



# **Generic Environmental Impact Statement for License Renewal of Nuclear Plants**

**Supplement 25**

**Regarding  
Brunswick Steam Electric Plant, Units 1 and 2**

**Final Report**

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



# **Generic Environmental Impact Statement for License Renewal of Nuclear Plants**

## **Supplement 25**

### **Regarding Brunswick Steam Electric Plant, Units 1 and 2**

## **Final Report**

---

---

Manuscript Completed : March 2006  
Date Published: April 2006

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



# Abstract

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

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by the Carolina Power & Light Company (CP&L) (now doing business as Progress Energy Carolinas, Inc.) to renew the OLs for Brunswick Steam Electric Plant, Units 1 and 2 (BSEP) for an additional 20 years under 10 CFR Part 54. This SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action.

Regarding the 69 issues for which the GEIS reached generic conclusions, neither CP&L nor the staff has identified information that is both new and significant for any GEIS generic conclusion that applies to BSEP. In addition, the staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the BSEP OLs would 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<sup>(a)</sup> significance (except for collective offsite radiological impacts from the fuel cycle and high-level waste and spent fuel, which were not assigned a single significance level).

Regarding the remaining 23 issues, those that apply to BSEP are addressed in this SEIS. The staff concludes that the significance of the potential environmental impacts of renewal of the OLs is SMALL for each applicable issue, with one exception. The magnitude of impact for the chronic effects of electromagnetic fields is "uncertain". The staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. The staff determined that information provided during the scoping process did not identify any new issue that has a significant environmental impact.

---

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

## Abstract

- | The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for BSEP 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 CP&L; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.



## Contents

2.2	Plant Interaction with the Environment	2-18
2.2.1	Land Use	2-18
2.2.2	Water Use	2-19
2.2.3	Water Quality	2-19
2.2.4	Air Quality	2-20
2.2.5	Aquatic Resources	2-22
2.2.6	Terrestrial Resources	2-31
2.2.7	Radiological Impacts	2-43
2.2.8	Socioeconomic Factors	2-44
2.2.8.1	Housing	2-45
2.2.8.2	Public Services	2-46
2.2.8.3	Offsite Land Use	2-48
2.2.8.4	Visual Aesthetics and Noise	2-50
2.2.8.5	Demography	2-50
2.2.8.6	Economy and Taxes	2-53
2.2.9	Historic and Archaeological Resources	2-55
2.2.9.1	Cultural Background	2-55
2.2.9.2	Historic and Archaeological Resources at BSEP	2-57
2.2.10	Related Federal Project Activities and Consultations	2-58
2.3	References	2-59
3.0	Environmental Impacts of Refurbishment	3-1
3.1	References	3-3
4.0	Environmental Impacts of Operation	4-1
4.1	Cooling Systems	4-2
4.1.1	Entrainment of Fish and Shellfish in Early Life Stages	4-10
4.1.2	Impingement of Fish and Shellfish	4-13
4.1.3	Heat Shock	4-15

4.2	Transmission Lines .....	4-17
4.2.1	Electromagnetic Fields – Acute Effects .....	4-22
4.2.2	Electromagnetic Fields – Chronic Effects .....	4-22
4.3	Radiological Impacts of Normal Operations .....	4-23
4.4	Socioeconomic Impacts of Plant Operations During the License Renewal Term .....	4-24
4.4.1	Housing Impacts During Operations .....	4-26
4.4.2	Public Services: Public Utility Impacts During Operations .....	4-28
4.4.3	Offsite Land Use During Operations .....	4-28
4.4.4	Public Services: Transportation Impacts During Operations .....	4-30
4.4.5	Historic and Archaeological Resources .....	4-30
4.4.6	Environmental Justice .....	4-31
4.5	Groundwater Use and Quality .....	4-33
4.6	Threatened or Endangered Species .....	4-37
4.6.1	Aquatic Species .....	4-37
4.6.2	Terrestrial Species .....	4-39
4.7	Evaluation of Potential New and Significant Information on Impacts of Operations During the Renewal Term .....	4-40
4.8	Cumulative Impacts of Operations During the License Renewal Term .....	4-40
4.8.1	Cumulative Impacts Resulting from Operation of the Plant Cooling System .....	4-41
4.8.2	Cumulative Impacts Resulting from Operation of the Transmission Lines .....	4-42
4.8.3	Cumulative Radiological Impacts .....	4-43
4.8.4	Cumulative Socioeconomic Impacts .....	4-44
4.8.5	Cumulative Impacts on Groundwater Use and Quality .....	4-44
4.8.6	Cumulative Impacts on Threatened or Endangered Species .....	4-45
4.8.7	Conclusions Regarding Cumulative Impacts .....	4-48
4.9	Summary of Impacts of Operations During the Renewal Term .....	4-48
4.10	References .....	4-49

## Contents

5.0 Environmental Impacts of Postulated Accidents .....	5-1
5.1 Postulated Plant Accidents .....	5-1
5.1.1 Design-Basis Accidents .....	5-2
5.1.2 Severe Accidents .....	5-3
5.2 Severe Accident Mitigation Alternatives (SAMAs) .....	5-4
5.2.1 Introduction .....	5-4
5.2.2 Estimate of Risk .....	5-5
5.2.3 Potential Plant Improvements .....	5-6
5.2.4 Evaluation of Risk Reduction and Costs of Improvements .....	5-8
5.2.5 Cost-Benefit Comparison .....	5-8
5.2.6 Conclusions .....	5-11
5.3 References .....	5-11
6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management .....	6-1
6.1 The Uranium Fuel Cycle .....	6-2
6.2 References .....	6-9
7.0 Environmental Impacts of Decommissioning .....	7-1
7.1 Decommissioning .....	7-2
7.2 References .....	7-5
8.0 Environmental Impacts of Alternatives to Operating License Renewal .....	8-1
8.1 No-Action Alternative .....	8-1
8.1.1 Land Use .....	8-2
8.1.2 Ecology .....	8-3
8.1.3 Water Use and Quality .....	8-4
8.1.4 Air Quality .....	8-4
8.1.5 Waste .....	8-4
8.1.6 Human Health .....	8-4
8.1.7 Socioeconomics .....	8-5
8.1.8 Aesthetics .....	8-5



8.1.9	Historic and Archaeological Resources .....	8-6
8.1.10	Environmental Justice .....	8-6
8.2	Alternative Energy Sources .....	8-6
8.2.1	Coal-Fired Generation .....	8-8
8.2.1.1	Closed-Cycle Cooling System .....	8-9
8.2.1.2	Once-Through Cooling System .....	8-22
8.2.2	Natural Gas-Fired Generation .....	8-22
8.2.2.1	Closed-Cycle Cooling System .....	8-23
8.2.2.2	Once-Through Cooling System .....	8-23
8.2.3	Nuclear Power Generation .....	8-33
8.2.3.1	Closed-Cycle Cooling System .....	8-33
8.2.3.2	Once-Through Cooling System .....	8-41
8.2.4	Purchased Electrical Power .....	8-41
8.2.5	Other Alternatives .....	8-41
8.2.5.1	Oil-Fired Generation .....	8-42
8.2.5.2	Wind Power .....	8-43
8.2.5.3	Solar Power .....	8-43
8.2.5.4	Hydropower .....	8-44
8.2.5.5	Geothermal Energy .....	8-44
8.2.5.6	Wood Waste .....	8-44
8.2.5.7	Municipal Solid Waste .....	8-45
8.2.5.8	Other Biomass-Derived Fuels .....	8-45
8.2.5.9	Fuel Cells .....	8-46
8.2.5.10	Delayed Retirement .....	8-46
8.2.5.11	Utility-Sponsored Conservation .....	8-47
8.2.6	Combination of Alternatives .....	8-48
8.3	Summary of Alternatives Considered .....	8-51
8.4	References .....	8-52

## Contents

9.0 Summary and Conclusions .....	9-1
9.1 Environmental Impacts of the Proposed Action – License Renewal .....	9-4
9.1.1 Unavoidable Adverse Impacts .....	9-5
9.1.2 Irreversible or Irretrievable Resource Commitments .....	9-6
9.1.3 Short-Term Use Versus Long-Term Productivity .....	9-6
9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives .....	9-7
9.3 Staff Conclusions and Recommendations .....	9-7
9.4 References .....	9-9
Appendix A – Comments Received on the Environmental Review .....	A-1
Appendix B – Contributors to the Supplement .....	B-1
Appendix C – Chronology of NRC Staff Environmental Review Correspondence Related to Carolina Power & Light Company’s Application for License Renewal of Brunswick Steam Electric Plant, Units 1 and 2 .....	C-1
Appendix D – Organizations Contacted .....	D-1
Appendix E – Carolina Power & Light Company’s Compliance Status and Consultation Correspondence .....	E-1
Appendix F – GEIS Environmental Issues Not Applicable to Brunswick Steam Electric Plant, Units 1 and 2 .....	F-1
Appendix G – NRC Staff Evaluation of Severe Accident Mitigation Alternatives for Brunswick Steam Electric Plant, Units 1 and 2 in Support of the License Renewal Application Review .....	G-1

# Figures

2-1	Location of BSEP, 50-mi Region .....	2-2
2-2	Location of BSEP, 6-mi Region .....	2-3
2-3	BSEP Site Boundary Map .....	2-4
2-4	BSEP General Plant Layout .....	2-5
2-5	BSEP Transmission Line Map .....	2-16
4-1	Geographic Distribution of Minority Populations (shown in shaded areas) Within 50 mi of the BSEP Site Based on 2000 Census Block Group Data .....	4-34
4-2	Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 50 mi of the BSEP Site Based on 2000 Census Block Group Data .....	4-35

## Tables

2-1	BSEP Transmission Lines .....	2-17
2-2	Federally Listed and State-Listed Aquatic Species Potentially Occurring in the Vicinity of BSEP .....	2-25
2-3	Federally Listed Terrestrial Species Reported from Counties Associated with BSEP and Its Transmission Line Rights-of-Way .....	2-34
2-4	North Carolina State-Listed Terrestrial Species Reported From Counties Associated with BSEP and Its Transmission Line Rights-of-Way .....	2-35
2-5	BSEP Permanent and Contractor Employment .....	2-45
2-6	Housing Units by County During 1990 and 2000 .....	2-46
2-7	Water Supply and Demand in the Lower Cape Fear Planning Group .....	2-47
2-8	Traffic Counts for Roads in the Vicinity of BSEP .....	2-49
2-9	Land-Use Classification in the 50 mi Region of BSEP .....	2-49
2-10	Regional Population Growth .....	2-52
2-11	Year 2000 Population Distribution Within 50 mi of the BSEP Site .....	2-52
2-12	Local Government Revenues and Property Tax Payments for BSEP .....	2-55
3-1	Category 1 Issues for Refurbishment Evaluation .....	3-2
3-2	Category 2 Issues for Refurbishment Evaluation .....	3-3
4-1	Category 1 Issues Applicable to the Operation of the BSEP Cooling System During the License Renewal Term .....	4-2
4-2	Category 2 Issues Applicable to the Operation of the BSEP Cooling System During the License Renewal Term .....	4-10
4-3	Category 1 Issues Applicable to the BSEP Transmission Lines During the License Renewal Term .....	4-19
4-4	Category 2 and Uncategorized Issues Applicable to the BSEP Transmission Lines During the License Renewal Term .....	4-21
4-5	Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the License Renewal Term .....	4-23
4-6	Category 1 Issues Applicable to Socioeconomics During the License Renewal Term .....	4-25
4-7	Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the License Renewal Term .....	4-27
4-8	Category 1 Issue Applicable to Groundwater Use and Quality During the License Renewal Term .....	4-36
4-9	Category 2 Issue Applicable to Threatened or Endangered Species in the Vicinity of BSEP During the License Renewal Term .....	4-37
4-10	Actions that Would Determine Cumulative Impacts to Sea Turtles in the Vicinity of BSEP .....	4-47

5-1	Category 1 Issue Applicable to Postulated Accidents During the License Renewal Term . . . . .	5-3
5-2	Category 2 Issue Applicable to Postulated Accidents During the License Renewal Term . . . . .	5-4
5-3	BSEP Core Damage Frequency for Internal Events . . . . .	5-7
5-4	Breakdown of Population Dose by Containment Release Model . . . . .	5-7
6-1	Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management During the License Renewal Term . . . . .	6-2
7-1	Category 1 Issues Applicable to the Decommissioning of BSEP Units 1 and 2 Following the License Renewal Term . . . . .	7-2
8-1	Summary of Environmental Impacts of the No-Action Alternative . . . . .	8-3
8-2	Summary of Environmental Impacts of Coal-Fired Generation Using Closed-Cycle Cooling at the BSEP Site and an Alternate Site . . . . .	8-10
8-3	Summary of Environmental Impacts of Coal-Fired Generation Using Once-Through Cooling at the BSEP Site . . . . .	8-22
8-4	Summary of Environmental Impacts of Natural Gas Combined-Cycle Generation Using Closed-Cycle Cooling at the BSEP Site and at an Alternative Site . . . . .	8-24
8-5	Summary of Environmental Impacts of Natural Gas Combined-Cycle Generation Using Once-Through Cooling at the BSEP Site . . . . .	8-32
8-6	Summary of Environmental Impacts of New Nuclear Generation Using Closed-Cycle Cooling at the BSEP Site and an Alternate Site . . . . .	8-35
8-7	Summary of Environmental Impacts of a New Nuclear Power Plant Using Once-Through Cooling at the BSEP Site . . . . .	8-42
8-8	Summary of Environmental Impacts of an 1460 MW(e) of Natural Gas-Fired Generation, 300 MW(e) from Purchased Power and 149 MW(e) from Demand-Side Management Measures . . . . .	8-49
9-1	Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation Using Closed-Cycle Cooling Except as Otherwise Specified . . . . .	9-8
A-1	Individuals Providing Comments During Scoping Comment Period . . . . .	A-2
A-2	Comments Received on the Draft SEIS . . . . .	A-9
E-1	Consultation Correspondence Regarding License Renewal for BSEP Units 1 and 2 . . . . .	E-1

## Contents

E-2	Federal Permits, Licenses, and Other Entitlements Related to Renewal of the BSEP OLS .....	E-3
F-1	GEIS Environmental Issues Not Applicable to BSEP .....	F-1
G-1	BSEP Core Damage Frequency for Internal Events .....	G-3
G-2	Breakdown of Population Dose by Containment Release Method .....	G-4
G-3	BSEP PSA Historical Summary .....	G-6
G-4	SAMA Cost-Benefit Screening Analysis .....	G-18

# Executive Summary

On October 18, 2004, the Carolina Power and Light Company (CP&L), now doing business as Progress Energy Carolinas, Inc., submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Brunswick Steam Electric Plant, Units 1 and 2 (BSEP) for an additional 20-year period. If the OLs are renewed, State regulatory agencies and CP&L will ultimately decide whether the plant will continue to operate, based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, then the plant must be shut down at or before the expiration dates of the current OLs, which are September 8, 2016, for Unit 1, and December 27, 2014, for Unit 2.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) requires an environmental impact statement (EIS) for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the 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. In addition, 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2.<sup>(a)</sup>

Upon acceptance of the CP&L 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 BSEP site in January 2005 and held public scoping meetings on January 27, 2005, in Southport, North Carolina. In the preparation of this supplemental environmental impact statement (SEIS) for BSEP, the staff reviewed the CP&L Environmental Report (ER) and compared it to the GEIS, consulted with other agencies, conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, 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 are provided in Appendix A, Part 1, of this SEIS.

The staff held two public meetings in Southport, North Carolina, on October 18, 2005, to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating comments on this SEIS. When the 75-day comment period ended, the staff considered and dispositioned all of the comments received. These comments are addressed in Appendix A, Part II, of this SEIS.

---

(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.

## Executive Summary

- | 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 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 evaluation criterion for 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 would ultimately determine whether the existing nuclear power plants continue to operate beyond the period of the current OLS.

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

The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of reactor operation—generic determination of no significant environmental impact"] and in accordance with § 51.23(b).



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

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

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

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

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

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

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

## Executive Summary

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

CP&L 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 CP&L 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 review has identified any new issue applicable to BSEP 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 BSEP.

CP&L's license renewal application presents an analysis of the Category 2 issues, plus environmental justice and chronic effects from electromagnetic fields. The staff reviewed the CP&L analysis for each issue and conducted an independent review of each issue. Six Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at BSEP. Four Category 2 issues are not discussed in this SEIS, because they are specifically related to refurbishment. CP&L 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 being necessary to support the continued operation of BSEP for the license renewal term. In addition, any replacement of components or additional inspection activities that are within the bounds of normal plant operation are not expected to affect the environment outside the bounds of the plant operations evaluated in the *Final Environmental Statement Related to Operation of Brunswick Nuclear Steam Electric Plant Units 1 and 2*, issued by the U.S. Atomic Energy Commission in 1974.

Eleven Category 2 issues related to operational impacts and postulated accidents during the license 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 license renewal term and are only discussed in this SEIS in relation to operation during the license renewal term. For all 11

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 and of the individual plant examination of external events report for BSEP and the plant improvements already made, CP&L identified 12 potentially cost-beneficial SAMAs. CP&L has committed to further evaluate these 12 SAMAs. The staff concludes that three additional SAMAs are potentially cost-beneficial. However, none of the potentially cost-beneficial SAMAs identified relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

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

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person would undertake such other actions. For purposes of this analysis, where BSEP license renewal impacts were deemed to be SMALL, the staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources.

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

The recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for BSEP are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the ER submitted by CP&L; (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

μm	micrometer(s)
ac	acre(s)
AC	alternating current
ACC	averted cleanup and decontamination costs
ADAMS	Agencywide Document Access and Management System
AEA	Atomic Energy Act of 1954
AEC	U.S. Atomic Energy Commission
AOC	averted offsite property damage costs
AOE	averted occupational exposure
AOG	augmented off-gas
AOSC	averted onsite costs
APE	(cultural resources) area of potential effect
APE	averted public exposure
ATWS	anticipated transient without scram
AQCR	air quality control region
AQI	air quality index
BA	biological assessment
Bq	becquerel(s)
BSEP	Brunswick Steam Electric Plant, Units 1 and 2
Btu	British thermal unit(s)
BWR	boiling water reactor
BWROG	Boiling Water Reactor Owners Group
°C	Degree Celsius
CAIR	Clean Air Interstate Rule
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)
CO	carbon monoxide
COE	cost of enhancement
COPC	chemicals of potential concern
CP&L	Carolina Power & Light Company
CRD	control rod drive
CWA	Clean Water Act
DBA	design-basis accident(s)

## Abbreviations/Acronyms

DC	direct current	
DCH	direct containment heating	
DHR	decay heat removal	
DOE	U.S. Department of Energy	
DPR	demonstration project reactor	
DSM	demand-side management	
EA	environmental assessment	
EDG	emergency diesel generator	
EFH	essential fish habitat	
EIA	Energy Information Administration (of DOE)	
EIS	environmental impact statement	
ELF-EMF	extremely low frequency-electromagnetic field	
EOP	Emergency Operating Procedure	
EPA	U.S. Environmental Protection Agency	
EPRI	Electric Power Research Institute	
EPU	extended power uprate	
EQ	equipment qualification	
ER	environmental report	
ESA	Endangered Species Act	
ESRP	Environmental Standard Review Plan, NUREG-1555, Supplement 1, Operating License Renewal	
°F	Degree Fahrenheit	
FAA	U.S. Federal Aviation Administration	
FES	final environmental statement	
FONSI	finding of no significant impact	
FR	Federal Register	
FSAR	final safety analysis report	
ft	foot (feet)	
FWPCA	Federal Water Pollution Control Act (also known as the Clean Water Act of 1977)	
FWS	U.S. Fish and Wildlife Service	
g/d	gallons per day	
gal	gallon(s)	
GDC	general design criteria	
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants	
GIS	geographic information system	
GL	generic letter	
gpm	gallons per minute	

## Abbreviations/Acronyms

ha	hectare(s)
HCLPF	high confidence of low probability of failure
HCTL	heat capacity temperature limit
HEP	human error probability
HHSI	high heady safety injection
HLW	high-level waste
hr	hour(s)
Hz	hertz
HIC	high-integrity container
HVAC	heating, cooling, and air-conditioning
in.	inch(es)
IPA	integrated plant assessment
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISFSI	independent spent fuel storage installation
ISLOCA	interfacing systems loss-of-coolant accident
J	joule(s)
kg	kilogram(s)
km	kilometer(s)
kV	kilovolt(s)
kV/m	kilovolts per meter
kWh	kilowatt hour(s)
L	liter(s)
L/s	liters per second
lb	pound(s)
LCFWSA	Lower Cape Fear Water and Sewer Authority
LERF	large early release frequency
LLW	low-level waste
LNG	liquefied natural gas
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
LWR	light-water reactor
m	meter(s)
m/s	meters per second
m <sup>3</sup> /d	cubic meters per day
m <sup>3</sup> /s	cubic meters per second

## Abbreviations/Acronyms

mA	milliampere(s)	
MAAP	Modular Accident Analysis Program	
MACCS2	MELCOR Accident Consequence Code System 2	
MACR	maximum averted cost risk	
MCR	main control room	
MGD	million gallons per day	
mi	mile(s)	
mL	milliliter(s)	
MMACR	modified maximum averted cost risk	
MOVs	motor-operated valves	
mph	miles per hour	
mrad	millirad	
mrem	millirem	
MSA	Metropolitan Statistical Area	
MSIV	main steam isolation valve	
msl	mean sea level	
MT	metric ton(s) (or tonne[s])	
MTHM	metric tonnes heavy metal	
MTU	metric ton(s)-uranium	
MW	megawatt(s)	
MWd/MTU	megawatt-days per metric ton of uranium	
MW(e)	megawatt(s) electric	
MW(t)	megawatt(s) thermal	
MWh	megawatt hour(s)	
NA	not applicable	
NAS	National Academy of Sciences	
NCCLT	North Carolina Coastal Land Trust	
NCDENR	North Carolina Department of Environment and Natural Resources	
NCDOT	North Carolina Department of Transportation	
NCNHP	North Carolina Natural Heritage Program	
NCI	National Cancer Institute	
NCSDC	North Carolina Statistical Data Center	
NEPA	National Environmental Policy Act of 1969	
NESC	National Electric Safety Code	
ng/J	nanogram per joule	
NHPA	National Historic Preservation Act	
NIEHS	National Institute of Environmental Health Sciences	
NMFS	National Marine Fisheries Service	
NOAA	National Oceanic and Atmospheric Administration	
NO <sub>x</sub>	nitrogen oxide(s)	

## Abbreviations/Acronyms

NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NWPPC	Northwest Power Planning Council
ODCM	Offsite Dose Calculation Manual
OL	operating license
PAME	primary amoebic meningoencephalitis
PM <sub>2.5</sub>	particulate matter, 2.5 microns or less in diameter
PM <sub>10</sub>	particulate matter, 10 microns or less in diameter
ppt	parts per thousand
PSA	Probabilistic Safety Assessment
PSD	prevention of significant deterioration
RAI	request for additional information
RCIC	reactor core isolation cooling
RCS	reactor coolant system
REMP	radiological environmental monitoring program
RLE	review level earthquake
rms	root mean square
RPC	replacement-power cost
RRW	risk-reduction worth
s	second(s)
SAMA	severe accident mitigation alternative(s)
SAR	safety analysis report
SBO	station blackout
SBLOCA	small break loss-of-coolant accident
SCR	selective catalytic reduction
SEIS	supplemental environmental impact statement
SER	Safety Evaluation Report
SHPO	State Historic Preservation Officer
SO <sub>2</sub>	sulfur dioxide
SO <sub>x</sub>	sulfur oxide(s)
tpy	tons per year
UAT	unit auxiliary transformer
UDB	urban development boundary
UFSAR	Updated Final Safety Analysis Report
U.S.	United States



## Abbreviations/Acronyms

USC	United States Code	
USCB	U.S. Census Bureau	
USDA	U.S. Department of Agriculture	
USGS	U.S. Geologic Survey	
USI	unresolved safety issue	
V	volt(s)	
W	watt(s)	
W/m <sup>2</sup>	watts per meter squared	
yr	year(s)	