimates

Duke's estimate of offsite risk at ONS is based on Revision 2 of the ONS PRA. For purposes of this review, the staff considered the ONS study in terms of the following major elements:

- the Level 1 and 2 risk models that form the bases for the November 1990 IPE submittal (Duke 1990)

- the major modifications to the IPE model that have been incorporated in Revision 2 of the PRA (Duke 1997b)

- the external event models that form the basis for the December 1995 IPEEE submittal (Duke 1995)

- the analyses performed to translate fission product release frequencies from the Level 2 PRA model into offsite consequence measures.

The staff reviewed each of these analyses to determine the acceptability of Duke's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the ONS IPE is described in an evaluation report dated April 1, 1993 (NRC 1993). In that review, the staff evaluated the methodology, models, data, and assumptions used to estimate CDF and characterize containment performance and fission product releases. The staff concluded that Duke's analysis met the intent of Generic Letter 88-20 (NRC 1988); that is, the IPE was of adequate quality to be used to look for design or operational vulnerabilities. Although the staff reviewed certain aspects of the IPE in more detail than others, the review primarily focused on the licensee's ability to examine ONS for severe accident vulnerabilities and not specifically on the detailed findings or quantification estimates. However, ONS's risk profile and important IPE findings compare well to those of other B&W plants (NUREG-1560) (NRC 1997a) and any differences are well understood. Overall, the staff believes that the ONS PRA is of adequate quality to be used as a tool in searching for areas with high potential for risk reduction and to assess such risk reductions, especially when the PRA models are used in conjunction with insights, such as those from risk importance, sensitivity, and uncertainty analyses.

The staff's review of the applicant's IPEEE is currently under way. The preliminary results did not identify any significant shortcomings or deficiencies. A limited review of the Duke submittal finds that the overall method, scope, and level of detail are generally comprehensive. The staff also notes that the Duke IPEEE has been subjected to both internal and external peer reviews. Based on these findings, the staff concludes that the external events portion of the ONS PRA provides an acceptable platform for identifying potential SAMAs and for assessing risk reductions.

The staff reviewed the process used by Duke to extend the containment performance (Level 2) portion of the IPE to the offsite consequence (Level 3) assessment. This included consideration of the source terms used to characterize fission product releases for each containment release category and the major input assumptions used in the offsite consequence analyses. This information is provided in Section 6.3 of Duke's IPE submittal. Duke used the Modular Accident Analysis Program code to analyze postulated accidents and develop radiological source terms for each of 35 containment release categories used to represent the containment end-states identified in Table 5-4. These source terms were incorporated as input to the CRAC2 analysis. The staff reviewed Duke's source term estimates for the major release categories and found these predictions to be in reasonable agreement with estimates of NUREG-1150 (NRC 1990a) for the closest corresponding release scenarios. The staff concludes that the assignment of source terms is acceptable.

The CRAC2 code has been superceded by the Melcor Accident Consequence Code System (MACCS), which, among other advancements, incorporates more recent models for calculating health effects (e.g., latent cancers). Although MACCS represents a significant improvement over CRAC2, both

codes use a straight line Gaussian plume dispersion and transport model and, for the same input assumptions, provide comparable estimates of population dose (person-rem). Thus, the CRAC2 code is considered acceptable for purposes of estimating population dose for a severe accident.

The CRAC2 input in PRA, Revision 2, used site-specific meteorological data processed from measurements taken during the mid-1970s. To assess the impact that data from two different time periods may have on offsite dose, Duke obtained more recent data from the ONS site for the period January 1, 1997, through December 31, 1997. Re-analysis of the Level 3 portion of the PRA using the 1997 meteorological data (Duke 1999) shows that the risk results are only slightly impacted (reduced by about 2 percent). The staff therefore considers the meteorological data in PRA, Revision 2, to be representative of the climate for the site.

The population distribution used in Revision 2 of the PRA is based on 1990 census data. The impact of population increases was not included in Revision 2 since the purpose of the PRA was to understand the risk associated with current operation of the plant. Based on information contained in NUREG-1437 (NRC 1996), the population within an 80-km (50-mi) radius of the ONS site is projected to increase by about 33 percent between the years 1990 and 2030. Since the population dose is roughly proportional to the total population, use of the increased population value would result in an increase in the total risk from all initiators of approximately 1.6 person-rem per year. This increase is small in absolute terms and does not have a significant impact on the conclusions of the SAMA analysis, as discussed later.

Evacuation modeling is based on site-specific evacuation studies carried out by Duke. It was assumed that only 95 percent of the people within the emergency planning zone (determined by the plume exposure pathway) would participate in the evacuation. The remaining 5 percent would delay evacuation for 24 hours. This assumption is conservative relative to the NUREG-1150 (NRC 1990a) study, which assumed evacuation of 99.5 percent of the population within the emergency planning zone.

Site-specific economic data were used in the CRAC2 code. However, as discussed later, the applicant based their assessment of offsite costs on generic cost estimates rather than CRAC2 code calculations.

The staff concludes that the methodology used by Duke to estimate the CDF and offsite consequences for ONS 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 Duke.

5.2.3 Potential Design Improvements

The process for identifying potential design improvements, the staff's evaluation of this process, and the design improvements evaluated in detail by Duke are discussed in this section.

5.2.3.1 Process for Identifying Potential Design Improvements

Duke's process for identifying potential plant improvements consisted of the following three elements.

- the core damage cutsets from Revision 2 of the ONS PRA were reviewed to identify potential SAMAs that could reduce CDF

- the Fussell-Vesely (F-V) importance measures were evaluated for the basic events (including initiating events, random failure events, human error events, and maintenance/testing unavailabilities), and the importance ranking was examined to identify any events of significant F-V importance

- potential enhancements to reduce containment failure modes of concern for ONS (including early containment failure, containment isolation failure, and containment bypass), were reviewed for possible implementation.

This included a review of recommendations from the ONS IPE and IPEEE (those that had not been implemented), results of other plant-specific SAMA analyses, and insights from the staff's report on the individual plant examination (NRC 1997a) for possible inclusion of these concepts as additional SAMAs.

As a starting point for the core damage cutset review, Duke developed a listing of the top 100 cutsets (severe accident sequences) based on internal initiators and the top 100 cutsets for external initiators. These 200 sequences include all potential core damage sequences with at least a 0.06 percent contribution to the total CDF. Duke reviewed the cutsets to identify potential SAMAs that could reduce CDF. Cutoff values of 4.5E-7 per year and 8.5E-7 per year were used to screen internal and external events, respectively. To account for the cumulative effect of cutsets below these cutoff values, the basic events importance measure was also used to identify potential enhancements, as discussed below.

For each seismic initiator cutset, Duke calculated the associated offsite risk based on the person-rem risk and CDF for the plant damage states (PDSs) attributable to the seismic initiator. Duke conservatively assumed that the implementation of plant enhancements for seismic events would completely eliminate the seismic risk and calculated the present worth of the averted risk based on a $2000 per person-rem conversion factor, a discount factor of 7 percent, and a 20-year license renewal period. This process was repeated for each of the remaining seismic initiator cutsets above the cutoff frequency. The present worth of averted risk for all of the seismic cutsets combined was estimated to be about $51,000. Duke cited sensitivity studies performed previously as part of the IPEEE analysis, which show that most of the seismic upgrades to plant components would result in only a small reduction in CDF (less than 5E-6 per year). On the basis of the small risk reduction achievable and the large

costs associated with substantial seismic upgrades, Duke eliminated seismic SAMAs from further consideration.

Duke reviewed the F-V Basic Event Importance Ranking presented in the ONS PRA, Revision 2, report and identified the top 30 basic events for further consideration. These included seismic-related events, initiating events, equipment failures, and human error events. Seismic-related events were not evaluated further for reasons discussed above. Duke judged that all but one of the initiating events, such as tornado, dam failure, and fire events, could not be significantly impacted by SAMAs and that the remaining initiator (reactor trip initiator) is adequately addressed by their current ORAM-SENTINEL configuration management system. Based on a review of the remainder, Duke identified nine events/sequences and a potential plant enhancement to address each event. The list of the potential enhancements to reduce CDF are presented in Table 5-5.

Duke also considered potential alternatives to reduce containment failure modes of concern for ONS. These alternatives included nine containment-related improvements evaluated as part of the staff's assessment of Severe Accident Mitigation Design Alternatives for Watts Bar (NRC 1995a) and five containment-related improvements derived from the staff's report on the individual plant examination program (NRC 1997a). Duke eliminated those alternatives that are either (1) not applicable to ONS (e.g., containment air return fans used only in ice condenser containments), (2) related to control of hydrogen combustion (since the Level 2 PRA shows the ONS containment is capable of withstanding large hydrogen burns), or (3) already implemented at ONS, e.g., by inclusion either in emergency operating procedures, severe accident management guidelines, or the operator training program. Based on the screening, Duke designated seven of the containment related SAMAs for further study. The list of the potential enhancements to improve containment performance is presented in Table 5-6.

5.2.3.2 Staff Evaluation

Duke's effort to identify potential SAMAs focused on areas found to be risk-significant in the ONS PRA. The list of SAMAs generally coincide with accident categories that are dominant CDF contributors or with issues that tend to have a large impact on a number of accident sequences at ONS. Duke made a reasonable effort to use the ONS PRA to search for potential SAMAs and to review insights from other plant-specific risk studies and previous SAMA analyses for potential applicability to ONS. The staff notes that Duke identified a number of recommendations for reducing risk as a result of the ONS IPE and IPEEE, and that many of these plant improvements have been implemented or are planned and being tracked for resolution (Duke 1998c, and Duke 1999). For those recommendations that were not implemented, Duke provided justification as to why these improvements are not warranted.

Table 5-5. Value-Impact Results for Potentially Cost-Beneficial SAMAs that Prevent Core Damage

SAMA	Sequences/Failures Addressed	Percent Reduction		Present Worth	Cost of Enhancement
		CDF[a]	P-Rem[b]		
Strengthen east and west penetration rooms and BWST[c] to withstand tornado winds	Tornado strikes that damage penetration room and BWST	2.1	14.6	74,000	>$1M
Man SSF[d] 24 hours a day with a trained operator	Operator failure to align SSF RCM[e] system in events with turbine building fire or failure of Jocassee Dam	1.4	10.0	49,500	>$5M
Install an automatic backup system to refill elevated water storage tank for HPI[f] cooling	Operator failure to refill elevated water storage tank during turbine building flood	6.5	8.7	230,000	>$1M
Install automatic swap of HPI to spent fuel pool	Operator failure to swap HPI to spent fuel pool during a flood	3.3	4.3	117,000	>$1M
Increase the height of the SSF flood barrier	Failures of the Jocassee Dam that result in flood levels exceeding 5 foot flood barrier	2.9	1.6	103,000	$500K
Install protective barrier around upper surge tanks	Tornado strikes that cause a LOCA[g] with failure of all power and upper surge tanks	6.0	8.1	212,000	>$1M
Upgrade 4160 switchgear in turbine building to withstand F4 intensity tornadoes	Tornado strikes that cause a LOCA with failure of all power and upper surge tanks	6.0	8.1	212,000	>$1M
Install automatic swap from injection to high pressure recirculation	Operator failure to initiate high pressure recirculation during LOCAs	4.6	6.3	163,000	>$1M
Replace reactor pressure vessel	Spontaneous failure of the reactor vessel	1.1	<0.1	37,100	>$1M

(a) Total CDF = 8.9E-5/year.
(b) Total offsite dose = 4.92 person-rem/year.
(c) BWST = borated water storage tank.
(d) SSF = standby shutdown facility.
(e) RCM = reactor coolant makeup.
(f) HPI = high pressure injection.
(g) LOCA = loss of coolant accident.

Table 5-6. Value-Impact Results for Potentially Cost-Beneficial SAMAs that Improve Containment Performance

SAMA	Sequences/Failures Addressed	Percent Reduction		Present Worth	Cost of Enhancement
		CDF [a]	P-Rem [b]		
Install independent containment spray systems	Late containment failure from over-temperature or steam over-pressure	NA	43.7	46,200	>$1M
Install filtered containment vent system	Late containment failure from over-pressure	NA	43.7	46,200	>$1M
Install additional containment bypass instrumentation	Inter-system LOCAs[c] which could be mitigated through improved detection capabilities	NA	25.2	27,300	>$1M
Add independent source of feedwater to reduce induced SGTR[d]	Induced steam generator tube failures in high pressure core melt sequences	NA	2.8	3,100	>$1M
Install reactor depressurization system	Direct containment heating and induced steam generator tube failures in high pressure core melt sequences	NA	10.9	14,300	>$1M
Install reactor cavity flooding system	Basemat failure due to core-concrete interactions	NA	6.7	7,300	>$1M
Install core retention device	Basemat failure due to core-concrete interactions	NA	6.7	7,300	>$1M

(a) Total CDF = 8.9E-5/year.
(b) Total offsite dose = 4.92 person-rem/year.
(c) LOCA = loss of coolant accident.
(d) SGTR = steam generator tube rupture.

The staff reviewed the set of potential enhancements considered in Duke's SAMA identification process. These include improvements oriented toward reducing the CDF and risk from major contributors specific to ONS, improvements identified as part of the NRC containment performance improvement program, accident management strategies identified by NRC in Generic Letter 88-20, Supplement 2 (NRC 1990b), and improvements identified in the previous severe accident mitigation design alternative review for Watts Bar (NRC 1995a) that would be applicable to ONS. The SAMAs also include a filtered containment vent and a flooded rubble bed core retention device, which are cited specifically in NUREG-0660 (NRC 1980) for evaluation as part of Three Mile Island Task Action Plan Item II.B.8.

The staff notes that most of the SAMAs involve major modifications and significant costs and that less expensive design improvements and procedure changes could conceivably provide similar levels of risk reduction. However, lower cost improvements are not expected to offer significant risk reduction, given that external events account for the majority (80 percent) of the risk. Much of this risk is due to postulated earthquakes with ground accelerations significantly greater than the ONS design-basis earthquake. As such, SAMAs that would significantly reduce overall risk would involve substantial upgrades in the seismic ruggedness of the plant and would be very costly.

It should be noted that Duke has been a pioneer in the development and use of PRA methods to gain insights regarding severe accidents at ONS. Risk insights from various ONS risk assessments, such as the ONS IPE, the ONS IPEEE, the Keowee PRA, and ONS HPI reliability study, have been identified and implemented to improve both the design and operation of the plant. For example, using the IPE process, Duke identified and implemented modifications to procedures to (1) isolate the high pressure service water (HPSW) to the component cooling water (CCW) pumps during a turbine building flooding event to extend the time the elevated water storage tank (EWST) inventory would last, (2) power the standby shutdown facility (SSF) from the Unit 2 main feeder bus, (3) terminate containment sprays to conserve the borated water storage tank (BWST) inventory to enhance long-term HPI cooling following a flooding event in the turbine building, and (4) cope with common cause failure of both HPI suction valves. Examples of plant improvements that resulted from IPEEE findings and whose implementation is being planned by Duke are (1) the mounting of the combustible storage locker near the SSF diesel to prevent combustible materials from being spilled around the diesel during a seismic event or knocked over by personnel, and (2) the replacement of the deluge (open head) sprinklers in the Cable and Equipment Rooms with closed head sprinklers to reduce water damage to equipment important to safety during a fire. The implementation of such improvements reduced the risk associated with the major contributors identified by the ONS PRA and contributed to the reduced number of candidate SAMAs identified as part of Duke's application for license renewal.

The staff concludes that Duke has used a systematic process for identifying potential design improvements for ONS and that the set of potential design improvements identified by Duke is reasonably comprehensive and, therefore, acceptable.

5.2.4 Risk Reduction Potential of Design Improvements

The process used by Duke to determine the risk reduction potential for each enhancement is described in Section 4.3 of the ER.

For each seismic initiator cutset, Duke calculated the associated offsite risk based on the person-rem risk and CDF for the PDSs attributable to the seismic initiator. Implementation of the plant enhancement was assumed to completely eliminate the seismic risk associated with the cutset. For each (non-seismic) sequence/enhancement, Duke assigned a PDS based on the type of plant damage and potential containment release characteristics. In general, where an alternative impacted more than one PDS, Duke used the PDS with the highest conditional person-rem risk to characterize the associated risk and assumed that implementation of the alternative would completely eliminate the risk. For each containment-related improvement, Duke assumed that all of the person-rem risk associated with the release categories impacted by the SAMA would be eliminated. For those alternatives that benefit more than one containment failure mode (i.e., independent containment spray system, reactor depressurization system, and filtered containment vent), the total person-rem dose for all affected failure modes was assumed to be completely eliminated by implementing the alternative.

The staff notes that Duke evaluated the risk reduction potential for each SAMA in a bounding fashion, i.e., each SAMA was assumed to completely eliminate all sequences that the specific enhancement was intended to address. As a result, the benefits are generally over-estimated and conservative. Accordingly, the staff based its estimates of averted risk for the various SAMAs on Duke's risk reduction estimates.

5.2.5 Cost Impacts of Candidate Design Improvements

Duke's estimated costs for each potential design enhancement are provided in Tables 4-2 and 5-1 of Attachment K to the ER. For most of the SAMAs, Duke estimated the cost of implementation to be greater than $1 million based on cost estimates developed in previous industry studies. For three SAMAs, Duke developed plant-specific cost estimates because there was no readily available information on the estimated cost to implement similar alternatives and because the basic events associated with these alternatives were found to have a high importance in the ONS PRA. These SAMAs involve (1) increasing the height of the SSF flood barrier, (2) manning the SSF 24 hours a day with trained operators, and (3) installing a protective barrier for the upper surge tanks or upgrading the 4160 volt switchgear to withstand tornado winds. The costs to implement these SAMAs were estimated to be on the order of $500,000, $5 million, and $1 million, respectively. Because the safety benefits of the potential SAMAs were significantly less than their estimated implementation costs (by about a factor of five), none of the cost estimates were further refined.

The staff compared Duke's cost estimates with estimates developed elsewhere for similar improvements, including estimates developed as part of the evaluation of severe accident mitigation design

alternatives for operating reactors and advanced light-water reactors. The staff notes that Duke's estimated implementation costs of $1 million dollars or greater are consistent with the values reported in previous analyses for changes of similar scope and are not unreasonable for the SAMAs under consideration, given that these enhancements involve major hardware changes and impact safety-related systems.

Although the applicant did not provide the underlying bases for its cost estimates, the staff views their cost estimates as reasonable for evaluating the SAMAs because the estimates are consistent with those developed by others and because the spread between the estimated costs and benefits is significant. Accordingly, the staff adopted Duke's cost estimates for the various candidate improvements.

5.2.6 Cost-Benefit Comparison

The cost-benefit comparison as evaluated by Duke and the staff's evaluation of the cost-benefit analysis are described in the following sections.

5.2.6.1 Duke Evaluation

In the analysis provided in the ER, Duke did not include several factors in its cost-benefit evaluation, specifically, the averted onsite cleanup and decontamination cost, replacement power cost, and averted offsite property damage cost. In view of the significant impact of these averted costs on the estimated benefit for a SAMA, the staff requested that Duke include these factors in their cost-benefit analysis for each affected SAMA. In their response to the request for additional information, Duke updated the benefit estimates to include these factors for all SAMAs that reduce CDF. The methodology used by Duke was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997b), and NUREG/BR-0058, *Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission* (NRC 1995b). The guidance involves determining the net value for each SAMA according to the following formula:

$$\text{Net Value} = (\text{APE} + \text{AOC} + \text{AOE} + \text{AOSC}) - \text{COE}$$

where APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure ($)
AOSC = present value of averted onsite costs ($)
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 is not considered beneficial. Duke's derivation of each of the associated costs is summarized below.

Averted Public Exposure (APE)

Averted public exposure costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/reactor-year)
× monetary equivalent of unit dose
× present value conversion factor

Duke estimated the annual reduction in public exposure for each SAMA as discussed previously. The reduction in public exposure (person-rem per year) was converted to a monetary equivalent by applying NRC's conversion factor of $2000 per person-rem and then discounting the monetary equivalent to present value. A 20-year period for the license renewal period and a 7 percent real discount rate was assumed, resulting in a present value conversion factor of 10.76.

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.

Averted Offsite Property Damage Costs (AOC)

Averted offsite property damage costs were calculated 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

Duke determined the offsite economic costs for a severe accident based on the weighted costs for offsite property damage for the five NUREG-1150 plants (reported in Table 5.6 of NUREG/BR-0184). These costs were inflated to year 2000 dollars based on a 4 percent inflation rate, yielding a value of $364 million. Calculated values for offsite economic costs were discounted to present value in the same manner as for averted public exposure.

Averted Occupational Exposure (AOE)

Averted occupational exposure was calculated using the following formula:

AOE = Annual CDF reduction
× occupational exposure per core-damage event
× present value conversion factor

Duke derived the values for averted occupational exposure based on information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997b). Best estimate values provided for immediate occupational dose (3,300 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 using 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.

Averted Onsite Costs (AOSC)

AOSC includes averted cleanup and decontamination costs and averted power replacement costs. Duke derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997b).

Averted cleanup costs are calculated using the following formula:

ACC = Annual CDF reduction
× present value of cleanup costs per core-damage event
× present value conversion factor

The net present value for cleanup and decontamination of a severe accident (discounted over 10 years) is given as $1.1 billion in the handbook (NRC 1997b). Use of a discount factor of 10.76 to account for the 20-year license renewal period yields an integrated cleanup cost of $12 billion. This value was multiplied by the annual reduction in core damage frequency to obtain the averted cleanup costs portion of the AOSC.

Long-term replacement power costs (U_{RP}) are calculated as

U_{RP} = 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

In accordance with guidance provided in Section 5.7.6.2 of the handbook (NRC 1997b), Duke estimated the net present value of replacement power for a single event to be $1.23 billion, based on a replacement power cost for each ONS unit of $152 million (year 2000 dollars), a real discount rate of 7 percent, and a 20-year license renewal period. This value was multiplied by a factor of 8.1 to obtain a summation of the single-event costs over the entire license renewal period, yielding a replacement power cost of $10.0 billion. This value was multiplied by the annual reduction in core damage frequency to obtain the averted replacement costs portion of the AOSC.

The value-impact results for the 16 SAMAs are presented in Tables 5-5 and 5-6. All of the SAMAs have a negative net value even when bounding risk reduction benefits are assumed and AOSC is included. Duke concluded that implementation of SAMAs is not justified since the cost of implementation far exceeds the benefit of these SAMAs. As such, Duke has decided not to pursue any of these SAMAs further.

5.2.6.2 Staff Evaluation

The updated cost-benefit analysis provided by Duke (Duke 1999) was based primarily on NRC's Regulatory Analysis Technical Evaluation Handbook (NRC 1997b). The only noted deviation from the regulatory guidance was the omission of the averted offsite property damage cost component for those SAMAs that impact only containment performance. (A reduction in offsite consequences results in both averted public exposure and averted offsite property damage. Duke appropriately considered averted offsite property damage costs for the SAMAs that prevent core damage, but failed to include these averted costs for the SAMAs that improve containment performance.) The staff has evaluated the averted offsite property damage cost component for these SAMAs and found it to be small (less than $100,000 for the most effective mitigative SAMA identified) and well below the cost of the enhancements. Thus, the total present worth benefit for any of the containment-related SAMAs would be less than $150,000.

The staff concludes that the cost of implementing any of the 16 SAMAs would far exceed the estimated benefit, with a margin of about a factor of five. Based on its review, the staff notes the following:

- Averted onsite costs are the single most important factor in the cost-benefit analysis. However, no SAMAs are cost-beneficial when these costs are included in the analysis in accordance with NRC's regulatory analysis guidance.

- Use of a 3 percent discount rate in place of the 7 percent discount rate used in the base case analysis increases net values, but does not lead to identification of any cost-beneficial SAMAs.

- The effect of implementing the SAMA in the near term rather than delaying implementation until the start of the license renewal period (i.e., use of a 35-year rather than a 20-year period in the value impact analysis) is bounded by the sensitivity study which assumed a 3 percent discount rate, and does not lead to identification of any cost-beneficial SAMAs.

5.2.7 Conclusions

Duke completed a comprehensive effort to identify and evaluate potential cost-beneficial plant enhancements to reduce the risk associated with severe accidents at ONS. As a result of this assessment, Duke concluded that no additional mitigation alternatives are cost-beneficial and warrant implementation at ONS.

Based on its review of SAMAs for ONS, the staff concurs that none of the candidate SAMAs are cost beneficial. This conclusion is consistent with the low residual level of risk indicated in the ONS PRA

and the fact that Duke has already implemented many plant improvements identified from previous plant-specific risk studies. Both the conditional probability of an early release of fission products and the total offsite risk at ONS are quite small (less than 4 percent and 5 person-rem per year, respectively). External events account for the majority (80 percent) of the risk, with much of this from postulated earthquakes with ground accelerations significantly greater than the ONS design-basis earthquake. Because of the low level of residual risk and the large cost of containment-related enhancements, cost-beneficial enhancements that can significantly reduce risk are unlikely. The margins in the analysis are considered ample to cover uncertainties in risk and cost estimates given that, in general, estimates for these factors were conservatively evaluated.

5.3 References

10 CFR 51.53, "Postconstruction environmental reports."

10 CFR 51, Subpart A, Appendix B, Table B-1, "Environmental effect of renewing the operating license of a nuclear power plant."

Duke Energy Corporation. 1990. Letter from Tuckman, Duke Energy Corporation. Subject: Transmitting Individual Plant Examination. Dated November 30, 1990.

Duke Energy Corporation. 1995. Letter from Hampton, Duke Energy Corporation. Subject: Transmitting Individual Plant Examination for External Events. Dated December 28, 1995.

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6.0 Impacts from the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996). The GEIS included 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. Category 1 issues are those that the GEIS defines as having met 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 did not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

This chapter addresses those 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 Appendix B to Subpart A of 10 CFR Part 51 that are applicable to ONS. The generic potential impacts of the radiological and non-radiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based on the generic impacts provided in 10 CFR Part 51, Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The GEIS also addresses the impacts from radon and technetium. With the exception of transportation of high-level waste, all aspects of the impacts from the uranium fuel cycle and solid waste management are Category 1 issues.

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 ONS from the uranium fuel cycle and solid waste management are listed in Table 6-1. Duke stated in its ER

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 Sections
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	3.1; 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
Offsite radiological impacts (spent fuel and high level waste disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4
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
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
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

(Duke 1998) that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste): Based on information in the GEIS, the Commission found:

> Offsite impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part [10 CFR Part 51]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, are small.

The staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (collective effects): Based on information in the GEIS, the Commission found:

> The 100-year environmental dose commitment to the U.S. population from the fuel cycle, HLW, and spent fuel disposal is calculated to be about 14,800 rem [148 Sv], 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 (for example, 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 judgement as to the regulatory NEPA implications of these matters should be made, and it makes no sense to repeat the same judgement 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 value of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no collective impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (spent fuel and HLW disposal): Based on information in the GEIS, the Commission found:

> For the HLW and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for the offsite releases of radioactive nuclides 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 Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site that will comply with such limits, peak doses to virtually all individuals will be 100 millirem (1 mSv) 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 millirem (1 mSv) 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 some fraction of the 100 millirem (1 mSv) per year. The lifetime individual risk from 100 millirem (1 mSv) annual dose limit is about 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 DOE in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 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 population doses 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 the 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 judgement as to the regulatory NEPA implications of these matters should be made, and it makes no sense to repeat the same judgement 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 value of significance for the impacts of spent fuel and high-level waste disposal, this issue is considered Category 1.

The staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no collective impacts of the uranium fuel cycle 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:

  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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are 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:

  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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are 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:

  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 decommission requirements.

The staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are 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:

> The expected increase in volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

The onsite spent fuel impacts were determined to be SMALL. The staff has not identified any significant new information in its review of the Baltimore Gas and Electric (BGE) environmental report (ER), the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are 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:

> 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 nonradiological waste impacts were determined to be SMALL. The staff has not identified any significant new information in its review of the BGE ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

The GEIS and 10 CFR Part 51, Subpart A, Appendix B, Table B-1 lists transportation, which is discussed in Subsection 6.1.1 (see Table 6-2) as a Category 2 issue.

Table 6-2. Category 2 Issue 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	Category	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Supplement 1 Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT				
Transportation	2	6.3.1; 6.3.2; 6.3.3; 6.3.4	M	6.1.1

6.1.1 Transportation of Radiological Waste

The staff reviewed the submittal by the applicant regarding transportation for the uranium fuel cycle and waste management, which is a Category 2 issue for license renewal.

This issue has two components. The first component is that the effects of transporting fuel and waste shall be reviewed in accordance with 10 CFR 51.52, "Environmental Effects of Transportation of Fuel and Waste--S-4."

Section 51.52 includes Table S-4, which identifies the environmental impacts of transportation of fuel and waste. The impacts identified in Table S-4 are valid if a licensee meets all of the criteria outlined.

In recent years, licensees have requested authorization to increase fuel enrichment and fuel burnup. Duke can operate ONS at a maximum fuel burnup rate of 62,000 MWd/MTU, in accordance with the methodology presented in B&W topical report BAW-10186P-A, which was approved by the staff in its letter dated April 29, 1997 (NRC 1997). Based on a reassessment of the impacts resulting from the transportation of spent fuel, the staff's preliminary determination is that the environmental impacts are either unchanged or reduced from those summarized in Table S-4.

The second component of this issue is that the review include a discussion of the generic and cumulative impacts associated with transportation operation in the vicinity of a HLW repository site. The candidate site at Yucca Mountain was to be used for the purposes of this analysis. In its application, Duke referenced a staff-initiated rulemaking activity to change the categorization of this issue, and therefore, Duke did not provide a site-specific review of the environmental impacts from transportation of HLW. A proposed rule that would amend 10 CFR 51.53(c)(3)(ii)(M) to categorize the impacts of transportation of HLW as a Category 1 issue was published in the Federal Register in February 1999 (64 FR 9884).

The staff anticipates that a final rule will be published in the Federal Register no later than August 1999 and will be effective 30 days later, no later than September 1999. The basis for the proposed rule is a

supplemental analysis performed by the staff to evaluate the cumulative environmental impacts of spent nuclear fuel transport to the proposed Yucca Mountain HLW repository.

In a staff requirements memorandum (SRM), "Staff Requirements - SECY-97-279 - Generic and Cumulative Environmental Impacts of Transportation of High-Level Waste (HLW) in the Vicinity of an HLW Repository (SRM M970612)," dated January 13, 1998 (NRC 1998), the Commission directed the staff to require an applicant to provide a discussion in the plant-specific ER only if a license renewal application is received before the rulemaking activity is completed and a delay due to the generic rulemaking might affect the licensing process for a license renewal. Because the rulemaking is scheduled to be completed before the completion of the staff's environmental review for ONS license renewal, a plant-specific evaluation is not performed in this SEIS.

Duke has stated that it is unaware of any new and significant information related to impacts from the transportation of radiological wastes. The staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes the radiological environmental impacts from the transportation of fuel and waste attributable to license renewal of a power reactor are small. It is the staff's preliminary determination that the impacts of transporting spent fuel with average burnup for the peak rod to levels up to 62,000 MWd/MTU would not appreciably change 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." The proposed rule confirmed that the values in Table S-4 are bounding for transportation of high-level waste in the vicinity of a high-level repository.

6.2 References

10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR 51.23, "Temporary storage of spent fuels after cessation of reactor operation—generic determination of no significant environmental impact."

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."

10 CFR 51.53(c), "Postconstruction environmental reports, operating license renewal stage."

10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

40 CFR Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

64 FR 9884. February 26, 1999, "Changes to requirements for environmental review for renewal of nuclear power plant operating licenses." Federal Register.

Duke Energy Corporation. 1998. Application for Renewed Operating Licenses. Oconee Nuclear Station Units 1, 2, and 3. Volume IV Environmental Report.

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*, Washington, D.C.

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plant* (GEIS), NUREG-1437, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997. Letter from NRC to Framatome Technologies, Inc., Subject: Acceptance for Referencing of FCF Topical Report, BAW-10186P, "Extended Burnup Evaluation." Dated April 29, 1997.

U.S. Nuclear Regulatory Commission (NRC). 1998. Staff Requirements - SECY-97-279- "Generic and Cumulative Environmental Impacts of Transportation of High-Level Waste (HLW) in the Vicinity of an HLW Repository (SRM M970612)." Dated January 13, 1998.

U.S. Nuclear Regulatory Commission (NRC). 1999. Letter from NRC to Duke Energy Corporation. Subject: Use of Framatome Cogema Fuels Topical Report on High Burnup - Oconee Nuclear Station, Units 1, 2, and 3. Dated March 1, 1999.

7.0 Decommissioning

Environmental issues associated with decommissioning resulting from continued plant operation during the renewal term were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants*, NUREG-1437 (NRC 1996). The GEIS included 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. Category 1 issues are those that the GEIS defines as having met 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 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 not likely 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 did not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to ONS decommissioning following the renewal term are listed in Table 7-1. Duke stated in its ER (Duke 1998) that it is not aware of any new and significant information associated with the renewal of the Oconee operating licenses. No significant new information has been identified by the staff in the review process and in the staff's independent review.

Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL, and 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 the ONS Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
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 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: "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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no radiation doses associated with decommissioning following license renewal beyond those discussed in the GEIS.

- Waste management: Based on information in the GEIS, the Commission found: "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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of 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: "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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of license renewal on air quality during decommissioning beyond those discussed in the GEIS.

- Water quality: Based on information in the GEIS, the Commission found: "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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of the license renewal term on water quality during decommissioning beyond those discussed in the GEIS.

- Ecological resources: Based on information in the GEIS, the Commission found: "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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of the license renewal term on ecological resources during decommissioning beyond those discussed in the GEIS.

- Socioeconomic Impacts: Based on information in the GEIS, the Commission found: "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 staff has not identified any significant new information in its review of the Duke ER, the site visit, the scoping process, and its independent evaluation of available information. Therefore, the staff concludes that there are no impacts of license renewal on the socioeconomic impacts of decommissioning beyond those discussed in the GEIS.

7.1 References

10 CFR Part 51, Subpart A, Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant."

Duke Energy Corporation. 1998. Application for Renewed Operating Licenses. Oconee Nuclear Station. Units 1, 2, and 3. Volume IV-Environmental Report.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plant (GEIS)*, NUREG-1437. Washington, D.C.

8.0 Alternatives to License Renewal

This chapter examines the potential environmental impacts associated with denying a renewed operating license (i.e., the no-action alternative); the potential environmental impacts from electric generating sources other than from the renewal of the ONS operating licenses; the potential impacts from instituting additional conservation resources to reduce the total demand for power; and the potential impacts from power imports.

8.1 No-Action Alternative

For license renewal, the No-Action alternative refers to a scenario in which NRC would not renew the ONS operating licenses, and the applicant would then decommission ONS when plant operations cease. Demand side management and energy conservation (perhaps supplied by an energy service company), imported power, or some generating alternative other than ONS would replace the capacity of ONS to generate electricity. However, due to the influence of the ongoing deregulation of the retail market, Duke might not be the ultimate power supplier.

Duke would be required to comply with NRC decommissioning requirements whether or not the operating licenses are renewed. If the ONS operating licenses are renewed, decommissioning activities may be postponed for up to an additional 20 years. If the licenses are not renewed, then Duke would begin decommissioning activities when plant operations cease, beginning in 2013 or perhaps sooner. The impacts of decommissioning would occur concurrently with the impacts of supplying replacement power. The GEIS (NRC 1996), and the *Final Generic Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586 (NRC 1988) provide a description of decommissioning activities.

The environmental impacts associated with decommissioning under the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of the SEIS, and NUREG-0586 (NRC 1996). The impacts of decommissioning after 60 years of operation generally would not be significantly different from those occurring after 40 years of operation.

The GEIS contains the results of a systematic evaluation of the consequences of renewing an operating license and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using a three-level standard of significance—small, moderate, or large—based on Council on Environmental Quality guidelines. These significance levels are defined 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.

When ONS ceases operation, there will be a decrease in employment and tax revenues associated with the closure. This impact would be concentrated in Oconee County, and to a lesser degree in Pickens, Anderson, and Greenville counties. Most secondary employment impacts and impacts on population would also be expected in these counties. Table 2.5 shows the current geographic distribution of the residences of ONS employees by county. Most of the tax revenue losses would occur in Oconee County. The No-Action alternative results in the loss of these taxes and payrolls 20 years earlier than if the licenses are renewed (Table 8-1).

Table 8-1. Summary of Environmental Impacts from No-Action Alternative

Impact Category	Impact	Comment
Socioeconomic	MODERATE to LARGE	Decrease in employment and tax revenues
Archaeological and Historical Resources	SMALL to LARGE	Sale or transfer of land within plant site leads to changes in land-use pattern
Environmental Justice	SMALL to MODERATE	Loss of employment opportunities and social programs

- Socioeconomic: Duke pays taxes on ONS of about $22 million per year to Oconee County, as stated in Section 2.2.8. This tax base would be lost in the No-Action alternative. It is expected that energy costs in the area would also be higher in a regulated utility environment. It is not clear from the staff's interviews with local real estate agents and appraisers whether there would be a significant adverse impact on housing values as a result of closing ONS. While the loss of payrolls and workers would be substantial, particularly in Oconee County, future real estate values may be driven more by vacation/retirement home demand and the suburban growth surrounding Greenville.

  It is not clear that Duke's industrial recruitment efforts in the Tri-County region or their success would be maintained after closure of the Oconee plant. Duke's power costs would be expected to be higher without the plant, and there would be fewer incentives for Duke to assist in recruiting in the region if its presence is significantly diminished.

  The recreational property, lake, and hydroelectric facilities associated with the Keowee-Toxaway project are not likely to be affected by the closure of Oconee. However, there is one potential change that could be significant. In part, because of the need for clean water at the ONS, Duke has provided aggressive corporate, political, and technical leadership in maintaining high water quality in Jocasee and Keowee Lakes. Hydroelectric facilities can tolerate much lower water quality and Crescent Resources (the real estate division of Duke Energy Corporation) may have divested enough holdings by 2013 that Duke will have fewer corporate incentives to keep water quality exceptionally high if ONS closes. Therefore, many of the water quality services currently provided by Duke may become the responsibility of the counties or the state. If water quality begins to decline, then tourism and the vacation home and retirement industry in the area may be adversely affected.

- Archaeological and Historical Resources: The potential for future adverse impacts to known or unrecorded cultural resources at the ONS following decommissioning will depend on the future land use of the site. Known resources and activities include the current visitors center and associated interpretative efforts that are funded and maintained by Duke. Eventual sale or transfer of the land within the plant site could result in adverse impacts to these resources should the land-use pattern change dramatically.

- Environmental Justice for No-Action: Current operations at ONS do not have disproportionate impacts on low-income and minority populations of the surrounding counties, and no environmental pathways have been identified that would cause disproportionate impacts. Since closure would result in a decrease in employment and tax revenues in Oconee County, it is possible that the county's ability to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the low-income or minority populations. There is some possibility of negative and disproportionate impacts on low-income or minority populations from this source under the No-Action Alternative.

8.2 Alternative Energy Sources

Nuclear power plants are commonly used for base-load generation; the GEIS indicates that coal-fired and gas-fired generation capacity are the feasible alternatives to nuclear power generating capacity, based on current (and expected) technological and cost factors. The alternatives of coal-fired generation and gas-fired generation are presented in Sections 8.2.1 and 8.2.2, respectively, if such plants were constructed at the ONS site, using the existing water intake and discharge structures, switchyard, and transmission lines, or at an alternate location which could be either a current industrial site or an undisturbed, pristine site requiring a new generating building and facilities, new switchyard, and at least some new transmission lines. For purposes of this SEIS, a "greenfield" site is assumed to be an undisturbed, pristine site.

Depending on the location of an alternative site, it might also be necessary to provide a connection to the nearest gas pipeline (in the case of natural gas) or rail connection (in the case of coal). The requirement for these additional facilities also likely would increase the environmental impacts relative to those that would be experienced at the ONS site, although this is less certain.

The cooling water needs of a fossil-fired plant of equal capacity to the ONS facility would require use of either a once-through cooling system located on a large body of water such as Lake Keowee or a closed cycle system using cooling towers.

The potential for using imported power is discussed in Section 8.2.3. Imported power is considered feasible, but would result in the transfer of environmental impacts from the current region in South Carolina to some other location in South Carolina, another state, or a Canadian province. Several other technologies were considered, but were determined not to be reasonable replacements for a nuclear power plant. These options included wind, solar, hydropower, geothermal, wood energy, municipal solid waste, oil, advanced nuclear, fuel cells, delayed retirement of other generating units, and conservation.

8.2.1 Coal-Fired Generation

It was assumed that it would take 2500 MWe of coal-fired generation capacity to replace the approximately 2500-MWe ONS. The typical size (MWe) and configuration used by the electrical power industry in the application of coal-fired generation technology varies.

8.2.1.1 Once-Through Cooling System

Section 8.2.1.1 sets forth the environmental impacts of converting the current ONS site to a coal-fired generation facility with once-through cooling and building a similar facility on a greenfield site. Differences in impacts with closed-cycle cooling are covered in Section 8.2.1.2. Land use in the discussion that follows was based on two of Duke's current coal-fired generating plants: the four-unit, 2090 MWe Marshall Steam Station in Catawba County, North Carolina, which occupies 650 ha (1600 acres), and the 2-unit, 2370 MWe Belews Creek Steam Station in Stokes County, North Carolina, which occupies 280 ha (700 acres) (Duke 1999a). Environmental impacts were based on data in EPA (1995). The impacts are summarized in Table 8-2.

Construction of the coal-fired alternative would take approximately 5 years. The workforce during the construction period would be expected to average 1500, with a peak of 2500 (GEIS, adjusted for large scale of the ONS replacement plant) and during operations to average 500 (Duke 1998).

Additional water would be needed for controlling wet-scrubber sulfur oxides emissions and for boiler makeup.

- **Land Use**

  Based on Duke operating experience, approximately 900,000 MT (1,000,000 tons) of solid waste per year would be generated, including 630,000 MT (700,000 tons) of flyash and bottom ash, selective catalytic reduction (SCR) catalyst (used for nitrogen oxides control), and sulfur oxide scrubber sludge/waste. Approximately 90 percent of this would be flyash, and 10 percent would be bottom ash, depending on the type of coal burned and the type of emission control equipment used. The SCR would generate approximately 230 m^3 (8000 ft^3) of spent catalyst material per year. This catalyst material would have high concentrations of metals that are removed from the fly ash. A new coal-fired facility would also require sulfur oxides scrubbers to be installed as emission control equipment. This would result in the generation of approximately 350,000 MT (387,000 tons) per year of scrubber sludge. Facilities would be constructed to control and treat leachate from coal storage areas and ash and scrubber waste disposal areas. These facilities are included in the land-use estimates. The existing switchyard and transmission system would be used. Duke assumed that between 220 ha (550 acres) and 800 ha (2000 acres) would be required based on two existing Duke coal-fired power plants. It is assumed that coal-fired generation structures and facilities, including coal storage and waste disposal, would be located in one or more of the unused areas of the Oconee site and on adjacent Duke-owned land.

Table 8-2. Summary of Environmental Impacts from Coal Alternative—Once-Through Cooling

Impact Category	Oconee Site		Alternative "Greenfield" Site	
	Impact	Comments	Impact	Comments
Land Use	MODERATE	Uses another 220 ha (550 acres) within or adjacent to ONS site, plus 25 ha (60 acres) for 13-16 km (8-10 mi) rail line	MODERATE to LARGE	200 ha (500 acres) to 800 ha (2000 acres), including transmission lines
Ecology	MODERATE	Uses undeveloped areas in current ONS site plus other nearby land, plus rail corridor	MODERATE to LARGE	Impact will depend on ecology of site
Water Use and Quality				
- Surface Water	SMALL	Uses existing intake and discharge structures Volume 1 m^3/sec (16,000) gpm and temperature rise same as ONS	SMALL to MODERATE	Impact will depend on volume and other characteristics of receiving water
- Groundwater	SMALL	Little groundwater is currently used at ONS. This practice likely would continue	SMALL to LARGE	Impact will depend on site characteristics and availability of groundwater
Air Quality	MODERATE	Sulfur oxides –11,800 MT (13,000 tons)/yr –allowances required Nitrogen oxides –11,800 MT (13,000 tons)/yr –allowances required Particulate –1600 MT (1800 tons)/yr Carbon monoxide –1600 MT (1800 tons)/yr Carbon dioxide –16 million MT (18 million tons)/yr VOC –190 MT (210 tons)/yr Trace amounts of mercury, arsenic, chromium, beryllium, selenium	MODERATE	Same impacts as Oconee site, although pollution control standards may vary
Waste	MODERATE	636,000 MT (700,000 tons)/yr fly ash and scrubber sludge	MODERATE	Same impacts as Oconee site; waste disposal constraints may vary
Human Health	SMALL	Impacts considered minor	SMALL	Same impact as Oconee site
Socioeconomics	MODERATE	1500 to 2500 additional workers during 5-year construction period, followed by reduction from current 1700 workforce to 500 persons	MODERATE	Construction impacts would be relocated. Community near ONS would still experience reduction from 1700 persons to 500 persons

Table 8-2. (contd)

Impact Category	Oconee Site		Alternative "Greenfield" Site	
	Impact	Comments	Impact	Comments
Aesthetics	MODERATE to LARGE	Visual impact of large industrial facility and stacks would be significant	MODERATE to LARGE	Alternate locations could reduce aesthetic impact if siting is in an industrial area
Archeological and Historical Resources	SMALL	Affects previously developed parts of current ONS site, nearby land, and 13-16 km (8-10-mi) rail corridor	SMALL	Alternate location would necessitate cultural resource studies
Environmental Justice	MODERATE	Impacts on low income and minority communities should be similar to those experienced by the population as a whole. Some impacts on housing are likely.	SMALL to LARGE	Impacts will vary depending on population distribution and make up

As described above, the coal-fired generation alternative would necessitate converting roughly an additional 220 ha (550 acres) of the Duke-owned land across Highway 130 or 183 from the ONS (the current site is only 207 ha [512 acres]) to industrial use (plant, coal storage, and ash and scrubber sludge disposal), expanding the altered area at the site from 200 ha (500) acres to over 400 ha (1000 acres). The land surrounding ONS is owned by one of Duke's subsidiaries and could most likely be made available.

In addition, a new rail line would have to be built between Newry and the ONS site (13 to 16 km [8 to 10 mi]) requiring approximately 25 ha (60 acres) to bring the coal to the site. The impact of coal-fired generation on land use is best characterized as MODERATE.

In contrast, land use for a coal-fired generation alternative using once-through cooling at an alternative greenfield site would require 4 ha (10 acres) for offices, roads, etc. This is in addition to up to 800 ha (2000 acres) for generating facilities and cooling structures, coal storage ash basin, and flyash disposal discussed previously. Additional land might be needed for transmission lines, depending on the location of the site relative to the nearest intertie connection. Depending on the transmission line routing, these alternatives could result in MODERATE or LARGE land-use impacts consistent with the GEIS characterization of land-use at a greenfield site.

- **Ecology**

Locating an alternate energy source at the existing ONS site would noticeably alter ecological resources because of using undeveloped areas and modifying the existing intake and discharge system. The impact to the Lake Keowee ecology would be expected to remain unchanged

because the once-through cooling system at ONS has not shown significant negative impact to the lake. The appropriate characterization of coal-fired generation ecological impacts of the ONS site would be MODERATE

Constructing a coal-fired plant at a greenfield site, particularly one sited in a rural area with considerable natural habitat, would certainly alter the ecology and could impact any endangered or threatened species present at the site. These ecological impacts could be MODERATE to LARGE, consistent with the GEIS characterization of ecological impacts at a greenfield site.

- **Water Use and Quality**

Surface Water. The coal-fired generation alternative is assumed to use the existing ONS intake and discharge structures as part of a once-through cooling system. This alternative would minimize environmental impacts since minimal construction would be required to adapt the system to the coal-fired alternative. It is assumed that the coal-fired alternative cooling water volume and temperature rise would be approximately the same as for the current nuclear plant (1 m^3/sec [16,000 gpm]. This temperature rise would comply with the ONS National Pollutant Discharge Elimination System (NPDES) permit. The GEIS analysis determined that surface water quality, hydrology, and use impacts for license renewal would be SMALL. Because the coal-fired generation alternative is assumed to have the same discharge characteristics as ONS, surface water impacts are expected to remain SMALL; the impacts would be so minor that they would not noticeably alter any important attribute of the resource.

For alternative greenfield sites, the impact to the surface water would depend on the volume associated with the cooling system and characteristics of the receiving body of water. The impacts would be SMALL or MODERATE.

Groundwater. No variation would be expected in the amount of groundwater used, since groundwater wells only are used to supply water for drinking and the restroom facility at the station baseball field, as well as to supply irrigation water for site landscaping during the summer months (June through September). However, the leachate from coal storage areas and ash and scrubber waste disposal areas would have to be controlled to avoid groundwater contamination. For this reason, the appropriate characterization of coal-fired generation groundwater impacts would be SMALL; the impacts would be so minor that they would not noticeably alter any important attribute of the resource.

For alternative greenfield sites, the impact to the groundwater would depend on the site characteristics, including the amount of groundwater available. The impacts would range between SMALL and LARGE.

- **Air Quality**

Air quality impacts of coal-fired generation vary considerably from those of nuclear power due to emissions of sulfur oxides, nitrogen oxides, particulates, and carbon monoxide. Although the entire State of South Carolina and the nearby areas of North Carolina and Georgia are currently in attainment for meeting National Ambient Air Quality Standards, the Oconee site is within 80 km (50 mi) of two Prevention of Significant Deterioration Class I areas (Great Smoky Mountains National Park, and Shining Rock Wilderness Area) that would be of concern for a major coal-fired plant. Also, future economic and population growth may make future compliance more difficult.

Sulfur oxides emissions. Using current control technology for sulfur oxides emissions, the total annual stack emissions would include approximately 11,800 MT (13,000 tons) of sulfur oxides, most of which would be sulfur dioxide. Additional reductions could become necessary. The acid rain provision of the Clean Air Act (CAA) (Sections 403 and 404) capped the nation's sulfur dioxide emissions from power plants. Under the Act, affected fossil-fired steam units are allocated a number of sulfur dioxide emission allowances. To achieve compliance, each utility must hold enough allowances to cover its sulfur dioxide emissions annually or be subject to certain penalties. If the utility's sulfur dioxide emissions are less than its annually allocated emission allowances, then the utility may bank the surplus allowances for use in future years. A sulfur dioxide allowances market has been established for the buying and selling of allowances. Duke has sulfur dioxide allowances for its existing coal-fired plants, however, Duke would have to purchase additional allowances in order to operate an additional coal-fired plant (Duke 1999b).

Nitrogen oxides emissions. Using currently available control technology, the total annual nitrogen oxides emission would be approximately 11,800 MT (13,000 tons). Section 407 of the CAA establishes an annual reduction program for the nitrogen oxides emissions program. The new EPA 8-hour ozone standard, the new EPA $PM_{2.5}$ particulate standard, and Regional Haze rules create additional burdens on coal use. To cite one example, the South Carolina Department of Health and Environmental Control (SCDHEC) has identified several counties that may be impacted, including Anderson and Greenville Counties, as well as counties of concern, including Oconee and Anderson Counties (South Carolina Air Quality Annual Report Volume XVII, 1997 [SCDHEC 1998]). To implement a coal-fired alternative, Duke might be required to offset its corporate nitrogen oxides emissions through further reductions in nitrogen oxides emissions elsewhere, by shutting other sources down, or by back-fitting to reduce nitrogen oxides formation (e.g., installing over-fired air, low nitrogen oxides burners, flue gas re-circulation, and selective non-catalytic and catalytic reduction systems). Alternatively, offsets might be available for purchase on the open market.

Particulate emissions. The total estimated annual stack emissions would include 1600 MT (1800 tons) of particulates. In addition, coal handling equipment would introduce fugitive particulate emissions.

Carbon monoxide emissions. The total carbon monoxide emissions would be approximately 1600 MT (1800 tons) per year.

Carbon dioxide emissions. The total carbon dioxide emissions would be approximately 16 million MT (18 million tons) per year.

Mercury. Coal-fired boilers account for nearly a third of mercury emissions in the United States. Technologies available to control mercury emissions have varying degrees of success. In response to growing concerns with mercury, the CAA Amendments of 1990 have required the EPA to identify mercury emission sources, evaluate the contributions of power plants and municipal incinerators, identify control technologies, and evaluate the toxicological effects from the consumption of mercury-contaminated fish. It is likely that these studies will lead to additional restrictions concerning mercury emissions associated with coal-fired power plants, as well as other sources of mercury emissions. Recent studies by the Maryland Power Plant Research Program have indicated that although coal-fired power plants contribute to mercury emissions, the resulting concentrations are not high enough to adversely affect humans or other organisms (Maryland Department of Natural Resources 1999). Therefore, the probable affect of trace mercury emissions on human health would be SMALL.

The GEIS analysis did not quantify coal-fired emissions, but implied that air impacts would be substantial and mentioned global warming and acid rain as potential impacts. Adverse human health effects from coal combustion have led to important Federal legislation in recent years, and public health risks, such as cancer and emphysema, have been associated with the products of coal combustion. Federal legislation and large-scale concerns, such as acid rain and global warming, are indications of concerns about air resources. Sulfur oxide emission allowances, nitrogen oxide emission offsets, low nitrogen oxide burners, overfire air, selective catalytic reduction, fabric filters or electrostatic precipitators, and scrubbers may be required as mitigation measures. As such, the appropriate characterization of coal-fired generation air impacts would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Siting the coal-fired generation elsewhere would not significantly change air quality impacts, although it could result in installing more or less stringent pollution control equipment to meet applicable standards. Therefore, the impacts would be MODERATE.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. Based on Duke experience at two coal-fired plants, approximately 636,000 MT (700,000 tons) of this waste would be generated annually for 40 years and disposed of onsite, accounting for between 60 percent and 40 percent of land used at the site (120 out of 200 ha to 160 out of 800 ha [300 out of 500 acres of 400 out of 2000 acres]). While only half of these values are directly attributable to the alternative to a 20-year ONS license renewal, the total values are pertinent as a cumulative impact. This impact could extend well after the 40-year operation life because revegetation management and groundwater monitoring for leachate contaminant impacts could be a permanent requirement.

The GEIS analysis concluded that large amounts of fly ash and scrubber sludge would be produced and would require constant management. Disposal of this waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land would be available for other uses, and regulatory requirements would ensure groundwater protection. For these reasons, the appropriate characterization of impacts from waste generated from burning coal would be MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

Siting the facility on an alternate greenfield site would not alter waste generation, although other sites might have more constraints on disposal locations. Therefore, the impacts would be MODERATE.

- **Human Health**

Coal-fired power generation introduces worker risks from fuel and lime/limestone mining and worker and public risks from fuel and lime/limestone transportation and stack emissions inhalation. Stack impacts can be very widespread and health risks difficult to quantify. This alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

The GEIS analysis noted that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but did not identify the significance of this impact. Regulatory agencies, such as the EPA and SCDHEC, focus on air emissions and revise regulatory requirements or propose statutory changes, based on human health impacts. Such agencies also impose site-specific emission permit limits as needed to protect human health. Thus, human health impacts from inhaling toxins and particulates generated by burning coal would be SMALL.

Siting the facility at an alternate greenfield site would not alter the expected human health effects. Therefore, the impacts would be SMALL.

- **Socioeconomics**

Construction of the coal-fired alternative would take approximately 5 years. It is assumed that construction would take place concurrently while ONS continues operation and would be completed at the time ONS would cease operations. Thus, the workforce would be expected to average 1500 with a peak of 2500 additional workers during the 5-year construction period, based on estimates given in the GEIS (NRC 1996) and scaled for the large plant size. The surrounding communities would experience demands on housing and public services that could have large impacts. After construction, the communities would be impacted by the loss of jobs; construction workers would leave, the nuclear plant workforce (1700) would decline through a decommissioning period to a minimal maintenance size, and the coal-fired plant would introduce only 500 new jobs.

The GEIS analysis concluded that socioeconomic impacts at a rural site would be larger than at an urban site because more of the 1200 to 2500 peak construction workforce would need to move to

the area to work. While the site is not rural within the meaning of the GEIS, the facility is roughly twice the size examined in the GEIS. Operational impacts could result in moderate socioeconomic benefits in the form of several hundred additional jobs, substantial tax revenues, and plant expenditures.

The size of the construction workforce for a coal-fired plant and plant-related spending during construction would be noticeable. However, due to the site's proximity to large labor pools in the Greenville and Spartanburg areas, significant numbers of construction workers would not be expected to move to the ONS area. Operational impacts would include an eventual loss of approximately 1200 jobs (1700 for three nuclear units down to 500 for the coal-fired plant), with a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. The area's rapid population growth would prevent any destabilization of socioeconomic resources. For these reasons, the appropriate characterization of socioeconomic impacts for a coal-fired plant would be MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

Construction at another site would relocate some socioeconomic impacts, but would not eliminate them. The community around ONS would still experience the impact of ONS operational job loss, and the communities around the new site would have to absorb the impacts of a large, temporary workforce and a moderate, permanent workforce. Therefore, the impacts are MODERATE. The impacts would be noticeable, but would not destabilize the economy or community.

- **Aesthetics**

Plant structures (the stacks) would be visible over intervening trees for kilometers around, particularly along Lake Keowee. This view would contrast strongly with what is otherwise a natural-appearing vacation-home and rural area, with woods and farming areas. Coal-fired generation would also introduce additional mechanical sources of noise (e.g., induced-draft fans and coal handling equipment) that may be audible offsite due to their proximity to Lake Keowee.

The GEIS concluded that aesthetic impacts from such a large construction effort in a rural area could be substantial. Industrial structures that would be located at the Oconee site would tower above area vegetation and create a noticeable visual impact for a large area. Aesthetics is a significant attribute of Lake Keowee, given the predominantly natural-appearing rural viewscape from the lake and shoreline. A coal-fired generating station would contrast strongly with the existing resource. The aesthetics impacts would be MODERATE to LARGE; noticeable but not destabilizing.

Alternative locations could reduce the aesthetic impact of coal-fired generation if siting were in an area that was already industrialized. In such a case, however, the introduction of such tall stacks and cooling towers would probably still have a MODERATE incremental impact. Other sites could show a LARGE impact.

- **Archaeological and Historical Resources**

The GEIS analysis concluded that impacts to cultural resources would be relatively SMALL unless important site-specific resources were affected. Under this alternative, cultural resources inventories would be required for any lands that have not been previously disturbed to the extent that no archaeological or historical resources might remain. Other lands that are purchased to support the facility would also require an inventory of field cultural resources, identification and recording of extant archaeological and historical resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site. Therefore, the impacts would be SMALL.

Construction at another site would necessitate studies to identify, evaluate, and mitigate potential impacts of new plant construction on cultural resources. This would be required 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, or other rights-of-way). Impacts can generally be managed and maintained as SMALL.

- **Environmental Justice**

No environmental pathways 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 ONS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations. Impacts at other sites would depend upon the site chosen. These impacts would be MODERATE.

If the replacement plant were built in Oconee County, the county's tax base would be largely maintained, and some potential negative socioeconomic impacts on the minority or low-income would be avoided. If the plant were built elsewhere, environmental justice impacts would be SMALL to LARGE, depending on the plant location and nearby population distribution.

8.2.1.2 Closed-Cycle Cooling System

This alternative would add an approximately 160-m (520 ft) high natural draft cooling tower to each unit, which would occupy a total of approximately 10 ha (25 acres). This section describes the differences in impacts of using a closed-cycle cooling system at a coal-fired power plant that would replace ONS. These differences would be roughly the same at both the Oconee site and other greenfield sites. Based on Duke's experience with a similar cooling tower at the Catawba Nuclear Station, cooling water consumption would be approximately 1.5 m^3/s (24,000 gpm) (Duke 1999a). The closed-cycle cooling system would introduce cooling tower blowdown that would be much higher in dissolved solids in comparison to Lake Keowee. Cooling tower operation would require more electrical power than the once-through cooling system due to the modified pumping systems. The towers would discharge a plume of water vapor and a measurable amount of cooling tower drift.

Mechanical draft cooling towers are an alternative to natural draft cooling towers. Mechanical draft cooling towers are 15-m (50-ft) to 30-m (100-ft) tall, but would demonstrate operational impacts similar to the natural draft towers noted above.

The change in environmental impacts from redesigning the site for cooling towers are listed in Table 8-3. The overall impacts are also discussed below.

Table 8-3. Summary of Environmental Impacts from Alternate Cooling System (Cooling Towers with Closed-Cycle Cooling)

Impact Category	Change in Impact from ONS Once-Through Cooling	Comments
Land Use	Minor to moderate change	10 additional ha (25 acres) required
Ecology	Minor change	Additional impact to terrestrial ecology from cooling tower drift Reduced impact to aquatic ecology
Water Use and Quality		
Surface Water	Minor change	Blowdown has higher dissolved solids Reduced flow/Less thermal load
Groundwater	No change	None
Air Quality	No change	None
Waste	No change	None
Human Health	No change	None
Socioeconomics	No change	None
Aesthetics	Small change	Addition of 160-m (520-ft) cooling towers *or* Noise from mechanical draft towers and vapor plume
Archaeology and Historical Resources	Minor change	Minimal cultural studies possibly required
Environmental Justice	No change	None

- **Land Use**

A closed-cycle cooling system alternative would impact an additional 10 ha (25 acres) for cooling tower construction at either the greenfield site or the ONS site (Duke 1999). These alternatives would result in a minor to moderate change above those already considered for the once-through cooling alternative. The overall impact would be MODERATE at ONS, MODERATE to LARGE elsewhere.

- **Ecology**

The closed-cycle cooling system alternative would further reduce operational aquatic ecology impacts, but would introduce risk to vegetation from salt drift. However, these ecological impacts result in minor changes above those for the once-through cooling alternative, resulting in MODERATE overall impacts at ONS and MODERATE to LARGE impacts elsewhere.

- **Water Use and Quality**

Surface Water. Although surface water impacts are expected to remain small, the closed-cycle cooling system alternative would introduce cooling tower blowdown that would have higher dissolved solids, but because of the reduced flow, changes that impact surface water quality would result in minor changes above those already considered for the once-through cooling alternative. Thermal load would be less than with a once-through cooling system. The overall impact would be SMALL at ONS and SMALL to MODERATE elsewhere.

For alternative greenfield sites, the impact to the surface water would depend on the volume associated with the cooling system and characteristics of the receiving body of water. The impacts would be SMALL or MODERATE.

Groundwater. The facility's use of groundwater would not be impacted as a result of the variation between a once-through cooling system and a cooling tower-based system. Overall impacts would be SMALL at ONS and SMALL to LARGE elsewhere.

For alternative greenfield sites, the impact to the groundwater would depend on the site characteristics, including the amount of groundwater available. The impacts would range between SMALL and LARGE.

- **Air Quality**

The air quality would be the same whether a cooling tower-based closed-cycle cooling system or a once-through cooling system was used. Overall impacts would be MODERATE at all locations.

- **Waste**

The amount of waste and impacts resulting from waste disposal would be the same whether a cooling tower-based closed-cycle cooling system or a once-through cooling system was used. Overall impacts would be MODERATE at all locations.

- **Human Health**

  Human health effects would be the same whether a cooling tower-based closed-cycle cooling system or a once-through cooling system was used. Overall impacts would be SMALL at all locations.

- **Socioeconomics**

  Socioeconomic impacts would be the same whether a cooling tower-based closed-cycle cooling system or a once-through cooling system was used. Overall impacts would be MODERATE at all locations.

- **Aesthetics**

  The closed-cycle cooling system alternative would increase aesthetic impacts by adding three 160-m (520-foot) cooling towers and associated plumes. Although the environmental report assumed the use of natural draft towers as an alternative technology, mechanical draft towers are also available. Such devices, being only 15-m (50 ft) to 30-m (100-ft) tall, would reduce the visual impact of natural draft towers. Mechanical draft towers, however, introduce another noise source. Small incremental change; MODERATE to LARGE overall impact.

- **Archaeological and Historical Resources**

  Minimal amounts of additional cultural resource studies would be required before construction of cooling towers. If towers were constructed on land that had already had cultural resource studies, further studies would not be necessary. Minor incremental change; SMALL impacts at all locations.

- **Environmental Justice**

  Environmental justice impacts would be the same whether a cooling tower-based closed-cycle cooling system or a once-through cooling system was used. Overall impacts are MODERATE at ONS; SMALL to MODERATE elsewhere.

8.2.2 Gas-Fired Generation

It was assumed that a replacement natural gas-fired plant would use combined cycle technology. In the 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 steam generator to generate additional electricity. The size, type, and configuration of gas-fired generation units and plants currently operational in the United States vary and include simple-cycle combustion and combined cycle units that range in size from 25 MW to 600 MW (EPA 1994). As with coal-fired technology, units may be configured and combined at a location to produce the desired amount of megawatts, and construction can be phased to meet electrical power needs.

Section 8.2.2.1 discusses the environmental impacts of converting the current ONS site to a natural gas-fired generation facility with once-through cooling and building a similar facility on a greenfield site. Differences in impacts with closed-cycle cooling are discussed in Section 8.2.2.2.

8.2.2.1 Once-Through Cooling System

Providing 2500 MW of replacement power with a combined cycle would require a minimum of 5 units. Natural gas typically has an average heating value of 3.7×10^7 J/m^3 (1,000 Btu per cubic foot) (DOE 1996; EPA 1993), and it would be the primary fuel; the gas-fired alternative plant would burn approximately 1.24 J/m^3-s (100 billion cubic feet per year). Low-sulfur No. 2 fuel oil would be the backup fuel (Duke 1998), but due to the relatively high cost of fuel oil, would not be the primary fuel for this technology. The discussion in this section mentions in passing the few differences in the impacts between gas- and oil-fired combustion turbine/combined cycle power plants.

As a surrogate for a similar-sized gas-fired alternative plant, the staff used Baltimore Gas and Electric's Perryman Power Plant and Polk Power Plant (BGE 1989; EPA 1984). The staff assumes that each unit would be less than 30 m (100 feet) high and would be designed with dry, low nitrogen oxides combusters, water injection, and selective catalytic reduction.

Each unit would exhaust through a 70-m (230-foot) stack after passing through heat recovery steam generators. This stack height is consistent with EPA regulations (40 CFR 51.100), which address requirements for determining the stack height of new emission sources.

Natural gas would have to be delivered via pipeline. Approximately 60 ha (150 acres) would be disturbed during pipeline construction. The nearest gas pipeline large enough to support a new combined cycle plant is at Anderson, near Interstate 85, approximately 40 km (25 mi) from the Oconee site. Construction cost of installing a gas line to Oconee averages approximately $1 million per mile (Duke 1999b). Duke believes that the installation of a gas line to the Oconee site would not be economical and would require an additional 60 ha (150 acres) of land (Duke 1999b). To the degree existing rights-of-way could be used, the level of impact could be reduced.

Environmental impacts of conversion to the gas-fired generation option at both ONS and a "greenfield" site are summarized in the following text, and are listed in Table 8.4.

- **Land Use**

  Gas-fired generation at the Oconee site would require converting a minimum additional 24 ha (60 acres) of the site and adjacent land to industrial use. Almost all would be used for the power block. An additional 60 ha (150 acres) would be disturbed during pipeline construction. Gas-fired generation land-use impact at the existing ONS site is MODERATE; the impact would noticeably alter habitat but it would not destabilize any important attribute of the resource.

  Construction at a greenfield site would impact approximately 8 ha (20 acres) to 20 ha (50 acres) for offices, roads, parking areas, fuel tanks, and a switchyard, as well as the 20 ha (50 acres) required for the power block. In addition, another 170 ha (424 acres) would be necessary for transmission lines (assuming the plant is sited 16 km [10 mi] from the nearest intertie connection). Plants of this type are usually built very close to existing natural gas pipelines. Including minimal acres required for pipeline construction, a greenfield site would require approximately 30-40 ha (70-100 acres). Depending on the transmission line routing, the greenfield site alternative could result in SMALL to MODERATE land-use impacts.

The GEIS estimated that land-use requirements for a 1000-MW gas-fired plant at a greenfield site would be SMALL (approximately 45 ha [110 acres] for the plant site), and that co-locating with a retired nuclear plant would reduce these impacts. The Duke land-use estimate is about the same as the GEIS, even though the plant is larger. The land-use change should not noticeably alter the overall site pattern for natural land-use. Therefore, the impacts would be SMALL to MODERATE.

Table 8-4. Summary of Environmental Impacts from Gas-Fired Generation—Once-Through Cooling Alternative

	Oconee Site		Alternative "Greenfield" Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Additional 24 ha (60 acres) required for power block Additional 60 ha (150 acres) disturbed for pipeline construction	SMALL to MODERATE	30-40 ha (70-100 acres) required
Ecology	MODERATE	Constructed on land adjacent to Oconee site. Significant habitat loss due to pipeline construction	SMALL to MODERATE	Impact depends on location and endangered and threatened species
Water Use and Quality				
Surface Water	SMALL	70% reduction in water flow	SMALL to MODERATE	Impact depends on volume and characteristics of receiving body of water
Groundwater	SMALL	Reduced groundwater withdrawals due to reduced workforce	SMALL to LARGE	Groundwater would be used for potable water only
Air Quality	MODERATE	Primarily nitrogen oxides --4300 MT/yr (4,700 tons/yr) with gas –11,800 MT/yr (13,000 tons/yr) with fuel oil Sulfur dioxide –3600 MT/yr (4,000 tons per yr) with fuel oil, none with gas Particulates –2300 MT/yr (2,500 tons/yr) with fuel oil –280 MT/yr (310 tons/yr) with gas Carbon dioxide –11 million MT/yr (12.5 million tons/yr) with fuel oil –8 million MT/yr (9.2 million tons/yr) with gas	MODERATE	Same impacts as for Oconee site
Waste	SMALL	Waste generation is 740 m^2/yr 8000 (ft^2/yr) of spent catalyst with fuel oil, minor with gas	SMALL	Same impacts as for Oconee site
Human Health	SMALL	Impacts considered to be minor	SMALL	Same impacts as for Oconee site

Table 8-4. (contd)

Impact Category	Oconee Site		Alternative "Greenfield" Site	
	Impact	Comments	Impact	Comments
Socioeconomics	SMALL	500 to 750 additional workers during 3-year construction period; followed by reduction from 1700 persons to 300 persons (400 if fuel oil is used)	SMALL	Construction impacts would be relocated. Community near ONS would still experience reduction from 1700 persons to 300 persons.
Aesthetics	SMALL to MODERATE	Visual impact of stacks and equipment would be noticeable, but not as significant as coal option	SMALL to MODERATE	Alternate locations could reduce the aesthetic impact if siting is in an industrial area.
Archaeological and Historical Resources	SMALL	Only previously disturbed and adjacent areas would likely be affected	SMALL	Alternate location would necessitate cultural resource studies
Environmental Justice	SMALL to MODERATE	Impacts on minority and low income should be similar to those experienced by the population as a whole. Impacts on housing are possible.	SMALL to MODERATE	Impacts vary depending on population distribution and makeup

- **Ecology**

Siting gas-fired generation at the existing ONS site would have MODERATE ecological impact because the facility would be constructed partly on previously disturbed areas and would disturb relatively little acreage at the site. However, significant habitat (60 ha [150 acres]) would be disturbed by 40 km (25 miles) of pipeline construction (Duke 1999b). To the extent that existing rights-of-way could be used, impact would be reduced. Ecological impacts would also be minimized by using the existing intake and discharge system. Past operational monitoring of the effects of once-through cooling at ONS have not shown significant negative impacts to Lake Keowee ecology, and this would be expected to remain unchanged. At the existing site, adding gas-fired generation would introduce construction impacts and new, albeit incremental, operational impacts.

The GEIS noted that land-dependent ecological impacts from construction would be SMALL unless site-specific factors should indicate a particular sensitivity and that operational impacts would be smaller than for other fossil fuel technologies of equal capacity. The staff has identified the gas pipeline as a site-specific factor that would make gas-fired alternative ecological impacts larger than for the license renewal. The appropriate characterization of gas-fired generation ecological impacts would be MODERATE.

Construction at a greenfield site would certainly alter the ecology of the site and could impact threatened and endangered species. These ecological impacts could be SMALL to MODERATE.

- **Water Use and Quality**

Surface Water. The plant would use the existing ONS intake and discharge structures as part of a once-through cooling system; however, since cooling requirements would be less (70 percent reduction; EPA 1994). Water quality impacts would continue to be SMALL.

Water quality impacts from sedimentation during construction was another land-related impact that the GEIS categorized as small. The GEIS also noted that operational water quality impacts would be similar to, or less than, those from other centralized generating technologies. The staff has concluded that water quality impacts from coal-fired generation would be small, and gas-fired alternative water usage would be less than that for coal-fired generation. Surface water impacts would remain SMALL; the impacts would not be detectable or be so minor that they would not noticeably alter any important attribute of the resource.

For alternative greenfield sites, the impact on surface water would depend on the volume and other characteristics of the receiving body of water. The impacts would be SMALL or MODERATE

Groundwater. No variation would be expected in the amount of groundwater used, since groundwater wells only are used to supply water for drinking and the restroom facility at the station baseball field, as well as to supply irrigation water for site landscaping during the summer months (June through September). The groundwater impacts would be SMALL; the impacts would be so minor that they would not noticeably alter any important resource.

For alternative greenfield sites, the impact to the groundwater would depend on the site characteristics, including the amount of groundwater available. The impacts would range between SMALL and LARGE.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. Because the ONS is not or near a non-attainment area for ozone, air quality impacts of gas-fired generation would not be of concern. Nitrogen oxides emissions from the gas-fired alternative would be 4300 MT (4700 tons) with gas to 11,800 MT (13,000 tons) with fuel oil per year.

The GEIS noted that gas-fired air quality impacts are less than other fossil technologies because fewer pollutants are emitted, and sulfur dioxide is not emitted at all. Emissions from the gas-fired alternative would be less than emissions from the coal-fired alternative. However, the gas-fired alternative would contribute nitrogen oxides emissions to an area that in the future may become a nonattainment area for ozone. Because nitrogen oxides contribute to ozone formation, the reduced nitrogen oxides emissions are still of future concern, and low nitrogen oxides combusters, water injection, and selective catalytic reduction could become regulatory-imposed mitigation measures.

For these reasons, the appropriate characterization of air impacts from a gas-fired plant would be MODERATE; the impacts, primarily nitrogen oxides, would be clearly noticeable, but would not be sufficient to destabilize air resources as a whole.

Siting the gas-fired plant elsewhere would not significantly change air quality impacts since the site could also be located in a greenfield area that was not a serious nonattainment area for ozone. In addition, the location could result in installing more or less stringent pollution control equipment to meet the regulations. Therefore, the impacts would be MODERATE.

- **Waste**

There will be only small amounts of solid waste products (i.e., ash) from burning natural gas fuel. The GEIS concluded that waste generation from gas-fired technology would be minimal. Gas-firing results in very little combustion byproducts because of the clean nature of the fuel. Waste generation would be limited to typical office wastes. This impact would be SMALL; waste generation impacts would be so minor that they would not noticeably alter any important resource attribute.

Siting the facility at an alternate greenfield site would not alter the waste generation; therefore the impacts would continue to be SMALL.

- **Human Health**

The GEIS analysis mentions potential gas-fired alternative health risks (cancer and emphysema). The risk may be attributable to nitrogen oxides emissions that contribute to ozone formation, which in turn contributes to health risks. As discussed in Section 8.2.1 for the coal-fired alternative, legislative and regulatory control of the nation's emissions and air quality are protective of human health, and the appropriate characterization of gas-fired generation human health impacts would be SMALL; that is, human health effects would not be detectable or would be so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.

Siting of the facility at an alternate greenfield site would not alter the human health effects that would be expected. Therefore, the impacts would be SMALL.

- **Socioeconomics**

It is assumed that gas-fired construction would take place while ONS continues operation, with completion at the time that the nuclear plant would halt operations. Construction of the gas-fired alternative would take much less time than it would for construction of other plants (NRC 1996). During the time of construction, the surrounding communities would experience demands on housing and public services that could have moderate impacts. After construction, the communities would be impacted by the loss of jobs; construction workers would leave, the nuclear plant workforce (1700) would decline through a decommissioning period to a minimal maintenance size, and the gas-fired plant would introduce about 300 or an oil-fired plant, 400 new jobs.

The GEIS concluded that socioeconomic impacts from constructing a gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts (local purchases and taxes) of any nonrenewable technology. Compared to the coal-fired alternative, the smaller size of the construction workforce, the shorter construction time frame, and smaller size of the operations workforce, all would reduce socioeconomic impacts. For these reasons, gas-fired generation socioeconomic impacts would be SMALL; that is, socioeconomic effects would be so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.

Construction at another site would relocate some socioeconomic impacts, but would not eliminate them. The community around the ONS site would still experience the impact of ONS operational job loss, and the communities around the new site would have to absorb the impacts of a moderate, temporary workforce and a small, permanent workforce. Therefore, the impacts would be SMALL.

- **Aesthetics**

The combustion turbines and heat recovery boilers would be relatively low structures and would be screened from most offsite vantage points by intervening woodlands. The steam turbine building would be taller, approximately 30 m (100 feet) in height, and together with 70-m (230-foot) exhaust stacks, would be visible offsite.

The GEIS analysis noted that land-related impacts, such as aesthetic impacts, would be small unless site-specific factors indicate a particular sensitivity. As in the case of the coal-fired alternative, aesthetic impacts from the gas-fired alternative would be noticeable. However, because the gas-fired structures are shorter than the coal-fired structures and more amenable to screening by vegetation, the staff determined that the aesthetic resources would not be destabilized by the gas-fired alternative. For these reasons, the appropriate characterization of aesthetic impacts from a gas-fired plant would be SMALL to MODERATE; the impacts would be clearly noticeable, but would not destabilize this important resource.

Alternative locations could reduce the aesthetic impact of gas-fired generation if siting were in an area that was already industrialized. In such a case, however, the introduction of the steam generator building, stacks, and cooling tower plumes would probably still have a SMALL to MODERATE incremental impact.

- **Archaeological and Historical**

The GEIS analysis noted, as for the coal-fired alternative, that gas-fired alternative cultural resource impacts would be small unless important site-specific resources were affected. Gas-fired alternative construction at the ONS site would affect a smaller area within the footprint of the coal-fired alternative. As discussed in 8.2.1, site knowledge minimizes the possibility of cultural resource impacts. Cultural resource impacts would be SMALL; that is, cultural resource effects

would not be detectable or would be so minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Therefore, the impact is SMALL.

Construction at another site could necessitate instituting cultural resource preservation measures, but impacts can generally be managed and maintained as SMALL. Cultural resources studies would be required for the pipeline construction and any other areas of ground disturbance associated with this alternative.

- **Environmental Justice**

No environmental pathways have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement gas-fired plant were built at the ONS site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority or low-income populations. The impacts would be SMALL to MODERATE. Impacts at other sites would depend upon the site chosen. If the replacement plant were built in Oconee County, the county's tax base would be largely maintained, and some potential negative socioeconomic impacts on the minority or low-income populations would be avoided. If the plant were built elsewhere, Environmental Justice impacts would be SMALL to MODERATE, depending on the population density.

8.2.2.2 Closed-Cycle Cooling System

Cooling for the gas-fired facility could also be accomplished by a closed-cycle system, which would also use the existing intake and discharge structures, but flow requirements would be 90 percent less than the once-through cooling system (Gilbert/Commonwealth 1996). This alternative would use an approximately 160-m (520-ft) high natural draft cooling tower for each unit. Based on Duke's experience with a similar cooling tower at the Catawba Nuclear Station, cooling water consumption would be approximately 1.5 m^3/s (24,000 gpm) (Duke 1999a). The closed-cycle cooling system alternative would introduce a cooling tower blowdown that would be higher in dissolved solids in comparison to Lake Keowee. Cooling tower operation would require more electrical power than the once-through alternative due to the modified pumping systems. Cooling towers would discharge a plume of water vapor and a small amount of cooling tower drift. Thermal rise would be less than with once-through cooling.

Mechanical draft cooling towers are an alternative to natural draft cooling towers. Mechanical draft cooing towers are 15-m (50-ft) to 30-m (100-ft) tall, but would demonstrate operational impacts similar to the natural draft towers noted above.

The incremental environmental impacts of converting to a closed-cycle cooling system at a gas plant are essentially the same incremental impacts of converting to a closed-cycle cooling system at a coal-fired plant. The impacts are discussed in Section 8.2.1.2 and are listed in Table 8-5.

Table 8-5. Summary of Environmental Impacts of Gas Fired Generation with Alternate Cooling System (Cooling Towers with Closed-Cycle Cooling)

Impact Category	Change in Impact Oconee Once-Through Cooling	Comments
Land Use	Minor change	Uses an additional 10 ha (25 acres) for cooling tower construction
Ecology	Minor change	Additional impact to terrestrial ecology from cooling tower drift; Reduced impact to aquatic ecology
Water Use and Quality		
Surface Water	Minor change	Blowdown has higher dissolved solids ; Reduced flow
Groundwater	No change	None
Air Quality	No change	None
Waste	No change	None
Human Health	Small	Impacts considered minor
Socioeconomics	No change	None
Aesthetics	Minor change	Addition of eight 160-m (520-ft) high natural draft cooling towers or noise from mechanical draft towers and vapor plume
Archaeology and Historical Resources	Minor change	Minimal studies (if necessary) before construction of cooling towers
Environmental Justice	No change	None

8.2.3 Imported Electrical Power

"Imported power" means power purchased and transmitted from electric generation plants that the applicant does not own and that are located elsewhere within the region, nation, or Canada. Duke purchases substantial amounts of capacity on the wholesale market. For example, requests for proposals in 1995 yielded numerous short- and long-term proposals, from which Duke purchased options for 250 MW of capacity from PECO Energy for the period 1998 through 2001 (Duke 1998). In theory, importing (purchasing) additional power is a feasible alternative to ONS license renewal. However, Duke points out that there is no assurance that sufficient capacity or energy would be available in the 2013 through 2034 time frame to replace the 2500 MW(e) base load generation. More importantly, regardless of the technology used to generate imported power, the generating technology would be one of those described in this SEIS and in the GEIS (probably coal, natural gas, nuclear, or

Canadian hydroelectric). The GEIS, Chapter 8, description of the environmental impacts of other technologies, is representative of the imported electrical power alternative to ONS license renewal.

According to the EIA's International Energy Outlook 1998 (EIA 1997):

> Hydro Quebec has targeted the U.S. market for future sales growth. Hydro Quebec currently owns Vermont Gas and has signed a deal with Enron to market electricity in the Northeast while selling Enron's gas in Quebec. In April 1997, Hydro Quebec petitioned the FERC (Federal Energy Regulatory Commission) to sell electricity in the United States. In return, it would allow U.S. competitors to wheel electricity into Quebec. In November 1997, Hydro Quebec received FERC approval to sell power in the United States at market-based rates.

Depending on transmission availability, relative power costs, whether Canadian environmental and aboriginal rights controversies over the hydroelectric James Bay Project in Northern Quebec could be solved, and appropriate transmission agreements and facilities could be put in place, Hydro Quebec could be a future source of imported power. However, there would be significant environmental impacts in Northern Quebec.

8.2.4 Other Alternatives

This section identifies alternatives to ONS license renewal that are not feasible and describes why the alternatives are not feasible and will not be considered further within this SEIS.

8.2.4.1 Wind

Wind power in the northwest area of South Carolina averages less than 100 w/m^2 (9.3 w/ft^2) at 10 m (33 ft) elevation or 200 w/m^2 (18.6 w/ft^2) at 50 m (164 ft) per hour. This is the lowest class on the 7-point scale (Wind Energy Resource Atlas, PNL-3195 [Zabransky et al. 1981]). The National Wind Technology Center, a branch of the U.S. Department of Energy, classifies potential wind farm resource areas from Power Class 1 through Power Class 7. Areas designated as Class 4 or higher are considered as areas of potential wind farm development using advanced wind turbine technology under development today. Power class 3 areas may be suitable for future generation technology. The average annual capacity factor was estimated by the applicant at 21 percent in 1995 and projected at 29 percent in 2010 (Duke 1998). This low capacity factor compared with current base load technologies (Oconee's capacity factor is 78 percent) results from the intermittency of the wind resource (DOE/EIA-0561). Current energy storage technologies are too expensive to permit wind power to serve as a large base load. Based on the GEIS land-use estimate for wind power (the GEIS, Section 8.3.1, estimates 60,750 ha [150,000 acres] per 1000 MW-electric for wind power), replacement of ONS generating capacity, even assuming ideal wind conditions, would require dedication of almost 150,000 ha (375,000 acres) in the area in which ONS is located. Given the amount of land required, a large greenfield site would be necessary, which would result in a large environmental impact.

8.2.4.2 Solar

Solar power technologies, photovoltaic and thermal, cannot currently compete with conventional fossil-fueled technologies in grid-connected applications due to high costs per kilowatt of capacity (DOE 1995). The average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 percent to 40 percent. Energy storage requirements prevent the use of solar energy systems as base load. According to the GEIS, land requirements are also high—14,000 ha (35,000 acres) per 1000 MW(e) for photovoltaic and 6000 ha (14,000 acres) per 1,000 MW(e) for solar thermal systems. Neither type of solar electric system would fit at the ONS site, and either would have large environmental impacts at a greenfield site.

8.2.4.3 Hydropower

Hydroelectric power has an average annual capacity factor of 46 percent. As GEIS, Section 8.3.4, points out, hydropower's percentage of the country's generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and destruction of natural river courses. GEIS, Section 8.3.4, estimates land use of 400,000 ha (1 million acres) per 1000 MW(e) for hydroelectric power. Based on this estimate, replacement of ONS generating capacity would require flooding more than 6700 km^2 (2600 mi^2). Due to the lack of locations for siting a hydroelectric facility large enough to replace ONS, local hydropower is not a feasible alternative to ONS license renewal.

8.2.4.4 Geothermal

Geothermal has an average capacity factor of 90 percent and can be used for baseload power where available. However, as illustrated by the GEIS, Figure 8.4, geothermal plants might be located in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent, but there is no feasible location for 2500 MW(e) of geothermal capacity to serve as an alternative to ONS license renewal.

8.2.4.5 Wood Energy

A wood burning facility can provide base load power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (GEIS, Section 8.3.6) The fuels required are variable and site-specific. A significant barrier to use of wood waste to generate electricity is the high delivered fuel cost. States with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan, benefit from using local resources. The pulp, paper, and paperboard industries, which consume large quantities of electricity, are the largest consumer of wood and wood waste for energy, benefitting from use of waste materials that could otherwise represent a disposal problem. The larger wood waste power plants are only 40 to 50 MW in size. Estimates in the GEIS suggest that the overall level of construction impact 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. Duke estimates that a rough

construction cost for a 2500 MW(e) plant in the Oconee area would be about $2400/KW, which would not be competitive for baseload power (Duke 1998).

8.2.4.6 Municipal Solid Waste

The initial capital costs for municipal solid waste plants are greater than for comparable steam turbine technology at wood waste facilities. This is due to the need with municipal solid waste for specialized waste separation and handling equipment. 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 (DOE 1995). Therefore, municipal solid waste would not be a feasible alternative to ONS license renewal, particularly at the scale required.

8.2.4.7 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive for automotive fuel), and gasifying energy crops (including wood waste). The GEIS 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 ONS. For these reasons, such fuels do not offer a feasible alternative to ONS license renewal.

8.2.4.8 Oil

Oil is not considered a stand-alone fuel because it is not cost-competitive when natural gas is available. The cost of oil-fired operation is about eight times as expensive as nuclear and coal-fired operation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation (DOE 1996). For these reasons, oil-fired generation is not a feasible alternative to ONS license renewal.

8.2.4.9 Nuclear Power

Work on advanced reactor designs has continued, and nuclear plant construction continues overseas. However, the cost of building a new nuclear plant and the political uncertainties that have historically surrounded many nuclear plant construction projects are among the factors that have led energy forecasters such as the Energy Information Administration to predict no new domestic orders for the duration of current forecasts (through the year 2010 [DOE 1996]). For these reasons, new nuclear plant construction is not a feasible alternative to ONS license renewal.

8.2.4.10 Fuel Cells

Phosphoric Acid Fuel Cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. Two-hundred turn-key plants have been installed in the United States, Europe, and Japan. Recent estimates suggest that a company would have to produce about 100 MW of fuel cell stacks annually to achieve a price of $1000 to $1500 per kilowatt.[a] However, the current production capacity of all fuel cell manufacturers only totals about 60 megawatts per year. Therefore, the staff considers fuel cells not to be a feasible alternative to license renewal at this time.

8.2.4.11 Delayed Retirement

Duke's 1997 Integrated Resource Plan (IRP) (Duke 1998) discusses the strategy for meeting overall energy needs for the next 15 years. The IRP discusses decision dates (as opposed to retirement dates) for the following proposed combustion turbine generating requirements: 303 MW(e) in 2004; 88MW(e) in 2005; 85 MW(e) in 2006. The IRP also discusses retirement of the following fossil generation: 276 MW(e) in 2010 and 438 MW(e) in 2011. The period of time evaluated for the IRP does not extend to the retirement dates for Oconee.

However, the delayed retirement of the above generation resources could not be used to replace the 2500 MW(e) generated at Oconee. In part because of their high operating cost, combustion turbines and small fossil units are used for peaking and intermediate generation. Therefore, it would not be feasible for the combustion turbines and small fossil plants listed above to replace base load generation. Additionally, it is unlikely that these fossil units could operate economically for an additional 20 years after the current decision dates. Duke does not have any plans to retire any of its base load units. Therefore, delayed retirement of base load fossil units could not be used as an alternative to license renewal.

8.2.4.12 Conservation

Demand-side measures have been included in the past IRPs, and Duke currently has several general demand-side actions in their current plan (Duke 1998). These measures are discussed below.

Focus on Education – to help maintain competitive electricity rates, Duke is shifting the energy efficiency focus from an emphasis on energy efficiency options that are large, high-cost, and incentive based to less costly education-based options.

Implementation of Demand-Side Competitive Bidding – Duke assessed the potential benefits of paying a third-party or customer to design and/or market demand-side resource options. Duke has entered into contracts with four bidders for a total projected resource of 4.7 MW.

(a) Source: "Advanced Fuel Cell Systems - A Revolutionary Power Technology" U.S. Department of Energy/Fossil Energy-Fuel Cell Power Systems overview. http://www.fe.doe.gov/coal-power/fc_sum.html.

Demand-side options currently used at Duke include the following:

Energy efficiency – High Energy (HE) compressed air systems and HE motor systems and replacements

Interruptibles – Residential load control ride: A/C and water heating, power service rider, generator control rider

Load shifts – Residential water heating, controlled/submerged

Strategic Sales – Electrotechnology strategy, HE food service appliance, nonresidential space heating

Energy Efficiency and Strategic Sales – New residential housing program, existing residential housing program, and nonresidential heat pump program.

Currently, the demand side measures are expected to account for 950 MW(e) in 1999. This number is projected to decrease to 750 MW(e) in 2004. In addition, the demand side measures are included in the growth projections. The applicant considers it unlikely that another cost-effective 2500MW(e) can be found to replace ONS. Therefore the conservation option is not considered a reasonable replacement for the license renewal alternative.

8.3 References

40 CFR 50.9, "National primary and secondary ambient air quality standard for nitrogen dioxide."

40 CFR 50.10, "Postconstruction environmental reports."

40 CFR 51.100, "Definitions."

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U.S. Department of Energy (DOE). 1995. *Electric Power Annual.* U.S. Department of Energy, Energy Information Administration, Washington, D.C.

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U.S. Environmental Protection Agency (EPA). 1993. *Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources.* EPA, AP-42, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1994. *Final Environmental Impact Statement, Volume I: Tampa Electric Company - Polk Power Station.* EPA 904/9-94, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1988. *Final Generic Impact Statement on Decommissioning of Nuclear Facilities.* NUREG-0586, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS).* NUREG-1437, U.S. Environmental Protection Agency,

Washington, D.C.

Zabransky, J., J. M. Vilardo, J. T. Schakenback, D. L. Elliott, W. R. Barchet, and R. L. George. 1981. *Wind Energy Resource Atlas: Volume 6–The Southeast Region.* PNNL-3195 WERA-6, Pacific Northwest Laboratory, Richland, Washington.

9.0 Summary and Conclusions

By letter dated July 7, 1998, Duke Energy Corporation (Duke 1998) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the Oconee Nuclear Station (ONS), Units 1, 2, and 3 operating licenses for an additional 20-year period. If the operating licenses are renewed, Federal (other than NRC) decisionmakers, 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. If the operating licenses are not renewed, the plant will be shut down at or before the expiration of the current operating licenses on February 6, 2013, for Unit 1, October 6, 2013, for Unit 2, and July 19, 2014, for Unit 3.

Under the National Environmental Policy Act (NEPA), an environmental impact statement (EIS) is required for major Federal actions significantly affecting the quality of the human environment. The NRC has implemented section 102 of NEPA in 10 CFR Part 51. 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 operating license; 10 CFR 51.95(c) states that the EIS prepared at the operating license renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996).

Upon acceptance of the Duke 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 (63 FR 50257). The staff visited the ONS site in October 1998 and held public scoping meetings on October 19, 1998, in Clemson, South Carolina (NRC 1999). The staff reviewed the Duke ER and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in the draft *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 1999).

This supplemental environmental impact statement (SEIS) presents the staff's preliminary analysis of the environmental impacts of renewal of the ONS operating licenses. The analysis considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse impacts. It also includes the 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 criterion to be used in evaluating the environmental impacts, found in 10 CFR 51.95(c)(4) and in the GEIS is as follows:

> ... 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.

The statement of purpose and need and the evaluation criterion both implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether ONS continues to operate beyond the period of the current operating licenses.

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) and in accordance with § 51.23(b).[(a)]

The GEIS contains the results of a systematic evaluation of the consequences of renewing an operating license and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using a three-level standard of significance—small, moderate, or large—based on Council on Environmental Quality guidelines. These significance levels are defined 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.

(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."

For 68 of the 92 issues considered in the GEIS, the analysis in the GEIS has shown:

(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 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.

These 68 issues were identified in the GEIS as Category 1 issues. In accordance with 10 CFR 51.71(d), the staff will rely on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 in the absence of significant new information.

Of the 24 issues not meeting the criteria set forth above, 22 were identified 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 also be addressed in a plant-specific supplement to the GEIS. Information on chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared or at the time this document was prepared.

This SEIS evaluates all 92 environmental issues considered in the GEIS. The SEIS considers the environmental impacts associated with alternatives to license renewal and compares the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that are considered include the no-action alternative (not renewing the ONS operating licenses) and alternative methods of power generation. Among the alternative methods of power generation, coal-fired and gas-fired generation appear the most likely if the power from ONS is replaced. These alternatives are evaluated assuming that the replacement power generation plant is located at either the ONS site or an unspecified "greenfield" site.

9.1 Environmental Impacts of the Proposed Action - License Renewal

Duke and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Duke nor the staff is aware of any significant new information related to Category 1 issues that would call into

question the conclusions in the GEIS. Similarly, neither Duke nor the staff has identified any new issue applicable to the ONS that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all 68 Category 1 issues.

Duke's license renewal application presents analyses of the Category 2 issues. The staff has reviewed the Duke analysis for each issue and has conducted an independent review of each issue. Five Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at ONS. Four additional Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. Duke (1998) has stated that their 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 Oconee beyond the end of the existing operating licenses. In addition, any replacement of components or additional inspection activities are within the bonds 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 FES for ONS.

The remaining Category 2 issues, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. For 12 issues, the staff concludes that the potential environmental effects are of SMALL significance in the context of the GEIS. For threatened and endangered species, the staff's preliminary determination is that the impact of license renewal would be SMALL and further mitigation is not warranted. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for ONS, the staff concludes that none of the candidate SAMAs are cost-beneficial. For transportation of spent fuel, it is the staff's preliminary determination that the impacts of transporting spent fuel with average burnup for peak rod levels up to 62,000 MWd/MTU would not appreciably change 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."

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

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 stage 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 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 identified are considered to be of SMALL significance, and none warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives in the event that ONS ceases operation at or before the expiration of the current operating license will not be

smaller than those associated with continued operation of ONS, 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 the ONS during its current license period was made when the plant was built. The resource commitments to be considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent 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. The ONS replaces approximately 60 fuel assemblies in each of the three units during every refueling outage, which occurs on an 18-month cycle. Assuming no change in use rate, about 2400 spent fuel assemblies would be required for operation during a 20-year license renewal period.

The likely power generation alternatives in the event ONS ceases operation on or before the expiration of the current operating licenses will require 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 ONS site was set when the plants were approved and construction began. That balance is now well established. Renewal of the ONS operating licenses and continued operation of the plants will not alter the existing balance, but it may postpone the availability of the site for other uses. Denial of the application to renew the operating licenses will lead to shutdown of the plants and will alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the ONS 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 operating licenses for Oconee Nuclear Station Units 1, 2 and 3. Chapter 2 describes the ONS and the environment in the vicinity of the plant. Chapters 4 through 7 discuss environmental issues associated with renewal of the operating licenses. Environmental issues associated with the no-action alternative and alternatives involving power generation are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the operating licenses), the no-action alternative (denial of the application), and alternatives involving coal and gas-fired generation of power at the ONS site and an unspecified "greenfield site"

are compared in Table 9-1. Continued use of the ONS once-through cooling system is assumed for Table 9-1. Substitution of a cooling tower for the once-through cooling system in the evaluation of the coal-fired and gas-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. 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 Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants*, NUREG-1437, (2) the Environmental Report submitted by Duke, (3) consultation with other Federal and State agencies, and (4) its own independent review, the staff's preliminary recommendation is that the adverse environmental impacts of license renewal for Oconee Nuclear Station Units 1, 2 and 3 are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

9.4 References

10 CFR Part 51," Environmental protection regulations for domestic licensing and related regulatory functions."

10 CFR 51.20, "Criteria for and identification of licensing and regulatory actions requiring environmental impact statements."

10 CFR 51.23, "Temporary storage of spent fuel after cessation of reactor operation—generic determination of no significant environmental impact."

10 CFR 51.71, "Draft environmental impact statement—contents."

10 CFR 51.94, "Requirement to consider final environmental impact statement."

10 CFR 51.95, "Supplement to final environmental impact statement."

10 CFR Part 51, Subpart A, Appendix B, Table B-1, "Environmental effect of renewing the operating license of a nuclear power plant."

10 CFR 54.21, "Contents of application–technical information."

63 FR 50257, "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." September 21, 1998.

Duke Energy Corporation. 1998. *Application for Renewed Operating Licenses - Oconee Nuclear Station, Units 1, 2 and 3.* Volume IV, Environmental Report.

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

U.S. Nuclear Regulatory Commission (NRC). 1999. *Environmental Impact Statement Scoping Progress: Summary Report–Oconee Nuclear Station Units 1, 2, and 3. Oconee County, South Carolina. Washington, D.C.*

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation Assuming a Once-Through Cooling System

	Proposed Action	No-Action Alternative	Coal-Fired Generation		Gas-Fired Generation	
Impact Category	License Renewal	Denial of Renewal	ONS Site	Greenfield Site	ONS Site	Greenfield Site
Land Use	SMALL	SMALL	MODERATE	MODERATE to LARGE	MODERATE	SMALL to MODERATE
Ecology	SMALL	SMALL	MODERATE	MODERATE to LARGE	MODERATE	SMALL to MODERATE
Water Quality — Surface Water	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water Quality — Groundwater	SMALL	SMALL	SMALL	SMALL to LARGE	SMALL	SMALL to LARGE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	MODERATE	MODERATE
Waste	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	MODERATE to LARGE	MODERATE	MODERATE	SMALL	SMALL
Aesthetics	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Archeological and Historical Resources	SMALL	SMALL to LARGE	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL to MODERATE	MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE

Appendix A

Reserved for Comments on the Draft Supplement
Environmental Impact Statement Related to
Duke's Application for License Renewal
Oconee Nuclear Station

Appendix A

Reserved for Comments on the Draft Supplement Environmental Impact Statement Related to Duke's Application for License Renewal Oconee Nuclear Station

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 statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations and the Pacific Northwest National Laboratory.

Name	Affiliation	Function or Expertise
NUCLEAR REGULATORY COMMISSION		
James H. Wilson	Nuclear Reactor Regulation	Project Manager, Ecology
Thomas Kenyon	Nuclear Reactor Regulation	Project Manager
Barry Zalcman	Nuclear Reactor Regulation	Section Chief and Technical Monitor
Cynthia Sochor	Nuclear Reactor Regulation	Environmental Engineer
Ralph Architzel	Nuclear Reactor Regulation	Technical Assistant
Claudia Craig	Nuclear Reactor Regulation	Environmental Engineer
Kimberly Leigh	Nuclear Reactor Regulation	Environmental Scientist
Robert Jolley	Nuclear Reactor Regulation	Environmental Engineer
Thomas H. Essig	Nuclear Reactor Regulation	Health Physics
Robert Palla	Nuclear Reactor Regulation	Severe Accident Mitigation Alternatives
John Moninger	Nuclear Reactor Regulation	Severe Accident Mitigation Alternatives
Sid Feld	Nuclear Regulatory Research	Severe Accident Mitigation Alternatives
Nick Saltos	Nuclear Reactor Regulation	Severe Accident Mitigation Alternatives
PACIFIC NORTHWEST NATIONAL LABORATORY[a]		
Rebekah Harty		Task Leader
Eva Eckert Hickey		Deputy Task Leader/Radiation Protection
James V. Ramsdell, Jr.		Air Quality
Michael J. Scott		Socioeconomics
Duane A. Neitzel		Aquatic Ecology
Susan L. Blanton		Aquatic Ecology
Charles A. Brandt		Terrestrial Ecology
Michael R. Sackschewsky		Terrestrial Ecology
Paul R. Nickens		Cultural Resources
Paul L. Hendrickson		Land Use
Lance W. Vail		Water Use, Hydrology
Wayne C. Cosby		Technical Editor

(a) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.

Appendix C

Chronology of Licensing Correspondence

Appendix C

Chronology of Licensing Correspondence

This appendix contains a chronological listing of correspondence between the NRC and Duke Energy Corporation (Duke) and other correspondence related to the NRC staff's environmental review, under 10 CFR Part 51, of Duke's application for renewal for the Oconee Nuclear Station (ONS) Units 1, 2, and 3 operating licences. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, the Gelman Building, 2120 L Street, NW., Washington, D.C., and the Local Public Document Room for the ONS Units 1, 2, and 3 licenses in the Oconee County Library, 501 West Broad Street, Walhalla, SC 29691.

July 6, 1998	Letter from M. Tuckman, Duke Energy Corporation, to the NRC Document Control Desk, transmitting application to renew operating licenses for Oconee, Units 1, 2, and 3 for an additional operating period of twenty years beyond their current expiration dates
July 31, 1998	Letter from C. Grimes, NRC, to W.McCollum, Jr., Duke Energy Corporation, transmitting proposed NRC review schedule for Duke Energy Corporation application for renewal of operating licenses for Oconee Nuclear Station, Units 1, 2, and 3
August 5, 1998	Letter from J. Roe, NRC, to W. McCollum, Jr., Duke Energy Corporation, transmitting *Federal Register* Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of Licenses Nos. DPR-38, DPR-47, and DPR-56 For an Additional 20-Year Period
August 26, 1998	Letter from W. McCollum, Jr., Duke Energy Corporation, to the NRC Document Control Desk transmitting determination from U.S. Fish and Wildlife Service concerning effect of Oconee on listed or proposed rare or endangered species
September 14, 1998	Letter from T. Essig, NRC, to W. McCollum, Duke Energy Corporation, transmitting *Federal Register* Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process in support of the application for renewal of the Oconee Units 1, 2, and 3 operating licenses for an additional 20 years
October 10, 1998	Memorandum from J. Wilson, NRC, to T. Essig, NRC, providing the Meeting Notice announcing Oconee Nuclear Station's environmental scoping meeting open to the public
November 5, 1998	Memorandum from J. Wilson, NRC, to T. Essig, NRC, summarizing the Oconee Nuclear Station scoping meeting held in support of the review of the license renewal application
November 9, 1998	Memorandum from J. Wilson, NRC, to T. Essig, NRC, summarizing the Oconee Nuclear Station site visit in support of the environmental review for the license renewal application.
November 20, 1998	Acknowledgment letter from J. Wilson, NRC, to scoping commentors who provided written comments regarding Oconee Nuclear Station license renewal

1	December 29, 1998	Letter from J. Wilson, NRC, to W. McCollum, Duke Energy Corporation, forwarding requests for additional information for the review of the Oconee Nuclear Station license renewal application regarding severe accident mitigation alternatives
2	December 29, 1998	Letter from J. Wilson, NRC, to W. McCollum, Duke Energy Corporation, forwarding requests for additional information for the review of the Oconee Nuclear Station Environmental Report associated with license renewal
3	March 4, 1999	Letter from M. Tuckman, Duke Energy Corporation, to the NRC Document Control Desk, transmitting the response to the requests for additional information
4	April 29, 1999	Letter from J. Wilson, NRC, to W. McCollum, Duke Energy Corporation, forwarding followup to request for additional information dated December 29, 1998, related to the environmental portion of the review of the license renewal application for Oconee Nuclear Station.
5	April 29, 1999	Letter from W. McCollum, Duke Energy Corporation, to the NRC Document Control Desk, transmitting the response to the followup to the request for additional information related to the environmental portion of the review of the license renewal application for Oconee Nuclear station.
6	May 10, 1999	Letter from C. Carpenter, NRC, to W. McCollun, Duke Energy, transmitting NRC staff's determination of the scope of transmission lines for the review of Duke Energy's license renewal application.
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Appendix D

Organizations Contacted

Appendix D

Organizations Contacted

During the course of the staff's independent review of environmental impacts form operations during the renewal term, the following State, regional, and local agencies were contacted:

Anderson County, Department of Economic and Community Development, Anderson County, Clemson, South Carolina

Appalachian Council of Governments, Economic Development/Planning Services, Greenville, South Carolina

Bureau of Water, SC Department of Health and Environmental Control, Columbia, South Carolina

Coldwell Banker (Appraiser), Anderson, South Carolina

Federal Energy Regulatory Commission, Office of Hydropower Licensing, Washington, DC

HITT & Associates (Appraiser), Pickens, South Carolina

Institute of Earth Science, University of South Carolina, Columbia, South Carolina

Keowee–Toxaway State Park, Sunset, South Carolina

Knight Realty & Appraisals, Pickens, South Carolina

Landrith and Associates (Appraisers), Seneca, South Carolina

Luther Fields (Appraiser), Clemson, South Carolina

Moss and Associates (Appraiser), Walhalla, South Carolina

Museum of the Cherokee Indians, Cherokee, North Carolina

North Carolina Department of Parks and Recreation, Natural Heritage Program, Raleigh, North Carolina

Oconee County, Department of Economic Development, Oconee County, Walhalla, South Carolina

Old Pickens Presbyterian Church, Perpetual Care Committee, Salem, South Carolina

Pickens County, Economic Development and Planning Department, Pickens County, Pickens, South Carolina

Pickens County Museum, Pickens, South Carolina

Planner for Oconee County Social Services, Oconee County, Walhalla, South Carolina

Secretary for the Oconee County Planning Commission, Walhalla, South Carolina

South Carolina Department of Natural Resources, Wildlife Diversity office

South Carolina Institute of Archaeology and Anthropology (State Archaeologist), University of South Carolina, Columbia, South Carolina

South Carolina State Historic Preservation Office, Columbia, South Carolina

State Toxicologist, South Carolina Department of Health and Environmental Control, Columbia South Carolina

U.S. Fish and Wildlife Service, Charlotte, North Carolina

U.S. Fish and Wildlife Service, Columbia, South Carolina

Appendix E

Duke Compliance Status and Consultations

Appendix E

Duke Compliance Status and Consultations

As part of Duke Energy Corporation's (Duke's) application for renewal of their operating licenses for Units 1, 2, and 3, they prepared a list of licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities pertinent to ONS operations. The list with minor changes, is shown in the first attachment.

Correspondence from Federal and State agencies acknowledging Duke's permits and status compliance with requirements is also attached including

- SCDHEC letter providing status of NPDES permit
- SCDHEC letter stating that there seems no significant threat to off-site persons from pathogenic microorganisms whose abundance might be promoted by artificial warming of recreational waters.
- FWS letter concurring with determination of no effect on listed or proposed endangered or threatened species
- State Historic Preservation Office letter stating that they know of no properties included in or eligible for inclusion in the National Register of Historic Places which will be affected by this project.

Table E-1. Oconee Environmental Permits and Compliance Status

Oconee Environmental Permits	Federal Act	Federal, State or Local Permitting Agency	Date Permit Issued or Expired/ Compliance Status
Operating Licenses DPR-38, DPR-47 and DPR-58	Atomic Energy Act, 10 CFR Part 50	U.S. Nuclear Regulatory Commission	Expires February 6, 2013; October 6, 2013; and July 19, 2014
Independent Spent Fuel Storage Installation, Materials License No. SNM-2503	Atomic Energy Act, 10 CFR Part 72	U.S. Nuclear Regulatory Commission	Expires January 31, 2010
FERC Project No. 2503	Federal Power Act, Section 4(e)	Federal Energy Regulatory Commission	Expires 2016
National Pollutant Discharge Elimination System (NPDES) Permit # SC0000515	Federal Water Pollution Control Act (FWPCA) Section 402	SCDHEC	Expired/currently being evaluated
Part A Hazardous Waste Permit #SCD043979822 Interim Storage Facility for Mixed Wastes	Resource Conservation and Recovery Act (RCRA) Section 3005	SCDHEC	Issued March 9, 1988 - In compliance
Operating Permit #1820-0041 Air Quality	Clean Air Act - Section 112	SCDHEC	Issued April, 22 1997 - In compliance
Landfill Permit #373303-1601	RCRA Subtitle D	SCDHEC	Issued January, 11 1995 - In compliance
Drinking Water Wells Permit #202098AI and Permit #204558	Safe Drinking Water Act 42, U.S.C. 1412	SCDHEC	In compliance
General Stormwater Permit SCR000000	FWPCA Section 402	SCDHEC	Issued October 10, 1992 - In compliance
Infectious Waste Permit #SC37-0051G	N/A	DHEC	Issued May 6, 1992 - In compliance

Table E-1. (contd)

Oconee Environmental Permits	Federal Act	Federal, State or Local Permitting Agency	Date Permit Issued or Expired/ Compliance Status
Environmental Laboratory Certification #37756001	N/A	SCDHEC	Issued May 6, 1992 - In compliance
Underground Storage Tank #06673	RCRA Subtitle I	South Carolina Department of Health and Environmental Control	Issued January 1, 1/1982 - In compliance
Underground Storage Tank Permit #11174	RCRA Subtitle I	SCDHEC	Issued November 3, 1988 - in compliance
Underground Storage Tank Permit #11843	RCRA Subtitle I	SCDHEC	Issued November 3, 1989 - In compliance
Endangered Species	Endangered Species Act, Section 7 - Consultation	FWS	Consultation
Historic Preservation	National Historic Preservation Act, Section 106	South Carolina Historic Preservation Office	Consultation



2600 Bull Street
Columbia, SC 29201-1708

April 21, 1999

Document Control Desk
U.S. Nuclear Regulatory Commission
ATTN: Jim Wilson
Mail Stop 0-11-F-1
Washington, DC 20555-0001

Dear Mr. Wilson,

In response to your request concerning the status of NPDES and land disposal permits for the Oconee Nuclear Station, the following is submitted for your review.

The Oconee Nuclear Station has been assigned NPDES permit number, SC0000515. Currently, the resolution of toxicity testing issues involving Outfall 002 and the public notice and comment period must be completed before final approval and issuance of the permit to Oconee. Included in this process is the approval for land disposal of solids. The solids land application permit is included and will be issued upon finalization of the NPDES permit.

The Bureau of Water is in the process of working with Oconee Nuclear staff towards the resolution of these issues. These are the only issues being considered by the Bureau (under the Clean Water Act) impacting water quality at the Oconee Nuclear Station and it's ability to continue operation and maintain compliance in the future.

Should you have any questions or need additional information, please call me at 803-896-4246 or e-mail at gandyrm@columb34.dhec.state.sc.us

Sincerely,

R. Michael Gandy

R. Michael Gandy, Health Physicist
SCDHEC Nuclear Power Relicensing Coordinator
Division of Radioactive Waste Management

South Carolina
DHEC
Department of Health and Environmental Control

ENVIRONMENTAL ENGINEERING AND PLANNING SECTION
OCT 31 1996
FILE
L. ICKLER DATE
COPY
ROUTE

October 25, 1996

Mr. Thomas W. Yocum
Environmental Engineering
Duke Power/MG03C1
1339 Hagers Ferry Rd.
Huntersville, NC 28078-7829

Dear Mr. Yocum:

Thank you for the telephone discussions and for technical documents you sent relative to public health considerations of thermophilic microorganisms. I have reviewed this material and related technical information in my own library.

While some microorganisms associated with thermal water discharges, especially related to air conditioning cooling towers, have been demonstrated to have deleterious human health effects, these events have occurred rarely and none have been identified with heated water sources associated with nuclear power plants, to my knowledge.

Pathogenic species of Legionella bacteria and Naegleria amoeba have been identified in heated cooling waters associated with nuclear plants. In most cases, the heated waters showed a very small increase (approximately 10-fold) over unheated source waters, but were higher in source waters in a few cases.

The most likely exposure to Legionella aerosol would be to workers within the plant. This would not impact the general public beyond the plant boundaries. A similar exposure possibility exists for Naegleria amoeba, with a slightly greater exposure potential for swimmers.

The potential public health hazard from pathogenic microorganisms whose abundance might be promoted by artificial warming of recreational waters is largely theoretical and not substantiated by available data. There is some justification for providing appropriate respiratory protection and dermal protection for workers regularly exposed to known contaminated water, but there seems no significant threat to off-site persons near such heated recreational waters. Routine monitoring for pathogenic microorganisms could be established if suspicious illnesses arose or if there were significant community concerns.

Please contact me at 803/737-4170 if you desire additional discussion of this matter.

Sincerely,

John F. Brown, DVM, PhD

John F. Brown, DVM, PhD
State Toxicologist

cc: Wm Miller

Duke Power
Energy Center
P.O. Box 1006
Charlotte, NC 28201-1006
Mail Code EC12Y

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1998
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June 23, 1998

Mr. Roger L. Banks
US Fish and Wildlife Service
PO Box 12559
Charleston, SC 29422-2559

RECEIVED JUN 26 1998

Subject: Oconee Nuclear Station - NRC License Renewal
FWS Log No. 4-6-98-227

Dear Mr. Banks:

Duke Power Company is in the process of preparing a license renewal package for Oconee Nuclear Station. As part of the license renewal process, the Nuclear Regulatory Commission (NRC) requires that applicants identify adverse impacts to rare and endangered species resulting from continued operation of the facility or refurbishment activities.

Duke Power Company hired Dr. L.L. Gaddy to survey a one-mile radius around the facility to identify any rare or endangered species. Enclosed please find the results of this survey titled *"Endangered, Threatened and Otherwise Noteworthy Plant and Animal Species of the Oconee Nuclear Station."*

Dr. Gaddy located four state-listed plant species within the one-mile radius. The locations of these plants are shown on Map 1 of the attached report. These areas are remote from the actual operation of the plant and there are no plans for future refurbishment activities in these locations. Therefore, Duke Power does not believe that continued operation of the facility will adversely impact these species. We ask that you provide your comments regarding both the survey report and our determination of no adverse impact.

Please do not hesitate to contact me at 704/373-4392 if you have any questions.

Sincerely:

Jennifer R. Huff
Scientist

Enclosure

cc: Mr. Ed Duncan, SCDNR

cc: Dr. L.L. Gaddy

Based on the information received 6-26-98 we concur with your determination that the proposed action:

- [X] will have no effect on listed or proposed endangered or threatened species.
- [ ] is not likely to adversely affect listed or proposed endangered or threatened species.
- [ ] is not likely to have significant adverse wetland impacts.

Ed Duncan
Acting Field Supervisor
U.S. Fish and Wildlife Service, Charleston Field Office
FWS Log No. 4-6-98-227 Date 7-30-98

97-OCON-NRC-NP
80F

Duke Power
A Duke Energy Company

Duke Power
Group Environment, Health & Safety
13339 Hagers Ferry Road
Huntersville, NC 28078-7929

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ENVIRONMENTAL ENGINEERING
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S. C. DEPARTMENT OF
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September 30, 1997

Ms. Nancy Brock
South Carolina Department of Archives
and History
PO Box 11669
Columbia, SC 292111

Subject: Oconee Nuclear Station
Historic and Archaeological Properties

Dear Ms. Brock:

Duke Power is currently preparing an application for renewal of Oconee Nuclear Station's operating license. One of the Nuclear Regulatory Commission's (NRC) requirements is that Duke must identify impacts to cultural resources resulting from the renewal of the license. Duke does not believe that there will be any impacts to cultural resources due to the fact that refurbishment is not anticipated to require any land-disturbing activities.

I have enclosed information about the relicensing process from Oconee's Environmental Report and the NRC's generic environmental report.

After you review the enclosed information, please send me a letter stating that impacts to cultural resources will be minimal and that there is no need for mitigation. Please do not hesitate to contact me at (704) 875-5966 if you have any questions or would like to discuss further.

Thank you for your assistance in this matter.

Sincerely:

Jennifer A. Rudisill
Resource Management

Enclosures (2)

"We know of no properties included in or eligible for inclusion in the National Register of Historic Places which will be affected by this project." 10/21/97
Nancy Brock
Review & Compliance Programs
Coordinator
State Historic Preservation
Officer

Appendix F

GEIS Environmental Issues Not Applicable to the Oconee Nuclear Station

Appendix F

GEIS Environmental Issues Not Applicable to the Oconee Nuclear Station

The following table lists those environmental issues listed in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) (NRC 1996) and 10 CFR Part 51, Subpart A, Appendix B ,Table B-1 to that are not applicable to the Oconee Nuclear Station (ONS) because of plant or site characteristics.

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 salinity gradients	1	4.2.1.2.2 4.4.2.2	ONS cooling system does not discharge to an estuary. Lake Keowee is freshwater.
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	This issue is related to heat dissipation systems that are not installed at ONS.
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING-TOWER-BASED HEAT DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	1	4.3.3	This issue is related to heat dissipation systems that are not installed at ONS.
Impingement of fish and shellfish	1	4.3.3	This issue is related to heat dissipation systems that are not installed at ONS.
Heat shock	1	4.3.3	This issue is related to heat dissipation systems that are not installed at ONS
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	ONS uses < 100 gpm of groundwater.
Groundwater-use conflicts (plants using cooling towers withdrawing makeup water from a small river)	2	4.3.2.1 4.4.2.1	This issue is related to heat dissipation systems that are not installed at ONS or are operated on bodies of water that are much smaller than Lake Keowee.
Groundwater-use conflicts (Ranney wells)	2	4.8.1.4	ONS does not have or use Ranney wells.

	ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
1 2	Groundwater quality degradation (Ranney wells)	1	4.8.2.2	ONS does not have or use Ranney wells.
3 4	Groundwater quality degradation (saltwater intrusion)	1	4.8.2.1	ONS is located on Lake Keowee, a freshwater lake.
5 6	Groundwater quality degradation (cooling ponds in salt marshes)	1	4.8.3	This issue is related to a heat dissipation system that is not installed at ONS.
7 8	Groundwater quality degradation (cooling ponds at inland sites)	2	4.8.3	This issue is related to a heat dissipation system that is not installed at ONS.
9	TERRESTRIAL RESOURCES			
10 11	Cooling tower impacts on crops and ornamental vegetation	1	4.3.4	This issue is related to a heat dissipation system that is not installed at ONS.
12	Cooling tower impacts on native plants	1	4.3.5.1	This issue is related to a heat dissipation system that is not installed at ONS.
13	Bird collisions with cooling towers	1	4.3.5.2	This issue is related to a heat dissipation system that is not installed at ONS.
14 15	Cooling pond impacts on terrestrial resources	1	4.4.4	This issue is related to a heat dissipation systems that is not installed at ONS.

16

17 ## References

18

19 10 CFR Part 51, Subpart A, Appendix B, Table B-1, "Environmental effect of renewing the operating
20 license of a nuclear power plant."

21

22 U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for*
23 *License Renewal of Nuclear Plants (GEIS)*, NUREG-1437. Washington, D.C.

NRC FORM 336 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG-1437, Supplement 2

2. TITLE AND SUBTITLE

Generic Environmental Impact Statement for License Renewal of Nuclear Plants
Supplement 2
Oconee Nuclear Station

Draft Report for Comment

3. DATE REPORT PUBLISHED

MONTH	YEAR
May	1999

4. FIN OR GRANT NUMBER

5. AUTHOR(S)

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7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION - NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

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

9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Same as 8. above.

10. SUPPLEMENTARY NOTES

Docket Numbers 50-269, 50-270, 50-287

11. ABSTRACT *(200 words or less)*

This draft supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Duke Energy Corporation (Duke Energy) to renew the operating licenses for the Oconee Nuclear Station (ONS) Units 1, 2, and 3 for an additional 20 years under 10 CFR Part 54. The supplemental environmental impact statement includes the 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 alternatives available for reducing or avoiding adverse impacts. It also includes the staff's preliminary recommendations regarding the proposed action.

Based on the analysis and findings in the GEIS, the Environmental Report submitted by BGE, consultation with other Federal and State agencies, and its own independent review, the staff's preliminary recommendation is that the adverse environmental impacts of license renewal for ONS Units 1, 2, and 3 are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Oconee Nuclear Station
Supplement to the Generic Environmental Impact Statement
National Environmental Policy Act
NEPA
License Renewal

13. AVAILABILITY STATEMENT

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