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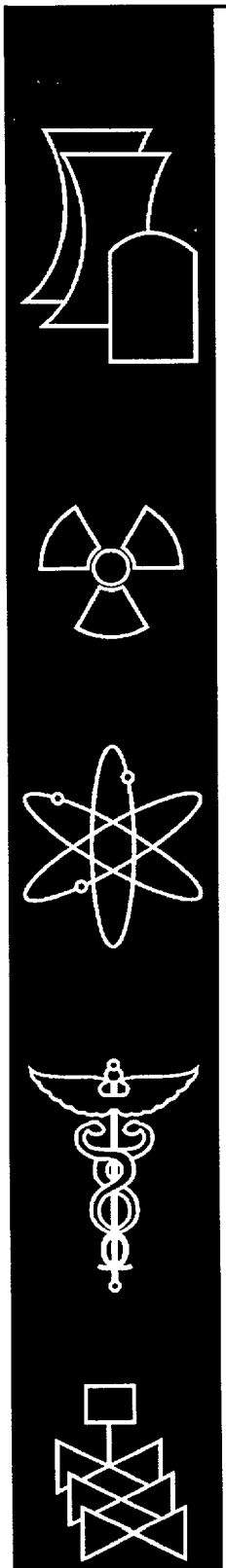

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 9

Regarding
Catawba Nuclear Station, Units 1 and 2

Draft Report for Comment

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

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NUREG-1437
Supplement 9

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 9

Regarding Catawba Nuclear Station, Units 1 and 2

Draft Report for Comment

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

COMMENTS ON DRAFT REPORT

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Electronic comments may be submitted to the NRC by the Internet at CatawbaEIS@nrc.gov.

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Abstract

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

This 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 OLs for Catawba Nuclear Station, Units 1 and 2 (Catawba) for an additional 20 years under 10 CFR Part 54 (Duke 2001a). This draft SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action.

Neither Duke nor the staff has identified information that is both new and significant for any issues for which the GEIS reached generic conclusions and that apply to Catawba Units 1 and 2. The staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the Catawba OLs will not be greater than impacts identified for these issues in the GEIS. For each of these issues, the GEIS conclusion is that the impact is of SMALL[(a)] 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).

Each of the remaining issues applicable to Catawba is addressed in this draft SEIS. For each applicable issue, the staff concludes that the significance of the potential environmental effects of renewal of the OLs is SMALL. The staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. The staff determined that information provided during the scoping process did not identify any new issue that has a significant environmental impact.

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for Catawba are not so great that preserving the

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

option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by Duke; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments received during the scoping process.

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Executive Summary

By letter dated June 13, 2001, Duke Energy Corporation (Duke) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Catawba Nuclear Station, Units 1 and 2 (Catawba) for an additional 20-year period. If the OLs are renewed, State regulatory agencies and Duke will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, the plant must be shut down at or before the expiration dates of the current OLs, which are December 6, 2024, for Unit 1, and February 24, 2026, for Unit 2.

Section 102 of the National Environmental Policy Act (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51, which identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a]

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 Catawba site in October 2001 and held public scoping meetings on October 23, 2001, in Rock Hill, South Carolina. The staff reviewed the Duke Environmental Report (ER) and compared it to the GEIS, consulted with other agencies, conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1 (*Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*), and considered the public comments received during the scoping process in preparation of this draft Supplemental Environmental Impact Statement (SEIS) for Catawba. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

The staff will hold two public meetings in Rock Hill, South Carolina, in June 2002 to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments on this

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

draft SEIS. When the comment period ends, the staff will consider and address all the comments received that are determined to be within the scope of this SEIS. These comments will be addressed in Appendix A, Part 2, of this SEIS.

This draft SEIS includes the NRC staff's preliminary analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures 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 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 goal of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

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

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

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

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or

any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of reactor operation–generic determination of no significant environmental impact"] and in accordance with § 51.23(b).

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

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

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

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

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

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

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

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

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

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

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

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 has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process nor the staff has identified any new issue applicable to Catawba that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all of the Category 1 issues that are applicable to Catawba.

Duke's license renewal application presents an analysis of the Category 2 issues plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the Duke analysis for each issue and has conducted an independent review of each issue. Six Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at Catawba. Four Category 2 issues are not discussed in this draft SEIS, because they are specifically related to refurbishment. Duke has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Catawba for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement, and therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the NRC's 1983 *Final Environmental Statement Related to the Operation of Catawba Nuclear Station, Units 1 and 2.*

Eleven Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this draft SEIS. Four of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are discussed in this draft SEIS only in relation to operation during the renewal term. For all 12 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Catawba Units 1 and 2 and the plant improvements already made, the staff concludes that none of the candidate SAMAs is 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.

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

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

Abbreviations/Acronyms

µCi	microcurie(s)
µCi/mL	microcuries per milliliter
µGy	microgray(s)
µm	micrometer(s)
µSv	microsieverts
AADT	annual average daily traffic (count)
ac	acre(s)
ACC	averted cleanup and decontamination costs
AEA	Atomic Energy Act of 1954
AEC	U.S. Atomic Energy Commission
AOC	averted offsite property damage costs
AOE	averted occupational exposure
AOSC	averted onsite costs
APE	averted public exposure
APRC	averted power replacement cost
ATWS	anticipated transient without SCRAM
BEA	Bureau of Economic Analysis
Bq	becquerel(s)
Bq/ml	becquerels per milliliter
BMT	basemat melt-through
Btu	British thermal unit(s)
°C	degrees Celsius
Catawba	Catawba Nuclear Station, Units 1 and 2
CCW	component cooling water
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CFS	cubic feet per second or ft^3/s
CHRS	containment heat removal system
Ci	curie(s)
cm	centimeter(s)
COE	cost of enhancement
COPC	chemicals of potential concern
CVCS	chemical and volume control system
CWA	Clean Water Act

DG	diesel generator
DBA	design-basis accident
DCH	direct containment heating
DOE	U.S. Department of Energy
DPR	demonstration project reactor
DSM	demand-side management
Duke	Duke Energy Corporation
ECCS	emergency care cooling system
EIA	Energy Information Administration (of DOE)
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EOP	Emergency Operating Procedure
EPA	U.S. Environmental Protection Agency
EPZ	Emergency Planning Zone
EQ	equipment qualification
ER	Environmental Report
ESA	Endangered Species Act
ESRP	Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Operating License Renewal, NUREG-1555, Supplement 1
EWP	Environmental Work Plan
°F	degrees Fahrenheit
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FES	Final Environmental Statement
FR	Federal Register
FSAR	Final Safety Analysis Report
ft	foot/feet
ft^3/yr	cubic feet per year
ft^3/s	cubic feet per second
F-V	Fussell-Vesely (importance measures used in risk analysis)
FWPCA	Federal Water Pollution Control Act (also known as the Clean Water Act of 1977)
FWS	U.S. Fish and Wildlife Service
gal	gallon
GDC	general design criteria
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437

GI-LLI	gastrointestinal tract-lower large intestine
gpm	gallons per minute
ha	hectare(s)
HHSI	high head safety injection
HLW	high-level waste
hr	hour(s)
Hz	Hertz
in.	inch(es)
IPE	Independent Plant Examination
IPEEE	Independent Plant Examination for External Event
ISFSI	independent spent fuel storage installation
ISLOCA	interfacing systems loss of coolant accident
kg	kilogram(s)
km	kilometer(s)
kV	kilovolt(s)
kV/m	kilovolt per meter
kWh	kilowatt hour(s)
L	liter(s)
lb	pound
LNG	liquefied natural gas
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
L/s	liters per second
LWR	light-water reactor
m	meter(s)
m/s	meter(s) per second
m^3/d	cubic meters per day
m^3/s	cubic meter(s) per second
mA	milliampere(s)
MACCS2	MELCOR Accident Consequence Code System 2
mi	mile(s)
mGy	milligray(s)
MGD	million gallons per day
mL	milliliter(s)
mph	miles per hour
mrad	millirad(s)

mrem	millirem(s)
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTU	metric ton(s)-uranium
MW	megawatt(s)
MWd/MTU	megawatt-days per metric ton of uranium
MW(e)	megawatt(s) electric
MW(t)	megawatt(s) thermal
MWh	megawatt hour(s)
NA	not applicable
NAS	National Academy of Sciences
NCDENR	North Carolina Department of Environmental and Natural Resources
NCI	National Cancer Institute
NEPA	National Environmental Policy Act of 1969
NESC	National Electric Safety Code
ng/J	nanogram per joule
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NWPPC	Northwest Power Planning Council
ODCM	Offsite Dose Calculation Manual
OL(s)	operating license(s)
PAR	passive autocatalytic recombiners
PDS(s)	plant damage state(s)
PM_{10}	particulate matter, 10 micrometers or less in diameter
ppt	parts per thousand
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSD	prevention of significant deterioration
PSW	plant service water
PWR	pressurized water reactor
PW	present worth

RAB	reactor auxiliary building
RAI	request for additional information
RCP	reactor coolant pump
RCS	Reactor Coolant System
REMP	radiological environmental monitoring program
RWST	Refueling Water Storage Tank
ry	reactor year
s	second(s)
SAG	Severe Accident Guideline
SAMA(s)	Severe Accident Mitigation Alternative(s)
SAMDA	Severe Accident Mitigation Design Alternative
SAMG	Severe Accident Management Guideline
SAR	Safety Analysis Report
SBO	station blackout
SC	South Carolina
SCH	South Carolina Highway
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Office
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCIAA	South Carolina Institute of Archaeology and Anthropology
SIC	Standard Industrial Classification
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
SSS	standby shutdown system
TBq	terabecquerel
UDB	urban development boundary
UFSAR	Updated Final Safety Analysis Report
U.S.	United States
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
UST	upper storage tank
yr	year

1.0 Introduction

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

The Duke Energy Corporation (Duke)[b] operates Catawba Nuclear Station, Units 1 and 2 (Catawba) in north-central South Carolina under OLs NPF-35 and NPF-52, which were issued by the NRC. These OLs will expire in December 2024 for Unit 1 and in February 2026 for Unit 2. On June 13, 2001, Duke submitted an application to the NRC to renew the Catawba OLs for an additional 20 years under 10 CFR Part 54 (Duke 2001a). Duke is a *licensee* for the purposes of its current OLs and an *applicant* for the renewal of the OLs. Pursuant to 10 CFR 54.23 and 51.53(c), Duke submitted an Environmental Report (ER; Duke 2001b) in which Duke analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects.

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

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

(b) Duke Energy Corporation has held the licenses for Catawba, Units 1 and 2 since September 16, 1997. Before this date, Duke Power Company held the license. Duke Power Company remains a division of Duke Energy Corporation.

1.1 Report Contents

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

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

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

- the preparers of the supplement
- the chronology of correspondence between NRC and Duke with regard to this SEIS
- the organizations contacted during the development of this SEIS
- Duke's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and sent during the evaluation process)
- GEIS environmental issues that are not applicable to Catawba.

1.2 Background

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

1.2.1 Generic Environmental Impact Statement

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

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

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

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

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

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

In the GEIS, the staff assigned a significance level to each environmental issue, assuming 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 and spent fuel disposal).

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

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

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

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues were not categorized. The latter two issues, environmental justice and chronic effects of electromagnetic fields, are to be addressed in a plant-specific analysis. Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the renewal term, and 8 apply to both refurbishment and operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OLs is required to submit an ER as part of its application. The license renewal evaluation process involves careful review of the applicant's ER and

assurance that all new and potentially significant information not already addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

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

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

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

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

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

In preparing to submit its application to renew the Catawba OLs, Duke developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for Catawba would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the licenses for Units 1 and 2 would be identified, reviewed, and assessed during the period of NRC review. Duke reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained

valid with respect to Catawba. This review was performed by personnel from Duke and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

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

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

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts to the environmental impacts of alternatives. Evaluation of the Duke license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the Federal Register (66 FR 42893 [NRC 2001a]) on August 15, 2001. The staff published a notice of intent to prepare an EIS and conduct scoping (66 FR 48489 [NRC 2001b]) on September 20, 2001. Two public scoping meetings were held on October 23, 2001, in Rock Hill, South Carolina. Comments received during the scoping meetings were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Catawba Units 1 and 2, Rock Hill, South Carolina* (NRC 2002). Comments that are applicable to this environmental review are presented in Part 1 of Appendix A.

The staff followed the review guidance contained in NUREG-1555, Supplement 1 (NRC 2000). The staff and contractors retained to assist the staff visited the Catawba site on October 22 and 23, 2001, to gather additional information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping, and consulted with Federal, State, regional, and local agencies. A list of the organizations consulted is provided in Appendix D. Other documents related to Catawba also were reviewed and are referenced.

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

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Filing of the draft SEIS, to allow members of the public to comment on the results of the NRC staff's review. During this comment period, two public meetings will be held in Rock Hill, South Carolina, in June 2002. During these meetings, the staff will describe the results of the NRC environmental review and will answer questions related to it to provide members of the public with information to assist them in formulating their comments.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OLs for Catawba, Units 1 and 2. Catawba is located in north-central South Carolina, in northeastern York County on the shore of Lake Wylie, approximately 29 km (18 mi) southwest of Charlotte, North Carolina, and 10 km (6 mi) north of Rock Hill, South Carolina, the nearest town. The current OL for Unit 1 expires on December 6, 2024, and for Unit 2 the OL expires on February 24, 2026. By letter dated June 13, 2001, Duke submitted an application to the NRC (Duke 2001a) to renew these OLs for an additional 20 years of operation.

The plant has two Westinghouse-designed, pressurized, light-water reactors, each with a design rating for a net electrical power output of 1129 megawatts electric (MW[e]). Plant cooling is provided by six mechanical draft cooling towers that discharge into Lake Wylie. Units 1 and 2 produce electricity to supply the needs of more than 619,000 homes.

1.4 The Purpose and Need for the Proposed Action

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

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

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

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

1.5 Compliance and Consultations

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

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

Agency	Authority	Requirement	Number	Permit Expiration or Consultation Date	Activity Covered
NRC	Atomic Energy Act, 10 CFR Part 50	Operating license	NPF-35 (Unit 1) NPF-52 (Unit 2)	December 6, 2024 (Unit 1) February 24, 2026 (Unit 2)	Operation of Catawba Units 1 and 2
FWS and NMFS	Endangered Species Act, Section 7	Consultation	NA	Consultation initiated December 2001	Operation during renewal term
FWS	Migratory Bird Treaty Act	Permit	DPRD 757484	Annual	Depredation permit
SCDHEC	Clean Water Act, Section 402	NPDES wastewater permit	SC0004278	April 30, 2006	Discharge of wastewater and cooling water into Lake Wylie
SCDHEC	Clean Water Act, Section 402	NPDES stormwater permit	SC000000; Permit Cert. No: SCR003773	January 31, 2003	Collection, treatment, and discharge of stormwater
SCDHEC	Clean Air Act	Air emissions and operating permits	2440-0070	December 31, 2005	Emissions from diesel emergency generators, miscellaneous diesel engines, and other miscellaneous units
SCIAA and SHPO	National Historic Preservation Act, Section 106	Consultation	NA	Consultation initiated October 24, 2001	Impact on sites listed or eligible for listing in the National Register of Historic Places

FWS - U.S. Fish and Wildlife Service
NA - Not applicable
NPDES - National Pollutant Discharge Elimination System
SCIAA - South Carolina Institute of Archaeology and Anthropology
SHPO - State Historic Preservation Office (located at the South Carolina Department of Archives and History)
SCDHEC - South Carolina Department of Health and Environmental Control

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

1.6 References

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

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

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

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

Clean Air Act (CAA). 42 USC 7401, et seq.

Duke Energy Corporation (Duke). 2001a. *Application for Renewed Operating Licenses, Catawba Nuclear Station Units 1 and 2.* Charlotte, North Carolina.

Duke Energy Corporation (Duke). 2001b. *Applicant's Environmental Report – Operating License Renewal Stage Catawba Nuclear Station Units 1 and 2.* Charlotte, North Carolina.

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

Federal Water Pollution Control Act (FWPCA). 33 USC 1251, et seq. (Also known as the Clean Water Act [CWA]).

Migratory Bird Treaty Act. 16 USC 703-712.

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

National Historic Preservation Act (NHPA). 16 USC 470, et seq.

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

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

The Catawba Nuclear Station, Units 1 and 2 (Catawba), owned by Duke Energy Corporation (Duke), is located in York County, South Carolina. It is situated on a peninsula that protrudes into Lake Wylie, a man-made lake created by the Wylie Dam. Both units are the subject of this action. Each reactor is a pressurized light-water reactor (LWR) with four steam generators producing steam that turns turbines to generate electricity. Each unit has six mechanical draft cooling towers for heat removal. The station and its environs are described in Section 2.1, and its interaction with the environment is presented in Section 2.2.

2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term

Catawba is located on 158 ha (391 ac) of Duke-owned land in rural north-central South Carolina (Duke 2001a). Figures 2-1 and 2-2 show the site location and features within 80 and 10 km (50 and 6 mi), respectively. Duke refuels each Catawba nuclear unit on an 18- to 24-month schedule. During these refueling periods, site employment increases by as many as 500 workers for temporary duty over a 30- to 40-day period. Catawba has approximately 1218 full-time workers employed by Duke and site contractors during normal plant operations. The plant is located approximately 29 km (18 mi) southwest of Charlotte, North Carolina. Rock Hill, South Carolina, the nearest city, is about 10 km (6 mi) south of the site.

Lying within the Piedmont physiographic province, the Catawba site is characterized by rolling hills and numerous small streams and rivers. The site and surrounding area vary in elevation from 174 to 193 m (570 to 632 ft), are dominated by Iredell soils, and harbor typical Piedmont plant communities and land cover types, predominantly pine and pine-mixed hardwoods (Duke 2001a).

Four parks, three located in and owned by York County (Ebenezer Park, Pitcarin Cove Park, and Wind Jammer Beach Park) and one located in and owned by Mecklenburg County (McDowell Park), are within a 10-km (6-mi) radius of the Catawba site. Eight state parks (Andrew Jackson State Park, Chester State Park, Croft State Park, Crowders Mountain State Park, Kings Mountain State Park, Lake Norman State Park, Rosehill Plantation State Park, and South Mountains State Park), Cowpens National Battlefield, Kings Mountain National Military Park, and the Catawba Indian Reservation are located within 80 km (50 mi) of Catawba (Duke 2001a).

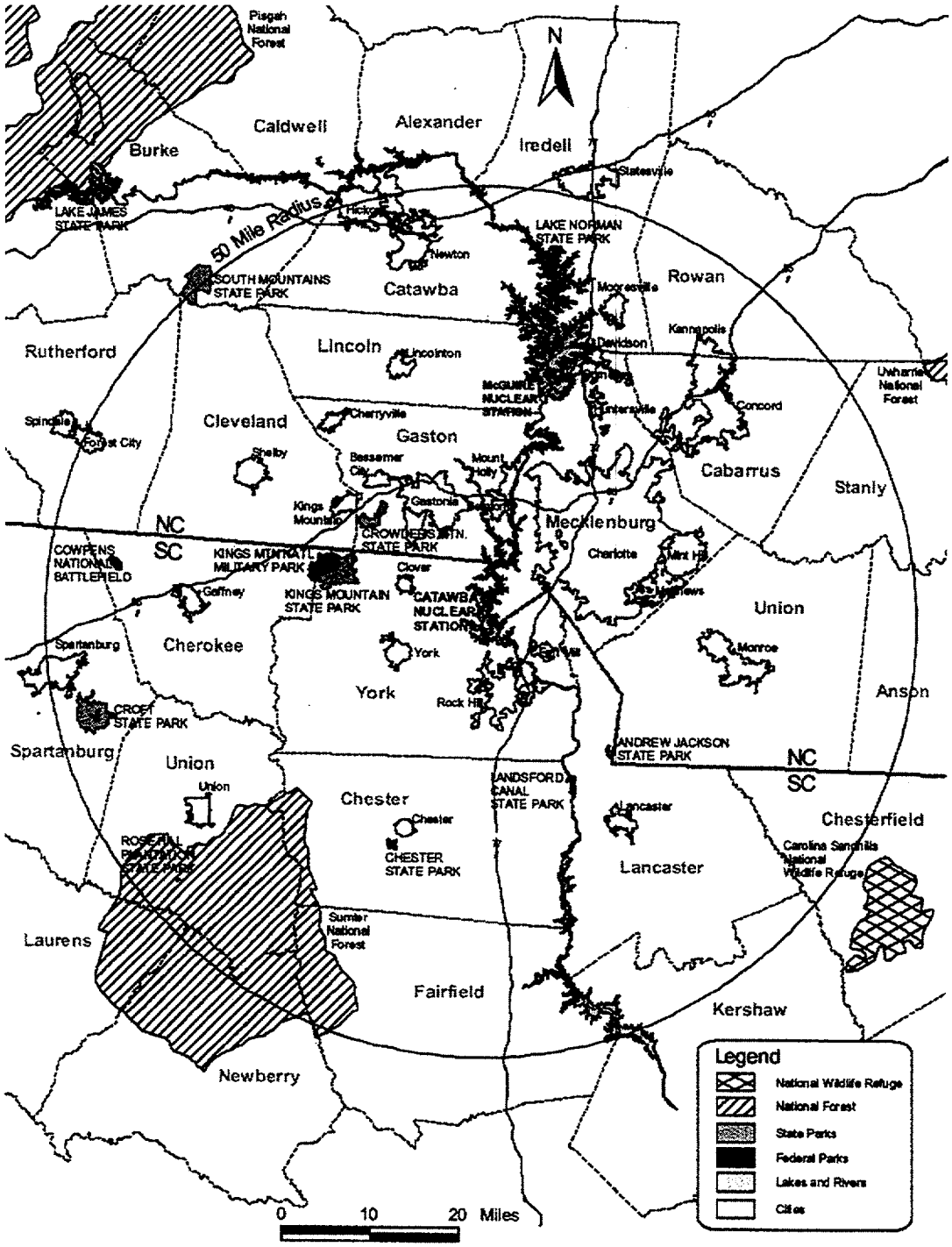

Figure 2-1. Location of Catawba 80-km (50-mi) Region (Duke 2001a)

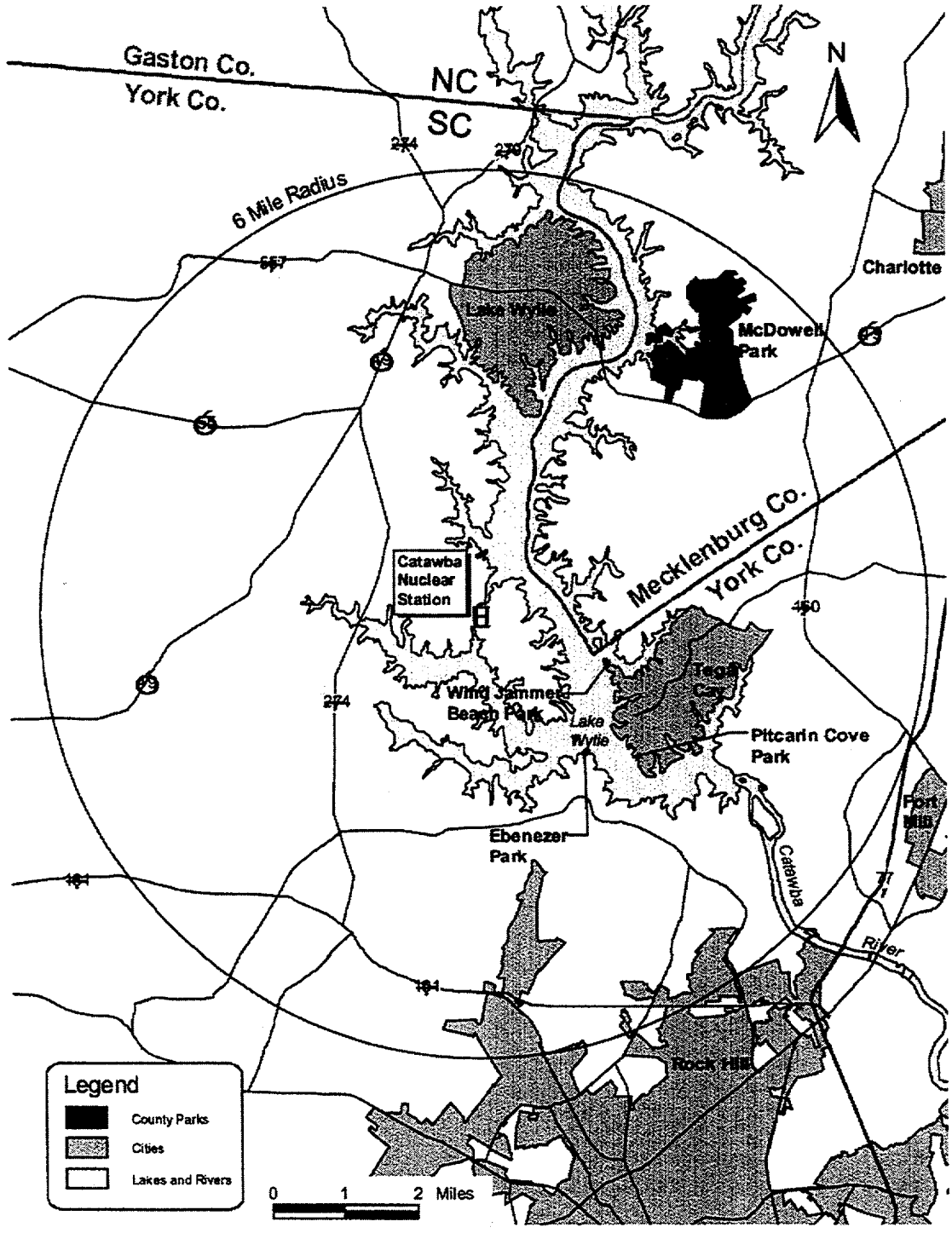

Figure 2-2. Location of Catawba 10-km (6-mi) Region (Duke 2001a)

2.1.1 External Appearance and Setting

Catawba consists of two reactor buildings, two turbine buildings, two diesel generator buildings, six mechanical draft cooling towers, one shared service building, one auxiliary building, one water chemistry building, and one switchyard. The cooling water intake and discharge structures and standby nuclear service water pond are shared features (Duke 2001a).

The Catawba site lies within the Piedmont physiographic province, a northeast trending zone from Georgia through Virginia that varies in width from about 129 to 193 km (80 to 120 mi) (Duke 2001a). The Piedmont physiographic province is bounded on the northwest by the Blue Ridge province and on the southeast by the Atlantic Coastal Plain province (AEC 1972).

The site is underlain by a variety of low-quartz granite known as adamellite. Although there are numerous faults in the Piedmont physiographic province (AEC 1972), it is an area of infrequent earthquakes of only moderate intensity (AEC 1973). No faults or other geological structures have been identified that could be expected to localize earthquakes in the immediate vicinity of the Catawba site (AEC 1972).

2.1.2 Reactor Systems

The Catawba site is shown in Figure 2-3. Units 1 and 2 are pressurized LWRs with four reactor coolant loops, each of which contains a steam generator that produces steam and turns turbines to generate electricity. Each unit is designed to operate at core power levels up to 3411 megawatts (thermal) (MW[t]), with a corresponding net electrical output of approximately 1129 megawatts (electric) (MW[e]). The nuclear steam supply system for each unit and the Unit 2 steam generators were supplied by Westinghouse Electric Corporation. The current Unit 1 steam generators, installed in 1996, were supplied by Babcock & Wilcox International.

The reactor containment is housed in a separate free-standing steel containment structure within a reinforced concrete shield building. The containment employs the ice condenser pressure-suppression concept, and is designed to withstand environmental effects and the internal pressure and temperature accompanying a postulated loss-of-coolant accident or steam-line break. Together with its engineered safety features, the containment structure for each unit is designed to adequately retain fission products that escape from the reactor coolant system.

The Catawba reactors are licensed for fuel that is slightly enriched uranium dioxide, up to 4.73 percent by weight uranium-235. Catawba has several different fuel designs that are used for the production of electricity. The Mark-BW design has a maximum fuel assembly burnup of 55,000 megawatt days/metric tons of uranium (MWd/MTU) and a maximum approved fuel pin

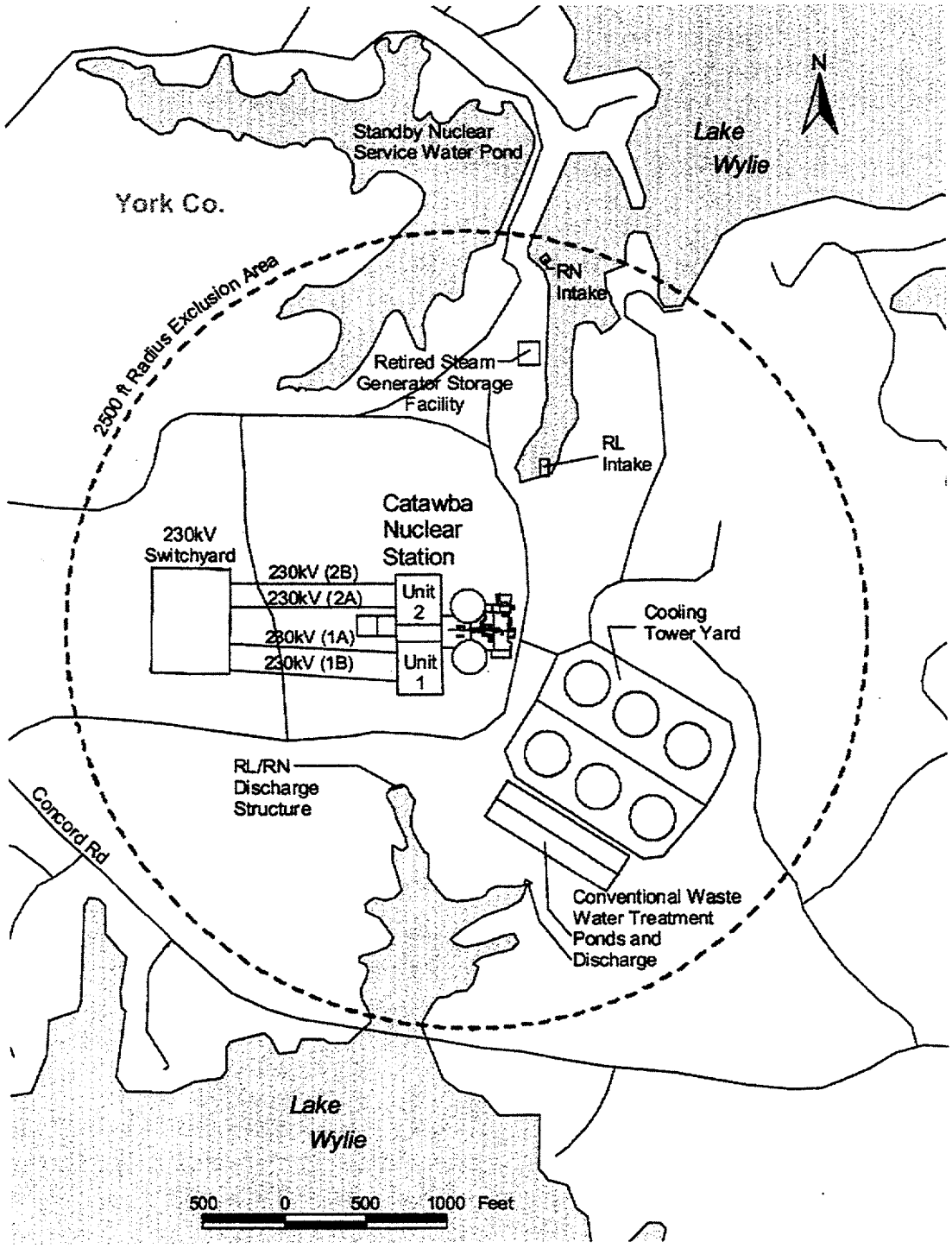

Figure 2-3. Catawba Exclusion Area (Duke 2001a)

burnup of 60,000 MWd/MTU. The Westinghouse Robust Fuel Assembly design does not have a maximum fuel assembly burnup limit; however, this burnup value would be limited by the maximum approved fuel pin burnup limit of 60,000 MWd/MTU (Duke 2001a).

2.1.3 Cooling and Auxiliary Water Systems

Catawba uses water from Lake Wylie for cooling and process water. The average daily withdrawal from Lake Wylie for the cooling water and other service water systems is 386 million liters per day (L/d) (102 million gallons per day [MGD]). The average daily discharge back into Lake Wylie from Catawba is 230 million L/d (60.7 MGD). The consumptive water losses result from evaporation and drift from the six mechanical-draft cooling towers that provide cooling for the condenser circulating water system.

Water from Lake Wylie is taken in through two intake structures. The low pressure service water intake structure is located on the Beaver Dam Creek arm of Lake Wylie (Figure 2-3; RL Intake). Trash racks and traveling screens are used to remove trash and debris from this intake water. The intake structure is designed for a maximum water velocity of 0.15 m/s (0.5 ft/s) in front of the trash racks at the maximum design drawdown of Lake Wylie. The low pressure service water system supplies water for various functions on the secondary side of the plant. The nuclear service water intake structure also is located in the Beaver Dam Creek arm (Figure 2-3; RN Intake). This intake supplies cooling water to various heat loads in the primary side of the plant and supplies water to the standby nuclear service water pond.

Catawba does not use cooling ponds for normal operations; however, it does have a standby nuclear service water pond. The purpose of this pond is to provide an ultimate heat sink in the event of a rapid decline in water level in Lake Wylie. The pond is isolated from the plant service water during normal plant operations.

The discharge structure is located on the Big Allison Creek arm of Lake Wylie (Figure 2-3; RL/RN Discharge Structure). This structure is designed to allow warm discharge water to float on the surface with a minimum amount of mixing. Approximately 1.48 million L/d (0.39 MGD) from the conventional waste water treatment system and from the sewage treatment system is discharged to Lake Wylie.

Catawba obtains potable water from the city of Rock Hill. There are a total of three groundwater supply wells at the Catawba site. These wells supply water on a periodic basis to remote locations and for seasonal irrigation. The average annual groundwater withdrawal rate from these wells is 1.89 L/s (30 gallons per minute [gpm]).

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

Catawba 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 operations. These systems process radioactive liquid, gaseous, and solid effluents before they are released to the environment. The waste disposal systems for Catawba meet the design objectives of 10 CFR Part 50, Appendix I (Numerical Guide for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents). These systems 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 LWRs. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products mostly are contained in the sealed fuel rods, but small quantities escape and contaminate the reactor coolant. Neutron activation of the primary coolant system also is responsible for coolant contamination.

Nonfuel solid wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant design modifications and operations and routine maintenance activities. Solid wastes may be shipped to a waste processor for volume reduction before disposal at a licensed burial site (Duke 2001a). Spent resins and filters are stored or packaged for shipment to a licensed offsite processing or disposal facility.

Fuel rods that have exhausted a certain percentage of their fuel and are removed from the reactor core for disposal are called spent fuel. Each unit is refueled approximately every 18 to 24 months, and refueling outages are staggered so both units are not in an outage at the same time. Spent fuel is stored onsite in one of the two spent fuel pools. Each unit has its own spent fuel pool and fuel storage facility. Although an independent spent fuel storage installation (ISFSI) is planned, Catawba does not currently have an ISFSI facility.

The waste gas and solid waste systems are common to both units. Portions of the liquid radioactive waste system are shared.

The *Offsite Dose Calculation Manual* (ODCM) for Catawba (Duke 2001b) describes the methods used for calculating radioactivity concentrations in the environment and the estimated

potential offsite doses associated with liquid and gaseous effluents. The ODCM also specifies controls for release of liquid and gaseous effluents to ensure compliance with the following:

- The concentration of radioactive liquid effluents released from the site to the unrestricted area will not exceed 10 times the concentration specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained gases. For dissolved or entrained noble gases, the concentration shall not exceed 7.4 Bq/mL (0.0002 μCi/mL).

- The dose or dose commitment per reactor to a member of the public from any radioactive materials in liquid effluents released to unrestricted areas shall be limited to the design objectives of 10 CFR Part 50 Appendix I (i.e., [1] less than or equal to 0.015 mSv [1.5 mrem] to the total body and less than or equal to 0.05 mSv [5 mrem] to any organ during any calendar quarter, and [2] less than or equal to 0.03 mSv [3 mrem] to the total body and less than or equal to 0.1 mSv [10 mrem] to any organ during any calendar year).

- The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to (1) less than or equal to 5 mSv/yr (500 mrem/yr) to the total body and less than or equal to 30 mSv/yr (3000 mrem/yr) to the skin due to noble gases, and (2) less than or equal to 15 mSv/yr (1500 mrem/yr) to any organ due to iodine-131, iodine-133, tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days per NUREG-1301 (NRC 1991).

- The air dose per reactor to areas at and beyond the site boundary due to noble gases released in gaseous effluents shall be limited to the design objectives of 10 CFR Part 50, Appendix I, of less than or equal to 0.1 mGy (10 mrad) for gamma radiation and less than or equal to 0.2 mGy (20 mrad) for beta radiation during any calendar year.

- The dose to any individual member of the public from nuclear facility operations will not exceed the maximum limits of 40 CFR Part 190 (less than 0.25 mSv [25 mrem]) and 10 CFR Part 20 (i.e., less than or equal to 5 mSv [500 mrem] in a year and less than or equal to 0.02 mSv [2 mrem] in any hour).

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

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

All radioactive and potentially radioactive liquids generated in the plant are collected, segregated, and processed. Most deaerated reactor- or primary-grade liquids containing fission product gases and other radioactive materials, including tritium, are collected in the reactor coolant drain tank in the reactor building or in the waste drain tank in the auxiliary building and then are recycled. The liquid radwaste system collects aqueous solutions from equipment flush and drain lines, floor drains, decontamination sink drains, ultrasonic cleaner drains, laundry drains, and ventilation equipment drains. These potentially contaminated liquid wastes are collected in storage tanks in the auxiliary building and waste monitor tank building for processing by filtration or demineralization or both. Wastes from the auxiliary building and from secondary system drains are processed in the waste monitor tank building. Waste input streams are segregated based on radioactivity content and disposed of depending on the concentration of radioactive material in the waste. Those waste streams containing little measurable activity above background levels are discharged to Lake Wylie.

Further processing by filtering, chemical treatment, or demineralization is required for other waste streams. Following treatment, effluents that meet regulated radioactivity levels for release are discharged into Lake Wylie. Wastes with higher radioactive material concentrations are packaged and shipped to an offsite vendor for further waste processing or for disposal in a licensed burial.

The ODCM (Duke 2001b) prescribes the alarm/trip setpoints for the liquid effluent radiation monitors; the setpoints are derived from 10 times the effluent concentration limits provided in 10 CFR Part 20, Appendix B, Table 2, Column 2. Liquid effluent radiation monitors are located on the waste monitor tank release line, the recycle monitor tank release line, the auxiliary monitor tank release lines, and conventional waste water treatment system release line.

During 2000, there were 192 batch releases of liquid effluents for the two units with a total volume of 5060 m^3 (1.33×10^6 gal) prior to dilution. The combined liquid waste volume prior to dilution for batch and continuous releases for 2000 was 305,000 m^3 (8.05×10^7 gal). The liquid waste holdup capacity for the plant is approximately 840 m^3 (221,500 gal) (Duke 2001a). In this liquid waste, there was a total fission and activation product activity of 0.003 TBq (0.083 Ci) and a total tritium activity of 26.6 TBq (718 Ci). These volumes and activities are typical of past years. The actual liquid waste generated is reported in the *Catawba Nuclear Station, Units 1 and 2, 2000 Annual Radioactive Effluent Release Report* (Duke 2001d). See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual as a result of these releases.

Duke does not anticipate any increase in liquid waste releases during the renewal period.

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

The waste gas system is designed to remove fission gases from radioactive contaminated fluids and to contain these gases. Fission gases are removed from other systems to the maximum extent possible and are contained in the waste gas system. The system is designed so storage and the subsequent decay of activity of these gases reduces to a large extent the need for regularly scheduled discharge of radioactive gases into the atmosphere during normal plant operation. There are times, however, when the release of radioactive gas may be necessary. As a result, there are provisions to sample and isolate each of the decay tanks.

The waste gas decay tanks, containment building purges, auxiliary building ventilation, and flow from the condenser air ejectors exhaust into the two unit vents. These four contributors to the unit vent exhaust are discussed below. The unit vents are the primary (major) gaseous release points from the plant and contain radiation monitors and flow rate measuring instrumentation (Duke 2001b).

- The waste gas system in the auxiliary building is shared between the two reactor units and consists of two waste gas compressors, two catalytic hydrogen recombiners, six gas decay storage tanks for use during normal power generation, and two gas decay storage tanks for use during shutdown and startup operations (Duke 2000a). Gases are allowed to decay in these tanks, then are released at permissible rates and activity to the vent as prescribed by the ODCM (Duke 2001b).

- Within the containment building, nonrecyclable reactor coolant leakage gases are released through the containment air release and addition system or through the containment purge system. The containment atmosphere is discharged through charcoal absorbers before its release.

- Gases collected inside the auxiliary building are released to the environment without further decay. Ventilation exhaust from potentially contaminated areas is passed through charcoal adsorbers before release.

- Gases from the condenser air ejectors are monitored continuously and discharged into the unit vent.

A separate gaseous effluent release point is the auxiliary monitor tank building. This effluent is normally considered nonradioactive. However, because of the potential for its release of radioactive effluents, ventilation of process areas pass through particulate and charcoal filters.

Radioactive gaseous wastes from Catawba are released primarily through the Unit 1 and Unit 2 vents. The exhaust streams that flow into the unit vents (i.e., waste gas decay storage tanks, containment ventilation, auxiliary building ventilation, and condenser air ejectors) are monitored for radioactivity. The unit vents are continuously monitored for noble gases, radioiodines, and particulate activity. The ODCM prescribes alarm/trip setpoints for these effluent monitors and control instrumentation to ensure that the alarm/trip will occur prior to exceeding the limits established in 10 CFR Part 20 for gaseous effluents (Duke 2001b). See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual as a result of these releases.

During 2000, there was a total fission and activation gas activity of 2.3 TBq (60.3 Ci), a total iodine activity of 7.77×10^{-7} TBq (2.1×10^{-5} Ci), a total particulate activity of 7.40×10^{-7} TBq (2.00×10^{-5} Ci), and a total tritium activity of 9.36 TBq (2.1×10^{2} Ci) released from the two units. These releases are typical of past years.

Duke does not anticipate any increase in gaseous releases during the renewal period.

2.1.4.3 Solid Waste Processing

Solid radioactive wastes from Catawba consist of spent resin and spent filters used in treating and separating radionuclides from gases and liquids; reactor components, equipment, and tools removed from service; contaminated oils and sludges; and contaminated protective clothing, paper, rags, and other trash generated from routine plant operations and from design modification and maintenance activities (Duke 2001a). The solid radwaste system is shared by the two units to contain and store radioactive waste materials and prepare them for shipment to a waste processor for volume reduction before disposal or for shipment directly to the licensed burial site.

Spent resin is flushed from plant demineralizers into spent resin storage tanks. The spent resin is processed by dewatering or solidification and packaged in a cask liner. Spent filter cartridges are removed from their housing and transferred to a shielded filter storage bunker where they are lowered into a disposal drum (Duke 2000a). Contaminated oils and sludges either are pumped to a processing area for solidification in cement or are shipped to an offsite vendor for processing prior to disposal.

Lower-activity wastes (i.e., miscellaneous solid materials) are processed at an offsite waste processing facility for volume reduction or segregation prior to disposal at a licensed facility such as those in Barnwell, South Carolina, or Envirocare in Utah. Higher-activity wastes (i.e., spent resins) are typically sent directly to a licensed disposal facility such as Barnwell, South Carolina (Duke 2001a). Onsite disposal within the owner-controlled area of slightly contami-

nated materials, of which secondary resins is an example, is approved by the NRC and the State of South Carolina in a process described in 10 CFR 20.2002 for materials confirmed to have acceptably low radionuclide concentrations.

Disposal and transportation of solid wastes are performed in accordance with the applicable requirements of 10 CFR Part 61 and Part 71, respectively. There are no releases to the environment from radioactive solid wastes created at Catawba.

Approximately 90 solid waste shipments containing contaminated parts, tools, and equipment and 10 radwaste shipments containing dry active waste, dewatered resins, and irradiated hardware are made from Catawba each year as reported in the Catawba ER (Duke 2001a). The average yearly radioactive contaminated waste generated is about 250 m^3 (8825 ft^3). The volume shipped for burial averages about 50 m^3 (1750 ft^3) per year. These quantities may vary significantly from year to year.

In 2000, Catawba made five shipments of radwaste with a volume of 26.6 m^3 (938 ft^3) to a disposal facility. This includes the volume but not the shipment numbers sent for brokered dry active waste treatment and waste reduction. The combined waste contained a total activity of 50 TBq (1343 Ci; Duke 2001d). Catawba has been aggressively reducing volume and minimizing waste for several years and intends to do so in the future.

2.1.5 Nonradioactive Waste Systems

Nonradioactive solid wastes from Catawba are disposed of in the onsite landfill or in other approved landfills. The onsite landfill typically handles the following types of wastes: asbestos, empty paint containers, and oil-contaminated materials. This landfill is permitted by the South Carolina Department of Health and Environmental Control (SCDHEC) (Duke 2001a). General office trash and cafeteria wastes are collected and transported to an offsite permitted landfill. Construction wastes are hauled to a county construction and demolition debris landfill. Items such as paper, aluminum cans, and scrap metal are sent to a recycler.

Nonradioactive liquid wastes are sampled and treated according to the Site National Pollutant Discharge Elimination System (NPDES) permits issued to Catawba by the SCDHEC. These wastes originate from system drainage/leakage, water treatment activities, housekeeping and cleaning wastes, stormwater runoff, and floor and yard drains. These wastes are treated by sedimentation, skimming, precipitation, neutralization, and mixing before being discharged to Lake Wylie (Duke 2001a). Sanitary wastes are treated in an aerated facultative lagoon followed by an effluent polishing basin. The treated sanitary wastes are discharged into Lake Wylie through the station discharge structure (NRC 1983).

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation. Maintenance activities conducted at Catawba include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating, but 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. Duke refuels each of the Catawba units every 18 to 24 months (Duke 2001a). Each outage is typically scheduled to last approximately 30 to 40 days, and the outage schedules are staggered so that both units are not shut down at the same time. One-third of the core is replaced at each refueling. Approximately 500 additional workers are onsite during a typical outage (Duke 2001a).

Duke provided an appendix in *Duke Energy Company Catawba Nuclear Station Updated Final Safety Analysis Report* (Duke 2000a) regarding the aging management review to manage the effects of aging on systems, structures, and components in accordance with 10 CFR Part 54. Chapter 3 and Appendix B of the Catawba license renewal application specify the programs and activities that will manage the effects of aging during the license renewal period (Duke 2001a). Duke expects to conduct activities related to the management of aging effects during plant operation or during normal refueling and other outages, but no outages specifically for refurbishment activities are planned. Duke has no plans to add additional full-time staff (non-outage workers) at the plant during the period of the renewed licenses.

2.1.7 Power Transmission System

Catawba has five 230-kV transmission lines leaving the site from the switch yard (NRC 1983, Duke 2001a). The five lines (Table 2-1) are contained within rights-of-way ranging from 35 to 46 m (115 to 150 ft) in width and from 1 to 40 km (0.7 to 24.4 mi) in length covering a total of approximately 295 ha (730 ac) (Duke 2001a, NRC 1983). The rights-of-way extend out from Catawba to the north, south, and west (Figure 2-4). The lines and rights-of-way were constructed or rebuilt between 1973 and 1983.

Duke owns less than 10 percent of the rights-of-way and has easements for the remaining 90 percent. Vegetation in the rights-of-way is managed through a combination of mechanical and herbicide treatments (Duke 2001a). Initial treatments include mowing and/or treatment with Arsenal (imazapyr) and Accord (glyphosate). Spot treatments then are applied once every 3 years using Arsenal, Accord, Garlon4A, and Krenite. Herbicide treatments in wetlands are limited to Arsenal and Accord, which are approved for use in wetlands. In addition, Duke cooperates with the South Carolina Department of Natural Resources (SCDNR) regarding

Table 2-1. Catawba Transmission Line Rights-of-Way

Line	Direction	kV	Length		Width		Area	
			km	(mi)	m	(ft)	ha	(ac)
Catawba-Allen	N	230	17.5	(10.9)	46	(150)	80	(198)
Catawba-Ripp	W	230	39.3	(24.4)	44	(145)	173	(426)
Catawba-Pacolet[a]	W	230	1.9	(1.2)	46	(150)	9	(22)
Newport (Allison Creek)	S	230	1.1	(0.7)	43	(140)	5	(12)
Newport (Newport)	S	230	8.4	(5.2)	35	(115)	29	(72)
Total			75.7	(42.4)			296	(731)

(a) An additional 64.4 km (40.1 mi) of line existing prior to construction of Catawba is shared but is not part of Catawba transmission system.

conservation easements and partners with The Wildlife Federation on vegetation management in some portions of the rights-of-way.

2.2 Plant Interaction with the Environment

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

2.2.1 Land Use

The Catawba site is located in the north-central portion of South Carolina 1.6 km (1 mi) west of the North Carolina-South Carolina state line and is situated within the Piedmont physiographic province. The power station is in northeastern York County, adjacent to Lake Wylie, and is approximately 16 km (10 mi) northeast of York, the county seat. The site is situated in the center of a peninsula about 1.6-km (1-mi) wide and 4.8-km (3-mi) long that protrudes into Lake Wylie, a body of water extending 45 km (28 mi) in length between dams and having a surface area of 4916 ha (12,139 ac) at normal operating level. Lake Wylie was formed by impounding the water of the Catawba River. Full pond was achieved in 1904, and an increase in dam

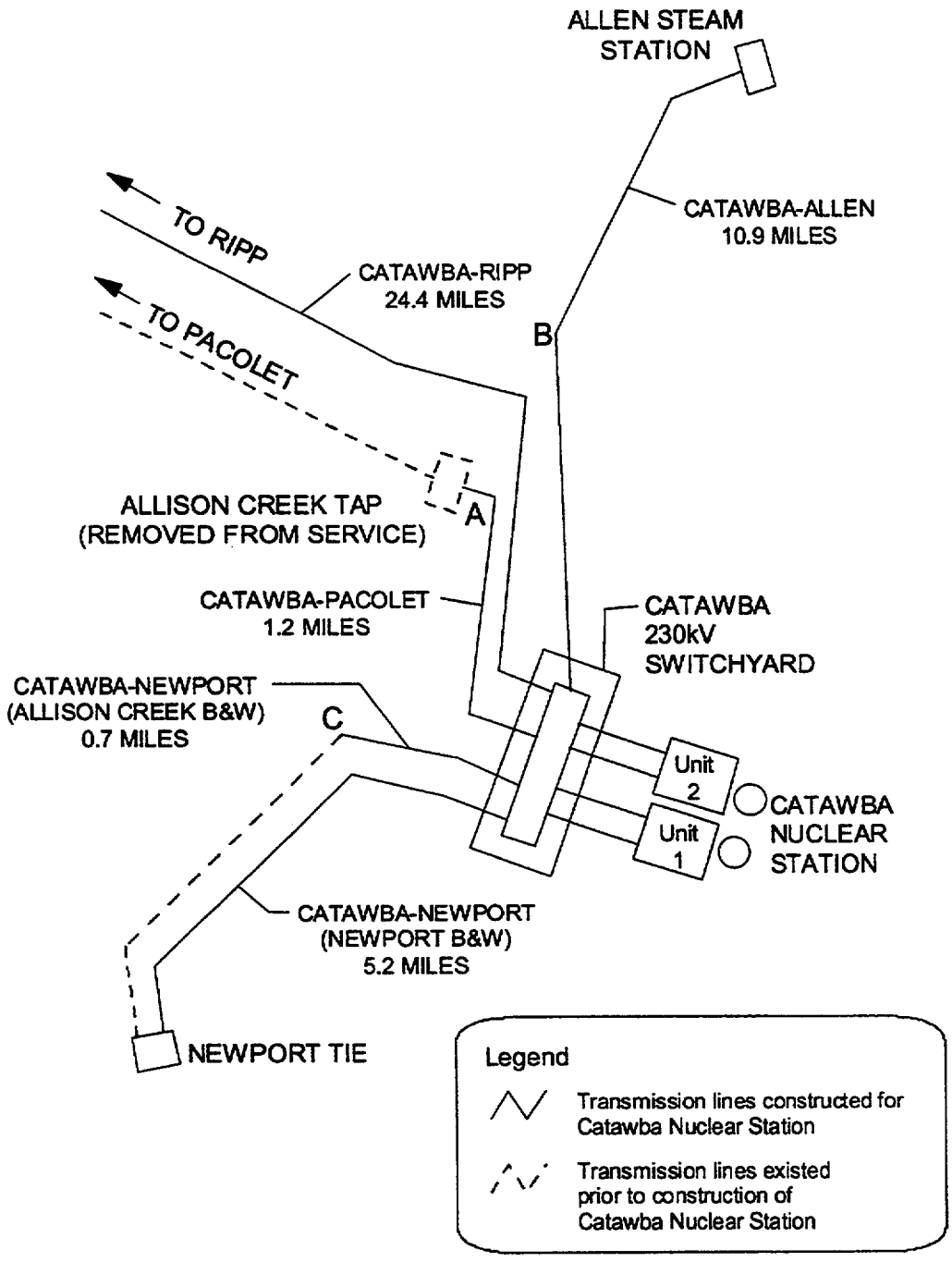

Figure 2-4. Catawba Transmission Lines and Rights-of-Way (Duke 2001a)

elevation in 1924 raised the water level and increased the size of the lake. Duke owns the land that underlays the lake up to the high-water mark. The lake level fluctuates in accordance with hydroelectric generation needs. Lake Wylie is a source of drinking water for several municipalities and supports extensive recreational use by fisherman, boaters, water skiers, and swimmers.

The total land area occupied by the site is 158 ha (391 ac) of which 106 ha (262 ac) is non-forested and contains generation, maintenance, and distribution facilities; a visitors center and lookout area; parking lots; open water; roads; a railroad line; and a fenced cemetery. A recreation park and boat launch for Duke employees is located on a small peninsula protruding into Lake Wylie. Plans for an independent spent fuel storage installation are in the early stages of development and involve use of land presently used for other station purposes. There are approximately 51 ha (125 ac) of pine and pine-mixed hardwood forests. Forests cover the majority of the land area in the region surrounding the site. Most of the land within 8 km (5 mi) of the station is level to rolling with elevations ranging from 183 to 213 m (600 to 700 ft) above mean sea level with a few hills reaching 244 m (800 ft) in elevation.

The land occupied by Catawba is in unincorporated York County. York County and its municipalities currently have land-use plans and zoning requirements that govern development activities within the county.

2.2.2 Water Use

Catawba uses water from Lake Wylie for cooling and service water. Lake Wylie is the seventh of 11 impoundments in the 410-km (255-mi) Catawba-Wateree Project managed by Duke and licensed by the Federal Energy Regulatory Commission (FERC). Lake Wylie extends 45 km (28 mi) upstream from Wylie Dam to Mountain Island Dam. Flow through the Catawba-Wateree Project is managed by Duke to optimize hydroelectric generation, provide flood control, meet FERC minimum release requirements, and maintain a constant and reliable water supply for thermoelectric generating stations, surrounding communities, and industry. Lake Wylie has a storage volume of 3.48×10^8 m^3 (281,900 ac-ft) and a mean depth of 7 m (23 ft). The minimum daily release from Wylie Dam is 11.6 m^3/s (411 cfs).

As mentioned in Section 2.1.3, during operation, the average daily withdrawal from Lake Wylie is 380 million L/d (102 MGD), and the average daily discharge back into Lake Wylie from Catawba is 230 million L/d (60.7 MGD). During full-power operation, the water loss of 156 million L/d (41.3 MGD), or equivalently 1.81 m^3/s (64 cfs), results from evaporation and drift from the cooling towers. From 1997 through 1999, the average overall annual consumptive use of water from the Catawba River by Catawba was approximately 1.47 m^3/s (52 cfs). The mean flow in the Catawba River (below Wylie Dam) is 124 m^3/s (4390 cfs); therefore, evaporation and

drift from Catawba from 1997 to 1999 represented a decrease of 1.46 percent in the long-term mean annual flow below Wylie Dam.

There are a total of three groundwater supply wells at the Catawba site. These wells supply water on a periodic basis to remote locations and for seasonal irrigation. The average annual groundwater withdrawal rate from these wells is 1.89 L/s (30 gpm). In addition to the groundwater wells, a dewatering system is used to reduce the hydrostatic pressures on the reactor and auxiliary buildings. The drainage system permanently maintains a groundwater level at or near the base of the foundation mat and basement walls, thus eliminating the hydrostatic forces. This groundwater drainage system consists of foundation underdrains and continuous exterior wall drains. The foundation underdrains and exterior wall drains discharge into three sumps. On a yearly basis, the average groundwater drainage discharge from these sumps is 2.15 L/s (34 gpm); therefore, total average annual groundwater use at Catawba is 4.04 L/s (64 gpm).

Potable water for Catawba is provided by the city of Rock Hill.

2.2.3 Water Quality

As Lake Wylie is situated in both North Carolina and South Carolina, both states are involved in the protection, from a watershed perspective, of the Lake Wylie's water quality. Lake Wylie exhibits thermal and oxygen dynamics similar to other southeastern reservoirs of comparable size, depth, flow conditions, and trophic status. Lake Wylie supports a good warm-water fishery.

Pursuant to the Federal Water Pollution Control Act (FWPCA) of 1977, also known as the Clean Water Act, the water quality of the plant effluents is regulated through the National Pollutant Discharge Elimination System (NPDES). The South Carolina Department of Health and Environmental Control (SCDHEC) is the agency delegated to issue NPDES permits. The current permit (SC0004278) was issued April 30, 2001, and is due to expire April 30, 2006. Any new regulations promulgated by EPA or the SCHDEC would be included in future permits.

The temperature of the discharge to Lake Wylie is one aspect of the discharge regulated by the NPDES permit. For temperature, discharge limitations are specified as an allowable temperature rise (between intake and discharge) of 5.6°C (10°F) for the months of April through September and 7.8°C (14°F) from October through March.

2.2.4 Air Quality

The site is located in the north-central region of South Carolina at the very southern end of a region known as the Piedmont. In this region, the basic climatic classification is subtropical where a majority of the rainfall occurs in the summer creating some periods of unpleasantly humid conditions. The winter season is generally pleasant and attracts migratory birds. A feature unique to this climatic area is the occasional entry of very cold air masses during the winter season plunging temperatures well below freezing with resulting calamitous effects on the vegetation in the region. Temperatures in the region rarely exceed 35°C (95°F) or fall below -12°C (10°F). The best available extreme temperature data for the region (Charlotte, North Carolina) indicates the highest recorded temperature being 40°C (104°F), with the lowest reported temperature being -20.5°C (-5°F). The average precipitation in the region is 109 cm (43.1 inches) per year, which is evenly distributed throughout the year.

Normally, about 42 thunderstorms per year occur in the region (NOAA 1983). A vast majority of these storms occur during the months of May through September (34 of the 42). The most recent severe weather event was Hurricane Fran in August 1996. Based on statistics for the 30 years from 1954 through 1983, on the average, only 9 tornadoes are expected to occur in the state of South Carolina during the course of a year (Ramsdell and Andrews 1986). The probability of a tornado striking the site is calculated to be about 1×10^{-4} per year.

The wind energy resource in the vicinity of the site is limited, with the annual average wind power rated as 1 on a scale of 1 to 7 (Elliott et al. 1987). Wind turbines are economical for wind power classes 4 through 7 that have average wind speeds of 5.6 to 9.4 m/s (12.5 to 21.1 mph; DOE 2001a). Areas suitable for wind turbine application in South Carolina are limited to the ridges along the Blue Ridge Mountains in the extreme northwest corner of the state.

The Catawba site is located in Metropolitan Charlotte Interstate Air Quality Control region (40 CFR 81.75). This region is designated as in-attainment or unclassified for all criteria pollutants in 40 CFR 81.334 except for the EPA's reinstated 1-hr ozone standard. The County is at risk of being classified as non-attainment regarding ozone in the future if a new 8-hr standard is implemented. The Cape Romain Area is the only area in South Carolina designated in 40 CFR 81.426 as a mandatory Class I Federal area in which visibility is an important value. There are more Class I areas located in North Carolina (40 CFR 81.422), but a vast majority are located in the region of the North Carolina-Tennessee border in the Smoky Mountains. None of these areas are within 80 km (50 mi) of the site.

Diesel generators, boilers, and other activities and facilities associated with Catawba operations emit various pollutants. Emissions from these sources are regulated under air quality permit number 2440-0070 issued by SCDHEC (Appendix E). This permit expires on December 31, 2005.

2.2.5 Aquatic Resources

Aquatic resources in the vicinity of Catawba are associated with Lake Wylie and the Catawba River. Lake Wylie, which serves as the cooling water source for Catawba, extends 45 km (28 mi) in length between Mountain Island Dam in North Carolina and Wylie Dam in South Carolina. Mountain Island Lake and Lake Wylie, which are part of the Catawba-Wateree Project, are owned and operated by Duke and are licensed by the Federal Energy Regulatory Commission (FERC) as FERC Project 2232. The Catawba-Wateree Project consists of 11 lakes on the Catawba River, which are operated for hydroelectric power. Lake Wylie is the third largest lake in the Catawba River chain (Duke 2001a). Tributaries for Lake Wylie include the Catawba River, Allison Creek, Mill Creek, Crowders Creek, and the South Fork Catawba River (NCDENR 1999; SCDHEC 1999).

Upon leaving Lake Wylie, the Catawba River flows about 40 km (25 mi) south to Landsford Canal (Figure 2-1). This reach is a substantial portion of the 67 km (42 mi) of the Catawba River's total 360 km (225 mi) upstream of Lake Wateree Dam that remains free-flowing (Duke 2000b). The Catawba River then continues to Lake Wateree, the lowermost lake of the Catawba-Wateree Project, which is about 80 km (50 mi) south of Wylie Dam. Lake Wylie and the Catawba River are part of the Santee-Cooper drainage unit (Warren et al. 2000). Counties directly adjacent to Lake Wylie, adjacent to the immediate reaches of the Catawba River upstream and downstream of Lake Wylie, or with tributaries into the immediate adjacent reaches of the Catawba River include Gaston, Mecklenburg, and Union Counties in North Carolina and York, Chester, and Lancaster Counties in South Carolina. Besides serving as the cooling water source for Catawba, Lake Wylie is the source of municipal drinking water for several cities in the region and is used extensively by fisherman, boaters, water skiers, and swimmers (Duke 2001a).

Lake Wylie was formed from the impoundment of the Catawba River by Duke's Wylie Dam and initially achieved full pond volume in 1904; however, the dam was raised 15 m (50 ft) in 1924 (NRC 1983). It is reasonably shallow (mean depth of 7 m [23 ft], maximum depth of 28.4 m [93.2 ft]) and has a full pond surface area of 4916 ha (12,139 ac), a full pond volume of 348 million m^3 (281,900 ac-ft), a shoreline length of 526 km (327 mi), and a drainage area of 7822 km^2 (3020 mi^2). The annual mean flow at Wylie Dam is 106.9 m^3/s (3774 ft^3/s) with a minimum average daily flow (as specified by FERC) of 11.6 m^3/s (411 ft^3/s). Maximum drawdown is 3 m (10 ft) (Duke 2001a).

Lake Wylie is typical of many shallow impoundments in the Piedmont physiographic province region. Since impoundment, it has gone through the typical ecological succession experienced by all man-made reservoirs in which the biotic community initially is highly productive and then decreases in production until it reaches ultimate stability (Paterson and Fernando 1970; Voschell and Simmons 1978). Lake Wylie had achieved a degree of stability by the time initial

aquatic studies were conducted (NRC 1983). More recent monitoring shows the aquatic community remains relatively stable (Duke 2001a, 2002a,b).

Duke's periodic biota monitoring program at Lake Wylie includes surveys of phytoplankton, zooplankton, and fisheries (Duke 2002a). The lake shows a pattern of aquatic organism distribution between up-lake and down-lake locations that is atypical from similar lakes. Up-lake locations are typically more diverse and productive due to the influx of nutrients from upstream, which are consumed further down-lake. However, the South Fork Catawba River, a major tributary, contributes substantial nutrient loads to lower Lake Wylie, and thus contributes to the unusual distribution of aquatic organisms (Duke 2001a).

Lake Wylie supports numerous phytoplankton, zooplankton, and macroinvertebrate communities. Ten phytoplankton classes comprising 114 genera and 293 species and varieties have been observed (Duke 1993). Cryptophyic algae, blue-green algae, green algae, and diatoms dominate, forming a generally stable community whose densities and relative importance change seasonally (Duke 1993, 2001a). The dominant zooplankton genera in Lake Wylie are primarily planktonic or limnetic species characteristic of most North American reservoirs (NRC 1983). Thirty-three taxa have been identified, with major groups including Rotifera (rotifers), Copepoda (copepods), and Cladocera (cladocerans) (Duke 1993).

A total of 88 macroinvertebrate taxa have been reported from Lake Wylie in the vicinity of Catawba (NRC 1983). Midges (Chironomidae) are the most diverse group, typically dominating macroinvertebrate assemblages (Duke 1993). The most abundant chironomid genera are *Coelotanypus*, *Chironomus*, *Tanytarsus*, *Ablesmyia*, and *Cryptochironomus* (Duke 1993). There are a few native freshwater mussels (primarily Unionids) in Lake Wylie (Duke 1988, 2001a). The only mussel of any abundance is the introduced Asiatic clam (*Corbicula sp.*). No consistent spatial trend in the Asiatic clam standing crop has been observed in Lake Wylie in previous studies (Duke 1993). Current Asiatic clam monitoring focuses on clam densities at the intake screen conducted to assess impacts to plant operations from its presence.

A total of 49 fish species from 10 families have been reported at Lake Wylie since sampling began in 1973 (Duke 1988). Dominant species include threadfin shad (*Dorosoma petenense*), gizzard shad (*D. cepedianum*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), redbreast sunfish (*L. auritus*), pumpkinseed (*L. gibbosus*), redear sunfish (*L. microlophus*), black crappie (*Pomoxis nigromaculatus*), white catfish (*Ameiurus catus*), channel catfish (*Ictalurus punctatus*), and yellow perch (*Perca flavescens*). Data collected between 1978 and 1979 found largemouth bass accounted for the greatest biomass of all species collected at locations near the Catawba site, whereas threadfin shad were the most numerous (NRC 1983). In studies conducted through 1993, gizzard shad, threadfin shad, and bluegill were the dominant species observed in cove rotenone sampling, white catfish and gizzard shad were the species captured most frequently in gill netting, and bluegill and red-

breast sunfish most frequently captured during electro-fishing (with threadfin shad and gizzard shad occasionally common). Threadfin shad was the dominant forage fish from 1993 to 1997 and comprised from 99.8 to 100 percent of the forage fish in purse seine hauls (Duke 2002a). Forage fish densities ranged from 1692 (1997) to 115,432 fish/ha (1993) (677 to 46,173 fish/ac, respectively). Total population estimates ranged from about 15 million (1997) to 403 million (1993). Between 1993 and 1997, the Lake Wylie littoral (shoreline) fish community, measured as mean total biomass, ranged from approximately 70 to160 kg fish/1000 m (250 to 570 lbs/mi) of shoreline electro-fished with a trend of decreasing biomass progressively downstream (Duke 2002b). Sunfish, catfish, and common carp (*Cyprinus carpio*) compose the majority of the biomass at all shoreline locations (Duke 2002b). Historic differences in species composition can be attributed to differences in areas sampled, sampling frequency, and sampling technique. Current fish monitoring consists of hydroacoustic and purse sein sampling and shoreline electro-fishing at 3-year intervals at locations that allow comparison to historic data (Duke 2002a, 2002b).

Lake Wylie supports a good warm-water fishery. The resident species generally favor the relatively stable water levels that are maintained in the reservoir (Duke 2001a). Game fish of the Centrarchid (sunfish) family (redbreast sunfish, pumpkinseed, bluegill, redear sunfish, largemouth bass, and black crappie) need relatively stable water levels during their springtime spawning seasons. Duke, in cooperation with SCDNR, implements a reservoir water level stabilization program each spring to ensure stable water levels during the spawning season for largemouth bass and other members of the Centrarchid family (Duke 2001a). White bass (*Morone chrysops*, a member of the Percichthyidae family) is the only fish species that makes an appreciable spawning run in Lake Wylie. This spawning run, which occurs during the February through April time period, is most evident in the area of Dutchman's Creek, which enters Lake Wylie on the extreme northwestern side of the reservoir. In the past few years, both blue catfish (*Ictalurus furcatus*) and flathead catfish (*Pylodictis olivaris*) have established populations in Lake Wylie (Duke 2001a). These fish are apparently migrants from upstream reservoirs and are presently represented by sparse populations. However, both populations are expanding and their predatory nature may eventually impact other species of fish (primarily other ictalurids) in Lake Wylie.

Table 2-2 lists Federal special status aquatic species found in Gaston, Mecklenburg, and Union Counties in North Carolina and York, Cherokee, Lancaster, and Chester Counties in South Carolina (Gaddy 2001, SCDNR 2001, North Carolina Atlas of Freshwater Mussels and Endangered Fish 2001, FWS 2002). No Federally listed fish species occur in counties immediately adjacent to Lake Wylie, counties adjacent to the Catawba River immediately upstream or downstream of Lake Wylie, or tributary streams crossed by Catawba transmission lines (York and Cherokee Counties). The Carolina darter (*Etheostoma collis*), a Federally-listed species of concern, has been found in small to medium-sized streams 2-3 ft (0.6-0.9 m) deep

Table 2-2. Aquatic Species as Endangered or Threatened by the FWS and Species that are Candidates for FWS Listing as Threatened or Endangered or are Considered Species of Concern by FWS Potentially Occurring in Gaston, Mecklenburg, and Union Counties in North Carolina, and York, Cherokee, Lancaster, and Chester Counties in South Carolina

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Fish			
Etheostoma collis	Carolina darter	SOC	SC-SOC
Freshwater mollusks			
Lasmigona decirata	Carolina heelsplitter	E	NC-E SC-E
Alasmidonta varicosa	Brook floater	SOC	NC-E SC-SOC

(a) SC = South Carolina, NC = North Carolina, E = endangered, SOC = species of concern

from backwater pools or near stream banks in slow moving water (Collette 1962). It has not been collected from Lake Wylie in the vicinity of Catawba.

The Carolina heelsplitter (*Lasmigona decorata*), a Federally listed endangered freshwater mollusk that is also listed as endangered by both North and South Carolina, occurs downstream of Lake Wylie. All known populations of this species occur in the Pee Dee, Catawba, and Savannah River systems (FWS 1996; FWS 2001). All known populations in the Catawba River system occur in tributary streams to the Catawba River downstream of Lake Wylie. Areas containing these populations comprise two of the six units proposed as critical habitat (FWS 2001). Unit 2 consists of a 20-km (12-mi) stretch of Waxhaw Creek in Union County, North Carolina. Waxhaw Creek enters the Catawba River just above Landsford Canal (Figure 2-1), about 24 to 32 km (15 to 20 mi) downstream of Wylie Dam. Unit 3 consists of a 10-km (6-mi) stretch of Gill Creek in Lancaster County, South Carolina. Flow from Gill Creek combines with Bear Creek just outside of the town of Lancaster (Figure 2-1), then joins Crane Creek before entering the Catawba River just below Landsford Canal about 48 km (30 mi) downstream from Wylie Dam. Three locations in the Catawba River downstream of Wylie Dam were surveyed for Carolina heelsplitter on October 26, 2001, by the FWS, NCDENR, and the North Carolina Department of Transportation (Duke 2002c). The locations surveyed included the river immediately below Lake Wylie Dam and the river at the I-77 bridge. The Catawba River at Landsford Canal State Park could not be surveyed due to high turbidity. No Carolina heelsplitter were found in this survey, and none have been observed in monitoring programs or surveys of Lake Wylie.

In addition, there are several aquatic species identified by North and South Carolina as state species of concern (rare species that have no legal protection) with potential to occur in the Catawba River system in counties in the vicinity of Lake Wylie. None of the species have been reported in monitoring or survey data from Lake Wylie.

2.2.6 Terrestrial Resources

The Catawba Nuclear Station is located in the Piedmont physiographic province (Bailey 1980). Common vegetation types on the Catawba site and the transmission line rights-of-way are pine *(Pinus* sp.), pine-mixed hardwood, mixed hardwoods, and bottomland hardwoods (Duke 2001a). Currently, ornamental plantings, parking areas, and facilities make up about 67 percent of the 183-ha (450-ac) Catawba Site. Thirty-two percent is forest habitat; and less than one percent is wetland habitat (Duke 2001a). Several of the ravines have mature mixed hardwood stands that include chalk maple (*Acer leucoderme*). In addition, many of the chalk maple stands in open dry bluff areas are dominated by black oak (*Quercus velutina*) rather than the more typical chestnut oak (*Quercus prinus*). The wetlands on the site are associated with beaver ponds, seeps, creeks, artificial impoundments, and Lake Wylie (Duke 2001a). Duke's environmental policies prohibit construction work in the wetlands and limit activities in woodlands.

Disturbed pastures and old fields are the dominant vegetation types in the transmission line rights-of-way with bluestems (*Andropogon* sp.), wire-grasses (*Aristida* sp.), asters (*Aster* sp.), sunflowers (*Helianthus* sp.), and goldenrods (*Solidago* sp.). Trees such as tag alder (*Alnus serrulata*) and black willow (*Salix nigra*) are common around seeps and ponds. These herbaceous communities in the transmission line rights-of-way are maintained by mowing and spot herbicide treatments.

Wetlands are found on portions of the transmission line rights-of-way and at the power station. These wetlands are small, and at the power station, they primarily are associated with Lake Wylie. Duke avoids these areas when possible during vegetation management activities, transmission line maintenance, and site maintenance, and consults with the U.S. Army Corps of Engineers as needed to comply with Section 404 of the Clean Water Act.

Eleven Federal and 14 State-listed threatened, endangered, and candidate species occur or potentially may occur at Catawba or along the transmission line rights-of-way (Duke 2001a, North Carolina 2001a, South Carolina 2001, FWS 2002). In addition, there are many species identified as species of concern (rare species that have no legal protection) that potentially may occur at the Catawba site or along the transmission line rights-of-way. Based on field surveys (Duke 2001a), no protected species, critical habitat, or species of concern are known to occur on the Catawba site or the transmission line rights-of-way, with the exception of the bald eagle (*Haliaeetus leucocephalus*). Eagles rarely are sighted near Catawba, and there are no known

nesting sites on the site or its transmission line rights-of-way (Duke 2001a). Dwarf-flowered heartleaf (*Hexastylis naniflora*) has been identified in Cherokee County and habitat exists within the transmission line corridors. However, no plants have been observed on Catawba or the transmission line corridors. Georgia aster *(Aster georgianus)* has been found near the Allison Creek transmission line corridor, however, no plants have been found in any of the corridors or at the Catawba site. Table 2-3 lists the State- and Federal-protected species and their status.

2.2.7 Radiological Impacts

Duke has conducted a radiological environmental monitoring program (REMP) around the Catawba site since 1981 (Duke 2001c). The radiological impacts to workers, the public, and the environment have been routinely monitored, documented, and compared to the appropriate standards. The objectives of the REMP are:

- provide surveillance of detailed effluent monitoring to evaluate the significance, if any, of the contributions to the existing environmental radioactivity levels that result from station operation (Duke 2001c)

- detect and identify changes in environmental levels as a result of station operations (Duke 2001c)

- provide representative measurements of radiation and radioactive materials in the exposure pathways for the radionuclides that have the highest potential for radiation exposures of members of the public (Duke 2000a)

- implement Section IV.B.2 of Appendix I to 10 CFR Part 50, verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways (Duke 2000a).

Radiological releases are summarized in the annual reports *Catawba Nuclear Station, Units 1 and 2, Annual Radiological Environmental Operating Report* (Duke 2001c) and *Catawba Nuclear Station Annual 2000 Radioactive Effluent Release Report* (Duke 2001d). The limits for all radiological releases are specified in the Catawba ODCM (Duke 2001b), and these limits are designed to meet Federal standards and requirements. The REMP includes monitoring of the air, direct radiation, surface water, drinking water, groundwater, shoreline sediment, milk, fish, broadleaf vegetation, and food products in about a 24-km (15-mi) radius of the station.

Review of historic data on releases and the resultant dose calculations revealed that the doses to maximally exposed individuals in the vicinity of the Catawba site were a small fraction of the

Table 2-3. Terrestrial Species Listed as Endangered, Threatened, Candidate, or Federal Species of Concern by the FWS, South Carolina, or North Carolina that Occur or Potentially Occur at Catawba or Its Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Reptiles			
Clemmys muhlenbergii	bog turtle	T	NC-T
Birds			
Haliaeetus leucocephalus	bald eagle	T	SC/NC-E
Picoides borealis	red-cockaded woodpecker	E	SC/NC-E
Mammals			
Myotis austroriparius	Southeastern myotis	SOC	SC-T
Vascular Plants			
Amphianthus pusillus	pool sprite	T	SC-T
Aster georgianus	Georgia aster	C	NC-T
Delphinium exaltatum	tall larkspur	SOC	NC-E
Echinacea laevigata	Smooth coneflower	E	SC/NC-E
Helianthus schweinitzii	Schweinitiz's sunflower	E	SC/NC-E
Hexastylis naniflora	dwarf-flowered heartleaf	T	SC/NC-T
Hymenocallis coronaria	shoals spider-lily	SOC	SC/SOC
Isoetes virginica	Virginia quillwort	SOC	NC-SOC
Isoetes melanospora	black-spored quillwort	E	SC-E
Lotus helleri	Heller's trefoil	SOC	NC-T
Oxypolis canbyi	Canby's dropwort	E	SC-E
Rhus michauxii	Michaux's sumac	E	NC-E
Rudbeckia heliopsidis	sun-facing coneflower	SOC	SC-SOC

(a) SC = South Caroline, NC = North Carolina, E = endangered, T = threatened, C = candidate., SOC = species of concern

limits specified in the EPA's environmental radiation standards 40 CFR Part 190 as required by 10 CFR 20.1301(d). For 2000 (the most recent year that data were available), dose estimates were calculated based on actual liquid and gaseous effluent release data (Duke 2001c) and on measured concentrations of radionuclides from the REMP (Duke 2001c). Dose estimates based on effluent data were performed using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM.

A breakdown of maximum dose to an individual located at the Catawba site boundary from effluent-based releases and environmental-based releases for the year 2000 are summarized in Duke (2001c) is as follows:

- Total body dose from liquid effluent-based estimates was 4.37E-4 mSv (4.37E-2 mrem) compared to 7.31E-4 mSv (7.31E-2 mrem) from environmental-based estimates. These estimates were approximately 1 percent of the 0.06-mSv (6-mrem) dose limit[(a)]. The maximum total organ dose for the liquid effluent-based estimates was 1.21E-3 mSv (1.21E-1 mrem) to the adult gastrointestinal tract-lower large intestine (GI-LLI) compared to 3.28E-3 mSv (3.28E-1 mrem) to the adult GI-LLI from the environmental-based estimates. These estimates were between 0.6 and 1.6 percent of the 0.20-mSv (20-mrem) dose limit (Duke 2001c).

- The air dose due to noble gases in gaseous effluents was 3.38E-4 mGy (3.38E-2 mrad) gamma (0.17 percent of the 0.20-mGy [20-mrad] gamma dose limit)[(a)] and 7.37E-4 mGy (7.37E-2 mrad) beta (0.18 percent of the 0.40-mGy [40-mrad] beta dose limit; Duke 2001c). Noble gases are not collected as part of the REMP; therefore, an environmental-based estimate was not calculated (Duke 2001c).

- The critical organ dose from gaseous effluents due to iodine-131, iodine-133, tritium, and particulates with half-lives greater than 8 days is 1.21E-2 mSv (1.21 mrem), which is 4 percent of the 0.30-mSv (30-mrem) dose limit (Duke 2001c).

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

(a) The dose limit is twice the dose limit in 10 CFR Part 50, Appendix I, because the limit is per reactor unit and Catawba has two operating reactor units.

2.2.8 Socioeconomic Factors

The staff reviewed the Catawba ER (Duke 2001a) and information obtained from several county, city, and economic development staff during a site visit to York County from October 22 through 26, 2001. The following information describes the economy, population, and communities near the Catawba site.

2.2.8.1 Housing

The full-time work force at Catawba is approximately 1218 employees, which includes permanent and contractor staff. Approximately 55 percent of these employees live in York County, South Carolina; 15 and 14 percent live in Gaston and Mecklenburg Counties, North Carolina, respectively; and the rest live in other locations (Table 2-4; Duke 2001a). Table 2-5 presents a further breakdown of employee residency by city and county. Since over half of the Catawba employees live in York County, the focus of the socioeconomic analysis for the most part is on that county.

Table 2-4. Catawba Permanent and Contractor Employee Residency by County

County	Number of Personnel	Percent of Total Personnel
York (SC)	673	55
Gaston (NC)	188	15
Mecklenburg (NC)	166	14
Other – NC	95	8
Other – SC	96	8
Total	1218	100

Source: Duke 2001a.

Table 2-5. Catawba Permanent and Contractor Employee Residency by County and City

County and City	Duke Power
YORK COUNTY, SOUTH CAROLINA	
Clover	76
Fort Mill	52
Lake Wylie	13
Rock Hill	362
York	131
Other Cites and Towns	39
Total York County	673

Table 2-5. (contd)

County and City	Duke Power
GASTON COUNTY, NORTH CAROLINA	
Belmont	34
Dallas	11
Mount Holly	15
Stanley	8
Gastonia	104
Other Cites and Towns	16
Total Gaston County	188
MECKLENBURG COUNTY, NORTH CAROLINA	
Charlotte	141
Huntersville	6
Matthews	11
Pineville	6
Other Cites and Towns	2
Total Mecklenburg County	166
CHEROKEE COUNTY, SOUTH CAROLINA	
Gaffney	27
Other Cites and Towns	4
Total Cherokee County	31
CHESTER COUNTY, SOUTH CAROLINA	
Chester	13
Other Cites and Towns	7
Total Chester County	20
LANCASTER COUNTY, SOUTH CAROLINA	
Lancaster	16
Other Cites and Towns	3
Total	19
UNION COUNTY, NORTH CAROLINA	
Other Cites and Towns	17
CABARRUS COUNTY, NORTH CAROLINA	
Concord	6
Harrisburg	5
Kannapolis	3
Total	14
CLEVELAND COUNTY, NORTH CAROLINA	
Kings Mountain	15
Shelby	7
Other Cites and Towns	3
Total	25

Table 2-5. (contd)

County and City	Duke Power
LINCOLN COUNTY, NORTH CAROLINA	
Denver	7
Lincolnton	15
Other Cites and Towns	3
Total	25
Other Counties	
North Carolina	31
South Carolina	9
Total	1,218

Source: Duke 2001a.

Duke refuels each reactor at Catawba on an 18- to 24-month cycle. During refueling outages, an average of 1400 workers are onsite during the day shift, compared to a norm of 900 workers onsite during normal plant operations (Duke 2001a).

Table 2-6 provides the number of housing units and housing unit vacancies for York, Gaston, and Mecklenburg Counties for 1990 and 2000. York County has an urban development boundary within which development is to take place, but otherwise, it does not have growth-management controls.

Table 2-6. Total, Occupied, and Vacant (Available) Housing Units by County 1990 and 2000

	1990	2000	Approximate Percentage Change
YORK COUNTY, South Carolina			
Housing Units	50,438	66,061	31.0
Occupied Units	47,006	61,051	29.9
Vacant Units	3,432	5,010	46.0
GASTON COUNTY, North Carolina			
Housing Units	69,133	78,842	14.0
Occupied Units	65,347	73,936	13.1
Vacant Units	3,786	4,906	29.6
MECKLENBURG COUNTY, North Carolina			
Housing Units	216,416	292,780	35.3
Occupied Units	200,219	273,416	36.6
Vacant Units	16,197	19,364	19.6

Sources: USCB 2000; USCB 1990.

Table 2-7 contains data on population, estimated population, and annual growth rates for York County, South Carolina, and Mecklenburg and Gaston Counties, North Carolina.

Table 2-7. Population Growth in York County, South Carolina, and Mecklenburg and Gaston Counties, North Carolina, 1970 to 2020

	York County		Mecklenburg County		Gaston County	
	Population	Annual Growth Percent[a]	Population	Annual Growth Percent	Population	Annual Growth Percent
1970	85,216	--	354,656	--	148,415	--
1980	106,720	2.3	404,270	1.3	162,568	0.9
1990	131,497	4.4	511,433	2.4	175,093	0.7
2000	164,614	2.3	695,454	2.5	190,365	0.8
2010	184,800	1.2	888,137	2.5	203,623	0.7
2020	211,500	1.4	1,089,258	2.1	215,587	0.6

(a) Annual percent growth rate is calculated over the previous decade.
-- = Data not available.
Sources: USCB 2000; USCB 1990; North Carolina 2001b.

2.2.8.2 Public Services

Public services include water supply, education, and transportation.

- **Water Supply**

  Table 2-8 summarizes the daily consumption and areas served for each of the two water systems within York County, the county most impacted by the re-licensing of Catawba. The county is served by two interconnected water systems–the eastern and western systems. The western system includes the town of York water treatment plant. The municipal water reservoir, which produces malodorous water when it turns over once each year, is the only source of drinkable water for the town of York. The town will soon remedy the problem through the construction of a new water treatment plant (York County 1999).

  Water treated by the town of York is purchased by York County for the unincorporated parts of the county. From the town of York, York County mains carry water through the central part of the county. The system branches off along Mount Gallant Road to Museum Road, where it connects to the city of Rock Hill water system and becomes the eastern part of the system. The central portion of the western system also branches off to the Catawba site and serves the Lake Wylie area.

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

Water System	Source	Maximum Daily Capacity m^3/day (MGD)	Average Daily Capacity m^3/day (MGD)	Areas Served
City of Rock Hill[a]	Lake Wylie	75,400 (20.0)	52,780 (14.0)	Rock Hill, Fort Mill, and unincorporated parts of York County
Town of York[b]	Lake Wylie	9048 (2.4)	4524 (1.2)	York, Lake Wylie, Catawba site, and unincorporated parts of York County

(a) Personal communication, Susan Featherstone, city of Rock Hill, South Carolina, November 28, 2001.
(b) Personal communication, Charles Helms, Director of Public Works, town of York, South Carolina, December 3, 2001.

The city of Rock Hill also has a water treatment plant and serves the eastern part of the county. York County purchases water from Rock Hill, and Rock Hill also sells water to the town of Fort Mill, which transports the water through its own lines to the York County water district where it is sold (York County 1999).

In addition, York County buys water from the Charlotte-Mecklenburg Utility District, North Carolina. This arrangement was initiated as a standing emergency agreement that began in the summer of 1998. Since then, water has been purchased as needed under the arrangement (York County 1999).

- **Education**

There are four school districts in York County. The Rock Hill School District is the largest with a total enrollment (elementary through high school) of 14,468 students. There are 44 elementary, 11 middle, and 7 high schools in the County. Catawba is located within the Clover School District, which receives 75 percent of the taxes paid by Catawba. The remaining 25 percent of this tax revenue is apportioned between York County and the remaining school districts. Table 2-9 presents summary information on each of the four school districts.

In addition, York County is the home of three colleges, all of which are located in Rock Hill. Winthrop University is the only comprehensive teaching university in South Carolina with 100 percent accreditation for all eligible programs. It offers programs in four broad areas: arts and sciences, business, visual and performing arts, and education. Total enrollment is approximately 6100 students (The Herald 2001).

Table 2-9. York County School District Profile

	York School District	Clover School District	Rock Hill School District	Fort Mill School District
Total enrollment	4,955	4,488	14,468	4,817
Number of schools				
Elementary	4	5	14	4
Middle	2	3[a]	4	2
High	2[b]	1	3[c]	1
Expenditures ($1000)	25,444	30,218	77,057	23,647

(a) Includes the Crowders Creek Elementary/Middle School complex.
(b) Includes the Floyd Johnson Vocational Center.
(c) Includes the Applied Technology Center.
Source: The Herald 2001.

York Technical College is a 2-year college with total enrollment of 3600 students. The college has 96 full-time faculty and offers 68 degree programs. It also offers certificates in business, computer, arts and sciences, health and human services, and industrial and engineering technology (The Herald 2001). Clinton Junior College is a 2-year college that offers course work in the liberal arts and business. It also offers a certificate in church ministry. Its total enrollment is less than 100 students (The Herald 2001).

- **Transportation**

There are 24 counties within the 80-km (50-mi) radius of the Catawba site: 13 in South Carolina and 10 in North Carolina. The 23-county area is served by 3 major interstate freeways. Interstate 85 (I-85) enters the region from the northeast and connects Charlotte, North Carolina, with points in Georgia to the southwest. Interstate 77 (I-77) runs in a north-south direction, passes through Charlotte into South Carolina through York County, and continues on to Columbia, South Carolina. Interstate 40 (I-40) lies in an east-to-west direction, bypassing Charlotte on the north.

York County is traversed by several highways. In addition to I-77, the county is traversed by several other Federal highways including U.S. Highways 21 and 321, which are north-south thoroughfares, and South Carolina Highway (SCH) 274. Major east-west highways are SCHs 5 and 161.

In June 1997, the citizens of York County passed a one percent sales tax for the purpose of generating funds for roadway improvements. New roadways and roadway improvements are currently on-going throughout the County. The tax was expected to raise approximately $100 million over a 7-year period. Tax revenues collected and accounted for to date have exceeded projections; therefore, the maximum amount of the tax, ($100 million) that could be collected over the 7-year period has been collected (York County 1999). Tax collection for the roadway improvements, therefore, has been terminated.

Access to the Catawba site is via Concord Road, a two-lane road leading to the plant entrance. The average annual daily traffic (AADT) count on the road numbers 3000 (Duke 2001a). Other roads lead to turnoffs for Concord Road from both North Carolina (State Route 49, the most heavily traveled route with AADT counts of 23,000 [Duke 2001a]) and South Carolina (SCHs 49, 274, 80, 55, and others). Level-of-service designations for these roads were not available (Duke 2001a).

2.2.8.3 Offsite Land Use

Land use designations have been applied in York County except for unincorporated areas. The county is divided into six major planning sectors for land use planning designations. Table 2-10 presents the major land use designations for York County.

Table 2-10. Land Use in York County

Land Use	Hectares	Acres	Percent of Total
Forest (all types)	118,570	292,990	65
Scrub/shrub[(a)]	18,600	45,970	10
Agriculture/grasslands	26,100	64,480	14
Water	4560	11,270	3
Urban/built up	10,780	26,640	6
Barren disturbed land	1910	4730	2
Total	180,520	446,080	100

(a) Scrub/Shrub class of land may include pasture or fallow farmland.
Note: Land use based on satellite imagery from 1988 to 1990.
Source: South Carolina 1998.

Each of the planning sectors, and the predominant land use characteristics in each sector, are briefly discussed below.

The Fort Mill Planning Sector encompasses the northern part of York County along the I-77 corridor. The presence of I-77, combined with the proximity of Fort Mill to the metropolitan area of Charlotte, North Carolina, and its municipal airport, which provides major airline service to other parts of the country, has resulted in substantial growth in population over the last 20 years. The last decade has seen growth in light industrial/commercial type development, including an office space buildup near I-77. Lake Wylie provides recreational and scenic amenities and a water supply, which increases the value of homes and encourages the development of high quality, residential property.[(a)]

The Rock Hill East Planning Sector encompasses the area east of Rock Hill, both south and west of the Catawba River and north to the adjoining Chester County border. Land use in this sector is impacted by I-77, the developing Catawba Indian Nation Reservation, and the Catawba River. Major employers in this planning sector include the Celanese-Acetate Corporation, AMP, Inc., State Farm Insurance, and Bowater, Inc. Major focal points of development include the intersection of SCH 161 and I-77. Land use has been historically rural but is transitioning to residential/subdivision use with building lots being 0.4 to 1.2 ha (1 to 3 ac) in size. Other communities located in the area include Leslie, Harmony, and Catawba, all of which are located along SCH 21 and the CSX railroad.[(b)]

The Rock Hill West Planning Sector is bounded on the north by Lake Wylie and on the east by the western portion of the city of Rock Hill. The more rural portion of this sector is the area along the Chester/York County boundary. The soils in this area tend to shrink/swell with wet and dry cycles, so for that reason, the county is discouraging intense residential development in the area (York County 1999a). Factors affecting land use patterns in this sector include the Rock Hill-York County Airport, which is surrounded by a mix of land uses including residential, commercial, and rural.[(a)]

The Bethel/Lake Wylie Planning Sector is bordered by Lake Wylie and Mecklenburg County, North Carolina, to the east and Gaston County, North Carolina, on the north. Given good road access, this area historically has encouraged the location of residential commuters to the sector's northern part. Parts of the area are in rapid transition from rural use to residential

(a) York County. York County Comprehensive Plan — Land Use Element. Planning and Development Services. York, South Carolina. <http://www.yorkcountygov.com/departments/Planning Development/docs/land%20use.pdf> (Accessed November 21, 2001).

(b) York County. York County Comprehensive Plan — Land Use Element. Planning and Development Services. York, South Carolina. <http://www.yorkcountygov.com/departments/Planning Development/docs/land%20use.pdf> (Accessed November 21, 2001).

development. Relatively more dense residential development is occurring around Lake Wylie. Historically, the sector has lacked open space and recreational land, but this situation has been remedied with acquisition of the Ferguson's/Nanny's Mountain area, which has been of prime, historical significance from colonial times when it served as a source of iron products during the Revolutionary War.[a]

The Clover/Kings Mountain Planning Sector has an observable difference between the more established and economically developed portions of eastern York County and the more rural sectors of the western part of the county. The area encompasses land that extends from the western town limits of the town of Clover to the boundary between Cherokee and York Counties. The predominant land use is agricultural conservation. The more developed, suburban/residential parts of the county lie to the east. Growth is projected to occur more to the east of Clover than to the west. Most of the workers from this section commute to Gaston and Mecklenburg Counties in North Carolina for employment. In recent years there have been ongoing attempts to foster growth within the town of Clover in hopes of reducing the amount commuting.[a]

The York/McConnells/Broad River Planning Sector includes the town of York, which is the county seat. The town of York is the principal urban land use influence within the sector. It has pursued aggressively the installation of water and sewer lines to the east of town along SCHs 161 and 5. Wal-Mart has opened a 150,000 square foot facility to the east of town, which is expected to be an area of further economic development. It is anticipated that SCH 5 to the west will be widened to five lanes and, when completed, will evolve into an east-west connector between I-85 and I-77.[a]

The areas to the south (McConnells) and west (Smyrna) of the town of York are predominantly rural and designated for agricultural conservation, and have been characterized as York County's last frontier. However, improved roads, which enable easier and faster access to the western part of the county, may lead to economic development similar to that experienced in the eastern part of the county (Bair 2001). Much of the land around McConnells is still farmed, and tree farming is the main economic activity in the land west of McConnell's and north to Smyrna. The County, in its update to the County-wide land use plan, will be placing increased emphasis on the preservation of rural lands. The Broad River, which has designated scenic status by the state of South Carolina, forms the sector's western boundary.[a]

(a) York County. York County Comprehensive Plan — Land Use Element. Planning and Development Services. York, South Carolina. <http://www.yorkcountygov.com/departments/Planning Development/docs/land%20use.pdf> (Accessed November 21, 2001).

2.2.8.4 Visual Aesthetics and Noise

Catawba is located on the shores of Lake Wylie, a reservoir on the Catawba River that separates North and South Carolina and one of a series of impoundments on the Catawba River. Lake Wylie has a full-pond surface area of approximately 4912 ha (12,139 ac) and is the third largest lake in the Catawba chain of reservoirs. It serves as a recreational resource for Charlotte, North Carolina, and York County, South Carolina; a source of cooling water for Catawba; and a source of drinking water for several cities in the region (Duke 2001a).

The Catawba site covers 158 ha (391 ac). Several transmission lines cut across the landscape leading to the site. Land use around the site is rural/suburban and wooded with houses. Visibility of the site when approaching by land from access off Concord Road is limited until close to the plant boundary. Condensation from the cooling towers is visible from many miles on cooler mornings.

From onsite, a panoramic view can be seen from the visitor's center (Energy Quest), which overlooks the site.

The nuclear station and its cooling towers also can be seen from Lake Wylie. Noise from Catawba, at both the Energy Quest building and on the lake, is noticeable but not obtrusive.

2.2.8.5 Demography

Population was estimated from the Catawba site out to 80 km (50 mi) in 16-km (10-mi) rings. Population estimates for the 80-km (50-mi) area surrounding the site are based on information provided by the University of North Carolina (Duke 2002c), derived from the 2000 census data. NRC Guidance calls for the use of the most recent United States Census Bureau (USCB) decennial census data, which in the case of the Catawba, was the 2000 census (USCB 2000; Duke 2001a).

- Resident Population within 80 km (50 mi). Table 2-11 presents the population distribution within 80 km (50 mi) of the Catawba site for population estimates in 10-year increments starting with 2000 and ending with 2040.

Table 2-11. Population Distribution from 2000 to 2040 Within 80 km (50 mi) of Catawba

	0 to 16 km (0 to 10 mi)	16 to 32 km (10 to 20 mi)	32 to 48 km (20 to 30 mi)	48 to 64 km (30 to 40 mi)	64 to 80 km (40 to 50 mi)	Total
Total 2000	140,760	586,474	524,292	404,417	383,522	2,041,465
Total 2010	182,527	694,129	694,243	504,540	119,202	2,524,641
Total 2020	228,349	814,999	875,273	612,428	528,018	3,059,067
Total 2030	276,446	944,688	1,061,916	726,321	614,635	3,624,006
Total 2040	326,238	1,080,791	1,252,307	844,328	706,416	4,210,080

Source: Duke 2002c

In 2000, an estimated 2,041,465 people lived within 80 km (50 mi) of Catawba. Between 2000 and 2010, total population within the 80-km (50-mi) radius is projected to increase by 24 percent. Between 2010 and 2020, the population is expected to increase by 21 percent. The growth rate then will experience a slight downward trend through 2030 and 2040, during which time the growth is projected to be 18 and 16 percent, respectively.

All or parts of 23 counties, one major city (Charlotte, North Carolina), and many small towns are located within 80 km (50 mi) of Catawba. Lake Wylie lies within a 16-km (10-mi) radius, as do the towns of Rock Hill (population 49,800), York (population 7000), and Fort Mill (population 7600). Over the past 25 years, York County has been ranked as one of the fastest growing counties in South Carolina, and between 1990 and 2000, the county experienced a population growth of 25.2 percent (USCB 2000, 1990).

The largest population center within a portion of the 32-km (20-mi) area is Charlotte, North Carolina, which is northwest of Catawba. The population of Charlotte in 2000 was 541,000 (USCB 2000).

Table 2-12 lists the projected age distribution for York (South Carolina), Gaston (North Carolina), and Mecklenburg (North Carolina) Counties in 2000 compared to the general age distribution of South and North Carolina. The population age distribution in York County tracks fairly closely with the general distribution for the State of South Carolina. The biggest difference is in the 65-and-over age bracket where York County's percentage of population is 10.4 percent compared to 12.1 percent for the general population in South Carolina. Gaston County's population age distribution closely parallels North Carolina's general population distribution. The exception is in the 18-to-24 age bracket where Gaston County

Table 2-12. Estimated Age Distribution of Population in 2000

	York County, S.C.		South Carolina		Gaston County, N.C.		Mecklenburg, N.C.		North Carolina	
Age Group	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Under-18	43,284	26.3	1,009,641	25.2	46,874	24.6	174,249	25.1	1,964,047	24.4
18-to-24	15,557	9.5	407,851	10.2	15,700	8.2	67,336	9.7	806,821	10.0
25-to-44	51,123	31.1	1,185,955	29.6	28,853	15.2	252,803	36.4	2,500,535	31.1
45-to-64	37,578	22.8	923,232	23.0	44,710	23.5	141,342	20.3	1,808,862	22.5
65-and-Over	17,072	10.4	485,333	12.1	23,985	12.6	59,724	8.6	969,048	12.0
Total	164,614		4,012,012		190,365		695,454		8,049,313	

Source: USCB 2000.

lags North Carolina by 1.8 percent. Mecklenburg County has a higher percentage of its population in the 25-to-44 age group than North Carolina (36.4 versus 31.1 percent, respectively). Mecklenburg County slightly exceeds North Carolina in the under-18 age bracket (25.1 versus 24.4 percent, respectively) and is less than the North Carolina general population in the 65-and-over age bracket.

- Transient Population. The transient population in the vicinity of the Catawba can be characterized 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. Table 2-13 presents information on the major employment sectors and number of employees by sector for York County.

  Seasonal transients also result from part-time residents' pursuit of recreational activities. Lake Wylie is a major source of recreation in York (South Carolina) and Mecklenburg (North Carolina) Counties. The daily and seasonal population associated with recreation on the lake is listed in Table 2-14.

  Lake Wylie is located west to southwest of Charlotte in Gaston and Mecklenburg Counties in North Carolina and in the northeast part of York County in South Carolina. The lake has a full-pond surface area of approximately 4912 ha (12,139 ac) and 526 km (327 mi) of shoreline at full pond elevation (Duke 2001a).

  Duke owns nine developed public recreational access locations on Lake Wylie. Three of these access locations are leased. There are several county and city parks. Three undeveloped county parks are owned by Mecklenburg County. Twelve commercial

Table 2-13. Major Employment Sectors in York County, South Carolina in 1999

Employment Sector	Number of Employees
Services	22,380
Retail trade	14,641
Manufacturing	12,733
Government and government enterprises	10,393

Source: BEA 1999.

Table 2-14. Visitors to Lake Wylie: 1999 and Projected 2050

Recreational Activity	Estimated 1999	Projected 2050
Boating – all types	1,076,299	2,550,256
Bank/pier fishing	299,132	733,461
Lake swimming	252,173	678,044
Tailrace fishing	26,460	64,878
Backpacking	1967	8132
Hunting	12,783	20,136
Tent/vehicle camping	17,699	80,996
Windsurfing	1967	4506
Bicycling	9833	28,985
Picnicking	112,514	359,466
Sightseeing	90,375	310,981
Hiking	29,797	106,673
Wildlife viewing	57,032	211,249
Use of playgrounds	10,816	33,497
Total	1,998,846	5,191,260

Source: Duke 2000b.

non-residential marinas and one commercial/residential marina provide additional public access to the lake (Duke 2000b).

In 1999, Duke undertook a study to estimate recreational use on Lake Wylie (Duke 2000a). Visitation figures were derived based on estimates of the traffic entering the Duke-owned

public access areas. During the 1999 study period, the estimated number of visits was 839,531. A visit is considered a vehicle or vehicle/trailer entering the site for any part of a day. From survey data, a ratio of 1.3 to 1 occupants per vehicle was observed for those respondents claiming use of both public and private access areas. Employing the 1.3 to 1 ratio, Duke estimated that overall recreational visitation for Lake Wylie during the 1999 study period totaled 1,076,300 visits for boating (including fishing, canoeing, jet skiing, kayaking, sailing, and water skiing/tubing; see Table 2-14).

Using population projections for the counties within 80 to 96 km (50 to 60 mi) of Lake Wylie (the impact zone) from 1999 to 2050 in 10-year increments, Duke estimated future recreational use on the reservoir (Duke 2000a). Population projections to 2050 used a combination of 1970-1990 population data and 2000 and 2010 population projections from USCB data.[a]

The recreational use projections were estimated by computing the projected population increase for each impact zone and incorporating indexed values for future recreational use for the various activities. The index values for each recreational activity were obtained from Cordell (1999). The indices are based on models that incorporate a number of variables, including age structure of the population, income, race, sex, population density, and other explanatory variables. For the year 2050, Duke has estimated that recreational use of the lake will total 5,191,260 visitors. Of this total, boating-related activities will account for 2,550,256 visitor days, or 49 percent. Table 2-14 presents information on the estimated use of Lake Wylie by recreational activity for 1999 and projections to 2050.

- Migrant Labor. Migrant workers typically are members of minority or low-income populations. Their travels, and the fact that they can temporarily spend a significant amount of time in an area without being an actual resident, means they may be unavailable for census counts. If this occurs, these workers would be "underrepresented" in minority and low-income population counts undertaken by the USCB.

  In 1997, York County had 726 individual farms. Nursery and greenhouse crops are increasing substantially, and migrant labor is used in these farming operations. There are about 500 migrant workers who reside in the county most of the year, and they work 8 to 10 months of the year.[b] The workers also may work in other lower paying occupations besides agriculture. Given the fact that they are not concentrated in a single location and

(a) USCB 1990 decennial census data was used because the 2000 census was not available at the time the recreational study was undertaken.
(b) Henry Nunnery and Rusty Thompson, personal communication, Clemson University Agricultural Extension Service, York, S.C. October 24, 2001.

their numbers are small, migrant workers probably do not materially change the population characteristics of any particular census tract in York County.

2.2.8.6 Economy

The prosperity of York County is closely linked to the economy of Charlotte, North Carolina. Charlotte (population 541,000; USCB 2000) is the second fastest growing region in the Nation behind Austin, Texas.[a] It is a major financial center for the southeastern United States and is the home of corporate headquarters for Bank of America, Wachovia Bank, and Duke Energy Corporation.

In 2000, York County was the sixth fastest growing county in South Carolina (York County 2001). Population in York County is expected to grow a total of 11 percent from 2000 to 2015. This is more than twice the general growth rate predicted for South Carolina, which is expected to grow a total of approximately 5 percent during the same time period. New job creation in the county increased from a little less than 500 per year in 1990 to 1500 per year in 2000. Capital investment increased from an annual $50 million (1990 dollars) to $250 million (2000 dollars).

From an economic standpoint, York County was a county in transition during the decade of the 1990s. Like many areas of the southeastern United States, the County has lost some of its manufacturing base, primarily in textiles and mining. Table 2-15 lists the major industrial groups by SIC code, their employment levels in 1990 and 1999, and the percentage change in employment. Significant increases in employment occurred in three major categories: (1) agricultural services, forestry, fishing and other; (2) retail and wholesale trade; and (3) services. Increases in employment more than offset losses in employment during the 7-year period.[b]

Still, York County is a net exporter of workers to surrounding counties linked to the economy of Charlotte. For example in 1990, 49 percent of the workers commuted to jobs outside York County with most of the commuters traveling to jobs in Mecklenburg and Gaston Counties in North Carolina. Table 2-16 presents information on York County labor commuting patterns between 1980 and 1990, which is the latest data available.

(a) Duke site presentation to NRC during the site audit, October 22, 2001.
(b) During the 9-year period there was a net increase in employment within the county of approximately 17,370.

Table 2-15. Economic Base for York County by Standard Industrial Classification (SIC) Code

Business Sector	Employment 1990	Employment 1999	Percent Change
Agriculture, forestry, and fishing	584	951	62.8
Mining	50	66	32.0
Construction	3994	4971	24.5
Manufacturing	14,858	12,733	-14.3
Transportation and public utilities	4070	3954	-2.9
Wholesale trade	2212	4397	98.8
Retail trade	10,367	14,641	41.2
Finance, insurance, and real estate	2711	3589	32.4
Services	13,783	22,380	62.4
Government and government enterprises	8207	10,393	26.6
Farm	1045	1174	12.3
Totals	61,881	79,249	

Source: BEA 1990, 1999.

Table 2-16. Commuting Patterns of York County Workers

	1980	1990	% Change
Residents working in York County	33,425	42,675	27.7
Residents commuting to:			
Mecklenburg County, N.C.	8057	16,849	109.1
Gaston County, N.C.	1359	2745	102.0
Chester County, S.C.	559	952	70.3
Lancaster County, S.C.	292	482	65.1
Workers commuting to York County from:			
Mecklenburg County, N.C.	1047	2389	128.2
Gaston County, N.C.	864	2166	150.7
Chester County, S.C.	1334	1780	33.4
Lancaster County, S.C.	969	917	-5.4

Source: York County 1999.

Economic development in York County is concentrated along the I-77 corridor running from Rock Hill north to the North Carolina border. This corridor is the location of the greatest commercial/industrial development and is home to new office parks and product distribution centers. Also, there is a concentration of new residential development paralleling I-77 and in a band roughly encompassed by the town of York and the city of Rock Hill. Along I-77, Fort Mill is experiencing a high level of mid-scale ($150,000 average per home) residential development.

To the west and northwest, development is influenced by Lake Wylie. Clean water, recreation opportunities, and an excellent fishery have led to construction of numerous upscale ($250,000-plus per home) residential developments around the lake.

The western part of the county, generally defined as that half of the county to the west of the towns of York and McConnell, is rural with agriculture and timber production being the predominant economic factors. Large farms and tracts of undeveloped land predominate, with a few residential developments and houses with acreage.

The economic contribution of agriculture to the economy of York County is significant. The market value of agricultural products produced and sold in York County increased from about $22 million in 1992 (1992 dollars) to $41 million in 1997 (1997 dollars) (USDA 1997). The main crop grown within York County is timber ($14.981 million in value in 1997 [South Carolina 2000]) with approximately 118,560 ha (293,000 ac; South Carolina 1998) in production during the 1990s.

Production of nursery and greenhouse crops is also increasing substantially. There are 20 greenhouse operations in the county.[a] Crop sales in 1992 were $5 million (1992 dollars) and increased by 173 percent to approximately $14 million (1997 dollars) in 1997 (USDA 1997). The increasing residential development in the county provides major market for the nurseries. Other crops of importance in the county are soybeans, hay, oats, and wheat (South Carolina 2001).

The unemployment rate for York County was at 3.6 percent at the beginning of 1990. It rose to a high of 8.1 percent as the economic ramifications of the North American Free Trade Agreement (NFTA) began to be felt in the southeastern part of the United States. Manufacturing in York County started to decline in 1992, and textile companies left to start plants in Mexico and other places. By December 2000, the unemployment rate in York County was at 2.7 percent[b] as the county continued its transition to a different type of employment base and economy.

(a) Personal communication Henry Nunnery and Rusty Thompson, Clemson University Agricultural Extension Service, October 24, 2001.

(b) Personal communication and supporting data from Matt Snellgrove, York County (South Carolina) Economic Development, November 28, 2001.

In 1990, the average per capita personal income in York County was $17,480 (1990 dollars). This average compares to the South Carolina average of $16,050 and the U.S. average of $19,585. By 1999, the average per capita income in York County had increased to $24,575 (an increase of 41 percent in nominal terms), while the increases in South Carolina and the United States were to $23,540 (47 percent increase) and $28,545 (46 percent increase), respectively (BEA 1999). While the increase was significant, York County tended to lag behind both South Carolina and the rest of the United States in average per capita income.

The percent of York County's population identified in poverty status remained fairly constant at 10.3 percent of the population in 1989 (compared to 15.4 percent for South Carolina) versus an estimated 11 percent in 1997 (compared to 14.9 percent for South Carolina; South Carolina 2000).

The growth that has occurred in York County may change the significance of Catawba's influence on the County's economy. If the economy continues to grow at the past-decade rate, which seems likely given the rising importance and significant impact of Charlotte on the regional economy, it is likely that the importance of Catawba as an employer and property tax payer in York County may decline. Catawba will continue to be an important contributor to the economic stability of the County and the surrounding region, particularly the Clover School District for which Catawba will continue to be a major economic benefactor. But the relative importance of its contribution will decline as the economic base of the region and county continues to grow and diversify.

Catawba currently pays a significant amount of annual property taxes to York County. There are five owners of the Catawba facility, and Duke's ownership share is approximately 9.6 percent. Table 2-17 presents information on the total real and personal property taxes paid by Catawba to York County, the total real and personal property taxes collected by the county, and

Table 2-17. Catawba Contribution to York County Property Tax Revenues

Year	Real and Personal Taxes Paid by Catawba ($)	Percent of Total County Property Taxes	Total County Real and Personal Property Taxes Collected ($)
1996	33,322,651	27.1	123,179,094
1997	35,377,146	26.4	133,762,343
1998	35,796,436	25.5	140,404,832
1999	35,957,979	23.4	153,351,879
2000	35,861,194	21.9	163,503,134

Source: Isaiah Boyd, York County Auditor, November 6, 2001.

the proportion of the total Catawba property taxes paid as it relates to the county total. This percentage declined between 1996 and 2000.

Approximately 75 percent of the property taxes paid by Catawba are allocated to support the schools in York County School District 2 (Clover District), the school district within which Catawba is located. The remaining 25 percent of the tax revenue from Catawba supports countywide operations and the three other school districts.

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known and potential historic and archaeological resources at Catawba and in the immediate surrounding area.

2.2.9.1 Cultural Background

The area around the Catawba plant is rich in prehistoric and historic Catawba Native American and historic Euro-American resources; although, in some cases the cultural periods have not been extensively documented. This is particularly true for the archaeological resources in the immediate area of the plant. General historical aspects of the Catawba Indians can be found in regional overviews (Brown 1966; Hudson 1970; Merrell 1989). More recently, the Catawba Indian Nation has initiated both archaeological (Kenion and May 1995) and historical projects through the Catawba Cultural Preservation Project to document the cultural resources both on the current reservation and the larger area of former occupation. Non-Indian history of the county, including information on historic properties, also has been documented (Shankman et al. 1983; Kissane and Kissane 1993; Thomas 1995).

- Prehistoric Period

  The prehistoric Native American occupation of the region that encompasses the Catawba site includes three periods: the Paleo-Indian period (about 10,000 to 8000 B.C.), the Archaic period (about 8000 to 1000 B.C.), and the Woodland period (about 1000 B.C. to A.D. 1600). Toward the end of the Woodland period from about A.D. 1500 to 1675, a transitional episode known as the Protohistoric period occurred during which initial contacts with Europeans and cultural changes associated with subsequent European settlement of the area took place.

  The prehistoric periods were marked by initial reliance on big game hunting subsistence, followed by increased use of smaller game animals and plant foods in the Archaic era. Major environmental changes in the Archaic period led to an increasingly more sedentary lifestyle, focused primarily in riverine settings. Late in the Archaic era, more sedentary villages and an increasing reliance on cultivated crops became the norm, and the

subsequent Woodland period was characterized by larger base camps in the river valleys with subsistence based on agriculture, hunting and gathering, and intergroup trade. The latter part of the Woodland period is primarily identified by the added presence of European trade goods.

- Native American Historic Period

At the time of European contact and subsequent intrusion into the area surrounding Catawba, the lands on both sides of the Catawba River in what would become North and South Carolina were occupied by the Catawba Indian Nation. Initial contact between the Catawba Indians and European explorers occurred in the 1560s, although European colonization of the region did not take place until nearly a century later. Following hostilities in the French and Indians Wars, a 39 km^2 (15 mi^2) reservation was established in 1763 for the Catawba Nation in South Carolina. This reservation was located in what would eventually become York and Lancaster Counties. The northern boundary line of the reservation was located just south of the current Catawba site. As a result of an 1840 treaty between the Catawba Nation and the State of South Carolina, the state purchased all of the land within the original reservation, much of which had already been leased by the Indians to white settlers. In 1850, a tract of some 254 ha (630 ac) of land on the west side of the Catawba River was purchased for the Catawba, including the reservation that continues to be occupied today. The reservation is located about 8 km (5 mi) southeast of the plant site. In 1962, the tribe was disbanded, and lands were divided among its members. The Catawba Tribe reorganized in 1973 and was awarded renewed Federal recognition in 1993.

- Euro-American Historic Period

In 1785, following the Revolutionary War, York County became one of the original counties in the newly created state of South Carolina. In a census taken 5 years later, the County had a population of just over 6600. Cotton was introduced to the area in the 1790s and quickly dominated the economy and land-use patterns of the County. Though interrupted by the Civil War, depletion of the County's soils as a result of intensive cultivation, and recurring ups and downs in the agricultural economy, cotton remained the primary crop into the first few decades of the 1900s when other crops, such as soybeans, became more prevalent.

An important event in the history of York County was the beginning of construction of the Catawba Dam and Power Plant in 1900. The completion of the dam and the newly formed Lake Wylie were instrumental in subsequent development of other dams and hydropower projects on the Catawba River and in sparking industrialization of the river corridor, including the beginnings of the Duke Power Company.

2.2.9.2 Historic and Archaeological Resources at Catawba

To assess known and potential cultural resource sites at Catawba, several existing literature and database sources were consulted, along with direct contacts at several organizations (see Appendix D). In addition to the sources included in Appendix D, electronic database searches were conducted at the National Park Service's National Register of Historic Places Information System and the Historic American Buildings Survey/Historic American Engineering Record listings.

Examination of the National Register listings did not disclose any listed or potentially eligible properties in proximity to the plant site. The closest potentially eligible property is the location of the Revolutionary-War-era Hill's Ironworks. This property is located near the point where SCH 274 crosses Allison Creek, about 2 miles southwest of the Catawba site. Similarly, discussions with personnel at the Catawba Cultural Preservation Project did not reveal the presence of any known archaeological or other traditional cultural properties at the Catawba site that might be of interest to the Catawba Indian Nation.

Examination of archaeological and historic site files at the South Carolina Department of Archives and History and the South Carolina Institute of Archaeology and Anthropology (SCIAA) indicated that no prehistoric or historic properties have been recorded at the Catawba site itself. However, no formal archaeological surveys have been completed at the plant. The nearest recorded archaeological sites are located along Catawba transmission line rights-of-way, southwest of the site, which was surveyed in 1978 (Brockington 1980), and by a more recent survey along SCH 274, running north-south to the west of the plant site (Joy and Stine 2000). There are six archaeological sites within 1.6 km (1 mi) of the plant, the closest being situated in a transmission line right-of-way at a distance of about 1 km (0.6 mi). None of these sites has been evaluated as being potentially eligible for the National Register of Historic Places.

Examination of historical maps and aerial photographs that include the Catawba site reveal the past presence of several historic properties either close to or within the plant site boundaries. Copies of these maps are located at either the South Carolina Department of Archives and History or the Historical Center of York County. Documents examined, along with results, include the following:

- York District, South Carolina Map, Surveyed by Gordon Moore, 1820, Improved for Mills Atlas 1825. This map shows the location of Hill's Old Ironworks on the south side of Allison Creek, southwest of the Catawba site and the Thorn's Ferry and Road that passed in an east-west direction to the south of the site. The ferry landing was located at the south end of Long Island, southeast of the site, and now is inundated by Lake Wylie. The boundary of the 1763 Catawba Indian Nation Reservation also is indicated.

- Map of York District Post Offices, 1802 - 1861. There are no post offices indicated within the Catawba site during this period. The closest post offices were at Hill's Ironworks, Clay Hill, and McElwee's Store, all to the southwest near Allison Creek.

- Grants of Land Made by Commissioner of Locations for York District, South Carolina, During the Years 1841-42 in the Catawba Indian Boundary, prepared by Mr. and Mrs. J. Thomas Williams, 1983. This map shows lands in the vicinity of the site being owned by the Biggers, Faris, Mitchell, and Partlow families.

- Geonostic Map of York District, 1858. This map shows churches and mineralogical, geological, and agricultural features. Nothing in these categories was shown at the current Catawba site.

- York County South Carolina, Geological and Agricultural Map, 1873. This map shows the Thorn's Ferry Road south of the plant site, along with the location of Mason's Ferry just upriver from the plant. A road from Allison Creek to this ferry crossed just northwest of the present Catawba site.

- York County, South Carolina, copyright 1910 by Jones and Walker, Rock Hill, South Carolina. This map was the first to show the Concord Church and Cemetery, along with several residences that once existed on lands now included within the Catawba site. Several homes, along with family names, are shown along Concord Road and along a road that extended north from the Concord Church vicinity through the site and across Beaver Dam Creek. In addition to the church and cemetery, some 12 homes and/or structures are indicated within the plant boundary. The Concord Cemetery, still located within the Catawba site boundary, is discussed below.

- U.S. Geological Survey Clover, SC - NC, 15' Quadrangle Map, 1947. This map shows the location of the Concord Road and Church, along with 12 homes or structures that were located either within or very close to the Catawba site.

- U.S. Department of Agriculture Soil Survey Map of York County, South Carolina, 1961. This map, actually an aerial photograph, shows the location of Concord and the associated road, cleared field or pasture areas along the road, and the presence of at least six structures in the vicinity of the Catawba site.

The Concord Cemetery is the only acknowledged cultural resource property within the Catawba site today, although the historical records listed above indicate that a church was once situated adjacent to the cemetery, and there were several residences in proximity along the Old Concord Road. Presently, the cemetery is located just north of the northwest corner of the plant's cooling tower yard and is fenced and protected within the plant site boundary. Since

1974 the cemetery has been owned and managed (including access) by the Concord Cemetery Association. Two tombstone surveys (Caldwell and Hart 1997, Hill 2001) have been conducted and indicate that over 150 persons are buried in the cemetery, the earliest occurring in 1834 and the most recent in 1995. The earliest interments were members of the Faris family, owners in the 1840s of parts of Long Island and other tracts south of the Catawba site.

2.2.10 Related Federal Project Activities and Consultations

The staff reviewed the possibility that activities of other Federal agencies (including FERC) might impact the renewal of the Catawba OLs. Any such activities could result in cumulative environmental impacts and the possible need for such a Federal agency to become a cooperating agency in the preparation of this SEIS (10 CFR 51.10[b][2]).

Duke's McGuire Nuclear Station (McGuire) is located approximately 48 km (30 mi) north of Catawba. Duke also is requesting that the NRC review the OLs for McGuire.

The Federal Power Commission, now FERC, issued a license (FERC Project No. 2232) to Duke Power Company on September 17, 1958, for the Catawba-Wateree Project. This license expires in 2008, and Duke plans to seek a renewal of the license. The Catawba-Wateree Project consists of 11 lakes on the Catawba River, which were formed by hydroelectric power plant dams. Lake Wylie, from which Catawba draws water, extends 45 km (28 mi) between Mountain Island Dam and Wylie Dam. This lake was formed by impounding the water of the Catawba River, and full pond volume was achieved in 1904. Following an increase in dam height in 1924, the lake now covers 4912 ha (12,139 ac) at a normal operating level, though fluctuations exist based on hydroelectric generation needs.

The Federal lands closest to the Catawba site are within the Kings Mountain National Military Park. The park is located near Blacksburg, South Carolina, and is operated by the U.S. National Park Service. The park is approximately 27 km (17 mi) northwest of Catawba.

The Native American land closest to the Catawba site is a section of the Catawba Indian Reservation, north of the city of Rock Hill, approximately 10 km (6 mi) southeast of Catawba.

After reviewing the Federal activities in the vicinity of Catawba, the staff determined there were no Federal project activities that could result in cumulative impacts or would make it desirable for another Federal agency to become a cooperating agency for the preparing this SEIS.

NRC is required under Section 102 of NEPA to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. NRC consulted with FWS, and the consultation correspondence is included in Appendix E.

2.3 References

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

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

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

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

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

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

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

40 CFR 190. Code of Federal Regulations, Title 40, *Protection of the Environment*, 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 are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

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

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

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

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

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

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

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

Table 3-1. Category 1 Issues for Refurbishment Evaluation

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

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

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Duke Energy Corporation (Duke) indicated that it has performed an evaluation of structures and components pursuant to 10 CFR 54.21 and, "based on that review, no major plant refurbishment activities were identified as necessary to maintain the structure and component intended functions consistent with the current licensing basis during the period of extended operations" (Duke 2001).

Table 3-2. Category 2 Issues for Refurbishment Evaluation

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

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

Duke stated that routine replacement of certain components are within the bounds of normal plant maintenance and they will not affect the environment outside the bounds of plant operations as evaluated in the final environmental statement (NRC 1983).

As previously stated, 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 Catawba beyond the end of the existing operating licenses. Therefore, refurbishment is not considered in this draft Supplemental Environmental Impact Statement.

3.1 References

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

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

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U.S. Nuclear Regulatory Commission (NRC). 1983. *Final Environmental Statement Related to the Operation of Catawba Nuclear Station, Units 1 and 2, Duke Power Company, et al.* Docket Nos. 50-413 and 50-414, NUREG-0921, Washington D.C.

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

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

4.0 Environmental Impacts of Operation

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

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site 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 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 for Category 1 and, therefore, additional plant-specific review of these issues is required.

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

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

are summarized in Section 4.8. Finally, Section 4.9 lists the references for Chapter 4. Appendix F list Category 1 and Category 2 issues that are not applicable to Catawba because they are related to plant design features or site characteristics not found at Catawba.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to Catawba cooling system operation during the renewal term are listed in Table 4-1. Duke Energy Corporation (Duke) stated in its Environmental Report (ER; Duke 2001) that it is not aware of any new and significant information associated with the renewal of the Catawba operating licenses (OLs). The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts are SMALL, and additional 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 of 10 CFR Part 51, Subpart A, Appendix B, for each of these issues follows Table 4-1.

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
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 wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2

Table 4-1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
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
AQUATIC ECOLOGY (PLANTS WITH COOLING-TOWER-BASED HEAT DISSIPATION SYSTEMS)	
Entrainment of fish and shellfish in early life stages	4.3.3
Impingement of fish and shellfish	4.3.3
Heat shock	4.3.3
TERRESTRIAL RESOURCES	
Cooling tower impacts on crops and ornamental vegetation	4.3.4
Cooling tower impacts on native plants	4.3.5.1
Bird collisions with cooling towers	4.3.5.2
HUMAN HEALTH	
Microbiological organisms (occupational health)	4.3.6
Noise	4.3.7

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, its evaluation of other available information including the National Pollutant Discharge Elimination System (NPDES) permit for Catawba, or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharges of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

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

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

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

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

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

The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, its evaluation of other available information including the NPDES permit for Catawba, or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its 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 that

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

  The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. 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 that

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

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

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

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

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

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

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

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

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

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

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

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

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

The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other 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 in the discharge. Based on information in the GEIS, the Commission found that

> Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been

> found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

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

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

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

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

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

The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts regarding stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Entrainment of fish and shellfish in early life stages (cooling-tower-based heat dissipation). Based on information in the GEIS, the Commission found that

  > Entrainment of fish has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts regarding entrainment of fish and shellfish in early life stages during the renewal term beyond those discussed in the GEIS.

- Impingement of fish and shellfish (cooling-tower-based heat dissipation). Based on information in the GEIS, the Commission found that

  > The impingement has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Catawba ER the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts regarding impingement of fish and shellfish during the renewal term beyond those discussed in the GEIS.

- Heat shock (cooling-tower-based heat dissipation). Based on information in the GEIS, the Commission found that

  > Heat shock has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts regarding heat shock during the renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on crops and ornamental vegetation. Based on information in the GEIS, the Commission found that

  > Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the renewal term.

  The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no cooling tower impacts on crops and ornamental vegetation during the renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on native plants. Based on information in the GEIS, the Commission found that

  > Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation 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 during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no cooling tower impacts on native vegetation during the renewal term beyond those discussed in the GEIS.

- Bird collisions with cooling towers. Based on information in the GEIS, the Commission found that

  > These collisions 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 during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts regarding bird collisions with cooling towers during the renewal term beyond those discussed in the GEIS.

- Microbiological organisms (occupational health). Based on information in the GEIS, the Commission found that

> 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 during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other 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 that

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

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

The Category 2 issues related to cooling system operation during the renewal term that are applicable to Catawba are listed in Table 4-2 and are discussed in Sections 4.1.1 and 4.1.2.

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE			
Water-use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	4.3.2.1, 4.4.2.1	A	4.1.1
HUMAN HEALTH			
Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	4.3.6	G	4.1.2

4.1.1 Water-Use Conflicts

Consumptive water use can adversely impact riparian vegetation and associated animal communities by reducing the amount of water available for plant growth, maintenance, and reproduction. While changes, albeit small, in average annual stream flow downstream of Lake Wylie are inevitable due to the decrease in the total water supply, any changes that might occur in the pool elevation in Lake Wylie are less clear.

Under average conditions, the effect of Catawba consumptive use is a decrease of about 1.2 percent in outflow from Lake Wylie. Water levels in the Catawba River downstream of Lake Wylie Dam fluctuate on a daily basis as a result of releases from the Lake Wylie Hydro Station. However, using the rating table for USGS gauge 02146000, the reduction in outflow attributable to Catawba operations results in a stage decrease of 6 mm (0.2 in.) for the Catawba River downstream of Lake Wylie under average conditions. Under low flow conditions, Catawba consumptive use does not affect downstream conditions because of the minimum release requirement.

Lake Wylie is the seventh of eleven impoundments in the 410-km (255-mi) Catawba-Wateree Project managed by Duke and licensed by Federal Energy Regulatory Commission (FERC). The Catawba-Wateree Project releases water from its dams to optimize hydroelectric generation, provide flood control, and meet minimum release requirements while maintaining a constant and reliable water supply for thermoelectric stations, surrounding communities, and industry. Consumptive water demand by Catawba is only one of numerous considerations in the overall operation of the Catawba-Wateree Project that will define the pool elevation of Lake Wylie.

Total evaporative losses for Lake Wylie are estimated to be 3.68 m^3/s (130 cfs). Consumptive use by Catawba represents 1.47 m^3/s (52 cfs) (1997 through 1999 average) of the total. Since Lake Wylie is managed to maintain a stable pool elevation, consumptive uses by Catawba do not affect pool elevations as long as there is adequate inflow. Under 7Q10 (the estimated 7-day minimum flow occurring on the average once in 10 years) conditions, total outflow from Lake Wylie would be 0.71 m^3/s (25 cfs) greater that inflow. The 7Q10 inflow into the lake is estimated to be 14.6 m^3/s (516 cfs), and the total outflow would be 15.3 m^3/s (541 cfs), including the 11.6 m^3/s (411 cfs) minimum release from Lake Wylie Hydro Station and 3.68 m^3/s (130 cfs) for natural and forced evaporative losses. If Lake Wylie lost 0.71 m^3/s (25 cfs) for 7 days, the lake level would decline 9 mm (0.4 in.). Low water levels in Lake Wylie could be a factor for these riparian areas if prolonged drawdown occurs. However, as indicated above, such drawdowns do not occur. Rather, water levels are quite stable year-round. Under average conditions, Catawba operations do not affect lake levels, and during 7Q10 conditions, the effect of the operations on Lake Wylie pool elevations would be small.

Lake Wylie does not have the typical riparian areas found alongside a river. Most of the shoreline adjoins upland settings; however, there are extensive areas of riparian vegetation adjacent of the headwaters of the reservoir in the area of Interstate 85 and at confluences with major tributaries such as the South Fork River, Catawba Creek, Crowder's Creek, Big Allison Creek, and Little Allison Creek. There are smaller areas of riparian vegetation at the head of some shallow coves. These riparian zones are dominated by species typical of piedmont bottomlands and shallow water areas and include river birch (*Betula nigra*), buttonbush (*Cephalanthus occidentalis),* black willow (*Salix nigra),* red maple (*Acer rubrum*), cattail (*Typha latifolia*), Joe Pye weed (*Eupatorium sp.*), cardinal flower (*Lobelia cardenalis*), pickerel weed (*Pontederia cordata*), and numerous sedges (*Carex sp.*) and rushes (*Juncus sp.*).

White bass (*Morone chrysops*) is the only fish species that makes an appreciable spawning run in Lake Wylie. This spawning run is most evident in the Dutchman's Creek area, which enters Lake Wylie on the extreme northwestern side of the reservoir. Because of the relatively stable lake levels, coupled with the fact that white bass make their spawning migration in the February-April time period, the time of the highest rainfall in the area, the impact of any consumptive loss from Catawba plant operations is considered negligible.

There are a few native freshwater mussels (primarily unionids) in Lake Wylie, but because water levels do not fluctuate significantly, mussel stranding is not an issue. The only mussel of any abundance in Lake Wylie is the nonindigenous Asiatic Clam (*Corbicula spp.*), and this organism is considered a nuisance organism.

Catawba consumptive use of water is not expected to change during the period of the proposed license renewal. It is impossible to reliably predict the quantity of future withdrawals over the renewal term. However, state and Federal regulations are in place to ensure future withdrawals do not adversely impact the aquatic and riparian communities in Lake Wylie and downstream. The impact of the consumptive use of water by Catawba on these and other aquatic communities in Lake Wylie is SMALL, and additional mitigation is not warranted.

4.1.2 Microbiological Organisms (Public Health)

The Catawba River, which was impounded to form Lake Wylie, has an annual average flow rate of 123 m^3/s (4390 ft^3/s). Catawba uses Lake Wylie as a source of condenser cooling and station service water. The station uses closed-loop cooling towers, and the distance from the discharge canal to the nearest dock is approximately 440 m (1360 ft).

Duke, in consultation with public health staff from the SCDHEC, conducted an assessment of whether continued operation of Catawba would induce public health impacts due to the enhancement of thermophilic organisms. Based on Catawba-specific experience, a review of available technical literature on thermophilic organisms, and the fact that there is little heated

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 and dermal protection for workers regularly exposed to known contaminated water, but there seems no significant health threat to off-site persons near such heated recreational waters.

There has been no known impact of Catawba's operation on public health related to thermophylic microorganisms, and consultation with the SCDHEC indicates that the impact of deleterious microbiological organisms during continued operation of the plant during the renewal term are low.

The staff concludes that the potential impacts to public health from microbiological organisms resulting from operation of the plant cooling water discharge system to the aquatic environment on or in the vicinity of the site are SMALL, and mitigation is not warranted.

4.2 Transmission Lines

Catawba has five, 230-kV transmission lines leaving the site from the switchyard (NRC 1983, Duke 2001). The five lines are contained within rights-of-way ranging from 35 to 46 m (115 to 150 ft) in width and from 1 to 40 km (0.7 to 24.4 mi) in length covering a total of approximately 295 ha (730 ac) (see Table 2-1 of this report; Duke 2001, NRC 1983). The rights-of-way, which were constructed or rebuilt between 1973 and 1983, extend out from Catawba to the north, south, and west (Figure 2-4). The vegetation in the rights-of-way is managed through a combination of mechanical and herbicide treatments. Initial treatments include mowing and/or treatment with Arsenal and Accord. Spot treatments then are applied once every 3 years using Arsenal, Accord, Garlon4A, and Krenite. Herbicide treatments in wetlands are limited to Arsenal and Accord, which are approved for use in wetlands. In addition, Duke cooperates with the South Carolina Department of Natural Resources regarding conservation easements and partners with The Wildlife Federation on vegetation management in some portions of the rights-of-way.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to transmission lines from Catawba are listed in Table 4-3. Duke stated in the Catawba ER (Duke 2001) that it is not aware of any new or significant information associated with the license renewal of Catawba. The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. 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 additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-3. Category 1 Issues Applicable to the Catawba Transmission Lines During the Renewal Term

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

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

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

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

  The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, discussion with the FWS, or its evaluation of other information. Therefore, the staff concludes that there are no impacts regarding power line rights-of-way maintenance during the renewal term beyond those discussed in the GEIS.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no onsite land-use impacts 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 that

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

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

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

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

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

4.2.1 Electromagnetic Fields—Acute Effects

In the GEIS (NRC 1996), the staff found that without a review of the conformance of each nuclear plant transmission line with the *National Electrical Safety Code* (NESC) criteria (Institute of Electrical and Electronic Engineers [IEEE] 1997), it is not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing

process for some plants. For other plants, land use in the vicinity of the transmission lines may have changed, or the power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(C)(3)(ii)(H), the applicant must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

The Catawba 230-kV switchyard is connected to the primary Duke transmission system by five 230-kV, double-circuit, overhead transmission lines. An evaluation was performed to determine if the transmission lines meet the requirements of NESC. Duke completed an evaluation of the transmission lines and determined that, for all spans, the measured clearances from the sagged plan and profile of each of the five 230-kV transmission lines exceed the original design vertical clearance requirement (Duke 2001). The utility did not perform any specific modeling or experimental studies to determine if induced currents would exceed requirements established in NESC. However, upon review of the information provided by Duke, the staff concluded the assessment was adequate to meet the intent of 10 CFR 51.53. The staff also concludes that the impact of the potential for electric shock is SMALL, and additional mitigation is not warranted.

4.2.2 Electromagnetic Fields—Chronic Effects

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

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

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

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

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Catawba in regard to radiological impacts are listed in Table 4-5. Duke stated in the Catawba ER that it is not aware of any new and significant information associated with the renewal of the Catawba OLs. No significant new information has been identified by the staff in its 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 additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-5. 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 Section
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 that

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

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

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

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

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

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-6. Duke stated in the Catawba ER that it is not aware of any new and significant information associated with renewal of the Catawba OLs. The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-6. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

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

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

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

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

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

  > Only impacts of small significance are expected.

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

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

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

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

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

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 4-7 lists the Category 2 socioeconomic issues that require plant-specific analysis and environmental justice, which was not addressed in the GEIS.

Table 4-7. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the License Renewal Term

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

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

4.4.1 Housing Impacts During Operations

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

In 2000, the population living within 32 km (20 mi) of Catawba is estimated to be approximately 727,200 (Duke 2002a). This total converts to a population density of about 225 persons/km^2 (580 persons/mi^2) living on the land area within a 32-km (20-mi) radius of Catawba. This concentration falls into the GEIS sparseness Category 4 (i.e., having greater than or equal to 46 persons/km^2 [120 persons/mi^2]).

In 2000, an estimated 2,041,465 people lived within 80 km (50 mi) of Catawba, equating to a population density of around 100 persons/km^2 (260 persons/mi^2) on the available land area

(Duke 2001, 2002a). Applying the GEIS proximity measures (NRC 1996), Catawba is classified as Category 4 (i.e., having greater than or equal to 73 persons/km^2 [190 persons/mi^2] within 80 km [50 mi] of the site). According to the GEIS, these sparseness and proximity scores identify the nuclear units as being located in a high-population area.

10 CFR Part 51, Subpart A, Appendix B, Table B-1, states that impacts on housing availability are expected to be of small significance at plants located in a high-population area where growth-control measures are not in effect. Catawba is located in a high-population area and York County is not subject to growth-control measures that would limit housing development, although the county does have zoning requirements that govern development in the county. Based on the NRC criteria, Catawba expects housing impacts to be SMALL during continued operations (Duke 2001).

SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). In the GEIS, the staff assumes that an additional staff of 60 permanent workers per unit might be needed during the license renewal period to perform routine maintenance and other activities. Catawba expects to perform these routine activities during scheduled outages and does not plan to add additional employees to their permanent staff during license renewal (Duke 2001). However, to establish an upper bound on possible increased employment during the license renewal term, staff assumes the hiring by Duke of 60 additional permanent workers, plus 73 indirect jobs,[(a)] would result in an increased demand for a total of 162 housing units around the Catawba site (or approximately 90 housing units for York County).[(b)]

The demand for housing units could be met with the construction of new or use of existing, unoccupied housing. Civilian jobs were projected to be approximately 572,000 in 1996 within a 48-km (30-mi) radius of Rock Hill, South Carolina, and the civilian population was around 1.0 million in 2000 (York County 1999). The increase in projected housing units would not create a discernible change in housing availability, change in rental rates or housing values, or spur new construction or conversion.[(c)]

The staff reviewed the available information relative to housing impacts and the conclusions stated in the Catawba ER (Duke 2001). Based on this review, the staff concludes that the impact on housing during the license renewal period would be SMALL, and additional mitigation is not warranted.

(a) The multiliplier used for York County is 2.2239. This is the South Carolina employment multiplier for electrical utilities (BEA 1999).
(b) This assumes 55 percent of the new hires reside in York County (see Section 2.2.8.1).
(c) The estimate of 162 housing units (90 units for York County) is likely to be an extreme "upper bound" estimate. Most of the potential new jobs would most likely be filled by existing area residents, thus creating no, or little, net demand for housing.

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 of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service (e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. In the GEIS, the staff indicates that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies (NRC 1996).

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the permitted water withdrawal rate and actual use of water. Duke plans no refurbishment at Catawba, so plant demand for water would not change beyond current needs (Duke 2001).

The staff assumed an increase of 60 employees during license renewal period, the generation of 133 new jobs, and a net overall population increase of approximately 319 as a result of those jobs.[(a)] The impact of this increase in the number of workers onsite is expected to be SMALL. The plant-related population increase would require an additional 60 to 92 m^3/day (0.016 to 0.026 MGD) of potable water.[(b)] Catawba receives its domestic water through the York County west system. In 2000, the town of York provided water services from January through August. The city of Rock Hill provided domestic water services for the remainder of the year (Duke 2001). The marginal increase in domestic water Catawba would use per year as a result of a hypothetical increase in employment of 60 license renewal employees is well within the residual capacity of the city of Rock Hill water treatment plant.[(c)] However, at times the town of York's water treatment plant utilization exceeds capacity and, during these times, the town of York could not supply Catawba's needs for water. The town of York is in the process of building a new treatment plant and reservoir to meet expanded needs. However, the city of Rock Hill has more than enough excess capacity to meet the marginal increase in needs represented by an increase of 60 employees. Thus the staff finds that the impact of increased water use is SMALL and mitigation is not warranted.

(a) Calculated by assuming that the average number of persons per household is 2.4 (133 jobs x 2.4 = 319). Average persons per household is calculated by dividing the population of York (South Carolina) and Mecklenburg (North Carolina) Counties by the total number of households in the Counties (USCB 2000).

(b) Calculated assuming that the average American uses between 50 and 80 gallons of water for personal use per day: 319 people x 80 gallons per person/day = 96 m^3/day (0.026 MGD).

(c) Personal communication and data provided by Matt Snellgrove, York County (South Carolina) Economic Development, November 28, 2001.

4.4.3 Offsite Land Use During Operations

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

In Sections 3.7.5 and 4.7.4 of the GEIS, the staff defines the magnitude of land-use changes as a result of plant operation during the license renewal term as follows:

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

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

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

The staff has identified a maximum of 60 additional employees during the license renewal term plus an additional 73 indirect jobs (for a total of 133 jobs) in the community. In Section 3.7.5 of the GEIS (NRC 1996), the staff states that if plant-related population growth is less than 5 percent of the study area's total population, offsite land-use changes would be SMALL, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km^2 (60 persons/mi^2), and at least one urban area with a population of 100,000 or more within an 80-km (50-mi) radius. In this case, population growth will be less than 5 percent of the area's total population, the area has established patterns of residential and commercial development, a population density of well over 23 persons/km^2 (60 persons/mi^2), and at least one urban area (Charlotte) with a population of 100,000 or more within the 80-km (50-mi) radius. Consequently, the staff concludes that population changes resulting from license renewal are likely to result in SMALL offsite land-use impacts.

Tax revenue can affect land use because it enables local jurisdictions to provide the public services (e.g., transportation and utilities) necessary to support development. In Section 4.7.4.1 of the GEIS, the staff states that the assessment of tax-driven, land-use impacts during the license renewal term should consider (1) the size of the plant's payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant's tax payments are projected to be small relative to the community's total revenue, tax-driven land-use changes during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. In Section 4.7.2.1 of the GEIS, the staff states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdictions revenue, the significance level would be SMALL. If the plant's tax payments are projected to be medium to large relative to the community's total revenue, new tax-driven, land-use changes would be MODERATE.

York County is the only jurisdiction that taxes Catawba directly, and the Clover School District receives 75 percent of the tax revenue as a result of Catawba's presence. Because no major refurbishment or new construction activities are associated with license renewal, no new sources of plant-related tax payments are expected that could significantly influence land use in York County. However, continued operation of the plant would provide a significant continuing source of tax revenues to York County and the Clover School District. As discussed in Section 2.2.8.6 and shown in Table 2-16, Catawba paid an average of $35.3 million in taxes to York County over the 5-year period from 1996 to 2000, or approximately 25 percent of the total property taxes collected by the county. These payments represent a substantial, positive impact on the fiscal condition of York County and the Clover School District.

York County has experienced an increase in population of approximately 25 percent over the last decade (see Table 2-6). The growth is not related directly to the presence of Catawba. York County does not have growth control measures that limit housing. Land use projections for York County show that new commercial and industrial developments are expected to be concentrated in the eastern part of the county, along the I-77 corridor. New residential development is being encouraged in areas of the county that are already developed or undergoing development. The rest of the county (particularly the more rural western part) is expected to remain in agricultural and forest use. In combination, these two factors (lack of growth directly related to the presence of Catawba and directed growth locations) would be expected to result in SMALL land-use impacts from Catawba-related taxes.

The continued collection of taxes from Catawba will help keep tax rates below the levels they otherwise would have to be to fund the schools (particularly in Clover) and the county government. This source of revenue also provides for a higher level of public infrastructure and services than otherwise would be possible. All of these factors contribute to York County's attractiveness as a place to live.

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

4.4.4 Public Services: Transportation Impacts During Operations

On October 4, 1999, 10 CFR 51.53(c)(3)(ii)(J) and 10 CFR Part 51, Subpart A, Appendix B, Table B-1, were revised to clearly state that "Public Services: Transportation Impacts During Operations" is a Category 2 issue (see NRC 1999 for more discussion of this clarification). The issue is treated as such in this draft Supplemental Environmental Impact Statement (SEIS).

In the year 2000, most of the roadways within York County operated at acceptable levels of service. As discussed in Section 2.2.8.5, the area of greatest potential population growth in

York County may be in its western part, even though there is a concerted effort at the county level to preserve the natural resources of the county's western half. The overall county population is expected to increase by 28.5 percent, between 2000 and 2020 (see Table 2-10). It is the intent of the county government to channel this growth into areas already developed in its eastern part. Continued population growth in areas adjacent to Catawba is expected, thus necessitating increases in road construction to handle the increased demand.

However, none of this expected growth is due directly to increases in employment at Catawba. The permanent employment associated with Catawba is currently 1218 employees (including Duke employees and contractors; Duke 2001). During periods of refueling, which occur at approximately 18- to 24-month intervals and take 30 to 40 days to complete, an additional 500 workers are hired on a temporary basis (Duke 2001). The "upper bound" potential increase in permanent staff during the license renewal term is 60 additional workers, or approximately 4.9 percent of the current permanent and contract workforce of 1218. The level of access to the Catawba site is over secondary, as opposed to primary, roads. Based on these facts, Duke concluded that the impacts on transportation during the license renewal term would be SMALL, and no mitigative measures would be warranted.

The staff reviewed Duke's assumptions and resulting conclusions and conducted independent onsite interviews and observations of transportation conditions around the Catawba site. The staff concludes that any impact of Catawba license renewal on transportation service degradation is likely to be SMALL and would not require additional mitigation.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA), as amended through 1992, requires that Federal agencies take into account the potential effects of their undertakings on historic properties. The historic review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation in 36 CFR Part 800. Renewal of an OL for a nuclear power plant is an undertaking that could possibly affect either known or potential historic properties that may be located at the plant. Therefore, in accordance with the provisions of NHPA, the NRC is required to make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Officer (SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess the possible adverse effects of the undertaking.

Areas within a nuclear plant site boundary can be placed into one of the following three categories:

(1) Areas with no potential for historic or archaeological resources include areas where past disturbances related to construction of the power station and appurtenant facilities have

taken place to such an extent that any cultural resources that once existed are no longer present. No further archaeological investigations are recommended for these areas.

(2) Areas with low potential for historic or archaeological resources include areas that are relatively undisturbed but possess characteristics which would normally indicate a low probability for most types of cultural resources to occur. For the most part, these lands have a degree of slope greater than 15 percent. For most of these areas, further archaeological work would not be necessary, although there could be smaller areas within the larger zone where specific ground conditions could require investigation.

(3) Areas with moderate-to-high potential for archaeological resources include areas that are relatively undisturbed by past activities and that have a likelihood for prehistoric and historic archaeological sites according to local models of prehistoric and historic land use and settlement patterning. Archaeological investigation is recommended prior to undertaking any ground-disturbing activities in these areas.

According to the Catawba ER (Duke 2001), the plant site is small in terms of total acreage, and consequently, plant features take up much of the available landscape. The plant includes about 122 ha (301 ac) that is covered by water or highly disturbed by past construction of power generation and maintenance facilities, parking lots, and roads. The remaining acreage (60 ha [149 ac]) consists of either pine or mixed hardwood-pine forested areas. Forested or generally undisturbed areas occur primarily along the southern and eastern sectors of the exclusion zone. Given the potential for historical period archaeological resources (e.g., dwelling and outbuilding foundations, dumps, privies, etc.; see Section 2.2.9.2), forested areas within the exclusion zone should be treated as having moderate-to-high potential for historic or archeological resources.

Duke has indicated that no additional land-disturbing activities at the plant site or along the existing transmission line rights-of-way are planned for the license renewal period. In the event that ground disturbance should occur, Duke stated that it will ensure that any archaeological and historical resources that might be encountered will be protected by adherence to existing conditions in the Catawba Nuclear Site Environmental Work Practices (EWP Section 3.1 LAND DISTURBING ACTIVITY) (Duke 2001). This work practice calls for construction activities to halt immediately until Duke Environmental Management staff at the site and State Historic Preservation Office personnel have been notified and the issue has been resolved.

Based on the presently known cultural resources status at Catawba, the existence of written procedures to provide immediate reaction and notification in the event of inadvertent discovery of cultural resources, and the staff's cultural resource analysis and consultation, it is the staff's conclusion that the potential impacts on historic and archaeological resources during the license renewal period are expected to be SMALL, and additional mitigation is not warranted.

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 minority[a] or low-income populations. The memorandum accompanying Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969 (NEPA). The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although compliance with the executive order is not mandatory for independent agencies, the NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" (NRC 2001).

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of Catawba, employing the 1990 Census (USCB 1991) for low-income populations and the 2000 Census (USCB 2000) for minority populations. The populations within an 80-km (50-mi) radius of Catawba encompassed counties in both North and South Carolina. The analysis was also supplemented by field inquiries to the planning department and a social service agency in York County.[b]

For the purpose of the staff's review, a minority population is defined to exist if the percentage of each minority and aggregated minority category within the census block groups potentially affected by the license renewal of Catawba exceeds the corresponding percentage of minorities in the entire states of North and South Carolina by 20 percent, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group[c] exceeds the corresponding percentage of low-income population in the entire states of

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(a) The NRC Guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native, Asian, Native Hawaii or other Pacific Islander, or Black races, or Hispanic ethnicity. "Other" races and multi-racial individuals may be considered as a separate minority category as well as multi-racial individuals (NRC 2001).

(b) York County was the focus of this inquiry because Catawba is located in the County. The staff contacted several organizations working with low-income and minority populations, including the Catawba Indian Tribe through their Catawba Cultural Center. The staff concluded that any findings of environmental justice issues in the county would warrant further field of inquiries in the neighboring Counties. For reasons stated later in this section, further investigation was not warranted.

(c) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the Census Bureau collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance with Census Bureau guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2001).

North and South Carolina by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent. For counties and census block groups within an 80-km (50-mi) radius of Catawba, the percentage of minority and low-income populations is compared to the percentage of minority and low-income populations in North and South Carolina as applicable.

Duke followed the convention of employing census block groups and included the groups located in or partially in the 80-km (50-mi) radius of Catawba (Duke 2001). Using this convention, the 80-km (50-mi) radius includes 1407 and 1461 census block groups in the 2000 and 1990 censuses, respectively. The "more than 20 percentage points above the comparison area" criterion was used to determine whether a census tract should be counted as containing a minority or low-income population (Duke 2001). Because the 20 percentage points is a lower threshold, the 50 percent criteria was not needed.

The staff followed the convention of employing census block groups and counts of individuals in minority or low-income status. Figure 4-1 shows the distribution of minority populations (shaded areas) within the 80-km (50-mi) radius. Minority populations are concentrated to the southeast and southwest of the site. Beginning initially at approximately 42 km (26 mi) from the site, minority populations are concentrated in Fairfield, Lancaster, Kershaw, Chester, and Union Counties. Minority populations exist east of Catawba in Anson County along the 80-km (50-mi) radius. Pockets of minority populations exist in York County (around Rock Hill and the town of York) and in other counties around the Catawba site. A fairly large block of minority populations exists in Mecklenburg County, North Carolina, which encompasses much of the Charlotte metropolitan area.

Data from the 1990 census characterize low-income populations within an 80-km (50-mi) radius of Catawba in North and South Carolina (USCB 1991). Applying the NRC criterion of "more than 20 percent greater," the census block groups containing low-income populations were identified. Figure 4-2 shows the locations of the low-income populations within 80 km (50 mi) of Catawba. Census block groups containing low-income populations are concentrated around Charlotte, North Carolina. There is a small pocket of low-income population group in York County, South Carolina, around the town of York. Also, between approximately 64 to 80 km (40 to 50 mi) to the south of the Catawba plant, there is a concentration of low-income population in Union and Chester Counties. To the southeast and slightly on and extending outside the 80-km (50-mi) radius, there are low-income populations in Fairfield and Kershaw Counties.

With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Based on staff guidance

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of Catawba Based on Census Block Group Data and Individual Counts

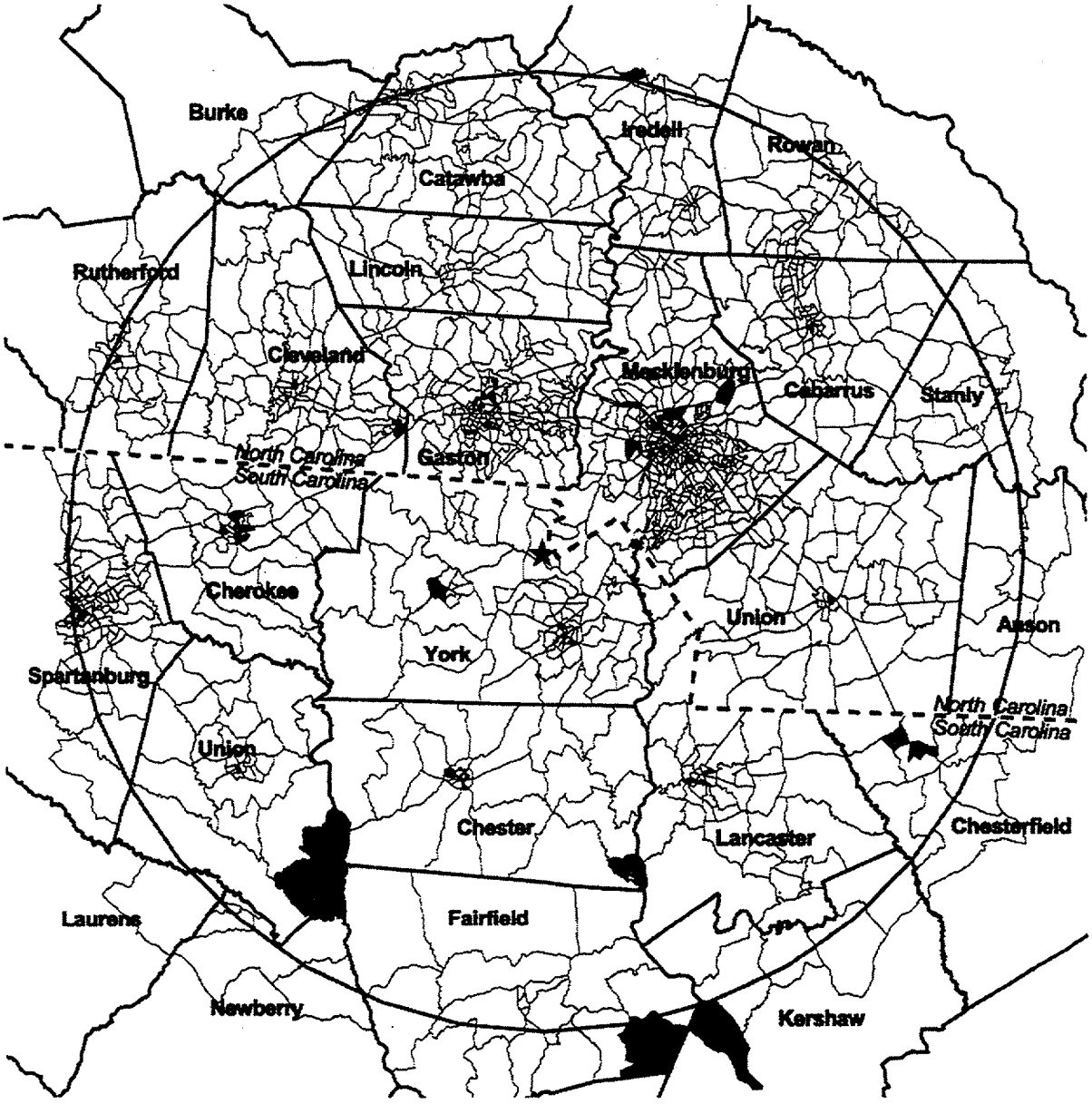

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of Catawba Based on Census Block Group Data and Individual Counts

(NRC 2001), air, land, and water resources within about 80 km (50 mi) of the Catawba site were examined. Within that area, a few potential environmental impacts could affect human populations. All of these were considered SMALL for the general population.

The pathways through which the environmental impacts associated with Catawba license renewal can affect human populations are discussed in each associated section. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations. The staff concludes that offsite impacts from Catawba to minority and low-income populations would be SMALL, and no special mitigation actions are warranted.

4.5 Groundwater Use and Quality

The Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that is applicable to Catawba groundwater use and quality is listed in Table 4-8. Duke stated in its ER that "no new information existed for the issues that would invalidate the GEIS conclusions" (Duke 2001). The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. 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 4-8. 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 Section
GROUNDWATER USE AND QUALITY	
Groundwater-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, for each of these issues follows.

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

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

  As discussed in Section 2.2.2, Catawba groundwater use is less than 0.068 m^3/s (100 gpm). The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no groundwater-use conflicts during the renewal term beyond those discussed in the GEIS.

The Category 2 issue related to groundwater use that is applicable to Catawba is listed in Table 4.9 and discussed in Section 4.5.1.

Table 4-9. Category 2 Issues Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
GROUNDWATER USE AND QUALITY			
Groundwater-use conflicts (plants using cooling towers withdrawing makeup water from a small river)	4.8.1.3, 4.4.2.1	A	4.5.1

4.5.1 Groundwater-Use Conflicts (makeup water)

Reductions in the total surface water supply in Lake Wylie and downstream could reduce the water available to groundwater users. In some regions, surface water is a significant source of recharge to groundwater aquifers. However, the geohydrology and relatively stable pool of Lake Wylie make such impacts negligible for Catawba.

Catawba is located in the Piedmont physiographic province of the southeastern United States. Groundwater in this area is derived predominately from infiltration of local precipitation. Therefore, groundwater resources are less impacted by recharge from surface water than from local precipitation.

As stated in Section 4.1.1, the lake level will decline only 9 mm (0.4 in.) in 7 days under drought conditions as a result of consumptive use by Catawba. Such a small change in the lake surface elevation would have no detectable impact on groundwater users. Also, as stated in

Section 4.1.1, consumptive use of water by Catawba operations results in a stage decrease of 6 mm (0.24 in.) for the Catawba River downstream of Lake Wylie under average conditions. Such a small change in river elevation would have no detectable impact on groundwater users.

Catawba consumptive use is not expected to change during the period of the proposed license renewal. It is impossible to reliably predict the quantity of future withdrawals and groundwater demands over the renewal term. However, there are State and Federal regulations in place to ensure future withdrawals do not adversely impact the groundwater resources around Lake Wylie and downstream. The impact of the consumptive use of water by Catawba on groundwater use is considered to be SMALL, and additional mitigation is not warranted.

4.6 Threatened or Endangered Species

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

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

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they would be adversely affected by continued operation of the nuclear plant during the license renewal term. The presence of threatened or endangered species in the vicinity of Catawba is discussed in Sections 2.2.5 and 2.2.6.

Duke maintains contacts with agencies responsible for protected and sensitive species to ensure compliance of its activities. In addition to its on-going dialogues, Duke provided information to the U.S. Fish and Wildlife Service (FWS) regarding license renewal application. With respect to Catawba, the FWS (Banks 2001) responded that, based on its review of the GEIS

> the Service believes that all issues concerning fish and wildlife resource have been adequately identified.

The staff sent a letter to FWS requesting a list of threatened, endangered, and proposed species, and critical habitat (NRC 2001). NRC will conduct any necessary consultation with FWS in accordance with Section 7 of the Endangered Species Act.

4.6.1 Aquatic Species

The Carolina heelsplitter is the only Federal- or State-listed aquatic species with the potential to occur in Lake Wylie or in streams in the transmission line rights-of-way. All known occurrences of this species in the Catawba River system are limited to small tributary streams located downstream of Lake Wylie (FWS 1996). In addition, a survey conducted in the Catawba River downstream of Lake Wylie failed to locate the species (Duke 2002b); thus, it is highly unlikely this species could be found in Lake Wylie as a consequence of downstream movement of spawn. This species has not been observed in Lake Wylie or in streams along the transmission line rights-of-way.

The staff has conducted a site visit, reviewed the information provided by the applicant and other available reports, and contacted the FWS, the South Carolina Department of Natural Resources (SCDNR), and the North Carolina Department of Environment and Natural Resources (NCDENR). Based on this information, it is the staff's conclusion that the impacts on aquatic endangered, threatened, proposed, or candidate species of an additional 20 years of operation and maintenance of Catawba and associated transmission lines would be SMALL, and additional mitigation is not warranted.

4.6.2 Terrestrial Species

The bald eagle is the only Federal- or State-listed terrestrial species observed at Catawba or along the transmission line rights-of-way. Bald eagles are rarely observed as transients at the Catawba site or along the transmission line rights-of-way. Dwarf-flowered heartleaf and Georgia aster are the only other species known to occur in the vicinity of the Catawba site or the transmission line rights-of-way, but neither of the species have been observed in these areas during field surveys. The towers and transmission lines do not pose a hazard to birds. There have been no reports of collisions or electrocutions of endangered or threatened species along the transmission lines or at the cooling towers. Transmission line maintenance activities are conducted so as to minimize impacts. Vegetation management protocols for the transmission lines have been developed in cooperation with the SCDNR. In addition, Duke has conducted several rare species surveys along the transmission line rights-of-way, the most recent in the spring of 2001.

The staff has reviewed the information provided by the applicant and has contacted the FWS, the SCDNR, and the NCDENR. Based on the site visit, review of the Catawba ER (Duke 2001), other reports, and consultation with the FWS, the SCDNR, and the NCDENR, it is the staff's conclusion that the impacts on endangered, threatened, proposed, or candidate species of an additional 20 years of operation and maintenance of Catawba and associated transmission lines would be SMALL, and additional 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 listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation during the renewal term. The staff reviewed the discussion of environmental impacts associated with operation during the renewal term in 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 information that is both new and significant related to any of the applicable Category 1 issues associated with the Catawba 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 additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 10 Category 2 issues applicable to Catawba operation during the renewal term and for environmental justice. For nine issues and environmental justice, the staff concluded that the potential environmental impact of renewal term operations of Catawba would be of SMALL significance in the context of the standards set forth in the GEIS and that mitigation would not be warranted. For Offsite Land Use (License Renewal), the staff determined that impact to tax-driven land use changes would be MODERATE and no mitigation is warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields. Therefore, no evaluation of this issue is required.

4.9 References

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

36 CFR 800. Code of Federal Regulations, Title 36, Parks, Forests, and Public Property, Part 80, "Advisory Council on Historic Preservations."

59 FR 7629. Executive Order 12898. "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations." *Federal Register.* Volume 59, No. 32. February 16, 1994.

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5.0 Environmental Impacts of Postulated Accidents

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

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

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

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

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

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

This chapter describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents (DBAs) and severe accidents, as discussed below.

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

Design-Basis Accidents.

In order to receive approval from the U.S. Nuclear Regulatory Commission (NRC) to operate a nuclear power facility, an applicant must submit a safety analysis report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

DBAs are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in 10 CFR Part 50 and 10 CFR Part 100.

The environmental impacts of DBAs are evaluated during the initial license process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license (OL). The results of these evaluations are found in license documentation such as the applicant's Final Safety Analysis Report (FSAR), the staff's Safety Evaluation Report (SER), the Final Environmental Statement (FES), and Section 5.1 of this Supplemental Environmental Impact Statement (SEIS). The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, design-basis events are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs make them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and,

therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. The issue applicable to Catawba is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
POSTULATED ACCIDENTS	
Design-basis accidents (DBAs)	5.3.2; 5.5.1

Based on information in the GEIS, the Commission found that

> The NRC staff has concluded that the environmental impacts of design basis accidents are of small significance for all plants.

Duke Energy Corporation (Duke) stated in its Environmental Report (ER; Duke 2001) that it is not aware of any new and significant information associated with the renewal of the OLs for Catawba Nuclear Station, Units 1 and 2 (Catawba). The staff has not identified any significant new information during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS.

Severe Accidents.

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. In the GEIS, the staff assessed the impacts of severe accidents during the license renewal period, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Severe accidents initiated by external phenomena such as tornadoes, floods, earthquakes, and fires have not traditionally been discussed in quantitative terms in FESs and were not specifically considered for the Catawba site in the GEIS (NRC 1996). However, in the GEIS, the staff did evaluate existing impact assessments performed by NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from beyond design-basis earthquakes at existing nuclear power plants is SMALL. Additionally, the staff concluded that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents.

Based on information in the GEIS, the Commission found that

> The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The issue applicable to Catawba is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	POSTULATED ACCIDENTS		
Severe Accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	L	5.2

The staff has not identified any significant new information with regard to the consequences from severe accidents during its independent review of the Catawba ER, the staff's site visit, the scoping process, or its evaluation of other 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 severe accident mitigation alternatives (SAMAs) for Catawba. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for Catawba; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

Duke submitted an assessment of SAMAs for Catawba as part of the ER (Duke 2001a). The assessment was based on Revision 2b of the Catawba Probabilistic Risk Assessment (PRA) (Duke 2001b), which is a full scope Level-3 PRA that includes the analysis of both internal and external events. The internal events analysis is an updated version of the Individual Plant Examination (IPE) model (Duke 1992), and the external events analysis is based on Individual Plant Examination for External Events (IPEEE) model (Duke 1994). In identifying and evaluating potential SAMAs, Duke took into consideration the insights and recommendations from the plant-specific PRA, as well as other studies, such as the Severe Accident Mitigation Design Alternative (SAMDA) analysis for Watts Bar (NRC 1995a) and NUREG-1560 (NRC 1997c). Duke concluded that none of the candidate SAMAs evaluated were cost-effective for Catawba.

Based on review of the SAMA assessment, the staff issued a request for additional information (RAI) to Duke by letter dated November 19, 2001 (NRC 2001). Key questions concerned (1) further information on several candidate SAMAs, especially those that mitigate the consequences of a station blackout (SBO) event; (2) details on the PRA used for the SAMA analysis, including results as they pertain to containment failure and releases; and (3) the impact of including elements of averted risk that were omitted in the ER. Duke submitted additional information by a letter dated February 1, 2002 (Duke 2002a), which provided details on the updated PRA, the requested PRA results, and other information identified in the RAI (NRC 2001). Duke provided additional information in a telephone conference call with the staff on February 25, 2002 (NRC 2002a). In these responses, Duke included supplemental tables showing the impacts of including averted replacement power costs for SAMAs that have the potential to reduce core damage frequencies and averted offsite property damage costs for SAMAs that have the potential to improve containment performance – both of which were omitted in the original analysis. Also, Duke presented their position on the value of providing back-up hydrogen control capability during SBO events. Duke's responses addressed the staff's concerns and reaffirmed that none of the SAMAs would be cost-beneficial. However, based on review of the cost and benefit information provided by Duke, the staff concludes that two SAMAs are cost-beneficial under the assumptions presented. One cost-beneficial SAMA involves plant and procedure modifications to enable the existing hydrogen control (igniter) system to be powered from an ac-independent power source in SBO events. Duke has not implemented this SAMA at Catawba; this issue is currently being addressed by the NRC as part of the resolution of Generic Safety Issue 189 - Susceptibility of Ice-Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident (NRC 2002b). The other cost-beneficial SAMA involves installing a watertight wall around the

6900/4160 V transformers in the basement of the turbine building. Duke has not implemented this SAMA at Catawba; this issue has been identified for follow-up as a current operating plant issue at Catawba.

The staff's assessment of SAMAs for Catawba follows.

5.2.2 Estimate of Risk for Catawba Units 1 and 2

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

5.2.2.1 Duke's Risk Estimates

The Catawba PRA model, which forms the basis for the SAMA analysis, is a Level 3 risk analysis; that is, it includes the treatment of core damage frequency, containment performance, and offsite consequences. The model, which Duke refers to as PRA, Revision 2b (Duke 2001b), consists of an internal events analysis based on an updated version of the original IPE (Catawba PRA, Revision 1; Duke 1992) and an external events analysis based on the current version of the IPEEE (Duke 1994). The calculated total core damage frequency (CDF) for internal and external events in Revision 2b of the Catawba PRA is 5.8E-05/ry.

Since the Catawba PRA is a "living" PRA, the original version of the IPE has been updated to reflect various design and procedural changes, such as those related to the improvements identified in the IPE, and to reflect operational experience. The CDF for internal and external events was reduced from 7.8E-05 per reactor-year (Revision 1) to 5.8E-05 per reactor-year (Revision 2b). The Level 1 PRA changes associated with the Catawba PRA Revision 2b model included:

- incorporation of updated data for component reliability, unavailabilities, initiating event frequencies, common cause failures, and human error probabilities
- conversion from a sequence-based solution to a single-top fault tree
- modifications to reflect changes to the plant configuration.

The most significant plant enhancement incorporated was providing back-up cooling to one of the two high-head charging pumps. In an event in which normal cooling to the high-head charging pumps is lost, a means to provide back-up cooling from the drinking water supply was implemented to reduce the likelihood of a reactor coolant pump seal loss-of-coolant accident (LOCA). Another important change occurred in the interfacing systems LOCA (ISLOCA)

evaluation. The generic database adopted for the Revision 2b analysis had significantly higher failure rates for valve ruptures. This resulted in a significant increase in the CDF contributed by the ISLOCA, an important risk contributor.

The breakdown of the CDF from Revision 2b to the PRA is provided in Table 5-3. Internal event initiators represent about 80 percent of the total CDF and are composed of transients (24 percent of total CDF), LOCAs (29 percent of total CDF), internal flood (24 percent of total CDF), and reactor pressure vessel rupture (2 percent of total CDF). Remaining contributors together account for less than 3 percent of total CDF. External event initiators represent about 20 percent of the total CDF and are composed of seismic initiators (15 percent of total CDF), tornado initiators (4 percent of total CDF), and fire initiators (2 percent of the total CDF). Although not explicitly reported in Table 5-3, SBO events account for 43 percent of the total CDF for internal and external events in Revision 2b of the PRA (Duke 2002a).

Table 5-3. Catawba Core Damage Frequency (Revision 2b of PRA)

Initiating Event	Frequency (per reactor-year)	Percent of Total CDF
Transients	1.4E-05	24
Loss-of-coolant accident (LOCA)	1.7E-05	29
Internal flood	1.4E-05	24
Anticipated transient without scram	3.0E-07	<1
Steam generator tube rupture (SGTR)	3.6E-08	<1
Reactor pressure vessel rupture	1.0E-06	2
Interfacing system LOCA	2.5E-07	<1
CDF from internal events	**4.7E-05**	**81**
Seismic	8.5E-06	15
Tornado	2.1E-06	4
Fire	1.2E-06	2
CDF from external events	**1.1E-05**	**19**
Total CDF	**5.8E-05**	**100**

The Level 2 (also called containment performance) portion of the Catawba PRA model, Revision 2b, is essentially the same as the IPE Level 2 analysis. However, the following changes were made:

- modification of the containment event tree (CET) logic regarding the potential for corium contact with the containment liner
- recognition that the refueling water storage tank inventory would drain through a failed reactor vessel in some sequences (e.g., SBO); this was factored into the CET logic.

These changes resulted in a slight increase in the potential for early containment failure as a result of corium contact with the containment liner and a reduction in basemat melt-through due to reactor cavity flooding via the reactor vessel breach.

The offsite consequences and economic impact analyses (i.e., Level 3 PRA Analyses) were carried out using the NRC-developed MELCOR Accident Consequence Code System 2 (MACCS2) code. Inputs for this analysis include plant and site-specific input values for core radionuclide inventory, source term and release fractions, meteorological data, projected population distribution, and emergency response evacuation modeling.

Duke estimated the dose to the population within 80 km (50 mi) of the Catawba site from all initiators (internal and external) to be 0.314 person-Sieverts (Sv) (31.4 person-rem) per reactor-year (Duke 2001a). The breakdown of the total population dose by containment

Table 5-4. Breakdown of Population Dose by Containment End-State
[Total dose = 0.314 person-Sv (31.4 person-rem) per reactor-year]

Containment End State	Percent of Total Dose – Internal Initiators	Percent of Total Dose – External Initiators	Percent of Total Dose – All Initiators
Steam generator tube rupture[a]	0.2	<0.1	0.2
Interfacing system LOCA[a]	8.3	0.0	8.3
Containment isolation failure	<0.1	1.0	1.0
Early containment failure	13.2	9.9	23.1
Late containment failure	45.1	22.1	67.2
Basemat melt-through	<0.1	<0.1	<0.1
No containment failure	0.1	<0.1	0.1
Total	**66.9**	**33.1**	**100**

(a) Containment bypass events

end-state is summarized in Table 5-4. Internal events account for approximately 0.21 person-Sv (21.0 person-rem) per reactor-year, and external events account for approximately 0.104 person-Sv (10.4 person-rem) per reactor-year. As can be seen from this table, early and late containment failures account for the majority of the population dose.

5.2.2.2 Review of Duke's Risk Estimates

Duke's determination of offsite risk impacts at Catawba is based on the Revision 2b of the Catawba PRA and a separate MACCS2 analysis. For the purposes of this review, the staff considered the Catawba study in terms of the following major elements:

- the Level 1 and 2 risk models that form the bases for the September 1992 IPE submittal (Duke 1992)
- the major modifications to the IPE models that have been incorporated in Revision 2b of the PRA (Duke 2001b)
- the external events models that form the basis for the June 1994 IPEEE submittal (Duke 1994)
- the analyses performed to translate fission product release frequencies from the Level 2 PRA model into offsite consequence measures (Duke 2001a).

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 Catawba IPE is described in a staff report dated June 7, 1994 (NRC 1994). In that review, the staff evaluated the methodology, models, data, and assumptions used to estimate the 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), which means the IPE was of adequate quality to be used to look for design or operational vulnerabilities. The staff's review primarily focused on the licensee's ability to examine Catawba for severe accident vulnerabilities and not specifically on the detailed findings or quantification estimates. Overall, the staff believed that the Catawba IPE was 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 risk models are used in conjunction with insights, such as those from risk importance, sensitivity, and uncertainty analyses.

The staff's review of the Catawba IPEEE is described in an evaluation report dated April 12, 1999 (NRC 1999b). Duke did not identify any fundamental weaknesses or vulnerabilities to severe accident risk with regard to the external events. In the SAR the staff concluded that the

IPEEE met the intent of Supplement 4 to Generic Letter 88-20 (NRC 1991), and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities.

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 (MAAP) code to analyze postulated accidents and develop radiological source terms for each of 29 containment release categories used to represent the containment end-states. These source terms were incorporated as input to the MACCS2 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 1990) for the closest corresponding release scenarios. The staff concludes that the assignment of source terms is acceptable.

The plant-specific input to the MACCS2 code includes the Catawba reactor core radionuclide inventory, emergency response evacuation modeling based on Catawba evacuation time estimate studies, release category source terms from the Catawba PRA Revision 2b analysis (same as the source terms used in the IPE), site-specific meteorological data, and projected population distribution within a 80-km (50-mi) radius for the year 2040.

MACCS2 requires a file of hourly meteorological data consisting of wind speed, wind direction, atmospheric stability category, and precipitation. For the Catawba SAMA analysis, the meteorological data was obtained from the meteorological tower located on the Catawba site; the meteorological data used in MACCS2 contained data for one year, January 1 through December 31, 1991.

The Catawba PRA Revision 2b and the SAMA offsite consequence analyses use three distinct evacuation schemes in order to adequately represent evacuation time estimates for the permanent resident population, the transient population, and the special facility population (schools, hospitals, etc.). The three groups are defined by the time delay from initial notification to start of evacuation. For each evacuation scheme, the fraction of the population starting their evacuation is included. For the permanent resident evacuation schemes, it was assumed that 5 percent of the population would delay evacuation for 24 hours after being warned to evacuate. The delay time and fraction of population for the remaining two schemes was developed from information given in the latest update to the Catawba evacuation time estimate study for the 10-mile Emergency Planning Zone (EPZ). The evacuation schemes include additional information such as evacuation distance, average evacuation speed, sheltering, and shielding considerations. In the Catawba evacuation model, only the 10-mile EPZ is assumed

to be involved in the initial evacuation. The MACCS2 model assumes that persons outside of the 10-mile EPZ will wait 24 hours before evacuating (provided that radiological conditions warrant evacuation).

The staff reviewed the Duke responses (Duke 2002a) to questions regarding meteorological data, population data, and emergency planning. The responses confirmed that Duke used appropriate values for the consequence analysis.

The staff also reviewed the Duke responses (Duke 2002a) to questions regarding the low frequency of steam generator tube ruptures (SGTR) accidents (3.6E-08 per reactor-year). Duke explained the low value as largely due to the use of IPE success criteria, under which sequences are categorized as successes if core damage occurs beyond 24 hours, an assumption not in accordance with current, generally accepted industry practice. Duke indicated that the next revision of the Catawba PRA will reflect this correction. The staff notes that the impact of this correction can be sizable, as demonstrated in Duke's revision to the McGuire PRA, in which the frequency of SGTR accidents increased by a factor of 600 (NRC 2002d). However, even with the higher SGTR frequency, the maximum benefit associated with completely eliminating SGTR events at McGuire was estimated to be about $100,000 (present worth for the 20-year license renewal period). Previous analyses of severe accidents mitigation alternatives (e.g., for advanced light water reactors) have shown that implementation costs for alternatives to prevent or mitigate SGTR events would be expensive (on the order of several million dollars). The staff concludes it is unlikely that a cost-beneficial alternative could be implemented to substantially reduce SGTR risk given the low expected benefits and the high implementation costs.

The staff concludes that the methodology used by Duke to estimate the CDF and offsite consequences for Catawba provides an acceptable basis from which to proceed with an assessment of the risk reduction potential for candidate SAMAs. Additionally, the risk profile used is similar to other PWRs with ice-condenser containments. Accordingly, the staff bases its assessment of offsite risk on the CDF and population doses reported by Duke.

5.2.3 Potential Design Improvements

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

5.2.3.1 Process for Identifying Potential Design Improvements

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

- The core damage cut sets from Revision 2b of the Catawba 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 Catawba (including early containment failure, containment isolation failure, and containment bypass) were reviewed for possible implementation.

In addition, Duke reviewed the Watts Bar SAMDA analysis (NRC 1995a), and insights from the staff's generic report on the IPE (NRC 1997c) to identify additional SAMAs.

As a starting point for the core damage cut set review, Duke developed a listing of the top 100 cut sets (severe accident sequences) based on internal initiators and the top 100 cut sets for external initiators. These 200 sequences include all potential core damage sequences with at least a 0.08 percent contribution to the total CDF. Additionally, some cut sets contributing as little as 0.01 percent to the total CDF were considered. Duke reviewed the cut sets to identify potential SAMAs that could reduce CDF. A cutoff value of 5.8E-07 per reactor-year (for internal and external event initiators) was used to screen events. To account for the cumulative effect of cut sets below this cutoff value, the basic events importance measure was also used to identify potential enhancements, as discussed below. Duke indicated in response to the RAIs (Duke 2002a) that the estimated CDF for the 200 cut sets is 4.1E-05 per reactor-year, which is about 71 percent of the total CDF.

For each seismic initiator cut set, Duke calculated the associated offsite risk based on the population dose 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 ($200,000 per person-SV) 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 cut sets above the cutoff frequency. The present worth of averted risk for all of the seismic cut sets combined was estimated to be about $316,000 (not including the cost of replacement power and offsite property damage, the significance of which is discussed in Section 5.2.6.2). On the basis of the small risk reduction

achievable [0.08 person-Sv (8.0 person-rem)] and the large costs associated with substantial seismic upgrades (estimated at several million dollars), Duke eliminated seismic SAMAs from further consideration.

Duke reviewed the F-V Basic Event Importance Ranking presented in the Catawba PRA report, Revision 2b, and identified several 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. Five potential enhancements for reducing CDF were identified through this process and are presented in Table 5-5.

Duke indicated in the ER that two design options – installing a watertight wall around the 6900/4160 V transformers in the turbine building basement and moving the 6900/4160 V transformers – were evaluated as part of a previous design study for Catawba to address concerns raised in the IPE over a turbine building flood causing an extended loss of offsite power. Neither of these options were considered cost-effective at that time. At the staff's request (NRC 2001), Duke provided further information regarding the addition of a watertight wall as a potential SAMA (Duke 2002a, NRC 2002a). This plant modification is included as an additional SAMA in Table 5-5.

Duke also considered potential alternatives to reduce containment failure modes of concern for Catawba. These alternatives included nine containment-related improvements evaluated as part of the staff's assessment of SAMDAs for Watts Bar (NRC 1995a) and five containment-related improvements (e.g., procedures for reactor coolant system depressurization, procedures to cope with and reduce induced SGTR) derived from the staff's generic report on the individual plant examination program (NRC 1997c). Duke eliminated those alternatives that were either (1) already implemented at Catawba or (2) not applicable to the Catawba containment. Based on the screening, Duke designated nine of the containment-related SAMAs for further study. The list of the potential enhancements to improve containment performance is presented in Table 5-6.

In the Catawba ER, Duke identified the installation of back-up power to the igniters and the installation of back-up power to air-return fans as two separate SAMAs. However, in responses to staff RAIs, Duke indicated that the availability of air-return fans would be essential to the effective operation of igniters in an SBO; therefore, Duke treated the combined modification as a single SAMA. Accordingly, these two hydrogen control related SAMAs are shown as a single SAMA in Table 5-6. This effectively reduces the number of containment-related SAMAs to eight.

Table 5-5. SAMA Cost/Benefit Screening Analysis–SAMAs that Reduce CDF

Potential Alternative	Sequences/Failures Addressed	Risk Reduction		Total Benefit (per unit)	Cost of Enhancement (per unit)
		CDF[a]	Population Dose [b] (person-Rem [c])		
Man standby shutdown system (SSS) 24 hours/day with trained operator	Turbine building flood with a failure of diesel generators to run and operators fail to initiate SSS seal injection following a loss of offsite power (LOOP) event	5.4E-06	4.1	$241,000	>$2.5M[d]
Install automatic swap-over to high pressure recirculation	LOCA cut sets with failure of operators to establish high pressure recirculation	1.5E-05	1.1	$448,000	>$1M
Replace reactor vessel with stronger vessel	Failure of reactor pressure vessel with failure to prevent core damage following a reactor pressure vessel (RPV) breach	1.0E-06	< 0.1	$30,000	>$1M
Install third diesel generator	LOOP events, which includes turbine building flood and LOOP initiators.	1.6E-05	14.0	$754,000	>$2M
Install automatic refill to upper storage tank (UST)	Loss of instrument air with a failure of nuclear service water system (RN) sources and operators fail to refill UST from condensate grade sources	4.0E-06	0.3	$120,000	>$1M
Install watertight wall around the 6900/4160 V transformers in turbine building basement	Turbine building flood causing an extended loss of offsite power	1.4E-05	12.4	$663,000	$250,000

(a) Total CDF = 5.8E-5 per reactor-year
(b) Total population dose = 31.4 person-rem per reactor-year
(c) One person-Sv+100 person-rem
(d) Cost estimates for manning the standby shutdown system apply on a per site rather than per unit basis. In order to provide a consistent basis for comparison with the estimated benefits (which are per unit), the estimated site costs were divided by two.

Table 5-6. SAMA Cost/Benefit Screening Analysis–SAMAs that Improve Containment Performance

Potential Alternative	Risk Reduction CDF	Risk Reduction Population Dose (person-rem)[a]	Total Benefit (per unit)	Cost of Enhancement (per unit)
Install independent containment spray system	N/A	28.4	$918,000[b]	>$1M
Install filtered containment vent system	N/A	28.4	$918,000[b]	>$1M
Install back-up power to igniters and Install back-up power to air-return fans	N/A	28.4	$918,000[b]	$270K[c]
Install containment inerting system	N/A	28.4	$918,000[b]	>$1M
Install additional containment bypass instrumentation (ISLOCA)	N/A	2.6	$84,000	>$1M
Add independent source of feedwater to reduce induced SGTR	N/A	< 0.1	< $3,200	>$1M
Install reactor cavity flooding system	N/A	7.3	$239,000	>$1M
Install core retention device	N/A	< 0.1	< $3,200	>$1M

(a) One person-Sv = 100 person-rem
(b) Total benefit based on eliminating all early and late containment failures
(c) Cost estimates for back-up power were provided on a per site rather than per unit basis. In order to provide a consistent basis for comparison with the estimated benefits (which are per unit), the estimated site costs were divided by two.

5.2.3.2 Staff Evaluation

It should be noted that Duke has made extensive use of PRA methods to gain insights regarding severe accidents at Catawba. Risk insights from various Catawba risk assessments 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) provide back-up cooling water to the centrifugal charging pumps, (2) improve plant personnel's awareness of the standby shutdown system importance, (3) improve standby shutdown system availability by administratively controlling and limiting the times when the standby shutdown system may be taken out of service, and (4) decrease the time required for service water system and component cooling water system maintenance. Examples of plant improvements being planned for implementation by Duke based on IPEEE findings are:

(1) addition of spacers and stiffening of side rails on the diesel generator battery racks

(2) relocation of an instrument to avoid a potential seismic interaction with adjacent piping

(3) replacement of a valve to eliminate seismic spatial interaction with a nearby spent fuel cooling line

(4) addition of instructions in the pre-fire plan for the electrical bus switching area

(5) replacement of reciprocal air compressors with centrifugal compressors, and routing cables for the new compressors to give sufficient redundancy in case of fires

(6) reinstallation of missing door bolts in the auxiliary shutdown panel cabinets (NRC 1999).

The implementation of such improvements reduced the risk associated with the major contributors identified by the Catawba PRA and contributed to the reduced number of candidate SAMAs identified as part of Duke's application for license renewal.

Duke's effort to identify potential SAMAs focused on areas found to be risk-significant in the Catawba 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 Catawba. Duke made a reasonable effort to use the Catawba PRA to search for potential SAMAs and to review insights from other plant-specific risk studies and previous SAMA analyses for potential applicability to Catawba. The staff reviewed the set of potential enhancements considered in Duke's SAMA identification process. These enhancements include improvements oriented toward reducing the CDF and risk from major contributors specific to Catawba and improvements identified in the previous SAMDA review for Watts Bar (NRC 1995a) that would be applicable to Catawba.

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. The staff requested additional information (NRC 2001) from Duke on less expensive alternatives that would yield similar benefits. In response, Duke provided additional information on (1) the cost to provide alternative power to hydrogen igniters for SBO, (2) the cost to provide passive autocatalytic recombiners (PARs) as an alternative to igniters, (3) the cost to install a dedicated line from the Wylie hydroelectric station as an alternative source of ac power, and (4) the cost to install a watertight wall around the 6900/4160 V transformers. This information was responsive to the staff's requests and provided additional depth to the SAMAs considered. These additional alternatives are further evaluated, along with the other SAMAs, in the sections that follow.

The staff concludes that Duke has used a systematic process for identifying potential design improvements for Catawba 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

Section 4.3 of Attachment H to the Catawba ER describes the process used by Duke to determine the risk reduction potential for each enhancement.

For each seismic initiator cut set, Duke calculated the associated offsite risk based on the population dose 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 cut set. For each (non-seismic) sequence/enhancement, Duke evaluated the severe accident sequences. In general, where an alternative impacted more than one severe accident sequence, Duke determined the cumulative risk reduction achievable by each SAMA. This was performed by identifying which basic events in the cut sets would be affected by the implementation of the particular SAMA and assuming that implementation of the basic event(s) would be completely eliminated by the SAMA. For each containment-related improvement, Duke assumed that all of the population dose 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, filtered containment vent, back-up power to igniters, back-up power to air-return fans, containment inerting system, and reactor cavity flooding system), the total population dose for all affected failure modes was assumed to be completely eliminated by implementing the alternative. For example, installation of a standpipe in containment for reactor cavity flooding, which could reduce the likelihood of both early containment failure associated with reactor vessel breach and late containment failure due to basemat melt-through, was assumed to completely eliminate the associated early and late containment failures.

The staff questioned Duke (NRC 2001) regarding the estimated risk reduction associated with addition of a third diesel generator (DG). This SAMA was estimated to provide about a 60 percent reduction in the CDF for SBO sequences (from 2.5E-05 per reactor-year to 9.0E-06 per reactor-year). Duke indicated that the risk reduction was based on eliminating all failures to start, failures to run, and common cause failures of the existing two DGs. However, it was assumed that the third DG would not be seismically qualified; therefore, it would not be effective in seismic events. Since seismic events account for approximately one-third of the SBO CDF, the limited risk reduction estimated for the third DG appears reasonable. Duke also considered the additional benefit if the third diesel were seismically qualified similar to the existing DGs. Duke estimated that an additional reduction in CDF of about 4.0E-7 per reactor-year would be achieved by eliminating all random failures of DGs in seismic events. This risk reduction is limited because the seismic results are dominated by seismic failures in the 4-kV power system for which improving diesel generator availability provides no benefit. The staff concludes that Duke's risk reduction estimates for this SAMA are reasonable.

An estimate of the risk reduction for the SAMA involving installation of a dedicated power line to the Wylie hydroelectric station was not provided in Duke's RAI response. However, the risk reduction would be comparable to that for adding a third DG, because the seismic fragility of the hydroelectric unit is expected to be similar to that for the seismically qualified DGs.

The staff notes that Duke evaluated the risk reduction potential for each SAMA, including the dedicated power line, in a bounding fashion. Each SAMA was assumed to completely eliminate all sequences that the specific enhancement was intended to address; therefore, the benefits are generally overestimated and conservative, including SAMAs related to SGTR events. 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 4-1, 4-2, and 5-1 of Attachment H 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 one SAMA, which involved installing a third DG, 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 this alternative were found to have a high importance in the Catawba PRA. Because the safety benefits ($754,000) of the potential SAMA was significantly less than the estimated implementation costs ($2 million), the cost estimate was not 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 SAMDA for operating reactors and advanced LWRs. The staff notes that Duke's estimated implementation costs of $1 million or greater are consistent with the values reported in previous analyses for major hardware 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. For example, Duke estimated the cost to install a third DG to be approximately $2 million; this value is less than the cost estimates reported in previous SAMDA analyses for a similar design change.

Duke's estimate of the cost to install a dedicated line from the Wylie hydroelectric station as an alternate source of ac power also appears reasonable. This line would be buried to eliminate weather-related common cause failures. The estimated cost ($8 million) is greater than, but comparable to the cost estimates for a similar modification provided by Duke (Duke 2002b) for the McGuire Nuclear Station ($3 million) and by Dominion Power (NRC 2002c) for the Surry Nuclear Power Station ($2 to 5 million). Even the lowest of these estimates is far greater than the calculated benefit of $750,000 for Catawba.

The staff questioned Duke regarding the costs of less expensive alternatives that could offer similar risk reduction benefits, particularly with regard to installation of a watertight wall to address turbine flooding events and hydrogen control improvements for SBO events. Duke's estimate of the cost to install a watertight wall around the 6900/4160 V transformers in the turbine building basement is $250,000 per unit (NRC 2002a). The estimated cost breakdown is $75,000 for engineering, $25,000 for materials, and $150,000 for installation labor. These costs appear reasonable given the constraints in installing the modification in an existing plant.

In a February 1, 2002, response to staff RAIs (Duke 2002a), Duke provided additional information on the costs associated with installing a passive hydrogen control system based on the use of PARs in lieu of the present ac-dependent hydrogen igniters and the costs of powering a subset of the current hydrogen igniters from a back-up generator. For scoping purposes, Duke provided supplementary information regarding the cost of back-up power to the igniters and air-return fans in response to a follow-up RAI (NRC 2002a).

Duke's estimate of the cost to establish a capability to power a subset of igniters from a back-up generator was $205,000 for the site. This modification, as defined by Duke, would involve pre-staging a single, dedicated generator outdoors on a concrete pad (for ventilation and exhaust considerations), and supplying the necessary power cables and circuit breakers to enable connection to the igniter branch circuits in either unit. The breakdown of this cost is $5,000 for engineering, $50,000 for materials, $110,000 for installation labor, and $40,000 for maintenance and operation. This cost estimate does not include an enclosure, tornado protection for the generator, or any seismic design. When one air-return fan is added to this estimate, the combined cost is $540,000 per site. The breakdown of this cost is $50,000 for engineering, $210,000 for materials, $240,000 for installation labor, and $40,000 for maintenance and operation. Duke points out there will be additional costs not included in these estimates. In order to provide a consistent basis for comparison with the estimated benefits (which are per unit), the above site costs were divided by two to derive an approximate per unit cost.

The staff requested additional information on PARs, since PARs are to be installed in French pressurized water reactor (PWR) by 2007 to mitigate the consequences of hydrogen combustion events. In response (Duke 2002a), Duke estimated that the installation of PARs would cost more than $750,000 per unit, which is well above the estimated benefit (see Table 5-7, Section 5.2.6.2). This cost estimate is consistent with independent staff cost estimates for installing PARs. Duke further noted that providing electric power to hydrogen igniters during a SBO or installing PARs will not be effective without also powering at least one of the containment air-return fans and that this will further increase the cost of these options.

The staff asked for further information on the basis for the greater than $1 million cost estimate for installing an automatic swap-over to high pressure recirculation. Duke (NRC 2002a)

referenced NUREG-0498, Supp. 1 (NRC1995a), which estimated a cost of about $2.1 million for a similar alternative (i.e., "automate the alignment of emergency care cooling system [ECCS] recirculation to the high-pressure charging and safety injection pumps"). This would reduce the potential for related human errors made during manual realignment. This cost estimate is considerably higher than the estimated averted risk benefit for Catawba of about $448,000. (Benefits are discussed further in Section 5.2.6.)

The staff concludes that the cost estimates provided by Duke are reasonable and adequate for the purposes of this SAMA evaluation. As noted in Section 5.2.6.2, further attention will be placed on the costs associated with SBO-related plant improvements by the NRC as part of the resolution of Generic Safety Issue 189 - Susceptibility of Ice-Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident (NRC 2002b). Also, as noted in Section 5.2.6.2, the need for additional evaluation and possible implementation of the watertight wall around the 6900/460 V transformers has been identified as a current operating plant issue.

5.2.6 Cost-Benefit Comparison

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

5.2.6.1 Duke Evaluation

In the analysis provided by Duke in the ER, Duke did not include the following factors in its cost-benefit evaluation: replacement power costs for SAMAs that have the potential to reduce CDF and averted offsite property damage costs for SAMAs that have the potential to improve containment performance. 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 the cost-benefit analysis for each affected SAMA. In response to the RAI (Duke 2002a), Duke updated the benefit estimates to include averted replacement power costs and averted offsite property damage costs.

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]). The guidance involves determining the net value for each SAMA according to the following formula:

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

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

Averted Public Exposure (APE) Costs

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/reactor-year)
x monetary equivalent of unit dose ($2000 per person-rem)
x present value conversion factor (10.76 based on a 20-year period with a 7 percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997b), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. Duke used the following expression when calculating the APE for the 20-year license renewal period:

APE = $2.20E+04 x (Change in public exposure)

Averted Offsite Property Damage Costs (AOC)

For SAMAs that reduce CDF, the AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

Duke derived the values for averted offsite property damage costs based on information provided in Section 5.7.5 of NUREG/BR-0184 (NRC 1997b). A discount factor of 7 percent and

a 4 percent rate of inflation were used. Duke used the following expression when calculating the AOC for the 20-year license renewal period:

AOC = $3.92E+09 x (Change in annual CDF)

Originally, as part of the ER, Duke did not include the AOC for containment-related SAMAs. In response to staff RAIs (Duke 2002a), Duke incorporated AOC as follows.

For containment-related SAMAs (which impact population dose but not CDF), Duke estimated the combined AOC and APE costs based on a conversion factor of $3000/person-rem, which Duke attributed to NUREG/CR-6349 (NRC 1995b). Duke used the following expression when calculating these costs (for containment-related SAMAs) for the 20-year license renewal period:

AOC + APE = $3.23E+04 x (Change in public exposure).

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction
x occupational exposure per core damage event
x monetary equivalent of unit dose
x present value conversion factor.

Duke derived the values for averted occupational exposure based on information provided in Section 5.7.3 of NUREG/BR-0184 (NRC 1997b). Best estimate values provided for immediate occupational dose 33 person-Sv (3300 person-rem) and long-term occupational dose [200 person-Sv (20,000 person-rem) over a 10-year cleanup period] were used. The present value of these doses was calculated using the equations provided in NUREG/BR-0184 in conjunction with a monetary equivalent of unit dose of $2000 per person-rem, a discount rate of 7 percent, and a time period of 20 years to represent the license-renewal period. Duke used the following expression when calculating the AOE for the 20-year license renewal period:

AOE = $3.81E+08 x (Change in annual CDF)

Averted Onsite Cleanup Costs (AOSC) (Not Including Replacement Power Costs)

The AOSCs, as calculated by Duke, include averted cleanup and decontamination costs. NUREG/BR-0184, Section 5.7.6.2 states that long-term replacement power costs must also be considered (NRC 1997b). Duke did not include this cost in the ER. However, Duke did add it in the responses (Duke 2002a) to the staff's RAIs.

Averted cleanup and decontamination costs (ACC) are calculated using the following formula:

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

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in NUREG/BR-0184 (NRC 1997b) as $1.5E+09 (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. Duke used the following expression when calculating the ACC for the 20-year license renewal period:

ACC = $1.18E+10 x (Change in annual CDF)

Averted Power Replacement Cost (APRC)

The Duke estimate of the annual power replacement cost for Catawba is based on an assumed discount rate of 7 percent for the 20-year license renewal period.

The estimated present power replacement costs of a severe accident occurring in each year of the license renewal period is given by (equation from NUREG/BR-0184, page 5.44):

$$PV_{RP} = [\$1.2E+08/0.07][1 - \exp(-0.07 * 20)]^2$$

$$PV_{RP} = \$9.73E+08$$

Then, to estimate the net present value of power replacement over the 20-year license renewal (equation from NUREG/BR-0184, page 5.44):

$$U_{RP} = [PV_{RP}/0.07][1 - \exp(-0.07 * 20)]^2$$

$$U_{RP} = \$7.89E+09$$

APRC = U_{RP} * (Change in annual CDF)

Since the APRC from the NUREG is in 1990 dollars, an assumption is made to include a 4 percent inflation rate over 11 years to bring the value into 2001 dollars; therefore,

APRC = $1.21E+10 x (Change in annual CDF)

Duke Results

The total benefit associated with each of the 14 SAMAs evaluated by Duke (six that reduce CDF and eight that improve containment performance) is provided in Tables 5-5 and 5-6. Two of the SAMAs have a positive net value (i.e., the total benefit is greater than the cost of the enhancement). These SAMAs involve installing a watertight wall around the 6900/4160 V transformers and installing back-up power to igniters and air-return fans. All of the remaining SAMAs have a negative net value even given the bounding risk reduction benefits inherent in these estimates.

5.2.6.2 Staff Evaluation

The cost-benefit analysis provided by Duke (Duke 2001a; Duke 2002a) was based primarily on NRC's *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997b). In the original Catawba ER, Duke did not include averted replacement power costs for SAMAs that reduce CDF and averted offsite property damage costs for SAMAs that improve containment performance. However, the impact of these factors was included in supplemental analyses provided by Duke in response to the staff's RAIs (Duke 2002a; NRC 2002a). The averted replacement power costs were assessed appropriately and the values calculated by Duke are consistent with independent staff assessments.

Duke used a conversion factor of $3,000/person-rem to determine the averted offsite property damage and averted public exposure costs. This effectively assumes a $1,000/person-rem conversion factor as a surrogate for averted offsite property damage, in addition to the accepted $2,000/person-rem conversion factor for averted offsite public exposure costs. Because offsite property damage costs are plant and site-specific, it would be more consistent with standard practice to actually calculate the property damage using the MACCS code. Nevertheless, the averted offsite costs values (for health effects and property damage) calculated by Duke provide reasonably good agreement with typical site values and are acceptable for purposes of estimating the value of containment-related SAMAs. Inclusion of averted replacement power and offsite property damage costs did not result in identification of any additional cost-beneficial SAMAs, and would not call into question Duke's decision to eliminate seismic SAMAs from consideration given the large costs associated with seismic SAMAs.

Based on the staff evaluation, the two SAMAs that are potentially cost-beneficial, which involve installing a watertight wall around the 6900/4160 V transformers and installing back-up power to igniters and air-return fans, are discussed below. Several of the containment-related SAMAs (Table 5-6) have total benefits that are only slightly less than the estimated cost to implement the enhancement, specifically, installation of an independent containment spray system, a filtered containment vent system, and a containment inerting system. However, the estimated

risk reduction in Table 5-6 is based on the bounding assumption that all early and late containment failures would be completely eliminated. Realistically, only a small fraction of the total risk would be eliminated by any one SAMA. Also, the cost to implement any of these three SAMAs would be substantially (i.e., a factor of 5) greater than $1 million, as each SAMA would involve a major hardware modification. Thus, these three SAMAs would not be cost-beneficial. All of the remaining SAMAs have costs that are at least a factor of two higher than the dollar equivalent of the associated benefits. This difference is considered to provide ample margin to cover uncertainties in the risk and cost estimates since estimates for these factors were generally evaluated in a conservative manner. This is true even when considering the 3 percent versus 7 percent discount rate sensitivity case or the use of a 40-year versus 20-year time period.

The positive net value of the watertight wall is due in part to the relatively large (approximately 30 percent) contribution of internal floods to total CDF. Duke assumed that the watertight wall would completely eliminate the turbine building flood initiators. The net value of this SAMA is approximately $400,000 (the difference between the estimated benefit and estimated cost in Table 5-5). This value is based on risk reduction estimates derived from PRA Revision 2b, and is consistent with the NRC's *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997b): the value assumes a 7 percent discount rate and includes averted onsite costs and averted power replacement costs.

Duke (NRC 2002a) provided a revised risk reduction estimate for the watertight wall based on an updated PRA model which accounts for recently installed reactor coolant pump seals that use O-ring materials that perform better at high temperature. This plant modification is expected to reduce the probability of a reactor coolant pump seal LOCA following a loss of seal cooling. Since a large fraction of the core damage sequences initiated by the turbine building flood involve seal LOCAs, the modification will reduce the CDF contribution from the flood and the risk reduction associated with the watertight wall. Using the revised PRA model, Duke estimates that the watertight wall will provide a CDF reduction of 1.0E-5 per reactor-year and a population dose reduction of 0.151 person-Sv (15.1 person-rem) per reactor year.

Based on the revised risk reduction values, the watertight wall would have an estimated benefit of $550,000 (positive net value of $300,000). Use of a 3 percent discount rate would increase the net value to about $500,000. If averted onsite costs and averted power replacement costs are neglected in the analysis, the estimated benefit would be approximately $214,000 (negative net value of $36,000). However, using either a 3 percent discount rate or 40-year time period, the net value would remain positive even when averted onsite costs and averted power replacement costs are neglected. Based on this information, the staff concludes that the installation of the watertight wall would be cost-beneficial. The need for additional evaluation and possible implementation of the watertight wall around the 6900/460 V transformers will be addressed as a current operating plant issue.

The positive net value of installing back-up power to igniters is due in part to the relatively high frequency of SBO events for Catawba (which account for 43 percent of the total CDF of 5.8E-05 per reactor-year based on Revision 2b of the PRA), combined with the vulnerability of ice-condenser containments to hydrogen combustion in SBO events, as described in NUREG/CR-6427 (NRC 2000). The NUREG found that early containment failure is dominated by hydrogen combustion events rather than direct containment heating (DCH) events and that no ice-condenser plant is inherently robust to all credible DCH or hydrogen combustion events in station blackout. The study concluded that all ice-condenser plants would benefit from reducing SBO frequency or from providing some means of hydrogen control that is effective in SBO events.

In light of the issues raised in NUREG/CR-6427 concerning the likelihood of early containment failure in SBO events, the staff requested Duke to provide a reevaluation of the benefits associated with the hydrogen control measures (install back-up power to igniters and air-return fans) assuming a containment response consistent with the findings in NUREG/CR-6427 (i.e., using the containment failure probabilities for DCH and non-DCH events reported in the study, in place of the conditional failure probabilities implicit in the baseline PRA). Under these assumptions, Duke estimated that the averted population dose from eliminating early containment failures would rise from a base case value of 0.073 person-Sv (7.3 person-rem) per reactor-year to 0.12 person-Sv (12.0 person-rem) per reactor-year. The benefit values based on use of the NUREG/CR-6427 containment failure probability for Catawba are reported in Table 5-7. Also shown are the benefit values for the sensitivity case involving use of a 3 percent discount rate instead of a 7 percent discount rate. All of the values in Table 5-7 include averted offsite property damage.

A number of points are worth noting regarding the Duke base case results and these sensitivity assessments:

- Not all early and late releases can be eliminated by providing hydrogen control. For example, late failures due to long-term containment over-pressure could still occur. Also, the non-safety related, non-seismic back-up power source may not be available in large seismic and tornado events, if it is not designed to withstand such events. An upper bound estimate can be provided by assuming that all containment failures, early and late, would be eliminated. More realistically, most of the early and some of the late releases would be eliminated. The assumption that hydrogen control would eliminate all early failures is considered to provide a reasonable estimate of the risk reduction benefit. Accordingly, the estimated benefits shown in Table 5-7 are based on eliminating all early containment failures.

Table 5-7. Sensitivity Results for Hydrogen Control SAMAs (all benefits based on eliminating early failures only)

SAMA	Estimated Cost (per unit)	Estimated Benefits for Hydrogen Control SAMAs Under Various Assumptions (per unit): Based on Revision 2b of the PRA	Based on conditional containment failure probabilities from NUREG/CR-6427	Based on a 3% discount rate compared to a 7% discount rate in the base case
Back-up power to igniters and air-return fans	$270,000[(a)]	$236,000	$387,000	$329,000
PARs	$750,000	$236,000	$387,000	$329,000
Back-up power to igniters only	$102,500[(a)]	Duke: no benefit, since air-return fans are needed	Duke: no benefit, since air-return fans are needed	Duke: no benefit, since air-return fans are needed

(a) Cost estimates for back-up power were provided on a per site rather than per unit basis. In order to provide a consistent basis for comparison with the estimated benefits (which are per unit), the estimated site costs were divided by two.

- It is Duke's position that powering the igniters without also powering the air-return fans would not achieve effective hydrogen control. According to Duke, in order to realize the stated benefits, the air-return fans must also have a back-up power source. More than half of the cost of the SAMA to provide back-up power to igniters and air-return fans comes from powering the fans. Based on available technical information, it is not clear that operation of the air-return fans is necessary to provide effective hydrogen control. The need to also supply back-up power to the air-return fans is being further assessed by the NRC as part of the resolution of Generic Safety Issue 189. If only the igniters need to be powered during SBO, a less-expensive option of powering a subset of igniters from a back-up generator, addressed by Duke in responses to RAIs (Duke 2002a, NRC 2002a),is within the range of averted risk benefits and would warrant further consideration.

- If a 3 percent discount rate is assumed in contrast to a 7 percent discount rate assumed in the base case analysis, the SAMA appears cost-beneficial, even when including back-up power to the air-return fans. This further supports the position that the benefits are large and that a hydrogen-related SAMA may be cost-beneficial.

- 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 40-year rather than a 20-year period in the value analyses) is bounded by the sensitivity study that assumed a 3 percent discount rate.

The NRC has recognized that ice-condenser containments like Catawba's are vulnerable to hydrogen burns in the absence of power to the in-place hydrogen ignitor system. This is sufficiently important for all PWRs with ice-condenser containments that NRC has made the issue a Generic Safety Issue, GSI-189 - Susceptibility of Ice-Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident (NRC 2002b). As part of the resolution of GSI-189, NRC is evaluating potential improvements to hydrogen control provisions in ice-condenser plants to reduce their vulnerability to hydrogen-related containment failures in SBO. This will include an assessment of the costs and benefits of supplying igniters from alternate power sources, such as a back-up generator, as well as containment analyses to establish whether air-return fans also need an ac-independent power source, as part of this modification. The need for plant design and procedural changes will be resolved as part of GSI-189 and addressed for Catawba and other ice-condenser plants as a current operating license issue.

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 Catawba. As a result of this assessment, Duke concluded in the ER that no additional mitigation alternatives are cost-beneficial and warrant implementation at Catawba. Based on its review of SAMAs for Catawba, the staff concludes that two of the SAMAs are cost-beneficial. These SAMAs involve installing a watertight wall around the 6900/4160 V transformers and providing back-up power to the hydrogen igniters for SBO events.

Duke has not provided a position or commitment for follow-up concerning installation of the watertight wall. Based on the analyses presented, the staff concludes that this SAMA is cost-beneficial. However, as this SAMA does not relate to adequately managing the effects of aging during the period of extended operation, it need not be implemented as part of license renewal pursuant to 10 CFR Part 54. The staff intends to pursue this matter as a current operating license issue.

Duke's position, regarding the SAMA that would establish hydrogen control in SBO events by providing back-up power to igniters, is that this SAMA is not cost-effective because back-up power would need to be supplied to the air-return fans from ac-independent power sources in order to ensure mixing of the containment atmosphere, and the cost of powering both the igniters and the air-return fans would exceed the expected benefit. However, based on available technical information, it is not clear that operation of air-return fans is necessary to provide effective hydrogen control. If only the igniters need to be powered during SBO, a less-expensive option of powering a subset of igniters from a back-up generator, addressed by Duke in responses to RAIs (Duke 2002a, NRC 2002a), is within the range of the averted risk benefits and would warrant further consideration. Even if air-return fans are judged to be necessary to

ensure effective hydrogen control in SBOs, the results of sensitivity studies suggest that this combined SAMA might also be cost-beneficial.

The staff concludes that the SAMA that would establish hydrogen control in SBO events by providing back-up power to igniters is cost-beneficial under certain assumptions, which are being examined in connection with resolution of GSI-189. However, this SAMA does not relate to adequately managing the effects of aging during the period of extended operation. Therefore, it need not be implemented as part of license renewal pursuant to 10 CFR Part 54. The need for plant design and procedural changes will be resolved as part of GSI-189 and addressed for Catawba and all other ice-condenser plants as a current operating license issue.

5.3 References

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6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

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

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site 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 likely not to be sufficiently beneficial to warrant implementation.

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

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

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to the Catawba Nuclear Station, Units 1 and 2 (Catawba). The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c),

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

Table 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-222 and technetium-99.

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 Catawba from the uranium fuel cycle and solid waste management are listed in Table 6-1.

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

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
Uranium Fuel Cycle and Waste Management	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4, 6.6
Offsite radiological impacts (spent fuel and HLW disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4, 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2; 6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6, 6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4, 6.6
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

Duke Energy Corporation (Duke) stated in its Environmental Report (ER; Duke 2001) that it is not aware of any new and significant information associated with the renewal of the Catawba operating licenses (OLs). The staff has not identified significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other available information. 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 except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and additional 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, 10 CFR 51 for each of these issues, follows:

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW). Based on information in the GEIS, the Commission found that

  > Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.

  The staff has not identified any significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle (with regard to individual effects from other than the disposal of spent fuel and HLW) during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (collective effects). In the GEIS, the staff concluded that

  > The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem [148 person 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 which 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 [National Environmental Policy Act] 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 level 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 during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

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

  For the high level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for 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 the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 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 a 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 the Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 [DOE 1980]. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1000 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 high level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of 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 [Environmental Protection Agency'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 1000 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 level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.

Since the GEIS was originally issued in 1996, the U.S. Environmental Protection Agency (EPA) has published radiation protection standards for Yucca Mountain, Nevada, at 40 CFR Part 197, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada," on June 13, 2001 (66 FR 32132). The Energy Policy Act of 1992 (42 USC 10101 et seq) directed that the NRC adopt these standards into its regulations for reviewing and licensing the repository. The Commission published its regulations at 10 CFR Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada," on November 2, 2001 (66 FR 55792). These standards include the following: (1) 0.15 mSv/year (15 mrem/year) dose limit for members of the public during the storage period prior to repository closure, (2) 0.15 mSv/year (15 mrem/year) dose limit for the reasonably maximally exposed individual for 10,000 years following disposal, (3) 0.15 mSv/year (15 mrem/year) dose limit for the reasonably maximally exposed individual as a result of a human intrusion at or before 10,000 years after disposal, and (4) a groundwater protection standard that states for 10,000 years of undisturbed performance after disposal, radioactivity in a representative volume of groundwater will not exceed (a) 0.19 Bq/L (5 pCi/L) (radium-226 and radium-228), (b) 0.56 Bq/L (15 pCi/L) (gross alpha activity), and (c) 0.04 mSv/year (4 mrem/year) to the whole body or any organ (from combined beta and photon emitting radionuclides).

On February 15, 2002, subsequent to the receipt of a recommendation by the Secretary, Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste.

This change in regulatory status does not cause the staff to change its position with respect to the impact of spent fuel and HLW disposal. The staff still considers the Category 1 classification in the GEIS appropriate.

The staff has not identified any significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle with regard to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

> The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

The staff has not identified any significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

> The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site 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 during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

> The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and

> nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

> The expected increase in the 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 staff has not identified any significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

> No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

The staff has not identified any significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

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

> The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to

> 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4–Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.

Catawba meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The staff has not identified any significant new information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no transportation impacts associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 References

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

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

10 CFR 63. Code of Federal Regulations, Title 63, *Energy* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

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

40 CFR 197. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 197, "Public Health and Radiation Protection Standards for Yucca Mountain, Nevada."

Duke Energy Corporation (Duke). 2001. *Applicant's Environmental Report – Operating License Renewal Stage Catawba Nuclear Station Units 1 and 2.* Charlotte, North Carolina.

Energy Policy Act of 1992, 42 USC 10101, et seq.

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

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

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste.* DOE/EIS 00046-G, Volumes 1-3, Washington, D.C.

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

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report,* "Section 6.3 - Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

7.0 Environmental Impacts of Decommissioning

Environmental issues associated with decommissioning, which result from continued plant operation during the renewal term, were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*, NUREG-1437 (NRC 1996, 1999).[a] 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. 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 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. There are no Category 2 issues related to decommissioning Catawba Nuclear Station, Units 1 and 2 (Catawba).

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to Catawba decommissioning following the renewal term are listed in Table 7-1. Duke Energy Corporation (Duke) stated in its Environmental Report (ER; Duke 2001) that it is aware of no new and significant information regarding the environmental impacts of Catawba license renewal. The staff has not identified any new and significant information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues,

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

Table 7-1. Category 1 Issues Applicable to the Decommissioning of Catawba Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation doses	7.3.1; 7.4
Waste management	7.3.2; 7.4
Air quality	7.3.3; 7.4
Water quality	7.3.4; 7.4
Ecological resources	7.3.5; 7.4
Socioeconomic impacts	7.3.7; 7.4

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

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

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

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

  > Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

The staff has not identified any new and significant information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

  > Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

  > The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

  The staff has not identified any new and significant information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

  > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

  The staff has not identified any new and significant information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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 that

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

The staff has not identified any new and significant information during its independent review of the Catawba ER (Duke 2001), the staff's site visit, the scoping process, or its evaluation of other 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.

There are no Category 2 issues related to decommissioning.

7.1 References

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

Duke Energy Corporation (Duke). 2001. *Applicant's Environmental Report – Operating License Renewal Stage Catawba Nuclear Station Units 1 and 2.* Charlotte, North Carolina.

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

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report.* "Section 6.3–Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.