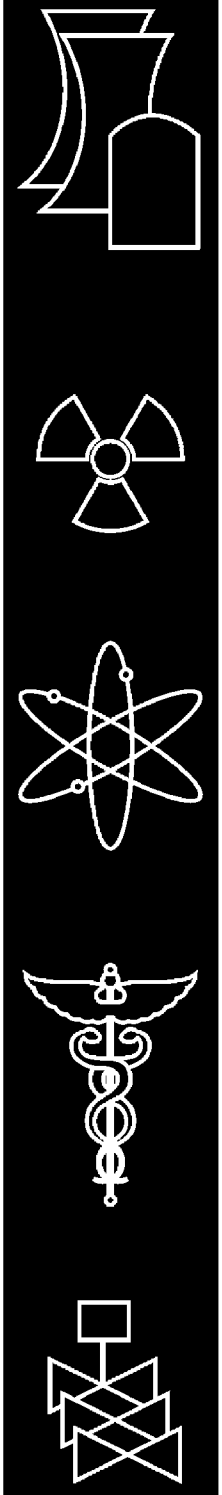
NUREG-1437
Supplement 15



Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 15

Regarding
Virgil C. Summer Nuclear Station

Final Report

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

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Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
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Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental impacts of renewing nuclear power plant operating licenses 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 Code of Federal Regulations Part 51. In the GEIS (and its Addendum 1), the staff identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 69 of these issues that apply to all plants or to plants with specific design or site characteristics. Additional plant-specific review is required for the remaining 23 issues. These plant-specific reviews are to be included in a supplement to the GEIS.

This Supplemental Environmental Impact Statement (SEIS) has been prepared in response to an application submitted to the NRC by the South Carolina Electric and Gas Company (SCE&G) to renew the operating license for the Virgil C. Summer Nuclear Station (V.C. Summer) for an additional 20 years under 10 Code of Federal Regulations Part 54. This SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action and responses to comments received on the draft SEIS to the GEIS.

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

The remaining issues that apply to V.C. Summer are addressed in this SEIS. For each applicable issue, the staff concludes that the significance of the potential environmental impacts of renewal of the operating license is SMALL. The staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. The staff

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

determined that information provided during the scoping and draft SEIS comment processes did not identify any new issue that has a significant environmental impact.

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

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Executive Summary

By letter dated August 6, 2002, South Carolina Electric and Gas Company (SCE&G) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for the Virgil C. Summer Nuclear Station (V.C. Summer) for an additional 20-year period. If the OL is renewed, State regulatory agencies and SCE&G will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OL is renewed, the schedule is to issue the renewed license by June 2004. The renewed license would supersede the current license. The renewed license would expire on August 6, 2042, which is 20 years after the original license expiration date. If the OL is not renewed, then the plant must be shut down at or before the expiration date of the current OL, which is August 6, 2022.

Section 102 of the National Environmental Policy Act of 1969 (42 U.S. Code 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 Code of Federal Regulations (CFR) Part 51. Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plant*s (GEIS), NUREG-1437, Volumes 1 and 2.[(a)]

Upon acceptance of the SCE&G 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 V.C. Summer site in December 2002 and held public scoping meetings on December 11, 2002, in Jenkinsville, South Carolina. In the preparation of this supplemental environmental impact statement (SEIS) for V.C. Summer, the staff reviewed the V.C. Summer Environmental Report and compared it to the GEIS, consulted with other agencies, conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, and considered the public comments received during the scoping process. The public comments received during the scoping process and draft SEIS public comment process that were considered to be within the scope of the environmental review are provided in Appendix A of this SEIS.

On July 17, 2003, the Notice of Availability of the Draft SEIS and Notice of Public Meetings to discuss the draft SEIS was published in the Federal Register (68 FR 42431). A 75-day comment period began on that date, during which members of the public could comment on the

(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.

| preliminary results of the staff's review. The staff held two public meetings in Jenkinsville, South Carolina, on August 26, 2003, to describe the preliminary results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on the draft SEIS. All of the comments received on the draft SEIS were considered in developing the final SEIS and are presented in Appendix A, Part II.

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

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

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

The 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 decisionmakers would be unreasonable.

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

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

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

> need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of reactor operation–generic determination of no significant environmental impact"] and in accordance with § 51.23(b).

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

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

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

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

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

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

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in

the GEIS for issues designated as Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

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

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

SCE&G 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 SCE&G 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 V.C. Summer 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 V.C. Summer.

SCE&G'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 SCE&G analysis for each issue and has conducted an independent review of each issue. Three Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at V.C. Summer. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. SCE&G 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 V.C. Summer 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 1981 *Final Environmental Statement Related to the Operation of Virgil C. Summer Nuclear Station Unit No 1*.

Fifteen Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Four of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For all 15 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 V.C. Summer, and the plant improvements already made, the staff concludes that none of the candidate SAMAs are cost-beneficial.

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

If the V.C. Summer OL is not renewed and the unit ceases operation on or before the expiration of the current OL, then the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of V.C. Summer. The impacts may, in fact, be greater in some areas.

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

Abbreviations/Acronyms

°	degree(s)
μm	micrometer(s)
AADT	annual average daily traffic (volume)
ac	acres
ACC	averted cleanup and decontamination costs
AD	Anno Domini
ADAMS	Agencywide Document Access and Management System
AOC	averted offsite property damage costs
AOE	averted occupational exposure
AOSC	averted onsite costs
APE	averted public exposure (costs)
BC	before Christ
Bq/L	becquerel per liter
Btu/ft^3	British thermal units per cubic foot
Btu/h	British thermal units per hour
Btu/kWh	British thermal units per kilowatt-hour
C	Celsius
CCW	component cooling water
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	curie(s)
cm	centimeter(s)
DBA	design-basis accident
DC	direct current
DO	dissolved oxygen
DOE	U.S. Department of Energy
DSM	demand-side management
EFW	emergency feedwater
EIA	Energy Information Administration (U.S. DOE)
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EPA	U.S. Environmental Protection Agency
ER	Environmental Report

F	Fahrenheit
FERC	Federal Energy Regulatory Commission
fish/ac	fish per acre
fish/hr	fish per hour
fish/ha	fish per hectare
FPSF	Fairfield Pumped Storage Facility
FR	*Federal Register*
ft	foot/feet
ft^3	cubic feet
ft^3/yr	cubic feet per year
gal	gallon(s)
gal/d	gallons per day
GEIS	*Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437*
gpm	gallons per minute
GWPS	gaseous waste processing system
Gy	gray; energy corresponding to 1 joule per kilogram
ha	hectares
HCLPF	high confidence of low probability of failure
HEPA	high-efficiency particulate air (filter)
HLW	high-level waste
h	hour(s)
Hz	Hertz
ICRP	International Commission on Radiological Protection
in.	inch(es)
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISLOCA	interfacing systems loss-of-coolant accident
J	joule(s)
kg	kilograms
kg/ha	kilograms per hectare
KkW	thousand kilowatts
km	kilometers
km^2	square kilometers
kV	kilovolts
kWh	kilowatt-hour
L	liter(s)
L/d	liters per day

L/s	liters per second
lb/ac	pounds per acre
lb/MWh	pounds per megawatt hour
LERF	large early release frequency
LLW	low-level waste
LR	license renewal
LWPS	liquid waste processing systems
m	meters
m/s	meters per second
m^3	cubic meters
m^3/s	cubic meters per second
m^3/yr	cubic meters per year
mA	milliamperes
MAB	maximum attainable benefit
MACCS2	MELCOR Accident Consequence Code System 2
MGD	million gallons per day
mg/L	milligrams per liter
mGy	milligray(s)
mi	mile(s)
mi^2	square miles
mJ	millijoule(s)
mJ/m^3	milijoules per cubic meter
mph	miles per hour
mrad	millirad(s)
mrem	millirem(s)
mrem/year	millirems per year
mSv	millisievert(s)
mSv/year	millisieverts per year
MT	metric ton(s)
MT/yr	metric tons per year
MTHM	metric tonne
MWd/MTU	megawatt-days per metric ton of uranium
MW(e)	megawatts electric
MW(t)	megawatts thermal
NA	not applicable
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act of 1969
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act of 1966
NIEHS	National Institute of Environmental Health Sciences
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System

NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
ODCM	Offsite Dose Calculation Manual
OL	operating license
PAR	Publicly Available Records
pCi/L	picocuries per liter
person-rem	person-roentgen equivalent man
person-sV	person-sievert
persons/km^2	persons per square kilometer
persons/mi^2	persons per square mile
PM_{10}	particulate matter, 10 microns or less in diameter
PORV	power-operated relief valve
ppm	parts per million
PRA	probabilistic risk assessment
psig	pounds per square inch gauge
PWR	pressurized water reactor
rad	0.01 joule per kilogram; 0.01 gray
RAI	request for additional information
RCP	reactor coolant pump
rem	roentgen equivalent man; special unit of dose equivalent, equal to 0.01 sievert
REMP	radiological environmental monitoring program
RHR	residual heat removal
RPC	replacement power costs
RRW	risk-reduction worth
RWST	refueling water storage tank
SAMA	severe accident mitigation alternative
SAR	safety analysis report
SBO	station blackout
SCDAH	South Carolina Department of Archives and History
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric and Gas Company
SCDNR	South Carolina Department of Natural Resources
SEIS	Supplemental Environmental Impact Statement
SG	steam generator
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SO_x	sulfur oxides
Sv	sievert(s)

TBq	terabecquerel(s)
TDEFWP	turbine-driven emergency feedwater pump
tons/yr	tons per year
U.S.	United States
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
V	volt
V.C. Summer	Virgil C. Summer Nuclear Station
WOG	Westinghouse Owners Group
yr	year(s)

1.0 Introduction

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

The South Carolina Electric and Gas Company (SCE&G) operates Virgil C. Summer Nuclear Station (V.C. Summer) in South Carolina on behalf of itself and of the South Carolina Public Service Authority (Santee Cooper), which has a one-third non-operating interest in the station. SCE&G operates V.C. Summer under OL NPF-12, which was issued by the NRC. This OL will expire on August 6, 2022. On August 6, 2002, SCE&G submitted an application to the NRC to renew the V.C. Summer OL for an additional 20 years under 10 CFR Part 54. SCE&G is a *licensee* for the purposes of its current OL and an *applicant* for the renewal of the OL. Pursuant to 10 CFR 54.23 and 51.53(c), SCE&G submitted an Environmental Report (ER) (SCE&G 2002a) in which SCE&G analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects.

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

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

1.1 Report Contents

The following sections of this introduction (1) describe the background for the preparation of this SEIS, including the development of the GEIS and the process used by the staff to assess the environmental impacts associated with license renewal, (2) describe the proposed Federal action to renew the V.C. Summer OL, (3) discuss the purpose and need for the proposed action, and (4) present the status of SCE&G'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 a summary of the evaluation of potential environmental impacts of plant accidents and includes consideration of severe accident mitigation alternatives (SAMAs); a more detailed discussion of SAMAs is in Appendix G. Chapter 6 discusses the uranium fuel cycle and solid waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to license renewal. Finally, Chapter 9 summarizes the findings of the preceding chapters and draws conclusions about the adverse impacts that cannot be avoided, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and the irreversible or irretrievable commitment of resources. The final chapter also presents the staff's recommendation with respect to the proposed license renewal action.

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

- the preparers of the supplement,
- the chronology of correspondence between NRC and SCE&G with regard to this SEIS,
- the organizations contacted during the development of this SEIS,
- SCE&G's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and issued during the evaluation process),
- GEIS environmental issues that are not applicable to V.C. Summer, and
- SAMAs.

1.2 Background

Use of the GEIS, which examines the possible environmental impacts that could occur as a result of renewing individual nuclear power plant OLs under 10 CFR Part 54, and the established license renewal evaluation process 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, the GEIS (1) describes the activity that affects the environment, (2) identifies the population or resource that is affected, (3) assesses the nature and magnitude of the impact on the affected population or resource, (4) characterizes the significance of the effect for both beneficial and adverse effects, (5) determines whether the results of the analysis apply to all plants, and (6) considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

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

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

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

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

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are 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 two 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, six are related only to decommissioning, 67 apply only to operation during the renewal term, and eight apply to both refurbishment and operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

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

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

- provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B in accordance with 10 CFR 51.53(c)(3)(ii)

- 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 51.23(c)(3)(iii) and (iv).

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

In preparing to submit its application to renew the V.C. Summer OL, SCE&G developed a process to ensure that information not addressed in or available during the GEIS evaluation

regarding the environmental impacts of license renewal for V.C. Summer would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the license for V.C. Summer would be identified, reviewed, and assessed during the period of NRC review. SCE&G 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 V.C. Summer. This review was performed by personnel from SCE&G and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

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

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

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts with the environmental impacts of alternatives. The evaluation of the SCE&G license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the *Federal Register* (FR; 67 FR 62272 [NRC 2002a]) on October 4, 2002. The staff published a notice of intent to prepare an EIS and conduct scoping (67 FR 65612 [NRC 2002b]) on October 25, 2002. Two public scoping

meetings were held on December 11, 2002, in Jenkinsville, South Carolina. Comments received during the scoping period were summarized in the *Environmental Scoping Summary Report, V.C. Summer Nuclear Station, Fairfield County, South Carolina* (NRC 2003a) dated January 14, 2003. Comments that are applicable to this environmental review are presented in Part I of Appendix A.

The staff followed the review guidance contained in NUREG-1555, Supplement 1, in the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff and contractors retained to assist the staff visited the V.C. Summer site on December 10 and 11, 2002, to gather information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping and consulted with Federal, State, regional, and local agencies. A list of the organizations contacted is provided in Appendix D. Other documents related to V.C. Summer were reviewed and are referenced.

On July 17, 2003, the Notice of Availability of the Draft SEIS and Notice of Public Meetings to discuss the draft SEIS was published in 68 FR 42431 (NRC 2003b). A 75-day comment period began on that date, during which members of the public could comment on the preliminary results of the staff's review. The staff held two public meetings in Jenkinsville, South Carolina, on August 26, 2003, to describe the preliminary results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on the draft SEIS. All of the comments received on the draft SEIS were considered in developing the final SEIS and are presented in Part II of Appendix A. The NRC responses to these comments are also provided.

This SEIS presents the staff's analysis that considers and weighs the environmental effects of the proposed renewal of the OL for V.C. Summer, 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.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OL for V.C. Summer. V.C. Summer is located in north-central South Carolina, in Fairfield County, approximately 42 km (26 mi) northwest of Columbia, South Carolina. The current OL for V.C. Summer expires on August 6, 2022. By

letter dated August 6, 2002, SCE&G submitted an application to the NRC (SCE&G 2002b) to renew this OL for an additional 20 years of operation (i.e., until August 6, 2042).

The plant has one Westinghouse-designed pressurized light-water reactor, with a design rating for a net electrical power output of 966 megawatts electric [MW(e)]. Plant cooling is provided by a once-through cooling water system that dissipates heat primarily by discharge into Monticello Reservoir. V.C. Summer produces electricity to supply the needs of more than 135,000 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 of 1954 or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of State regulators and utility officials as to whether a particular nuclear power plant should continue to operate. From the perspective of the licensee and the State regulatory authority, the purpose of renewing an OL is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant's license.

1.5 Compliance and Consultations

SCE&G is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In its ER, SCE&G provided a list of the authorizations from Federal, State, and local authorities for current operations as well as environmental approvals and consultations associated with V.C. Summer license renewal. Authorizations and consultations relevant to the proposed OL renewal action are included in Appendix E.

The staff has reviewed SCE&G's authorizations and consultations and has 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 SCE&G is in compliance with applicable environmental standards and requirements for V.C. Summer. The staff has not identified any environmental issues that are both new and significant.

1.6 References

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

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

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

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

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

South Carolina Electric and Gas Company (SCE&G). 2002a. *Virgil C. Summer Nuclear Station License Renewal Application*. "Appendix E, Environmental Report." Docket Number 50/395; License Number NPF-12. Jenkinsville, South Carolina.

South Carolina Electric and Gas Company (SCE&G). 2002b. *License Renewal Application for Virgil C. Summer Nuclear Station*, V.C. Summer Nuclear Station. Jenkinsville, South 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.

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

U.S. Nuclear Regulatory Commission (NRC). 2002a. "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station; Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of License No. NPF-12 for an Additional Twenty-Year Period." *Federal Register,* Vol. 67, No. 193, pp. 62272-62273. October 4, 2002.

U.S. Nuclear Regulatory Commission (NRC). 2002b. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register,* Vol. 67, No. 207, pp. 65612-65613. October 25, 2002.

U.S. Nuclear Regulatory Commission (NRC). 2003a. *Environmental Scoping Summary Report V.C. Summer Nuclear Station, Fairfield County, South Carolina*. Rockville, MD. January 14, 2003.

U.S. Nuclear Regulatory Commission (NRC). 2003b. "South Carolina Electric and Gas, Virgil C. Summer Nuclear Station; Notice of Availability of the Draft Supplement 15 to the Generic Environmental Impact Statement and Public Meeting for the License Renewal of Virgil C. Summer Nuclear Station." *Federal Register,* Vol. 68, No. 137, p. 42431. July 17, 2003.

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

Virgil C. Summer Nuclear Station (V.C. Summer), owned by South Carolina Electric and Gas (SCE&G) and South Carolina Public Service Authority (Santee Cooper), is located in Fairfield County, in predominantly rural north-central South Carolina. It is situated on the shore of Monticello Reservoir about 42 km (26 mi) northwest of Columbia, the State capital. The plant consists of a nuclear reactor, cooling and auxiliary water systems, and transmission facilities. The nuclear reactor is a pressurized light-water reactor with three steam generators turning turbines to generate electricity. Cooling system water is provided from Monticello Reservoir. The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

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

V.C. Summer is located on 909 ha (2245 ac) of SCE&G-owned land approximately 133 m (436 ft) above sea level, 24 km (15 mi) west of the County seat of Winnsboro, and 42 km (26 mi) northwest of Columbia, the State capital. Fairfield County is part of the Central Midlands Region (approximately 600,000 residents in year 2000) that also encompasses Lexington, Richland, and Newberry counties. Figures 2-1 and 2-2 depict the site location and features within 80 and 10 km (50 and 6 mi), respectively. The site exclusion area boundary's western axis is slightly longer (1783 m [5850 ft]) than its eastern axis (1631 m [5350 ft]) (SCE&G 1978). The exclusion area boundary also represents the site boundary.

V.C. Summer is located in a sparsely populated, largely rural area, with forests and small farms composing the dominant land use. This Piedmont terrain varies from gently rolling to hilly and includes broad stream valleys. Jenkinsville and Peak are the closest settlements, although there are also homes built along the main plant access road. The Broad River flows in a northwest-to-southeast direction approximately 1.6 km (1 mi) west of the site and serves as the boundary between Fairfield County (to the east) and Newberry County (to the west).
V.C. Summer is co-located with a hydroelectric facility. The general area has been used for energy production since 1914 when this reach of the Broad River was impounded for a small, run-of-the-river hydroelectric plant and Parr Reservoir was created. Later, a coal-fired power plant operated for decades nearby. Originally 750 ha (1850 ac), Parr Reservoir was enlarged to approximately 1780 ha (4400 ac) in 1977 by raising the level of the dam by 2.7 m (9 ft) (SCE&G 1978). This modification was necessary to support the development of the Fairfield Pumped Storage Facility (FPSF), which was built on Frees Creek, a small tributary of the Broad River. Monticello Reservoir, a 2630-ha (6500-ac) impoundment, was built in the Frees Creek

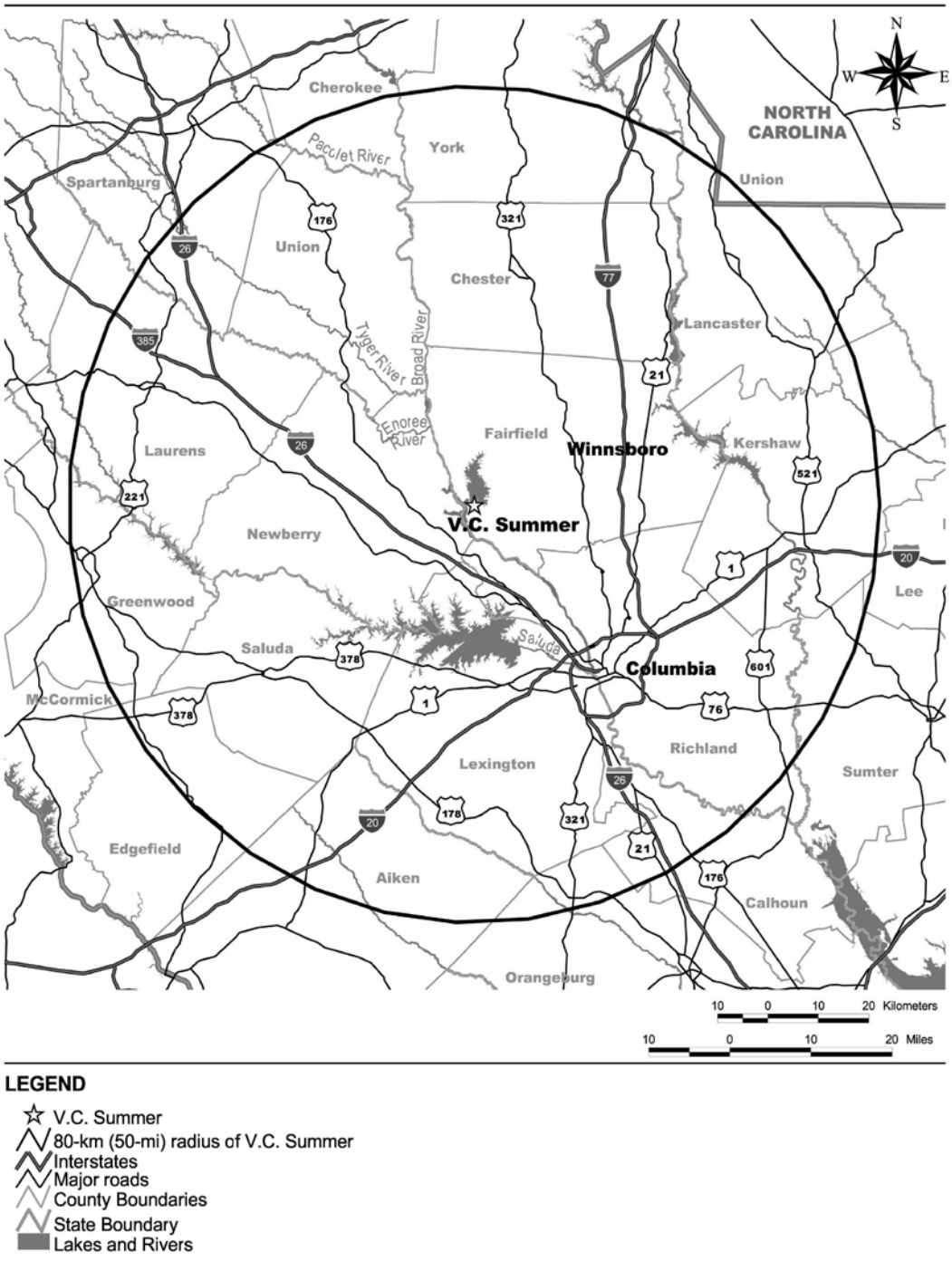

Figure 2-1. Location of V.C. Summer 80-km (50-mi) Region

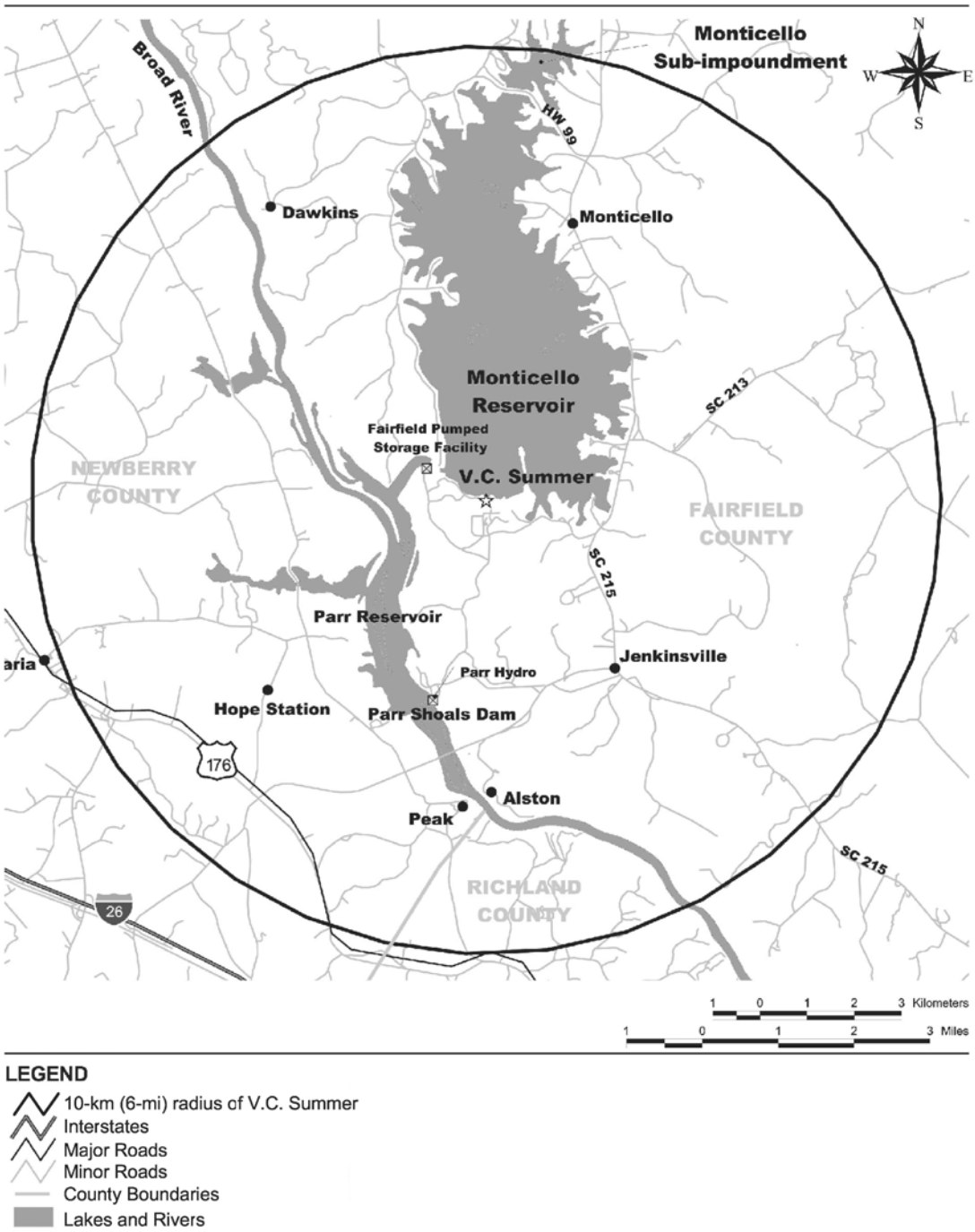

Figure 2-2. Location of V.C. Summer 10-km (6-mi) Region

valley to serve as the upper pool for FPSF and the cooling water source for V.C. Summer. Parr Reservoir, which had historically been the source of water for Parr Hydro, assumed a dual function, providing water for both Parr Hydro and FPSF.

V.C. Summer is located on the south shore of Monticello Reservoir (Figure 2-2). Monticello Reservoir is hydrologically connected (by a conduit that passes under the Highway 99 causeway) to a smaller 121-ha (300-ac) body of water known as the Monticello Sub-impoundment that is managed for recreational boating and fishing by SCE&G and South Carolina Department of Natural Resources (SCDNR). SCE&G maintains the property, which includes boat launch, swimming, and picnic facilities. Lake Monticello Park, situated on the eastern shore of Monticello Reservoir, provides day-use recreation including a playground, tennis courts, ball fields, picnic sites, and swimming.

Lake Murray to the southwest of V.C. Summer impounds the Saluda River and provides marinas with fishing and boating and camping opportunities, and includes Dreher Island State Park. Lake Wateree State Recreation Area, 24 km (15 mi) to the east of Winnsboro, permits motorized boating and is popular for fishing. The 64,900 ha (161,000 ac) Enoree Ranger District of the Sumter National Forest is immediately north of Lake Monticello, about 6.4 km (4 mi) from V.C. Summer, and provides recreational opportunities. The Congaree Swamp National Monument is 32 km (20 mi) south southeast of Columbia on the Congaree River. The monument protects one of the last tracts of old-growth bottom-land hardwood forest remaining in the United States.

2.1.1 External Appearance and Setting

The domed reactor building is the tallest structure at V.C. Summer. It is surrounded by the auxiliary buildings, the control building, turbine building, and diesel generator building. There are facilities for fuel handling and related support shops, warehouses, and storage. Service water pond dams extend into Monticello Reservoir to the east as do the discharge bay and canal. The intake structure is located north of the station. A wastewater treatment area and the substation are located to the south. The FPSF is about one-half mile to the west.

The entire nuclear station and support facilities are not easily visible from adjacent communities because of the topography and forested cover. The station can be viewed from SC 215 and lands along the eastern shore of Monticello Reservoir.

The V.C. Summer site lies within the Piedmont Physiographic Province and is underlain by igneous and metamorphic crystalline rocks, including migmatites in transitional areas between metamorphic and igneous bodies. Bedrock within this portion of the Piedmont is metasedimentary and metavolcanic and contains granites, gneisses, and schists

(SCE&G 2002a). Crystalline bedrock has been deeply weathered into a saprolitic mantle of soil 40 to 20 m (40 to 85 ft) thick at the site. The upper soil profile is characterized by a silty and clayey horizon (SCE&G 2002a).

2.1.2 Reactor Systems

V.C. Summer is a single-unit plant with a domed concrete containment building. The station includes a pressurized light-water reactor nuclear steam supply system designed and furnished by Westinghouse Electric Company and a turbine generator manufactured by General Electric Corporation. The unit was designed for an output of 2775 megawatts thermal [MW(t)] with corresponding net electrical output of approximately 900 megawatts electric [MW(e)]. It achieved initial criticality in October 1982 and began commercial operation in January 1983 (SCE&G 2002a).

In 1996, SCE&G sought approval from the U.S. Nuclear Regulatory Commission (NRC) to upgrade performance to a core power output of 2900 MW(t) with a net electrical output of 945 MW(e). In August 1997, instrument changes improving measurement accuracy resulted in a 9 MW increase in indicated electrical power output, to 954 MW(e). In the spring of 1999, a more efficient high-pressure turbine rotor increased the net electrical output to 966 MW(e) (SCE&G 2002a).

The reactor containment structure is a steel-lined, reinforced-concrete, 46.9-m (154-ft) diameter cylinder with a hemispheric dome and a flat reinforced concrete foundation mat (SCE&G 2002a). The concrete vertical walls are 1.2 m (4 ft) thick, with an outside diameter of 40.8 m (134 ft). The dome is 0.9 m (3 ft) thick, and the overall height is approximately 50.6 m (166 ft) above grade. Air pressure inside the containment structure is maintained at between -0.1 and +1.5 psig below atmospheric pressure for routine operations. Together with its engineered safety features, the containment structure is designed to withstand an internal pressure of 57 psig above atmospheric pressure and provides radiation shielding for both normal operation and design basis accident conditions (SCE&G 2002a).

2.1.3 Cooling and Auxiliary Water Systems

V.C. Summer operates as a once-through cooling plant that withdraws from and discharges to a cooling pond, Monticello Reservoir. Monticello Reservoir was built to supply cooling water to the station and to provide an upper reservoir for the FPSF located on Parr Reservoir.

To limit the heat load rejected to Monticello Reservoir, in 1996 SCE&G installed the turbine building closed-cycle cooling water system to provide cooling for certain station loads that were

previously handled by the circulating water system. The closed system does not handle any of the heat load directly associated with reactor cooling. The closed-cycle cooling water system supplies cooling water to equipment associated with the turbine, generator, and other nonnuclear systems in the turbine building. The system uses a forced-draft (closed-cycle) cooling facility with four fans and eight cooling coils to reject waste heat to the atmosphere. This cooling structure is 26 by 13 m (86.9 by 41.9 ft) with an overall height of 7 m (22.4 ft) above grade (SCE&G 1996). It is located outside of the protected area fence, approximately 152 m (500 ft) northwest of the reactor building. Under normal operation, one of the two closed-cycle cooling water pumps circulates treated water through the cooling coils, transferring heat removed from the various components to spray water and then to the atmosphere by evaporation of the spray water in the air stream produced by the cooling fans. The turbine building closed-cycle water system is independent of plant emergency cooling facilities and is not required for reactor protection or safe shutdown (SCE&G 2002a).

The main cooling system at V.C. Summer is the circulating water system. It is designed to remove 6.67 x 10^9 Btu/h of heat from the main and auxiliary condensers as well as the turbine auxiliaries (NRC 1981). Cooling water is drawn from the Monticello Reservoir at a rate of approximately 32 m^3/s (1143 cfs), passed through the condensers and ultimately returned to Monticello Reservoir. The intake structure, located along the south shoreline of the reservoir, has three pump bays, each with two entrances. Each entrance is 4 m (13 ft) wide and 8 m (25.5 ft) high, extending from the bottom of the pump house (elevation 119 m [390.0 ft]) to the bottom of a skimmer wall (elevation 127 m [415.5 ft]). The entrances are each equipped with vertical traveling screens (mesh size 1.0 x 0.89 cm [0.4 x 0.35 in.]) and two sets of trash racks of conventional design (NRC 1981).

After leaving the condensers, circulating water moves via a 3.7-m (12-ft) diameter pipe from the plant to a semi-enclosed discharge basin. From the basin, the heated effluent moves through a 305-m (1000-ft) long discharge canal to Monticello Reservoir. The discharge canal directs the discharge flow (heated effluent) to the northeast. A 790-m (2600-ft) long jetty prevents the recirculation of the heated water. Figure 2-3 shows the intake structure, discharge basin, discharge canal, and associated features of the V.C. Summer circulating water system.

To mitigate the effects of excessively warm water in the discharge canal on the fishery, the entire length of the discharge canal was dredged during July and August of 1993. The dredging increased the amount of cool water that flows into the canal during low reservoir levels. Dredging altered the circulation patterns in the canal and increased the cool water flow such that the temperature at the bottom of the discharge bay in summer remained 10 to 15 degrees cooler than “end-of-pipe” discharge temperatures (SCE&G 1996). Between 1995 and 2000, the maximum water temperatures measured in Monticello Reservoir at a sampling station just outside the mouth of the discharge canal ranged between 35.1 and 39.8 °C (95.2 and

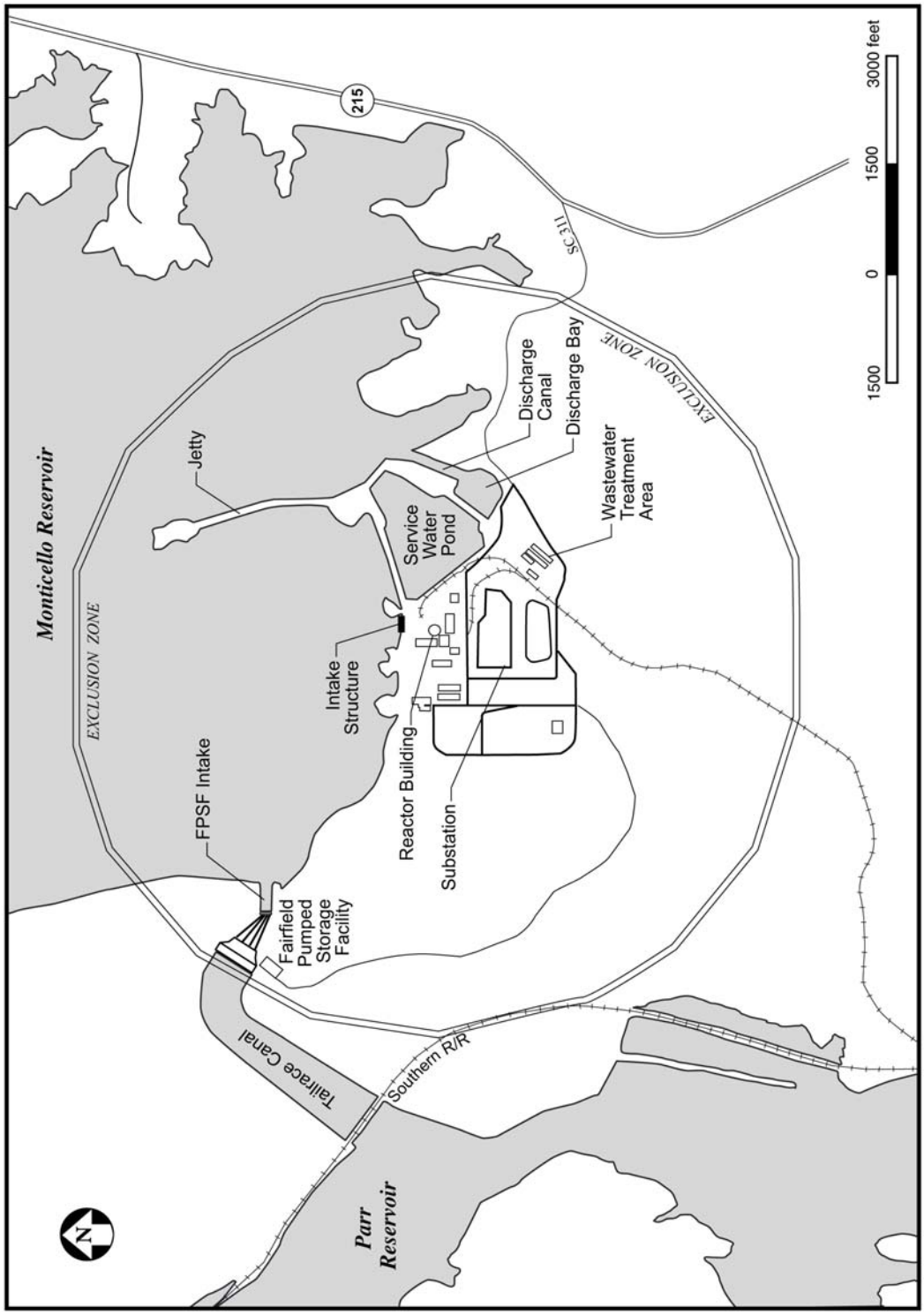

Figure 2-3. V.C. Summer Powerblock Area

103.7 °F). The maximum discharge temperature established by the National Pollutant Discharge Elimination System (NPDES) permit and measured at the point at which the flow from the cooling system enters the discharge embayment is 45 °C (113 °F) (SCDHEC 2002). The maximum plume temperature measured at the intake of the FPSF is 32.2 °C (90 °F) (SCDHEC 2002). The discharge canal conveys the water from the discharge embayment toward the main body of the reservoir and toward the FPSF.

The NRC defines "cooling pond" as a manmade impoundment that does not impede the flow of a navigable system and that is used primarily to remove waste heat from condenser water (NRC 1996). Under this definition, Monticello Reservoir is categorized as a cooling pond. The NRC notes that nuclear power plants with cooling ponds represent a unique subset of closed-cycle systems in that they operate as once-through plants (with large condenser flow rates), but withdraw from relatively small bodies of water created for the plant (NRC 1996). The "natural body of water" (the Broad River/Parr Reservoir) is not relied on for heat dissipation, but is used as a source of makeup water to replace that lost to evaporation from the cooling pond (Monticello Reservoir) and as a receiving stream for discharges from the cooling pond.

V.C. Summer Nuclear Station Quarterly Water Use Reports indicate the theoretical maximum loss of cooling system water to evaporation is 0.6 m^3/s (22 cfs) (SCE&G 1998, 1999b). Because cooling water is withdrawn from and discharged back to Monticello Reservoir, the evaporative loss occurs from the reservoir. Makeup water for the evaporative losses is taken from the Broad River/Parr Reservoir. The theoretical maximum evaporative loss represents 14.7 percent of the minimum allowable instantaneous flow of 4.2 m^3/s (150 cfs), 9.4 percent of the lowest daily mean flow 6.6 m^3/s (235 cfs), and approximately 0.3 percent of the daily mean flow 185 m^3/s (6535 cfs) of the Broad River at Alston, South Carolina. However, water potentially used for cooling at the facility is not removed directly from a stream with natural flow, but from the Parr Reservoir, an impounded section of the Broad River. The minimum flow restrictions are Federal Energy Regulatory Commission- (FERC-) mandated as part of the relicensing of the Parr Hydroelectric Project. The restrictions do not directly apply to V.C. Summer. While V.C. Summer has established minimum water surface elevation guidelines for Monticello Reservoir to be considered as part of the cooling system operations, there is no minimum water surface elevation requirement for Monticello Reservoir. Therefore, the timing or quantity of water to be withdrawn from the Parr Reservoir to replenish the Monticello Reservoir is not subject to a regulatory requirement.

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

SCE&G uses liquid, gaseous, and solid radioactive waste management systems to collect and treat the radioactive materials that are a by-product of V.C. Summer plant operations. These systems process radioactive liquid, gaseous, and solid effluents to maintain releases within

regulatory limits and to maintain levels as low as reasonably achievable before they are released to the environment. The V.C. Summer waste processing systems meet the design objectives of Title 10 Code of Federal Regulations (CFR) Part 50, Appendix I ("Numerical Guides for Design Objective, and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water Cooled Nuclear Power Reactor Effluents"). Radioactive material in the reactor coolant is the primary source of gaseous, liquid, and solid radioactive wastes in light-water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods, but small quantities escape from the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system is also responsible for coolant contamination.

Nonfuel solid waste results from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid waste also consists of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant design modifications and operations and routine maintenance activities. Solid waste is shipped to a waste processor for volume reduction before disposal or is sent directly to the licensed disposal facility. Spent resins and filters are dewatered and packaged for shipment to licensed offsite processing or disposal facilities (SCE&G 2002b). Currently, solid waste is shipped to Barnwell, South Carolina, and to Clive, Utah.

Fuel assemblies that have exhausted a certain percentage of their fuel and have been removed from the reactor core for disposal are called spent fuel. V.C. Summer currently operates on an 18-month refueling cycle. The spent fuel is currently stored onsite in a spent fuel pool in the auxiliary building adjacent to the containment building. Spent fuel has been stored at V.C. Summer since 1984 with anticipated storage capacity being available until 2018. V.C. Summer does not currently have an independent spent fuel storage installation.

The Offsite Dose Calculation Manual (ODCM) for V.C. Summer describes the methods used for calculating concentration of radioactive material in the environment and the estimated potential offsite doses associated with liquid and gaseous effluents from V.C. Summer (SCE&G 1999a). The ODCM also specifies controls for release of liquid and gaseous effluents to ensure compliance with NRC regulations (NRC 1991).

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

The liquid waste processing system (LWPS) at V.C. Summer collects and processes potentially radioactive liquid waste for recycle or for release to the environment (SCE&G 2001). Liquid

waste is sampled and analyzed before it is discharged or may be monitored during release. Based on a laboratory analysis, this waste is either released under controlled conditions via the penstocks of the FPSF or retained for further processing. The LWPS consists of five collection systems that are fed by the waste holdup tank, floor drain tank, the laundry and hot shower tank, the excess liquid waste processing system (the excess waste holdup tank and the decontamination pit collection tank), and the laboratory drain system. The LWPS does not process secondary system waste. In addition to the LWPS, very low concentrations of radioactive liquid waste are also released to Monticello Reservoir in the circulating water discharge for V.C. Summer (SCE&G 1999a).

The waste holdup tank collects reactor-grade water that enters the LWPS via equipment leaks and drains, valve leakoff, pump seal leakoffs, tank overflows, and other tritiated and aerated water sources. De-aerated, tritiated water inside the reactor building from sources such as valve leakoff, which is collected in the reactor coolant drain tank, may be routed to the recycle holdup tanks for processing.

The basic composition of the liquid collected in the waste holdup tank is boric acid and water with some radioactive contamination. Liquid in this tank is normally processed through the demineralizers and released to the environment under controlled conditions. Alternatively, the liquid may be recycled for use in the plant. Liquid waste is released from the waste monitor tanks through the penstocks of the FPSF. The discharge valve is interlocked with a process radiation monitor and is closed automatically when radioactivity levels in the liquid discharge exceed a preset limit. The waste monitor tank acts as a reservoir for holding waste which is to be released from the LWPS to the FPSF. Prior to entering these tanks, the liquid may pass through a waste monitor tank demineralizer and a waste monitor tank filter. A sample is taken and, after analysis, the result is logged and the liquid is discharged or recycled. Liquid waste discharge flow and volume are recorded.

The floor drain tank collects nonreactor grade (nonrecyclable) liquid waste. This includes floor drains, equipment drains containing nonreactor grade liquids, and other nonreactor grade sources. If the radioactivity level in the floor drain tank is higher than the discharge limits, then the liquid is processed through the demineralizers prior to release under controlled conditions via the penstocks of the FPSF. Nonrecyclable reactor coolant leakage enters the floor drain tank from system leaks inside the reactor building via the reactor building sump and from system leaks in the auxiliary building via the floor drains. Laundry and hot shower drains normally need no treatment for removal of radioactive material. This liquid is transferred to waste monitor tank Number 2 via the laundry and hot shower filter. A sample is taken, and after analysis, results are logged and the liquid may be discharged if the radioactivity level is below acceptable limits.

The excess LWPS consists of two storage tanks: the excess liquid waste holdup tank, and the decontamination pit holdup tank. The excess waste liquid holdup tank stores waste from the floor drain tank, laundry and hot shower tank, and waste holdup tank when these tanks are filled to capacity. The liquid from the excess waste liquid holdup tank can be recycled back to these tanks, released directly to the environment via the waste monitor tank, or processed through the demineralizers prior to release under controlled conditions via the penstocks of the FPSF. The decontamination pit collection tank collects liquid from the fuel handling building sumps, the radiological maintenance building drains, excess waste holdup area sump, and decontamination pit drains. If the radioactivity level in the pit collection tank is higher than the discharge limits, then the liquid is processed through the demineralizers prior to release under controlled conditions via the penstocks of the FPSF.

The laboratory drain system consists of three sinks in the radiochemical laboratory and two sinks in the sample room. In the radiochemical laboratory, spent reactor coolant samples, equipment rinse water, and other nonreactor grade fluids are routed through the two sinks that drain to the floor drain tank. No liquids or wastes are intentionally routed to the sink that drains to the chemical drain tank. In the sample room, excess sample purges of reactor grade liquids and spent reactor coolant samples are drained from one sink to the waste holdup tank for processing. The other sink is used for draining nonreactor grade liquids to the nuclear blowdown holdup tank.

The spent resin sluice portion of the LWPS consists of a spent resin storage tank, a spent resin sluice pump, and a spent resin sluice filter. The system is designed to transport spent resin to the spent resin storage tank for treatment. Following treatment, the sluice water is available for subsequent resin sluicing operations.

The ODCM prescribes the alarm/trip setpoints for the liquid-effluent radiation detection monitors, which are derived from 10 times the effluent concentration limits provided in 10 CFR Part 20, Appendix B, Table 2, Column 2 (SCE&G 1999a). There are two liquid-effluent radiation monitors for the primary radioactive liquid waste discharge pathway at V.C. Summer. The alarm/trip setpoint for each liquid-effluent monitor is based on the concentration of radioactive material in a batch of liquid to be released or in the continuous liquid discharge (SCE&G 1999a).

During 2001, there were 335 batch releases of liquid effluents with a total volume of 8.90×10^7 L (2.35×10^7 gal) of liquid waste released prior to dilution (SCE&G 2002b). In this liquid waste, there was a total fission and activation product activity of 0.0015 TBq (0.04 Ci) and total tritium activity of 18.65 TBq (504 Ci). These volumes and activities are typical of past years. Each drain channel uses one 3.8×10^4 L (10,000 gal) liquid waste-holdup tank. The actual liquid waste generated is reported in the Annual Effluent and Waste Disposal Report for

V.C. Summer (SCE&G 2002b). See Section 2.2.7 for a discussion of the calculated doses to the maximally exposed individual as a result of these releases.

SCE&G 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 gaseous waste processing system (GWPS) is the primary gaseous waste handling system for V.C. Summer. It is designed to remove fission product gases from the reactor coolant in the volume control tank (SCE&G 2001). The system is also designed to collect gases from the boron recycle and waste evaporators, reactor coolant drain tank, recycle holdup tanks, and reactor vessel. The GWPS is a closed-loop system composed of two waste gas compressors, two catalytic hydrogen recombiners, eight gas decay tanks to accumulate the fission product gases, one gas decay tank drain pump, one gas drain filter, and four gas traps. All of the equipment is located in the auxiliary building. The principal source to the GWPS during normal operation is taken from the gas space in the volume control tank.

During normal power operation, nitrogen gas is continuously circulated around the GWPS loop by one of the two compressors. Hydrogen gas is added to the volume control tank where it is mixed with fission gases, which are stripped from the reactor coolant. The contaminated hydrogen gas is then vented from the tank into the circulating nitrogen stream to transport the fission gases into the GWPS. The resulting nitrogen-hydrogen-fission gas is pumped to the recombiner where oxygen is combined with the hydrogen to produce water vapor. After the water vapor is removed, the resulting gas stream is circulated to the waste gas decay tanks and back to the compressor suction to complete the loop circuit.

The auxiliary building charcoal exhaust system continuously exhausts air drawn from building areas with the potential for radioactive contamination. The supply and exhaust ducts are arranged so that air flow is always in the direction of progressively greater potential contamination. Exhaust air from these areas is drawn through the roughing/high-efficiency particulate air (HEPA)/charcoal filter plenums continuously and is routed to the main exhaust fans and plant vent.

In addition to the GWPS, the reactor building can also release radioactive gases intermittently. Radioactive gases are released inside the reactor building when primary system components are opened or if leakage from the primary system occurs. The gaseous activity inside the reactor building may be purged continuously by a small purge system during normal operation. Purge system use is limited to 1000 hours per year based on technical specification limits. Radioactive gases may also be released when the larger reactor building purge system is used during cold shutdown. If necessary, the reactor building charcoal cleanup system can be used

to recirculate the reactor building atmosphere prior to purging. The reactor building purge systems are exhausted to the outside atmosphere through HEPA filters and charcoal absorber.

Secondary systems that can also release gaseous waste include the turbine building, the condenser air removal system, and steam generator blowdown. Turbine building steam leakage may release radioactive gas if primary to secondary leakage occurs. Turbine building ventilation system exhausts are not treated prior to release. If primary to secondary leakage occurs, then offgas from the condenser air removal system may contain radioactive gases. When condenser offgas contains any significant amount of radioactive material, it is exhausted through HEPA filters and charcoal adsorber in the auxiliary building charcoal exhaust system for particulate and iodine removal. Offgas from the condenser air removal system (not from primary or secondary leakage) is normally released through the charcoal exhaust system. Gaseous releases from steam generator blowdown are infrequent. Radioactive gaseous effluents can also be released from the oil incineration facility when it is operated on an as needed or infrequent basis.

Radioactive gaseous waste is monitored at three primary release points at V.C. Summer: auxiliary building, reactor building (intermittently), and the turbine building. These release points are monitored for noble gases and radioiodines and particulate activity, as appropriate (SCE&G 2001). Two radiation monitors (routine and high-range back-up) provide noble gas monitoring and iodine and particulate sampling for the auxiliary building exhaust. The reactor building also has two similar radiation monitors. The turbine building only has one monitor for gases. 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 of 10 CFR Part 20 for gaseous effluents (SCE&G 1999a). These release points are continuously or intermittently monitored and provide alarms with automatic valve closure when radiation levels exceed a preset level, thus terminating discharge (SCE&G 1999a).

During 2001, there was a total fission and activation gas activity of 2.08×10^{-3} TBq (5.63×10^{-2} Ci), no iodine activity, a total particulate activity of 6.88×10^{-7} TBq (1.86×10^{-5} Ci), and a total tritium activity of 1.00×10^{-3} TBq (0.27 Ci) released from V.C. Summer (SCE&G 2002b). These releases are typical of past years. The actual gaseous waste generated is reported in the Annual Effluent and Waste Disposal Report for V.C. Summer (SCE&G 2002b). See Section 2.2.7 for a discussion of the calculated doses to the maximally exposed individual as a result of these releases.

SCE&G does not anticipate any increase in gaseous releases during the renewal period.

2.1.4.3 Solid Waste Processing

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

Liquid waste contained in the waste evaporator concentrates tank or chemical drain tank can be transferred into the liner located in the solidification area as needed. When required, radwaste solidification is accomplished using approved vendor-supplied equipment and process-control program.

Primary and secondary spent resins are transferred from their respective holdup tanks to either a disposable liner in the solidification area or a liner in the truck bay. The resins may then be either solidified or dewatered for shipment. Storage and disposal of all filters (disposable cartridges) is within either high-integrity containers or U.S. Department of Transportation-approved containers, depending on the specific activity of the filters. Radioactively contaminated hardware can consist of damaged or used equipment or instruments. Such material is disposed of in the same manner as filter cartridges or compacted waste, depending upon radiation levels.

The solid waste system is normally operated on a batch basis. Radioactive waste is generally stored in the shielded areas of the radwaste area (SCE&G 2001). Storage areas are designed to accommodate the waste generated over a period in excess of a month. Solid waste from V.C. Summer is either shipped directly to an offsite licensed disposal facility (e.g., spent resins) or consigned to a licensed processing facility for volume-reduction and decontamination activities (e.g., compactible trash). The material that remains after volume reduction is transported by the processing facility to a final disposal facility, depending on the radioactive limits. Lower-activity waste (e.g., miscellaneous solid material) is disposed of at a licensed facility such as one in Barnwell, South Carolina, or Clive, Utah. Higher-activity waste (e.g., spent resins) is typically sent directly to a licensed disposal facility such as Barnwell, South Carolina (SCE&G 2002b).

Disposal and transportation of solid waste are performed in accordance with the applicable requirements of 10 CFR Parts 61 and 71, respectively. There have been no releases to the environment from radioactive solid wastes generated at V.C. Summer.

In 2001, V.C. Summer made 12 shipments of solid waste to Envirocare (Clive, Utah) and two shipments of solid waste to Barnwell, South Carolina, with a total volume of 11.2 m^3 (396 ft^3) and a total activity of 2.93 TBq (79.17 Ci) (SCE&G 2002b). These shipments are representative of the shipments made in the past several years and are not expected to change

substantively during the license renewal period. The actual amount of solid waste generated is reported in the Annual Effluent and Waste Disposal Report for V.C. Summer (SCE&G 2002b). SCE&G continues to reduce its solid waste volumes and minimize waste generated.

2.1.5 Nonradioactive Waste Systems

Various nonradioactive wastewater management and disposal activities are conducted at V.C. Summer. They include collection, treatment, and disposal of the following (SCDHEC 2002):

- sanitary waste,
- condensate polisher backwash,
- clarifier blowdown,
- carbon filter backwash,
- gravity filter backwash,
- steam generator blowdown,
- wastewater from various sumps,
- boiler house drains,
- ion exchange regeneration,
- chemical metal cleaning waste (primarily citric acid), and
- sumps in the chemical feed equipment area, caustic tank area, and “D” battery room.

Subsequent to the appropriate treatment processes the wastewater streams are discharged to Monticello Reservoir and monitored and regulated according to NPDES permit number SC0030856 administered by the South Carolina Department of Health and Environmental Control (SCDHEC) (SCDHEC 2002).

Storm water from the western portions of the V.C. Summer area is discharged to an unnamed tributary of the Broad River that flows into Parr Reservoir. Storm water from the eastern portions of the V.C. Summer area flows into Mayo Creek, which also drains to the Broad River, but enters the river from below the dam.

Four wastewater treatment lagoons are used to process the various types of wastewater. Wastewater potentially containing oil is processed through an oil/water separator and then solids are settled prior to discharge.

Sanitary wastewater is treated in an aeration pond, followed by a stabilization pond. The effluent is chlorinated in a chlorine contact chamber prior to commingling with other wastewater and subsequent discharge.

For wastewater resulting from backwash, filtering, and blowdown processes, treatment consists of sedimentation for the reduction of suspended solids content, after which the water is discharged.

For wastewater resulting from ion exchange regeneration and sumps in the chemical feed equipment area, caustic tank area, and "D" battery room, treatment consists of flow equalization and neutralization in a 3.8×10^5 L (100,000 gal) wastewater treatment tank before the effluent is discharged.

Wastewater that contains chemical metal cleaning waste is treated by neutralization and sedimentation prior to discharge.

Solid waste is disposed of using licensed disposal methods appropriate for the waste type. Paint, oils, and solvent waste are managed by permit as hazardous waste and disposed of in accordance with the rules and regulations of the SCDHEC Bureau of Land and Waste Management.

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear plant. Maintenance activities conducted at V.C. Summer include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and public safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. SCE&G refuels V.C. Summer on an 18-month schedule. Up to 700 additional contractor employees are employed for the 30- to 40-day refueling outage.

SCE&G performed an aging management review and developed an integrated plant assessment for managing the effects of aging on systems, structures, and components in accordance with 10 CFR Part 54. The aging management program is described in Section 3 of the License Renewal Application (SCE&G 2002c). The integrated plant assessment identified the programs and inspections that are managing the effects of aging at V.C. Summer. Previously, SCE&G has performed some major component replacement activities at V.C. Summer (e.g., steam generator replacement), and the integrated plant assessment did not identify any need for additional refurbishment or replacement activities. SCE&G assumes that an additional 60 employees will be needed to perform all the necessary surveillance, monitoring, inspections, testing, trending, and recordkeeping activities during the license renewal period.

2.1.7 Power Transmission System

SCE&G built eight transmission lines for the specific purpose of connecting V.C. Summer to the transmission system. Two additional transmission lines were built by Santee Cooper, the co-owner of V.C. Summer, to connect it to the regional grid. A number of these lines share the same corridor and a number of these are tie lines into an existing line. A pre-existing Duke Power Company transmission line crosses the V.C. Summer site, but does not connect to the V.C. Summer switchyard or the SCE&G transmission system.

Originating at V.C. Summer, the SCE&G transmission lines generally run in a southerly direction, with five terminations near V.C. Summer (Parr 1 and 2, Fairfield 1 and 2, and Summer-McMeekin-Edenwood), one near Aiken, South Carolina (Graniteville), and two near Columbia, South Carolina (Pineland and Denny Terrace 2) (Figure 2-4). The Santee Cooper lines run approximately east and west to substations near Blythewood and Newberry, South Carolina, respectively.

Table 2-1 identifies the transmission lines by where each line connects to the electric grid. A discussion of the features of the transmission lines, including voltage, right-of-way width and length, and presence of other lines in the right-of-way, follows and is summarized in Table 2-1.

Table 2-1. V.C. Summer Transmission Line Corridors

Transmission Line or Tie Line	Number of Lines	kV	Length		Width		Area	
			km	(mi)	m	(ft)	ha	(ac)
Parr 1 and 2	2	230	3.7	2.3	70	240	27	67
Fairfield 1 and 2	2	230	1.6	1	50	170	8	21
Summer-McMeekin-Edenwood	1	230	4	2.5	30	100	12	30
Pineland 1	1	230	38	23.5	70	240	277	684
Denny Terrace 2	1	230	40	25	30	100	132	327
Graniteville	1	230	100	62.5	50	170	521	1288
Blythewood	1	230	32	20	30	100	98	242
Newberry	1	230	29	18	30	100	88	218

Source: SCE&G 2002a.

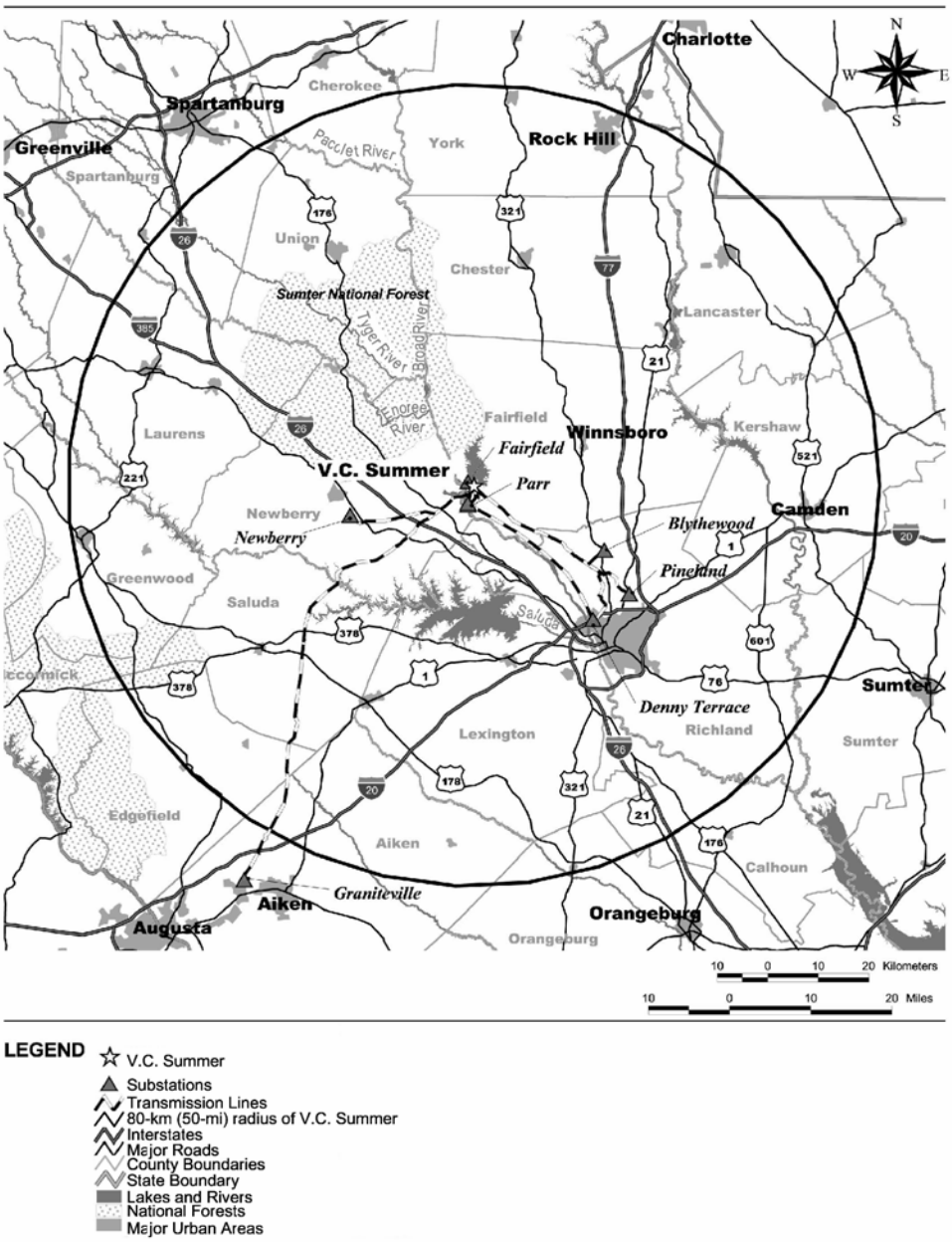

Figure 2-4. V.C. Summer Transmission Lines

- Summer-Parr No. 1 and No. 2 – These two SCE&G lines, which occupy the same 70-m (240-ft) right-of-way to the Parr Substation, operate at 230 kV. The lines' lengths are each 3.7 km (2.3 mi). For approximately 0.8 km (0.5 mi), these lines share the corridor with the Graniteville line and Santee Cooper's Newberry line.

- Summer-Fairfield No. 1 and No. 2 – These two 230-kV lines provide power to and from SCE&G's FPSF. The lines are only 1.6 km (1 mi) long and occupy a 50-m (170-ft), SCE&G wholly-owned corridor.

- Summer-McMeekin-Edenwood – This 230-kV line provides power to SCE&G's Edenwood Substation by way of a 4-km (2.5-mi) line running from V.C. Summer to the pre-existing Parr-McMeekin-Edenwood line (total of 52 km [32.5 mi] between V.C. Summer and the Edenwood substation). This line occupies a 30-m (100-ft) right-of-way.

- Summer-Pineland No. 1 – This SCE&G line provides power at 230 kV to the Pineland Substation 9.6 km (6 mi) northeast of Columbia. The right-of-way width is 70 m (240 ft) for the approximately 29 km (18 mi) that the line shares the corridor with the Denny Terrace No. 2 line and then 30 m (100 ft) for the remaining 8.8 km (5.5 mi). Santee Cooper's Blythewood line parallels this line for approximately 27 km (17 mi).

- Summer-Denny Terrace No. 2 – This 230-kV SCE&G line to the Denny Terrace Substation two miles north of Columbia follows the Pineland corridor for approximately 29 km (18 mi) and then continues for approximately 11 km (7 mi) in a 30-m (100-ft) right-of-way. Santee Cooper's Blythewood line parallels this line for 27 km (17 mi).

- Summer-Graniteville – This SCE&G line provides 230 kV of power to the Graniteville Substation. The line is 100 km (62.5 mi) long. For the first 0.8 km (0.5 mi), it occupies the same right-of-way as the Newberry and Summer-Parr No. 1 and No. 2 lines. Then for 4 km (2.5 mi) it parallels the Newberry line. For the remaining 96 km (59.5 mi), it is the sole occupant of the corridor. The right-of-way width is 50 m (170 ft) as far as the Broad River and then 30 m (100 ft) to Graniteville.

- Summer-Blythewood – The Blythewood line is owned by Santee Cooper. It is a 230-kV line that runs for approximately 32 km (20 mi), sharing the corridor with the Summer-Pineland and the Denny Terrace No. 2 lines for the first 27 km (17 mi). For the remaining 5 km (3 mi), the right-of-way is 30 m (100 ft).

- Summer-Newberry – This Santee Cooper line, which is approximately 29 km (18 mi) long, operates at 230 kV and provides power to the Newberry Substation. For the first 0.8 km

(0.5 mi), it shares the corridor with the Summer-Parr No. 1 and No. 2 and the Graniteville lines. For the next 4 km (2.5 mi) it shares the corridor with the Summer-Graniteville line. For the remaining 24 km (15 mi), it occupies the 30-m (100-ft) right-of-way alone.

In total, for the specific purpose of connecting V.C. Summer to the transmission system, SCE&G and Santee Cooper have constructed approximately 250 km (160 mi) of transmission lines (over 190 km [120 mi] of corridor because of co-located lines) that occupy approximately 800 ha (2000 ac) of corridor.

2.2 Plant Interaction with the Environment

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

2.2.1 Land Use

The V.C. Summer site covers approximately 909 ha (2245 ac), an area that includes portions of Monticello Reservoir and FPSF. Approximately 348 ha (860 ac) are covered by the waters of Monticello Reservoir. A portion of the property (approximately 150 ha [370 ac]) consists of generation and maintenance facilities, supply areas, parking lots, roads, and mowed grass. Some functions, such as the truck equipment and maintenance facility, serve both V.C. Summer and the FPSF. Some 50 ha (125 ac) are dedicated to transmission line rights-of-way. However, much of the V.C. Summer property consists of forested areas (approximately 360 ha [890 ac]). The primary terrestrial habitats at V.C. Summer are pine forest, deciduous forest, and mixed pine-hardwood forest (SCANA 2000). The pine forests at V.C. Summer include planted pines and naturally vegetated pines. Most of the deciduous forests at the site are located along stream bottoms and surrounding slopes. Streamside management zones at the site are protected in accordance with best management practices established by the South Carolina Forestry Commission.

The lands at V.C. Summer are designated for industrial development in the Fairfield County Comprehensive Plan (Fairfield County 1997), which states that these lands are intended to encourage industrial growth that provides quality employment opportunities and make effective use of the County's resources. These are the only industrial lands in western Fairfield County.

The lands surrounding Monticello Reservoir are designated by the Plan for Residential Conservation and Development and Rural Development. Several commercial clusters are also depicted along SC 215 near V.C. Summer on the Comprehensive Land Use and Development Plan. The Fairfield County Comprehensive Plan observes the unfulfilled development potential of Monticello Reservoir and designates it for Resource Preservation. Monticello Reservoir has experienced less development than other lakes in the region.

2.2.2 Water Use

Monticello Reservoir, a 2630 ha (6500 ac) impoundment, was built in the Frees Creek Valley to serve as the upper pool for the FPSF and the source of make-up cooling water for V.C. Summer. Cooling water is drawn from Monticello Reservoir at a rate of approximately 32 m^3/s (1143 cfs), passed through the condensers, and ultimately returned to Monticello Reservoir. The primary consumption of water from the Monticello Reservoir by the nuclear station is only attributable to evaporative loss. V.C. Summer Quarterly Water Use Reports indicate the theoretical maximum loss of cooling system water to evaporation is 0.6 m^3/s (22 cfs) (SCE&G 1998, 1999b). Ultimately, these losses are made up from water acquired from the Parr Reservoir on the Broad River. Water is withdrawn from Monticello Reservoir for potable use and other noncooling-related uses at V.C. Summer. This water is treated at the water treatment plant prior to use. For the year 2002, the total rate of water withdrawal from Monticello Reservoir by the water treatment plant was 0.01 m^3/s (0.045 cfs).

Pursuant to the Federal Water Pollution Control Act of 1977, also known as the Clean Water Act, the water quality of the plant effluents is regulated through the NPDES. The SCDHEC is the agency delegated to issue NPDES permits. The current permit (SC0030856) was issued in December 2002 and is due to expire in April 2007. Any new regulations promulgated by the U.S. Environmental Protection Agency (EPA) and SCDHEC would be included in future permits.

The Broad River was impounded in 1914 for a small, run-of-the-river hydroelectric plant (Parr Hydro). The impoundment is known as Parr Reservoir. In 1977, the surface area of Parr Reservoir was expanded from 750 ha (1850 ac) to 1780 ha (4400 ac) by raising the level of the dam by 2.7 m (9 ft) (SCE&G 1978). This modification was necessary to support the development of the FPSF. Parr Reservoir, which had historically been the source of water for Parr Hydro, assumed a dual function, providing a headwater pool for Parr Hydro and a tailwater pool for FPSF.

The daily cycle of operation at the FPSF transfers up to 416 m^3/s (14,700 cfs) of water from Parr Reservoir to Monticello Reservoir and back (NRC 1981). Operations vary, depending on the season and system needs. In summer, FPSF generally pumps water from Parr Reservoir

to Monticello Reservoir between the hours of 11 pm and 8 am and generates power (by releasing water) between the hours of 10 am and 11 pm. In winter, FPSF generally pumps water from Parr Reservoir to Monticello Reservoir between 11 pm and 6 am and generates between the hours of 6 am and 1 pm. The level of generation varies from one generator up to the maximum output of eight, depending on demand. Maximum output may not be necessary on all days. Pumping is normally done at maximum capacity. FPSF is normally operated seven days a week.

As a result of FPSF operations, Parr Reservoir is subject to daily fluctuations in water level of as much as 3 m (10 ft) (NRC 1981), but the daily average is approximately 1.2 m (4 ft) (Dames and Moore 1985a). Approximately 1030 ha (2550 ac) of land around Parr Reservoir may be exposed or covered when water-levels fluctuate with each cycle of pumpback and generation (release of water). The amount of water pumped from and returned to Parr Reservoir daily represents as much as 88 percent of its total volume (NRC 1981).

The annual mean flow of the Broad River is approximately 5.8×10^9 m^3/yr (2.1×10^{11} ft^3/yr). The Federal Power Commission (FERC's predecessor agency) licensed the Parr Hydroelectric Project in 1974, contingent upon a minimum instantaneous release at the Parr Powerhouse of 4.2 m^3/s (150 cfs) during most months of the year and a minimum instantaneous release of 28 m^3/s (1000 cfs) during the March-April-May striped bass (*Morone saxatilis*) spawning period (NRC 1981). For the periods 1896 to 1907 and 1980 to 2000, the lowest daily mean flow of the Broad River at the Alston, South Carolina, gauging station was 6.7 m^3/s (235 cfs) (Cooney et al. 2001). The lowest recorded daily mean flow of 4.2 m^3/s (149 cfs) was measured at the Richtex Station, approximately 11 km (7 mi) downstream of Parr Reservoir (NRC 1981).

There are two groundwater removal (dewatering) wells on the site that are used to lower the water table and alleviate problems with water seepage into below-grade portions of buildings. This is the only withdrawal of groundwater associated with V.C. Summer. It is estimated that both wells withdraw less than 1.6 L/s (26 gpm), and both wells discharge to the site storm water system (SCE&G 2002a).

2.2.3 Water Quality

Potential environmental issues associated with water quality include three separate areas: the Monticello Reservoir, the Broad River and Parr Reservoir, and groundwater.

2.2.3.1 Monticello Reservoir Hydrology and Water Quality

The most complete source of information on the water quality and biotic resources of Monticello Reservoir is a series of reports prepared in support of a Federal Water Pollution Control Act

Section 316(a) Demonstration for V.C. Summer and summarized in a final report (Dames and Moore 1985a) submitted to SCDHEC and the NRC in April 1985. A station-to-station comparison of pre-operational (1978 to 1982) and operational (1983 to 1984) water chemistry in Monticello Reservoir showed significant differences in 13 of 27 chemical parameters analyzed (Dames and Moore 1985a). In 10 cases, concentrations of chemicals or measurements were higher in the pre-operational phase, and in three cases concentrations were higher in the operational phase. None of these differences was related to operations of V.C. Summer.

The highest temperature observed in Monticello Reservoir over the 1983 to 1984 operational phase was 34.2 °C (93.6 °F) at a depth of one foot at Station 14 (the sampling point closest to the discharge canal) in August 1983 (Dames and Moore 1985a). A discernible thermal plume was present on 12 of 24 monthly field surveys at this same location, but survey results were confounded by plant operations (the plant was off-line during four surveys and at 50 percent power or less during three surveys). When plumes were detected, they were observed to a depth of 0.3 to 0.9 m (1 to 3 ft). Below this depth, the influence of the thermal plume was not evident. In more recent years (1995 to 2000), maximum temperatures at a sampling station just outside the mouth of the discharge canal ranged from 35.1 to 39.8 °C (95.2 to 103.7 °F). The maximum discharge temperature established by the NPDES permit and measured at the point at which the flow from the cooling system enters the discharge embayment is 45 °C (113 °F) (SCDHEC 2002). The maximum monthly average plume temperature measured at the intake of the FPSF is 32.2 °C (90 °F) (SCDHEC 2002). Monticello Reservoir is currently rated as one of the least eutrophic reservoirs in South Carolina, and is characterized by low nutrient (total phosphorus and total nitrogen) concentrations (SCDHEC 1998).

Storm water and waste water discharges to Monticello Reservoir and Mayo Creek are regulated and monitored under NPDES permit number SC0030856 (SCDHEC 2002) administered by the SCDHEC. The range of parameters monitored includes flow, temperature, various metals, pH, total suspended solids, oil and grease, biochemical oxygen demand, fecal coliform, residual chlorine, and ammonia. Two minor violations, one for oil and grease and one for residual chlorine, were noted by SCDHEC over the past five years and promptly investigated and corrective measures were taken.

2.2.3.2 Broad River and Parr Reservoir Hydrology and Water Quality

The 1998 SCDHEC report notes that water quality in the Broad River from the Tyger River to the Parr Shoals dam is suitable for a range of aquatic life, but is experiencing a significantly increasing trend in total phosphorous concentrations (SCDHEC 1998) from upstream (agricultural and municipal) sources. In addition, fecal coliform bacteria levels are occasionally elevated in this stretch of the river.

Temperatures and dissolved oxygen (DO) levels in water leaving Parr Reservoir are monitored at a U.S. Geologic Survey water-quality monitoring station just downstream of the Parr Hydro powerhouse. Temperature and DO levels vary seasonally and show an inverse relationship, with high temperatures associated with relatively low DO levels and low temperatures associated with relatively high DO levels. Temperatures in water year 1999-2000 (Oct. 1, 1999, through Sept. 30, 2000) ranged from 3.5 °C (38.3 °F) in February to 31 °C (87.8 °F) in August, with corresponding DO concentrations of 13.1 mg/L and 4.9 mg/L (13.1 ppm and 4.9 ppm) (Cooney et al. 2001).

Currently, Parr Reservoir maintains an intermediate trophic state among reservoirs in South Carolina; its river-like flows and short retention time (approximately four days) produce high DO levels (in most months) and high turbidity in the reservoir. Aquatic life and recreational uses are fully supported in Parr Reservoir, according to SCDHEC (1998), meaning that water quality is adequate to support a balanced indigenous community of organisms, with no restrictions on recreational users.

2.2.3.3 Groundwater Quality

V.C. Summer does not discharge directly to groundwater. However, before construction of the Monticello Reservoir, groundwater flowed toward Frees Creek. After construction and filling of the reservoir, the local groundwater table would have been raised and the flow direction would have reversed, away from the Frees Creek drainage.

Groundwater in the vicinity of the site is highly mineralized, due to prolonged contact with, and dissolution of, rock minerals, and as a result, is generally higher than local surface waters in hardness, dissolved solids, and conductivity (Dames and Moore 1985a). The water of Monticello Reservoir is relatively low in the concentration of common ions, low in hardness, and low in dissolved solids/conductivity (Dames and Moore 1985a).

Groundwater is monitored semiannually as required by NPDES permit number SC0030856 (SCDHEC 2002) administered by the SCDHEC. The range of parameters monitored include groundwater table elevation, ammonia, pH, specific conductivity, iron, lead, sulfate, nitrate, and total dissolved solids.

2.2.4 Air Quality

V.C. Summer is located approximately 42 km (26 mi) northwest of Columbia, South Carolina, with terrain consisting of rolling hills. The region has a temperate climate and is located midway between the humid eastern and dry western climatic zones. The weather at any time may be typical of either of these zones, or it may represent a combination of the zones. The region has

long, hot summers and cool winters. Rapid changes in the weather are common, especially during the winter. Climatological records for Columbia, South Carolina, are generally representative of V.C. Summer. These records indicate that the average maximum temperatures for Columbia range from a low of about 13.9 °C (57.1 °F) in January to a high of about 33.5 °C (92.3 °F) in July. The annualized average maximum temperature is about 23.9 °C (75.1 °F). Average minimum temperatures range from a low of about 2.89 °C (37.2 °F) in January to a high of about 21.8 °C (71.3 °F) in July. The annualized average minimum temperature is about 12.2 °C (54.0 °F).

The average precipitation ranges from a low of about 6.5 cm (2.57 in.) in October to a high of about 14.0 cm (5.50 in.) in July. The average annual precipitation is about 115.0 cm (45.1 in.). The summer rains are largely in the form of local thunderstorms, occurring on an average of 11 days per month during this season. Strong winds and heavy rains are experienced once or twice per year, as effects of passing tropical storms. The average annual snowfall is about 3.1 cm (1.2 in.), most of which falls in the months of January and February. Based on statistics for the 30 years from 1954 through 1983 (Ramsdell and Andrews 1986), on the average, only nine tornadoes are expected to occur in South Carolina during the course of a year. The probability of a tornado striking the site is expected to be about 6×10^{-5} per year.

Wind energy potential is generally rated on a scale of 1 through 7. Areas suitable for wind turbine applications have a rating of 3 or higher. There is little wind-energy potential in the Southeast region for existing wind turbine applications (Elliot et al. 1987). Even along coastal areas, existing data from exposed sites indicate at best only class 2 at 50 m (164 ft) above ground. The only places in the Southeast region estimated to have class 3 or higher annual average wind resource are the exposed ridge crests and mountain summits confined to northeastern Georgia and extreme northwestern South Carolina (along the ridges of the Blue Ridge Mountains).

V.C. Summer is located within the Columbia Intrastate Air Quality Control Region (40 CFR 81.108). The Columbia Intrastate Air Quality Control Region consists of the territorial area encompassed by the boundaries of Fairfield County, Lexington County, Newberry County, and Richland County in the State of South Carolina. The air quality in these regions is designated as better than national standards, in attainment, or unclassified for all criteria pollutants, in 40 CFR 81.341. There are no mandatory Class I Federal areas, in which visibility is an important value designated in 40 CFR Part 81, within 160 km (100 mi) of the V.C. Summer site.

In July 1997, the EPA revised the national standard for ground-level ozone from a 0.12-ppm, 1-hour “peak” standard to a 0.08-ppm, 8-hour “average” standard (62 *Federal Register* 38856). This new standard is commonly referred to as the 8-hour standard. The District of Columbia

Court of Appeals ruled against EPA in October 1999, and later the U.S. Supreme Court upheld the 8-hour standard in February 2001. It is not yet clear when EPA will make the 8-hour ozone nonattainment designations; however, the State is responding proactively. On August 23, 2002, SCDHEC published a "Notice of Drafting" in the State Register for an Early Action Plan for measures to attain the 8-hour standard before any nonattainment designation. The State intends to implement control measures in anticipation of future EPA actions.

Diesel generators, boilers, and other activities and facilities associated with the V.C. Summer site emit various nonradioactive air pollutants to the atmosphere. Air emissions from these sources are subject to the terms, limitations, standards, and schedules of a SCDHEC Conditional Major Air Quality Permit (Air Permit). Emissions are regulated under Air Quality Permit Number CM-1000-0012, which expires in July 2004. Equipment with nonradioactive air emissions at the facility includes

- emergency diesel generator #1 (5100 KkW);
- emergency diesel generator #2 (5100 KkW);
- 112 million Btu/h No. 2 oil auxiliary boiler;
- 750,000 Btu/h waste oil incinerator;
- water treatment clay transfer silo; and
- other insignificant sources, including petroleum product storage, diesel-engine air compressors and water pumps, and maintenance facilities.

The air permit includes facility-wide limits on emissions of sulfur dioxide, nitrogen oxides, and carbon monoxide and includes source-specific limitations on particulate matter, opacity, sulfur dioxide, and hours of operation. There are no significant changes proposed for nonradioactive air emissions from the V.C. Summer site, and there are no significant changes proposed to the limits and conditions of the Air Permit.

2.2.5 Aquatic Resources

Aquatic resources in the vicinity of V.C. Summer are associated with Monticello Reservoir on Frees Creek and with Parr Reservoir on the Broad River. Monticello Reservoir (2630 ha [6,500 ac]) was constructed in 1977 on Frees Creek to serve as the cooling water source for V.C. Summer and as the upper reservoir for the FPSF. Parr Reservoir was established in the early 1900s with the construction of the Parr Hydro facility. In 1977, Parr Reservoir was enlarged from 750 ha (1850 ac) to 1780 ha (4400 ac) for added pumped storage exchange with Monticello Reservoir and as makeup water for evaporative losses from Monticello Reservoir due to V.C. Summer operations (SCE&G 2002a). Parr Reservoir undergoes daily depth fluctuations due to the operations of the FPSF. The reservoir is shallow, and pumped storage withdrawals, amounting to 88 percent of the reservoir's volume, can drop water levels as much

as 3 m (10 ft) daily, exposing up to 1030 ha (2550 ac) of the reservoir's 1780 ha (4400 ac). Average daily water fluctuations are 1.2 m (4 ft).

The aquatic environment of Monticello Reservoir is also dominated by daily fluctuations in surface elevation of up to 1.4 m (4.5 ft) due to pumped storage activities. Monticello Reservoir is deep (average depth of 18 m [59 ft]; maximum depth of 38 m [126 ft]) and has a small watershed of 445 ha (11,000 ac) with little natural surface water flow. Surface water temperatures in the vicinity of V.C. Summer may reach as high as 39.8 °C (103.7 °F) from cooling water releases, with a monthly permitted average of 32.2 °C (90 °F) near the FPSF.

SCE&G monitored water quality and aquatic communities in the Monticello Reservoir, Broad River, and Parr Reservoir from mid-1978 through 1984 to assess the impacts of FPSF and V.C. Summer operations (Dames and Moore 1985a, 1985b). These studies represent the most comprehensive information on the biotic communities of the Broad River in the vicinity of V.C. Summer.

The reservoir is one of the least eutrophic lakes in the State, with low hardness and low phosphorus and nitrogen levels (Haddon 1995, SCE&G 2002a). The small watershed provides limited opportunity for nutrient sources to support aquatic productivity, although daily pumping from the Broad River by the FPSF may provide an additional nutrient supply. The reservoir supports a smaller shad population compared to some other reservoirs in the region (Christie and Stroud 1996, Nash et al. 1990); this condition may be a reflection of the low productivity of the reservoir. The near-shore environment is dominated by the daily fluctuations in reservoir surface elevation and may provide little opportunity for establishment of aquatic vegetation.

Monticello Reservoir contains a diverse fish community with 38 reported species. Additionally, the exotic Asiatic clam (*Corbicula* spp.) has become established in the reservoir. Standing crop of fish in 1984, approximately two years after the plant began operating, was dominated by bluegill (*Lepomis macrochirus*) and gizzard shad (*Dorosoma cepedianum*), with substantial populations of pumpkinseed (*L. gibbosus*) and channel catfish (*Ameiurus punctatus*) (Table 2-2). Based on studies conducted in 1978 to 1984, fish community structure in Monticello Reservoir appeared to be unaffected by V.C. Summer operations (Dames and Moore 1985b). However, it would have been difficult to distinguish changes in the fish community due to V.C. Summer's operations from those associated with natural fish succession.

From 1986 to 1995, the SCDNR conducted cove rotenone studies of Monticello Reservoir fish populations, which yielded higher standing stocks than earlier studies (Table 2-2). Dominant fish in 1986-1987 included gizzard shad, bluegill, channel catfish, and white catfish (*Ameiurus catus*). In 1989 and 1995, blue catfish (*Ictalurus furcatus*) and white perch (*Morone americana*) were collected from Monticello Reservoir for the first time. By 1996, blue catfish was the most

Table 2-2 Standing Stock of Dominant Fishes of Monticello Reservoir

Species	1984[a] kg/ha (lb/ac)	1987[b] kg/ha (lb/ac)	1988[b] kg/ha (lb/ac)	1989[b] kg/ha (lb/ac)	1995[c] kg/ha (lb/ac)	1996[d] kg/ha (lb/ac)
gizzard shad (*Dorosoma cepedianum*)	13.69 (12.2)	84.4 (75.3)	37.0 (33.0)	25.2 (22.5)	46.8 (41.8)	103 (91.9)
threadfin shad (*Dorosoma petenense*)	0.14 (0.12)	16.5 (14.7)	10.6 (9.5)	10.4 (9.3)	1.71 (1.52)	2.8 (2.5)
channel catfish (*Ameiurus punctatus*)	2.78 (2.5)	62.7 (55.9)	75.9 (67.7)	31.5 (28.1)	36.1 (32.2)	98.7 (88.1)
white catfish (*Ameiurus catus*)	0.70 (0.62)	25.7 (22.9)	55.6 (49.6)	30.5 (27.2)	0.38 (0.34)	48.3 (43.1)
blue catfish (*Ictalurus furcatus*)	- -	- -	- -	4.9 (4.4)	7.67 (6.84)	123.7 (110.4)
white perch (*Morone americana*)	- -	- -	- -	- -	0.50 (0.45)	24.6 (21.9)
white bass (*Morone chrysops*)	present	0.7 (0.62)	0.3 (0.26)	1.0 (0.9)	30.0 (26.8)	0.2 (0.2)
bluegill (*Lepomis macrochirus*)	14.69 (13.1)	57.3 (51.1)	55.9 (49.6)	70.9 (13.3)	18.5 (16.5)	56.0 (49.9)
pumpkinseed (*Lepomis gibbosus*)	3.48 (3.1)	3.5 (3.1)	5.49 (4.9)	4.6 (4.1)	0.86 (0.77)	3.1 (2.8)
black crappie (*Pomoxis nigromaculatus*)	0.03 (0.026)	8.7 (7.8)	6.16 (5.5)	0.3 (0.27)	0.01 (0.01)	0.5 (0.45)
largemouth bass (*Micropterus salmoides*)	1.04 (0.93)	6.4 (5.7)	6.4 (5.7)	3.9 (3.5)	4.19 (3.74)	6.5 (5.8)
yellow perch (*Perca flavescens*)	0.59 (0.53)	10.0 (8.9)	14.8 (13.2)	9.7 (8.7)	- -	4.4 (3.9)
TOTAL	40.13 (35.8)	306.3 (273.2)	281.2 (250.8)	204.5 (182.5)	154.3 (137.7)	482.3 (430.3)

(a) Dames and Moore 1985b.
(b) Nash et al. 1990.
(c) Christie and Stroud 1996.
(d) Christie and Stroud 1997.

dominant fish and white perch was the sixth most dominant species. Other dominant species included gizzard shad, bluegill, channel catfish, and white catfish. Other recently introduced and newly collected species included the green sunfish (*Lepomis cyanellus*), brook silversides (*Labidesthes sicculus*), and the swallowtail shiner (*Notropis procne*). The introduction of the blue catfish and white perch is of concern to the reservoir fishery because of their competition for limited forage and predation on other species (SCE&G 2002a).

Fishery investigations (Christie and Stroud 1996, 1997, 1998, 1999, Nash et al. 1990) suggest that introduction of blue catfish and white perch has had a significant effect on the fishery of Monticello Reservoir. In 1987-1989, catfish comprised 61 percent of the number of fish caught and white perch were not present (Nash et al. 1990). By 1999, catfish species comprised 82 percent of fish numbers and 88 percent of fish weight harvested. The most harvested species were blue catfish (60,202 fish, 51 percent by weight); channel catfish (44,630 fish, 33.7 percent by weight); white perch (17,205 fish, three percent by weight); and bluegill (11,479 fish, one percent by weight) (Christie and Stroud 1999).

At the upper end of Monticello Reservoir is a smaller impoundment, known as Monticello Sub-impoundment. Although hydraulically connected to the main reservoir by a conduit that passes under SC 99, the water level in this Sub-impoundment is minimally influenced by pumped storage operations on the main impoundment. The Sub-impoundment is managed for recreation by SCE&G and SCDNR. Dominant fish species include gizzard shad, sunfish, crappie, and largemouth bass.

Monticello Reservoir and the Sub-impoundment are used for recreational fishing. The recreational fishery of Monticello Reservoir is dominated by catfish and sunfish. A roving creel survey, including interviews with fishermen, was conducted by SCDNR from June 1997 through May 1999 (Christie and Stroud 1999). Anglers expended an estimated 115,973 hours of fishing effort during that time. Fishing occurred from the bank (26 percent of effort), from docks (six percent of effort), and from boats (68 percent of effort). Catfish were targeted by 51 percent of the total effort, while black crappie and largemouth bass received 15 percent and five percent of the effort. Fishing success was 0.9 fish per hour (fish/hr), ranging from a high of three fish/hr in the summer to 0.8 fish/hr in the fall. Harvest rates were 56.1 fish/ha or 11.9 kg/ha (22.7 fish/ac or 10.8 lbs/ac). Harvest was dominated by blue catfish, channel catfish, and white perch.

No aquatic Federal- or State-listed endangered or threatened species are known to occur in Monticello Reservoir or in Parr Reservoir in the vicinity of V.C. Summer or in aquatic habitats crossed by the transmission lines. Two Federal-listed and 12 State-listed aquatic species have been reported from the counties of the V.C. Summer site and transmission lines (Table 2-3).

Table 2-3. Aquatic Species Listed or Candidates for Listing as Endangered or Threatened by the USFWS or the State of South Carolina that Occur or Potentially Occur Within or Near the V.C. Summer Site or the Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]
Plants			
Myriophyllum laxum	Piedmont watermilfoil	--	SC
Potamogeton confervoides	algae-like pondweed	--	SC
Crustaceans			
Distocambarus youngineri	Saluda crayfish	--	SC
Mollusks			
Elimia catenaria	gravel elimia	--	SC
Elliptio lanceolata	yellow lance	--	SC
Lasmigona decorata	Carolina heelsplitter	E	SC
Pyganodon cataracta	Eastern floater	--	SC
Strophitus undulatus	squawfoot	--	SC
Villosa delumbis	Eastern creekshell	--	SC
Fish			
Acipenser brevirostrum	shortnose sturgeon	E	--
Etheostoma collis	Carolina darter	--	SC
Fundulus diaphanus	banded killifish	--	SC
Notropis chiliticus	redlip shiner	--	SC
Rhinichthys atratulus	blacknose dace	--	SC

(a) E = endangered, SC = South Carolina species of special concern, -- = no listing.

One Federal-listed endangered species, the shortnose sturgeon (*Acipenser brevirostrum*), historically occurred in the Broad River in Lexington and Newberry Counties, but has been extirpated from that stretch of the Broad River. Passage of this species up the Broad River is blocked by dams. Shortnose sturgeon are found in rivers that flow into Winyah Bay, rivers that flow into Lake Marion, the Santee, Cooper, and Savannah Rivers, and the ACE Basin (made up of the Ashepoo, Combahee, and Edisto Rivers). In the latter, shortnose sturgeon are typically found at the freshwater/saltwater interface. There are no recorded occurrences of this species in streams or rivers that are crossed by or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The Carolina heelsplitter (*Lasmigona decorata*), a freshwater mussel listed as Endangered under the provisions of the Endangered Species Act, was historically found in South Carolina in the Pee Dee River system (USFWS 1993). Before a 1987 U.S. Fish and Wildlife Service (USFWS) survey, the Carolina heelsplitter had not been recorded in the State since the mid-19th century (USFWS 1993). The USFWS conducted intensive surveys between 1987 and 1990 and found only two surviving populations of the Carolina heelsplitter in the Pee Dee River system: the Goose Creek and Lynches River/Flat Creek populations (USFWS 1993). During the USFWS surveys, a total of only 12 live specimens were found in Flat Creek (1987–1990) and two live specimens were found in the Lynches River (both found in 1990). The Carolina heelsplitter populations have been found only in other tributaries to the Pee Dee River, not in the Broad River system near the V.C. Summer site. There are no recorded occurrences of this species in Monticello Reservoir, Parr Reservoir, or streams or rivers that are crossed by or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

Twelve additional species are listed by the State as species of special concern. Two submerged aquatic plants of shallow water, Piedmont watermilfoil (*Myriophyllum laxum*) and algae-like pondweed (*Potamogeton confervoides*), are listed as species of special concern for Lexington and Richland Counties. There are no recorded occurrences of these species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The Saluda crayfish (*Distocambarus youngineri*), a burrowing species, is known from Newberry County at two localities over 40 km (25 mi) west of V.C. Summer. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The gravel elimia (*Elimia catenaria*) is an aquatic snail listed as a species of special concern for Richland County. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The yellow lance (*Elliptio lanceolata*) is a mussel found in clean sands in flowing water and is listed as a species of special concern for Newberry County. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The Eastern floater (*Pyganodon cataracta*) is a mussel found in mud, sand, and gravel in ponds, lakes, and streams; it is listed as a species of special concern for Fairfield County. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The squawfoot (*Strophitus undulatus*) is a mussel found in mud, sand, or gravel in streams and small rivers; it is listed as a species of special concern in Richland County. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The Eastern creekshell (*Villosa delumbis*) is a mussel found in muds or soft sand in small rivers and creeks; it is listed as a species of special concern for Fairfield and Richland Counties. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The Carolina darter (*Etheostoma collis*) is a small bottom-dwelling fish of warm pools and runs in small streams; it is listed as a species of special concern for Fairfield and Richland Counties. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The banded killifish (*Fundulus diaphanus*) is a small topwater fish of quiet shallow backwaters of lakes, ponds, rivers, and estuaries; it is listed as a species of special concern for Richland County. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The redlip shiner (*Notropis chiliticus*) is a small minnow of pools and runs in small streams; it is listed as a species of special concern for Richland County. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The blacknose dace (*Rhinichthys atratulus*) is a small minnow found in small streams with clear water and a gravel bottom; it is listed as a species of special concern for Richland County. There are no recorded occurrences of this species at V.C. Summer or in or adjacent to the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

2.2.6 Terrestrial Resources

The V.C. Summer site covers approximately 909 ha (2245 ac), an area that includes portions of Monticello Reservoir and FPSF. Approximately 348 ha (860 ac) are covered by the waters of Monticello Reservoir. A significant portion of the property (approximately 150 ha [370 ac]) consists of generation and maintenance facilities, supply areas, parking lots, roads, and mowed grass. Some 50 ha (125 ac) are dedicated to transmission line rights-of-way. However, much of the V.C. Summer property consists of forested areas (approximately 360 ha [890 ac]). The primary terrestrial habitats at V.C. Summer are pine forest, deciduous forest, and mixed pine-hardwood forest (SCE&G 2002a). The pine forests at V.C. Summer include planted pines and naturally vegetated pines. Most of the deciduous forests at the site are located along stream bottoms and surrounding slopes.

Forested areas within the 909-ha (2245-ac) V.C. Summer site are managed by SCANA Services' Forestry Operations group, but timber is not routinely harvested. Parr Reservoir provides some limited freshwater marsh habitat in shallow backwaters, around low-lying islands, and in an area east of the FPSF tailrace that was used in the 1970s for the disposal of dredge spoil. These marshes and adjacent shallows are used by migrating dabbling ducks, including mallard (*Anas platyrhynchos*), black duck (*A. rubripes*), and teal (*A. discors* and *A. crecca*). Monticello Reservoir and its Sub-impoundment also provide resting areas for wintering waterfowl and provide year-round habitat for nonmigratory Canada geese (*Branta canadensis*). Terrestrial wildlife species found in the forested portions of the V.C. Summer property are those typically found in the Piedmont forests of South Carolina.

No areas designated by the USFWS as critical habitat for endangered species exist at V.C. Summer or in or adjacent to associated transmission lines. In addition, the transmission corridors do not cross any State or Federal parks, wildlife refuges, or wildlife management areas. Table 2-4 lists the protected species and their status. SCE&G conducted a survey of threatened and endangered species at V.C. Summer and transmission line corridors associated with V.C. Summer (SCE&G 2002e).

Six bald eagle (*Haliaeetus leucocephalus*) nesting sites occur within an 8-km (5-mi) radius of V.C. Summer (SCDNR 2001a). Four of these six nests were believed to be active nesting sites; the status of two nests was unknown (SCDNR 2001b). There are four bald eagle nesting sites on Parr Reservoir. Three (one active, two unknown status) are in the same area (within 0.8 km [0.5 mi] of one another), on the western shore of the reservoir, approximately 3 km (2 mi) west of V.C. Summer. The fourth (an active nest) is on the Heller's Creek arm of Parr Reservoir, approximately 6.5 km (4 mi) northwest of V.C. Summer. There is a single active bald eagle nesting site on the eastern shore of Monticello Reservoir, approximately 5.5 km (3.5 mi) north of V.C. Summer. There is also an active nesting site approximately 3.2 km (2 mi) east of Monticello Reservoir (6.5 km [4 mi] northeast of V.C. Summer) on a tributary of the Little River. Two additional bald eagle nesting sites are near transmission lines. One active bald eagle nest in Saluda County is approximately 0.8 km (0.5 mi) west of the Summer-Graniteville transmission line, and one bald eagle nest in Richland County is located approximately 1.4 km (0.9 mi) south of the Summer-Denny Terrace transmission line (SCDNR 2001b). The current status of the Richland County nest is unknown, but the nest was active as recently as 1995 (SCDNR 2001b). Bald eagles are generally associated with lakes, rivers, and coastal areas (USACE 2002). The bald eagle is Federal-listed as threatened and State-listed as endangered. Bald eagles are commonly observed foraging around Monticello Reservoir, the FPSF tailrace canal, Parr Reservoir, and on the Broad River downstream of Parr Shoals dam.

Table 2-4. Terrestrial Species Listed or Candidates for Listing as Endangered or Threatened by the USFWS or the State of South Carolina that Occur or Potentially Occur Within or Near the V.C. Summer Site or the Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]
Birds			
Haliaeetus leucocephalus	bald eagle	T	E
Mycteria americana	wood stork	E	E
Picoides borealis	red-cockaded woodpecker	E	E
Plants			
Amphianthus pusillus	pool sprite	T	T
Aster georgianus	Georgia aster	C	--
Echinacea laevigata	smooth coneflower	E	E
Lysimachia asperulifolia	rough-leaved loosestrife	E	E
Oxypolis canbyi	Canby's dropwort	E	E
Ptilimnium nodosum	harperella	E	E
Trillium reliquum	relict trillium	E	E
Amphibians			
Hyla andersonii	pine barrens treefrog	--	T
Plethodon websteria	Webster's salamander	--	E
Mammals			
Corynorhinus rafinesquii	Rafinesque's big-eared bat	--	E
Reptiles			
Gopherus polyphemus	gopher tortoise	--	E

(a) E = endangered, T = threatened, C = candidate for Federal listing, -- = no listing.

The wood stork (*Mycteria americana*), State- and Federal-listed as endangered, is known to occur in Aiken County. Although they do not nest in Aiken County, wood storks from the Birdsville Colony (near Millen, Georgia) forage in shallow wetlands on the U.S. Department of Energy's Savannah River Site and in specially constructed ponds on the National Audubon

Society's Silver Bluff Sanctuary, near Jackson, South Carolina (DOE 1997; NAS undated). No transmission line corridors associated with V.C. Summer cross or approach the Savannah River Site or the Silver Bluff Sanctuary.

The red-cockaded woodpecker (*Picoides borealis*), State- and Federal-listed as endangered, is known to occur in Aiken and Richland Counties (SCDNR 2002). Active nest cavities of this cooperative breeder occur in open, mature pine stands with sparse midstory vegetation (USFWS 2002). Suitable habitat for this species does not occur at V.C. Summer, and there are no known active or abandoned cavity trees at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) is State-listed as endangered. This bat is found in forested areas, especially in pine flatwoods and pine-oak woodlands. It roosts in hollow trees, under bark, in old cabins and barns, and in wells and culverts (Brown 1997). The species has been recorded in Aiken and Richland Counties (SCDNR 2002), but there are no recorded occurrences at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

The gopher tortoise (*Gopherus polyphemus*) is State-listed as endangered and is known to occur in Aiken County (SCDNR 2002). The gopher tortoise inhabits sandy, well-drained areas where adequate vegetation for foraging exists (Martoff et al. 1980). The gopher tortoise has not been recorded north of Aiken County, and no burrows have been recorded at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e). The species' burrows, which are readily visible, have not been observed at V.C. Summer. The gopher tortoise is generally not found in areas of Piedmont soils, which characterize most of the transmission line corridors associated with V.C. Summer.

The pine barrens treefrog (*Hyla andersonii*) is State-listed as threatened and is known to occur in Richland County (SCDNR 2002). This species inhabits trees in swamps adjacent to sandhill habitats (Martoff et al. 1980). There are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

Webster's salamander (*Plethodon websteria*) is State-listed as endangered. It has been recorded in Saluda and Edgefield Counties (SCDNR 2002), which represent the eastern extent of its range. Webster's salamander inhabits moist, mixed hardwood forests on steep north-facing slopes with rock outcrops (Martoff et al. 1980). There are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

The pool sprite (*Amphianthus pusillus*), also known as little amphianthus, is State- and Federal-listed as threatened. This aquatic plant occurs in small (usually less than one square meter) shallow pools on the crests and flattened slopes of granite outcrops (USFWS 2002). These pools completely dry out in summer droughts. Within South Carolina, the pool sprite is known from three counties (USFWS 2002; SCDNR 2002), one of which (Saluda) is crossed by the transmission lines associated with V.C. Summer. Only one occurrence of this plant is known from Saluda County (USFWS 2002), but there are no recorded occurrences at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b).

The Georgia aster (*Aster georgianus*), a candidate for Federal listing, is found in dry, open woodlands and disturbed areas, such as roadsides and utility rights-of-way that are regularly mowed. Populations have been found in Edgefield, Fairfield, and Richland Counties (SCDNR 2002). There are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

The smooth coneflower (*Echinacea laevigata*), State- and Federal-listed as endangered, is known to occur in Aiken and Richland Counties (SCDNR 2002). Reported habitat for this perennial herb is open woods, cedar barrens, roadsides, clear cuts, limestone bluffs, and transmission line corridors. Fire or other disturbance, such as well-timed mowing or clearing, is essential to maintaining the open habitat required for this species (USFWS 2002). There are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

The rough-leaved loosestrife (*Lysimachia asperulifolia*) is State- and Federal-listed as endangered. Habitat for this perennial herb consists of Carolina bays and the ecotones between longleaf pine (*Pinus palustris*) uplands and pond pine (*P. serotina*) pocosins. The only known location of the rough-leaved loosestrife within South Carolina is at Fort Jackson in Richland County (USFWS 2002); there are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

Canby's dropwort (*Oxypolis canbyi*) is State- and Federal-listed as endangered. This perennial plant is known to occur in 11 counties within South Carolina, one of which (Richland) is crossed by V.C. Summer transmission lines (SCDNR 2002). This coastal plain species grows in wet meadows, wet pineland savannas, ditches, sloughs, and along the edges of cypress-pine (*Callitris* spp.) ponds (USFWS 2002). There are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

Harperella (*Ptilimnium nodosum*) is State- and Federal-listed as endangered. Typical habitat for this annual herb is rocky or gravel shoals, margins of swift-flowing streams, and edges of intermittent pineland ponds (USFWS 2002). Harperella is known in South Carolina from Aiken and Saluda Counties (SCDNR 2002). There is one recorded population of harperella approximately 0.8 km (0.5 mi) west of the Summer-Graniteville transmission line corridor in Saluda County. The most recent observation of this population in the SCDNR database was from 1985 (SCDNR 2001b). There are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

Relict trillium (*Trillium reliquum*) is State- and Federal-listed as endangered. Habitat for this perennial herb is mature, moist, undisturbed hardwood forests (USFWS 2002). Relict trillium is known from Aiken and Edgefield Counties (SCDNR 2002). There are no recorded occurrences of this species at or adjacent to V.C. Summer or the transmission line corridors associated with V.C. Summer (SCDNR 2001b, SCE&G 2002e).

2.2.7 Radiological Impacts

SCE&G conducts an annual radiological environmental monitoring program (REMP) in and around the V.C. Summer site. This program was initiated before plant operation in 1982 (SCE&G 2002d). Through this program, radiological impacts to employees, the public, and the environment are monitored, documented, and compared to the appropriate standards. The objectives of the REMP are to:

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

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

Radiological releases are summarized in two annual reports: SCE&G Radiological Environmental Monitoring Report (SCE&G 2002d) and SCE&G Annual Effluent and Waste Disposal Report (SCE&G 2002b). The limits for all radiological releases are specified in the V.C. Summer ODCM (SCE&G 1999a), and these limits are designed to meet Federal standards and requirements. The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment); atmospheric environment (airborne radioiodine, gross beta, and gamma); terrestrial environment (vegetation); and direct radiation.

SCE&G's review of historical data on releases and the resultant dose calculations revealed that the calculated doses to maximally exposed individuals in the vicinity of V.C. Summer were a small fraction of the limits specified in the SCE&G ODCM (SCE&G 1999a) to meet EPA radiation standards in 40 CFR Part 190 as required by 10 CFR 20.1301(d). For 2001 (the most recent year that data were available), dose estimates were calculated based on actual liquid and gaseous effluent release data (SCE&G 2002b). Dose estimates were performed by SCE&G using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM.

An assessment of doses to the maximally exposed individual from gaseous and liquid effluents was performed by SCE&G for locations representing the maximum dose. In all cases, doses were well below the technical specification limits as defined in the ODCM (SCE&G 2002d). A breakdown of the calculated maximum dose to an individual located at the V.C. Summer boundary from liquid and gaseous effluents released during 2001 is summarized as follows:

- Total body dose from liquid effluents at the site discharge was 3.96×10^{-5} mSv (3.96×10^{-3} mrem), which is about 0.13 percent of the 0.03 mSv (3 mrem) dose limit specified in 10 CFR Part 50, Appendix I. The critical organ dose due to the liquid effluents at the site discharge was 4.71×10^{-5} mSv (4.71×10^{-3} mrem). This dose was about 0.05 percent of the 0.10 mSv (10 mrem) dose limit (SCE&G 2002b).

- The air dose due to noble gases in gaseous effluents was 9.93×10^{-7} mSv (9.93×10^{-5} mrad) gamma (0.001 percent of the 0.10 mGy [10 mrad] gamma dose limit) and 3.56×10^{-7} mGy (3.56×10^{-5} mrad) beta (0.0002 percent of the 0.20 mGy [20 mrad] beta dose limit) (SCE&G 2002b).

- The critical organ dose from gaseous effluents due to iodine-131, iodine-133, tritium, and particulates with half-lives greater than eight days was 1.52×10^{-6} mSv (1.52×10^{-4} mrem), which is 0.001 percent of the 0.15 mSv (15 mrem) dose limit (SCE&G 2002b).

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

2.2.8 Socioeconomic Factors

The staff reviewed the *V.C. Summer Environmental Report* (SCE&G 2002a) and information obtained from meetings with local and regional agencies during a site visit to Fairfield County and the surrounding area from December 10-12, 2002. The following information describes the housing, public services, land use, demographics, and economy of the communities near V.C. Summer.

2.2.8.1 Housing

SCE&G employs a permanent workforce of approximately 600 employees at V.C. Summer and an additional 130 to 140 long-term contract employees who provide security, maintenance, engineering, and janitorial support; this is within the range of 600 to 800 personnel per reactor unit estimated in the Generic Environmental Impact Statement (GEIS) (NRC 1996). Approximately 95 percent of the permanent employees live in Lexington, Richland, Fairfield, and Newberry Counties. The remaining five percent are distributed across 11 South Carolina counties. About 10 percent of the employees live in Fairfield County, and 48 of these (81 percent) live in Winnsboro or Jenkinsville. Table 2-5 summarizes the information for the permanent workforce. Given the predominance of regular employees living in the Central Midlands Region and the absence of the likelihood of significant socioeconomic effects in other counties, the focus of this analysis is Fairfield, Lexington, Newberry, and Richland Counties.

Table 2-5. V.C. Summer Employee Residence Information by County

County	Number of Personnel	Percent of Total
Fairfield	59	9
Lexington	210	34
Newberry	126	20
Richland	197	32
Other Counties	29	5
TOTAL	621	100

Source: SCE&G 2002a.

V.C. Summer is on an 18-month refueling cycle. During refueling outages, which typically last for 30 to 40 days, the number of contractor employees on site increases substantially. In three recent outages, V.C. Summer brought in between 591 and 791 contractor employees for an average of 665 additional contractor employees per outage. Most of these temporary contractor employees are assumed to be located in the same geographic areas as the permanent SCE&G staff. This falls within the GEIS range of 200 to 900 additional contractor employees per reactor outage (SCE&G 2002a).

Table 2-6 provides the number of housing units and housing unit vacancies for the four Central Midlands Counties for 1990 and 2000, derived from U.S. Census Bureau information. Each of

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

	1990	2000	Approximate Percentage Change 1990–2000
Fairfield County			
Housing Units	8730	10,383	18.9
Occupied Units	7467	8774	17.5
Vacant Units	1263	1609	27.4
Newberry County			
Housing Units	14,445	16,805	16.3
Occupied Units	12,314	14,026	13.9
Vacant Units	2141	2779	29.8
Lexington County			
Housing Units	67,510	90,978	34.8
Occupied Units	61,592	83,240	35.1
Vacant Units	5918	7738	30.6
Richland County			
Housing Units	109,563	129,793	18.5
Occupied Units	101,588	120,101	18.2
Vacant Units	7975	9692	21.5

Source: U.S. Census Bureau (USCB) 2000 and CMCOG 2003a.

these counties has a comprehensive plan that addresses housing needs and provides policies for guiding housing choices. Fairfield County accounted for just 1.7 percent of the Central Midlands Region's new housing units in 2001, compared to 56.5 percent in Richland, 38.2 percent in Lexington, and 3.6 percent in Newberry County (CMCOG 2001). These figures do not include mobile homes, which constitute a growing segment of the affordable housing supply in South Carolina. The U.S. Census Bureau reported that 29.3 percent of all housing units in Fairfield County in 2000 were mobile homes (this includes manufactured housing), and these structures provided 24.4 percent of the total housing units in Newberry County compared to 23.1 percent in Lexington County, just 6.6 percent in Richland County, and 20 percent for South Carolina (USCB 2000). Fairfield County has the smallest housing stock in the Central

Midlands Region while Richland County has the largest. The Lexington County housing stock grew the fastest, by nearly 35 percent between 1990 and 2000, but it also had the largest change in vacancy rates. The vacancy rate in Fairfield County in 2000 was 15.5 percent but nearly half of these (724 homes) are actually seasonal and vacation homes (USCB 2000). The vacancy rate for the four Central Midlands counties in 2000 was 8.8 percent and represents nearly 22,000 homes.

2.2.8.2 Public Services

Public services include water supply, education, and transportation.

- **Water Supply**

  Table 2-7 summarizes the daily water consumption and areas served by each water system in Fairfield County, the County most impacted by the relicensing of V.C. Summer. Fairfield County has five public water systems, serving approximately 51 percent of the population. Less than two percent receive water from private residential water systems. The remaining 47 percent rely on individual wells (Fairfield County 1997). Only the town of Winnsboro draws water from a surface supply. The source is a reservoir west of Winnsboro that is part of the Jackson Mill Creek watershed. The reservoir contains approximately 600 million gallons of water (Fairfield County 1997). The remaining four public systems draw from groundwater sources, which have a relatively low yield in the area. However, each of the systems is currently operating below capacity, with room for additional growth and development (Fairfield County 1997). The County has been working to expand water service along major transportation corridors and there has been some discussion of establishing a sewer authority, but the focus of these efforts would likely be the areas along U.S. 21 between Interstate 77 and Lake Wateree and SC 269 south of Winnsboro. Development in western Fairfield County tends to be low-density, single-family residential and served by septic systems that require lots to be an acre or more.

  The major public providers of water in Lexington County include Columbia, West Columbia, the Lexington County Joint Municipal Water and Sewer Commission, Cayce, Lexington, Batesburg-Leesville, Chapin, Pelion, Swansea, the Gilbert-Summit Rural Water District, Gaston Water District, and the Bull Swamp Water District. The remainder are private systems. Nonpublic providers include AAA Utilities, Inc., Carolina Water Service, and Heater Utilities, Inc. Lexington County has ample capacity for additional growth.

Table 2-7. Fairfield County Public and Private Water Suppliers and Capacities

Water Supplier	Average Daily Use m^3/day (MGD)	Maximum Daily Capacity m^3/day (MGD)
Community Systems		
Town of Winnsboro[b]	6738 (1.78)	11,735 (3.1)
Town of Ridgeway[b]	549 (0.145)	3785 (1.0)
Jenkinsville Water District[b]	477 (0.126)	651 (0.172)
Mid-County Water District 1[b]	276 (0.073)	916 (0.242)
Mid-County Water District 2[b]	246 (0.065)	378 (0.100)
Mitford Water District[b]	303 (0.080)	1514 (0.400)
Private Residential Systems		
Royal Hills Subdivision[a]	7.6 (0.002)	45 (0.012)
Chappel Mobile Home Park[b]	not available	95 (0.025)
Coley's Mobile Home Park[b]	not available	7.9 (0.03)
Fairview Manor[a]	not available	15.8 (0.06)
Lambright Care[a]	not available	not available
Industrial Systems		
V.C. Summer[b]	7.3 (0.0278)	342 (1.296)

(a) Fairfield County 1997.
(b) SCDHEC 1998.

Constraints in Newberry County will be mitigated by the construction of additional water treatment facilities as the need arises (Newberry County 1998). While water is available at the interstate interchanges, the supply is not sufficient for industrial or large-scale residential development. The Water and Sewer Authority will make the investment to install water tanks or larger lines only when the demand requires it (Newberry County 1998).

Water service is available to Richland County through public and private water systems. The major public system is operated exclusively by the city of Columbia which has primary

water lines extending into four major planning areas. Water service is provided as far west as Chapin and Lake Murray and north to the town of Blythewood. Water service in the northeast extends very close to the Kershaw County line. Southeast of the city, water lines reach to the McEntire Air National Guard Base and the Hopkins area. Columbia's position has been to delay further water extension into unserved, sparsely populated areas until a sufficient customer base has formed. Outside of Columbia's service area, water supply depends on private wells.

- **Education**

  The Central Midlands Region includes 11 school districts and 170 public schools with enrollment totaling more than 107,000 students. There are also 75 private schools and nine colleges and universities (CCEDA 2002). Fairfield County will be the focus of this analysis as it is the school district most directly and fiscally impacted by the relicensing of V.C. Summer.

  The Fairfield County School District operates eight schools serving 3600 students. The high school is located in Winnsboro, as is the middle school (Grades 6 to 8). There are also an intermediate school (Grades 4 to 6), one elementary, and one primary school (Grades K to 6) in Winnsboro. There are also two schools providing pre-K through 6th Grade in Blair and Ridgeway. The operating budget for the Fairfield County School District in 2002 was $29.5 million of which approximately $11.4 million is derived from V.C. Summer taxes. Per pupil expenditures for the Fairfield County School District are the highest in the Central Midlands at $8062 in 1999. This compares with $5189 to $6117 for Lexington schools, $5989 for Newberry, and $6035 to $6552 for Richland schools and $5556 for South Carolina (CCEDA 2002).

- **Transportation**

  The Central Midlands Region has a transportation network of trucking and railroad terminals and interstate highway access to nine regional airports, three international airports, and three international seaports, giving the area access to both domestic and international markets (CCEDA 2002).

  Fairfield County operates a basic public transportation system that operates along established routes but can deviate up to 3.2 km (2 mi) off the route, and does pass close to V.C. Summer along SC 215. The primary means of personal transportation for commuting is private vehicles. Approximately 14 percent of the households in Fairfield County do not have a vehicle (USCB 2000). Road access to V.C. Summer is via SC 311 (Ollie Bradham Boulevard), a two-lane paved road (see Figure 2-3). SC 311

intersects with SC 215 approximately 2.4 km (1.5 mi) east of V.C. Summer. SC 215 has a north-south orientation and is used by employees traveling from the Richland and Fairfield Counties areas. Additionally, employees traveling from the Richland and Lexington Counties areas may use U.S. 176 north to SC 213, which intersects with SC 215 3.2 to 4.8 km (2 to 3 mi) south of V.C. Summer.

Employees coming from the west and Newberry County area may use several secondary roads such as SC 773 or SC 202 to intersect with U.S. 176 and head south to intersect with SC 213. Traffic counts for each of these highways/roads are shown in Table 2-8 (SCE&G 2002a). Two projects appear on the Long-Range Rural System Upgrades map in the vicinity of V.C. Summer: improvements to SC 213 between SC 215 and SC 176, and for the "Peak Bypass."

Railroad access to V.C. Summer is provided with a spur from the Norfolk Southern line along the east side of Broad River that runs through Columbia and Spartanburg. There is a municipal airport south of Winnsboro and another in Newberry County while Columbia Metropolitan Airport provides the entire region with commercial and freight service.

Table 2-8 Traffic Counts for Roads in the Vicinity of V.C. Summer

Route No.	Route Location	Est. AADT[(a)] (total of both directions)	AADT Year
U.S. 176	SC 34 to SC 219	900	2000
U.S. 176	SC 219 to Richland County Line	1450	2000
SC 213	Newberry County line to SC 215	2300	2000
SC 213	U.S. 176 to Fairfield County line	1750	2000
SC 215	Richland County line to SC 213	1500	2000
SC 215	SC 213 to Chester County line	1250	2000
SC 202	Interstate 26 to U.S. 176	1100	2000
SC 202	U.S. 76 to Interstate 26	1850	2000
SC 773	U.S. 76 to U.S. 176	2700	2000

(a) annual average daily traffic volume.
Source: SCE&G 2002a.

2.2.8.3 Offsite Land Use

Fairfield County

Fairfield County contains approximately 177,414 ha (438,400 ac). Developed or urban land composes just two percent of the County. The largest land use category is forest, accounting for 87 percent of the total acreage. This includes public, commercial, and noncommercial forests, as well as farm woodlands. Nonforested land, including all urban or developed land, accounts for the remaining 13 percent. The surface waters of Wateree Lake and Monticello Reservoir, along with the Broad and Catawba Rivers, compose four percent of the County (Fairfield County 1997). Roughly three percent of the forested land in the County is government owned, primarily in the Sumter National Forest, located in the northwestern part of the County. Privately owned forest land in the County is dominated by corporations, individuals, and the forest products industry. Only six percent of the forested land is owned by farmers, reflecting the continued decline in farming in Fairfield County since the Depression era (Fairfield County 1997). Table 2-9 provides more information about these land use patterns.

Most of the growth in Fairfield County has occurred between Winnsboro and Wateree Lake, along the Interstate 77 corridor, and suburbanization is close to Richland County. Elsewhere, development is characteristically sparse and rural, characterizing the County's agricultural past (Fairfield County 1997). The dominant form of residential land use is single-family detached housing and includes a growing number of mobile homes and other manufactured structures. Residential development is found in both isolated and cluster patterns along most County roads (Fairfield County 1997). In the 20 years that V.C. Summer has operated, Fairfield County has experienced minimal population growth: the increase from 1990 to 2000 was only 0.5 percent. The County's economic base continues to be manufacturing, followed by government, industry, and services. Land use trends tend to be evolving simultaneously with the nationwide movement away from agricultural production and toward commerce built on the processing/ production of goods and the distribution of services. The Fairfield County Comprehensive Plan was prepared in 1997 and provides policies that promote orderly development while protecting natural resources and prime farmland. The Plan also contains eight policies that promote the location and retention of appropriate industries.

Lexington County

Lexington County contains over 110,000 parcels located in a 1813-km^2 (700-mi^2) area (Lexington County 1999). Farmland represents 21 percent of the land, as the County is a relatively strong agricultural center. However, Lexington County is encouraging the growth of residential areas by promoting the quality of the school systems and the accessibility of

Table 2-9. Land Use in Fairfield County, 1997

	ha (ac)	Percent of County Land
Total Area	177,424 (438,400)	
Forested Land (by ownership)	155,240 (383,607)	87
Public		
National Forest	4678 (11,560)	3
Municipal, County, State	193 (478)	0.1
Private		
Forest Industries	52,860 (130,622)	30
Farms (farmers)	11,747 (29,027)	6
Corporations and Individuals	85,761 (211,920)	48
Nonforested Land	22,184 (54,818)	13
Developed (urban)	2974 (7350)	1
Water	6239 (15,416)	4
Other	12,971 (32,052)	7

Source: Fairfield County, 1997.

resources. Overall, Lexington County has no specific growth control regulations or ordinances; however, it does have a blend of zoning styles, unrelated to growth control, that encourages a quality type of expansion characterized by a reduction in land allocations that are random and sporadic. According to the Lexington County Land Use Plan (Lexington County 1999), land will continue to be available for development for a variety of uses for several decades.

Newberry County

Newberry County has a total land area of 1678 km^2 (648 mi^2). According to the Comprehensive Plan for Newberry County (Newberry County 1998), the land is characterized by a mixture of rural and urban uses including agricultural, residential, commercial, industrial, public and

semi-private uses and vacant land. The Comprehensive Plan study was limited to the areas around the municipalities, the lake shores of Lake Greenwood and Lake Murray, the U.S. 76 corridor between the town of Little Mountain and the city of Newberry, and portions of SC 773, SC 219, SC 34, and SC 121. The unincorporated portions of the County that fall outside the defined study area do not have land use regulations but may eventually need them for future development (Newberry County 1998). Residential development is generally characterized by low- to medium-density, single-family development. There are a number of vacant lots inside and outside of the study area. Most of these are located along the lake shores, where most of the neighborhood subdivisions have occurred (Newberry County 1998). There are very few multifamily units in the unincorporated areas of the County. The option most selected for affordable housing is the manufactured home. The number of manufactured homes has increased dramatically since 1980. Most are located on individual lots and, more recently, in subdivisions (Newberry County 1998). Unlike a municipality where there is dense commercial development in a downtown or some other commercial district, Newberry County's commercial development is much less dense. In most cases, the commercial development is limited to stores located at the intersections of major roads. The remainder of commercial development exists in areas that serve local residents (Newberry County 1998). Agriculture is represented by 200 or more ha (500 ac) scattered throughout the Comprehensive Plan study area, an area comprised mostly of incorporated and developed portions of the County. Generally, there is ample land available for future development in the County; however, the exact locations of growth will be guided by two major constraints: natural features and infrastructure. The study area is crisscrossed with streams and rivers, so there will be areas where topography and flood plain characteristics will constrain development.

Richland County

Richland County occupies roughly 1937 km^2 (748 mi^2) of land area. Approximately 38 percent of the unincorporated portion of the County is developed, while the remaining 62 percent of the unincorporated land in the County is undeveloped. The unincorporated portions of the County were divided into four separate planning areas and two subareas to facilitate planning (Richland County 1999). A recently prepared comprehensive plan (Richland County 1999) noted that zoning controls were not established in Richland County until September 7, 1977. The absence of zoning controls and restrictions produced an environment where existing development patterns have been a mixture of many types of residential, commercial, and industrial uses. The plan noted further that rural open spaces and prime farmlands are being converted to residential and other suburban uses. The plan concluded that, in order to protect significant agricultural lands, natural areas, and open space corridors, Richland County will ultimately have to develop specific zoning and growth management tools for directing future development to sustainable areas. As yet, growth control measures have not been developed or adopted.

2.2.8.4 Visual Aesthetics and Noise

V.C. Summer is situated in an undulating wooded area that is primarily rural in character. Residential low-density development typifies this part of Fairfield County. V.C. Summer is visible from certain vantage points along the shore of Monticello Reservoir and SC 215. Several transmission lines can be seen when crossing roads in the area. Noise is generally not an issue because the actual facilities are within an exclusion and buffer zone and front the reservoir.

2.2.8.5 Demography

Population was estimated from V.C. Summer out to 80 km (50 mi) in 16-km (10-mi) concentric rings. In accordance with NRC Guidance, SCE&G used the most recent decennial U.S. Census Bureau census data (USCB 2000) and a geographic information system software to determine demographic characteristics in the V.C. Summer vicinity. Table 2-10 shows population growth rates and projections in the Central Midlands Region from 1980 to 2040.

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

  All or parts of 21 South Carolina counties and the city of Columbia (State capital), are located within 80 km (50 mi) of V.C. Summer. A small portion of one North Carolina

Table 2-10. Population Growth in the Central Midlands Region of South Carolina 1980 to 2040

	Fairfield County		Lexington County		Richland County		Newberry County	
Year	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1980	20,700[a]	0.4	140,353[a]	5.8	269,735[a]	1.5	31,242[a]	0.7
1990	22,295[a]	0.8	167,611[a]	1.9	285,720[a]	5.9	33,172[a]	0.6
2000	23,454[a]	0.5	216,014[a]	2.9	320,677[a]	1.2	36,108[a]	0.9
2010	24,200[b]	0.5	244,600[b]	1.7	329,000[b]	0.7	36,400[b]	0.5
2020	25,300[b]	0.5	280,400[b]	1.5	350,100[b]	0.6	38,100[b]	0.5
2030	26,474[b]	0.5	321,473[b]	1.5	377,575[b]	0.6	40,304[b]	0.6
2040	27,565[b]	0.4	359,133[b]	1.2	400,258[b]	0.6	42,091[b]	0.4

(a) USCB 2000.
(b) CMCOG 1999.

County (Union) also lies within the 80-km (50-mi) radius. In 2000, an estimated 1.03 million people live within 80 km (50 mi) of V.C. Summer, which equates to a population density of 131 persons per square mile. Table 2-11 presents the population distribution within 80 km (50 mi) of V.C. Summer in 10-year increments between 1990 and 2010.

Table 2-11. Resident Population Within 80 km (50 mi) of V.C. Summer

	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 1990	9720	101,479	353,400	160,349	268,826	893,774
Total 2000	10,574	127,716	397,546	189,377	307,117	1,032,330
Total 2010 (est.)	11,247	151,154	437,851	215,455	340,649	1,156,356

Source: CMCOG 2003b.

Applying the GEIS proximity measures, V.C. Summer is classified as Category 3 (having one or more cities with 100,000 or more persons and less than 73 persons/km^2 [190 persons/mi^2] within 80 km [50 mi]). According to the GEIS sparseness and proximity matrix, V.C. Summer ranks of sparseness Category 3 and proximity Category 3 result in the conclusion that V.C. Summer is located in a medium population area.

The largest population centers within the 16-km (10-mi) area are the communities of Jenkinsville (948 people in 2000) in Fairfield County and Peak in Newberry County. These areas have not experienced growth relative to other areas that lie outside the 16-km (10-mi) ring, but some new residential development has occurred along SC 215 on the shore of Monticello Reservoir. In fact, the Monticello-Salem area of Fairfield County, where V.C. Summer is located, lost about 10 percent of its population (approximately 240 people) between 1970 and 1990, and currently has a population of about 2200. Fairfield County had a lower population in 2000 (23,454) than it did at the turn of the 20th Century in 1900 (29,425), and it has experienced the slowest growth compared to the three other counties (USCB 2000).

Winnsboro is 24 km (15 mi) west of V.C. Summer and has a population of 16,000. The Fairfield County Comprehensive Plan projects that most of the housing and population growth will occur in and around Winnsboro and Ridgeway. These areas of Fairfield County increased in population by nearly 10 percent or about 1700 people between 1980 and 1990 (Fairfield County 1997). The area between Winnsboro, the Broad River, and U.S. 321 is projected to grow up to eight percent between 2000 and 2010 (CMCOG 2002).

Areas 32 to 48 km (20 to 30 mi) from V.C. Summer include eastern Newberry County, northern Lexington County, including the rapidly growing Irmo area, and Columbia, the State capitol in Richland County. These are the most rapidly growing areas within the 80 km (48 mi) radius of V.C. Summer where population gains of the 1990s are projected to continue at similar rates during the next 10 years (CMCOG 2002). There were 163 residential building permits issued in 2001 in Newberry County, in contrast to 1724 in Lexington County, and 2550 in Richland County. By comparison, just 78 residential building permits were issued in Fairfield County (CMCOG 2002). The Columbia metropolitan statistical area (Lexington and Richland Counties) grew by 8.4 percent during the 1990s, and is projected to grow by 10.7 percent between 2000 and 2010 (CCEDA 2002).

Population and growth rates 64 to 80 km (38 to 48 mi) away from V.C. Summer tend to diminish with distance. This is particularly true to the north and east.

Table 2-12 lists the age distribution of Fairfield County reported by the 2000 census and compares it to South Carolina's population for the same year. Fairfield County is essentially consistent with South Carolina for each age bracket.

- **Transient Population**

The area within the first 16 km (10 mi) of V.C. Summer is characterized as rural, wooded, and low-density residential. There is no concentration of industrial or commercial facilities or uses within this area, and none are anticipated based upon the

Table 2-12. Age Distribution of Population in Fairfield County

	Fairfield County		South Carolina	
Age Group	**Number**	**Percentage**	**Number**	**Percentage**
Under 4	1580	6.7	264,679	6.6
5 to 17	4548	19.4	744,962	18.5
18 to 44	8539	36.4	1,593,806	39.6
45 to 64	5693	24.3	923,232	23.2
65 and over	3094	13.2	485,333	12.1
Total	23,454	100.00	4,012,012	100.00

Source: CMCOG 2003b.

land uses denoted in the Comprehensive Plans for Fairfield and Newberry Counties. Transient employment is most likely to be out of this zone rather than into it, with the exception of V.C. Summer.

Monticello Reservoir and the private wooded lands that predominate are within the 16-km (10-mi) area. A small part of the Sumter National Forest is also within this area. The reservoir offers recreational opportunities, including camping and fishing, and day-time activities such as picnic tables, ball fields, and a playground. There are five public boat ramps related to the Parr Project (two on Monticello Reservoir, one on the Monticello Sub-impoundment, and two on Parr Reservoir). Gasoline-powered boat use is only restricted on the Monticello Sub-impoundment. Deer hunting is very popular in this area of Fairfield County. Private lands are leased specifically for this purpose by various sports clubs because the County is among the most densely forested in South Carolina.[(a)]

Peak daily and annual transient population numbers are not available for these lake and hunting activities. The Rock Around the Clock Festival is held in late September in Winnsboro to celebrate the nation's oldest continually running municipal clock and attracts between 5000 and 12,000 people. The Pig in the Ridge Barbeque is held in Ridgeway in November and attracts several thousand. V.C. Summer refuels on an 18-month cycle and the employee population increases substantially during these 30- to 40-day outages. An average of 665 additional contractor employees have been brought in during the past three refueling outages.

- **Migrant Labor**

Migrant farm workers are individuals whose employment requires travel to tend or harvest agricultural crops. Migrant workers are typically members of minority or low-income populations. Because migrant workers travel and can temporarily spend a significant amount of time in an area without being actual residents, they may be unavailable for census takers to count. If this occurs, migrant workers would be under-represented in U.S. Census Bureau minority and low-income population counts. There is a growing Hispanic presence in the Central Midlands living near work opportunities such as the poultry processing plants in Newberry and Columbia Farms in Lexington County.[(b)] While Hispanics are increasingly represented in Fairfield County,

(a) Personal communication with Mark Talbert, Clemson Agricultural Extension Service, Winnsboro, South Carolina, December 10, 2001.
(b) Personal communication with Cary Smith, United Way of the Central Midlands, Columbia, South Carolina, December 10, 2001.

there has been an exceptional increase in Newberry County as indicated by the 2000 census that shows 4.2 percent of the population as Hispanic, which is a nine-fold increase since 1990 (United Way of the Central Midlands 2002).

In 1997, Fairfield County had 172 individual farms averaging 108 ha (271 ac) and 51 full-time farms. Hay and turkeys are the major products, and the County ranks 38th of 46 in agricultural cash receipts—about $13.5 million in 2001. Timber harvesting is important in Fairfield County where the 1999 delivered value of timber was $32.2 million, placing the County third out of 46 in the State (South Carolina Agricultural Statistics Service 2002 and USDA 1997). The Clemson Agricultural Extension Service estimates that tree harvesting has increased considerably during the past 20 years while the labor to accomplish this has decreased considerably. Approximately 200 people, mostly local African Americans, are employed seasonally, and crews of migrant workers from Mexico plant trees and spray them. There are no migrant worker camps within Fairfield County.(a)

Given the expected small number of migrant workers, and the fact that they are not concentrated in Fairfield County, the staff concludes that migrant workers would not materially change the population characteristics of any particular census tract within the County.

2.2.8.6 Economy and Taxes

The communities potentially impacted socioeconomically by relicensing V.C. Summer are located in the four Central Midlands counties: Fairfield, Lexington, Newberry, and Richland. Fairfield County would experience the largest impacts of relicensing because V.C. Summer is located there, and because economic conditions including the County's tax base are much more affected by V.C. Summer than are the other three counties. Table 2-13 summarizes and compares the unemployment, family poverty level, and median household income for each of the four counties and compares these figures with the State of South Carolina. The data are from the 2000 Census.

Fairfield County has the highest unemployment and poverty rates and the lowest median household income when compared to the three other Central Midlands counties and South Carolina. There is a higher percentage of families in poverty in Fairfield County than in the State (Table 2-13). The contrast is higher when compared to the three other counties, particularly Lexington and Richland where family poverty is below the State levels. Both

(a) Personal communication with Mark Talbert, Clemson Agricultural Extension Service, Winnsboro, South Carolina, December 10, 2001.

Table 2-13. Unemployment, Poverty Level, and Median Household Income Comparison

	Percent Unemployed in Civilian Labor Force	Percent Families Below Poverty Level	Median Household Income in Dollars
Fairfield County	6.9	17.2	30,376
Lexington County	2.6	6.4	44,659
Newberry County	4.7	13.6	32,867
Richland County	4.3	10.1	39,961
South Carolina	5.9	10.7	37,082

Source: USCB 2000; Fairfield County Chamber of Commerce 2002.

Newberry and Fairfield Counties also have a median household income that is lower than the State; however, the median household income in Fairfield County is projected to rise 24 percent over the next 10 years. Fairfield County unemployment has lowered over time: it was close to 10 percent in 1997. The staff concludes that Fairfield County economic trends should be more closely analyzed regarding the relicensing of V.C. Summer because of these factors.

The Central Midlands Region, composed of Richland, Lexington, Newberry, and Fairfield Counties, is a varied mixture of rural and metropolitan areas with a total population of almost 600,000 (596,253) and an average annual growth rate of 1.7 percent (USCB 1991, 2000).

Newberry and Fairfield Counties are rural. Richland and Lexington Counties encompass the metropolitan area of Columbia, the State capital, and comprise 90 percent of the Central Midland Region's population. From 1990 to 2000, South Carolina's average annual population growth rate was 1.5 percent, while Richland, Lexington, Newberry, and Fairfield Counties increased by 1.2, 2.9, 0.9, and 0.5 percent, respectively (USCB 1991, 2000). Between 2000 and 2040, Richland, Newberry, Lexington, and Fairfield Counties are projected to grow at average annual rates of 0.6, 0.4, 1.7, and 0.4 percent, respectively (USCB 2000, TtNUS 2002). In 2000, South Carolina reported a population of approximately 4.0 million people (USCB 2000). By the year 2040, South Carolina is projected to have 5.6 million people, growing at an average annual rate of 1.0 percent (USCB 2000, TtNUS 2002).

Fairfield and Newberry Counties were settled by Scotch-Irish, English, and German immigrants in the mid-18th century. In the 19th century, large-scale cotton farming replaced small farms, and the introduction of the railroad made this a leading area for the cotton market. In recent years, emphasis has been on the manufacturing, trade, and government sectors. More

specifically, manufacturing is the number one sector for Fairfield and Newberry Counties (34.2 percent and 41.3 percent, respectively). Trade (28 percent) and government services (29.7 percent) are the largest sectors for Lexington and Richland Counties (CCEDA 1998). Although agriculture played a more significant role in the past, it is no longer a dominant force in the regional economy.

Columbia, the State capital, is located in Richland County. Nineteen Fortune 500 companies and 41 company headquarters are located in Columbia. Columbia's top employers in the public sector include Federal, State, and local government, Fort Jackson, and the University of South Carolina. Major employers in the private sector include SCE&G, Richland Memorial Hospital, Blue Cross and Blue Shield of South Carolina, Computer Sciences Corporation (formerly Policy Management Systems), and Bell South (Realty World America 2002). The major private employers in Fairfield County include V.C. Summer, Uniroyal Goodrich, Standard Products, Isola USA, Fuji Copian, Plastech Engineered Products, Salant, Wal-Mart, Lang Mekra, and Gividi USA. These 11 companies employed approximately 2835 people in 2002. Mack Truck, which employed 1300 employees during peak operations in the late 1990s, recently shut down its Fairfield County operations (CCEDA 2002). Government employs about 1030 people, and 250 work at the hospital. Since nearly 11,000 residents in Fairfield County are in the civilian labor force, and employees commute to these major employers from outside the County, it can be surmised that most County residents work in other pursuits and smaller businesses. For example, nearly 1200 list retail trade as a household occupation in the 2000 census. Private wage and salary workers compose about 78 percent of the labor pool, government accounts for about 18 percent, and those who are self-employed account for five percent. This is nearly consistent with the State as a whole, where 78 percent are private wage and salary workers, 16 percent are government workers, and six percent are self-employed (USCB 2000). Table 2-14 lists the major employers in Fairfield County.

Most of the retail and service establishments in Fairfield County are located in the incorporated areas of Winnsboro and Ridgeway where the population is sufficiently concentrated to support business activities. Most of the industrial plants are located in or near Winnsboro, and newer development occurs at the Walter Brown Industrial Park near Interstate 77 (Fairfield County 1997). While the trend is toward diversification in the manufacturing base, major employment in Fairfield County continues to be in the government, services, and retail sectors. An example of this is the October 2002 announcement that Infinity Health Foods will move into a previously occupied manufacturing facility on SC 321 and will employ up to 100 people over the next five years (CCEDA 2002). V.C. Summer has been and will continue to be a major employer located in Fairfield County, provided that it is relicensed and continues operations.

V.C. Summer pays annual property taxes to Fairfield County. These taxes fund Fairfield County operations, including the Fairfield County Public Schools. The County's operating budget includes the coroner, assessor, auditor, sheriff, detention center, road maintenance,

Table 2-14. Major Employers in Fairfield County, South Carolina

Employer	Product	Number of Employees
Fairfield County Schools	government	700
V.C. Summer	power plant	625
Ben Arnold-Sunbelt Beverage Co.	bottler	372
Uniroyal Goodrich Tire Co.	tire cords	317
Standard Products Co.	automotive trim	302
Fairfield Memorial Hospital	medical services	250
Isola USA	printed circuit boards	238
Fairfield County	government	235
Fuji Copian Corp.	typewriter cassettes	209
Plastech Engineered Products Co.	molded automotive plastics	200
Salant Corporation	textiles and clothing	200
Wal-Mart	retail	170
Lang Mekra	truck mirrors	138
Town of Winnsboro	government	96
Gividi USA	fiberglass computer parts	64

Source: CCEDA 2002, Fairfield County Chamber of Commerce 2002.

solid waste, emergency management, social services, veterans affairs, and recreation facilities. For the years 1995 to 2000, V.C. Summer property taxes provided between about 41 percent and 50 percent of Fairfield County's total property tax revenue and approximately the same percentage of Fairfield County's total operating budget. The trend has been downward during this time. Residential property taxes have increased modestly during this time as well. Other sources of revenue include various fees and fines, State aid, inventory taxes, and motor carrier taxes (Johnson 2002).

Schools in South Carolina are funded primarily with the property tax. The Fairfield County School District derived $11.4 million from taxes paid by V.C. Summer in 2002. This equates to almost 40 percent of the district's $29.5 million budget. Table 2-15 compares V.C. Summer's tax payments to Fairfield County tax revenue and operating budgets.

Table 2-15. Fairfield County Property Tax Revenues, Property Taxes Paid by V.C. Summer, and Fairfield County Operating Budget 1995 to 2000

Year	Total Fairfield County Property Tax Revenues[(a)] (excluding debt)	Property Tax Paid by V.C. Summer	Percent of Total Property Taxes	Operating Budget for Fairfield County[(a)] (excluding debt)
1995	23,338,821	11,671,000	50	23,096,221
1996	24,472,690	12,324,000	50	24,387,997
1997	25,256,855	12,629,000	50	25,234,991
1998	26,730,639	12,943,000	48	26,795,321
1999	27,772,061	12,529,000	45	27,508,743
2000	29,604,792	12,272,000	41	29,540,322

(a) SCE&G 2002a.

The South Carolina Legislature is studying the issue of electric power industry deregulation. The effects of deregulation are not yet fully known but could affect tax payments by utilities to the counties. Any changes to V.C. Summer tax rates due to deregulation would, however, be independent of license renewal.

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known and potential historic and archaeological resources at V.C. Summer and the immediate surrounding area.

2.2.9.1 Cultural Background

The area around V.C. Summer is rich in prehistoric and historic Native American and historic Euro-American resources. Recent literature provided adequate background information for the area. Consequently, only a brief summary is provided here. Prehistoric period overviews for South Carolina are provided by U.S. National Park Service (2003) and South Carolina Indians (2002). Historic period overviews for South Carolina are provided by Edgar (1998) and Milling (1969).

Prehistoric Period

The prehistoric Native American occupation of the region around V.C. Summer includes four general periods: Paleo-Indian period (about 10,000 to 8000 BC), the Archaic period (about

8000 to 1000 BC), the Woodland period (about 1000 BC to 900 AD), and the Mississippian and late prehistoric period (about 900 to 1500 AD). This late prehistoric period is a transitional period in which initial contacts were made 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 for subsistence, followed by increased use of smaller game animals and plant foods in the Archaic period. Major environmental changes in the Archaic period led to an increasingly more sedentary lifestyle, primarily in riverine settings. Late in the Archaic period, more sedentary villages and an increased reliance on cultivated crops became the norm. The Woodland and Mississippian periods were characterized by larger base camps in the river valleys, with subsistence based on agriculture, hunting and gathering, and intergroup trade. The late prehistoric period is primarily identified by the introduction of European trade goods.

Native American Historic Period

At least 29 distinct groups of Indians lived in South Carolina, each having a separate dialect, many of these dialects being distinct languages. The common language families were Algonquian, Iroquoian, Muskogean, Siouan, and Yuchi. The Eno and Shakori Indians, now extinct tribes, lived in the area of present-day Fairfield County. The Catawba, Pee Dee, Chicora, Edisto, Santee, and Chicora-Waccamaw Tribes are all still present in South Carolina as are many descendants of the Cherokee. By 1750, the smaller Indian tribes throughout South Carolina disappeared, probably merging with larger groups, such as the Catawba and Cherokee of South Carolina or the Creeks of Georgia. In 1830, the Indian Removal Act was passed by the United States government. In 1838, the Cherokee Indians were forced to leave their eastern homeland and travel to Indian Territory in Oklahoma. In 1993, the Catawba Tribe received its Federal recognition status. Today, the Catawba Tribe is the only Federally recognized Tribe in the State of South Carolina and numbers 1200 individuals living in the vicinity of Rock Hill, South Carolina.

Euro-American Historic Period

South Carolina is one of the 13 original colonies. The Spanish and French explorers arrived in the area in the 16th century and found the land inhabited by many small tribes of Native Americans, the largest were the Cherokees and the Catawbas. The first European settlements failed. In 1670, an English settlement was established on the coast near present-day Charleston. The colony was divided in 1710 into South Carolina and North Carolina. Settlers from the British Isles, France, and other parts of Europe built plantations throughout the coastal low country. African slaves were brought into the colony in large numbers to provide labor for the plantations, and by 1720 they formed the majority of the population. The port city of

Charleston became an important center of commerce and culture. The interior was slowly settled by small farmers and traders, who pushed the dwindling tribes to the west.

South Carolina was one of the richest colonies in America by the time of the American Revolution. More Revolutionary War battles were fought in South Carolina than any other state. South Carolina ratified the United States Constitution on May 23, 1788, becoming the eighth State to enter the Union.

Early settlement of Fairfield County in the mid-1700s brought cotton to the County, and it remained the main crop until depletion of the soil and the industry was brought to a halt in the 1920s. Granite deposits in the County led to the early development of quarrying. In December 1832, Winnsboro was incorporated as a town.

2.2.9.2 Historic and Archaeological Resources at V.C. Summer

Archaeological site file searches were conducted at the South Carolina Institute of Archaeology and Anthropology to identify cultural resources that might be present at V.C. Summer. In addition, the geographic information system database and files at the South Carolina State Historic Preservation Office were searched for information that may pertain to the proposed action.

The Final Environmental Statement (AEC 1973) for the construction of V.C. Summer listed three historic sites in the vicinity. At that time, it was determined that none of the sites were "endangered" by V.C. Summer. Additionally, four archaeological sites were discovered within or near the boundary of the site and a recommendation was made by Dr. Robert L. Stephenson, State Archaeologist, that the area be surveyed and that two of the known sites be excavated (AEC 1973).

In 1972, SCE&G funded an archaeological survey that was conducted by a team from the University of South Carolina Institute of Archaeology and Anthropology. The archaeological survey was conducted to assess the nature and distribution of the sites present and to assess the effect of the Parr Hydroelectric Project on historic and archaeological resources. The Parr Hydroelectric Project consisted of a series of related actions: (1) elevation of the Parr Reservoir Dam, raising the level of the Parr Reservoir, (2) construction of a series of dams on Frees Creek to create the upper reservoir for a new pumped-storage facility and supply cooling water for V.C. Summer, and (3) construction of the FPSF and V.C. Summer.

The Institute of Archaeology and Anthropology team identified 27 additional sites and performed the excavation of two others. Approximately five sites were covered by water when Monticello Reservoir was filled in 1978 and are now inaccessible; the remaining sites lie along

the banks of Monticello and Parr Reservoirs. Periods represented included the Early Archaic, Middle Archaic, Woodland, Mississippian, and Early Historic (SCE&G 2002a).

Since the publication of the 1973 Final Environmental Statement, 41 sites have been added to the National Register of Historic Places (NRHP) for Fairfield County. Ten of these sites fall within a 9.6-km (6-mi) radius of V.C. Summer. Twenty-eight sites have been added to the NRHP for Newberry County. Four of these sites fall within a 9.6-km (6-mi) radius of V.C. Summer. No sites listed on the NRHP fall within a 1.6-km (1-mi) radius of V.C. Summer.

There are two other historic sites within a 9.6-km (6-mi) radius of V.C. Summer that are not listed on the NRHP but are protected by SCE&G. One is the Mayo family cemetery, which is in a wooded area approximately 4.0 km (2.5 mi) south of V.C. Summer on land that is owned by SCE&G but is not part of V.C. Summer property. This small family plot contains headstones dating back to 1895. The other historic site, approximately 2.4 km (1.5 mi) southwest of V.C. Summer, is a large monument erected in 1943 by the Daughters of the American Revolution marking the grave of General John Pearson, a Fairfield County native who served with distinction in the Revolutionary War. This monument is in a wooded area on land that is not part of V.C. Summer property, but is maintained as a buffer zone around the site. SCE&G's Forestry Operations group is familiar with these sites, which are marked on their timber inventory and land cover maps, and takes appropriate measures to protect them when conducting forest management activities in the vicinity of either historic site (SCE&G 2002a).

2.2.10 Related Federal Project Activities and Consultations

The staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the operating license for V.C. Summer. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparation of this supplemental environmental impact statement (SEIS).

The Federal Power Commission (which became FERC) issued a license (Project Number 1894) to SCE&G on June 30, 1974, for the Parr Hydroelectric Project, which consisted of a set of related actions (elevation of Parr Shoals Dam, enlargement of Parr Reservoir, construction of FPSF, impoundment of Frees Creek for Monticello Reservoir). The Federal Power Commission prepared an environmental impact statement for this major Federal licensing action that evaluated potential environmental impacts, including the inundation of 3784 ha (9350 ac) of land (eliminating farmland, timber, wildlife habitat, and 25 homes) and enhanced recreational opportunities provided by the public recreational facilities at the expanded Parr Reservoir and new Monticello Reservoir. The Federal Power Commission concluded that the loss of 3784 ha (9350 ac) of farmland and wildlife habitat was significant (Federal Power Commission 1974),

but that, with prudent evaluation and selection of construction methods and project operation, no serious cumulative adverse environmental impacts were foreseen. FPSF began commercial operation in 1978, four years before V.C. Summer. The FERC license for the Parr Hydroelectric Project, including FPSF, expires on June 30, 2020. Under current rules, SCE&G will have to file a notice of intent with FERC by the year 2015 declaring whether or not it intends to renew the license for the hydroelectric project. At least two years before the current FERC license expires (i.e., prior to June 30, 2018), SCE&G will have to file an application for a license renewal.

Federal activities within the 80-km (50-mi) radius of V.C. Summer include the Sumter National Forest managed by the U.S. Department of Agriculture, the Congaree Swamp National Monument managed by the U.S. Department of Interior, and the United States Army's 20,800-ha (52,000-ac) Fort Jackson southeast of Columbia. The 8800-ha (22,000-ac) Congaree Swamp hosted nearly 110,000 visitors in fiscal year 2001. Fort Jackson employs 3900 civilians and is the largest and most active Initial Entry Training Center in the Army, training 19,000 each year. Fort Jackson has added several new schools and training institutions, including the Soldier Support Institute, the Chaplains Center and School, and the U.S. Department of Defense Polygraph Institute. Shaw Air Force Base is located in Sumter, South Carolina, outside of the Central Midlands Region but also within the 80-km (50-mi) area.

The staff determined that there were no Federal projects or activities in the vicinity of V.C. Summer that would result in cumulative impacts or would make it desirable for another Federal agency to become a cooperating agency for preparing this SEIS.

The NRC is required under Section 102(c) of the National Environmental Policy Act of 1969 (NEPA 1969) to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the SEIS. NRC is consulting with the USFWS and the South Carolina State Historic Preservation Office. Consultation correspondence is included in Appendix E.

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

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

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

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3.0 Environmental Impacts of Refurbishment

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

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

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective 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 in this supplemental environmental impact statement 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 issues are listed in Table 3-2.

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

Table 3-1. Category 1 Issues for Refurbishment Evaluation

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

Category 1 and Category 2 issues related to refurbishment that are not applicable to the Virgil C. Summer Nuclear Station (V.C. Summer), because they are related to plant design features or site characteristics not found at V.C. Summer, 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. South Carolina Electric and Gas (SCE&G) indicated that it performed its integrated plant assessment, the evaluation of structures and components pursuant to 10 Code of Federal Regulations (CFR) 54.21, to identify activities that are necessary to continue operation of V.C. Summer during the requested 20-year period of extended operation. In its Environmental Report, SCE&G stated that it completed major modifications (e.g., steam generator replacement) that were necessary for the operation of V.C. Summer during its initial licensing term (SCE&G 2002).

Table 3-2. Category 2 Issues for Refurbishment Evaluation

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

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

SCE&G stated that, as a result of its integrated plant assessment, it has not identified the need to undertake major refurbishment or replacement activities for important structures, systems, or components during the license renewal period. Routine maintenance and inspection activities are within the bounds of normal plant component replacement and inspections; therefore, SCE&G is not expected to affect the environment outside the bounds of plant operations as evaluated in the final environmental statement (AEC 1973).

In addition, the SCE&G 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 V.C. Summer beyond the end of the existing operating license. Therefore, refurbishment is not considered in this Supplemental Environmental Impact Statement.

3.1 References

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

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

South Carolina Electric and Gas Company (SCE&G). 2002. *Virgil C. Summer Nuclear Station License Renewal Application*. "Appendix E, Environmental Report." Docket Number 50/395; License Number NPF-12. Jenkinsville, South Carolina.

U.S. Atomic Energy Commission (AEC). 1973. *Final Environmental Statement Related to Operation of Virgil C. Summer Nuclear Station, Unit 1, South Carolina Electric & Gas Company*. Docket No. 50-395, Directorate of Licensing. Washington, D.C.

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

4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation 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 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, and are applicable to the Virgil C. Summer Nuclear Station (V.C. Summer). Section 4.1 addresses issues applicable to the V.C. Summer cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality, while Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses new information that

(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.

was raised during the scoping period. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.8. Finally, Section 4.9 lists the references for Chapter 4. Category 1 and Category 2 issues that are not applicable to V.C. Summer because they are related to plant design features or site characteristics not found at V.C. Summer are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to V.C. Summer cooling system operation during the renewal term are listed in Table 4-1. South Carolina Electric and Gas (SCE&G) stated in its Environmental Report (ER) (SCE&G 2002a) that it is not aware of any new and significant information associated with the renewal of the V.C. Summer operating license (OL). The staff has not identified any significant new information during its independent review of the SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff 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 is not likely to be sufficiently beneficial to be warranted.

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

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found 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 SCE&G ER, the staff's site visit, public comments, or staff 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.

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.4.3
Altered thermal stratification of lakes	4.2.1.2.3; 4.4.3
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.3
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.3
Eutrophication	4.2.1.2.3; 4.4.3
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2; 4.4.3
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2; 4.4.3
Discharge of other metals in wastewater	4.2.1.2.4; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.2.2; 4.4.1.2; 4.4.3; 4.6.1.1
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.2.2.1.10; 4.2.2.2; 4.4.3
Cold shock	4.2.2.1.5; 4.2.2.1.10; 4.2.2.2; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.2.2.2; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.2.2.2; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.2.2.2; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.2.2.2; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.2.2.2; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.2.2.2; 4.4.3
Stimulation of nuisance organisms (e.g., shipworms)	4.2.2.1.11; 4.2.2.2; 4.4.3
TERRESTRIAL RESOURCES	
Cooling pond impacts on terrestrial resources	4.4.4
HUMAN HEALTH	
Noise	4.3.7

- 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 SCE&G ER, the staff's site visit, public comments, and staff review of monitoring programs and 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 SCE&G ER, the staff's site visit, public comments, or staff evaluation of other available information. Therefore, the staff concludes that there are no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found 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 SCE&G ER, the staff's site visit, public comments, and staff review of monitoring programs and 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 SCE&G ER, the staff's site visit, public comments, and staff review of monitoring programs and evaluation of other available information including plant monitoring data and technical reports. Therefore, the staff concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found 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 SCE&G ER, the staff's site visit, public comments, or staff evaluation of other available information including the National Pollutant Discharge Elimination System (NPDES) permit for V.C. Summer (SCDHEC 2002), or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the SCE&G ER, the staff's site visit, public comments, or staff evaluation of other available information including the NPDES permit for V.C. Summer (SCDHEC 2002) 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 SCE&G ER, the staff's site visit, public comments, or staff evaluation of other available information, including the NPDES permit for V.C. Summer (SCDHEC 2002) 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.

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

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

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

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

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

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

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

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

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

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

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

  The staff has not identified any significant new information during its independent review of the SCE&G ER, the staff's site visit, public comments, or staff 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 SCE&G ER, the staff's site visit, public comments, or staff evaluation of other available

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

- Cooling pond impacts on terrestrial resources. Based on information in the GEIS, the Commission found that

  > Impacts of cooling ponds on terrestrial ecological resources are considered to be of small significance at all sites.

  The staff has not identified any significant new information during its independent review of the SCE&G ER, the staff's site visit, public comments, or staff evaluation of other available information. Therefore, the staff concludes that there are no impacts of cooling ponds on terrestrial resources 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 SCE&G ER, the staff's site visit, public comments, or staff 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 V.C. Summer are discussed in the section that follows and are listed in Table 4-2. Although the SCE&G ER identified only microbiological organisms (public health) as an applicable Category 2 issue, the staff determined that all the Category 2 issues pertaining to plants with cooling ponds are applicable to V.C. Summer.

4.1.1 Water Use Conflicts (Make-up Water from a Small River)

Water use conflicts has been determined to be a Category 2 issue because consultations with regulatory agencies indicate that water use conflicts may be a problem at some plants because consumptive water loss associated with closed-cycle cooling systems may represent a substantial proportion of the flows in small rivers (NRC 1996).

V.C. Summer operates as a once-through cooling plant that withdraws from and discharges to a cooling pond, Monticello Reservoir. This issue applies because Monticello Reservoir receives its make-up water from the Broad River, which has an annual mean flow of approximately

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS[(a)] Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	4.2.1.3, 4.2.2.2, 4.4.2.1	A	4.1.1
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.3.3	B	4.1.2
Impingement of fish and shellfish	4.2.2.1.3; 4.3.3	B	4.1.3
Heat shock	4.2.2.1.4; 4.3.3	B	4.1.4
HUMAN HEALTH			
Microbiological organisms (public health) (plants using lakes or canals or cooling towers that discharge into a small river)	4.3.6	G	4.1.5

(a) Supplemental Environmental Impact Statement

6 x 10^9 m^3/yr (2.1 x 10^{11} ft^3/yr) (185 m^3/s [6,535 cfs]) (Cooney et al. 2001). Monticello Reservoir was built to supply cooling water to the station and to provide an upper reservoir for the Fairfield Pumped Storage Facility (FPSF), located on Parr Reservoir. Parr Reservoir was created (1913-1914) by impounding the Broad River approximately 42 km (26 mi) upstream of the confluence of the Broad and Saluda Rivers.

The Federal Power Commission (Federal Energy Regulatory Commission's [FERC] predecessor agency) licensed the Parr Hydroelectric Project in 1974, contingent upon a minimum instantaneous release at the Parr Powerhouse of 4.2 m^3/s (150 cfs) during most months of the year and a minimum instantaneous release of 28 m^3/s (1000 cfs) during the March-April-May striped bass (*Morone saxatilis*) spawning period (NRC 1981). For the periods 1896 to 1907 and 1980 to 2000, the lowest daily mean flow of the Broad River at the Alston, South Carolina, gauging station was 6.6 m^3/s (235 cfs) (Cooney et al. 2001). The lowest recorded daily mean flow of 4.2 m^3/s (149 cfs) was measured at the Richtex Station, approximately 11.3 km (7.0 mi) downstream of Parr Reservoir (NRC 1981).

The 1981 Final Environmental Statement indicated that approximately 0.37 m^3/s (13 cfs) of the 33 m^3/s (1180 cfs) of water withdrawn from Monticello Reservoir for condenser cooling would be lost to evaporation. This water loss was to be made up by pumping back from Parr Reservoir. The projected evaporative loss of 0.37 m^3/s (13 cfs) from condenser cooling represented approximately nine percent of the minimum allowable instantaneous flow of 4.2 m^3/s (150 cfs), 5.5 percent of the lowest daily mean flow (6.6 m^3/s [235 cfs]), and approximately 0.2 percent of the annual mean flow (185 m^3/s [6535 cfs]) of the Broad River at Alston, South Carolina. The daily cycle of operation at the FPSF transfers up to 11,736 ha-ft (29,000 ac-ft) of water (equivalent to 416 m^3/s [14,700 cfs]) from Parr Reservoir to Monticello Reservoir and back on a daily basis.

Based on a higher (theoretical maximum) cooling water withdrawal rate of 37 m^3/s (1308 cfs), V.C. Summer Quarterly Water Use Reports indicate that 0.62 m^3/s (22 cfs) is lost to evaporation (SCE&G 1998, 1999). This loss represents 14.7 percent of the minimum allowable instantaneous flow of 4.2 m^3/s (150 cfs), 9.4 percent of the lowest daily mean flow (6.6 m^3/s [235 cfs]), and approximately 0.3 percent of the annual mean flow (185 m^3/s [6535 cfs]) of the Broad River at Alston, South Carolina. Under normal circumstances, evaporative losses from Monticello Reservoir represent less than one percent reduction in Broad River flows. Any impacts to riparian ecological communities in Parr Reservoir would be small.

Severe drought conditions were experienced throughout the summer of 2002. However, no situations were encountered where make-up water for the evaporative losses due to V.C. Summer operations affected the flow conditions in the Broad River so as to impinge upon any of the FERC-mandated flow restrictions. A discussion with the FERC oversight staff member of the Parr Hydropower facility confirmed that the operation of V.C. Summer causes no discernable impacts to maintaining minimum flow conditions in the Broad River. There is no concern on the part of the FERC concerning this issue.[(a)]

The staff has reviewed the available information, including the rate of evaporative water loss associated with V.C. Summer operations, maintenance of minimum flow conditions on the Broad River, and information concerning past operations. Based on this evaluation, any impacts from V.C. Summer on the Broad River flow conditions or in stream and riparian communities in Parr Reservoir or the Broad River over the license renewal term would be SMALL and would not warrant mitigation.

(a) Personal communication with Mr. John Lyon (FERC), February 20, 2003.

4.1.2 Entrainment of Fish and Shellfish in Early Life Stages

For plants with once-through cooling systems, entrainment of fish and shellfish in early life stages into cooling water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal. Entrainment of fish and shellfish in early life stages at V.C. Summer has been investigated as part of the 316(b) demonstration for the SCDHEC NPDES permit (SCDHEC 2002). Entrainment sampling of V.C. Summer intake waters for ichthyoplankton (fish eggs and larvae) took place between October 1983 through September 1984 (Dames and Moore 1985a). No other specific entrainment studies have been conducted at the site. The current NPDES permit for V.C. Summer (No. SC003085) states that the V.C. Summer cooling water intake structure(s) reflect the best technology available for minimizing adverse environmental impact. Therefore, the South Carolina Department of Health and Environmental Control (SCDHEC) has not required further sampling. From 1987 through 1998, South Carolina Department of Natural Resources (SCDNR) conducted other general fisheries studies; these have been summarized in Section 2.2 of this Supplemental Environmental Impact Statement (SEIS).

Entrainment studies, including ichthyoplankton studies were conducted in 1983-1984 (Dames and Moore 1985a), prior to the introduction of white perch (*Morone americana*) to the reservoir. Gizzard shad (*Dorosoma cepedianum*) larvae were the most abundant organisms collected, representing 87 percent to 93 percent of the ichthyoplankton samples. Other larvae collected included white bass (*Morone chrysops*), yellow perch (*Perca flavescens*), crappie (*Pomoxis nigromaculatus*), and sunfish. Catfish eggs and larvae were not collected. Larval fish densities were greatest at the surface at the sampling location nearest to the intakes to V.C. Summer. Total mean densities for this sampling location were 53.9 larvae/100 m^3 (53.9/26,400 gal) at the surface. Mean densities at mid-depth were 11.8 larvae/100 m^3 (11.8/26,400 gal) at this sampling location; and ranged up to 18.3 larvae/100 m^3 (18.3/26,400 gal) at the reference station at the upper end of the reservoir. At the sampling location closest to the intakes to V.C. Summer, white bass represented approximately five percent of the sample. Other species collected at this sampling location include minnows, suckers, perch, and sunfish. The composition of these samples reflects the overall composition of the fish stocks in Monticello Reservoir (Table 2-2) at the time of sampling (Dames and Moore 1985a).

Since the 1983-1984 study, the fish composition of the Monticello Reservoir has changed, with recently introduced blue catfish (*Ictalurus furcatus*) becoming the dominant fish, and white bass becoming abundant (Table 2-2). Currently, the fish most vulnerable to entrainment in early life stages, due to a combination of both life history and abundance in the reservoir, include gizzard shad, white perch, and yellow perch. In addition, very small and weak-swimming fry of benthic nesting fish, such as sunfish and crappie, are also vulnerable to entrainment, although less so than the gizzard shad, white perch, and yellow perch. V.C. Summer plus FPSF pump the

equivalent of 10 percent of Monticello Reservoir's surface waters per day. Even with the large volumes of surface water pumped by both facilities, and related potential fish entrainment, Monticello Reservoir maintains sustainable populations of a variety of fish, and a sustainable fishery, as described in Section 2.2. Changes in fish communities since 1985 have coincided with the introduction of new species, including the white perch and blue catfish, which are effective predators and competitors with other species. While entrainment of fish and shellfish in early life stages from V.C. Summer operations would continue during the renewal period, the potential impacts on fish populations in Monticello Reservoir would be small. Under natural conditions, only a very small percentage of juvenile fish survive predation, competition, and other mortality to become adult, reproducing fish.

Molluscan species such as freshwater clams, which incubate eggs internally but release larvae that continue their life as fish parasites, may briefly be vulnerable to entrainment in short time periods before they reach their hosts. The Asiatic clam (*Corbicula* spp.) releases free-living (free-floating) larvae which also may be vulnerable to entrainment. While euplanktonic crustaceans, such as copepods and cladocerans, are vulnerable to entrainment, benthic crustaceans such as amphipods and crayfish brood their eggs and young prior to release to independent living. However, individuals of these crustaceans may be entrained if they are swept into the intake canals. No mollusks or crustaceans of economic importance as fisheries resources are present in Monticello Reservoir.

Monticello Reservoir has maintained a diverse fish community and sustainable fishery throughout the period of operations of V.C. Summer and FPSF (Christie and Stroud 1996, 1997, 1998, 1999; Dames and Moore 1985b; Nash et al. 1990). Information on ichthyoplankton from V.C. Summer's 316(b) demonstration (Dames and Moore 1985a) has been incorporated into the NPDES permit, and SCDHEC has determined that further mitigative efforts are not warranted at this time (SCDHEC 2002). NPDES permits are renewed every five years. The most recent NPDES permit (see Appendix E), which expires on April 30, 2007, does not require that SCE&G conduct entrainment studies of the aquatic organisms in the station's cooling-water flow (SCDHEC 2002). No Federal- or State-listed threatened or endangered fish, mollusks, or crustaceans are present in the Monticello Reservoir; therefore, there will be no impacts on any listed species due to entrainment at V.C. Summer during the renewal period.

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, the SCDHEC, public comments, and other public sources. Using this information, the staff evaluated the potential impacts due to entrainment of early life stages of fish and shellfish by continued operation and maintenance of V.C. Summer. The staff concluded that the potential impacts due to entrainment of fish and shellfish in early life stages during the renewal term are SMALL.

During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of V.C. Summer. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on the assessment to date, the staff expects that the measures in place at V.C. Summer (e.g., placement of the intake structure) provide mitigation for all impacts related to entrainment, and no new mitigation measures are warranted.

4.1.3 Impingement of Fish and Shellfish

For plants with once-through cooling systems, impingement of fish and shellfish on debris screens of cooling water systems associated with nuclear power plants is considered a Category 2 issue, requiring site-specific assessment before license renewal. Impingement was monitored and impingement impacts were evaluated at V.C. Summer from October 1983 through September 1984 as part of V.C. Summer's 316(b) demonstration (Dames and Moore 1985a). No other specific impingement studies have been conducted. The current NPDES permit for V.C. Summer (No. SC003085) states that the V.C. Summer cooling water intake structure(s) reflect the best technology available for minimizing adverse environmental impact. Therefore, the SCDHEC has not required further sampling. There have been other general fisheries studies conducted in the mid-1990s; these are summarized in Section 2.2.

Fish present in Monticello Reservoir that are potentially most vulnerable to impingement are the non-benthic species: threadfin shad, gizzard shad, white perch, and white bass. However, benthic species may also be occasionally swept into the intake structures and become impinged on the screens. As part of the 316(b) demonstration, fish were collected from the traveling screens twice monthly for one day (total of 22 sampling days). A total of 5140 fish were collected, and yearly impingement was estimated to be 85,000 fish weighing 515 kg (1133 lb). This represented about one half of one percent of the estimated standing stock of the reservoir at the time the studies were conducted. The highest number of fish were impinged during January, and cold shock was implicated in the high numbers, as shad are particularly affected by cold temperatures. The fish collected from the screens represented 17 species belonging to six families. The most impinged fish (Table 4-3) were gizzard shad (83 percent) and members of the perch family (7.6 percent). Members of the sunfish family represented 4.8 percent of the fish sampled (Dames and Moore 1985a).

The study suggested that any impact of operational water withdrawal by V.C. Summer will be primarily on gizzard shad (83 percent of impinged fish). During the one-year study, V.C. Summer was estimated to impinge about 16 kg (35 lb) of an estimated total standing crop of 37,700 kg (82,940 lb) in the reservoir (Dames and Moore 1985a). Gizzard shad was an abundant species in the reservoir and the species has high reproductive and growth rates.

Table 4-3 Species Comprising More than One Percent of Impingement Samples: Results of 316(b) Impingement Studies, V.C. Summer (Dames and Moore 1985a)

Species	Percent Total Catch by Occurrence	Percent Total Catch by Weight
gizzard shad	82.6	54.8
yellow perch	7.6	8.1
white catfish	2.4	17.6
bluegill	1.5	2.1
channel catfish	1.3	4.7
black crappie	1.3	2.5
pumpkinseed	1.1	1.1
threadfin shad	0.8	0.6
warmouth	0.6	2.8
white bass	0.3	5.2
white crappie	0.3	3.3

Thus, SCE&G (SCE&G 2002a) concluded in the ER that V.C. Summer operations will have a negligible impact on the identified species.

During the period from 1985 through 1999, fish populations in Monticello Reservoir have changed as the result of the introduction of the white perch and blue catfish, two species that are effective predators and competitors with other species already inhabiting the reservoir.

During the period 1986 to 1999, fish standing stocks do not appear to have declined as a result of V.C. Summer operations, and introductions of blue catfish and white perch are coincident with higher standing stocks of these species (Christie and Stroud 1996, 1997, 1998, 1999; Nash et al. 1990) (See Section 2.2). These data support a conclusion that Monticello Reservoir maintains a diverse fish community and a sustainable recreational fishery despite any losses of fish due to impingement mortality from V.C. Summer operations, including cumulative effects from the FPSF, and that standing stocks will continue to be influenced by introduction of new species and stabilization of fish populations subsequent to those introductions.

All species of mollusks and macrocrustaceans in Monticello Reservoir are benthic as adults and are not normally vulnerable to impingement. However, individuals living in the areas of the intake, upon death or accident, may be swept into the intake screens.

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, the SCDHEC, public comments, and other public sources. Using this information, the staff evaluated the potential impacts due to impingement of fish and shellfish by continued operation and maintenance of V.C. Summer. It is the staff's conclusion that the potential impacts due to impingement of fish and shellfish during the renewal term are SMALL.

During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of V.C. Summer. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on the assessment to date, the staff expects that the measures in place at V.C. Summer (e.g., the operational design of the intake screens) provide mitigation for all impacts related to impingement, and no new mitigation measures are warranted.

4.1.4 Heat Shock

For plants with cooling ponds or reservoirs, including V.C. Summer, heat shock is considered a Category 2 issue, requiring a site-specific assessment before license renewal**.** The staff independently reviewed the V.C. Summer ER (SCE&G 2002a), visited the site, and reviewed the applicant's NPDES permit (SC0030856, effective February 1, 2003, to April 30, 2007)**.** The staff also independently reviewed monitoring reports for the circulating cooling water discharge, the cooling water bay, and the cooling water canal.

In the late 1980s, fish kills were observed in the V.C. Summer discharge bay in the late summer and early fall. Monitoring by SCE&G identified high discharge temperatures combined with Monticello Reservoir drawdowns as the probable cause of the fish kills. At lower reservoir levels, the flow of cooler water along the bottom of the discharge canal into the discharge bay was restricted, and temperatures rose to lethal levels for fish. From 1991 to 1993, SCE&G undertook several measures to resolve this problem, including removing a hump in the discharge canal (1992), limiting drawdown of Monticello Reservoir (1992), and dredging the entire length of the canal (1993). Monitoring in 1994 and 1995 verified that fish kills in the discharge channel had ceased (SCE&G 2002a).

Heat shock to fish from thermal discharges has been investigated by SCE&G. In the Monticello Reservoir, the major factor of plant operations affecting heat-related deaths of fish is the temperature of water in the discharge bay and the discharge canal (SCE&G 2002a). The

current NPDES permit limits the daily maximum discharge temperature to 45 °C (113 °F) and monthly average plume temperature to 32 °C (90 °F). As discussed in Section 2.2.5, in the late 1980s, periodic fish kills were observed in the discharge bay during the summer. Thermal effects from combined operations of V.C. Summer and drawdown of the reservoir for pumped storage operations were the suspected cause of mortality of fish congregating in this area. These thermal effects were mitigated by dredging in the discharge canal in 1993. Subsequent monitoring demonstrated that the modifications were successful in reducing the temperature regimes and eliminating the conditions believed responsible for the fish kills. Further fish kills have not been observed (SCE&G 1994, 1996).

The staff has reviewed the available information and, based on the conditions of the NPDES permit, the operating history of V.C. Summer, the staff's site visit, public comments, and other public sources, the staff concludes that the potential impacts of discharging heated water from V.C. Summer to Monticello Reservoir are SMALL. When preparing this SEIS, the staff considered the potential impacts to aquatic resources due to heat shock for an additional 20 years of operation and maintenance of V.C. Summer, mitigation measures, and the cumulative impacts of operations of the FPSF. Based on assessments to date, the staff expects that the measures in place at V.C. Summer will provide mitigation for all impacts related to heat shock, and no new mitigation measures are warranted.

4.1.5 Microbiological Organisms (Public Health)

For plants discharging cooling water to cooling ponds, lakes, canals, or small rivers with annual average flow rates less than 9×10^{10} m^3/yr (3.15×10^{12} ft^3/yr), the effects of microbiological organisms on human health are listed as a Category 2 issue and require plant-specific evaluation before license renewal. This issue is applicable to V.C. Summer because the station uses a cooling pond (Monticello Reservoir) that discharges to Parr Reservoir, which is part of the Broad River. The Broad River has an average annual flow of 6×10^9 m^3/yr (2.1×10^{11} ft^3/yr) and is categorized as a small river in the GEIS (NRC 1996).

The Category 2 designation is based on the potential for public health impacts associated with the enhancement of thermophilic organisms such as *Naegleria fowleri*, a pathogenic amoeba, that could not be determined generically. The U.S. Nuclear Regulatory Commission (NRC) noted that impacts of nuclear plant cooling towers and thermal discharges are considered to be of small significance if they do not enhance the presence of microorganisms that are detrimental to water quality and public health (NRC 1996). The assessment criteria relate to thermal discharge temperature, thermal characteristics, thermal conditions for the enhancement of these microorganisms, and impact to public health. Thermophilic bacteria generally occur at temperatures of 25 °C to 80 °C (77 °F to 176 °F), with maximum growth at 50 °C to 60 °C (122 °F to 140 °F) (SCE&G 2002a).

SCE&G monitors water temperature at an "uplake" location, near the water intake, and at a location near the discharge canal. The maximum temperature observed by SCE&G during the years 1995 to 2000 was 39.8 °C (103.7 °F), which occurred in July 1999 (SCE&G 2000a). Maximum temperatures for the other years ranged from 35.1 °C to 38.4 °C (95.2 °F to 101.2 °F). All of these maximum temperatures were observed in July and August at the surface. Temperatures at 1 m (3 ft) or deeper in the vicinity of the discharge canal were generally 2 °C to 5 °C (3.0 °F to 9.0 °F) lower during the summer months. Maximum temperatures in Monticello Reservoir outside of the discharge canal are below the optimal temperature range for growth and reproduction of thermophilic organisms.

In addition to reactor cooling water discharges, V.C. Summer releases turbine building closed-cycle cooling water system discharges to Monticello Reservoir. V.C. Summer adds a bromine compound to the open side of this cooling system during normal operations. The bromine compound is used to eliminate microorganisms that would be a potential human health problem. Another factor that affects the survival and growth of thermophilic organisms in Monticello Reservoir is the disinfection of V.C. Summer sewage treatment plant effluents. This treatment reduces the potential for introducing or enhancing existing populations of these organisms in the discharge canal or the reservoir.

There is public access to Monticello Reservoir, including recreational fishing, boating, and waterfowl hunting. Some subsistence fishing may also occur along the eastern shore, where all the lakeshore residences are located. Public use of the reservoir creates the potential for human exposure to thermophilic organisms. However, given the thermal characteristics of Monticello Reservoir in the vicinity of the discharge outfall and the disinfection of non-reactor cooling tower water and sewage effluents, these organisms would not be expected to pose a threat to recreational or subsistence users of the reservoir or downstream users.

SCE&G requested that the SCDHEC provide information on any studies the agency might have conducted concerning thermophilic microorganisms in Monticello Reservoir and any concerns the agency might have relative to these organisms (SCE&G 2002a). SCDHEC's response indicated that public health hazards from thermophilic organisms are largely theoretical and do not represent a significant health threat to offsite users of Monticello Reservoir's waters.

Based on its review of the above information, the staff concludes that the potential impacts to public health from microbiological organisms resulting from operation of V.C. Summer's cooling water discharge system to the aquatic environment on or in the vicinity of the site area are SMALL, and additional mitigation is not warranted.

4.2 Transmission Lines

SCE&G built eight transmission lines for the specific purpose of connecting V.C. Summer to the transmission system. Two additional transmission lines were built by Santee Cooper, co-owner of V.C. Summer, to connect the station to the regional grid.

In total, for the specific purpose of connecting V.C. Summer to the transmission system, SCE&G and Santee Cooper have constructed approximately 250 km (160 mi) of transmission lines (over 190 km [120 mi] of corridor) that occupy approximately 800 ha (2000 ac) of corridor. The corridors pass through land that is primarily rolling hills covered in forests or farmland. The areas are mostly remote, with low population densities. The longer lines cross numerous State and U.S. highways, including Interstate 26 and Interstate 20.

The transmission corridors are maintained by mowing, trimming of undesirable vegetation from the sides of the corridors, and by applying nonrestricted-use herbicides. Under normal circumstances, the mowing and herbicide schedule follows a three-year cycle. Trees are side-trimmed every 10 years by helicopters carrying hydraulically operated saws. Aerial patrols of transmission corridors are conducted four times a year by SCE&G and twice a year by Santee Cooper. Dead and diseased trees at the edges of corridors are removed if they could fall and strike the transmission lines or support structures.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to transmission lines from V.C. Summer are listed in Table 4-4. SCE&G stated in its ER that it is not aware of any new and significant information associated with the renewal of the V.C. Summer OL. The staff has not identified any significant new information during its independent review of the SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff 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, and additional plant-specific mitigation is not likely to be sufficiently beneficial to be warranted.

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

Table 4-4. Category 1 Issues Applicable to the V.C. Summer Transmission Lines During the Renewal Term

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

The staff has not identified any significant new information during its independent review of the SCE&G ER, the staff's site visit, public comments, consultation with the U.S. Fish and Wildlife Service (USFWS) and the SCDNR, or staff evaluation of other information. Therefore, the staff concludes that there are no impacts of power line right-of-way maintenance during the renewal term beyond those discussed in the GEIS.

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

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

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

- Air quality effects of transmission lines. Based on 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 SCE&G ER, the staff's site visit, public comments, or staff 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 SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff 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 right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.

  The staff has not identified any significant new information during its independent review of the SCE&G ER, the staff's site visit, public comments, or staff 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 4-5 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-5. Category 2 and Uncategorized Issues Applicable to the V.C. Summer 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 National Electrical Safety Code (NESC) criteria (IEEE 1997), it was not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies

may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the 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.

SCE&G built eight transmission lines for the specific purpose of connecting V.C. Summer to the transmission system (NRC 1981, Section 3.2.7). Two additional transmission lines were built by Santee Cooper, co-owner of V.C. Summer, to connect the station to the regional grid. A total of 10 transmission lines connect V.C. Summer to the transmission system. SCE&G and Santee Cooper have constructed approximately 257 km (160 mi) of transmission lines (193 km [120 mi] of corridor) that occupy approximately 800 ha (2000 ac) of corridor. SCE&G and Santee Cooper designed and constructed all V.C. Summer transmission lines in accordance with the NESC and industry guidance that was in effect when the lines were built (SCE&G 2002a).

To support its conclusion that the transmission lines at V.C. Summer are in compliance with the NESC 5-mA, electric-field-induced current limit, SCE&G conducted a computer-model-based analysis evaluating the conformance of the transmission lines at V.C. Summer with the NESC requirement that transmission lines be designed to limit the steady-state current due to electrostatic effects to 5 mA in a tractor-trailer parked under the lines (SCE&G 2002a). SCE&G calculated electric field strength and induced current for both Santee Cooper- and SCE&G-owned lines using a computer code called AC/DCLINE, produced by the Electric Power Research Institute (EPRI 1991). The results of this computer program have been field-verified through actual electric field measurements by several utilities. The input parameters included the limiting case configuration for each line, that line sag be determined at 48.9 °C (120 °F) conductor temperature, and the maximum vehicle size under the lines is a tractor-trailer.

The analysis determined that none of the transmission lines has the capacity to induce as much as 5 mA in a tractor-trailer parked beneath the lines. Therefore, V.C. Summer transmission line designs conform to the NESC provisions for preventing electric shock from induced or steady-state current.

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, public comments, and other public sources. Using this information, the staff evaluated the potential impacts for electric shock resulting from operation of V.C. Summer and associated transmission lines. The staff considered the cumulative impacts of past, current, and foreseeable future actions at the site regardless of which agency (Federal or non-Federal) or person undertakes such other actions. It is the staff's conclusion that the potential impacts for electric shock during the renewal term are SMALL.

During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of V.C. Summer. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on the assessment to date, the staff expects that the measures in place at V.C. Summer (e.g., transmission lines are in compliance with the NESC) provide mitigation for all impacts related to acute effects of electromagnetic fields, and no new mitigation measures are warranted.

4.2.2 Electromagnetic Fields—Chronic Effects

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

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. 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 V.C. Summer in regard to radiological impacts are listed in Table 4-6. SCE&G stated in its ER

(SCE&G 2002a) that it is not aware of any new and significant information associated with the renewal of the V.C. Summer OL. No new and significant information on these issues has been identified by the staff during its independent review of the V.C. Summer ER, the staff's site visit, public comments, discussions with other agencies, or staff 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 these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation is not likely to be sufficiently beneficial to be warranted.

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

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

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

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found 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 SCE&G ER, the staff's site visit, public comments, or other staff evaluations 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 SCE&G ER, the staff's site visit, public comments, or staff 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 Term

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-7. SCE&G stated in its ER (SCE&G 2002a) that it was not aware of any new and significant information associated with the renewal of the V.C. Summer OL. The staff has not identified any significant new information during its independent review of the SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff evaluation of other 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 is not likely to be sufficiently beneficial to be warranted.

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

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

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

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

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

The staff has not identified any significant new information during its independent review of the SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff 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 SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff 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 SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff 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 SCE&G ER (SCE&G 2002a), the staff's site visit, public comments, or staff 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 4-8 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS. These issues are discussed in Sections 4.4.1 through 4.4.6.

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

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

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

4.4.1 Housing Impacts During Operations

Housing impacts is a Category 2 issue (10 CFR 51, Subpart A, Appendix B, Table B-1). 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 criteria, "sparseness" and "proximity" (GEIS Section C.1.4 [NRC 1996]). Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80 km (50 mi). Each factor has categories of density and size (GEIS Table C.1), and a matrix is used to rank the population category as low, medium, or high (GEIS Figure C.1).

SCE&G used 2000 census data from the U.S. Census Bureau website (USCB 2000) and geographic information system software to determine demographic characteristics in the V.C. Summer vicinity. As derived from Census Bureau information, an estimated 136,842 people live within 32 km (20 mi) of V.C. Summer. Applying the GEIS sparseness measures, V.C. Summer has a population density of 109 persons per square mile within 32 km (20 mi) and falls into a less sparse category, Category 3 (having 60 to 120 persons per square mile).

As derived from U.S. Census Bureau information, an estimated 1.02 million people live within 80 km (50 mi) of V.C. Summer. This equates to a population density of 131 persons per square mile within 50 miles. Applying the GEIS proximity measures, V.C. Summer is classified as Category 3 (having one or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 mi). According to the GEIS sparseness and proximity matrix, the V.C. Summer ranks of sparseness Category 3 and proximity Category 3 result in the conclusion that V.C. Summer is located in a medium-population area.

Refurbishment activities and continued operations could result in housing impacts due to increased staffing. However, SCE&G does not plan to perform refurbishment and concluded that there would be no refurbishment-related impacts to area housing. Accordingly, the following discussion focuses on impacts of continued operations on local housing availability. The maximum impact to area housing is calculated using the following assumptions: (1) all direct and indirect jobs would be filled by in-migrating residents; (2) the residential distribution of new residents would be similar to current employee distribution; and (3) each new job created (direct and indirect) represents one housing unit. As described in Section 2.2.8, approximately 95 percent of V.C. Summer employees reside in Fairfield, Lexington, Newberry, and Richland Counties. Therefore, the focus of the housing impact analysis is on these areas in Section 2.2.8.

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 medium-population area where growth-control measures are not in effect. This conclusion is supported by the following site-specific housing analysis. The GEIS assumes that an additional staff of 60 permanent SCE&G employees per unit might be needed during the license renewal period to perform routine maintenance and other activities, and Section 3.4 of the SCE&G ER (SCE&G 2002a) conservatively estimates that 60 additional employees during the license renewal period could generate demand for 237 housing units (60 direct and 177 indirect jobs). If it is assumed that 95 percent of the 237 new employees would locate in these four counties, consistent with current employee trends, then approximately 225 housing units would be required in Fairfield, Lexington, Newberry, and Richland Counties. The V.C. Summer site is located in a

medium-population area and neither Fairfield nor the adjacent Central Midlands Counties are subject to growth-control measures that would limit housing development. There are ample housing options to absorb this increase in all four counties as detailed in Table 2-5 with nearly 248,000 units and almost 22,000 vacant units in 2000.

Based on the NRC criteria, the SCE&G ER (SCE&G 2002a) expects housing impacts to be SMALL during continued operations at V.C. Summer. SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996).

The staff reviewed the available information relative to housing impacts and SCE&G's conclusions. Based on this review and because the bounding number of new housing units needed is a very small percentage of the available units, the staff concludes that the impact on housing during the license renewal period would be SMALL, and additional mitigation is not warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

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

Analysis of impacts on the public water supply system considered plant demand and plant-related population growth. Section 2.2.2 describes the V.C. Summer permitted withdrawal rate and actual use of water. V.C. Summer does not use water from a municipal system and is planning no major refurbishment, so plant demand would not change beyond current demands (SCE&G 2002a).

The NRC considers both plant demand and plant-related population growth demands on local water resources. The impact to the local water supply systems from plant-related population

growth can be determined by calculating the amount of water that would be required by these individuals. The average American uses between 190 and 300 L (50 and 80 gal) per day for personal use (Fetter 1980).

In Section 3.4 of the SCE&G ER (SCE&G 2002a), the applicant uses a conservative estimate of 60 additional employees during the license renewal period who could generate a total of 237 new jobs, which could result in a population increase of 640 in the area [237 jobs multiplied by 2.7, which is the average number of persons per household in the area (CMCOG 1999)]. Using this consumption rate, the plant-related population increase could require an additional 192,000 L/d (51,200 gal/d) (640 people multiplied by 300 L/d [80 gal/d]) in an area where the public water supply capacity is more than 570 million L/d (150 million gal/d). If it is assumed that this increase is distributed across the four potentially affected counties, consistent with current employee trends, the increase in water demand would not create shortages in capacity of the water supply systems in these communities.

The staff has reviewed the available information and the SCE&G analysis discussed above. Because the increase in water use is such a small percentage of the available capacity in the region, the staff concludes that the impact of the increase in water use is SMALL, requiring no additional mitigation.

4.4.3 Offsite Land Use During Operations

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

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

> SMALL - Little new development and minimal changes to an area's land-use pattern.
>
> MODERATE - Considerable new development and some changes to the land-use pattern.
>
> LARGE - Large-scale new development and major changes in the land-use pattern.

SCE&G has identified a maximum of 60 additional employees during the license renewal term plus an additional 177 indirect jobs (total 237) in the region (SCE&G 2002a). In Section 3.7.5 of the GEIS (NRC 1996), the staff found that if plant-related population growth is less than five percent of the study area's total population, then offsite land use changes would be small. This is especially pertinent 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 80 km (50 mi). In the case of V.C. Summer, population growth will be less than five percent of the four-county area's total population, each county in the area has established patterns of residential and commercial development guided by comprehensive plans, there is a population density of 131 persons per square mile within a 50-mi radius, and there is one urban area (Columbia) with a population of 116,278 in the city and a metropolitan area population of 536,691 (USCB 2000). 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 be able 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 jurisdiction's revenue, the significance level would be SMALL. If the plant's tax payments are projected to be medium to large relative to the community's total revenue, new tax-driven land-use changes would be MODERATE. If the tax payments are projected to be a dominant source of the community's total revenue, new tax-driven land uses would be LARGE (NRC 1996a).

Fairfield County is the only local jurisdiction that taxes V.C. Summer directly. V.C. Summer tax payments to Fairfield County represented approximately 47 percent of total annual property tax revenues and 47 percent of the County's annual operating budget between 1995 and 2000. Continued operation of V.C. Summer over the license renewal term would be important to maintaining the current level of development and public services, but would not result in changes to local land-use and development patterns or result in additional costs for public services. V.C. Summer has been, and would probably continue to be, the dominant source of tax revenue for Fairfield County. However, despite having this income source since the early

1980s, Fairfield County has not experienced large land-use changes, especially on the west side near V.C. Summer. The V.C. Summer environs have remained largely rural, County population growth rates after V.C. Summer construction have been minimal, and County planners are not projecting large changes (SCE&G 2002a).

SCE&G does not anticipate major refurbishment or construction during the license renewal period and, therefore, does not anticipate any increase in the assessed value of V.C. Summer due to refurbishment-related improvements nor any related tax-increase-driven changes to offsite land-use and development patterns. If the OL for V.C. Summer was not renewed and the station was decommissioned, then impacts to the tax base of the surrounding communities and their economic structures could be significant, as discussed in Section 8.4.7 of the GEIS (NRC 1996). However, based on the information presented above, the staff concludes that tax-related land-use impacts related to renewing the OL for V.C. Summer are likely to be SMALL.

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 SEIS for V.C. Summer.

As described previously, no major refurbishment is planned and no refurbishment impacts to local transportation are therefore anticipated. The V.C. Summer workforce includes approximately 600 SCE&G and between 130 and 140 contract employees. On an 18-month cycle, 600 to 800 additional contractor employees join the permanent workforce during refueling outages. The SCE&G projection of 60 additional employees associated with license renewal for V.C. Summer represents a conservative estimate that would result in no more than a 10 percent increase in the current number of permanent employees and an even smaller percentage of employees present onsite during a typical refueling outage. This increase in employees and consequent trips generated by renewing the OL would not impact the roadway system that serves V.C. Summer. The area surrounding the station is essentially rural, low-density residential and there is adequate roadway network capacity even though these are rural roads. Roadway improvements are proposed in the vicinity of V.C. Summer to SC 213 and the Peak Bypass and are shown on the Long-Range Rural System Upgrades Map maintained by the Central Midlands Council of Governments.

The staff has reviewed the SCE&G ER (SCE&G 2002a) and other information made available during interviews with local officials and observation of the transportation conditions around

V.C. Summer and concludes that impacts of V.C. Summer license renewal on transportation would be SMALL and mitigation would not be warranted.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act of 1966 (NHPA), as amended, requires Federal agencies to take into account the effects of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Renewal of an OL could potentially affect historic properties that may be located at the site. Therefore, in accordance with the NHPA, the NRC must 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 and resolve possible adverse effects of the undertaking.

In January 2001, SCE&G requested that the South Carolina SHPO provide comments on the V.C. Summer license renewal process. In this letter, SCE&G determined that the continued operation of V.C. Summer will have no impact on historic properties (SCE&G 2001). In a response dated January 29, 2001, the South Carolina SHPO stated that license renewal for the continuing operation of plants such as this one typically has no effect on historic properties (SHPO 2001). On June 13, 2003, NRC sought concurrence from the South Carolina SHPO regarding license renewal at V.C. Summer that this undertaking would have no effect on historic properties (NRC 2003b). On July 9, 2003, the South Carolina SHPO responded to the NRC letter and recommended that additional information be provided in a revised cultural resources report in order to make an assessment of the effect. On October 22, 2003, NRC provided the additional information in a revised cultural resources report (NRC 2003c). The South Carolina SHPO concluded that the undertaking will have no adverse effect on historic properties on November 19, 2003 (SHPO 2003). Copies of these correspondence and reports are provided in Appendix E.

Major refurbishment of V.C. Summer is not required during the license renewal period, so there will be no need to use currently undeveloped portions of the site for operations during the renewal period. Operation of V.C. Summer, as planned under the application for license renewal, would protect undiscovered historic or archaeological resources on the site because the undeveloped natural landscape and vegetation would remain undisturbed, and access to the site would remain restricted.

SCE&G established a land use and shoreline management plan. The purpose of this plan is to help maintain and conserve the area's natural and human-made resources as well as assist in providing a balance between recreational use and development and environmental preservation and control. This management plan addresses environmental policies including the exclusion zone, public access, public fishing, and boating and hunting, as well as shoreline activities. Erosion control measures are identified as well as restrictions on the removal of under brushing (SCE&G 2002b).

SCE&G operating procedures take into account the inadvertent discovery of historic and archaeological remains at V.C. Summer. However, care should be taken during normal operational and maintenance conditions to ensure that historic properties are not inadvertently impacted. These activities may include not only operation of V.C. Summer itself but also land management-related actions such as recreation, wildlife habitat enhancement, or maintaining/upgrading V.C. Summer access roads through the site and on transmission line rights-of-way.

Based on the staff's cultural resources analysis and consultation, on SCE&G conclusions that major refurbishment activities will not be undertaken related to the license renewal of V.C. Summer, and on the fact that operation will continue within the bounds of station operations as evaluated in the Final Environmental Statement (AEC 1973), the staff concludes that there are no adverse effects on historic properties; therefore the potential impacts are SMALL, and no additional mitigation is warranted.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy that requires that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its actions on minority[(a)] or low-income populations. The memorandum accompanying Executive Order 12898 (59 *Federal Register* 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969. The Council on Environmental Quality has provided guidance for addressing environmental justice (CEQ 1997). Although the Executive Order is not mandatory for independent agencies, the NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, *Procedural*

(a) The NRC Guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native, Asian or Pacific Islander, Black not of Hispanic Origin, or Hispanic (NRC 2001).

Guidance for Preparing Environmental Assessments and Considering Environmental Issues (NRC 2001). The Commission has since issued draft guidance on environmental justice (68 *Federal Register* 62642 [NRC 2003d]).

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of V.C. Summer, using the 2000 Census (USCB 2000) for minority and low-income populations. The radius within 80 km (50 mi) of V.C. Summer encompassed 21 South Carolina counties and a small portion of one county in North Carolina. The analysis was supplemented with interviews with local governments and social service agencies in Fairfield County and the Central Midlands Region.

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 V.C. Summer exceeds the corresponding percentage of minorities in the entire State of 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[(a)] exceeds the corresponding percentage of low-income population in the entire State of South Carolina by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent.

The U.S. Census Bureau data characterize South Carolina as 0.3 percent American Indian or Alaskan Native; 0.9 percent Asian; 0.0 percent Native Hawaiian or other Pacific Islander; 29.5 percent Black races; 1.0 percent all other single minorities; 1.0 percent multiracial; 32.8 percent aggregate of minority races; and 2.4 percent Hispanic ethnicity (USCB 2000). U.S. Census Bureau data characterize North Carolina as 1.2 percent American Indian or Alaskan Native; 1.4 percent Asian; 0.0 percent Native Hawaiian or other Pacific Islander; 21.6 percent Black races; 2.3 percent all other single minorities; 1.3 percent multiracial; 27.9 percent aggregate of minority races; and 4.7 percent Hispanic ethnicity (USCB 2000).

(a) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Census Bureau 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 U.S. Census Bureau guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2001).

The SCE&G ER (SCE&G 2002a) reported that aggregate minority populations exist in 230 block groups based on the more than 20 percent criterion. Figure 4-1 displays the location of these minority block groups distributed among the counties in the geographic area. The African American minority population exists in 209 block groups based on the more-than-20-percent criterion. Based on the more-than-20-percent criterion, American Indian or Alaskan Native minority populations exist in a single block group in York County. The Catawba Indian Nation has tribal lands (approximately 283 ha [700 ac]) in the Rock Hill, South Carolina, area (EDA 2000). Total tribal membership is believed to be around 3000, with approximately half of this number living in York County and Lancaster County (EDA 2000; EPA 2001). Based on the more-than-20-percent criterion, Hispanic ethnicity minority populations exist in two block groups that are in Saluda County and Greenwood County. Based on the more-than-20-percent criterion, the Asian minority population exists in a single block group in Richland County. No Native Hawaiian or other Pacific Islander, other single minorities, or multiracial minorities exist in the geographic area based on the more-than-20-percent or the exceeds-50-percent criteria.

The U.S. Census Bureau had not yet released 2000 census data for low-income households when the SCE&G ER (SCE&G 2002a) was prepared. Therefore, SCE&G used 1990 census data from the U.S. Census Bureau website (USCB 1991) in reporting the percentage of the total households within the States of North Carolina and South Carolina that are deemed low-income households and in identifying low-income households within 80 km (50 mi) of V.C. Summer. The 2000 census data for low-income households has since been made available by the U.S. Census Bureau and, subsequently, the staff assessed this matter using the more recent data.

NRC guidance defines low-income using U.S. Census Bureau statistical poverty thresholds (NRC 2001, Appendix D). The low-income household numbers for each census tract were divided by the total households for that census tract to obtain the percentage of low-income households per census tract. U.S. Census Bureau data (USCB 1991) characterize 15.8 percent of South Carolina and 14.0 percent of North Carolina households as low income. Based on the more-than-20-percent criterion, 15 1990-census tracts contained a low-income population. Eleven of these tracts were found in Richland County, two in York County, and one each in Lexington and Sumter Counties. Figure 4-2 displays the locations of low-income household tracts among the counties in the geographic area.

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

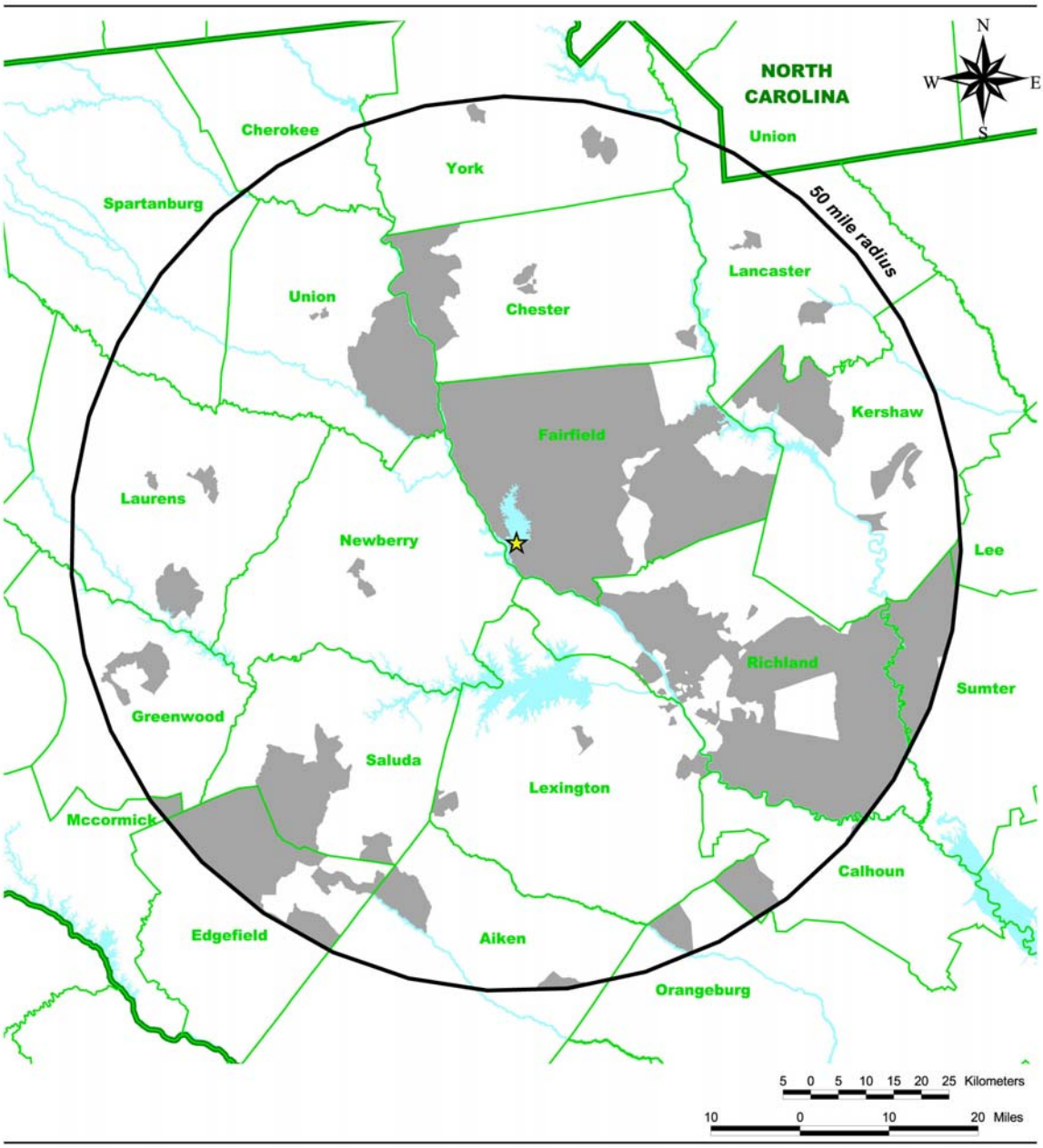

Figure 4-1. Geographic Distribution of Minority Populations within 80 km (50 mi) of V.C. Summer

Figure 4-2. Locations of Low-income Populations within 80 km (50 mi) of V.C. Summer

(NRC 2001), air, land, and water resources within about 80 km (50 mi) of V.C. Summer 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 V.C. Summer license renewal can affect human populations are discussed throughout this SEIS. The staff 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 affected in a disproportionately high and adverse way. In addition, the staff did not identify any location-dependent disproportionately high and adverse impacts affecting these minority and low-income populations. The staff concludes that offsite impacts from V.C. Summer to minority and low-income populations would be SMALL, and no special mitigation is warranted.

It is evident from staff consultations with local officials and research that Fairfield and Newberry Counties demonstrate many of the hallmarks of communities likely to be impacted by environmental justice issues. There are many indicators that this is a valid observation that can be supported by the reports of local social service agencies (United Way of the Central Midlands 2002). It can also be concluded that the presence of V.C. Summer may counteract and mitigate some of these socioeconomic issues and concerns.

4.5 Groundwater Use and Quality

The single Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that is applicable to V.C. Summer groundwater use and quality is listed in Table 4-9. SCE&G stated in its ER that it is not aware of any new and significant information associated with the renewal of the V.C. Summer OL (SCE&G 2002a). The staff has not identified any significant new information during its independent review of the SCE&G ER, the staff's site visit, public comments, or staff evaluation of other available information. Therefore, the staff concludes that

Table 4-9. Category 1 Issue Applicable to Groundwater Use and Quality During the Renewal Term

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

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 additional plant-specific mitigation is 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, 10 CFR 51, follows.

- Groundwater-use conflicts (potable and service water; plants that use <100 gpm).

  Based on information in the GEIS, the Commission found that

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

  The V.C. Summer groundwater use is less than 100 gpm. The staff has not identified any significant new information during its independent review of the SCE&G ER, the staff's site visit, public comments, or staff 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.

Category 2 issues related to groundwater use and quality during the renewal term that are applicable to V.C. Summer are discussed in the sections that follow. These issues, which require plant-specific analysis, are listed in Table 4-10.

Table 4-10. 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 Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
GROUND-WATER USE AND QUALITY			
Groundwater-use conflicts (plants using cooling towers or cooling ponds that withdraw make-up water from a small river)	4.8.1.3 4.4.2.1	A	4.5.1
Groundwater quality degradation (cooling ponds at inland sites)	4.8.3	D	4.5.2

4.5.1 Groundwater Use Conflicts (Plants Using Cooling Towers or Cooling Ponds that Withdraw Make-up Water from a Small River)

The issue of groundwater use conflicts applies to V.C. Summer because it withdraws from and discharges to a cooling pond, Monticello Reservoir, which receives its make-up water from Parr Reservoir on the Broad River. The Broad River is considered a small river, based on an average flow of 5.9×10^9 m^3/yr (2.1×10^{11} ft^3/yr).

Daily mean flow in the Broad River in the vicinity of V.C. Summer (at Alston, South Carolina, 1.9 km [1.2 mi] downstream of the Parr Shoals dam) ranged from 6.65 m^3/s (235 to 130,000 cfs) over the period of record, with an annual average of 185.05 m^3/s (6535 cfs). According to the Final Environmental Statements for construction (AEC 1973) and operation (NRC 1981) of Summer Station, the lowest recorded daily mean flow at a gauging station in the vicinity of V.C. Summer was 4.22 m^3/s (149 cfs) at Richtex, South Carolina, 11.26 km (7 mi) downstream of the Parr Shoals dam. This U.S. Geological Survey station was taken out of service in 1983. Monticello Reservoir water lost to evaporation is replaced with water from Parr Reservoir as part of the normal operation of the FPSF. Water is cycled between the reservoirs daily. The V.C. Summer water use reports for 1998 and 1999 indicate that evaporative losses as high as 0.62 m^3/s (22 cfs) are associated with V.C. Summer operations (SCE&G 1998, 1999). This loss represents approximately 1.7 percent of the cooling water removed from the reservoir (37.04 m^3/s [1308 cfs]) and approximately 0.3 percent of the average annual natural stream flow of 185.05 m^3/s (6535 cfs). The potential evaporative loss represents 14.8 percent of the lowest recorded daily mean stream flow of 4.22 m^3/s (149 cfs) reported in the Final Environmental Statement (NRC 1981).

Water used for cooling at the facility is not removed from a stream with natural flow, but from Parr Reservoir, an impounded section of the Broad River. The flow is regulated to maintain a minimum downstream release of 4.25 m^3/s (150 cfs) (NRC 1981). The site is located within the Piedmont Physiographic Province of South Carolina. Rivers in the South Carolina Piedmont typically are high-energy, shallow, rocky-bottomed streams that tend not to develop extensive alluvial flood plains. The Broad River is typical of the area. With the construction of Parr Reservoir, the upstream river flood plain was inundated. The surrounding area is characterized by a surficial water table aquifer in saprolitic soils and shallow fractures in rocks (SCE&G 2002a). With the construction of Parr Reservoir, the water in the surficial aquifer adjacent to the reservoir rose. Water flow within saprolitic soil is typically very slow due to the relatively impermeable natural soils, and the flow direction follows the surface topography within drainage basins toward discharge points along the stream valleys. These soils release water slowly back to reservoir during extreme low-level periods. The fact that Broad River water is pumped (via FPSF) to Monticello Reservoir for condenser cooling has had no significant impact on the

alluvial aquifer in the vicinity of the site during periods of low natural stream flow. The water in Parr Reservoir itself and the surrounding surficial aquifer distributes any loss in reservoir water level in such a way as to be considered insignificant to the alluvial aquifer. Impacts of V.C. Summer operation on the alluvial aquifer over the license renewal term would likewise be SMALL and would not warrant mitigation.

The staff has reviewed the available information including the discharge history of the Broad River, maintenance of minimum flow conditions on the Broad River, the physiographic and hydrogeologic setting, and the demands placed on the Broad River during low-flow conditions to compensate for evaporative losses. Based on this evaluation, any impacts from V.C. Summer on the Broad River flow conditions or associated, sparsely distributed alluvial groundwater that would affect instream and riparian communities in Parr Reservoir or the Broad River over the license renewal term would be SMALL and would not warrant mitigation.

4.5.2 Groundwater Quality Degradation (Cooling Ponds at Inland Sites)

The issue of groundwater degradation applies to V.C. Summer because the station uses a cooling pond. V.C. Summer employs a once-through cooling system, but withdraws from and discharges to a cooling pond, Monticello Reservoir. Monticello Reservoir provides once-through cooling water to V.C. Summer and acts as the upper reservoir for the FPSF. Parr Reservoir, created by the damming of the Broad River, serves as the lower reservoir for the FPSF. Make-up water for Monticello Reservoir is supplied from Parr Reservoir. As part of FPSF operations, water is released from Monticello Reservoir through FPSF and discharged to Parr Reservoir during the day. Water is then pumped at night from Parr Reservoir to Monticello Reservoir to maintain the level of the upper reservoir. Over time, the water quality of Monticello Reservoir due to the constant cycling and mixing of water is basically that of the Broad River (NRC 1981).

Water quality monitoring data indicate that Monticello Reservoir waters are relatively low in concentrations of common ions, low in hardness, and low in dissolved solids/conductivity (Dames and Moore 1985). Groundwater in the vicinity of the site is highly mineralized, due to prolonged contact with, and solution of, rock minerals, and as a result is generally higher than local surface waters in hardness, dissolved solids, and conductivity (Dames and Moore 1985, Table 2.2.2; SCE&G 2002a). There is no indication that evaporative losses associated with operation of V.C. Summer have increased concentrations of common ions, minerals, or solids in Monticello Reservoir water, and no indication that groundwater quality in the area has been affected by this cooling pond. Therefore, there appears to have been little or no negative impact on groundwater quality as a result of the operation of V.C. Summer. Impacts of continued operation would be SMALL and would not warrant mitigation.

The staff has reviewed the available information including the physiographic and hydrogeologic setting and the water quality of Monticello Reservoir and the regional groundwater. Based on this evaluation, overall groundwater quality is likely to be improved by the presence of Monticello Reservoir and any negative impacts from V.C. Summer on the groundwater in the vicinity of the Station over the license renewal term would be SMALL and would not warrant mitigation.

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 4-11.

Table 4-11. 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 V.C. Summer is discussed in Sections 2.2.5 and 2.2.6.

4.6.1 Aquatic Species

No Federal-listed threatened or endangered aquatic species or their habitats are known to occur at the V.C. Summer site, including Monticello/Parr Reservoir system or in streams that are crossed by a V.C. Summer transmission line corridor (SCE&G 2002a).

Aquatic species that may have historically inhabited the Broad River include the shortnose sturgeon (*Acipenser brevirostrum*), a Federal-listed endangered species of fish, and a mussel, the Carolina heelsplitter (*Lasmigona decorata*). The shortnose sturgeon is currently not known from the Broad River; the nearest documented populations are in Lakes Marion and Moultrie in the Santee Cooper system. The upstream migration of this species is prevented by dams. Although the Carolina heelsplitter is known from several creeks in the western portion of

Edgewood County, this mussel is not known from the watersheds of creeks in the northeastern portion of the county that is crossed by a V.C. Summer transmission line corridor.

The staff has prepared an assessment evaluating the potential impacts on aquatic threatened or endangered species resulting from the operation of V.C. Summer for an additional 20 years during the renewal period. The staff concluded that V.C. Summer license renewal will have no effect on the shortnose sturgeon or the Carolina heelsplitter. In a letter dated June 26, 2003, the staff transmitted its biological assessment to the USFWS and requested concurrence on its determination. The letter to USFWS and the staff's biological assessment are included in Appendix E to this SEIS.

The staff has reviewed the V.C. Summer ER (SCE&G 2002a), visited the site, reviewed the current NPDES permit (SC003856, issued 9/29/97) and related operational and biological information, and consulted with the USFWS. The staff concludes that license renewal will not impact Federal-listed aquatic threatened or endangered species or their critical habitat. During the course of its evaluation, the staff considered whether further mitigation for continued operation of V.C. Summer was warranted. Based on this evaluation, the staff determined that mitigation in place at V.C. Summer is appropriate and no additional mitigation is warranted.

4.6.2 Terrestrial Species

There are 10 Federal-listed or candidate terrestrial species that are known to occur in the vicinity of V.C. Summer or in counties crossed by the transmission lines (see Section 2.2.6). However, of these species, the bald eagle (*Haliaeetus leucocephalus*) is the only terrestrial species known to occur at V.C. Summer or along its transmission line corridors. There have been no reports of collisions or electrocutions of bald eagles along the transmission lines. SCE&G and Santee Cooper participate with the U.S. Department of Agriculture-Natural Resources Conservation Service, SCDNR, and other organizations in a wildlife management program for transmission line corridors. The “Power for Wildlife” program is designed to help landowners whose property is crossed by transmission lines convert transmission corridors into productive habitat for wildlife. In addition, SCE&G’s procedures require that it follow the USFWS habitat management guidelines for the bald eagle in the Southeast Region (USFWS 1987) and submit a raptor incident report in the event that an electrocuted eagle is found.

The staff has prepared an assessment evaluating the potential impacts on terrestrial threatened, endangered, or candidate species resulting from the operation of V.C. Summer for an additional 20 years during the renewal period. The staff concluded that V.C. Summer license renewal will have no effect on the wood stork, red-cockaded woodpecker, pool sprite, Georgia aster, smooth coneflower, rough-leafed loosestrife, Canby's dropwort, harperella, or relict trillium. The license renewal may affect, but is not likely to adversely affect, the bald

eagle. In a letter dated June 26, 2003, the staff transmitted its biological assessment to the USFWS and requested concurrence on its determination. The USFWS concurred with the staff's conclusions in a letter dated October 17, 2003. The letter to USFWS, the staff's biological assessment, and the letter from USFWS are included in Appendix E to this SEIS.

The staff has reviewed the information provided by the applicant, met with the SCDNR, and has consulted with the USFWS. Based on the site visit, review of the ER, other reports, and consultation with the USFWS and the SCDNR, the staff concludes that the impacts on terrestrial endangered, threatened, or candidate species of an additional 20 years of operation and maintenance of V.C. Summer and its associated transmission lines would be SMALL, and further mitigation is not warranted.

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

The staff has not identified significant new 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 public scoping meetings, to identify issues with significant new information. Processes for identification and evaluation of new information are described in Section 1.2.2, License Renewal Evaluation Process.

4.8 Evaluation of Cumulative Impacts of Operations During the Renewal Term

The staff considered potential cumulative impacts during the evaluation of information applicable to each of the potential impacts identified within the GEIS. The impacts of the proposed license renewal are combined with other past, present, and reasonably foreseeable actions to determine whether cumulative impacts exist. For the purposes of this analysis, past actions were those related to the resources at the time of the plant licensing and construction. Current actions are the operation of the power plant and future actions are considered to be those that are reasonably foreseeable through the end of plant operation. Therefore, the analysis considers potential impacts through the end of the current license term, as well as the 20-year renewal license term. The geographical area over which past, present, and future actions that could contribute to cumulative impacts depends on the type of action considered, and is described below for each impact area.

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

For the purposes of this analysis, the geographic area considered is the Broad River. As described in Section 4.1, the staff found no new and significant information indicating that the conclusions regarding any of the cooling system-related Category 1 issues as related to V.C. Summer are inconsistent with the conclusions in the GEIS. Additionally, the staff has determined that none of the cooling system-related Category 2 issues were likely to have greater than a SMALL impact on local water quality or aquatic resources.

Cumulative impacts to the Broad River involve water use conflicts. As described in Section 2.1.3, V.C. Summer utilizes the Monticello Reservoir as a source of cooling water for its condenser. Monticello Reservoir is connected hydrologically to the Broad River by the Parr Reservoir and the Fairfield Pumping Station. Even through severe drought conditions, operations at V.C. Summer did not exceed any FERC-mandated flow restrictions. There are no known or planned activities on the Broad River that could potentially produce additional water conflicts. Therefore, the cumulative impact is SMALL and no mitigation measures are warranted.

4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines

The continued operation of the V.C. Summer electrical transmission facilities was evaluated to determine if there is the potential for interactions with other past, present, and future actions that could result in adverse cumulative impacts to terrestrial resources such as wildlife populations and the size and distribution of habitat areas, aquatic resources such as wetlands and floodplains, and both the acute and chronic effects of electromagnetic fields. For the purposes of this analysis, the geographic area that encompasses the past, present and foreseeable future actions that could contribute to adverse cumulative effects is the area within 80 km (50 miles) of the V.C. Summer site, as depicted in Figure 2-1.

As described in Section 4.2, the staff found no new and significant information indicating that the conclusions regarding any of the transmission line-related Category 1 issues related to V.C. Summer are inconsistent with the conclusions in the GEIS. For the category 2 issue related to electromagnetic fields-acute effects (electric shock), the impact is small and the uncategorized issue of chronic effects is still considered “not applicable.” There are no known or planned activities within the 80 km (50 miles) radius area of consideration that could potentially produce additional impacts associated with transmission lines. Therefore, the cumulative impact is SMALL and no mitigation measures are warranted.

4.8.3 Cumulative Radiological Impacts

The radiological exposure limits for protection of the public and for occupational exposures have been developed assuming long-term exposures, and therefore incorporate cumulative impacts. As described in Section 2.2.7, the public and occupational doses resulting from V.C. Summer are well below regulatory limits, and as described in Section 4.3, the impacts of these exposures are SMALL. For the purposes of this analysis, the geographical area is the area included within a 80 km (50 miles) radius of the V.C. Summer site (Figure 2-1). The NRC would regulate any reasonably foreseeable future actions in the vicinity of V.C. Summer that could contribute to cumulative radiological impacts.

Therefore, the staff has determined that the cumulative radiological impacts of continued operation of V.C. Summer will be SMALL, and that additional mitigation is not warranted.

4.8.4 Cumulative Socioeconomic Impacts

Much of the analyses of socioeconomic impacts presented in Section 4.4 of this SEIS already incorporate cumulative impact analysis because the metrics used for quantification only make sense when placed in the total or cumulative context. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that will be available in the impacted area. Therefore, the geographical area of the cumulative analysis varies depending on the particular impact considered, and may depend on specific boundaries, such as taxation jurisdictions or may be distance related, as in the case of Environmental Justice.

The continued operation of V.C. Summer is not likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Sections 4.4. In other words, the impacts of issues such as transportation or offsite land use are likely to be non-detectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff has determined that the impacts on housing, public utilities, public services, and environmental justice would all be SMALL. The staff has determined that the impact on offsite land use is SMALL because, even though V.C. Summer provides greater than 10 percent of the property tax revenue for the Fairfield County School District, there are no refurbishment actions planned at V.C. Summer. There are no reasonably foreseeable scenarios that would alter these conclusions in regard to cumulative impacts.

Related to historic resources, there are no structures eligible for the inclusion in the National Register of Historic Places on the V.C. Summer site or along the transmission lines. The staff

has concluded that the impacts of license renewal would be SMALL. There is no reason to believe that the continued operation and maintenance of the V.C. Summer site and transmission line rights-of-way would impact any properties beyond the site or right-of-way boundaries, and therefore the contribution to a cumulative impact on historic resources would be negligible.

Based on these considerations, the staff concludes that continued operation of V.C. Summer is not likely to make a detectable contribution to the cumulative effects associated with any of the socioeconomic issues discussed in Section 4.4, and therefore, the cumulative impacts will be SMALL and no additional mitigation measures are warranted.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

There are no known or planned projects that would require withdrawal of groundwater that, if implemented in addition to license renewal, would potentially cause an adverse impact on groundwater. The V.C. Summer groundwater use is less than 100 gpm. The current impact on the alluvial aquifer due to plant operations and current groundwater withdrawals is small as discussed in Section 4.5. Therefore, the cumulative impact is SMALL and no mitigation measures are warranted.

4.8.6 Cumulative Impacts on Threatened or Endangered Species

The geographic area considered in the analysis of cumulative impacts to threatened or endangered species includes V.C. Summer project area and the associated transmission line right-of-way. As discussed in Sections 2.2.5 and 2.2.6, there are several threatened or endangered species that occur within this area. However, the staff determined in Section 4.6 that continued operation of V.C. Summer would have no effect or is not likely to adversely affect any of these species. Therefore, the continued operation of V.C. Summer will not contribute to a regional cumulative impact to these species, regardless of whether or not other actions occur that could have adverse impacts.

Therefore, the staff has determined that the cumulative impacts to threatened or endangered species due to continued operation at the V.C. Summer site and associated transmission line will be SMALL, and that additional mitigation measures would not be warranted.

4.9 Summary of Impacts of Operations During the Renewal Term

Neither SCE&G 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 V.C. Summer 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 is not likely to be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 14 Category 2 issues applicable to V.C. Summer operation during the renewal term and for chronic effects of electromagnetic fields and environmental justice. For all issues, the staff concluded that the potential environmental impact of renewal term operations of V.C. Summer would be of SMALL significance in the context of the standards set forth in the GEIS and that additional mitigation would not be warranted.

4.10 References

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

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Domestic Licensing of Production and Utilization Facilities."

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

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forest, and Public Property*, Part 800, "Protection of Historic Properties."

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5.0 Environmental Impacts of Postulated Accidents

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

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

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 in the following sections.

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

5.1.1 Design-Basis Accidents

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

The DBAs are evaluated by both the licensee and the NRC staff 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 Code of Federal Regulations (CFR) Part 50 and 10 CFR Part 100.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the OL. The results of these evaluations are found in license documentation such as the applicant's Final SAR, the staff's Safety Evaluation Report, and the NRC's Final Environmental Statement (NRC 1981). 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 requirement that aging management programs be in effect for license renewal and the requirement that the consequences of any DBA remain below specified acceptable levels at all times during plant operation, 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 period of extended operation 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 makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and,

therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to the Virgil C. Summer Nuclear Station (V.C. Summer) is listed in Table 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.

South Carolina Electric and Gas Company (SCE&G) stated in its Environmental Report (ER) (SCE&G 2002) that it is not aware of any new and significant information associated with the renewal of the V.C. Summer OL. The staff has not identified any significant new information during its independent review of the ER (SCE&G 2002), the staff's site visit, public comments, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to design basis accidents beyond those discussed in the GEIS.

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

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, 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, fires, and sabotage have not traditionally been discussed in quantitative terms in Final Environmental Statements and were not specifically considered for the V.C. Summer site in the GEIS (NRC 1996). However, in the GEIS, the staff did evaluate existing impact assessments performed by the NRC and by the industry for 44 nuclear plants in the United States. As set forth in the GEIS, the staff concluded that the risk from sabotage and 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 groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to V.C. Summer, is listed in Table 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 ER (SCE&G 2002), the staff's site visit, public comments, 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 V.C. Summer. The results of its review are discussed in Section 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

5.2 Severe Accident Mitigation Alternatives (SAMAs)

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 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 V.C. Summer; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluation for V.C. Summer conducted by SCE&G and described in the ER (SCE&G 2002) and of the NRC's review of that evaluation. The details of the review are described in the NRC staff evaluation that was prepared by the staff with contract assistance from Information Systems Laboratories, Inc. The entire evaluation is presented in Appendix G.

The SAMA evaluation for V.C. Summer was a multi-step process. In the first step, SCE&G quantified the level of risk associated with potential reactor accidents using the plant-specific probabilistic risk assessment (PRA) and other risk models.

The second step involved the development of a list of potential measures to reduce plant risk. This list was compiled based on information included in the V.C. Summer Individual Plant Examination (IPE) (SCE&G 1993), V.C. Summer Individual Plant Examination and External Events (IPEEE) (SCE&G 1995), previously submitted SAMA analyses, and NRC/industry documentation discussing potential plant improvements. The proposed risk reduction measures were subsequently compared against PRA results to ensure the major risk contributors were addressed by the proposed enhancements. Common ways of reducing risk are changes to components, systems, procedures, and training. SCE&G identified 268 potential SAMAs. Using a set of screening criteria, the number of SAMAs warranting further consideration was reduced to 32. Of these remaining SAMAs, 20 were screened from further analysis because, based on plant-specific PRA insights, they did not provide a significant safety benefit, or because the cost of implementation would be greater than the benefits associated with implementing the SAMA.

In the third step, the benefits and costs for the 12 remaining candidate SAMAs were estimated. Estimates were made of how much each proposed SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997). The costs of implementing the proposed SAMAs were also estimated.

Finally in the fourth step, the costs and benefits of each of the 12 final SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning the benefits of the SAMA were greater than the costs (a positive cost-benefit). In the final analysis, none of these 268 SAMAs were determined to be cost-beneficial for V.C. Summer.

Each of these four steps is discussed in more detail in the sections that follow.

5.2.2 Estimate of Risk

SCE&G submitted an assessment of SAMAs for V.C. Summer as part of the ER (SCE&G 2002). This assessment was based on the most recent V.C. Summer PRA available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2, and insights from the V.C. Summer IPE (SCE&G 1993) and IPEEE (SCE&G 1995). The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 5.6×10^{-5} per year, and the baseline large early release frequency is approximately 7.0×10^{-7} per year. The CDF and large early release frequency are based on the risk assessment for internally-initiated events. The CDF represents a sizeable change from the original IPE CDF value of 2.0×10^{-4} per year. SCE&G did not include the contribution of risk from external events within the V.C. Summer risk estimates, but in response to a request for additional information, SCE&G applied a factor of two multiplier to the estimated internal events benefits to account for additional benefits in external events. The breakdown of CDF by initiating event/accident class is summarized in Table 5-3. Transients and loss of offsite power events are the dominant contributors to the CDF.

Table 5-3. V.C. Summer Core Damage Frequency

Initiating Event/Accident Class	CDF (Per Year)	Contribution to CDF (percent)
Loss of Offsite Power (LOOP)	3.9×10^{-5}	70
Transients	7.5×10^{-6}	13
Special Initiators	4.4×10^{-6}	8
Loss-of-Coolant Accident (LOCA)	1.7×10^{-6}	3
Steam Generator Tube Rupture (SGTR)	1.7×10^{-7}	<1
Interfacing Systems LOCA (ISLOCA)	1.8×10^{-7}	<1
Others	2.6×10^{-6}	5
Total CDF (from internal events)	**5.6×10^{-5}**	**100**

SCE&G estimated the dose from all postulated accidents to the population within 80 km (50 mi) of the V.C. Summer site to be approximately 0.01 person-Sv (1.0 person-rem). The breakdown of the population dose by containment release mode is summarized in Table 5-4. Bypass events (steam generator tube rupture [SGTR], interfacing system loss-of-coolant accident [ISLOCA]) dominate the population dose.

Table 5-4. Breakdown of Population Dose-Risk by Containment Release Mode

Containment Release Mode	Population Dose (Person-Rem[(a)] Per Year)	Contribution (percent)
SGTR	0.27	27
Interfacing Systems LOCAs	0.63	63
Containment isolation failure	0.05	5
Early containment failure	0.00	0
Late containment failure	0.05	5
Total	1.0	100

(a) One person-Rem = 0.01 person-Sv

SCE&G's determination of offsite risk at V.C. Summer is based on the following three major elements of analysis:

- the Level 1 and 2 risk models that form the bases for the 1993 IPE and 1995 IPEEE submittals (SCE&G 1993 and SCE&G 1995),
- the major modifications to the IPE model that have been incorporated in the V.C. Summer PRA, and
- the MELCOR Accident Consequence Code System 2 analysis performed to translate fission product release frequencies from the Level 2 PRA model into offsite consequence measures.

The staff has reviewed SCE&G's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for the candidate SAMAs. Specifically, the staff concludes that the Level 1 and Level 2 PRA models are of sufficient quality, SCE&G's consideration of external events is acceptable, and the methods, assumptions, and analyses applied in the estimation of offsite consequences are reasonable and acceptable for the purposes of SAMA evaluation. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses provided by SCE&G.

5.2.3 Potential Plant Improvements

Once the most risk significant parts of the plant design and operation were identified, SCE&G searched for ways to reduce those risks. To identify potential plant improvements, SCE&G's process consisted of the following elements:

- review of plant-specific improvements identified in the V.C. Summer IPE and IPEEE and subsequent PRA revisions

- review of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants

- review of other NRC and industry documentation discussing potential plant improvements, e.g., NUREG-1560.

SCE&G identified 268 potential risk-reducing improvements to plant components, systems, procedures, and training (SAMAs).

All but 69 of these SAMAs were removed from further consideration because: (1) the SAMA was not applicable at V.C. Summer due to design differences, (2) the SAMA had already been implemented at V.C. Summer, (3) the SAMA was sufficiently similar to another SAMA such that they could be combined, or (4) the SAMA would not provide a significant safety benefit. A preliminary cost estimate was prepared for each of the remaining 69 SAMAs.

The preliminary cost estimate of each of these 69 remaining SAMAs was compared to the maximum attainable benefit (MAB) of 1.2 million dollars. The MAB is the dollar value of the benefit that would be achieved if the plant risk and population dose from postulated accidents could be reduced to zero. If the cost of a SAMA exceeded the MAB, it could not be cost-beneficial because no single SAMA could eliminate all the risk. Using this comparison, 37 of the candidate SAMAs were eliminated from further consideration, leaving 32 candidate SAMAs for further evaluation in Phase 2. Of these remaining SAMAs, 20 were screened from further analysis because, based on plant-specific PRA insights, they did not provide a significant safety benefit, or because the cost of implementation would be greater than the benefits associated with implementing the SAMA. This culminated in identification of 12 candidate SAMAs.

The staff questioned SCE&G about lower cost alternatives to several of the SAMAs evaluated, including the use of: (1) portable battery chargers to supply power to the steam generator instrument panels, (2) a cross-tie to the existing non-safety station batteries, (3) a direct-drive diesel emergency feedwater pump, and (4) an automatic safety injection pump trip on low refueling water storage tank level as an alternative to an automatic swap to recirculation (NRC 2003). In response, SCE&G provided estimated benefits and implementation costs for each alternative (SCE&G 2003a). These are discussed further in Appendix G.

The staff concludes that SCE&G used a systematic and comprehensive process for identifying potential plant improvements for V.C. Summer, and that the set of potential plant improvements identified by SCE&G is reasonably comprehensive and therefore acceptable. This search included reviewing insights from the IPE and IPEEE, and plant improvements considered in

previous SAMA analyses. While explicit treatment of external events in the SAMA identification process was limited, the staff recognizes that the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

5.2.4 Risk Reduction Potential of Plant Improvements

SCE&G evaluated the risk-reduction potential of the 12 Phase 2 SAMAs applicable to V.C. Summer, as well as several additional SAMAs suggested by the staff. In response to a staff request, SCE&G further examined several SAMAs including those closest to being cost beneficial to determine the extent to which the SAMAs might reduce external event risk (SCE&G 2003b). The SAMAs considered include: Phase 2 SAMA 3, Phase 2 SAMA 10, use of portable 120V DC generator to supply power to steam generator level instrumentation, installation of direct-drive diesel emergency feedwater pump, and use of the fire service water for make-up to steam generators. This assessment included consideration of both seismic and fire risk.

Based on this assessment, SCE&G concluded that although some credit may be taken for these SAMAs in external events, the benefit is more limited than in the internal events analysis. For example, power recovery in fire events may create additional difficulties not present for the initiators addressed in the internal events model. Also, the low cost alternatives would not be required to meet the rigors of a seismically-qualified component, and therefore, may not be useable following a seismic event. Nevertheless, SCE&G conservatively increased the benefit for these SAMAs by a factor of two to account for external events. In addition, the estimated benefit for all SAMAs was increased by 15 percent to account for the resolution of peer review comments.

The staff has reviewed SCE&G's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and, for the above reasons, are generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on SCE&G's risk reduction estimates.

5.2.5 Cost Impacts of Candidate Plant Improvements

SCE&G estimated the costs of implementing the 12 SAMAs which were not initially screened out. The cost estimates conservatively did not include the cost of replacement power during any extended outages that might be needed to implement the modifications. Estimates that were taken from prior SAMA analyses were not adjusted to present-day dollars. For many of the SAMAs considered, the cost estimates were significantly greater than the benefits

calculated such that a detailed evaluation was not necessary and a specific dollar value was not reported.

The staff reviewed the basis for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates (presented in Table F.6-1 of Appendix F to the ER) to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. A majority of the SAMAs were eliminated from further consideration on the basis that the expected implementation cost would be much greater than the estimated risk reduction benefit.

The staff notes that the cost to implement a direct-drive diesel emergency feedwater pump at another plant was estimated to be about $200K. However, SCE&G estimated the cost of the modification at V.C. Summer to be about $800K based on the following: $200K for design, $200K for evaluations, $100K for materials, $200K for implementation, $30K for training, and $80K for documentation and closeout (SCE&G 2003c). To verify the validity of the $800K cost, the staff reviewed the costs for similar modifications evaluated in other plants' SAMA analyses. These costs ranged from $300K to $2M.

Although SCE&G's cost estimate is significantly greater than $200K, it does not appear to be unreasonable relative to the cost estimates for similar modifications. The staff concludes that the cost estimates provided by SCE&G are sufficient and appropriate for use in the SAMA evaluation.

5.2.6 Cost-Benefit Comparison

The methodology used by SCE&G was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997). The staff reviewed the SCE&G SAMA analysis and questioned the treatment of uncertainties associated with the calculated CDF. SCE&G revisited the cost-benefit analyses for the 12 Phase 2 SAMAs and found SAMAs 3 and 10 potentially cost beneficial (SCE&G 2003a). SAMA 3 was further evaluated and SCE&G estimated the total benefit to be approximately $24K and the cost of implementation to be approximately $150K to $170K. Accordingly, this SAMA is not cost-beneficial. Similarly, SAMA 10 was evaluated further. SCE&G noted that this SAMA would require modification to controls in the main control room. Costs associated with this aspect were not considered in the original cost estimate provided, nor were costs associated with the engineering analysis needed to support the modification. When these additional costs factors are included, the implementation costs would be substantially greater than $50K. The total benefit for this SAMA was estimated to be approximately $48K, accordingly, this SAMA is not cost-beneficial.

The staff questioned SCE&G about lower cost alternatives to several of the SAMAs evaluated, including the use of: (1) portable 120V DC generator to supply power to the steam generator instrument panels, (2) a cross-tie to the existing non-safety station batteries, (3) a direct-drive diesel emergency feedwater pump, and (4) an automatic safety injection pump trip on low refueling water storage tank level as an alternative to an automatic swap to recirculation (NRC 2003). SCE&G provided estimated benefits and implementation costs for each alternative. Based on these estimates, none of these alternatives appear cost beneficial.

The staff concludes that the costs of all of the SAMAs assessed would be higher than the associated benefits. This conclusion is supported by sensitivity analysis and upheld despite a number of additional uncertainties and non-quantifiable factors in the calculations, summarized as follows:

- Uncertainty in the internal events CDF was not initially included in the calculations, which employed best-estimate values to determine the benefits. Even upon considering benefits at the 95th percentile value, no SAMAs were judged to be cost-beneficial.

- External events were similarly not included in the V.C. Summer risk profile. However, given that the expected external events contribution to CDF is calculated in a conservative fashion and is expected to be on the same order of magnitude as the internal events contribution to CDF, a factor of two increase in the estimated internal events benefits to account for the external events should be conservative

- Risk reduction and cost estimates are reasonable, and generally conservative. As such, uncertainty in the costs of any of the contemplated SAMAs would not likely have the effect of making them cost beneficial.

Based on its review of the SCE&G SAMA analysis, as set forth above, the staff finds that none of the candidate SAMAs is cost-beneficial.

5.2.7 Conclusions

SCE&G compiled a list of 268 SAMA candidates using the SAMA analyses as submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, and the plant-specific insights from the V.C. Summer IPE, IPEEE, and current PRA model. A qualitative screening removed SAMA candidates that (1) were not applicable at V.C. Summer due to design differences, (2) had already been implemented at V.C. Summer, (3) were sufficiently similar to another SAMA such that they could be combined, or (4) did not provide a significant safety benefit. A total of 199 SAMA candidates were eliminated based on the above criteria, leaving 69 SAMA candidates for further evaluation.

Using guidance in NUREG/BR-0184 (NRC 1997d), the current PRA model, and a Level 3 analysis developed specifically for SAMA evaluation, a maximum attainable benefit of about $1.2M was calculated, representing the total present dollar value equivalent associated with completely eliminating severe accidents at V.C. Summer. Thirty-seven of the 69 SAMAs were eliminated from further evaluation because their implementation costs were greater than this maximum attainable benefit. An additional 20 SAMAs were eliminated because, based on plant-specific PRA insights, they did not provide a significant safety benefit, or because the cost of implementation would be greater than the benefits associated with implementing the SAMA. For the remaining 12 SAMA candidates and several additional alternatives identified by the staff, more detailed conceptual designs and cost estimates were developed. The cost-benefit analyses showed that none of the candidate SAMAs were cost-beneficial.

The staff reviewed the SCE&G analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the small baseline risks support the general conclusion that the SAMA evaluations performed by SCE&G are reasonable and sufficient for the license renewal submittal. The unavailability of a seismic and fire PRA model precluded a quantitative evaluation of SAMAs specifically aimed at reducing risk of these initiators; however, improvements have been realized as a result of the IPEEE process at V.C. Summer that would minimize the likelihood of identifying further cost-beneficial enhancements in these areas. To assess the potential impact of uncertainties in the analysis or the inclusion of additional benefits in external events, SCE&G applied a factor of two multiplier to the estimated benefits based on internally-initiated events, and confirmed that even when considering the increase in the benefits, none of the SAMAs become cost beneficial.

Based on its review of the SCE&G SAMA assessment, and as explained above, the staff finds that none of the candidate SAMAs are cost beneficial. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the V.C. Summer PRA and the fact that V.C. Summer has already implemented plant improvements identified from the IPE and IPEEE processes.

5.3 References

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

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

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

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U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plant*s. NUREG-1437. Office of Nuclear Regulatory Research. Washington, D.C.

U.S. Nuclear Regulatory Commission. 1997. *Regulatory Analysis Technical Evaluation Handbook*. NUREG/BR-0184, Washington, D.C.

U.S. Nuclear Regulatory Commission. 2003. Letter from Gregory F. Suber, US NRC to Stephen Byrne, SCE&G. Subject: Request for Additional Information Related to the Staff's Review of Severe Accident Mitigation Alternatives for Virgil C. Summer Nuclear Station, January 17, 2003.

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

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

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

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

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are 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 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 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, and are applicable to the Virgil C. Summer Nuclear Station (V.C. Summer). 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,"

(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.

and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The GEIS also addresses the impacts from radon-222 and technetium-99. There are no Category 2 issues for the uranium fuel cycle and solid waste management.

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

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and HLW disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste (LLW) 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

South Carolina Electric and Gas Company stated in its Environmental Report (ER) (SCE&G 2002) that it is not aware of any new and significant information associated with the renewal of the V.C. Summer operating license (OL). The staff has not identified any significant new information on these issues during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, or staff 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 these issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

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

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

  The staff has not identified any new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW) of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

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

  > The 100 year environmental dose commitment to the U.S. population from the fuel cycle, 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 U.S. 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 new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, 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 radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 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 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 U.S. 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 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, the EPA's generic repository standards in 40 CFR part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 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 *Federal Register* 32074 [EPA 2001]). The Energy Policy Act of 1992 (42 U.S. Code 10101 et seq.) directs that the U.S. Nuclear Regulatory Commission (NRC) adopt these standards into its regulations for reviewing and licensing the repository. NRC published its regulations at 10 CFR Part 63, "Disposal of High-Level Radioactive Wastes in Geologic Repository at Yucca Mountain, Nevada" on November 2, 2001 (66 *Federal Register* 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) for radium-226 and radium-228, (b) 0.56 Bq/L (15 pCi/L) for 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, assuming consumption of 2 L/d of the affected water).

On February 15, 2002, subsequent to receipt of a recommendation by the Secretary, U.S. 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 HLW. The U.S. Congress approved this recommendation on July 9, 2002, in House Joint Resolution 87. On July 23, 2002, the President signed into law House Joint Resolution 87. This development does not represent new and significant information with respect to the offsite radiological impacts related to spent fuel and HLW disposal during the renewal term.

The staff has not identified any new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, or staff evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  > The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

  The staff has not identified any new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, 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 new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of LLW 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 new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, 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 new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, 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 new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, 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 HLW to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4 —Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.

  V.C. Summer meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The staff has not identified any new and significant information on this issue during its independent review of the V.C. Summer ER (SCE&G 2002), its site visit, public comments, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

6.2 References

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

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

10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

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

40 CFR Part 197. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 197, "Public Health and Environmental Radiation Protection Standards for Management and Disposal for Yucca Mountain, Nevada."

66 FR 32132, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada. *Federal Register*. Vol. 66, No. 114. June 13, 2001.

66 FR 55792, "Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada." *Federal Register.* Vol. 66, No. 213. November 2, 2001.

Energy Policy Act of 1992. 42 USC 10101, et seq.

South Carolina Electric and Gas Company (SCE&G). 2002. *Virgil C. Summer Nuclear Station License Renewal Application*. "Appendix E, Environmental Report." Docket Number 50/395; License Number NPF-12. Jenkinsville, South Carolina.

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-0046F. 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.

U.S. Environmental Protection Agency (EPA). 2001. "Public Health and Environmental Radiation Protection Standard for Yucca Mountain, Nevada." *Federal Register.* Vol. 66, No 114, pp. 32074–32135. June 13, 2001.

7.0 Environmental Impacts of Decommissioning

Environmental issues associated with decommissioning, which result from continued plant operation during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation 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. There are no Category 2 issues related to decommissioning.

Category 1 issues in Table B-1 of 10 Code of Federal Regulations Part 51, Subpart A, Appendix B that are applicable to decommissioning of the Virgil C. Summer Nuclear Station (V.C. Summer) following the renewal term are listed in Table 7-1. South Carolina Electric and Gas (SCE&G) stated in its Environmental Report (ER) (SCE&G 2002) that it is aware of no new and significant information regarding the environmental impacts of V.C. Summer license renewal. The staff has not identified any significant new information on these issues during its independent review of the SCE&G ER (SCE&G 2002), the staff's site visit, public comments,

(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 V.C. Summer Following the Renewal Term

ISSUE—10 Code of Federal Regulations 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

or staff 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, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation is 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 on this issue during its independent review of the SCE&G ER (SCE&G 2002), the staff's site visit, public comments, or staff 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 on this issue during its independent review of the SCE&G ER (SCE&G 2002), the staff's site visit, public comments, or staff 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 on this issue during its independent review of the SCE&G ER (SCE&G 2002), the staff's site visit, public comments, or staff 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 on this issue during its independent review of the SCE&G ER (SCE&G 2002), the staff's site visit, public comments, or staff 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 on this issue during its independent review of the SCE&G ER (SCE&G 2002), the staff's site visit, public comments, or staff 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 on this issue during its independent review of the SCE&G ER (SCE&G 2002), the staff's site visit, public comments, or staff 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.

7.1 References

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

South Carolina Electric and Gas Company (SCE&G). 2002. *Virgil C. Summer Nuclear Station License Renewal Application*. "Appendix E, Environmental Report." Docket Number 50/395; License Number NPF-12. Jenkinsville, South 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.

8.0 Environmental Impacts of Alternatives

This chapter examines the potential environmental impacts associated with denying the renewal of an operating license (OL) (i.e., the no-action alternative); the potential environmental impacts from electric generation sources other than the Virgil C. Summer Nuclear Station (V.C. Summer); the possibility of purchasing electric power from other sources to replace power generated by V.C. Summer and the associated environmental impacts; the potential environmental impacts from a combination of generation and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by V.C. Summer. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC) three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of 10 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B:

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

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999)[(a)] with the additional impact category of environmental justice.

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act of 1969 specify that the no-action alternative be discussed in an NRC environmental impact statement [10 CFR Part 51, Subpart A, Appendix A(4)]. For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the V.C. Summer OL, and South Carolina Electric and Gas Company (SCE&G) would then decommission V.C. Summer when plant operations cease.

(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.

SCE&G will be required to comply with NRC decommissioning requirements whether or not the OL is renewed. If the V.C. Summer OL is renewed, decommissioning activities may be postponed for up to an additional 20 years. If the OL is not renewed, SCE&G would conduct decommissioning activities according to the requirements in 10 CFR 50.82.

The environmental impacts associated with decommissioning under both license renewal and the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of this supplemental environmental impact statement (SEIS), and Supplement 1 to the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586 (NRC 2002). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

The environmental impacts of the no-action alternative are summarized in Table 8-1 and are discussed in the following paragraphs. Implementation of the no-action alternative would also have certain positive impacts in that adverse environmental impacts associated with current operation of V.C. Summer (e.g., solid waste impacts and adverse impacts on aquatic life) would be eliminated.

The no-action alternative is a conceptual alternative resulting in a net reduction in power production, but with no environmental impacts assumed for replacement power. In actual practice, the power lost by not renewing the V.C. Summer OL would likely be replaced by (1) demand-side management (DSM) and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than V.C. Summer, or (4) some combination of these options. This replacement power would produce additional environmental impacts as discussed in Section 8.2 of this report.

- **Land Use**

  Temporary changes in onsite land use could occur during decommissioning. Temporary changes may include addition or expansion of staging and laydown areas or construction of temporary buildings and parking areas. No offsite land-use changes are expected as a result of decommissioning. Following decommissioning, the V.C. Summer site would likely be retained by SCE&G for other corporate purposes. Eventual sale or transfer of land occupied by V.C. Summer, however, could result in changes to land use. Notwithstanding this possibility, the impacts of the no-action alternative on land use are considered SMALL.

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

Impact Category	Impact	Comment
Land Use	SMALL	Onsite impacts expected to be temporary. No offsite impacts expected.
Ecology	SMALL	Impacts to ecology are expected to be temporary and largely mitigatable using best management practices.
Water Use and Quality	SMALL	Water use will decrease. Water quality unlikely to be adversely affected unless onsite disposal of demolition debris is utilized.
Air Quality	SMALL	Greatest impact is likely to be from fugitive dust; impact can be mitigated by good management practices.
Waste	SMALL	Low-level radioactive waste (LLW) will be disposed of in licensed facilities. A permanent disposal facility for high-level waste is not currently available.
Human Health	SMALL	Radiological doses to employees and members of the public are expected to be within regulatory limits and comparable to, or lower than, doses from operating plants. Occupational injuries are possible, but injury rates at nuclear power plants are below the U.S. average industrial rate.
Socioeconomics	SMALL to LARGE	Decrease in employment in Fairfield County and surrounding counties and tax revenues in Fairfield County.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Minimal impact on land used during plant operations. Land occupied by V.C. Summer would likely be retained by SCE&G for other corporate purposes.
Environmental Justice	SMALL to MODERATE	Some loss of employment opportunities and social programs is expected.

- **Ecology**

  At V.C. Summer, impacts on aquatic ecology could result from removal or the filling of the intake structures discharge canal. Impacts to aquatic ecology would likely be short-term and could be mitigated. The aquatic environment is expected to recover naturally. Impacts on terrestrial ecology could occur as a result of land disturbance for additional laydown yards, stockpiles, and support facilities. Land disturbance is expected to be minimal and to result in relatively short-term impacts that can be mitigated using best management

practices (dust suppression and erosion control). The land is expected to recover naturally. Overall, the ecological impacts associated with decommissioning are considered SMALL.

- **Water Use and Quality**

  Cessation of plant operations would result in a reduction in water use because reactor cooling will no longer be required. As plant staff size decreases, the demand for potable water is expected to also decrease. Overall, water use and quality impacts of decommissioning are considered SMALL.

- **Air Quality**

  Decommissioning activities that can adversely affect air quality include dismantlement of systems and equipment, demolition of buildings and structures, and the operation of internal combustion engines. The most likely adverse impact would be the generation of fugitive dust. Best management practices, such as seeding and wetting, could be used to minimize the generation of fugitive dust. Overall, air quality impacts associated with decommissioning activities are considered SMALL.

- **Waste**

  Decommissioning activities would result in the generation of radioactive and non-radioactive waste. The volume of LLW could vary greatly depending on the type and size of the plant, the decommissioning option chosen, and the waste treatment and volume reduction procedures used. LLW must be disposed of in a facility licensed by NRC or a state with authority delegated by NRC. Recent advances in volume reduction and waste processing have significantly reduced waste volumes.

  A permanent repository for high-level waste is not currently available. The NRC has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in its spent fuel pool or at either onsite or offsite independent spent fuel storage installations [10 CFR 51.23(a)]. Overall, waste impacts associated with decommissioning activities are considered SMALL.

- **Human Health**

  Radiological doses to occupational workers during decommissioning activities are estimated to average approximately five percent of the dose limits in 10 CFR Part 20, and to be similar to, or lower than, the doses experienced by workers in operating nuclear power plants.

Collective doses to members of the public and to the maximally exposed individual as a result of decommissioning activities are estimated to be well below the limits in 10 CFR Part 20, and to be similar to, or lower than, the doses received from operating nuclear power plants. Occupational injuries to workers engaged in decommissioning activities are possible. However, historical injury and fatality rates at nuclear power plants have been lower than the average U.S. industrial rates. Overall, the human health impacts associated with decommissioning activities are considered SMALL.

- **Socioeconomics**

If V.C. Summer ceased operation at the end of its current OL, there would be a decrease in employment and tax revenues associated with the closure. Employment (primary and secondary) impacts and impacts on population would occur over a wide area. Employees working at V.C. Summer reside in a number of South Carolina counties; however, approximately 95 percent of employees live in Fairfield, Lexington, Newberry, and Richland Counties. The no-action alternative would result in the loss of plant payrolls 20 years earlier than if the OL were renewed.

Tax-related impacts would occur in Fairfield County and, to a much lesser extent, to other surrounding counties. Property tax payments made by SCE&G to Fairfield County for V.C. Summer constitute about 41 percent to 50 percent of the County's total property tax revenues (SCE&G 2002). The no-action alternative would result in the loss of the taxes attributable to V.C. Summer. There could also be an adverse impact on housing values and the local nearby economy if V.C. Summer were to cease operations.

Both Chapter 7 of the GEIS and Supplement 1 to NUREG-0586 (NRC 2002) note that socioeconomic impacts would be expected as a result of the decision to close a nuclear power plant, and that the direction and extent of the overall impacts would depend on the state of the economy, the net change in workforce at the plant, and the changes in local government tax receipts. The socioeconomic impacts of decommissioning activities themselves are expected to be SMALL. Appendix J of Supplement 1 to NUREG-0586 (NRC 2002) shows that the overall socioeconomic impact of plant closure plus decommissioning could be greater than SMALL.

The staff has concluded that when the property tax revenue from a nuclear power plant comprises over 20 percent of the tax revenue of a local jurisdiction, the socioeconomic impacts associated with the loss of the plant's tax revenue as a result of plant closure are considered LARGE. The property taxes that SCE&G pays for V.C. Summer comprise more than 40 percent of total revenue of Fairfield County; consequently, the socioeconomic impacts resulting from loss of this revenue are considered LARGE.

SCE&G employees working at V.C. Summer currently contribute time and money toward community involvement, including school, churches, charities, and other civic activities. It is likely that, with a reduced presence in the community following decommissioning, community involvement efforts by SCE&G and its employees in the region would be less.

- **Aesthetics**

  Decommissioning would result in the eventual dismantlement of buildings and structures at the site resulting in a positive aesthetic impact. Noise would be generated during decommissioning operations that might be detectable offsite; however, the impact is unlikely to be of moderate or large significance. Overall, the aesthetic impacts associated with decommissioning are considered SMALL.

- **Historic and Archaeological Resources**

  The amount of undisturbed land needed to support the decommissioning process will be relatively small. Activities conducted within operational areas are not expected to have a detectable effect on important cultural resources because these areas have been impacted during the operating life of the plant. Minimal disturbance of land outside the licensee's operational area for decommissioning activities is expected. Historic and archaeological resources on undisturbed portions of the site are not expected to be adversely affected. Following decommissioning, the site would likely be retained by SCE&G for other corporate purposes. Eventual sale or transfer of the site, however, could result in adverse impacts to cultural resources if the land-use pattern changes dramatically. Notwithstanding this possibility, the impacts of the no-action alternative on historic and archaeological resources are considered SMALL.

- **Environmental Justice**

  Current operations at V.C. Summer have no disproportionate impacts on the minority and low-income populations of Fairfield County and surrounding counties. It is evident from staff research and consultations with local officials that Fairfield and Newberry Counties have benefitted from V.C. Summer in ways that counteract and mitigate negative socioeconomic trends. Closure of V.C. Summer would result in decreased employment opportunities and tax revenues in Fairfield County and surrounding counties, with possible negative and disproportionate impacts on minority or low-income populations. Therefore, because V.C. Summer is located at the expanding boundary of the Columbia Metro Area with many employment opportunities, the environmental justice impacts under the no-action alternative are considered SMALL to MODERATE.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by V.C. Summer, assuming that the OL is not renewed. The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts. The following generation alternatives are considered in detail:

- coal-fired power generation at the V.C. Summer site and at an alternate South Carolina/greenfield site[(a)] (Section 8.2.1),

- natural gas-fired power generation at the V.C. Summer site and at an alternate South Carolina/greenfield site (Section 8.2.2), and

- nuclear power generation at the V.C. Summer site and at an alternate South Carolina/greenfield site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated at V.C. Summer is discussed in Section 8.2.4. Other power generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for V.C. Summer are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year the Energy Information Administration (EIA), a component of the U.S. Department of Energy, issues an Annual Energy Outlook. The *Annual Energy Outlook 2002 With Projections to 2020*, was issued in December 2001 (DOE/EIA 2001a). In this report, EIA projects that combined-cycle[(b)] or combustion turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electric generating capacity between the years 2000 and 2020. Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet baseload[(c)] requirements. Coal-fired plants are projected by EIA to account for approximately nine percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements. Renewable

(a) A greenfield site is assumed to be an undeveloped site with no previous construction.
(b) In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.
(c) A baseload plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation; i.e., these units generally run near full load.

energy sources, primarily wind, geothermal, and municipal solid waste units, are projected by EIA to account for the remaining three percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2005 and 2020, followed by coal-fired plants and then wind generation (DOE/EIA 2001a).

EIA projects that oil-fired plants will account for very little of new generation capacity in the United States during the 2000 to 2020 time period because of higher fuel costs and lower efficiencies (DOE/EIA 2001a).

EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States during the 2000 to 2020 time period because natural gas and coal-fired plants are projected to be more economical (DOE/EIA 2001a). In spite of this projection, a new nuclear plant alternative for replacing power generated by V.C. Summer is considered in Section 8.2.3. Since 1997, the NRC has certified three new standard designs for nuclear power plants under the procedures in 10 CFR Part 52 Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). The submission to the NRC of these three applications for certification indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, the staff received three early site permit applications under 10 CFR Part 52 Subpart A in September and October 2003, further indicating continued interest in building and operating nuclear power facilities.

V.C. Summer has a maximum net electrical output of 966 MW(e). For the coal and natural gas alternatives, SCE&G assumes two standard units in its Environmental Report (ER) (SCE&G 2002), each a maximum 408-MW(e) net electrical output. This approach is followed in this SEIS, although it results in some environmental impacts that are roughly 16 percent lower than if full replacement capacity were constructed. Although customized unit sizes can be built, use of standardized sizes is more economical. In addition, using three 408-MW(e) units for the analysis would overestimate environmental impacts and tend to make the fossil alternatives less attractive.

For purposes of analysis, SCE&G identified Cope Station near Bamberg, South Carolina, as the location for the coal-fired alternative (SCE&G 2002). Cope Station is the site of a new state-of-the-art coal-fired unit. Similarly, for purposes of analysis, SCE&G identified the V.C. Summer site as the location for the gas-fired alternative. This SEIS has been prepared taking account of these preferred and potential sites, but the analyses were not limited to these particular sites.

8.2.1 Coal-Fired Power Generation

The coal-fired alternative is analyzed for both V.C. Summer and an alternate site in South Carolina. As discussed in Section 8.2, the staff assumed construction of two 408-MW(e) units. Co-location with an existing coal-fired unit would preclude the need to construct additional transmission lines and other facilities needed to support coal-fired units.

Coal and lime or limestone for a coal-fired plant sited at V.C. Summer most likely would be delivered via the existing rail line. Lime[(a)] or limestone is used in the scrubbing process for control of sulfur dioxide (SO_2) emissions. Rail delivery also would be the most likely option for delivering coal and lime/limestone to an alternative site for the coal-fired plant. A coal slurry pipeline is also a technically feasible delivery option; however, the associated cost and environmental impacts make a slurry pipeline an unlikely transportation alternative. Construction at an alternative site could necessitate the construction of a new transmission line to connect to existing lines and a rail spur to the plant.

The coal-fired plant would consume approximately 2.4 million MT (2.60 million tons) per year of pulverized bituminous coal with an ash content of approximately 8.8 percent (SCE&G 2002). SCE&G assumes a heat rate of 3.0 J of fuel /J of electricity (10,200 Btu/kWh) and a capacity factor[(b)] of 0.85 in its ER (SCE&G 2002). After combustion, 99.9 percent of the ash (approximately 209,000 MT/yr [230,000 tons/yr]) would be collected and disposed of at the plant site. In addition, approximately 154,000 MT (170,000 tons) of scrubber sludge would be disposed of at the plant site based on annual lime usage of approximately 86,000 MT (95,000 tons).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the SCE&G ER (SCE&G 2002). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

(a) In a typical wet scrubber, lime (calcium hydroxide) or limestone (calcium carbonate) is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with sulfur dioxide to form calcium sulfite which precipitates and is removed in sludge form.

(b) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

8.2.1.1 Once-Through Cooling System

For purposes of this SEIS, the staff assumed that a coal-fired plant located at V.C. Summer would use the existing once-through cooling system. The staff also assumed that a greenfield site would use a once-through cooling system. In Section 8.2.1.2 of this SEIS, the staff discusses the environmental impact differences between closed-cycle and once-through cooling systems.

The overall impacts of the coal-fired generating system are discussed in the following sections and summarized in Table 8-2. The extent of impacts at an alternate South Carolina/greenfield site would depend on the location of the particular site selected.

- **Land Use**

  The V.C. Summer site is approximately 909 ha (2245 ac). Construction of the power block and coal storage area would impact some land area and associated terrestrial habitat. The existing facilities and infrastructure at V.C. Summer would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that the coal-fired replacement plant alternative would use the cooling system, switchyard, offices, rail spur, and transmission line rights-of-way.

  The coal-fired generation alternative would necessitate converting some of the unused land at V.C. Summer to coal storage and ash scrubber sludge disposal. SCE&G estimates that ash and scrubber waste disposal over a 40-year plant life would require approximately 85 ha (210 ac) (SCE&G 2002). There is sufficient space at V.C. Summer to accommodate the coal-fired plant, about 560 ha (1390 ac) based on estimates in the GEIS [NRC 1996], and the waste disposal area. After closure, the waste site would be re-vegetated and the land would become available for other uses. Additional land-use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. In the GEIS, the staff estimated that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing of the waste to support a 1000-MW(e) coal plant during its operational life (NRC 1996). Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for V.C. Summer.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at V.C. Summer and an Alternate Greenfield Site Using Once-Through Cooling

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Use of existing infrastructure. Uses about 560 ha (1390 ac) for plant, waste disposal of coal ash and scrubber sludge over 40-year plant life. Additional offsite land impacts for coal and limestone mining.	SMALL to LARGE	Uses approximately 860 ha (1390 ac), for plant, offices, parking and waste disposal; additional land impacts for coal and limestone mining; possible impacts for transmission line and rail spur. Degree of impact dependent on whether alternative site is disturbed: SMALL to MODERATE impact to previously developed site; LARGE impact to greenfield site.
Ecology	SMALL to MODERATE	Uses mainly previously disturbed areas at current V.C. Summer site, plus rail corridor. However, some additional areas at the site will be affected.	SMALL to LARGE	Impact depends whether site is previously developed (SMALL to MODERATE) or greenfield (MODERATE to LARGE). Factors to consider include location and ecology of site, surface water body used for intake and discharge, and transmission line and/or rail spur route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality	SMALL	Once-through cooling would use existing intake structures; surface water use should remain the same as current uses for V.C. Summer.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.

Table 8-2. (contd)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Air Quality	MODERATE	Sulfur oxides • 5669 MT/yr (6249 tons/yr) Nitrogen oxides • 582 MT/yr (642 tons/yr) Particulates • 102 MT/yr (113 tons/yr) of total suspended particulates which would include 24 MT/yr (26 tons/yr) of PM_{10}. Carbon monoxide • 582 MT/yr (642 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials–mainly uranium and thorium.	MODERATE	Potentially same impacts as the V.C. Summer site, although pollution-control standards may vary.
Waste	MODERATE	Total waste volume would be approximately 363,000 MT/yr (400,000 tons/yr) of ash and scrubber sludge requiring approximately 85 ha (210 ac) for disposal during the 40-year life of the plant.	MODERATE	Potentially same impacts as the V.C. Summer site.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.	SMALL	Potentially same impacts as the V.C. Summer site.

Table 8-2. (contd)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to LARGE	During construction, impacts would be SMALL to MODERATE. Up to 2500 additional contractor employees during the peak period of the 5-year construction period, followed by reduction from current V.C. Summer workforce of 740 to 70. Tax base preserved. Impacts during operation would be SMALL to MODERATE. Transportation impacts associated with construction contractor employees could be MODERATE to LARGE. Transportation impacts during operation would be SMALL due to decreased workforce. For rail transportation of coal and lime/limestone, the impact is considered SMALL to MODERATE.	SMALL to LARGE	Construction impacts depend on location, but could be LARGE if plant is located in a rural area. Fairfield County would experience loss of tax base and employment with potentially LARGE impacts. Impacts during operation at alternative site would be SMALL to LARGE, depending upon the economy at the alternate site. Transportation impacts associated with construction contractor employees could be MODERATE to LARGE. Transportation impacts during operation would be SMALL. For rail transportation of coal and lime/limestone, the impact is considered SMALL to MODERATE. For barge transportation, the impact is considered SMALL.
Aesthetics	SMALL to MODERATE	Two coal-fired power plant units and exhaust stack would be visible in daylight hours from offsite. Outside lighting at the plant would also be visible at night. Rail transportation of coal and lime/limestone would also have a MODERATE impact. Mechanical sources of noise would be audible offsite. These impacts are SMALL to MODERATE.	SMALL to LARGE	Impact would depend on the site selected and the surrounding land features and could be LARGE if a greenfield site is selected. If needed, a new transmission line or rail spur would add to aesthetic impact. Rail transportation of coal and lime/limestone would be SMALL to MODERATE, depending on the characteristics of the alternative site.

Table 8-2. (contd)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Historic and Archaeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 600 operating jobs (permanent and contractor) at V.C. Summer could reduce employment prospects for minority and low-income populations. Dependent, to some extent, on the economic growth of Columbia and surrounding area.	SMALL to LARGE	Impacts at alternate site will vary depending on population distribution and makeup. Could be SMALL to LARGE. Fairfield County would lose significant revenue, which could have MODERATE to LARGE impacts on minority and low-income populations in terms of services the County could provide with the smaller property tax and employment base.

The GEIS states that approximately 405 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant (NRC 1996).

The impact of a coal-fired generating unit on land use at V.C. Summer is best characterized as SMALL to MODERATE. The impact would definitely be greater than the OL renewal alternative.

In the GEIS, the staff estimated that a 1000-MW(e) coal-fired plant would require approximately 700 ha (1700 ac) (NRC 1996). Construction of a 816-MW(e) coal-fired

generation alternative at an alternative site could impact proportionately less land (about 560 ha [1390 ac]). The degree to which the land use would be impacted depends on whether the alternative site is a greenfield site or a previously developed industrial site (such as Cope Station). Additional land could be needed for a transmission line and a rail spur to the plant site. Depending on transmission line and rail line routing requirements, this alternative would result in SMALL to LARGE land-use impacts.

- **Ecology**

  Locating a coal-fired plant at V.C. Summer would alter ecological resources because of the need to convert approximately 85 ha (210 ac) (SCE&G 2002) for ash and scrubber sludge disposal. In addition, construction of the power block and coal storage area would impact about 475 ha (1190 ac) and associated habitat. Some of this area would have been previously disturbed. Operation of the coal-fired plant would use the existing cooling system, which would have adverse impacts to aquatic resources. In summary, because the coal-fired alternative is developed on a mainly previously disturbed area at an existing industrial site, and makes maximum use of existing facilities, it is expected that the ecological impacts would be SMALL to MODERATE, but still greater than renewal of the V.C. Summer OL.

  At an alternate site, the coal-fired generation alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Once-through cooling water withdrawal and discharge could have adverse aquatic resource impacts. If needed, construction and maintenance of the transmission line and a rail spur would have ecological impacts. Overall, the ecological impacts at an alternate site would be SMALL to MODERATE (previously developed site) or MODERATE to LARGE (greenfield site).

- **Water Use and Quality**

  Surface water. The coal-fired generation alternative at V.C. Summer is assumed to use the existing once-through cooling system, which would minimize incremental water-use and quality impacts. Thus surface-water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

  For a coal-fired plant located at an alternate site, the impact on the surface water would depend on the volume of water needed for make-up water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface

body of water would be regulated by the State of South Carolina. The impacts would be SMALL to MODERATE.

Groundwater. The staff assumed that the two groundwater removal wells would continue to be used to alleviate water seepage into the below-grade portions of coal-fired plant buildings located at V.C. Summer. Groundwater withdrawals would be equal to or less than the no-action and license renewal alternatives. Hence, impacts are considered SMALL. Use of groundwater for a coal-fired plant located at an alternative site is a possibility. Groundwater withdrawals at an alternative site would likely require a permit from the State of South Carolina. The impacts are considered SMALL.

- **Air Quality**

The air-quality impacts of coal-fired generation vary considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

V.C. Summer is located within the Columbia Intrastate Air Quality Control Region (40 CFR 81.108). The air quality in this region is designated as better than national standards, in attainment, or unclassified for all criteria pollutants, in 40 CFR 81.341. However, on August 23, 2002, the South Carolina Department of Health and Environmental Control (SCDHEC) published a "Notice of Drafting" in the State Register for an Early Action Plan for measures to attain the 8-hour standard prior to any non-attainment designation. The State intends to implement control measures in anticipation of future U.S. Environmental Protection Agency (EPA) actions. It is likely that the Columbia Intrastate Air Quality Control Region will be designated as a non-attainment area under the 8-hour ozone standard.

A new coal-fired generating plant located in V.C. Summer would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60 Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42a), SO_2 (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51 Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act. The air quality in this region is designated as better than national standards, in attainment, or unclassified for all criteria pollutants, in 40 CFR 81.341.

Section 169A of the Clean Air Act (42 U.S. Code [USC] 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from human-made air pollution. EPA issued a new regional haze rule on July 1, 1999 (64 *Federal Register* (FR) 35714 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a coal-fired plant were located close to a mandatory Class I Federal area, additional air pollution control requirements could be imposed.

South Carolina has only one area (Cape Romain Wildlife Area) designated in 40 CFR 81.426 as a mandatory Class I Federal area in which visibility is an important value. This Class I Federal area is not within 80 km (50 mi) of V.C. Summer.

In 1998, the EPA issued a rule requiring 22 eastern states, including South Carolina, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 to September 30) is set out at 40 CFR 51.121(e). For South Carolina, the amount is 111,656 MT (123,105 tons). Any new coal-fired plant sited in South Carolina would be subject to this limitation.

Impacts for particular pollutants are as follows:

Sulfur oxides emissions. SCE&G states in its ER that an alternative coal-fired plant located at Cope Station would use dry scrubber-calcium hydroxide for flue gas desulfurization (SCE&G 2002).

A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. The EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net

regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative.

SCE&G estimates that by using the best technology to minimize SO_x emissions, the total annual stack emissions would be approximately 5669 MT (6249 tons) of SO_x (SCE&G 2002).

Nitrogen oxides emissions. Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain nitrogen oxides (expressed as NO_2) in excess of 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

SCE&G estimates that by using NO_x burners with overfire air and selective catalytic reduction the total annual NO_x emissions for a new coal-fired power plant would be approximately 582 MT (642 tons) (SCE&G 2002). This level of NO_x emissions would be greater than the OL renewal alternative.

Particulate emissions. SCE&G estimates that the total annual stack emissions would include 102 MT (113 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 μm up to approximately 45 μm). The 102 MT (113 tons) would include 24 MT (26 tons) of PM_{10} (particulate matter having an aerodynamic diameter less than or equal to 10 μm). Fabric filters or electrostatic precipitators would be used for control. In addition, coal-handling equipment would introduce fugitive particulate emissions. Particulate emissions would be greater under the coal alternative than the OL renewal alternative.

During the construction of a coal-fired plant, fugitive dust would be generated. In addition, exhaust emissions would come from vehicles and motorized equipment used during the construction process.

Carbon monoxide emissions. SCE&G estimates that the total carbon monoxide emissions would be approximately 582 MT (642 tons) per year (SCE&G 2002). This level of emissions is greater than the OL renewal alternative.

Hazardous air pollutants including mercury. In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam generating units (65 FR 79825 [EPA 2000a]). The EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power

plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000a). The EPA concluded that mercury is the hazardous air pollutant of greatest concern. The EPA found that (1) there is a link between coal consumption and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000a). Accordingly, EPA added coal- and oil-fired electric utility steam-generating units to the list of source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (EPA 2000a).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a typical coal-fired plant released roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air-quality impacts would be substantial. The GEIS also mentioned global warming from unregulated carbon dioxide emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects such as cancer and emphysema have been associated with the products of coal combustion. The appropriate characterization of air impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Siting a coal-fired generation plant at a site other than V.C. Summer would not significantly change the air-quality impacts identified in this section, although it could result in installing more or less stringent pollution-control equipment to meet applicable local requirements. Therefore, the impacts would be MODERATE.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates spent selective catalytic reduction catalyst, additional ash, and scrubber sludge. Two 408-MW(e) coal-fired plants would generate approximately 363,000 MT (400,000 tons) of this waste annually for 40 years. The waste would be disposed of onsite, accounting for approximately 85 ha (210 ac) of land area over the 40-year plant life. Waste

impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses. Construction-related debris would also be generated during construction activities.

In May 2000, the EPA issued a Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels (65 FR 33213 [EPA 2000b]). The EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could present danger to human health and the environment under certain conditions; (2) EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 percent to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and (4) EPA identified gaps in state oversight of coal combustion wastes. Accordingly, the EPA announced its intention to issue regulations for disposal of coal combustion waste under Subtitle D of the Resource Conservation and Recovery Act of 1976 (42 USC 6901).

For these reasons, the appropriate characterization of impacts from waste generated from burning coal is MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

Siting the facility at a site other than V.C. Summer would not alter waste generation, although other sites might have more constraints on disposal locations. Therefore, the impacts would be MODERATE.

- **Human Health**

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

The staff stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the EPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As previously discussed, the EPA has recently concluded that certain segments of the United States population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal are characterized as SMALL.

- **Socioeconomics**

Construction and operation. Construction of the coal-fired alternative would take approximately five years. The staff assumed that construction would take place while V.C. Summer continues operation and would be completed by the time V.C. Summer permanently ceases operations. The workforce would be expected to vary between 1200 and 2500 contractor employees during the five-year construction period (NRC 1996). These employees would be in addition to the approximately 740 SCE&G employees at V.C. Summer. During construction of the new coal-fired plant, communities near V.C. Summer would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction contractor employees commuting to the site from outside the immediate area of the site, including Columbia, South Carolina. After construction, the communities would be impacted by the loss of the construction jobs.

If the coal-fired replacement plant were constructed at V.C. Summer and the nuclear unit were decommissioned, there would be a loss of approximately 670 permanent and contract employees, as SCE&G estimates that the completed coal-fired plant would employ approximately 70 employees (SCE&G 2002). There would be a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. The coal-fired plants would provide a new tax base to offset the loss of tax base associated with decommissioning of the nuclear unit. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for a coal-fired plant constructed at V.C. Summer would be SMALL to MODERATE; the socioeconomic impacts would be noticeable, but would be unlikely to destabilize the area. The impacts could be mitigated by the site's proximity to the Columbia metropolitan area and might be additionally offset if economic growth in Columbia and surrounding areas continued as it has during the last decade.

Construction of a replacement coal-fired power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. Fairfield County would

experience the brunt of V.C. Summer operational job loss and would lose a significant tax base. These losses could have potentially LARGE socioeconomic impacts to the County, particularly over the short to intermediate term (from five to 10 years following plant closure). Communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 employees at the peak of construction) and a permanent workforce of approximately 70 employees. The staff stated in the GEIS that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work. Alternative sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at or near an urban, previously developed industrial area would be SMALL. Socioeconomic impacts at a rural site would be MODERATE to LARGE, depending on the relative location of the site to towns and cities that might be able to accommodate such impacts.

Transportation. During the five-year construction period of replacement coal-fired units, up to 2500 construction contractor employees would be working at the site in addition to the 740 SCE&G employees at V.C. Summer. The addition of these contractor employees could place significant traffic loads on existing highways near V.C. Summer. Such impacts would be MODERATE to LARGE.

For transportation related to commuting of plant operating personnel, the impacts are considered SMALL. The maximum number of plant operating personnel would be approximately 70. The current V.C. Summer workforce is approximately 740. Therefore, traffic impacts associated with plant personnel commuting to a coal-fired plant would be expected to be SMALL compared to the current impacts from V.C. Summer operations.

Coal and lime/limestone would likely be delivered to V.C. Summer by trains. Each train would have approximately 115 open-top rail cars, each holding about 90 MT (100 tons) of coal. Additional cars would be needed for lime/limestone delivery. In all, approximately 224 trains per year would deliver the coal and lime/limestone for the two units. An average of nine train trips per week would be needed to transport the coal and lime/limestone. For each full train delivery, an empty train would return. On several days per week, there would be two to three trains per day using the rail spur to V.C. Summer. Socioeconomic impacts associated with rail transportation, such as delays at rail crossings, would likely be SMALL to MODERATE.

Transportation-related impacts associated with commuting construction contractor employees at an alternate site are site dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL due to a smaller workforce.

At an alternate site, coal and lime/limestone delivery would likely be by rail, although barge delivery would be feasible at a coastal location. Impacts of rail transportation would be SMALL in a rural area and MODERATE in a more crowded suburban area. Barge delivery of coal and lime/limestone would likely have SMALL socioeconomic impacts.

- **Aesthetics**

The two coal-fired power plant units would be visible in daylight hours from offsite. The exhaust stack would be about 160 m (525 ft) high. The stack would be visible for several miles in every direction during daylight hours. The units and associated stacks would also be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and color selection for buildings that are consistent with the environment. Visual impacts at night could be mitigated by reduced use of lighting and appropriate use of shielding or directional lighting.

Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime delivery, use of outside loudspeakers, and the commuting of plant employees. The incremental noise impacts of a coal-fired plant compared to existing V.C. Summer operations are considered to be SMALL to MODERATE.

At an alternate site, there would be an aesthetic impact from the buildings and exhaust stacks. This impact could be LARGE if a greenfield site is used. There would also be an aesthetic impact if construction of a new transmission line and/or rail spur were needed. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. In a more suburban location, the impacts are considered MODERATE. This is due to the frequency of train transport, the fact that many people are likely to be within hearing distance of the rail route, and the impacts of noise on residents in the vicinity of the facility and the rail line. At a more rural location, the impacts could be SMALL. Noise and light from the plant would be detectable offsite. Overall, the aesthetic impacts associated with locating at an alternative site can be categorized as SMALL to LARGE, depending on the characteristics of the alternative site.

- **Historic and Archaeological Resources**

  At the V.C. Summer site or an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Before construction at the V.C. Summer site or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts need to be evaluated on a site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary between SMALL to MODERATE, depending on the historic and archaeologic resources that may be present, and whether mitigation is necessary.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the V.C. Summer site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations to the extent housing frequented by these populations could come into increased demand. Closure of V.C. Summer would result in a decrease in employment of approximately 600 permanent and contract employees at the site. Resulting economic conditions could reduce employment prospects for minority or low-income populations. Overall, impacts would be SMALL to MODERATE, and may be mitigated by the economic vitality/expansion of the Columbia metropolitan and surrounding area.

  Impacts at other sites would depend upon the site chosen and the nearby population distribution. If a replacement coal-fired plant were constructed at an alternative site, Fairfield County would experience a loss of tax revenue that could affect their ability to provide services and programs. Fairfield County and surrounding counties would also lose 670 jobs. These impacts would be MODERATE to LARGE. Impacts at the alternative site would vary between SMALL and LARGE, depending on population makeup and distribution and the economy.

8.2.1.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a coal-fired generation system at an alternate location site using a closed-cycle cooling system with cooling towers. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a coal-fired plant using the once-through cooling system. However, there are some environmental impact differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation at an Alternate Site with Closed-Cycle Cooling System

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial biota from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation.
Groundwater Use and Quality	No change.
Air Quality	No change.
Waste	No change.
Human Health	No change.
Socioeconomics	No change.
Aesthetics	Introduction of cooling towers and associated plume. Natural draft towers could be up to 158 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact.
Historic and Archaeological Resources	No change.
Environmental Justice	No change.

8.2.2 Natural Gas-Fired Power Generation

The environmental impacts of the natural gas-fired alternative are examined in this section for both the V.C. Summer site and an alternate site. For the V.C. Summer site, the staff assumed that the plant would use the existing once-through cooling system.

V.C. Summer is not served by natural gas pipelines. A dedicated, 0.6-m (2-ft) diameter pipeline would have to be constructed to V.C. Summer from Aiken, South Carolina, a distance of about 113 km (70 mi). The pipeline right-of-way would require 298 ha (737 ac).[(a)]

The staff assumed that a replacement natural gas-fired plant would use combined-cycle technology (SCE&G 2002). In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

If a new natural gas-fired plant were built at an alternate site from V.C. Summer, a new transmission line may be needed to connect to existing lines. In addition, construction or upgrade of a natural gas pipeline from the plant to a supply point where an adequate and reliable supply of gas would be available also may be required.

The following additional assumptions are made for the natural gas-fired plants (SCE&G 2002):

- two 408-MW(e) net electrical units would be needed, each consisting of a 135-MW combustion turbine and a 138-MW heat recovery boiler,
- natural gas with an average heating value of 37 MJ/m^3 (1037 Btu/ft^3) will be the primary fuel,
- natural gas consumption will be 1.4 billion m^3/yr (50 billion ft^3/yr).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.2 are from the SCE&G ER (SCE&G 2002). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the natural gas-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a natural gas-fired plant).

(a) Calculated as follows: 70 mi x 100 ft easement = 298 ha or 737 ac.

8.2.2.1 Once-Through Cooling System

The overall impacts of the natural gas-generating system are discussed in the following sections and summarized in Table 8-4. The extent of impacts at an alternate site will depend on the location of the particular site selected.

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at V.C. Summer and an Alternate Greenfield Site Using Once-Through Cooling

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	45 ha (110 ac) of previously disturbed land needed for plant site. Additional impact of up to approximately 295 ha (729 ac) for construction of an underground gas pipeline. Maximum use of existing infrastructure at the site.	SMALL to LARGE	SMALL if infrastructure is in place, 45 ha (110 ac) for powerblock, offices, roads, and parking areas. MODERATE if additional land needed for transmission line and/or natural gas pipeline. LARGE if greenfield site and transmission lines required.
Ecology	SMALL to LARGE	Uses some undeveloped areas at V.C. Summer site, plus gas pipeline.	SMALL to LARGE	Impact depends on greenfield or previously developed site. Also impact depends on biota of the site, surface water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality	SMALL	Uses existing once-through cooling system.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface water body.

Table 8-4. (contd)

Impact Category	V.C. Summer Site Impact	V.C. Summer Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.
Air Quality	MODERATE	Sulfur oxides • 80 MT/yr (88 tons/yr) Nitrogen oxides • 301 MT/yr (332 tons/yr) Carbon monoxide • 395 MT/yr (435 tons/yr) PM_{10} particulates • 118 MT/yr (130 tons/yr) Some hazardous air pollutants.	MODERATE	Same emissions as V.C. Summer site.
Waste	SMALL	Small amount of ash produced.	SMALL	Small amount of ash produced.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 1200 additional contractor employees during the peak of the three-year construction period, followed by reduction from current V.C. Summer workforce of 740 to 150; tax base preserved. Impacts during operation would be SMALL to MODERATE, due to loss of employment in Fairfield County and surrounding counties, which may be offset by proximity to Columbia economy. Transportation impacts associated with construction contractor employees would be SMALL to MODERATE.	SMALL to LARGE	Impact depends on site characteristics. During construction, impacts on receiving County could be SMALL to MODERATE. Up to 1200 additional contractor employees during the peak of the three-year construction period. Fairfield County would experience loss of V.C. Summer tax base. Fairfield County and surrounding counties would experience loss of employment with potentially MODERATE to LARGE associated impacts. Transportation impacts associated with construction contractor employees would be SMALL to LARGE.

Table 8-4. (contd)

Impact Category	V.C. Summer Site		Alternate Greenfield Site	
	Impact	Comments	Impact	Comments
Aesthetics	SMALL	Some visibility of structures offsite.	SMALL to LARGE	Impact would depend on the site selected and the surrounding land features. SMALL if previously developed site and site disturbance minimal. MODERATE to LARGE if a greenfield site is selected.
Historic and Archaeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site. Any potential impacts can likely be effectively managed.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 590 operating jobs at V.C. Summer could reduce employment prospects for minority and low-income populations. Proximity to Columbia may mitigate impacts.	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site could be SMALL to LARGE. Fairfield County would lose significant revenue, which could have MODERATE to LARGE impacts on minority and low-income populations. Proximity to Columbia may mitigate impacts.

- **Land Use**

  For siting at V.C. Summer, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that the natural gas-fired replacement plant alternative would use the once-through cooling system, switchyard, offices, and transmission line right(s)-of-way. Much of the land that would be used has been previously disturbed. In the GEIS, staff estimated

that 45 ha (110 ac) are needed for a natural gas-fired plant site (NRC 1996). At V.C. Summer, this much previously disturbed land is available within the boundaries of the plant site (SCE&G 2002). There would be an additional impact of up to approximately 295 ha (729 ac) for construction of a natural gas pipeline to the V.C. Summer site (SCE&G 2002). SCE&G states that it would apply best management practices during construction of the pipeline such as minimizing soil loss and constructing the pipeline along existing utility corridors, if possible (SCE&G 2002). Land-use impacts at V.C. Summer would be SMALL to MODERATE and depend on the extent to which ecological damage could be minimized in the construction of the natural gas pipeline.

For construction at an alternate site, the staff assumed that 45 ha (110 ac) would be needed for the plant and associated infrastructure (NRC 1996). A previously developed site with substantial infrastructure in place (e.g., gas line and transmission line), would be characterized as having SMALL impacts. For any new natural gas plant, additional land could be impacted for construction of a transmission line and/or natural gas pipeline to serve the plant, in which case the impacts could be MODERATE. Land use impacts at a greenfield site could be considered LARGE.

Offsite of V.C. Summer or alternative site, additional land would be required for natural gas wells and collection stations. NRC staff estimated in the GEIS that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant. A replacement gas-fired plant for V.C. Summer would be 816 MW(e) and would affect proportionately less land. Partially offsetting these offsite land requirements would be the elimination of the need for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant. The staff estimated in the GEIS (NRC 1996) that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant. Because the two assumed replacement units for V.C. Summer would generate 408 MW(e) each, the land needed for gas wells and collection stations (and the land not needed for nuclear fuel) would be proportionately lower. Overall, land-use impacts would be MODERATE to LARGE.

- **Ecology**

At the V.C. Summer site, there would be ecological, land-related impacts for siting of the gas-fired plant; however the impacts would be SMALL considering the smaller footprint of the new facility (compared to the existing nuclear facilities) and the fact that the land at the site is previously disturbed. There would be ecological impacts associated with bringing a new gas pipeline to V.C. Summer. Impacts would include losses of less mobile animals such as mice, which are common throughout the area. Aquatic impacts could include habitat disturbance at stream crossings, removal of shading vegetation, and erosion and sedimentation. Habitat of State- or Federal-listed mussel species might be affected. Noise

and movement from employees would also disturb wildlife. SCE&G expects the impacts to be minor and temporary (SCE&G 2002). Overall, the ecological impacts are considered SMALL to LARGE.

Ecological impacts at an alternate site would depend on the nature of the land converted for the plant and the possible need for a new transmission line and/or gas pipeline. At a greenfield site, construction of a transmission line and a gas pipeline to serve the plant could be expected to have ecological impacts. Whether these impacts are temporary or permanent and the extent to which ecological resources are impacted is highly dependent on the location of the alternative site. Ecological impacts resulting from plant siting and utility easements could include impacts on threatened or endangered species. There could be wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Once-through cooling water withdrawal and discharge could have aquatic resource impacts. Aquatic impacts could include habitat disturbance at stream crossings, removal of shading vegetation, and erosion and sedimentation. Habitat of State- or Federal-listed mussel species might be affected. Hence, at a greenfield site the ecological impacts are expected to be MODERATE to LARGE. If the alternative site selected already has been developed, then the terrestrial ecological impacts would be SMALL if the required infrastructure is already in place. Aquatic impacts would be SMALL to MODERATE, depending on the site location and aquatic habitats affected. Overall, the ecological impacts at an alternative site are considered SMALL to LARGE, depending on the characteristics of the site selected.

- **Water Use and Quality**

Surface water. The gas-fired plant sited at V.C. Summer is assumed to use the existing once-through cooling system. Each of the gas-fired units would include a heat-recovery boiler from which steam would turn an electric generator. Steam would be condensed and circulated back to the boiler for reuse. Overall, water use and quality impacts at V.C. Summer are considered SMALL as operation impacts are minimized by use of the existing intake/discharge system. Water quality impacts from sedimentation during construction of a natural gas-fired plant is characterized by the staff in the GEIS as SMALL (NRC 1996). The staff also notes that operational water quality impacts would be similar to, or less than, those from other generating technologies.

For alternative sites, the impacts on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State of South Carolina. Water use and quality impacts at an alternative site are considered SMALL to MODERATE, depending on the characteristics of the alternative site.

Groundwater. The staff assumed that the two groundwater removal wells would continue to be used to alleviate water seepage into the below-grade portions of buildings located at V.C. Summer. Groundwater withdrawals would be equal to the no-action and license renewal alternatives. Hence, impacts are considered SMALL. Use of groundwater for a natural gas-fired plant located at an alternative site is a possibility. Groundwater withdrawals at an alternative site would likely require a permit from the State of South Carolina. For alternate greenfield sites, the impact to groundwater would depend on the site characteristics, including the amount of groundwater available. Overall, the impacts are considered SMALL.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Hence, it would be subject to the same air quality regulations as a coal-fired plant.

A new gas-fired generating plant located at V.C. Summer would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. A new combined-cycle natural gas power plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x. Obtaining air permits for construction of a combined-cycle plant would potentially require emission offsets from other generating facilities.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from human-made air pollution. EPA has various regulatory requirements for visibility protection in 40 CFR Part 51 Subpart P, including a specific requirement for review of any new major stationary source in an area designated attainment or unclassified under the Clean Air Act. EPA issued a new regional haze rule in 1999 (64 FR 35714; July 1,1999 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a state, the State must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a natural gas-fired plant were located close to a mandatory Class I Federal area, additional air pollution control requirements could be imposed. South Carolina has only one area (Cape Romain Wildlife Area) designated in 40 CFR 81.426 as a mandatory Class I Federal area in which visibility is an important value. This Class I Federal area is not within 80 km (50 mi) of V.C. Summer.

In 1998, the EPA issued a rule requiring 22 eastern states, including South Carolina, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 to September 30) is set out at 40 CFR 51.121(e). For South Carolina, the amount is 111,656 MT (123,105 tons).

SCE&G projects the following emissions for the natural gas-fired alternative (SCE&G 2002):

Sulfur oxides - 80 MT/yr (88 tons/yr)
Nitrogen oxides - 301 MT/yr (332 tons/yr)
Carbon monoxide - 395 MT/yr (435 tons/yr)
PM_{10} particulates - 118 MT/yr (130 tons/yr)

A natural gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). Natural gas-fired power plants were found by the EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal and oil-fired plants, the EPA did not determine that emissions of hazardous air pollutants from natural gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. These would be similar to the coal-fired alternative, but smaller due to the smaller construction workforce.

The preceding emissions would likely be the same at V.C. Summer or at an alternate site. Impacts from the above emissions would be clearly noticeable, but would not be sufficient to destabilize air resources as a whole. The overall air-quality impact for a new natural gas-generating plant sited at V.C. Summer or at an alternate site is considered MODERATE.

- **Waste**

There will be small amounts of solid-waste products (i.e., ash) from burning natural gas. In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in very few combustion by-products because of the clean nature of the fuel. Waste generation at a gas-fired plant would be largely limited to typical office wastes. Waste-generation impacts would be so minor that they would not

noticeably alter any important resource attribute. Construction-related debris would be generated during construction activities. Overall, the waste impacts would be SMALL for a natural gas-fired plant sited at V.C. Summer or at an alternate site.

In the winter it may become necessary for a replacement baseload natural-gas fired plant to operate on fuel oil due to lack of gas supply. Oil combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. The amount of ash and sludge generated would depend on the type and quantity of fuel oil combusted, Number 2 fuel oil doesn't produce any appreciable ash, while the heavier Number 6 fuel oil does. Overall, the waste impacts associated with fuel oil combustion at a combined-cycle plant are expected to be SMALL because the amount of oil combusted is expected to be relatively small. When natural gas is available, fuel oil is generally not price competitive with gas.

- **Human Health**

In the GEIS, the staff identified cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. NO_x emissions from a gas-fired plant in South Carolina would be regulated by SCDHEC. Human health effects are not expected to be detectable or would be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of the natural gas-fired alternative sited at V.C. Summer or at an alternate site are considered SMALL.

- **Socioeconomics**

Construction and Operation. Construction of a natural gas-fired plant would take approximately three years. Peak employment would be approximately 1200 construction contractor employees (NRC 1996). The staff assumed that construction would take place while V.C. Summer continues operation and would be completed by the time it permanently ceases operations. During construction, the communities surrounding the V.C. Summer site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction contractor employees commuting to the site from cities such as Columbia. After construction, the communities would be impacted by the loss of jobs. The current V.C. Summer workforce (740 permanent and contractor employees) would decline through a decommissioning period to a minimal maintenance size. Approximately 150 employees would be needed to operate the natural gas-fired plant (a loss of about 590 jobs). The new natural gas-fired plant partially would replace the nuclear tax base in Fairfield and surrounding counties. The

impacts could be SMALL to MODERATE and may be moderated by Fairfield County's proximity to Columbia.

Siting at an alternative site would result in the loss of the V.C. Summer tax base and associated employment in Fairfield and surrounding counties with potentially MODERATE to LARGE socioeconomic impacts. Socioeconomic impacts from locating the facilities at an alternative site would depend on the characteristics of the site. Impacts of construction could range between SMALL to MODERATE. Impacts during plant operation would be SMALL (smaller workforce), and the tax impacts could be SMALL to LARGE, depending on the relative proportion of taxes paid by the plant to total County taxes. In the GEIS (NRC 1996), the staff concluded that socioeconomic impacts from constructing a natural gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology. Compared to the coal-fired and nuclear alternatives, socioeconomic impacts would be mitigated by the smaller construction workforce, the shorter construction time frame, and the smaller operations workforce.

Overall socioeconomic impacts resulting from construction of a natural gas-fired plant at V.C. Summer would be SMALL to MODERATE, and may be offset by the continued growth of the economy in the Columbia and surrounding area. For construction at an alternate site, socioeconomic impacts would be SMALL to LARGE, depending on the characteristics of the alternative site.

Transportation. Transportation impacts associated with construction and operating personnel commuting to the V.C. Summer site would be SMALL to MODERATE. The impacts can be classified as SMALL to LARGE for siting at an alternative site and would be dependent on the characteristics of the alternative site, including transportation infrastructure.

Aesthetics

The turbine buildings and exhaust stacks would be visible during daylight hours from offsite creating incremental visual impacts to those from existing V.C. Summer facilities. The gas pipeline compressors would also be visible. Noise and light from the plant would be detectable offsite. At V.C. Summer, these impacts would result in a SMALL aesthetic impact.

At an alternate site, the buildings and stacks could be visible offsite. Aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities. Overall, the aesthetic impacts associated with an alternate site are categorized as SMALL. The impacts would be greater if a new transmission line is

needed and could be considered MODERATE. The impacts could be LARGE if a greenfield site is developed.

- **Historic and Archaeological Resources**

  At both V.C. Summer and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Before construction at V.C. Summer or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Historic and archaeological resource impacts need to be evaluated on a site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary between SMALL to MODERATE, depending on the historic and archaeologic resources that may be present, and whether mitigation is necessary.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement natural gas-fired plant were built at the V.C. Summer site. Some impacts on housing availability and prices during construction might occur, which could disproportionately affect minority and low-income populations. Closure of V.C. Summer would result in a decrease in employment of approximately 590 permanent and contract operating employees. Resulting economic conditions could reduce employment prospects for minority or low-income populations in Fairfield County. The impacts could be offset by projected economic growth and the ability of affected employees to commute to other jobs in Columbia or eastern Fairfield County. Overall, impacts are expected to be SMALL to MODERATE.

  Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. Minority and low-income populations at the alternative site could benefit from the plant's relocation through improved job prospects and the increased tax base that could enable more services to be provided. These impacts could be SMALL to LARGE. However, if a replacement natural gas-fired plant were constructed at an alternative site, Fairfield County would experience a significant loss of property tax

revenue, as well as jobs, which would affect the County's ability to provide services and programs. Impacts to minority and low-income populations in Fairfield County could be MODERATE to LARGE, again potentially offset by other economic growth in the area not related to V.C. Summer.

8.2.2.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a natural gas-fired generation system at an alternate location using closed-cycle cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a natural gas-fired plant using the once-through system. However, there are minor environmental impact differences between the closed-cycle and once-through cooling systems. Table 8-5 summarizes the incremental differences.

Table 8-5. Summary of Environmental Impacts of Natural Gas-Fired Generation at an Alternate Site with Closed-Cycle Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial biota from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated. Decrease water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation.
Groundwater Use and Quality	No change.
Air Quality	No change.
Waste	No change.
Human Health	No change.
Socioeconomics	No change.
Aesthetics	Introduction of cooling towers and associated plume. Possible noise impact from operation of cooling towers.
Historic and Archaeological Resources	No change.
Environmental Justice	No change.

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52 Subpart B. These designs are the 1300-MW U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the 1300-MW System 80+ Design (10 CFR Part 52, Appendix B), and the 600-MW AP600 Design (10 CFR Part 52, Appendix C). All of these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent escalation in prices of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint. Consequently, construction of a new nuclear power plant at the V.C. Summer site using the existing once-through cooling system and at an alternate site, using both closed- and open-cycle cooling, are considered in this section. The staff assumed that the new nuclear plant would have a 40-year lifetime.

NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs, sited at V.C. Summer or an alternate site. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of V.C. Summer, which has a capacity of 966 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on National Environmental Policy Act issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51 Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using once-through cooling is presented in Section 8.2.3.1 and using closed-cycle cooling in Section 8.2.3.2.

8.2.3.1 Once-Through Cooling System

The overall impacts of the nuclear generating system are discussed in the following sections. The impacts are summarized in Table 8-6. The extent of impacts at an alternate site will depend on the location of the particular site selected.

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at V.C. Summer and an Alternate Greenfield Site Using Once-Through Cooling

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Requires approximately 200 ha (500 ac) for the plant.	MODERATE to LARGE	Requires approximately 200 ha (500 ac) for the plant. Possible additional land if a new transmission line needed.
Ecology	SMALL to MODERATE	Uses undeveloped areas at current V.C. Summer site. Potential habitat loss and fragmentation, and reduced productivity and biological diversity.	MODERATE to LARGE	Impacts depend on location and ecology of the site, surface water body used for intake and discharge, and transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality	SMALL	Uses existing once-through cooling system.	SMALL to MODERATE	Impacts will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators and possibly other sources during operation.	SMALL	Same impacts as V.C. Summer site.

Table 8-6. (contd)

Impact Category	V.C. Summer Site Impact	V.C. Summer Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same impacts as V.C. Summer site.
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impacts as V.C. Summer site
Socioeconomics	SMALL to LARGE	During construction, impacts would be SMALL to MODERATE. Up to 2500 contractor employees during peak period of the five-year construction period. Operating workforce assumed to be similar to V.C. Summer, base preserved. Impacts during operation would be SMALL. Transportation impacts associated with construction contractor employees could be MODERATE to LARGE. Transportation impacts of commuting plant personnel would be SMALL.	SMALL to LARGE	Construction impacts depend on location. Impacts at a rural location could be LARGE. Fairfield County would experience loss of tax base and employment, potentially offset by economic growth of Columbia area. Operation impacts at an alternate site would be SMALL to MODERATE. Transportation impacts of construction contractor employees could be MODERATE to LARGE. Transportation impacts of commuting plant personnel could be SMALL to MODERATE
Aesthetics	SMALL	No exhaust stacks or cooling towers would be needed. Daytime visual impact could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated.	SMALL to LARGE	Impact would depend on the site selected and the surrounding land features. SMALL if previously developed site or adjacent to existing industrial area. LARGE if a greenfield site is selected. New transmission lines would add to the impact and would be MODERATE depending on the alternate site's characteristics.

Table 8-6. (contd)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Historic and Archaeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction.	SMALL to LARGE	Impacts will vary depending on population distribution and makeup at the site. Impacts to minority and low-income residents of Fairfield County associated with closure of V.C. Summer - MODERATE to LARGE. Impacts to receiving County is site-specific and could range form SMALL to LARGE.

- **Land Use**

  The existing facilities and infrastructure at the V.C. Summer site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that a replacement nuclear power plant would use the existing once-through cooling system, switchyard, offices, and transmission line right-of-way. Much of the land that would be used has been previously disturbed. A replacement nuclear power plant at the V.C. Summer site would alter approximately 200 ha (500 ac) of land, which likely would be previously disturbed. V.C. Summer would continue to operate as the new nuclear power facilities are being constructed.

  There would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel for the existing V.C. Summer reactor.

The impact of a replacement nuclear generating plant on land use at the existing V.C. Summer site is best characterized as MODERATE. The impact would be greater than the OL renewal alternative.

Land-use requirements at an alternative site would be approximately 200 ha (500 ac) plus the possible need for a new transmission line (NRC 1996). In addition, it might be necessary to construct a rail spur to an alternative site to deliver equipment during construction. Depending on new transmission line routing, siting a new nuclear plant at an alternative site could result in MODERATE to LARGE land-use impacts, and probably would be LARGE for a previously undisturbed greenfield site.

- **Ecology**

Locating a replacement nuclear power plant at the V.C. Summer site would alter ecological resources because of the need to convert roughly 200 ha (500 ac) of land to industrial use. Potential habitat loss and fragmentation and reduced productivity and biological diversity could result. Most of this land, however, has been previously disturbed. Siting at V.C. Summer would have a SMALL to MODERATE ecological impact that would be greater than renewal of the V.C. Summer OL.

At an alternate site, there would be construction impacts and new incremental operational impacts. The impacts would be greatest at an alternate greenfield site. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Once-through cooling water withdrawal and discharge could have adverse aquatic resource impacts. If needed, construction and maintenance of the transmission line would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE.

- **Water Use and Quality**

Surface water. The staff assumed that a replacement nuclear power plant at V.C. Summer would use the existing once-through cooling system, which would minimize incremental water-use and quality impacts. Surface-water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

For alternate sites, the impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State of South Carolina. The impacts would be SMALL to MODERATE.

Groundwater. No groundwater is currently used for operation of V.C. Summer. Two groundwater removal wells may be used to alleviate water seepage into the below-grade portions of the new nuclear plant buildings located at V.C. Summer. It is unlikely that groundwater would be used for an alternative nuclear power plant sited at V.C. Summer. The impacts are considered SMALL.

A nuclear power plant sited at an alternate site may use groundwater. Groundwater withdrawal at an alternative site would likely require a permit. The impacts would depend on availability and how water is withdrawn, but overall are considered SMALL.

- **Air Quality**

  Construction of a new nuclear plant sited at V.C. Summer or an alternate site would result in fugitive emissions during the construction. Exhaust emissions would also come from vehicles and motorized equipment used during the construction. An operating nuclear plant would have minor air emissions associated with diesel generators. Emissions would be regulated by the SCDHEC. Overall, emissions and associated impacts are considered SMALL.

- **Waste**

  The radiological waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts are considered SMALL.

  Siting the replacement nuclear power plant at a site other than V.C. Summer would not alter waste generation. Therefore, the impacts would be SMALL.

- **Human Health**

  Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51 Subpart A, Appendix B, Table B-1. Overall, human health impacts are considered SMALL.

  Siting the replacement nuclear power plant at a site other than V.C. Summer would not alter human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

  Construction and Operation. The construction period and the peak workforce associated with new nuclear power plant construction are currently unquantified (NRC 1996). In the

absence of quantified data, a construction period of five years and a peak workforce of 2500 is assumed. The staff assumed that construction would take place while the existing nuclear unit continues operation and would be completed by the time V.C. Summer permanently ceases operations. During construction, the communities surrounding the V.C. Summer site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction contractor employees commuting to the site from outside Fairfield County. After construction, the communities would be impacted by the loss of the construction jobs.

The replacement nuclear unit is assumed to have an operating workforce comparable to the 740 permanent and contractor employees currently working at V.C. Summer. The replacement nuclear unit would provide a new tax base to offset the loss of tax base associated with decommissioning of V.C. Summer. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for replacement nuclear units constructed at V.C. Summer would be SMALL to MODERATE; the socioeconomic impacts would be noticeable, but would be unlikely to destabilize the area.

Socioeconomic impacts at alternate sites would need to be analyzed on a case-by-case basis. In the GEIS (NRC 1996), the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work. Construction of a replacement nuclear power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. The communities around the V.C. Summer site would still experience the impact of operational job loss and loss of tax base, and the communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 contractor employees at the peak of construction) and a permanent workforce of approximately 740 SCE&G employees. For Fairfield County, the socioeconomic impacts could be LARGE. The impacts to the County at the alternate location could be SMALL to LARGE depending on the degree of economic development, the proportion of the County's property tax base represented by the new plant, etc.

Transportation. During the five-year construction period, up to 2500 construction contractor employees would be working at the V.C. Summer site in addition to the 740 employees already employed there. The addition of the construction contractor employees could place significant traffic loads on existing highways, particularly those leading to the V.C. Summer site. Such impacts would be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of V.C. Summer and are considered SMALL.

Transportation-related impacts associated with commuting construction contractor employees at an alternate site are site dependent, but could be MODERATE to LARGE.

Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL to MODERATE.

- **Aesthetics**

  The containment buildings for a replacement nuclear power plant sited at V.C. Summer and other associated buildings would likely be visible in daylight hours primarily from the Monticello Reservoir along SC 215. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. The replacement nuclear units would also likely be visible at night because of outside lighting. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed.

  Noise from operation of a replacement nuclear plant potentially could be heard offsite under calm wind conditions or when the wind is blowing in the direction of the listener. Mitigation, such as reduced or no use of outside loudspeakers, can be employed to reduce noise levels and maintain the impact of noise to SMALL.

  At an alternate site, there would be an aesthetic impact from the buildings. There would also be a significant aesthetic impact if a new transmission line is needed. Noise and light from the plant would be detectable offsite. The impact of noise and light would be mitigated if the plant is located in an industrial area adjacent to other power plants, or industrial facilities, in which case the impact is SMALL. The impact could be MODERATE if a transmission line needs to be built to the alternative site. The impacts could be LARGE if a greenfield site is selected.

- **Historic and Archaeological Resources**

  At both V.C. Summer and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Before construction at V.C. Summer or another site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts need to be evaluated on a

site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary between SMALL to MODERATE, depending on the historic and archaeologic resources that may be present, and whether mitigation is necessary.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement nuclear plant were built at the V.C. Summer site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations. However, this is expected to be mitigated by V.C. Summer's proximity to Columbia. After completion of construction, it is possible that the local government's ability to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. However, Fairfield County's economic health should be improved as the tax base of the older nuclear unit is replaced by the new, higher-valued (i.e., less depreciated) plant. Hence, the ability of the County to provide social services should improve because of the higher tax base, assuming assessment rates remain stable. Overall, impacts are expected to be SMALL.

  Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. If a replacement nuclear plant were constructed at an alternate site, Fairfield County would experience a significant loss of property tax revenue, which could affect the County's ability to provide services and programs. Impacts to minority and low-income populations in Fairfield County could be MODERATE to LARGE but potentially offset by economic growth in Columbia. Impacts to the receiving County could be SMALL to LARGE and depend on the relative increase to the tax base resulting from the new plant's construction.

8.2.3.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a nuclear power plant at an alternate location site using closed-cycle cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a nuclear power plant using the once-through system. However, there are environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant at an Alternate Site with Closed-Cycle Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial ecology from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation.
Groundwater Use and Quality	No change.
Air Quality	No change.
Waste	No change.
Human Health	No change.
Socioeconomics	No change.
Aesthetics	Introduction of cooling towers and associated plume. Natural draft towers could be up to 158 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact.
Historic and Archaeological Resources	No change.
Environmental Justice	No change.

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the V.C. Summer OL. SCE&G stated that power did not need to be purchased from out-of-state importers (SCE&G 2002).

Imported power from Canada or Mexico is unlikely to be available for replacement of V.C. Summer capacity. In Canada, 62 percent of the country's electrical generation capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2002). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (DOE/EIA 2002). Canada's nuclear generation is projected to increase by 1.7 percent by 2020, but its share of power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (DOE/EIA 2001b). EIA projects that total gross United States imports of electricity from Canada and Mexico will gradually increase from 46.5 billion kWh in year 2000 to 68.7 billion kWh in year 2005 and then gradually decrease to 28.6 billion kWh in year 2020 (DOE/EIA 2002). Consequently, it is unlikely that electricity imported from Canada or Mexico would be able to replace V.C. Summer capacity.

If power to replace V.C. Summer capacity were to be purchased from sources within the United States or a foreign country, the generating technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased electrical power alternative to renewal of the V.C. Summer OL. Thus, the environmental impacts of imported power would still occur but would be located elsewhere within the region, nation, or another country.

8.2.5 Other Alternatives

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

8.2.5.1 Oil-Fired Generation

EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States during the 2000 to 2020 period because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). Oil-fired operation is more expensive than nuclear or coal-fired operation. Future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its use for electricity generation. In Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 50 ha (120 ac). Additionally, operation of oil-fired plants would have environmental impacts (such as impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

8.2.5.2 Wind Power

Most of South Carolina is in a wind power Class 1 region (average wind speeds at 10-m [30-ft] elevation of 0 to 4.4 m/s [9.8 mph]). Class 1 has the lowest potential for wind energy generation (DOE 2001a). Wind turbines are economical in wind power Classes 4 through 7

(average wind speeds of 5.6 to 9.4 m/s [12.5 to 21.1 mph] [DOE 2001a]). Consequently, the staff concludes that locating a wind-energy facility on or near the V.C. Summer site would not be economically feasible given the current state of wind energy generation technology.

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heating and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies, photovoltaic and thermal, currently cannot compete with conventional fossil-fueled technologies in grid-connected applications due to higher capital costs per kilowatt of capacity. The average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 percent to 40 percent (NRC 1996). Energy storage requirements limit the use of solar-energy systems as baseload electricity supply.

There are substantial impacts to natural resources (wildlife habitat, land use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high—14,000 ha (35,000 ac) per 1000 MW(e) for photovoltaic and approximately 5700 ha (14,000 ac) per 1000 MW(e) for solar thermal systems. Neither type of solar electric system would fit at the V.C. Summer site, and both would have large environmental impacts at a greenfield site.

The V.C. Summer site receives approximately 4 to 5 kWh of solar radiation per square meter per day, compared to 7 to 8 kWh of solar radiation per square meter per day in areas of the western United States, such as California, which are most promising for solar technologies (DOE/EIA 2000a). Because of the natural resource impacts (land and ecological), the area's relatively low rate of solar radiation, and high cost, solar power is not deemed a feasible baseload alternative to renewal of the V.C. Summer OL. Some solar power may substitute for electric power in rooftop and building applications. Implementation of non-rooftop solar generation on a scale large enough to replace V.C. Summer would likely result in LARGE environmental impacts.

8.2.5.4 Hydropower

South Carolina has an estimated 480 MW of undeveloped hydroelectric resources (INEEL 1997). This amount is less than the amount needed to replace the 966-MW(e) capacity of V.C. Summer. As stated in Section 8.3.4 of the GEIS, hydropower's percentage of United States generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses.

In the GEIS (NRC 1996), the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e). Replacement of V.C. Summer generating capacity would require flooding nearly this amount of land. Due to the relatively low amount of undeveloped hydropower resource in South Carolina and the large land use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace V.C. Summer, the staff concludes that local hydropower is not a feasible alternative to V.C. Summer OL renewal on its own. Any attempts to site hydroelectric facilities large enough to replace V.C. Summer would result in LARGE environmental impacts.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. There is no feasible eastern location for geothermal capacity to serve as an alternative to renewal of the V.C. Summer OL. The staff concludes that geothermal energy is not a feasible alternative to renewal of the V.C. Summer OL.

8.2.5.6 Wood Waste

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 percent to 80 percent and with 20 percent to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Fairfield County is roughly 177,414 ha (438,400 ac) and developed or urban land comprises just two percent of the County. The largest land use category is forest, accounting for 87 percent of the total acreage. This includes public, commercial, and noncommercial forests, as well as farm woodlands. Timber harvesting is a major agricultural sector in Fairfield County where the 1999 delivered value of timber was $32.2 million, placing the County third out of 46 in the state. The Clemson Agricultural Extension Service in Winnsboro estimates that tree harvesting has increased considerably during the past 20 years while the labor needed has decreased considerably.

However, due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and high inefficiency, the staff has determined that wood waste is not a feasible alternative to renewing the V.C. Summer OL.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001c). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is due to the need for specialized waste-separation and waste-handling equipment for municipal solid waste (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternative such as landfills; (2) the 1994 Supreme Court decision *(C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that might have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2002).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters and/or scrubbers (DOE/EIA 2001b).

Currently there are approximately 102 waste-to-energy plants operating in the United States. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2001). The staff concludes that generating electricity from municipal solid waste would not be a feasible alternative to replace the 966 MW(e) of V.C. Summer and, consequently, would not be a feasible alternative to renewal of the V.C. Summer OL.

8.2.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuels, there are several other concepts for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In the GEIS, the staff states that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as V.C. Summer. For these reasons, such fuels do not offer a feasible alternative to renewal of the V.C. Summer OL.

8.2.5.9 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Phosphoric acid fuel cells are generally considered first-generation technology. Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

The U.S. Department of Energy projects that two second-generation fuel cell technologies using molten carbonate and solid oxide technology, respectively, will be commercially available in sizes up to 2 MW at a cost of $1000 to $1500 per kW of installed capacity (DOE 2001b). For comparison, the installed capacity cost for a natural gas-fired combined-cycle plant is on the order of $500 to $600 per kW (NWPPC 2000). As market acceptance and manufacturing capacity increase, natural-gas-fueled fuel cell plants in the 50- to 100-MW range are projected to become available (DOE 2001b). Presently, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Fuels cells are, consequently, not a feasible alternative to renewal of the V.C. Summer OL.

8.2.5.10 Delayed Retirement

SCE&G has no current plans to retire any existing generating units. For this reason, delayed retirement of other SCE&G generating units would not be a feasible alternative to renewal of the V.C. Summer OL.

8.2.5.11 Utility-Sponsored Conservation

SCE&G has developed residential, commercial, and industrial programs to reduce both the peak demands and daily energy consumption. These programs are commonly referred to as DSM. SCE&G currently operates the following DSM programs: standby generator program, interruptible service program, and real time pricing (SCE&G 2002). SCE&G stated that DSM programs and activities have been scaling back and that the trend is expected to continue (SCE&G 2002). However, SCE&G will continue their DSM.

Historic and projected reduction in generation needs as a result of DSM programs have been credited in SCE&G's planning to meet projected customer demand. Because these DSM savings are a part of the long-range plan for meeting projected demand, they are not available offsets for V.C. Summer. Therefore, the conservation option is not considered a reasonable replacement for the OL renewal alternatives.

8.2.6 Combination of Alternatives

Although individual alternatives to renewing the V.C. Summer OL might not be sufficient on their own to replace the capacity of this unit due to the small size or cost, it is conceivable that a combination of alternatives might be cost-effective.

As discussed in Section 8.2, V.C. Summer has a net electrical rating of 966 MW(e). For the coal and natural gas alternatives, SCE&G assumes in its ER two standard 408-MW(e) units as potential replacements for V.C. Summer (SCE&G 2002). This approach is followed in this SEIS, although it results in some environmental impacts that are roughly 16 percent lower than if full replacement capacity were constructed.

There are many possible combinations of alternatives to replace that power. Table 8-8 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of one 408-MW(e) combined-cycle, natural gas-fired unit at V.C. Summer using the existing once-through cooling system, and at an alternate location using a once-through cooling system. Purchase from other power generators could account for 204 MW(e) of power, and 204 MW(e) could be gained from additional DSM measures. The impacts associated with the combined-cycle, natural gas-fired units are based on the impact assumptions discussed in Section 8.2.2, adjusted for the reduced generating capacity.

Table 8-8. Summary of Environmental Impacts for an Assumed Combination of Generating and Acquisition Alternatives

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Nine ha (23 ac) for powerblock, offices, roads, and parking areas. Additional impact of up to approximately 295 ha (729 ac) for construction of an underground gas pipeline.	SMALL to LARGE	23 ha (34 ac) for powerblock, offices, roads, and parking areas. Additional impact for construction and/or upgrade of an underground gas pipeline and transmission lines.
Ecology	SMALL to LARGE	Uses some undeveloped areas at current V.C. Summer site, plus land for a new gas pipeline.	SMALL to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity. Greenfield site increases impact.
Water Use and Quality	SMALL	Uses existing once-through cooling system.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface water body.
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.
Air Quality	MODERATE	Natural Gas-Fired Units Some hazardous air pollutants Sulfur oxides • 40 MT/yr (44 tons/yr) Nitrogen oxides • 151 MT/yr (166 tons/yr) Carbon monoxide • 197 MT/yr (217 tons/yr) PM_{10} particulates • 59 MT/yr (65 tons/yr) Some hazardous air pollutants.	MODERATE	Same as siting at V.C. Summer.

Table 8-8. (contd)

Impact Category	V.C. Summer Site Impact	V.C. Summer Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Waste	SMALL	Small amount of ash produced.	SMALL	Same as siting at V.C. Summer.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 1200 additional contractor employees during the peak of the three-year construction period, followed by reduction from current V.C. Summer workforce of 740 to 75; tax base preserved. Impacts during operation would be SMALL to MODERATE due to loss of employment to Fairfield County. Transportation impacts associated with construction contractor employees would be SMALL to MODERATE. Transportation impacts during operation would be SMALL due to smaller workforce.	SMALL to LARGE	Construction impacts depend on location, but could be significant if location is in a more rural area than V.C. Summer. Fairfield County would experience loss of tax base and employment, potentially offset by potential economic growth in Columbia area. Impacts during operation at an alternate site would be SMALL to MODERATE depending on economy at alternate site and relative impact of plant to tax base. Transportation impacts associated with construction contractor employees would be SMALL to LARGE and dependent on population density at alternate site. Transportation impacts during operation would be SMALL due to smaller workforce.
Aesthetics	SMALL	Some visibility of structure offsite.	SMALL to LARGE	SMALL if alternate site previously developed. MODERATE impact from plant, stack, cooling tower plume, and new transmission lines. LARGE if greenfield site.

Table 8-8. (contd)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Historic and Archaeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 595 operating jobs at V.C. Summer could reduce employment prospects for minority and low-income populations. Impacts could be offset by projected economic growth and the ability of affected employees to commute to other jobs.	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site. Fairfield County would lose significant revenue, which could have MODERATE to LARGE impacts to minority and low-income populations. Impacts to receiving County could be SMALL to MODERATE.

While the DSM measures would have few environmental impacts, operation of the new gas-fired plant would result in increased emissions and environmental impacts. The environmental impacts of imported power would still occur but would be located elsewhere within the region, nation, or another country as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-8. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the V.C. Summer OL.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, license renewal, are SMALL for all impact categories (except collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, for which a single significance level was not assigned). The alternative actions, i.e., no-action alternative (discussed in Section 8.1), new generation alternatives (from coal, natural gas, and nuclear, discussed in Sections 8.2.1 through 8.2.3, respectively), purchased electrical power (discussed in Section 8.2.4), alternative technologies (discussed in Section 8.2.5), and the combination of alternatives (discussed in Section 8.2.6) were considered.

The no-action alternative would require the replacement of electrical generating capacity by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than V.C. Summer, or (4) some combination of these options and would result in the decommissioning of V.C. Summer. For each of the new generation alternatives (coal, natural gas, and nuclear), the environmental impacts would not be less than the impacts of license renewal. For example, the land-disturbance and aesthetics impacts resulting from construction of any new facility would be greater than the impacts of continued operation of V.C. Summer. The impacts of purchased electrical power (imported power) would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the V.C. Summer OL.

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

8.4 References

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

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

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

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

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

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