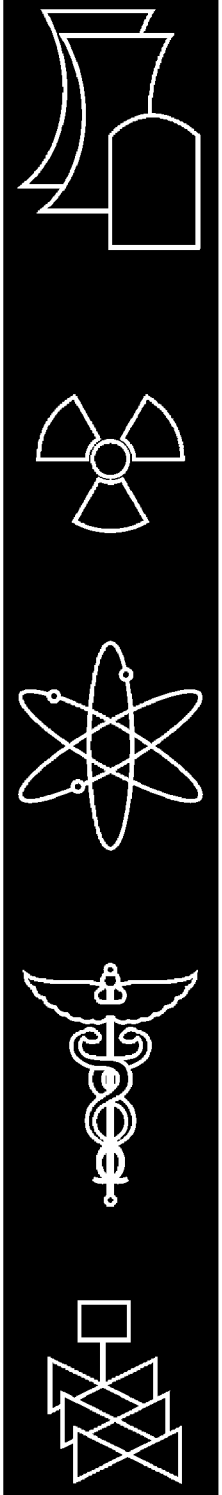
NUREG-1437
Supplement 11



Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 11

Regarding
St. Lucie Units 1 and 2

Final Report

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

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Generic Environmental Impact Statement for License Renewal of Nuclear Plants

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Division of Regulatory Improvement Programs
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 10 CFR Part 51. In the GEIS (and its Addendum 1), the staff identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 69 of these issues that apply to all plants or to plants with specific design or site characteristics. Additional plant-specific review is required for the remaining 23 issues. These plant-specific reviews are to be included in a supplement to the GEIS.

This Supplemental Environmental Impact Statement (SEIS) has been prepared in response to an application submitted to the NRC by the Florida Power and Light Company (FPL) to renew the OLs for St. Lucie Units 1 and 2 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 preliminary recommendation regarding the proposed action.

Neither FPL nor the staff has identified information that is both new and significant for any of the issues for which the GEIS reached generic conclusions. The staff determined that information provided during the scoping process did not call into question the generic conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the St. Lucie OLs 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 from high-level waste and spent fuel, which were not assigned a single significance level).

Each of the remaining issues that applies to St. Lucie Units 1 and 2 is addressed in detail in this SEIS. For each applicable issue, the staff concludes that the significance of the potential environmental impacts of renewal of the OLs is SMALL. The staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. The staff determined that information provided during the scoping process did not identify any new issue that has a significant environmental impact.

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for St. Lucie Units 1 and 2 are not so great that

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

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 FPL; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments received during the scoping process.

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Executive Summary

By letter dated November 29, 2001, the Florida Power and Light Company (FPL) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for St. Lucie Units 1 and 2 for an additional 20-year period. If the OLs are renewed, State regulatory agencies and FPL will ultimately decide whether the two units 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 units must be shut down at or before the expiration dates of the current OLs, which are March 1, 2016, for Unit 1, and April 6, 2023, for Unit 2.

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

Upon acceptance of the FPL application, the NRC staff began the environmental review process described in 10 CFR Part 51 by publishing, in the Federal Register, a notice of intent to prepare an EIS and conduct scoping. The staff visited the St. Lucie site in April 2002 and held public scoping meetings on April 3, 2002, in Port St. Lucie, Florida. In the preparation of the draft Supplemental Environmental Impact Statement (SEIS) for St. Lucie Units 1 and 2, the staff reviewed the FPL 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 comments and responses that were considered to be within the scope of the environmental review are provided in Appendix A, Part I, of this SEIS.

A draft SEIS was published for comment in November 2002. The staff held two public meetings in Port St. Lucie, Florida, in December 2002, 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. When the 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.

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 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 St. Lucie Units 1 and 2 and not replacing the power generated by these units [a conceptual alternative]) 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 Units 1 and 2 is replaced. These alternatives are evaluated in detail, assuming that the replacement power generation plant is located at an unspecified alternate location in Florida.

FPL 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 FPL 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 FPL, the scoping process, nor the staff have identified any new issue applicable to St. Lucie Units 1 and 2 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 St. Lucie Units 1 and 2.

FPL's license renewal application presents an analysis of the Category 2 issues plus environmental justice. The staff has reviewed the FPL analysis for each issue and has conducted an independent review of each issue. Six Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at St. Lucie. Nine Category 2 issues are not discussed in this SEIS, because they are specifically related to refurbishment. FPL 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 St. Lucie Units 1 and 2 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 U.S. Atomic Energy Commission's 1973 *Final Environmental Statement Related to Operation of St. Lucie Plant Unit No. 1* and U.S. Nuclear Regulatory Commission's 1982 *Final Environmental Statement Related to Operation of St. Lucie Plant, Unit No. 2*.

Eleven Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. For all 11 Category 2 issues and environmental justice related to the renewal term, 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 St. Lucie Units 1 and 2 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 St. Lucie OLs are not renewed and the units cease operation on or before the expiration of their current OLs, then the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of St. Lucie Units 1 and 2. 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 St. Lucie Units 1 and 2 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 FPL; (3) consultation with other Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments received during the scoping process and on the draft SEIS.

Abbreviations/Acronyms

°	degree(s)
µCi	microcurie(s)
µCi/mL	microcurie(s) per milliliter
µGy	microgray(s)
µm	micrometer(s)
µSv	microsievert(s)
AB	auxiliary building
ac	acre(s)
AC	alternating current
ACC	averted cleanup and decontamination costs
AEA	Atomic Energy Act of 1954
AEC	U.S. Atomic Energy Commission
AOC	present value of averted offsite property damage costs
AOE	present value of averted occupational exposure
AOSC	present value of averted onsite costs
AOT	allowed outage time
APE	present value of averted public exposure
ATWS	anticipated transient without scram
BEA	Bureau of Economic Analysis
Bq	becquerel(s)
BMT	basemat melt-through
Btu	British thermal unit(s)
C	Celsius
CCW	component cooling water
CDF	core damage frequency
CEOG	Combustion Engineering Owners Group
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHRS	containment heat removal system
Ci	curie(s)
cm	centimeter(s)
COE	cost of enhancement
COPC	chemicals of potential concern
CSS	containment spray system
CVCS	chemical and volume control system
CWA	Clean Water Act
CZMA	Coastal Zone Management Act

DBA	design-basis accident
DCH	direct containment heating
DOE	U.S. Department of Energy
DOH	Department of Health
DPR	demonstration project reactor
DSM	demand-side management
EDG	emergency diesel generator
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
EQ	equipment qualification
ER	Environmental Report
ESA	Endangered Species Act
ESRP	Environmental Standard Review Plan, NUREG-1555, Supplement 1, Operating License Renewal
F	Fahrenheit
FAA	U.S. Federal Aviation Administration
FES	Final Environmental Statement
FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
FNAI	Florida Natural Areas Inventory
FPL	Florida Power and Light Company
FPSC	Florida Public Service Commission
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
gal	gallon(s)
GDC	general design criteria
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
gpm	gallons per minute

ha	hectare(s)
HHSI	high head safety injection
HLW	high-level waste
HPSI	high pressure safety injection
hr	hour(s)
Hz	Hertz
in.	inch(es)
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
ISFSI	independent spent fuel storage installation
ISLOCA	interfacing system loss-of-coolant accident
J	joule(s)
kg	kilogram(s)
km	kilometer(s)
kV	kilovolt(s)
kV/m	kilovolt(s) per meter
kWh	kilowatt hour(s)
L	liter(s)
lb	pound
LLW	low-level waste
LNG	liquefied natural gas
LOCA	loss-of-coolant accident
LOOP	loss-of-offsite power
LOS	level-of-service (designation)
LWR	light-water reactor
m	meter(s)
m/s	meter(s) per second
m^3/d	cubic meter(s) per day
m^3/s	cubic meter(s) per second
mA	milliampere(s)
MAB	maximum attainable benefit
MACCS	MELCOR Accident Consequence Code System
MACCS2	MELCOR Accident Consequence Code System 2
MBq	megabecquerel(s)
MGD	million gallons per day
mGy	milligray(s)
mi	mile(s)

MJ	megajoule(s)
mL	milliliter(s)
mph	mile(s) per hour
mrad	millirad(s)
mrem	millirem(s)
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTHM	metric ton(s) heavy metal
MTU	metric ton(s)-uranium
MW	megawatt(s)
MWd/MTU	megawatt-day(s) 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
NCI	National Cancer Institute
NEPA	National Environmental Policy Act of 1969
NESC	National Electric Safety Code
ng/J	nanogram(s) per joule
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxide(s)
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
OL	operating license
PAR	passive autocatalytic recombiners
PARS	Publicly Available Records System
PDS	plant damage state
PM_{10}	particulate matter, 10 microns or less in diameter
PORV	power-operated relief valve
ppt	parts per thousand
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSD	prevention of significant deterioration
PSW	plant service water

PWR	pressurized water reactor
QA	quality assurance
RAB	reactor auxiliary building
RAI	request for additional information
RCP	reactor coolant pump
RCS	reactor coolant system
REMP	radiological environmental monitoring program
rms	root mean square
RPC	replacement power cost
RRW	risk reduction worth
RWST	refueling water storage tank
ry	reactor-year(s)
s	second(s)
SAG	Severe Accident Guideline
SAMA	severe accident mitigation alternative
SAMG	Severe Accident Management Guideline
SAR	safety analysis report
SBO	station blackout
SCR	selective catalytic reduction
SEIS	supplemental environmental impact statement
SER	safety evaluation report
SFWMD	South Florida Water Management District
SG	steam generator
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
SR	State Road or State Route
SSC	species of special concern
Sv	sievert(s)
TBq	terrabecquerel(s)
UDB	urban development boundary
UFSAR	Updated Final Safety Analysis Report
U.S.	United States
USACE	U.S. Army Corps of Engineers
USB	Urban Service Boundary
USC	United States Code

USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
yr	year(s)

1.0 Introduction

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

The Florida Power and Light Company (FPL) operates St. Lucie Units 1 and 2 in Florida under OLs DPR-67 and NPF-16, which were issued by the NRC. These OLs will expire on March 1, 2016, for Unit 1 and April 6, 2023, for Unit 2. On November 29, 2001, FPL submitted an application to the NRC to renew the St. Lucie OLs for an additional 20 years under the procedures in 10 CFR Part 54 (FPL 2001a). FPL is a *licensee* for the purposes of its current OLs and an *applicant* for the renewal of the OLs. Pursuant to 10 CFR 54.23 and 51.53(c), FPL submitted an Environmental Report (ER; FPL 2001b) in which FPL 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 FPL 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 St. Lucie Units 1 and 2 OLs, (3) discuss the purpose and need for the proposed action, and (4) present the status of FPL's compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies that are responsible for environmental protection.

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

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

- the preparers of the supplement
- the chronology of NRC correspondence regarding this SEIS
- the organizations contacted during the development of this SEIS
- FPL's permit compliance status (Table E-1) and copies of consultation correspondence prepared and sent during the evaluation process
- GEIS environmental issues that are not applicable to St. Lucie.

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

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

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 2 issues were not categorized. The latter two issues, environmental justice and chronic effects of electromagnetic fields, were to be addressed in a plant-specific analysis. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OLs is required to submit a supplement to the ER as part of its application (10 CFR 54.23). 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 St. Lucie OLs, FPL developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for St. Lucie Units 1 and 2 would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the licenses would be identified, reviewed, and assessed during the period of NRC review. FPL 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 St. Lucie Units 1 and 2. This review was performed by personnel from FPL and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (ESRP), NUREG-1555, Supplement 1 (NRC 2000). The search for new information includes (1) review of an applicant's ER and 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 an 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 St. Lucie Units 1 and 2. At the beginning of the discussion of each set of issues, a table 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 FPL license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the *Federal Register* (67 FR 4288 [NRC 2002a]) on January 29, 2002. The staff published a notice of intent to prepare an EIS and conduct scoping (67 FR 9333 [NRC 2002b]) on February 28, 2002. Two public scoping meetings were held on April 3, 2002, in Port St. Lucie, Florida. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – St. Lucie Units 1 and 2, Florida* (NRC 2002c) dated June 2002. Comments applicable to this environmental review are presented in Part I of Appendix A.

The staff followed the review guidance contained in the ESRP (NRC 2000). The staff and contractors retained to assist the staff visited the St. Lucie site on April 2, 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 consulted is provided in Appendix D. Other documents related to St. Lucie were reviewed and are referenced.

On November 1, 2002, the NRC published the Notice of Availability of the draft SEIS in 67 FR 66674 (NRC 2002d). A 75-day comment period began on the date of publication of the U.S. Environmental Protection Agency Notice of Filing of the draft SEIS to allow members of the public to comment on the preliminary results of the NRC staff's review. During this comment period, two public meetings were held in Port St. Lucie, Florida, in December 2002. During these meetings, the staff described the preliminary results of the NRC environmental review and answered questions related to it to provide members of the public with information to assist them in formulating their comments. The comment period for the St. Lucie draft SEIS ended January 13, 2003. Comments made during the 75-day comment period, including those made at the two public meetings, are presented in Part II of Appendix A of this SEIS. The NRC responses to those comments are also provided.

This SEIS presents the staff's analysis that considers and weighs the environmental effects of the proposed renewal of the St. Lucie OLs, 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 OLs for St. Lucie Units 1 and 2. The St. Lucie nuclear plant is located on Hutchinson Island in St. Lucie County, Florida. Port St. Lucie is the largest city within 80 km (50 mi) of St. Lucie Units 1 and 2.

The current OL for Unit 1 expires on March 1, 2016, and for Unit 2 on April 6, 2023. By letter dated November 29, 2001, FPL submitted an application to the NRC (FPL 2001a) to renew these OLs for an additional 20 years of operation (i.e., until March 1, 2036, for Unit 1 and April 6, 2043, for Unit 2).

The plant has two light-water reactors designed by Combustion Engineering, each with a design rating for a net electrical power output of 839 megawatts electric [MW(e)]. Once-through cooling water from the Atlantic Ocean is used to remove heat from the main (turbine) condensers via the circulating water system and from other auxiliary equipment via the intake

cooling water system (i.e., the auxiliary cooling water system). The majority of this cooling water is used for the circulating water system. St. Lucie produces enough electricity to supply the needs of more than 500,000 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 jurisdiction of the State 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 (AEA 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

FPL is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In the St. Lucie ER (FPL 2001b), FPL provided a list of the authorizations from Federal, State, and local authorities for current operations as well as environmental approvals and consultations associated with renewal of the St. Lucie OLs. Authorizations and consultations relevant to the proposed OL renewal action are included in Appendix E.

The staff has reviewed the list and consulted with the appropriate Federal, State, and local agencies to identify any compliance or permit issues or significant environmental issues of concern to the reviewing agencies. These agencies did not identify any new and significant environmental issues. The ER (FPL 2001b) states that FPL is in compliance with applicable environmental standards and requirements for St. Lucie Units 1 and 2. The staff also has not identified any environmental issues that are both new and significant.

1.6 References

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

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

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

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

Florida Power and Light Company (FPL). 2001a. *Application for Renewed Operating Licenses, St. Lucie Units 1 and 2*. Docket Nos. 50-335 and 50-389, Miami, Florida.

Florida Power and Light Company (FPL). 2001b. *Applicant's Environmental Report – Operating License Renewal Stage St. Lucie Units 1 and 2*. Docket Nos. 50-335 and 50-389, Miami, Florida.

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

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, 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. "Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of License Nos. DPR-67 and NPF-16 for an Additional Twenty-Year Period." *Federal Register*: Vol. 67, No. 198, pp. 4288-4290. January 29, 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. 40, pp. 9333-9335. February 28, 2002.

U.S. Nuclear Regulatory Commission (NRC). 2002c. *Environmental Impact Statement Scoping Process: Summary Report – St. Lucie Units 1 and 2, Port St. Lucie, Florida*. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2002d. "Florida Power and Light Co. Units 1 and 2, Notice of Availability of the Draft Supplement 11 to the Generic Environmental Impact Statement and Public Meeting for the License Renewal of St. Lucie, Units 1 and 2." 67 *Federal Register* 66674. November 1, 2002.

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

The Florida Power and Light Company's (FPL's) St. Lucie Units 1 and 2 are located on Hutchinson Island in St. Lucie County, Florida. The nearest municipalities are Fort Pierce, approximately 11 km (7 mi) northwest of the plant; Port St. Lucie, approximately 7 km (4.5 mi) to the west; and Stuart, approximately 13 km (8 mi) to the south. The plant consists of two units, Units 1 and 2, which are nuclear reactors and the subject of this action. 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

The St. Lucie Units 1 and 2 site consists of approximately 457 ha (1130 ac) of land on the widest section of Hutchinson Island in an area previously degraded by mosquito control projects, as described in the FPL Environmental Report (ER; FPL 2001a). Figures 2-1 and 2-2 show the site location and features within 80 km and 10 km (50 mi and 6 mi), respectively. Figure 2-3 shows the site boundary in relation to the power block and adjacent features.

St. Lucie Units 1 and 2 are located on the west side of State Road A1A in a relatively flat, sheltered area of Hutchinson Island. West of the facility, the land gradually slopes downward to a mangrove fringe bordering the intertidal shoreline of the Indian River Lagoon. East of the facility, land rises from the ocean shore to form dunes and ridges approximately 4.6 m (15 ft) above mean low water (FPL 2001a). Two county parks with beach access, Blind Creek Pass Park and Walton Rocks Park, lie within the St. Lucie Units 1 and 2 property boundary. Recreational facilities for FPL employees and their families are also available within the site property boundary.

The Indian River Lagoon is a long, shallow, tidally influenced estuary stretching along Florida's central east coast between the mainland and a series of offshore islands. At St. Lucie Units 1 and 2, the Indian River Lagoon is approximately 2195 m (7200 ft) wide. Blind Creek and Big Mud Creek, inlets off the Indian River Lagoon, are adjacent to the site. The stretch of lagoon adjacent to the site is designated as the Jensen Beach to Jupiter Inlet Aquatic Preserve. The North Fork St. Lucie River Aquatic Preserve is located on the north fork of the St. Lucie River at Port St. Lucie. The St. Lucie Canal connects the St. Lucie River with Lake Okeechobee and parallels State Road 76, south of Stuart.

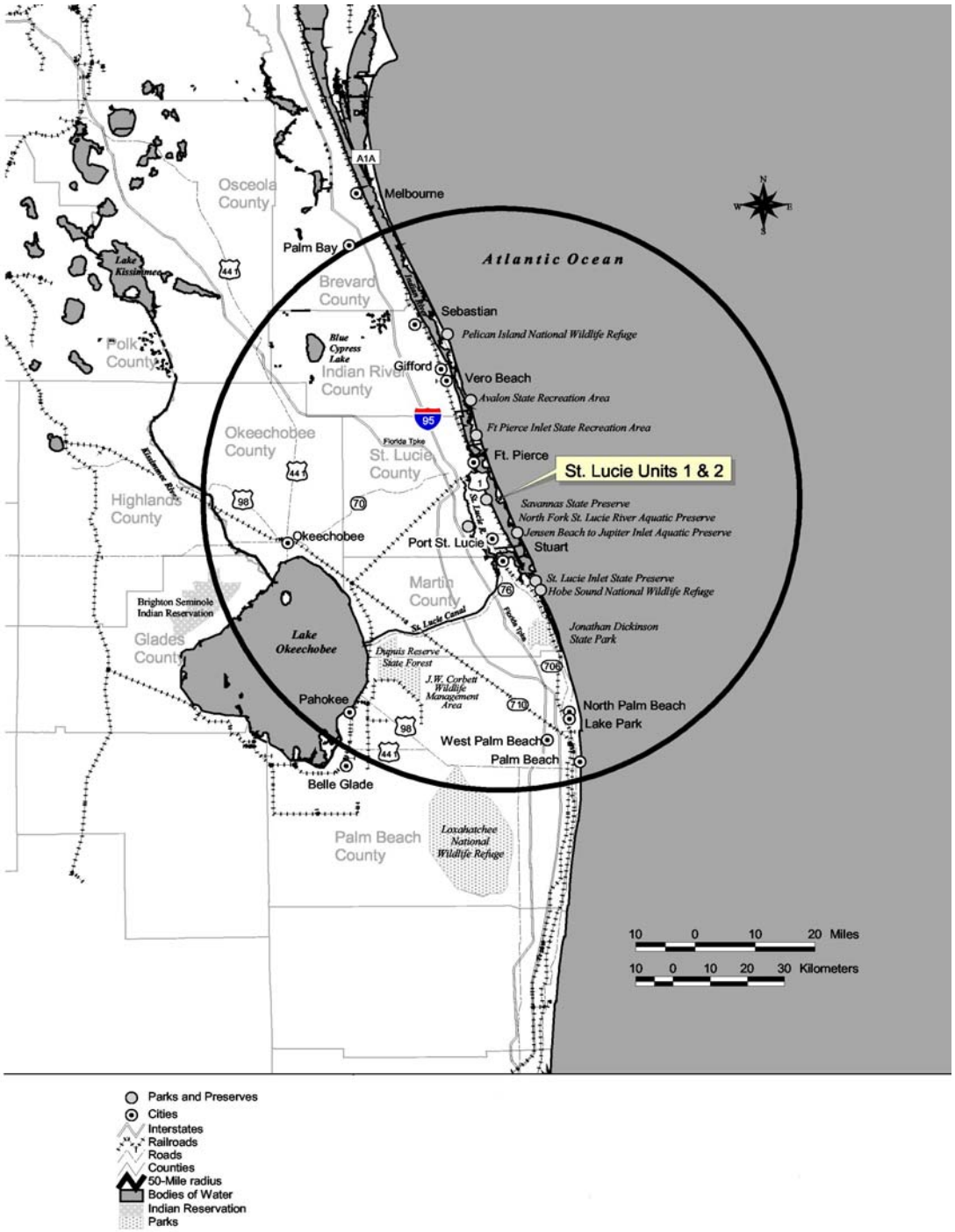

Figure 2-1. Location of St. Lucie Units 1 and 2, 80-km (50-mi) Region

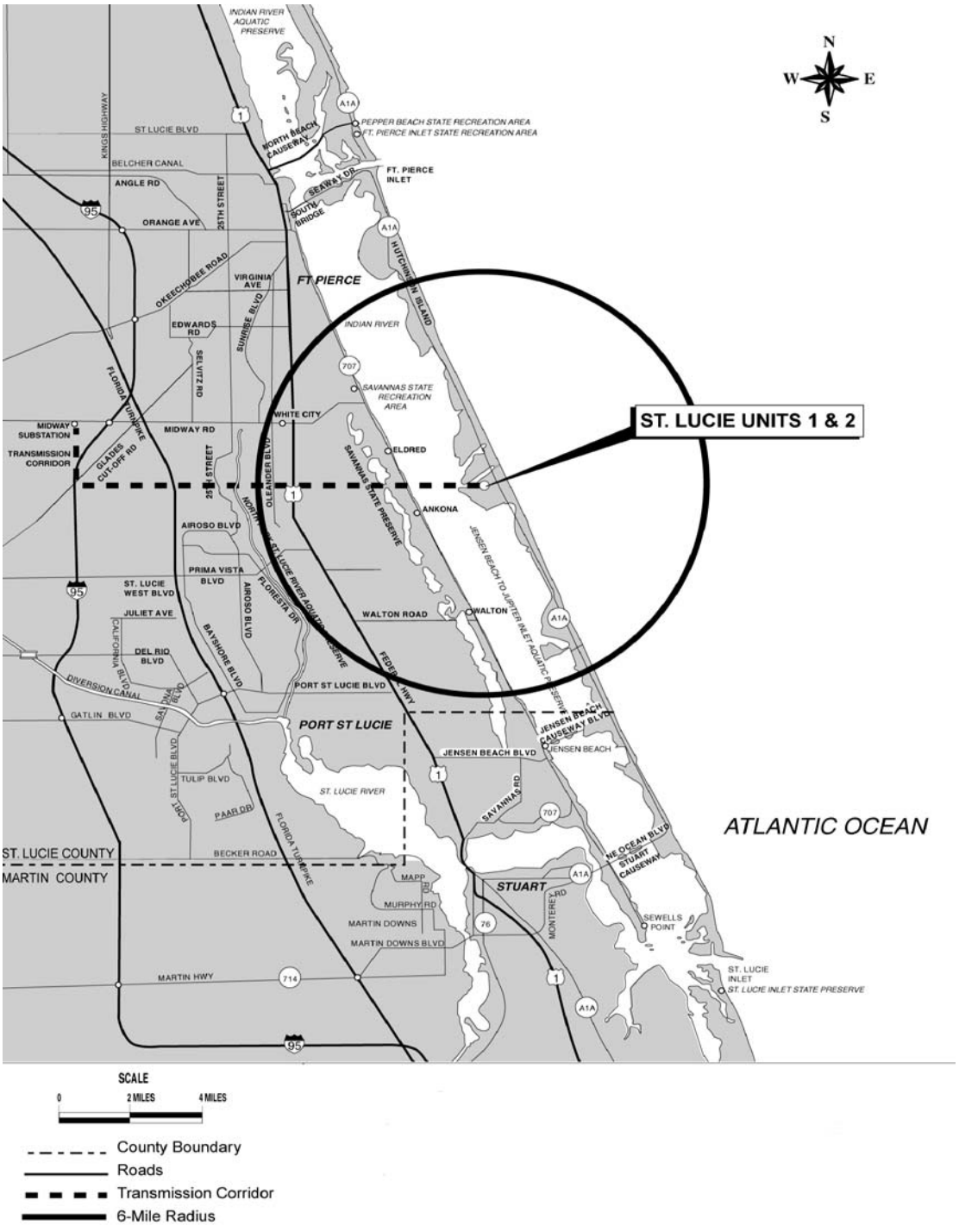

Figure 2-2. Location of St. Lucie Units 1 and 2, 10-km (6-mi) Region

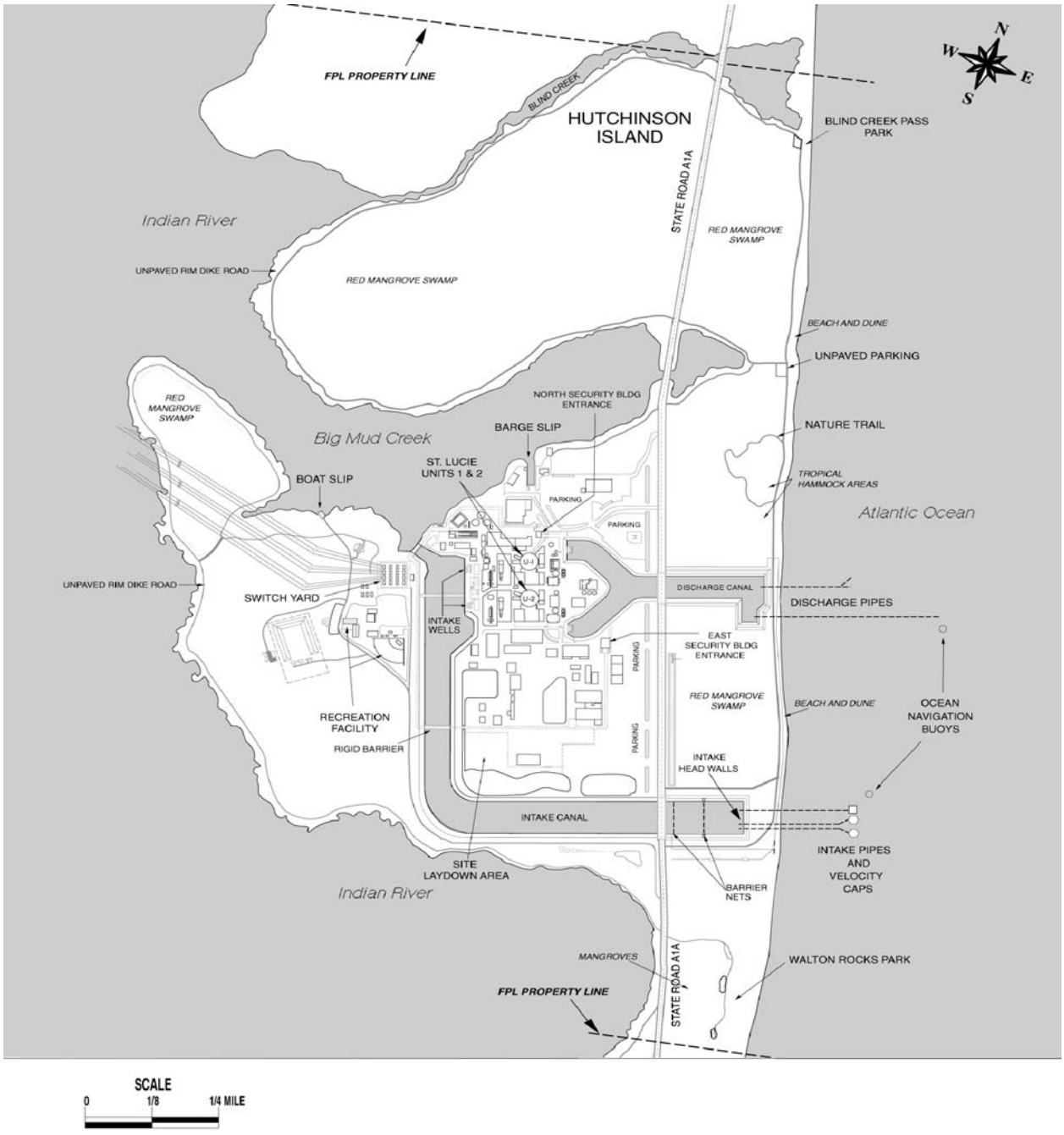

Figure 2-3. St. Lucie Units 1 and 2, Site Boundary

Fort Pierce Inlet State Recreation Area is approximately 14 km (9 mi) north of St. Lucie Units 1 and 2 immediately north of the Fort Pierce Inlet. Recreation area activities include beach access, swimming, picnicking, camping, and hiking. Other State recreation areas include Avalon, Savannas, and Pepper Beach. The Savannas State Preserve, a freshwater lagoon, is located on the mainland approximately 3.2 km (2 mi) west of St. Lucie Units 1 and 2, and offers fishing, hiking, picnicking, and other outdoor-related activities. Other prominent features within 80 km (50 mi) of St. Lucie Units 1 and 2 include Lake Okeechobee; Blue Cypress Lake; Jonathan Dickinson State Park; the Dupuis Reserve State Forest; J. W. Corbett Wildlife Management Area; a portion of the Brighton Seminole Indian Reservation; and the Hobe Sound, Pelican Island, and Loxahatchee National Wildlife Refuges (FPL 2001a).

2.1.1 External Appearance and Setting

The prominent structures and housed facilities and equipment associated with each of the units include the containment building, which houses the nuclear steam supply system including the reactor, steam generators, reactor coolant pumps, and related equipment; the turbine generator building, where the turbine generator and associated main condensers are located; the auxiliary building, which houses waste management facilities, engineered safety features components, and other facilities; and the fuel-handling building, where the spent fuel storage pool and storage facilities for new fuel are located. Prominent features beyond the power block area include the intake canal, discharge canal, intake wells, evaporation/percolation ponds, switchyard, technical and administrative support facilities, and public education facilities. The taller buildings on the site, particularly the containment buildings (approximately 61 m [200 ft] high) are visible from the mainland (FPL 2001a). Four evaporation-percolation ponds on the southern part of the site (Figure 2-4) accommodate storm-water runoff.

Two main aquifers are found in the area: a shallow, nonartesian or locally artesian aquifer within the Anastasia Formation, and a deeper, artesian aquifer known as the Floridan Aquifer. The two aquifers are separated by the Hawthorne Formation, which acts as an aquiclude. The groundwater flow direction in the Anastasia Formation is to the east precluding movement from the site westward toward the mainland. The piezometric level in the Floridan Aquifer is higher than that in the Anastasia Formation aquifer. This, in addition to the aquiclude (Hawthorne Formation) that separates the two aquifers, precludes water from moving from the site downward to the Floridan Aquifer (FPL 2000).

2.1.2 Reactor Systems

The arrangement of St. Lucie Units 1 and 2 major structures and equipment in the power block and nearby areas is shown in Figure 2-4. The nuclear power units for St. Lucie Units 1 and 2

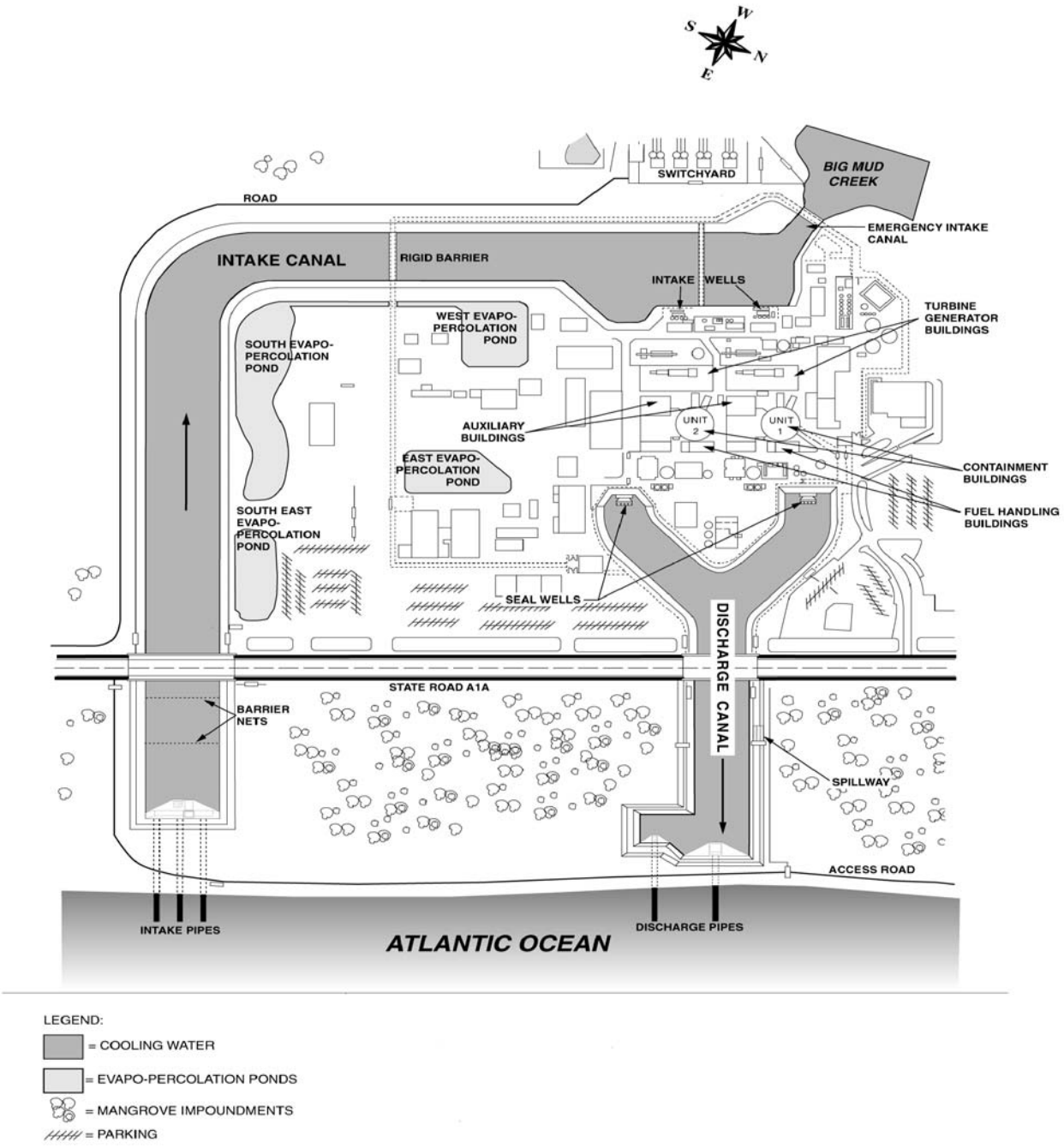

Figure 2-4. St. Lucie Units 1 and 2, Power Block Area

are of comparable design, each consisting of a pressurized light-water reactor (LWR) with two steam generators that produce steam, which turns a turbine to generate electricity. Each unit is currently licensed to operate at an output of approximately 2700 megawatts thermal [MW(t)], with a corresponding gross electrical output of approximately 890 megawatts electric [MW(e)], for a combined plant capability of 1678 MW(e), discounting onsite electrical power usage (net summer rating [FPL 2001a]).

Each reactor is housed in a containment structure comprising a steel-containment vessel surrounded by a reinforced concrete shield building. The dry-containment structures are designed to withstand environmental effects and the internal pressure and temperature accompanying a postulated loss-of-coolant accident (LOCA). Together with its engineered safety features, each containment structure is designed to adequately retain fission products that could escape from the reactor coolant system in the event of a LOCA.

St. Lucie Units 1 and 2 are licensed for uranium-dioxide fuel that is slightly enriched with up to 4.5 percent by weight uranium-235. The uranium-dioxide fuel is in the form of pellets contained in zircaloy tubes with welded end plugs to confine radionuclides. The tubes are fabricated into assemblies designed for loading into the reactor core. Each reactor core includes 217 fuel assemblies.

FPL currently replaces approximately one-third of the fuel assemblies in each reactor at an interval of approximately 18 months. FPL operates the reactors such that the average burnup is approximately 47,000 megawatt-days per metric ton uranium (MWd/MTU).

2.1.3 Cooling and Auxiliary Water Systems

Water from the Atlantic Ocean is used at St. Lucie Units 1 and 2 to remove heat from the main condensers and other auxiliary equipment. Most of this cooling water is used for the circulating-water system. Heat generated in the reactors is transferred in a way that useful energy is extracted to produce electricity. St. Lucie Units 1 and 2 have a two-loop, three-stage heat-transfer design. The primary system circulates reactor coolant (demineralized water that has been treated to control chemistry and corrosion) under high pressure through the reactor and two steam generators. The steam generators, steam turbine, and main turbine condensers are connected in a secondary closed loop containing treated, demineralized water. Secondary-system water flashes to steam in the steam generators, and the steam turns the turbine to generate electricity. After exiting the turbine, the steam in the secondary system passes through the main condensers, where it is cooled to liquid water before returning to the steam generator to complete the secondary loop.

The circulating-water system is the final (tertiary) stage in this heat-transfer system. The tertiary stage is unconfined. Water is drawn through three offshore ocean intake structures into

the intake canal. This water is then pumped from the intake canal at the intake wells through the main condensers to the discharge canal. The heated water is finally discharged back to the Atlantic Ocean through offshore diffusers (Figures 2-3 and 2-4). Water circulation in the system is provided by eight pumps (four per unit) located at the intake wells. Nominal total capacity of the pumps is 61,070 L/s (968,000 gpm), though capacity may range from 50,470 to 70,660 L/s (800,000 gpm to 1,120,000 gpm), depending on condenser cleanliness (FPL 1996). When all pumps are operating and both units are operating at 100 percent capacity, temperature rise across the condensers is about 13°C (24°F).

The three cooling-water intake structures for St. Lucie Units 1 and 2 are located about 370 m (1200 ft) offshore, where the water is about 7 m (23 ft) deep. Two of the structures were installed before startup of Unit 1 in 1976. The third intake structure is larger than the initial two and was installed in 1983. The designs of the structures are essentially identical, featuring a large concrete base with a vertical cylindrical opening in the center and a concrete velocity cap supported by columns extending about 1.8 m (6 ft) from the base (NRC 1982). The velocity cap configuration was designed to reduce potential entrainment of marine organisms by eliminating vertical flows and limiting horizontal flow velocities. Water withdrawn from the structures is conveyed through separate buried pipes, beneath the beach and dune system, to the intake canal. The inside diameters of the pipes, which correspond to those of the vertical cylindrical openings in the concrete bases of the structures, are 4.9 m (16 ft) for the large intake and 3.7 m (12 ft) for the two smaller intakes. Flow velocities vary within the intake system (Table 2-1) (Ecological Associates 2000).

The intake canal, a 1500-m (4920-ft) -long trapezoidal channel about 55 m (180 ft) wide and 9.1 m (30 ft) deep at normal water levels (USACE 1993), conveys cooling water to the intake wells during normal operation. FPL has installed and maintains three barriers in the channel to reduce potential losses of marine life, particularly sea turtles, and to facilitate the return of turtles to the ocean. These include deployment of a 12.7-cm (5-in.) mesh barrier net across the channel approximately midway between State Road A1A and the canal headwall, a 20.3-cm (8-in.) mesh barrier net immediately east of State Road A1A, and installation of a rigid barrier across the north-south arm of the intake canal (Figure 2-3) (Ecological Associates 2000).

FPL dredged accumulated sediments from the intake canal on several occasions, most recently in the fall of 2002. On one occasion (in the mid-1990s) the dewatered sediments were sold as clean fill. Dredging is in accordance with a U.S. Army Corps of Engineers (USACE) permit (USACE 1993). The permit includes provisions for periodic dredging in the future, if needed (USACE 1993). Under emergency conditions (e.g., failure of the intake canal headwall as a result of a design-basis earthquake), water can be withdrawn from Big Mud Creek via the emergency intake canal (Figure 2-4) through two 137-cm (54-in.) pipe assemblies in the barrier wall that separates the creek from the canal. FPL does not use this intake during normal

Table 2.1 Calculated Flow Velocities at Various Points in the Intake System of St. Lucie Units 1 and 2

	Velocity m/s (ft/s)	
Location	**3.7-m (12-ft) Diameter Intakes**	**4.9-m (16-ft) Diameter Intakes**
Velocity Cap Intake	0.11 to 0.12 (0.37 to 0.41)	0.27 to 0.30 (0.9 to 1.0)
Vertical Section	0.37 to 0.40 (1.2 to 1.3)	1.9 to 2.1 (6.2 to 6.8)
Intake Pipe	1.3 to 1.4 (4.2 to 4.7)	1.8 to 2.1 (5.9 to 6.8)
Intake Canal	0.30[(a)] (1.0)	

(a) Flow rate represents the combined flow from all intake pipes once merged in the intake canal.

operations but does test this system semiannually by exercising the valves in the two pipe inlets.

Water is withdrawn from the intake canal at eight separate intake wells (four per unit). Water enters the wells through a series of trash racks (vertical bars spaced 7.6 cm [3 in.] apart), then through traveling screens (1-cm [3/8-in.] mesh), which are periodically backwashed. The water is then pumped from the wells through the main turbine condensers. Heated water is discharged to the discharge canal. Biofouling of the condenser tubes and other system components is controlled exclusively using plastic foam balls (Taprogge® system) and injecting sodium hypochlorite. The foam balls are injected upstream from the condenser, scrub the condenser tubes as they pass through the tubes, and are collected in ball strainers downstream from the condensers (FPL 1996). FPL uses best management practices to minimize ball loss to the environment. Sodium hypochlorite injections are controlled to ensure that free available oxidant is at or below 0.5 mg/L at the condenser outlet and total residual oxidant concentration at the eastern end of the discharge canal is at or below 0.10 mg/L, as required by the Industrial Wastewater Facility Permit for St. Lucie Units 1 and 2 (FDEP 2000).

The discharge canal is about 670 m (2200 ft) long with transverse dimensions similar to those described for the intake canal. The canal transports the heated cooling water to two discharge pipes at its eastern terminus. The pipes transport water beneath the beach and dune system back to the Atlantic Ocean. One pipe, completed in 1975 to serve St. Lucie Unit 1, is 3.7 m (12 ft) in diameter, extends about 460 m (1500 ft) offshore, and terminates in a two-port "Y" diffuser. The second pipe, installed in 1981 for two-unit operation, is about 4.9 m (16 ft) in diameter, extends about 1040 m (3400 ft) offshore, and features a multiport diffuser. This diffuser consists of 58 41-cm (16-in.) -diameter ports located 7.3 m (24 ft) apart on the easternmost 430 m (1400 ft) of the pipe. The discharge of heated water through the Y-port and multiport diffusers ensure distribution over a wide area and rapid and efficient mixing with ambient waters (FPL 1996; Foster Wheeler 2000). Modeling studies presented by the U.S. Atomic Energy Commission (AEC) and the U.S. Nuclear Regulatory Commission (NRC) in

the operating stage Final Environmental Statements indicate that under typical conditions, the areas of the thermal plumes to the 1.1°C (2°F) isotherm (above ambient) from the St. Lucie Units 1 and 2 diffusers would be about 73 ha (180 ac) and 71 ha (175 ac), respectively (AEC 1973; NRC 1982).

The temperature of the discharged cooling water is limited by the Industrial Wastewater Facility Permit for St. Lucie Units 1 and 2 (FDEP 2000). These limits require that heated water from the diffusers, as measured near the exit from the discharge canal, do not exceed 45°C (113°F) or 16.7°C (30°F) above ambient during normal operations. A maximum temperature of 47.2°C (117°F) or 17.8°C (32°F) above ambient is permitted during certain maintenance operations, when throttling circulating water pumps to minimize use of chlorine, and when cleaning the circulating-water system.

The auxiliary cooling-water system for St. Lucie Units 1 and 2 is also a once-through cooling system, but uses much less water than the circulating-water systems. Up to 3660 L/s (58,000 gpm) of ocean cooling water is pumped from the intake canal using intake cooling-water pumps. This noncontact cooling water is pumped through heat exchangers to provide cooling for a wide variety of plant equipment and is discharged to the discharge canal. Low-level chlorination is used to control biofouling of this system (FPL 1996).

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

FPL uses liquid, gaseous, and solid radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes that are the by-products of the operation of St. Lucie Units 1 and 2. These systems process radioactive liquid, gaseous, and solid effluents to maintain releases to the environment within regulatory limits. The St. Lucie Units 1 and 2 waste disposal system meets the design objectives of 10 CFR Part 50, Appendix I ("Numerical guides for design objectives, and limiting conditions for operation to meet the criterion 'As Low as is Reasonably Achievable' for radioactive material in light-water-cooled nuclear power reactor effluents") and controls the processing, disposal, and release of radioactive liquid, gaseous, and solid wastes. Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive wastes in LWRs. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products 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 wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated

protective clothing, paper, rags, and other trash generated from plant design modifications and operations and routine maintenance activities. Solid wastes are shipped to a waste processor to reduce volume before disposal at a licensed burial site. Spent resins and filters are stored or packaged for shipment to a licensed offsite processing or disposal facility. St. Lucie Units 1 and 2 have separate radwaste systems. For reporting effluent releases and calculating offsite doses, the releases for the two units are combined (FPL 2000, 2001b).

Fuel rods that have exhausted a certain percentage of their fuel and are removed from the reactor core for disposal are called spent fuel. St. Lucie Units 1 and 2 currently operate on a staggered 18-month refueling cycle per unit. Spent fuel is stored onsite in the spent fuel pool in the Fuel Handling Building (FPL 2001a).

The *Offsite Dose Calculation Manual* (ODCM; FPL 2002) is subject to NRC inspection and describes the methods and parameters used for calculating offsite doses resulting from radioactive gaseous and liquid effluents. It is also used for calculating gaseous and liquid effluent monitoring alarm/trip setpoints for release of effluents from St. Lucie Units 1 and 2. Operational limits for releasing liquid and gaseous effluents are specified to ensure compliance with NRC regulations (FPL 2001b).

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

Potentially radioactive liquid wastes are processed by two systems: a boron recovery system and a liquid waste system. The boron recovery system processes water from the reactor coolant system that will be recycled in the plant. The liquid waste system processes liquid waste from outside of containment, such as process water from equipment drains, floor drains, laboratory drains, decontamination drains, building sumps, and laundry wastes (FPL 2000, 2001b).

The reactor coolant wastes, which are of potentially high activity, are collected from the chemical and volume control system and from valve and equipment leakage from containment drains and are placed in holdup tanks. The holdup tanks provide storage until there is an appropriate volume for batch processing. Storage allows for decay of the short-lived radionuclides. Degasification that occurs during storage is monitored by the plant vent monitors. The holdup tanks are sampled and processed until the contents meet the criteria for discharge. Before the controlled discharge of the treated liquid waste, the fluid is analyzed to determine that the activity is acceptably low for discharge. Discharged liquids pass through an effluent radiation monitor that records the release activity level and automatically terminates the release upon high radiation to the circulating water discharge. If the liquid is to be reused in the plant, it is analyzed for acceptability of both chemistry and activity (FPL 2000, 2001b).

The ODCM (FPL 2002) provides the control statements, limits, action statements, and surveillance requirements for ensuring that the liquid effluents released to unrestricted areas or the site boundary will be maintained within the requirements of 10 CFR Part 20, 40 CFR Part 190, 10 CFR 50.36.a, and 10 CFR Part 50, Appendix I. The ODCM also contains the calculation of the liquid effluent monitoring alarm/trip setpoints. The alarm/trip setpoint for each liquid-effluent monitor is based on the measurements of radioactivity in a batch of liquid to be released or in the continuous liquid discharge (FPL 2002).

During 2000, there were 31 batch releases for each unit at St. Lucie with a total volume of 7.2×10^7 L (1.9×10^7 gal) of liquid waste released before dilution for the two units. This liquid waste had a total fission and activation product activity of 2800 MBq (0.076 Ci) and total tritium activity of 2.1×10^7 MBq (557 Ci) (FPL 2001b). These volumes and activities are typical of past years.

FPL 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 systems for St. Lucie Units 1 and 2 process the vent gases from equipment located in the chemical volume control system, waste management system, and fuel pool system. Gaseous releases come from the reactor auxiliary building ventilation, turbine system leakage, steam jet air ejector operation, gland steam condenser operation, and containment purging in addition to releases from the gas collection header and gas surge header. The gaseous waste system is designed to protect workers and the public as well as meet the requirements in 10 CFR Part 20 and 10 CFR Part 50, Appendix I (FPL 2000, 2001b). Gases handled by the gaseous waste system may be compressed and stored in the gas decay tanks or may be released to the plant vent if the activity is sufficiently low. After decay, the gas in the waste gas decay tanks is sampled to ensure that the radioactivity levels are within acceptable limits for release. The monitored gaseous release points are the containment building purge, the reactor auxiliary building, the fuel-handling building, and the turbine generator building (FPL 2000). These release points are continuously monitored for noble gases, radioiodines, and particulate activity. The ODCM (FPL 2002) prescribes alarm/trip setpoints for these effluent monitors and control instrumentation to ensure that the alarm/trip will occur before exceeding the limits of 10 CFR Part 20 for gaseous effluents. These release points are continuously monitored and provide alarms and automatic valve closure when radiation levels exceed a preset level, thus terminating discharge.

During 2000, there was a total fission and activation gas activity of 5.2×10^5 MBq (14 Ci), a total iodine activity of 0.55 MBq (1.5×10^{-5} Ci), a total particulate activity including gross alpha, beta, and gamma of 14 MBq (3.8×10^{-4} Ci), and a total tritium activity of 6.6×10^6 MBq (178 Ci)

released from the two units. These releases are typical of past years. In addition, during 2000, there was a minor unplanned gaseous release from Unit 2 that resulted in a release of 2.3×10^5 MBq (6.2 Ci) of radioactive material (FPL 2001b). The dose contribution from this unplanned release was negligible and no site release rate, quarterly dose limits, or annual dose limits were exceeded.

FPL does not anticipate any increase in gaseous releases during the renewal period and releases will remain within the regulatory limits.

2.1.4.3 Solid Waste Processing

The solid wastes from St. Lucie Units 1 and 2 consist of concentrated liquid sludge, spent resin, spent filter cartridges, solid noncompactible and compactible trash, and miscellaneous materials from station and radwaste facility operation and maintenance. The Solid Waste Management System collects, controls, processes, packages, and temporarily stores solid radioactive waste and certain liquid radioactive waste generated as a result of normal plant operations. Concentrated liquid sludge is segregated by type, flushed to storage tanks, slurried into an appropriate container, and stored onsite before shipment offsite for disposal. Ion-exchange resins are sluiced into the spent resin tank or shipping container and dewatered. Filters are moved into shipping containers. Compressible waste is compacted if possible, or shipped offsite to a reduction facility for processing. Noncompressible waste is packaged in boxes or bags. All of these wastes are packaged and shipped offsite to an appropriate disposal or processing system (FPL 2000, 2001b).

In 2000, FPL made 21 shipments of solid waste from St. Lucie with a volume of 78.8 m^3 (2785.3 ft^3), and a total activity of 1.99×10^7 MBq (537 Ci) (FPL 2001b). These shipments are representative of the shipments made in the past several years and are not expected to change appreciably during the license renewal period.

2.1.5 Nonradioactive Waste Systems

When St. Lucie Units 1 and 2 were originally licensed, the sanitary waste system in use was a septic tank and associated leaching fields for treatment and disposal of onsite sewage. The flow of groundwater is predominately to the east towards the Atlantic Ocean. Because of the inherent problems with septic systems, the licensee anticipated tying into the municipal sewage facilities when a sewer line was installed on the island (AEC 1973, 1974). Since September 1997, upon completion of St. Lucie County's South Hutchinson Island Water Reclamation Facility, site sanitary wastewater has been discharged to the St. Lucie County system for treatment (FPL 2001a).

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear power plant. Maintenance activities at St. Lucie Units 1 and 2 include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. FPL refuels each of the St. Lucie nuclear units on an 18-month schedule, resulting in at least one refueling every year and two refuelings every third year (FPL 2001a). A third of the core is offloaded at each refueling. An additional 575 to 870 workers are temporarily onsite during a typical 30- to 40-day outage.

FPL provided its aging management review for each unit in its application to the NRC staff for renewed operating licenses for St. Lucie Units 1 and 2 (FPL 2001c). Chapter 3 and Appendix B of the St. Lucie Units 1 and 2 license renewal application outline the programs and activities that will manage the effects of aging during the license renewal period (FPL 2001c). FPL expects to conduct the activities related to the management of aging effects during plant operation or normal refueling and other outages, but plans no outages specifically for the purpose of refurbishment. FPL has no plans to add additional full-time staff (non-outage workers) at the plant during the period of the renewal licenses.

2.1.7 Power Transmission System

FPL constructed three 230-kV transmission lines to connect St. Lucie Units 1 and 2 to the transmission system (FPL 2001a). These three lines are all within a single transmission line right-of-way that runs west from the St. Lucie plant, crosses the Indian River, then runs over land for approximately 18 km (11 mi), terminating at the Midway substation (Figure 2-2). Most of the right-of-way is approximately 200 m (660 ft) wide, except for the last several miles where the three St. Lucie transmission lines share the right-of-way with other transmission lines that are not directly associated with St. Lucie Units 1 and 2. The last 2.4 km (1.5 mi) of the right-of-way is shared with four other 230-kV lines and one 500-kV line; the total right-of-way width along the majority of this leg is approximately 245 m (803 ft), with one short section of 330 m (1080 ft). In total, the right-of-way occupies approximately 310 ha (766 ac). FPL is the property owner for all of the transmission line right-of-way except for the last 2.4 km (1.5 mi), which is held in easement.

There are a variety of land uses and habitat types within the St. Lucie-to-Midway right-of-way including abandoned agricultural lands, pasture lands, sand pine scrub, dry prairie, pine

flatwoods, wet prairie, isolated marshes, and ruderal and disturbed sites (FPL 2001a). The right-of-way passes through a portion of the Savannas State Preserve, a nearly 2000-ha (4900-ac) environmental area managed by the Florida Department of Environmental Protection (FDEP) – Division of Parks.

FPL maintains the transmission right-of-way using a combination of trimming, mowing, and herbicide application. When required, FPL trims trees at a height of 4.3 m (14 ft) to maintain clearances below the conductors. Tree trimming is typically needed only at midspan. In open areas, FPL usually follows a 5-year mowing cycle. Herbicides are used both for spot treatment of individual trees and occasionally as broadcast applications to control exotic grasses. FPL uses only nonrestricted-use herbicides, which are applied under the supervision of licensed pesticide applicators.

2.2 Plant Interaction with the Environment

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

2.2.1 Land Use

St. Lucie Units 1 and 2 are located on Hutchinson Island in an unincorporated portion of St. Lucie County, Florida. The nearest municipalities are Fort Pierce, located approximately 11 km (7 mi) northwest of the plant; Port St. Lucie, located approximately 7 km (4.5 mi) west of the plant; and Stuart, located approximately 13 km (8 mi) south of the plant. Fort Pierce is the county seat of St. Lucie County. Port St. Lucie is the largest city within 80 km (50 mi) of the plant site.

St. Lucie Units 1 and 2 occupy approximately 457 ha (1130 ac) on the widest portion of Hutchinson Island. The plant site is zoned for utility use under the St. Lucie County Land Development Code.

Section 307(c)(3)(A) of the Coastal Zone Management Act [16 USC 1456(c)(3)(A)] requires that applicants for Federal licenses to conduct an activity in a coastal zone certify that the proposed activity is consistent with the enforceable policies of the State's coastal zone program. A copy of the certification is also to be provided to the State. The State is to notify the Federal agency whether the State concurs with or objects to the applicant's certification. This notification is to occur within 6 months of the State's receipt of the certification. The St. Lucie plant is within

Florida's coastal zone for purposes of the Act. Following submission of the FPL certification of consistency, the Florida Department of Community Affairs determined that renewal of the operating licenses for St. Lucie Units 1 and 2 would be consistent with the Florida Coastal Management Program (Collins 2002). A copy of the determination is in Appendix E of this Supplemental Environmental Impact Statement (SEIS).

2.2.2 Water Use

St. Lucie Units 1 and 2 receive water from the City of Fort Pierce and the Fort Pierce Utilities Authority for potable and service uses at the plant. This freshwater is derived from groundwater sources on the mainland, and plant operations do not involve any additional groundwater withdrawal. Current plant usage averages approximately 4.98×10^5 L (131,500 gal) per day with no restrictions on supply. Noncontact cooling water for St. Lucie Units 1 and 2 is withdrawn from the Atlantic Ocean. Additional minor amounts of ocean water are used to enhance the growth of mangroves, assist in mosquito control, and for mariculture and related projects.

2.2.3 Water Quality

In accordance with the Federal Water Pollution Control Act (also known as the Clean Water Act), the water quality of plant effluent discharges is regulated through the National Pollutant Discharge Elimination System (NPDES). FDEP is the agency in the State of Florida delegated by the U.S. Environmental Protection Agency (EPA) to issue discharge permits in Florida. The NPDES (FL0002208-Major) permit sets limitations on water quality in effluent discharges and establishes specific monitoring requirements and the reporting frequency. Discharge limitations for temperature are 45°C (113°F), or 16.7°C (30°F) above ambient conditions during routine operations. Discharge limits are also set for parameters such as total residual oxidants, free available oxidants, oil and grease, and total suspended solids. Additionally, the permit establishes requirements for management of industrial sludge generated by the facility, implementation of best management practices for pollution prevention, and record-keeping. The current NPDES permit expires on January 9, 2005.

Groundwater is generally very shallow at the site, and typically is just a few inches above mean sea level. Recharge of freshwater is via infiltration of rainfall, and the depth of freshwater is only a foot or so below the water table. No groundwater is withdrawn from the site as part of plant operations. Groundwater is withdrawn from the site to remediate a diesel fuel spill that occurred in 1992. The remediation is ongoing, with approximately 19,000 L (5000 gal) of spilled diesel fuel recovered to date. Approximately 760 L (200 gal) per year are still being recovered. Most of the diesel fuel has been filtered and reused onsite.

The current Industrial Wastewater Facility Permit (FDEP 2000) for St. Lucie Units 1 and 2 requires no groundwater monitoring at the site. Plant effluent is discharged to the Atlantic Ocean (a Class III marine water), the mangrove impoundment, and the intake canal. All discharges are monitored and regulated under the Industrial Wastewater Facility Permit (FDEP 2000).

An onsite package plant was originally used to treat the site sanitary wastewater. The treated wastewater was discharged to the discharge canal. Now the site's sanitary wastewater is discharged to St. Lucie County's South Hutchinson Island Water Reclamation Facility for treatment.

St. Lucie Units 1 and 2 have not had any significant NPDES compliance issues based on annual inspections the FDEP has conducted since 1993 (Davis 2002). Anticipated future operations at St. Lucie Units 1 and 2 suggest that compliance with NPDES regulations will continue.

2.2.4 Air Quality

The St. Lucie site has a subtropical climate with mild dry winters and long, warm summers with abundant rainfall. Climatological records for West Palm Beach, Florida, are generally representative of the St. Lucie site; the position of St. Lucie between the Indian River Lagoon and the Atlantic Ocean tends to moderate temperatures and alter precipitation amounts and timing.[(a)] Climatological records for West Palm Beach indicate that the dry season lasts from mid-November through April, and the wet season is from May through mid-November. Normal daily maximum temperatures for West Palm Beach range from about 24°C (75°F) in January to a high of about 32°C (90°F) in July and August. Normal minimum temperatures range from about 13°C (56°F) in January to about 24°C (75°F) in August. Normal monthly precipitation ranges from 5 to 8 cm (2 to 3 in.) in the dry season to 15 to 20 cm (6 to 8 in.) in the wet season.

Although thunderstorms occur in all months in the area, more than 80 percent of them occur from May through September. During July and August, thunderstorms occur on more than 50 percent of the days (FPL 2000). August and September are the height of the hurricane season. In any year, the probability of hurricane-force winds striking the site is about 1 in 15 (FPL 2000). Based on statistics for the 30 years from 1954 through 1983 (Ramsdell and Andrews 1986), the probability of a tornado striking the site is expected to be about 5×10^{-5} per year. Waterspouts, which are similar to weak tornadoes, occasionally occur along the Florida coast in the vicinity of St. Lucie. FPL estimates the probability of a waterspout striking a point offshore within 3.2 km (2 mi) of the coastline to be about 5×10^{-4} per year (FPL 2000).

(a) Climatological data for West Palm Beach are available at http://www.ncdc.noaa.gov/ol/climate/climatedata.html.

The wind energy resource in Florida is limited. The annual average wind power in most of Florida is rated 1 on a scale of 1 through 7; in coastal areas, the rating is 2 at best (Elliott et al. 1987). Areas suitable for wind turbine applications have a rating of 3 or higher. No area in Florida is rated 3 or higher.

Most of the year, the region is under the influence of the Bermuda high-pressure system. High-pressure systems are generally associated with low winds and increased potential for air pollution. However, because of its coastal location, meteorological conditions conducive to high air pollution are infrequent at St. Lucie. The St. Lucie site is located within the South Florida Intrastate Air Quality Control Region. In addition, the Central Florida Interstate Air Quality Control Region and the Southwest Florida Intrastate Air Quality Control Region are within 80 km (50 mi) of St. Lucie. These regions are designated as in attainment or unclassified for all criteria pollutants in 40 CFR 81.310.

The Everglades National Park is designated in 40 CFR 81.407 as a mandatory Class 1 Federal area in which visibility is an important value. The park, which is the closest Class 1 area to St. Lucie, is approximately 180 km (110 mi) from the St. Lucie site. The other Class 1 areas in Florida are more than 240 km (150 mi) from the site.

Diesel generators, boilers, and other activities and facilities associated with St. Lucie Units 1 and 2 emit various pollutants. Emissions from these sources are regulated under Air Permit 1110071-003-AO issued by the FDEP. The current air emissions permit expires on June 26, 2005.

2.2.5 Aquatic Resources

The St. Lucie Units 1 and 2 location on Hutchinson Island places it between two major aquatic ecosystems: the Atlantic Ocean to the east and the Indian River Lagoon to the west. The plant uses a once-through cooling-water system that withdraws from and discharges into the Atlantic Ocean via offshore intake and discharge structures. The plant is also equipped with an emergency cooling-water intake that can withdraw water from the Indian River Lagoon via Big Mud Creek, but this pathway is closed during normal operation (see Section 2.1.3). These areas contain markedly different habitats and biotic communities, as discussed below.

2.2.5.1 Atlantic Ocean

Submerged coquinoid rock formations parallel much of Hutchinson Island. A notable beach frontage feature at the plant site, just south of the St. Lucie Units 1 and 2 intake canal, is an intertidal coquina-rock formation that protrudes through the sand at Walton Rocks Park. The hard substrate is colonized extensively by encrusting tube-building marine polychaete worms

(family Sabellariidae). These worm reef communities in turn support a rich and diverse association of other invertebrates, algae, and fishes. The nearshore area has no reef structures, grass beds, or rock outcroppings. Seaward, the ocean floor consists of unconsolidated sediments composed of quartz and calcareous sands, broken shell fragments, and negligible amounts of silts and clays. The sea floor gently slopes into a trough with a maximum depth of about 11.9 m (39 ft) at about 1.9 km (1.2 mi) offshore. Continuing offshore, the sea floor rises to form the Pierce Shoal at about 3.2 km (2 mi).

The marine communities in the vicinity of St. Lucie Units 1 and 2 were studied in detail prior to startup of Unit 1 in 1976 (FPL 1973). Phytoplankton were collected at five locations offshore of Hutchinson Island. Densities ranged from 1 to over 35,000 cells/L during the study period, but varied little from location to location. The community was dominated by diatoms, the most common of which were the genera *Nitzschia*, *Bellerochea*, and *Chaetoceros*, and the species *Thalassionema nitzschioides* and *Skeletonema costatum*. The data indicated the possibility of two blooms per year, one during September-October and one during January. Chlorophyll *a* concentrations ranged from about 0.1 to 7.7 mg/m^3 and correlated well with the September-October phytoplankton bloom. The composition of the phytoplankton communities was typical of those described for other nearshore areas along the eastern seaboard of the United States.

Zooplankton were sampled at the same locations as phytoplankton, and ranged in density from about 250 to 12,000 organisms/m^3. The zooplankton community was characterized primarily by neritic holoplanktonic species (species that spend their entire life cycle in the water column). Copepods dominated the collections, with the genera *Acartia, Paracalamis, Oithona, Temora, Undinula, Corycaeus, Euterpina,* and *Labidocera* being common. Zooplankton density appeared to be broadly correlated with phytoplankton density.

Monitoring data indicates that there are three sub-tidal microhabitats offshore of the plant: shallow beach terrace, offshore shoal, and a deeper trough in between the two. Sediment composition differs among these zones. The biological composition of macroinvertebrate communities is largely influenced by sediment composition. Because of the sediment heterogeneity, the trough supports the most abundant fauna. It is characterized by high diversity and relatively rapid turnover of less abundant and more transient species. In the intertidal zone, the worm reef community provides yet another distinct habitat for macroinvertebrates. Patterns of fish abundance and diversity are also largely aligned along microhabitat boundaries. In addition to the habitats identified above, the surf zone harbors yet another distinct assemblage of fish.

Baseline data include 127 species of arthropods and nearly 300 species of mollusks. The diverse makeup of these groups, and to some extent their seasonal variability, was attributed to the transitional temperate, subtropical, and tropical mix of climate and water masses in the general vicinity of Hutchinson Island. Some estuarine affinities were also noted and attributed to water mass intrusions from the Indian River Lagoon by way of St. Lucie Inlet and prevailing

northerly coastal currents. Among species of direct commercial value, the Atlantic calico scallop (*Argopecten gibbus*) was the only mollusk recorded. Arthropods of potential commercial value included shrimp (of the family Penaeidae) and the blue crab (*Callinectes sapidus*). However, these species were generally collected infrequently and in small numbers.

Benthic studies conducted through 1984 produced remarkable databases for regional sediments, hydrology, and bottom-dwelling organisms. A total of 934 taxa of benthic macroinvertebrates, many species new to science, were identified.

The fish communities offshore are transitional assemblages of temperate and tropical forms. Since oceanic fishes are most diverse and abundant near reefs and other hard-bottom areas, FPL sited intake and discharge structures for St. Lucie Units 1 and 2 in areas devoid of these habitats.

Fisheries assessments were carried out in association with startup and operations of St. Lucie Units 1 and 2 (FPL 1973). Bottom trawls were used for several years, but collected few fish. For example, sampling every other month at five Hutchinson Island offshore locations from September 1971 to March 1972 resulted in 39 fish (13 species) collected. The sheepshead (*Archosargus probatocephalus*) was most abundant in these collections. Beach seines were deployed over this same time period. Ninety-eight percent of the catch of 11,598 fish was collected in November 1971, and consisted primarily of Cuban and longnose anchovies (*Anchoa cubana* and *A. nasuta*) and 20 other less abundant species. Ichthyoplankton were also sampled during the earlier monitoring (NRC 1982). Larvae of herring and anchovies were most common, and generally abundant during spring and summer. This monitoring yielded 5570 individuals distributed among 49 species. The five most abundant species accounted for nearly 70 percent of the catch: Atlantic bumper (*Chloroscombrus chrysurus*), Spanish mackerel (*Scomberomorus maculatus*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), and bluefish (*Pomatomus saltatrix*). Catches were higher in fall and winter than spring and summer. In comparing 8 years of monitoring data (1977-1984), investigators found temporal and spatial distributions to be highly variable (Applied Biology 1985).

Commercial and recreational fishing are important activities in the vicinity of St. Lucie Units 1 and 2. Commercial landing data for St. Lucie County were summarized for 1970-1972 (FPL 1973). Their evaluation focused on the three most abundant species in commercial catches at that time: bluefish, Spanish mackerel, and king mackerel (*Scomberomorus cavalla*). All are highly migratory, spawn in coastal waters from late summer into winter (depending on species), and migrate northward along the East Coast during the warmer seasons. These species are only seasonally abundant during migrations in spring and fall. For the 1971 season, landed weights of bluefish, Spanish mackerel, and king mackerel from St. Lucie County were about 104,000 kg (228,663 lb), 308,000 kg (679,110 lb), and 525,000 kg

(1,217,356 lb), respectively. These landings represented 10.7 percent, 6.8 percent, and 21.6 percent, respectively, of total Florida landings. These species were also prominent in the 1982 landings for St. Lucie County (Applied Biology 1985), ranging from about 107,000 kg (236,146 lb) of bluefish to about 408,000 kg (899,944 lb) of Spanish mackerel. However, several other species were quite abundant in 1982, including tilefish (*Caulolatilus* spp.) (267,000 kg [587,654 lb]) and swordfish (*Xiphias gladius*) (205,000 kg [451,503 lb]). Pre-operational studies revealed that bluefish, Spanish mackerel, and king mackerel occur farther offshore than where the intake and discharge lines now terminate, i.e., trough habitat (FPL 1973).

St. Lucie County is the northernmost county on Florida's east coast that has an extensive winter sport fishery (FPL 1973). Ladyfish (*Elops saurus*), common snook (*Centropomus undecimalis*), and various billfish species were common in recreational catches.

2.2.5.2 Indian River Lagoon

The Indian River Lagoon is a productive estuary that abuts the western edge of the St. Lucie Units 1 and 2 property. Environmental studies were conducted in the Lagoon from the late 1960s into the 1980s in association with siting, construction, and operation of St. Lucie Units 1 and 2 (FPL 1973; NRC 1982).

The lagoon is characterized by extensive growths of manatee grass (*Syringodium filiforme)* and red algae, such as the dominant form *Gracilaria* sp. In turn, the grass and algae are inhabited by a variety of gammarids, shrimp, isopods, crabs, and juvenile fish. A variety of microscopic organisms are supported by this vegetative community, including diatoms attached to the plant leaves. More than 90 phytoplankton species have been reported from the Lagoon. Benthic organisms are also abundant and include tube-dwelling worms and crustaceans, the latter including larger shellfish such as shrimp and blue crabs. Twenty-four decapod species (e.g., shrimp, crabs) were collected from Big Mud Creek near St. Lucie Units 1 and 2 in the early 1970s (FPL 1973).

Big Mud Creek, a backwater cove of the Indian River Lagoon, was dredged to a maximum depth of approximately 14 m (46 ft) during plant construction to provide deep-water access to the Intracoastal Waterway. Being some distance from both the Fort Pierce and St. Lucie inlets, Big Mud Creek receives little tidal influence and so has minimal water exchange with Indian River Lagoon. This results in water stratification in the summer and anoxic conditions on the bottom. During the winter months, the water masses turn over as the surface cools. A diverse and abundant fish community of over 300 species has been identified in the southern portion of the Indian River Lagoon (NRC 1982). Red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), common snook, sheepshead, and gray snapper (*Lutjanus griseus*) were commonly reported. During the last 20 years, the increasing levels of human activities in

its watershed have impacted the lagoon's water, sediment, and habitat quality. As the construction of extensive agricultural and urban drainage projects have increased the watershed's size, the land-use changes associated with increased residential, commercial, agricultural, and industrial development have altered the freshwater inputs to the lagoon. Alteration of the normal patterns of freshwater inputs has contributed to changes in the biological communities in the lagoon. Reductions in abundance and distribution of sea grasses and oysters are evidence of these changes.

2.2.5.3 Threatened or Endangered Aquatic Species

Fifteen species of aquatic fauna and flora, observed on or near the St. Lucie Units 1 and 2 site, are listed as threatened, endangered, or State species of special concern (SSC) by Federal or State agencies (Table 2-2). Several species of sea turtle and the Florida manatee (*Trichechus manatus*) have been documented at the St. Lucie Units 1 and 2 site. The most common occurrences of threatened or endangered species at the site are the sea turtles.

Table 2-2. Federally Listed and State of Florida-Listed Aquatic Species Occurring in St. Lucie County

Scientific Name	Common Name	Federal Status[a,b]	State Status[a,b]
Caretta caretta	loggerhead sea turtle	T	T
Chelonia mydas	green sea turtle	E	E
Dermochelys coriacea	leatherback sea turtle	E	E
Eretmochelys imbricata	hawksbill sea turtle	E	E
Lepidochelys kempi	Kemp's ridley sea turtle	E	E
Balaenoptera borealis	sei whale	E	E
Balaenoptera phusalus	finback whale	E	E
Eubalaena glacialis	North Atlantic right whale	E	E
Megaptera novaeanliae	humpback whale	E	E
Physeter catodon	sperm whale	E	E
Trichechus manatus	Florida manatee	E	E
Acipenser oxyrhynchus	Atlantic sturgeon	-	SSC
Centropomus undecimalis	common snook	-	SSC
Rivulus marmoratus	mangrove rivulus	-	SSC
Halophila johnsonii	Johnson's seagrass	T	T

(a) Sources: FDACS 1998; FFWCC 2001
(b) E = endangered; T = threatened, - = no listing status, SSC = species of special concern.

Five species of sea turtle have been reported on Hutchinson Island. The threatened loggerhead sea turtle (*Caretta caretta*) has historically been most common. Between 5000 and 8000 loggerhead nests have been reported on Hutchinson Island over the last 10 years (Ecological Associates 2000). The endangered green sea turtle (*Chelonia mydas*) also nests on Hutchinson Island, but these nests are less abundant than those of the loggerhead. The endangered leatherback sea turtle (*Dermochelys coriacea*) infrequently nests on Hutchinson Island. Nest numbers have shown an upward trend in the last 20 years, though they have varied widely. During 1996 through 2000, the number of leatherback nests has ranged from 42 in 1997 to 143 in 1999 (FPL 2001d). The endangered Kemp's ridley sea turtle (*Lepidochelys kempi*) and hawksbill sea turtle (*Eretmochelys imbricata*) do not nest on Hutchinson Island and have only infrequently been reported from the area.

Six protected mammals (five species of whales and the Florida manatee) occur in the vicinity of the St. Lucie site. The whales are listed as endangered by the Federal government and the State of Florida. All occur in ocean waters off Hutchinson Island. Both humpback (*Megaptera novaeanliae*) and North Atlantic right whales (*Eubalaena glacialis*) have been observed in relatively close proximity to the shore in the immediate vicinity of the plant. These sightings occur between January and March. Waters of the southeastern United States are considered wintering and calving grounds for right whales (Waring et al. 1999). Three additional species of whale have been reported on rare occasions.

The Florida, or West Indian, manatee inhabits the Indian River Lagoon and Atlantic coastal waters off Hutchinson Island. Although preferred habitats are in the Indian River Lagoon and other inland waterways where food sources are abundant, they do occasionally travel up and down the coast near the shore. Manatees are known to congregate in the warm water effluents of power plants during winter months. There are abundant food resources near the facilities where they congregate.

None of the fish species In Table 2-2 are Federally listed, but all are designated as SSC by the State of Florida. The Atlantic sturgeon (*Acipenser oxyrhynchus*) inhabits salt or brackish water and may move into freshwater to spawn (Gilbert 1992). It has been collected along the Atlantic coast off Hutchinson Island and is listed as an occasional inhabitant of the neritic and surf zones over sand and shell bottoms (Gilmore et al. 1981). Atlantic sturgeon have not been collected in the intake canal or during operational monitoring offshore near St. Lucie Units 1 and 2.

The mangrove rivulus (*Rivulus marmoratus*) is listed as a rare inhabitant of mangroves, freshwater tributaries, canals, and mosquito impoundments (Gilmore et al. 1981).

The common snook is a highly prized recreational species common to the Indian River Lagoon and nearshore ocean water adjacent to the St. Lucie plant. Fishing for this species is regulated

by the State of Florida. Snook were taken in offshore trawls during operational studies, and they are regularly entrained with cooling water.

The only listed species of aquatic vegetation found in the vicinity of the St. Lucie plant is Johnson's seagrass (*Halophila johnsonii*). Johnson's seagrass is found in the Indian River Lagoon, most often near inlets.

2.2.6 Terrestrial Resources

Hutchinson Island is typical of the offshore sandbars that line the southern U.S. Atlantic coastline. It consists of a sandbar on the eastern side that rises to about 4.6 m (15 ft) above mean sea level and a broader, sloping swale on the western side. The seaward side of the dunes currently has no vegetation, and the inland side of the dunes is dominated by sea oats (*Unida paniculata*), sea grape (*Coccoloba uvifera*), salt marsh hay (*Spartina patens*), Australian pine (*Casuarina equisetifolia*), marsh ox-eye (*Barrichia frutescens*), beach sunflower (*Helianthus debilis*), marsh elder (*Iva frutescens*), bay bean (*Canaualia rosea*), and railroad vine (*Ipomoea pescaprae*) (Foster Wheeler 2001).

Before the 1930s, the mangrove swamps on the western side of the island were maintained by tidal and occasional storm-driven incursions of seawater as well as by rain (AEC 1973). The swales were dominated by red mangrove (*Rhizophora mangle*), with black mangrove (*Avicennia nitida*) and white mangrove (*Raguncularia racemosa*) established in the higher and less frequently flooded ground. These mangrove swamps are noteworthy for their high productivity and the rich animal communities they support. Much of the natural mangrove swamp area was destroyed during the 1930s and 1940s as part of a mosquito control program initiated by the Work Project Administration. The swamps were trenched, diked, and flooded with seawater, which greatly reduced mosquito breeding but also led to the loss of many trees, especially the black mangrove (AEC 1973). Since that time, there has been partial restoration of the swales, but much of the area continues to be maintained in an inundated state by the local mosquito control districts.

A few small tropical hammock habitats exist on Hutchinson Island near the St. Lucie site; the largest is found in the mangrove stands north of the discharge canal. These habitats are unusual this far north. Prominent species include gumbo-limbo (*Bursera simaruba*), paradise tree (*Simarouba glauca*), white and Spanish stoppers (*Eugenia axillaris and E. foetida*), wild lime (*Zanthoxylum fagara*), white indigo berry (*Randia aculeata*), mastic (*Mastichodendron foetidissimum*), and snow berry (*Chiococcoca alba*).

Habitat in the transmission line right-of-way is a mixture of human-altered areas, sand pine scrub, prairie/pine flatwoods, wet prairie, and isolated marshes. In the 1970s, much of the

right-of-way was used for agricultural purposes such as orange groves, row crops, and pastureland (AEC 1973). Most of that agricultural use has since been abandoned, except for the western portions used for grazing.

There are no designated critical habitat areas for any Federally listed threatened or endangered species at the St. Lucie site or along the transmission line right-of-way. However, the beach areas on the eastern side of Hutchinson Island are important nesting areas for the loggerhead sea turtle, and they are also used to a lesser extent by green and leatherback sea turtles. Critical habitat for the Everglades snail kite (*Rostrhamus sociabillis*) is located approximately 19 km (11.8 mi) northwest of the Midway substation.

At least 13 species listed as threatened or endangered under the Federal Endangered Species Act (ESA) are known to occur within St. Lucie County (Table 2-3). There are no species currently proposed for formal listing or considered candidates for listing in St. Lucie County. The status of the Federally listed species in the vicinity of the plant site and transmission line right-of-way is discussed in the following paragraphs.

The eastern indigo snake (*Drymarchon corias couperi*) has not been observed on the St. Lucie site or along the transmission line right-of-way, but it has been observed elsewhere on Hutchinson Island (FPL 2001a). Gopher tortoises (*Gopherus polyphemus*) are present on the site, especially on the leeward side of the dunes to the east of the St. Lucie site and intake/discharge canals in areas with soft soil not subject to flooding (FPL 2001a). Gopher tortoises also are known to occur within the St. Lucie-to-Midway transmission line right-of-way, at least in the strip between the Indian River and the eastern marshes of the Savannas State Preserve (Foster Wheeler 2001). Indigo snakes are known to seek out gopher tortoise burrows for shelter and denning (FWS 1999), and they have been observed elsewhere on Hutchinson Island and in St. Lucie County. Therefore, it is likely that there are eastern indigo snakes either onsite or in the near vicinity of the St. Lucie site or transmission line right-of-way.

American alligators (*Alligator mississippiensis*) are common in freshwater wetland areas throughout South Florida. They are not present at the St. Lucie site because all aquatic environments in the immediate vicinity of the site are either salty or brackish. Although not observed during field surveys (Foster Wheeler 2001), alligators are likely to occur occasionally in the freshwater marsh areas and along the St. Lucie River within or near the transmission line right-of-way.

The southeastern beach mouse (*Peromyscus polionotus niveiventris*) inhabits the sea oats zone of the primary coastal dunes (FWS 1999). In many cases, suitable habitat for the southeastern beach mouse may only be a few meters wide, and in most cases it is highly heterogeneous. They primarily feed on the seeds of sea oats and panic grass (*Panicum amarum*), although they will eat insects and seeds of other dune species.

The current distribution is severely limited by the modification and destruction of habitat along the Florida barrier islands. The largest populations are located at Canaveral National Seashore, while Brevard County and Indian River County have a number of populations. Populations have been reported from St. Lucie County at Pepper Beach County Park, Fort Pierce Inlet State Recreation Area, and Surfside Beach State Park, all located at least 13 km (8.1 mi) north of the St. Lucie plant. However, recent surveys have failed to detect any southeastern beach mice at these sites within St. Lucie County, and they may have been extirpated from the county. There have been no specific surveys for this species at the St. Lucie site; however, if it were present, the site would probably be a refuge for this species because of the limited disturbance and human interference.

Table 2-3. Terrestrial Species Listed as Threatened or Endangered by the U.S. Fish and Wildlife Service that Have Been Reported to Occur Within St. Lucie County, Florida

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]
Reptiles			
Drymarchon corias couperi	eastern indigo snake	T	T
Alligator mississippiensis	American alligator	T(S/A)	SSC
Birds			
Aphelocoma coerulescens	Florida scrub jay	T	T
Haliaeetus leucocephalus	bald eagle	T	T
Mycteria americana	wood stork	E	E
Picoides borealis	red-cockaded woodpecker	E	T
Polyborus plancus audubonii	Audubon's crested caracara	T	T
Rostrhamus sociabilis	Everglades snail kite	E	E
Mammals			
Peromyscus polionotus niveiventris	southeastern beach mouse	T	T
Plants			
Asimina tetramera	four-petal paw paw	E	E
Dicerandra immaculate	Lakela's mint	E	E
Harrisia (Cereus) eriophorus	fragrant prickly apple	E	E
Polygala smallii	tiny milkwort	E	E

(a) E = endangered, T = threatened, T(S/A) = threatened due to similarity of appearance, SSC = species of special concern.

Sources: Based on U.S. Fish and Wildlife Service (FWS 2002a, 2002b); and the Internet sites of the Florida Natural Areas Inventory (FNAI) (FNAI 2002), Florida Fish and Wildlife Conservation Commission (FFWCC 2002), University of South Florida, Atlas of Florida Vascular Plants (2002); and Florida Geographic Data Library (2002).

Florida scrub jays (*Aphelocoma coerulescens*) are found in various forms of Florida scrub, including the coastal scrub found in eastern St. Lucie County. The largest populations of Florida scrub jays are located in the central portion of the Florida Peninsula in Polk and Highlands counties, but they are also found along both coasts and north of Orlando in Volusia, Lake, and Marion counties. Although it is fairly widespread throughout peninsular Florida, it has extremely specific habitat requirements (FWS 1999). It is endemic to the ancient dune ecosystems that are dominated by xeric oaks (*Quercus* spp.). Although scrub jays are not known from the St. Lucie plant site, they have been observed beneath the St. Lucie-to-Midway transmission lines within a narrow band of vegetation between the Indian River and the Savannas State Preserve that is suitable scrub jay habitat. There have been other periodic sightings of Florida scrub jays within the coastal scrub areas along the west shore of the Indian River within approximately 3 km (1.9 mi) of the St. Lucie transmission line (FGDL 2002). In general, the maintenance practices used by the applicant within the St. Lucie-to-Midway corridor may help to maintain the open scrub habitat required by the scrub jays.

Bald eagles (*Haliaeetus leucocephalus*) are known to nest approximately 2 km (1.2 mi) south of the St. Lucie transmission line corridor. They usually nest in tall trees near major waterways and feed on fish, waterfowl, and occasionally carrion. Bald eagles are occasionally observed along the Indian River and near the St. Lucie site, but they are not regular inhabitants of these areas.

The Audubon's crested caracara (*Polyborus plancus audubonii*) is a large, nonmigratory raptor. It occurs in south Texas, southwestern Arizona, and through Mexico from Baja California to Panama and Cuba. Only the Florida population is protected under the ESA (FWS 1999). In south Florida, the caracara occurs in dry or wet prairies with scattered cabbage palms (*Sabal palmetto*) or occasionally in lightly wooded areas. They usually build well-concealed nests within cabbage palms. Much of the historical habitat areas for the caracara have been greatly modified or destroyed, but there are indications that the caracara is able to use improved or semi-improved pastures (FWS 1999). Caracaras are opportunistic feeders and will consume both carrion and live prey. Although they may be present in the vicinity of the transmission line right-of-way, there are no known observations in the area, and they are primarily found in the western portions of St. Lucie County. Caracaras have not been observed at the St. Lucie site.

Wood storks (*Mycteria americana*) are large wading birds that rely on freshwater and estuarine habitats for nesting, roosting, and foraging. They build nests in colonies, usually in medium to tall trees that occur in either swamps or on islands surrounded by open water (FWS 1999), and they often share rookeries with other wading birds. The alterations of the natural hydrologic regime in south Florida have eliminated much of the seasonal variation on which wood storks historically relied—they exploited the fish that would become concentrated in alligator holes and other depressions during the dry season. Wood storks are observed occasionally in the vicinity

of the St. Lucie site and the transmission line right-of-way, but there are no known rookeries within many miles of the site or transmission line right-of-way.

The Everglades snail kite (*Rostrhamus sociabilis*) is a medium-sized raptor that feeds almost exclusively on apple snails (*Pomacea paludsa*) that are found in freshwater marshes and the shallow, vegetated edges of lakes. Most of the snail kite populations are located on the west side of Lake Okeechobee and in the Everglades west of Palm Beach, Fort Lauderdale, and Miami. However, there is one small area within St. Lucie County that has been designated as critical habitat for the snail kite. This area includes the Cloud Lake and Strazzulla reservoirs, approximately 19 km (12 mi) northwest of the Midway substation. This species has been observed within several kilometers of the transmission line right-of-way (FGDL 2002), and it might use the scattered freshwater marshes in the vicinity for foraging.

Red-cockaded woodpeckers (*Picoides borealis*) occur throughout the southeastern United States in pine stands or pine-dominated pine-hardwood stands with sparse understory and ample old-growth trees (FWS 1999). Population levels have drastically declined over the last century due to logging and conversion of habitat to other uses. The status of red-cockaded woodpeckers in south Florida, including St. Lucie County, is not well known (FWS 1999), but because of the requirements for old growth, pine-dominated forests, they are highly unlikely to occur at or near the St. Lucie site. Suitable habitat is very limited in or absent from the transmission line right-of-way (Foster Wheeler 2001).

The four-petal pawpaw (*Asimina tetramera*) is an aromatic shrub approximately 1 to 3 m (3 to 10 ft) tall. It occurs in sand pine scrub within the coastal dune system. Its historic range has been greatly reduced by habitat conversion, and it is now known from a few locations between Palm Beach Gardens and the Savannas State Preserve in Martin County, and a few locations in northern St. Lucie County (FWS 1999). This species is found in various seral stages of sand pine scrub and is adapted to infrequent, intense fires. This species is not likely to be found at the St. Lucie site or along the transmission line right-of-way; it would only be found near the west shore of the Indian River where suitable habitat is present. Field surveys have not detected this species within the transmission line right-of-way (Foster Wheeler 2001).

Lakela's mint (*Dicerandra immaculate*) is a small aromatic shrub that inhabits scrub areas of the Atlantic coastal ridge (FWS 1999). It occupies sites with varying amounts of organic litter, from partly covered to bare sand. This species is currently known from approximately six sites between Fort Pierce and Vero Beach, and at Hobe Sound National Wildlife Refuge, where it was introduced in 1991 and 1992 (FWS 1999). Although suitable habitat exists in the vicinity of the transmission line right-of-way at the western shore of the Indian River, this species was not found during field surveys (Foster Wheeler 2001).

The fragrant prickly apple (*Harrisia [Cereus] eriophorus*) is a solitary tree cactus that is endemic to St. Lucie County and is known only from approximately 11 small, disjunct sites, along the Atlantic Coastal Ridge on the western shore of the Indian River (FWS 1999). The St. Lucie-to-Midway transmission line right-of-way crosses this ridge between the Indian River and the marshes on the east side of the Savannas State Preserve. Several of the known populations are located within 2 to 3 km (1.2 to 1.9 mi) of this right-of-way, but none of the known populations is close enough to be affected by corridor maintenance. Field surveys of the corridor did not reveal any fragrant prickly apple (Foster Wheeler 2001).

The tiny milkwort (*Polygala smallii*) is a small, short-lived, herbaceous species that is restricted to sand pockets within pine rocklands, open sand pine scrub, slash pine, high pine, and well-drained coastal spoil (FWS 1999). It requires high light levels, and little to no organic litter accumulation. All known populations are within 9.7 km (6 mi) of the Atlantic coast between Miami-Dade County and St. Lucie County. The only known population in St. Lucie County is located approximately 6.9 km (4.3 mi) south of the St. Lucie-to-Midway transmission line. Field surveys of the transmission line right-of-way did not detect the presence of the tiny milkwort (Foster Wheeler 2001).

In addition to the species listed in Table 2-3, several other Federally listed species have been reported from the counties surrounding St. Lucie County. These conceivably could occur in the vicinity of the St. Lucie plant or associated transmission line right-of-way. These species include Atlantic salt marsh snake (*Nerodia fasciata taeniata*), Florida grasshopper sparrow (*Ammodramus savannarum floridanus*), piping plover (*Charadrius melodus*), Florida panther (*Felis concolor coryi*), perforate reindeer lichen (*Cladonia perforata*), and beach clustervine (*Jacquemontia reclinata*).

In addition to the Federally listed species, at least 72 species listed by the State of Florida as threatened, endangered, or of special concern occur in St. Lucie County (Table 2-4). Florida-State-listed animal species that have been observed at the site include a number of wading birds common to the region such as white ibis (*Eudocimus albus*), little blue heron (*Egretta caerulea*), tri-colored heron (*Egretta tricolor*), snowy egret, (*Egretta thula*) and roseate spoonbill (*Ajaia ajaja*), as well as the brown pelican (*Pelacanus occidentalis*) and southeastern American kestrel (*Falco sparverius paulus*). Black skimmers (*Rynchops niger*) and American oystercatchers (*Haematopus palliatus*) are known to nest along the intake canal shoreline, and the least tern (*Sterna antillarum*) has been found to nest atop buildings on the St. Lucie site (FPL 2001a). As described above, gopher tortoises are common within the stabilized dune system on the east side of the St. Lucie site and in the ancient dune system between the Indian River and the marshes of the Savannas State Preserve. State-listed plant species that have been observed at the St. Lucie site include the inkberry (*Scaevola plumieri*), common prickly pear (*Opuntia stricta*), burrowing four-o'clock (*Okenia hypogaea*), and coastal vervain (*Verbena [Glandularia] maritima*). Several additional State of Florida plant species of concern have been observed within the St. Lucie-to-Midway transmission line right-of-way, including the yellow

Table 2-4. Additional Terrestrial Species Listed by the State of Florida as Threatened, Endangered, or of Special Concern that Have Been Reported in St. Lucie County

Scientific Name	Common Name	State Status[(a)]
Reptiles		
Gopherus polyphemus	gopher tortoise	SSC
Pituophis melanoleucus mugitus	Florida pine snake	SSC
Amphibians		
Rana capito aesopus	Florida gopher frog	SSC
Birds		
Ajaia ajaja	roseate spoonbill	SSC
Aramus guarauna	limpkin	SSC
Egretta caerulea	little blue heron	SSC
Egretta rufescens	reddish egret	SSC
Egretta thula	snowy egret	SSC
Egretta tricolor	Louisiana heron	SSC
Eudocimus albus	white ibis	SSC
Falco peregrinus	peregrine falcon	E
Falco sparverius paulus	southeastern American kestrel	T
Grus canadensis pratensis	Florida sandhill crane	T
Haematopus palliatus	American oystercatcher	SSC
Pelacanus occidentalis	brown pelican	SSC
Rynchops niger	black skimmer	SSC
Speotyto cunicularia	burrowing owl	SSC
Sterna antillarum	least tern	T
Mammals		
Podomys floridanus	Florida mouse	SSC
Sciurus niger shermani	Sherman's fox squirrel	SSC
Plants		
Acanthocereus (Cereus) pentagonus	barbed wire cactus	T
Argusia gnaphalodes	sea lavender	E
Asclepias curtissii	Curtiss' milkweed	E
Caesalpinia major	yellow nickerbean	E
Calopogon multiflorus	many-flowered grass pink	E
Chamaesyce cumulicola	sand dune spurge	E
Chrysophyllum oliviforme	satinleaf	T
Coelorachis tuberculosa	piedmont jointgrass	T

Table 2-4. (cont'd)

Scientific Name	Common Name	State Status[(a)]
Plants (cont'd)		
Conradina grandiflora	large-flowered false rosemary	T
Drypetes lateriflora	guina plum	T
Encyclia boothiana	dollar orchid	E
Erithalis fruticosa	black torch	T
Ernodea littoralis	beach creeper	T
Eulophia (Pteroglossaspis) ecristata	non-crested coco	T
Harrisia (Cereus) gracilis var. *simpsonii*	prickly applecactus	E
Lantana depressa	pineland lantana	E
Lechea cernua	nodding pinweed	T
Lechea divaricata	pine pinweed	E
Lilium catesbaei	Catesby's lily	T
Linum carteri var. *smallii*	south Florida flax	E
Myrcianthes fragrans	Simpson's stopper	T
Nemastylis floridana	celestial lily	E
Nephrolepis biserrata	giant sword fern	T
Okenia hypogaea	burrowing four-o'clock	E
Oncidium bahamensis	dancing lady orchid	E
Ophioglossum palmatum	hand fern	E
Opuntia stricta	common prickly pear	T
Peperomia humilis	pepper	E
Pinguicula caerulea	blue butterwort	T
Pinguicula lutea	yellow butterwort	T
Pithecellobium keyense	blackbead	T
Platanthera nivea	snowy orchid	T
Pogonia ophioglossoides	rose pogonia	T
Polypodium (Pecluma) dispersa	polypoda fern	E
Polypodium (Pecluma) plumula	plume polypoda fern	E
Polypodium (Pecluma) ptilodon	swamp plume polypoda fern	E
Polystachya concreta	pale-flowered polystachya	E
Pteris bahamensis	Bahama brake	E
Remirea maritima	beach star	E
Scaevola plumieri	inkberry	T
Spermacoce terminalis	false buttonweed	T
Spiranthes lacinata	lace-lipped ladies' tresses	T

Table 2-4. (cont'd)

Scientific Name	Common Name	State Status[(a)]
Plants (cont'd)		
Spiranthes tuberosa	little pearl-twist	T
Stenorrhynchos lanceolatus	leafless beaked orchid	T
Tephrosia angustissima var. *curtissii*	hoary pea	E
Tillandsia balbisiana	inflated wild pine	T
Tillandsia flexuosa	twisted and banded airplant	T
Tillandsia valenzuelana	soft leaved wild pine	T
Vanilla mexicana	unscented vanilla	E
Verbena (Glandularia) maritima	coastal vervain	E
Verbena (Glandularia) tampensis	Tampa vervain	E
Zephyranthes simpsonii	Simpson's zephyr lily	T

(a) State status: E = endangered, T = threatened, SSC = species of special concern.

Sources: Based on FNAI, FFWCC, Atlas of Florida Vascular Plants, and Florida Geographic Data Library Internet sites as of March 2002.

butterwort (*Pinguicula lutea*), satinleaf (*Chrysophyllum oliviforme*), and the large-flowered false rosemary (*Conradina grandiflora*) (Foster Wheeler 2001).

2.2.7 Radiological Impacts

FPL began conducting a radiological environmental monitoring program (REMP) at St. Lucie in 1971 (AEC 1973, 1974). The radiological impacts to workers, the public, and the environment have been carefully monitored, documented, and compared to the appropriate standards. The twofold purpose of the REMP is to

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

- 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 the effluent measurements and the modeling of the environmental exposure pathways.

Radiological releases are summarized in two annual reports: *Annual Radiological Environmental Operating Report* (e.g., FPL 2001e) and *Annual Radioactive Effluent Release Report* (e.g., FPL 2001b). The limits for all radiological releases are specified in the St. Lucie ODCM and the *Annual*

Radioactive Effluent Release Report, and these limits are designed to meet Federal standards and requirements (FPL 2002, 2001b). The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway (i.e., ambient radiation), water exposure pathway (i.e., surface water), aquatic exposure pathway (i.e., shoreline sediments), and ingestion exposure pathway (i.e., fish, invertebrates, and broadleaf vegetables). Radiological environmental monitoring for the St. Lucie plant is conducted by the State of Florida, Department of Health (DOH), Bureau of Radiation Control. Samples are collected and analyzed by DOH personnel (FPL 2001e).

Review of historical data on releases and the resultant dose calculations revealed that the doses to maximally exposed individuals in the vicinity of the St. Lucie plant were a small fraction of the limits specified in the EPA's environmental radiation standards in 40 CFR Part 190 as required by 10 CFR 20.1301(d). For 2000 (the most recent year that data were available), dose estimates were calculated based on actual liquid and gaseous effluent release data (FPL 2001c). Calculations were performed using the plant effluent release data, onsite meteorological data or historical data, and appropriate pathways identified in the ODCM.

According to the 2000 *Annual Radioactive Effluent Release Report* for St. Lucie Units 1 and 2 (FPL 2001b), assessment of radiation dose from radioactive effluents to members of the public assumes a visitor is onsite 6 hours per day, 312 days per year, and is located 1.6 km (1 mi) southeast of the plant. The visitor is assumed to have received exposure from both Unit 1 and 2 gaseous effluents released during 2000. The total beta and gamma air dose from noble gases was estimated to be 2.4×10^{-7} mGy (2.4×10^{-5} mrad) and total body dose from gases, particulate, and iodine of 0.017 μSv (0.0017 mrem). The air dose due to noble gases in gaseous effluents was 1.1×10^{-7} mGy (1.1×10^{-5} mrad) gamma radiation (5.5×10^{-5} percent of the 0.20 mGy [20 mrad] gamma dose limit[a]), and 1.3×10^{-5} mGy (0.0013 mrad) beta radiation (0.003 percent of the 0.40 mGy [40 mrad] beta dose limit[a]) (FPL 2001b).

Total body dose from liquid effluents was 0.34 μSv (0.034 mrem), which is 0.6 percent of the 0.06 mSv (6 mrem) dose limit.(a) The critical organ doses to the gastrointestinal tract and thyroid from liquid effluents were 1 μSv (0.1 mrem) and 0.024 μSv (0.0024 mrem), respectively. These doses were 0.5 percent and 0.01 percent of the respective 0.20-mSv (20-mrem) dose limit(a) (FPL 2001b).

The applicant does not anticipate any significant changes to the radioactive effluent releases or exposures from St. Lucie Units 1 and 2 operations during the renewal period and, therefore, the impacts to the environment are not expected to change.

(a) The design objective is twice the 10 CFR Part 50, Appendix I, dose limit because the limit is per unit and St. Lucie has two operating units.

2.2.8 Socioeconomic Factors

The staff reviewed the applicant's ER (FPL 2001a) and information obtained from several county, city, and economic development staff during a site visit to St. Lucie and Martin counties from April 1 through 5, 2002. The following sections describe the economy, population, and communities near St. Lucie Units 1 and 2.

2.2.8.1 Housing

The full-time work force at St. Lucie is approximately 791 FPL and 138 contract employees. Approximately 46 percent of these employees (FPL and contract) live in St. Lucie County, 37 percent in Martin County, 8 percent in Indian River County, 6 percent in Palm Beach County, with the remainder living in other locations (see Table 2-5). Since approximately 83 percent of the St. Lucie employees live in St. Lucie and Martin counties, and St. Lucie is where the plant is located, the focus of the socioeconomic analysis is on these two counties.

FPL refuels St. Lucie Units 1 and 2 on an 18-month cycle. Typically, this means that at least one unit is refueled every year, and both units would be refueled every third year. During refueling, the number of employees increases by as many as 575 to 870 temporary workers for a period of 30 to 40 days. These temporary employees stay at hotels, motels, and temporary rental housing available in Fort Pierce, Port St. Lucie, and Stuart.

Table 2-6 provides the number of housing units and housing unit vacancies for St. Lucie and Martin counties for 1990 and 2000. Of interest is the fact that not only has the stock of housing increased, but the number of vacant units in both counties has declined over the decade. This could reflect the very high population growth in the counties and the resultant increase in demand for available housing.

Table 2-5. St. Lucie Units 1 and 2, Employee and Contract Employee Residence by County

County	Number of Personnel	Percent of Total Personnel
St. Lucie	427	46
Martin	344	37
Indian River	74	8
Palm Beach	56	6
Other	28	3
Total	929	100

Source: FPL 2001a

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

	1990	2000	Approximate Percentage Change
ST. LUCIE COUNTY			
Housing Units	73,843	91,262	23.6
Occupied Units	58,174	76,933	32.2
Vacant Units	15,669	14,329	-8.6
MARTIN COUNTY			
Housing Units	54,199	65,471	20.8
Occupied Units	43,022	55,288	28.5
Vacant Units	11,177	10,183	-8.9

Sources: U.S. Census Bureau (USCB) 2000 and USCB 1990a.

Planning agencies in both Martin and St. Lucie counties require that urban development be confined to areas of the county where public services and facilities are already provided or planned to be made available. In addition, neither county has growth-control measures in place restricting the development of new housing, and both counties have programs in place to promote the development of affordable housing.

Table 2-7 contains data on population, estimated population, and annual population growth rates for St. Lucie and Martin counties. Both counties saw similar growth in population during the 1990s.

Table 2-7. Population Growth in St. Lucie and Martin Counties, 1970 to 2020

	Martin County		St. Lucie County	
	Population	Annual Growth Percent[(a)]	Population	Annual Growth Percent
1970	28,033	--	50,837	--
1980	64,014	8.6	87,182	5.5
1990	100,900	4.7	150,171	5.6
2000	126,731	2.3	192,695	2.5
2010	152,701 (estimated)	1.9	234,383 (estimated)	2.0
2020	178,511 (estimated)	1.6	276,886 (estimated)	1.7

(a) Annual percent growth rate is calculated over the previous decade.
-- = No data available.
Sources: Florida Legislature 2001 (population for the years 1970 to 1990 and estimates for 2010 and 2020); and USCB 2000 (populations for year 2000 that are actual accounts from the 2000 census).

2.2.8.2 Public Services

Public services include water supply, education, and transportation.

- **Water Supply**

The South Florida Water Management District (SFWMD) estimated that in 1990, approximately 42 percent of St. Lucie County and 46 percent of Martin County residents obtained potable water from private wells (SFWMD 1998). The remaining residents receive their water from 107 and 139 water supply systems in St. Lucie and Martin counties, respectively, many of which are privately owned (FPL 2001a). The primary source of potable water supplies in the two counties is the shallow, unconfined surficial aquifer (SFWMD 1998).

Table 2-8 summarizes the daily consumption and areas served by the major (those permitted at over 3.8×10^3 m^3/d [1 million gallons/day [MGD]) public water supply districts. The primary

Table 2-8. Major[a] Public Water Supply Systems in St. Lucie and Martin Counties[b]

Water System	County	Source	Permitted Capacity m^3/d (MGD)	Average Daily Demand m^3/d (MGD)	Peak Demand Per Day m^3/d (MGD)	Area Served
City of Stuart	Martin	Surficial Aquifer	2.3×10^4 (6.0)	1.2×10^4 (3.2)[b]	2.0×10^4(5.4)	City of Stuart
Port Salerno	Martin	Surficial Aquifer	1.1×10^4 (3.0)	6.1×10^3 (1.6)	1.1×10^4(2.8)	Port Salerno
Hobe Sound	Martin	Surficial Aquifer	1.1×10^4 (3.0)	N/A	N/A	Hobe Sound
North Martin County	Martin	Surficial Aquifer	1.1×10^4 (3.0)	N/A	N/A	North Martin County
Fort Pierce Utilities Authority	St. Lucie	Surficial Aquifer	7.6×10^4(20)	3.2×10^4(8.5)	4.2×10^4(11)	City of Ft. Pierce and part of St. Lucie County
Port St. Lucie	St. Lucie	Surficial Aquifer	2.6×10^4 (6.9)	2.2×10^4(5.8)	3.1×10^4(8.2)	Port of St. Lucie and portions of St. Lucie County
		Floridan Aquifer	1.5×10^4 (4.0)			
St Lucie West Utilities	St. Lucie	Surficial Aquifer	3.8×10^3(1)	2.3×10^3(0.6)	N/A	City of Port St. Lucie

(a) Only permitted plants with a treatment capacity greater than 3.8×10^3 m^3/day (1 MGD) are listed in the table.
(b) SFWMD 1998; City of Port St. Lucie 1997; FPL 2001a

public water service providers in St. Lucie County are Fort Pierce and Port St. Lucie. In addition, Port St. Lucie is expanding its water and sewage treatment systems.

- **Transportation**

There are nine counties wholly or partially within the 80-km (50-mi) radius of St. Lucie (FPL 2001a). The nine-county area is served by one interstate freeway (Interstate 95 [I-95]) and the Florida Turnpike (see Figures 2-1 and 2-2). State Road 70 comes in from the west, transects Highlands and Okeechobee counties before entering St. Lucie County, crosses both I-95 and the Florida Turnpike, and ends in downtown Fort Pierce. U.S. Route 1 (US-1) is the coastal highway through Port St. Lucie, Fort Pierce (St. Lucie County), and Stuart in Martin County. US-1 serves as a major north-south thoroughfare through these cities and carries mostly local and regional traffic. Access to the St. Lucie site is via State Road A1A, a two-lane road running the length of Hutchinson Island.

The St. Lucie County International Airport is located north of Fort Pierce. It is a general aviation airport with several flight schools, an airplane manufacturer, and several businesses ancillary to the airport and flight operations (St. Lucie County 2001).

The Port of Fort Pierce is the region's only deep-water port. The port is approximately 35 ha (86 ac) and is largely undeveloped, except for a privately owned cargo operation at the southern end. The majority of the 35 ha (86 ac) is privately owned. The channel from the ocean leading to the port is 8.5 m (28 ft) deep. The port is mainly used for transport of agricultural commodities (St. Lucie County 2001).

2.2.8.3 Offsite Land Use

The following is a discussion of land use in St. Lucie and Martin counties (Table 2-9).

- **St. Lucie County**

St. Lucie County can be divided into three major land-use areas: the largely undeveloped coastal area, the developed area, and the agricultural area. The coastal area consists of the barrier islands and areas that front the Atlantic Ocean, and is approximately 34 km (21 mi) long. Approximately 11 km (7 mi) of the 34 km (21 mi) are under public ownership. About 3 km (2 mi) are owned by FPL and are the site of St. Lucie Units 1 and 2. These lands are largely undisturbed. The remaining oceanfront property is privately owned, and approximately 45 percent of that has been developed (St. Lucie County 2001). The major land uses within the coastal area are residential, commercial, and recreational (see Table 2-9).

Table 2-9. Land Use in St. Lucie and Martin Counties, Florida

	St. Lucie County[a]			Martin County[b]		
Land Use	Square Kilometers	Square Miles	% of Total	Square Kilometers	Square Miles	% of Total
Agriculture	945	365	56.9	1000	386	71.7
Residential	357	138	21.5	220	85	15.8
Commercial	41	16	2.5	13	5	0.9
Industrial	10	4	0.6	21	8	1.5
Recreation	86	33	5.2	5	2	0.4
Other	221	85	13.3	134	52	9.7
Total	1660	641	100.0	1393	538	100.0

(a) Existing unincorporated land use as of 2002. Personal communication Janet Merkt, April 29, 2002.
(b) Unincorporated Martin County only. Existing land use as of 1995.
Sources: Martin County 1999.

The developed area of the county lies generally between the Indian River Intracoastal Waterway, I-95, and the Florida Turnpike. This area establishes an Urban Service Boundary (USB) for which the county will provide services. Growth is targeted to take place within the USB. This area comprises the cities and towns of Port St. Lucie, St. Lucie West, Lakewood Park, St. Lucie Village, and Fort Pierce. The major land uses within this area are residential, commercial, and industrial.

To the west of the I-95/Florida Turnpike corridor is the agricultural area. The current county administration intends to restrict development and preserve agricultural lands. St. Lucie County does not have growth management restrictions in place; however, it does require that new development activities be authorized only in conjunction with the availability of the required public services to support the development. These services are generally provided only within the USB. Development west of the USB can occur, but it is limited to densities that range from one dwelling unit per 0.4 ha (1 ac) or one dwelling unit per 2 ha (5 ac). While greater densities can be approved, they require an amendment to the land-use map for the area, and any approval of the amendment requires the developer to provide the necessary infrastructure services at no cost to the local government. In addition, the conversion of agricultural land to residential or small farm use must maintain the viability of agricultural uses and activities on adjacent lands.

- **Martin County**

As with St. Lucie County, most urban development in Martin County occurs within the coastal area between the Florida Turnpike and I-95 and the Atlantic Ocean. The most intense urbanization is occurring around Stuart, the county seat of government and urban core of Martin County.

The part of the county west of the Turnpike is mainly for agricultural use. There are scattered, older residential and mobile home developments, and a developing western urban core in the Indiantown area. Indiantown contains a high percentage of minority and low-income populations.
Agriculture is one of the county's major exporting industries. As population growth in Martin County continues and the availability of land for development near the coast declines, development pressure on interior agricultural lands will increase. Such growth could increase the pressure for urbanization at the possible expense of agricultural and environmental quality. However, it is the policy of the county administrators that agricultural land is not vacant land. Agricultural activities are viewed as important for the economic diversity and health of the county and, as such, lands used for agricultural purposes are to be protected for future benefits and community identity (Martin County 1999).

2.2.8.4 Visual Aesthetics and Noise

St. Lucie Units 1 and 2 are located on Hutchinson Island, a barrier island separating mainland St. Lucie County from the Atlantic Ocean. The plant is bordered by the Atlantic Ocean on the east and the Indian River Intracoastal Waterway on the west. The topography of the site is flat with low sand dunes on the ocean side of the island.

The most prominent topographic feature on the island is State Road A1A, which runs almost the entire island's length and passes through the eastern portion of the St. Lucie site. Between the dunes on the Atlantic side of the island and State Road A1A, the principal feature is a series of mangrove-dominated mosquito impoundments interspersed with islands of natural, stranded coastal vegetation.

Approaching from the south on State Road A1A, the St. Lucie plant is not visible until approximately 1.2 km (0.75 mi) from the main entrance of the site. The view is blocked by vegetation along the west side of the road and is obscured as the main entrance is reached. However, the transmission lines from the plant are visible from greater distances due to their elevation. Approaching the plant from the north, the units are not visible until approximately 0.8 km (0.5 mi) from the site entrance.

From across Indian River, on the Fort Pierce and Port St. Lucie side, the plant is visible from the north and south from Indian River Drive. Many upscale homes ($280,000 and up [The Real Estate Book, not dated]) abut Indian River Drive and look out over Indian River toward the plant. Noise from the St. Lucie plant, at locations on the plant site, is barely noticeable except very close to the reactor containment vessels. From offsite, approaching from the north or south along State Road A1A or across Indian River, no noise is heard from the plant.

The nearest municipalities to the St. Lucie site are Fort Pierce, located approximately 11 km (7 mi) northwest of the plant, and Port St. Lucie, located approximately 7 km (4.3 mi) west of the plant across Indian River. Stuart, in neighboring Martin County, is approximately 13 km (8 mi) south of the plant.

2.2.8.5 Demography

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

Population was estimated from the St. Lucie site out to 80 km (50 mi) in 16-km (10-mi) annular rings (FPL 1999, 2000). An estimated 345,000 people live within 32 km (20 mi) of St. Lucie, and 1,180,000 live within 80 km (50 mi) (FPL 2001a).

The largest population center within the 80-km (50-mi) area is Port St. Lucie (population 88,769 [USCB 2000]). The next largest town is Fort Pierce (population 37,516 ([USCB 2000]). It is followed by Stuart, which serves as the county seat for Martin County and has a population of 14,633 (USCB 2000). St. Lucie and Martin are two of the fastest growing counties in Florida. Over the decade between 1990 and 2000, the St. Lucie County population grew by approximately 2.5 percent per year (USCB 1990b, 2000), and the Martin County population grew by 2.3 percent per year.

Table 2-10 presents information on the major employment sectors and number of employees for St. Lucie and Martin counties.

- **Migrant Labor**

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers may follow the harvesting of crops through Florida, Georgia, the Carolinas, and Virginia. Others may be permanent residents near the St. Lucie site who travel from farm to farm harvesting crops.

Table 2-10. Major Employment Sectors in St. Lucie and Martin Counties (2000)

	Number of Employees	
Employment Sector	**St. Lucie**	**Martin**
Services	21,145	27,537
Retail trade	12,981	13,864
Government & government enterprises	10,549	5,500
Finance, insurance, and real estate	5,581	7,149
Construction	5,225	6,308
Total jobs – full- and part-time	71,795	73,216

Source: Bureau of Economic Analysis (BEA) 2000

Migrant workers can be members of minority or low-income populations. Because migrant workers travel and can 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, these workers would be "underrepresented" in U.S. Census Bureau minority and low-income population counts (FPL 2001a).

Approximately 57 percent of St. Lucie County and 72 percent of Martin County are used for agriculture (see Table 2-9). In addition to St. Lucie and Martin counties, seven counties are wholly or partially within the 80-km (50-mi) radius of the St. Lucie site. All of the counties have agricultural production and farms that hire migrant or other labor (USDA 1997). In 1997, St. Lucie and Martin counties contained 359 farms that hire migrant or other labor (USDA 1997). While many follow the crop cycle, they maintain their permanent residence in the counties, where they may spend as much as 50 to 70 percent of their time.[(a)]

In 1997, approximately 20,800 farm workers worked in the seven-county area[(b)] around St. Lucie Units 1 and 2 (USDA 1997). In July 2001, approximately 11 percent of hired farm workers (at the national level) were classified as migrant labor (USDA 2001).[(c)] Using this 11-percent figure, approximately 2290 of the farm workers may have been migrant workers for the seven-county area. Given the large geographic area and the small number of migrants, FPL did not expect the migrant farm worker population to materially change the population

(a) Ms. Anita Neal (County Extension Director, St. Lucie County Extension), personal interview April 5, 2002, and Ms. Carol Bailey (County Extension Director, Martin County Extension), personal interview April 3, 2002.
(b) Specifically the following: St. Lucie, Martin, Indian River, Brevard, Okeechobee, Palm Beach, and Glades counties.
(c) State of Florida data on migrant farm workers were not available.

characteristics of any particular census tract in the seven-county area (FPL 2001a). FPL's conclusion is based on the assumption that the migrant laborers would be located throughout the seven-county agricultural area and not clustered in a single location.

2.2.8.6 Taxes

The St. Lucie plant is the largest source of tax revenue for St. Lucie County. Table 2-11 presents information on the total real and personal property taxes FPL paid to St. Lucie County for St. Lucie Units 1 and 2 and the relationship of taxes paid to total tax revenues of the county. The percentage of taxes paid by FPL for the St. Lucie site to the total amount collected by the county ranged between 7.9 and 10.3 percent.

Table 2-11. Property Taxes Paid to St. Lucie County by FPL for St. Lucie Units 1 and 2

Year	Real and Personal Property Tax Paid to St. Lucie County for St. Lucie 1 and 2	Total St. Lucie County Property Tax Revenues	Percent of Total County Property Taxes
1996	$19,449,952	$196,823,727	9.9
1997	$16,717,273	$211,942,795	7.9
1998	$19,766,291	$210,294,416	9.4
1999	$22,807,970	$221,893,569	10.3
2000	$18,888,240	$222,310,596	8.5

Source: Personal communication provided by the office of Mr. Robert Davis, St. Lucie County Tax Collector, April 23, 2002

2.2.9 Historic and Archaeological Resources

This description of the cultural background and the known historic and archaeological resources at the St. Lucie site and in the surrounding area is based on information from the ER (FPL 2001a), archives and records stored at the Florida Master File in the Florida Division of Historical Resources, and published literature on the history of southern and central Florida.

2.2.9.1 Cultural Background

The St. Lucie plant is located in St. Lucie County, about 45 km (28 mi) northeast of Lake Okeechobee in south-central Florida. The plant is located on Hutchinson Island, a barrier island that protects the lengthy shallow estuary known as Indian River Lagoon.

The archaeological site of Fort Pierce near the juncture of Fort Pierce Creek with the Indian River Lagoon is the nearest established and developed cultural or historic park. The developed reservation lands of the nearest Federally recognized Native American tribes are those of the Brighton Seminole, located about 76 km (47 mi) to the southwest of the St. Lucie plant and northwest of Lake Okeechobee. Also nearby are the Big Cypress Seminole and the Miccosukee, located about 109 km (68 mi) southwest of the plant and directly south of Lake Okeechobee. However, in 1996, the U.S. Bureau of Indian Affairs purchased 20 ha (50 ac) of land in St. Lucie County to be held in trust for the Seminole Tribe for the purpose of becoming the Fort Pierce Reservation. As of April 2002, development of housing for tribal members on this area had not begun.

The archaeological sequence of central and eastern Florida began at least 12,000 years ago (Rouse 1951; McGoun 1993; Bense 1994; Milanich 1994, 1998; Milanich and Proctor 1994; MacCauley 2000). The cultural history of the area can be divided into four major periods: (1) Paleoindian (10,000 B.C., and perhaps as early as 13,000 B.C., to around 8000 B.C.); (2) Archaic (8000 to 500 B.C.); (3) various regional cultural traditions, including that of the Indian River culture in the vicinity of the St. Lucie plant (500 B.C. to around A.D. 1500); and (4) Historic/Modern (A.D. 1500 to the present).

During the Paleoindian period, the native people apparently were organized into small mobile bands with economies based on hunting and fishing. The environment of the Paleoindian period was significantly different from the environment today. The last ice age was ending at that time, and glaciers covered much of the northern portion of North America. The presence of the glaciers also meant that ocean levels were much lower than present levels, perhaps on the order 23 to 30 m (75 to 100 ft) lower. Thus, many of the archaeological sites dating from this time period would be under water today or situated in and around wetlands.

The transition between the Paleoindian and Archaic periods was accompanied by substantial environmental change; most notable was the rise in sea level as the glaciers melted. These changing conditions led to the disappearance of megafauna such as the mammoth that traditionally had been quarry for the indigenous inhabitants of the region. In response, the Native Americans adapted by becoming more dependent on river systems and beginning the domestication of plants. The greatest cultural change occurred during the middle Archaic period when ocean levels reached or even slightly exceeded current levels. Evidence (e.g., the presence of storage pits, extensive refuse middens, and large quantities of fire-cracked rock) from middle and late Archaic period archaeological sites indicates that during that period the cultures of the Native Americans became more sedentary.

In the Indian River period (named for the Indian River Lagoon), Native American cultures along the east-central coast of Florida reached their modern configurations as observed and noted at the time of the initial European contact in the 16th and 17th centuries. The Indian River period is

subdivided into two phases: the Malabar I phase (500 B.C. to A.D. 750) and the Malabar II phase (A.D. 750 to around 1550). The Native American culture that existed during the Indian River period mirrors the better known St. Johns I and II period culture of the people immediately to the north of St. Lucie and Indian River counties, although the Indian River people had their own distinct economy and material culture.

During the Malabar I phase, groundwater and sea levels were lower than present levels; therefore, the environment in and around the Indian River Lagoon was dominated by prairies, pine flatwoods, and cabbage palm hammocks. That kind of environment would not be particularly productive, so Native American population levels in the Indian River region probably were lower than in surrounding regions, such as the St. John's Basin.

In the Malabar II phase, estuaries such as the Indian River Lagoon would have become wetter and more biologically productive, and thus more capable of sustaining larger populations of Native Americans. However, Indian River period coastal settlements were probably used only seasonally as bases for collecting shellfish (mainly oysters) and fishing (mainly marine catfish). The Indian River period people probably were primarily foragers rather than full-time sedentary agriculturalists as was the case for the Native Americans in neighboring regions. Indeed, most of the regions surrounding the Indian River Lagoon area, with the possible exception of Lake Okeechobee, apparently participated in the widespread and complex Mississippian culture phenomenon that resulted in the development of a number of chiefdoms throughout the Southeast. Even the Lake Okeechobee area, although not directly linked with the Mississippian culture, might have been an important center of ceremonial activities.

An example of a large Indian River period archaeological site is the King's Mound located immediately west of the St. Lucie plant on the west side of the Indian River Lagoon. This site contains a ramped sand mound, approximately 4 m (13.1 ft) in height and 30 m (97.6 ft) in diameter, along with an associated refuse midden that covers an area of about 5000 m^2 (5980 yd^2).

At the beginning of the 16th century, the area around Indian River Lagoon was occupied by the Ais Indians, who probably were descendants of the earlier Indian River period populations. The historic Ais were linguistically related to the better known Muskogean-speaking Tekesta (Tequesta) of the southern tip of Florida and the Calusa of southeastern Florida. All three groups relied on foraging to a much greater extent than did the tribes of northern Florida.

The Historic period in Florida began in 1513 when the first European explorers arrived. In that year, the Spanish explorer Ponce de León explored the southern coasts of Florida from the Gulf coast area around Fort Myers to the Atlantic coast south of Cape Canaveral (Rouse 1951; Bense 1994; Milanich 1998; Cumming 1998). An attempt to colonize a portion of the Calusa

territory led to the death of Ponce de León in 1521 and the subsequent abandonment of the colony. In 1564, the French established Fort Caroline at the mouth of the St. James River about 300 km (186 mi) north of the modern St. Lucie site. The French colonists were slaughtered in 1565 by a Spanish force under Pedro Menéndez de Avilés, who subsequently established the colony of St. Augustine at this location. The English buccaneer Sir Francis Drake sacked and burned St. Augustine in 1586, but the Spanish reoccupied, rebuilt, and fortified the colony.

After an unsuccessful attempt at establishing a mission by the Jesuit Order in the middle of the 16th century, the Catholic Church supported the Franciscan mission in Florida during the 17th and early 18th centuries (McEwan 1993). However, disease, slave raids, European warfare, and enforced removal to Cuba decimated the Ais, Calusa, and Tekesta tribes during the latter half of the 16th century and throughout the 17th century. By the mid-1600s most of the original Florida tribes were represented by a few hundred people, mostly attached to the Spanish missions. By the mid-18th century the Ais, Calusa, and Tekesta tribes had disappeared from the historic record and are now considered extinct.

One other notable event associated with the colonial history of the region occurred during the 18th century. During a hurricane on July 31, 1715, a 12-ship Spanish treasure fleet was lost on the reefs along the coast of the modern St. Lucie and Indian River counties. The 1500 survivors of this shipwreck established a camp and salvors station located about 60 km (37 mi) north of the modern St. Lucie plant.

During the period of the early to mid-1700s, Creek Indians began moving into northern and central Florida and by the 1760s were beginning to be recognized by the name Seminole. In 1817, Andrew Jackson attacked Seminole villages in Spanish Florida as a continuation of earlier warfare with the Creek Indians in Alabama and Georgia. This action is known as the First Seminole War.

In 1819, after a period of more than 100 years of contested colonization in the Southeast among France, England, and Spain, the United States annexed Florida. In 1830, then President Andrew Jackson was successful in convincing Congress to pass the Indian Removal Act. Under this Act, the Southeastern Indian tribes, including the Seminoles, were to be forcibly removed to lands west of the Mississippi River in what was to become the State of Oklahoma. The Seminoles refused to go, and in 1835, they launched what became known as the Second Seminole War. Two years later, 400 Seminole warriors and 800 Federal troops fought a pitched battle just north of Lake Okeechobee. After this battle, U.S. Army Lt. Col. Benjamin Kendrick Pierce established a fort to be used as the army headquarters for the duration of the Second Seminole War. After five more years of warfare, the Seminoles took refuge in the Everglades in 1842.

With the diminished threat of warfare, Fort Pierce began to develop rapidly into a civilian community that continues to exist. St. Lucie County was formally established from a portion of Mosquito County in 1844. The name of the county was changed to Brevard during the 1850s, but the name reverted to St. Lucie in 1905.

In 1845, Florida became the 27th State to join the United States of America, and in January 1861, it seceded from the Union and joined the Confederacy. Although no major Civil War battles were fought in southern or central Florida, Florida was involved in supplying people, materials, and food to the Confederate war effort. The physical effects of the Civil War and the abolishment of slavery fundamentally changed the economic basis of the Southeast between 1865 and 1917 (Bense 1994). While plantations were typically returned to their former owners, plant operations became dependent on voluntary contracts or tenant farming with their labor force. Over time, plantations became smaller; the average size was less than 40 ha (100 ac) by 1920. Expansion of the railroads, rebuilding of basic infrastructure, and the Industrial Revolution all led to major cultural changes.

The City of Fort Pierce was incorporated in 1901. The Fort Pierce economy at the end of the 19th and beginning of the 20th centuries was based on water transportation, fishing and the canning of fish, and cash crops dominated by pineapple and later by citrus fruit. The period between World War I and World War II saw the continued growth of small towns, small plantations, and independent farms. The railroad system allowed Fort Pierce to become the economic and commercial hub of Florida's so-called Treasure Coast.

2.2.9.2 Historic and Archaeological Resources at St. Lucie Site

As previously noted, historic and archaeological site file searches were conducted at the Florida Master File in the Florida Division of Historical Resources to identify specific historic cultural resources that might be present at the St. Lucie plant. In addition, record searches were conducted for nearby locations to gain perspective on the types of historic resources that may be present in the previously undeveloped and unsurveyed portions of the St. Lucie site.

An archaeological survey apparently was not conducted at the St. Lucie site prior to construction. However, an archaeological survey conducted in 1973 of the proposed transmission line right-of-way found no historic properties (Morrell 1973). Recent record searches revealed five known archaeological sites located on or immediately adjacent to the property boundaries for the St. Lucie Plant. Archaeological Site 8SL13 ("Blind Creek I") and Site 8SL44 ("Blind Creek II") are north of Blind Creek and situated immediately adjacent to, but outside, the northern property line of the plant. These sites represent Malabar I and possibly Malabar II mounds and middens, including a burial mound with a surface area of approximately 4 ha (10 ac). Archaeological Site 8SL26 is a historic shipwreck (a side-wheeler of

undetermined origin) situated on sand and dead reef fragments about 610 m (2000 ft) offshore from Hutchinson Island, which is immediately north and east of the eastern end of Blind Creek and outside the St. Lucie plant property boundary. Archaeological Site 8SL33 ("Swamp Wreck") is a buried shipwreck of undetermined origin (but more than 50 years old) situated in mangroves immediately inside of the southern property boundary of the St. Lucie plant. Archaeological Site 8SL55, a 19th century shipwreck of undetermined origin, is located along the shoreline of Hutchinson Island in the vicinity of and immediately south of Site 8SL33. Archaeological Site 8SL22, the remains of an undetermined vessel from the 1715 Spanish treasure fleet, is located in the vicinity of and immediately south of Site 8SL55. No structures or buildings at or near the St. Lucie plant are 50 years in age or older.

As previously mentioned, the original Native American inhabitants of the Indian River Lagoon area, the Ais and their predecessors from the Indian River period, became extinct as a tribe during the 18th century. However, the modern Seminole and Miccosukee Tribes have taken on tribal responsibilities for cultural resource issues pertaining to the archaeology of the Ais culture and their predecessors.

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 OLs for St. Lucie Units 1 and 2. Any such activities could result in cumulative environmental impacts, and the possible need for a Federal agency to become a cooperating agency for preparation of this SEIS [10 CFR 51.10(b)(2)].

The closest Federal lands to the St. Lucie plant are (1) Hope Sound National Wildlife Refuge located approximately 35 km (22 mi) south of the plant site, (2) Pelican Island National Wildlife Refuge located approximately 51 km (32 mi) north of the plant site, and (3) Loxahatchee National Wildlife Refuge located approximately 77 km (48 mi) south of the plant site. The U.S. Air Force Avon Park bombing and gunnery range is located approximately 95 km (59 mi) northwest of the plant. Patrick Air Force Base is located approximately 103 km (64 mi) north of the St. Lucie site.

The closest Native American land to the St. Lucie plant is the Brighton Seminole Indian Reservation located approximately 76 km (47 mi) southwest of the plant.

After reviewing the Federal activities in the vicinity of the St. Lucie plant, the staff determined that there were no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparation of this SEIS.

NRC is required under Section 102(C) of 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. During the preparation of this SEIS, NRC consulted with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Consultation correspondence is included in Appendix E.

2.3 References

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

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

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

40 CFR 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

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3.0 Environmental Impacts of Refurbishment

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

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

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

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

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

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

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

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

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

Table 3-1. Category 1 Issues for Refurbishment Evaluation

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

The potential environmental effects of refurbishment actions would be identified and the analysis would be summarized within this section, if such actions were planned. Florida Power and Light Company (FPL) indicated that it has performed an evaluation of structures and components pursuant to 10 CFR 54.21 to identify activities that are necessary to continue operation of St. Lucie Units 1 and 2 during the requested 20-year period of extended operation. These activities include replacement of certain components as well as new inspection activities and are described in the Environmental Report (FPL 2001).

However, FPL stated that the replacement of these components and the additional inspection activities are within the bounds of normal plant component replacement and inspections; therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in the Final Environmental Statements (AEC 1972, 1974). In addition, FPL's evaluation of structures and components as required by 10 CFR 54.21 did not identify any major plant refurbishment activities or modifications necessary to support the continued operation of St. Lucie Units 1 and 2 beyond the end of the existing operating licenses. Therefore, refurbishment is not considered in this SEIS.

Table 3-2. Environmental Justice and GEIS Category 2 Issues for Refurbishment Evaluation

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

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

3.1 References

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

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

Florida Power and Light Company (FPL). 2001. *Applicant's Environmental Report – Operating License Renewal Stage St. Lucie Units 1 and 2*. Miami, Florida.

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4.0 Environmental Impacts of Operation

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

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

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

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

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

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

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and are applicable to the St. Lucie Units 1 and 2. Section 4.1 addresses issues applicable to the St. Lucie 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 or endangered species. Section 4.7 addresses potential

(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.

new information received 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 because they are related to plant design features or site characteristics not found at St. Lucie Units 1 and 2 are listed in Appendix F.

4.1 Cooling Systems

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to the St. Lucie Units 1 and 2 cooling system operation during the renewal term are listed in Table 4-1. Florida Power and Light Company (FPL) stated in the Environmental Report (ER) that there is no new and significant information associated with the renewal of St. Lucie Units 1 and 2 that would warrant additional plant-specific analysis of the remaining Category 1 issues applicable to St. Lucie Units 1 and 2 (FPL 2001a). The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all Category 1 issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-1. Category 1 Issues Applicable to the Operation of the St. Lucie Units 1 and 2 Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3

Table 4-1. (cont'd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
Thermal plume barrier to migrating fish	4.2.2.1.6;4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Gas super saturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11; 4.4.3
HUMAN HEALTH	
Noise	4.3.7

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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

- 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other

available information. Therefore, the staff concludes that there are no impacts of temperature 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of scouring caused by discharged cooling water 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Compliance with the National Pollutant Discharge Elimination System (NPDES) permit for St. Lucie Units 1 and 2 has also been demonstrated (FDEP 2002). 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES (FDEP 2000) permit for St. Lucie Units 1 and 2. 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit (FDEP 2000) for St. Lucie Units 1 and 2 and the survey of aquatic environments potentially affected by the cooling canal system (Ecological Associates 2001). 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of available information, including the survey of aquatic environments potentially affected by

the cooling canal system (Ecological Associates 2001). 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of thermal

plume barriers to migrating fish during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other

available information. Therefore, the staff concludes that there are no impacts of low 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sub-lethal 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

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- 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 FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term that are applicable to St. Lucie Units 1 and 2 are listed in Table 4-2 and are discussed in the following sections.

Table 4-2. Category 2 Issues Applicable to the Operation of the St. Lucie Units 1 and 2 Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.3.3	B	4.1.1
Impingement of fish and shellfish	4.2.2.1.3; 4.3.3	B	4.1.2
Heat shock	4.2.2.1.4; 4.3.3	B	4.1.3

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

Impacts on fish and shellfish resources resulting from entrainment are a Category 2 issue. The impacts of entrainment are SMALL at many plants, but they may be MODERATE or LARGE impacts at some plants. Also, ongoing restoration efforts may increase the number of fish susceptible to intake effects during the license renewal period (NRC 1996). Information to be ascertained includes (1) the type of cooling system (whether once-through or cooling pond) and (2) the current Clean Water Act Section 316(b) determination or equivalent state documentation.

As indicated in Section 2.1.3, Cooling and Auxiliary Water Systems, St. Lucie Units 1 and 2 have a once-through heat-dissipation system. Potential entrainment at St. Lucie Units 1 and 2 was estimated from monitoring data taken at six stations in the ocean near the intake and stations in the intake and discharge canals during preoperational and early operational monitoring for Unit 1 (NRC 1982a). The most common larval fishes in the area of the intake were herrings and anchovies of the family Clupeidae (NRC 1982a). Under normal conditions, it was estimated that 0.4 percent (on average) of the fish eggs and larvae passing the site would be entrained during two-unit operation. Under extreme conditions, less than 4 percent of the fish eggs and larvae passing the intake would be entrained. Based on this assessment, the NRC concluded that entrainment losses under two-unit operation would not represent a significant impact to the local fisheries (NRC 1982a).

As indicated in the current Industrial Wastewater Facility Permit No. FL0002208-Major for St. Lucie Units 1 and 2 (FDEP 2000), both units have documentation of Clean Water Act

Section 316(b) compliance indicating that the existing intake structure reflects the best technology available for minimizing environmental impacts at the plant.

The staff has reviewed the available information, and based on the results of entrainment studies and the operating history of the St. Lucie Units 1 and 2 intake structure, concludes that the potential impacts of entrainment of fish and shellfish in the early life stages in the cooling-water intake system are SMALL. During the course of the Supplemental Environmental Impact Statement (SEIS) preparation, the staff considered mitigation measures for the continued operation of St. Lucie Units 1 and 2 along with cumulative impacts of past, current, and future activities at the site. Continued operation for an additional 20 years was considered, as were all of the specific effects on the environment (whether or not "significant"). Based on the assessment to date, the staff concludes that the measures in place at St. Lucie Units 1 and 2 (e.g., placement of the intake pipes) mitigate impacts related to entrainment, and no new mitigation measures are warranted.

4.1.2 Impingement of Fish and Shellfish

The impacts on fish and shellfish resources resulting from impingement are a Category 2 issue. Impingement impacts are SMALL at many plants, but might be MODERATE or LARGE at a few plants. Information to be ascertained includes (1) type of cooling system (whether once-through or cooling pond) and (2) current Clean Water Act 316(b) determination or equivalent state documentation.

St. Lucie Units 1 and 2 have a once-through heat-dissipation system. The NRC summarized impingement sampling carried out at St. Lucie Unit 1 during 1976 through 1978, as directed by the Unit 1 operating license (OL) (NRC 1982a). During this period, 226 24-hour collections were made of fish and shellfish trapped on the traveling intake screens. Assuming continuous operation, annual impingement rates were estimated at 34,000 (1978) to 131,000 (1976) finfish, and 26,000 (1976) to 37,000 (1978) shellfish. Over the course of the entire study, the mean numbers of finfish and shellfish impinged per 24-hour period were 222 and 82 individuals, respectively. Corresponding mean total weights per 24-hour period were 1.7 kg (3.7 lb) and 0.5 kg (1.1 lb), respectively. The most commonly impinged species groups were anchovy (*Anchoa* sp.), grunt (Haemulidae), jack (Carangidae), croaker (*Micropogonias* sp.), mojarro (Gerreidae), shrimp (Panaeidae), and blue crab (*Callinectes sapidus*). The length of over 80 percent of the impinged fish was 8 cm (~6 in.) or less, and virtually all of the impinged shrimp were 4 cm (~3 in.) or less in length. In January 1979, the U.S. Nuclear Regulatory Commission (NRC) issued an amendment to the Unit 1 OL deleting the requirement for impingement monitoring. It was concluded that impingement losses at Unit 1 were insignificant when compared to the fish populations in the site vicinity and (for shrimp) the number caught commercially off of Florida's east coast (NRC 1982b).

The NRC acknowledged that startup of Unit 2 would double the intake flow volume and increase impingement rates over those measured during Unit 1 operation (NRC 1982b). It was projected that a doubling of the weight of organisms impinged would be equivalent to less than one-half of one percent of the commercial catch of fish and shellfish in either St. Lucie or Martin county. Based on this, the NRC concluded that even the combined estimates of Unit 1 and Unit 2 impingement would be insignificant when compared to local commercial landings. Additional impingement monitoring for Unit 2 was not required.

Applied Biology (1985) reported on intake canal gill-net sampling carried out annually from 1976 to 1984. The purpose of this program was to determine the extent of entrapment and accumulation of fish and shellfish in the intake canal, and whether this could represent an adverse impact to the communities in the site vicinity. It was concluded that fish and shellfish were not accumulating in the intake canal, based on an average catch rate for the study period of 3.5 to 12.5 fish per 30 m (98 ft) of gill net per day. There were peaks in some years due to influxes of blue runners (*Caranx crysos*), crevalle jacks (*C. hippos*), and smooth dogfish (*Mustelus canis*) in 1977, 1978, and 1984, respectively. The highest mean catch rate for the period occurred in 1980 and resulted from an influx of spot (*Leiostomus xanthurus*) into the intake canal. In spite of these sporadic influxes of some species into the canal, no accumulation was documented. It is possible that factors such as predation within the canal operate to keep the numbers low. Some of the fish entrapped in the intake canal were commercial species, but losses were negligible relative to the weight of commercial landings. Of particular note is that of three of the most important commercial species, only five Spanish mackerel (*Scomberomorus maculatus*), 10 king mackerel (*S. cavalla*), and 37 bluefish (*Pomatomus saltatrix*) were found in the intake canal over the 9-year study period. The low rate of entrapment was attributed to the velocity caps at the ocean intakes, which create horizontal currents that are more easily avoided by fish than vertical currents.

Pursuant to a special condition of the St. Lucie Unit 2 site certification issued by the Florida Department of Environmental Protection (FDEP) in compliance with Florida law (FDEP 1976), a mitigation program was implemented whereby FPL periodically traps fish from the intake canal, tags them, and releases them in the ocean. This program is carried out at the behest of the Florida Fish and Wildlife Conservation Commission (FFWCC). Although the special condition specified that this mitigation take place during construction of St. Lucie Unit 2, FPL has continued the program beyond the construction period. Collections are made on a quarterly to a monthly basis, with a goal of tagging and releasing 1000 fish per year. FPL cooperates with various institutions to provide specimens for display and research.

As indicated in the current Industrial Wastewater Facility Permit No. FL0002208 for St. Lucie Units 1 and 2 (FDEP 2000), St. Lucie Units 1 and 2 have documentation of Clean Water Act 316(b) compliance indicating that the existing intake structure reflects the best technology available for minimizing environmental impacts at the plant.

The staff has reviewed the available information and, based on the results of impingement studies and the operating history of the St. Lucie Units 1 and 2 intake structure, concludes that the potential impacts of impingement of fish and shellfish on the debris screens of the cooling water intake system are SMALL. While preparing this SEIS, the staff considered mitigation measures for the continued operation of St. Lucie Units 1 and 2 along with cumulative impacts of past, current, and foreseeable future activities at the site. When continued operation for an additional 20 years was considered as a whole, all environmental impacts due to plant operation (whether or not "significant") were considered. Based on the assessment to date, the staff expects that the measures in place at St. Lucie Units 1 and 2 (e.g., intake screens and the placement of the intake pipes) will mitigate all impacts related to impingement and no new mitigation measures are warranted.

4.1.3 Heat Shock

The impacts on fish and shellfish resources resulting from heat shock are a Category 2 issue, because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions. Information to be ascertained includes (1) type of cooling system (whether once-through or cooling pond) and (2) evidence of a Clean Water Act 316(a) variance or equivalent State documentation.

St. Lucie Units 1 and 2 have a once-through heat-dissipation system (FPL 2001a). Before startup of both Units 1 and 2, extensive thermal plume modeling studies were conducted, as summarized by the NRC (NRC 1982b) and its predecessor agency, the U.S. Atomic Energy Commission (AEC 1973). These studies described rapidly rising, buoyant thermal plumes from the diffuser discharges with resulting surface temperatures less than the 36°C (97°F) surface water limitation in the Water Quality Standards (FDEP 1996). Potential interaction of the thermal plume with benthic, planktonic, and nektonic (fish and sea turtles) communities was evaluated and projected to be minimal. No detectable impact was predicted due to scouring of the benthic community, plume entrainment of plankton (including fish eggs and larvae), or heat shock to adult fish or turtle hatchlings. As indicated in Section 3(C)(1) of the Fact Sheet associated with the current Industrial Wastewater Facility Permit No. FL0002208-Major for St. Lucie Units 1 and 2 (FDEP 2000), the thermal discharge from the plant complies with Florida Water Quality Standards without recourse to a Clean Water Act Section 316(a) variance.

The staff has reviewed the available information, and, based on the conditions of the NPDES permit and the operating history of St. Lucie Units 1 and 2 discharge, concludes that the potential impacts of discharging heated water from the cooling water intake system are SMALL. While preparing the SEIS, the staff considered mitigation measures for the continued operation of St. Lucie Units 1 and 2 along with cumulative impacts of past, current, and future activities at the site. When continued operation for an additional 20 years was considered as a whole, all

environmental impacts due to plant operation (whether or not "significant") were considered. Based on the assessment to date, the staff expects that the measures in place at St. Lucie Units 1 and 2 (e.g., the placement of the discharge pipes) will mitigate all impacts related to heat shock and no new mitigation measures are warranted.

4.2 Transmission Lines

The Final Environmental Statements (FESs) for St. Lucie Units 1 and 2 (AEC 1973, 1974) describe three transmission lines that connect the plant with the transmission system. These transmission lines are all in a single right-of-way that covers approximately 310 ha (766 ac) over a total right-of-way length of approximately 18 km (11 mi). Tree trimming is normally required only at mid-span or when exotic species such as Australian pine (*Casuarina equisetifolia*) invade the tower pads or right-of-way. Herbicides are used occasionally, primarily applied to individual trees or shrubs to prevent re-sprouting, although broadcast applications are used to control exotic grasses. FPL only uses nonrestricted-use herbicides, and all applications are performed under the supervision of licensed applicators. Mowing follows a 5-year cycle. FPL uses a computer database to prepare management prescriptions for each section of transmission line right-of-way that incorporates known management concerns and environmental sensitivities.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to transmission lines from St. Lucie Units 1 and 2 are listed in Table 4-3. FPL stated in its ER (FPL 2001a) that it is not aware of any new and significant information associated with the renewal of the OLs for St. Lucie Units 1 and 2. The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those Category 1 issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and GEIS conclusions, as codified in 10 CFR Part 51, Subpart A, Appendix B, 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 4-3. Category 1 Issues Applicable to the St. Lucie Transmission Lines During the Renewal Term

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

The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2001a), the staff's site visit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS) and the FFWCC, or its 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 ER (FPL 2001a), the staff's site visit, the scoping process, consultation with the FWS and FFWCC, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, consultation with the FWS and FFWCC, or its 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 the information in the GEIS, the Commission found that

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

  The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no onsite land-use impacts during the renewal term beyond those discussed in the GEIS.

- Power line right-of-way (land use). Based on information in the GEIS, the Commission found that

  > Ongoing use of power line 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 ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of power line rights-of-way during the renewal term beyond those discussed in the GEIS.

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

Table 4-4. Chronic Effects of Electromagnetic Fields and GEIS Category 2 Issue Applicable to the St. Lucie 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

Based on information in the GEIS, the Commission found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (IEEE 1997) criteria, 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), an applicant for license renewal 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 National Electric Safety Code (NESC) for preventing electric shock from induced currents.

Three 230-kV transmission lines were constructed to connect St. Lucie Units 1 and 2 to the transmission system. The transmission lines run approximately 18 km (11 mi) from the plant switchyard to the Midway substation in a single corridor. After the lines leave the St. Lucie substation they run west across the Indian River (Intracoastal Waterway) and then turn northward for the final 2.4 km (1.5 mi). Over the Intracoastal Waterway, the minimum transmission-line clearance is 27 m (90 ft), and over the remainder of the river the clearance is 18 m (60 ft). Over land, the minimum transmission-line clearance is 6.7 m (22 ft). The St. Lucie 230-kV lines are the only lines in the corridor for most of the route. However, several other 230-kV lines and a 500-kV line not associated with St. Lucie share the corridor for approximately 2.4 km (1.5 mi) near the Midway substation.

The St. Lucie transmission lines were constructed before the NESC was adopted; therefore, FPL evaluated the potential electric shock impacts from the transmission lines using guidance developed by the Electric Power Research Institute (EPRI 1987), and the EPRI ENVIRO computer code (EPRI 1994). In the evaluation, a 20-m (65-ft)-long tractor-trailer was assumed to be parked beneath the 230-kV lines. The maximum steady-state current was estimated to be 2.3 mA. The analysis was repeated for the section of the corridor where the St. Lucie transmission lines share the corridor with a 500-kV line. For this section of corridor, the maximum steady-state current was estimated to be 4.5 mA. In both cases, the maximum steady-state current is below the NESC limit of 5 mA.

The calculations described above are specifically for a tractor-trailer parked beneath the transmission line. The FPL staff also considered the potential electric shock impacts for various classes of boats passing beneath the transmission lines crossing the Indian River. The FPL staff concluded that the potential impacts for boats were less than those for trucks.

On the basis of the results of these calculations, the staff concludes that the impact of the potential for electric shock is SMALL and additional mitigation is not warranted.

4.2.2 Electromagnetic Fields – Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2. They will not be categorized 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 St. Lucie Units 1 and 2 in regard to radiological impacts are listed in Table 4-5. FPL stated in its ER (FPL 2001a) that it is not aware of any new and significant information associated with the renewal of the St. Lucie OLs. No significant new information has been identified by the staff during its independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-5. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term

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

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

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found that

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

The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

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

The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

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

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-6. FPL stated in its ER (FPL 2001a) that it is not aware of any new and significant information associated with the renewal of St. Lucie Units 1 and 2 OLs. The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its 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 measures are not likely to be sufficiently beneficial to be warranted.

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SOCIOECONOMIC	
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 ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services – education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any significant new information during its independent review of the ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

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

  No significant impacts are expected during the license renewal term.

  The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-7 lists the Category 2 socioeconomic issues, 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 4-7. 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 Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	SOCIOECONOMIC		
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental justice	Not addressed[(a)]	Not addressed[(a)]	4.4.6

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

4.4.1 Housing Impacts During Operations

Impacts on housing are considered SMALL when a small or not easily discernible change in housing availability occurs. Impacts are considered MODERATE when there is discernible but short-lived reduction in available housing units because of project-induced migration. Impacts

are considered LARGE when project-related housing demands result in very limited housing availability and would increase rental rates and housing values well above normal inflation (NRC 1996).

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

In 2000, the population living within 32 km (20 mi) of St. Lucie Units 1 and 2 was estimated to have been approximately 345,000 (FPL 2001a). This total converts to a population density of about 215 persons/km^2 (550 persons/mi^2) living on the land area within a 32-km (20-mi) radius of St. Lucie.[(a)] This concentration falls into the GEIS sparseness Category 4 (i.e., having greater than or equal to 46 persons/km^2 [120 persons/mi^2]).

An estimated 1,180,000 people live within 80 km (50 mi) of the St. Lucie site (FPL 2001a), equating to a population density of around 117 persons/km^2 (300 persons/mi^2) on the available land area.[(b)] Applying the GEIS proximity measures (NRC 1996), St. Lucie Units 1 and 2 are classified as Category 4 (i.e., having more than or equal to 73 persons/km^2 [190 persons/mi^2] within 80 km [50 mi] of the site). According to the GEIS, these sparseness and proximity scores identify the nuclear units as being located in a high-population area.

10 CFR Part 51, Subpart A, Appendix B, Table B-1, states that impacts on housing availability are expected to be of SMALL significance at plants located in a high-population area where growth-control measures are not in effect. The St. Lucie site is located in a high-population area. Martin and St. Lucie counties are not subject to growth-control measures that would limit housing development.

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 GEIS assumes that an additional staff of 60 permanent per-unit workers might be needed during the license renewal period to perform routine maintenance and other activities. FPL has performed some

(a) These numbers differ from those presented in the ER (FPL 2001a). In their calculations presented in the ER, FPL took the surface area in the 32-km (20-mi) and 80-km (50-mi) radii and distributed the population evenly within the circles. However, the circles encompass a large area of the Atlantic Ocean. The staff assumed that the ocean encompasses half the area for the 32-km (20-mi) and 80-km (50-mi) circles. As such, the population concentrations were adjusted, resulting in higher population concentrations than those reported in the ER.

(b) Note that these conclusions differ from FPL's ER for the reasons stated in footnote (a).

major construction activities at St. Lucie (e.g., Unit 1 steam generator replacement and velocity cap repair [FPL 2001a]). Other major refurbishment or replacement actions during the license renewal period have not been identified by FPL, and as a result, employment will not change as a result of such activities. Thus, FPL concludes that there are no impacts to housing from license renewal activities (FPL 2001a). However, to establish an upper bound on possible increased employment during the license renewal term for the purposes of impact analysis, FPL assumed the hiring of 60 additional permanent workers, although FPL currently has no plans to add additional full-time staff. The hiring of 60 additional employees would result in 78 indirect jobs, or an increased demand for a total of 138 housing units (FPL 2001a). Using the fact that 83 percent of its employees live in Martin and St. Lucie counties (see Table 2-5), FPL concluded that a demand for 115 housing units would be created in the two counties. Using the GEIS guidance of 60 additional workers per unit, FPL's estimates would be doubled. The demand for the housing units could be met with the construction of new housing or use of existing, unoccupied housing. In 2000, St. Lucie and Martin counties had a total of 156,733 housing units (see Table 2-6) and vacancy rates in both counties were more than 15 percent. The increase in projected housing units would not create a discernible change in housing availability, rental rates, or housing values; or spur new construction or conversion. As a result, FPL concluded that the impacts would be SMALL, and mitigation measures would not be necessary or effective (FPL 2001a).[(a)]

The staff reviewed the available information relative to housing impacts, FPL's conclusions, and conclusions drawn from using assumptions on employment given in the GEIS. Based on this review, the staff concludes that the impact on housing during the license renewal period would be SMALL, and additional mitigation is not warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand, and thus there is no need to add capital facilities. Impacts are considered MODERATE if overtaxing of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service (e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. 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).

(a) The FPL estimate of 138 housing units (115 units for Martin and St. Lucie counties) is likely to be an extreme "upper bound" estimate. Most of the potentially new jobs would likely be filled by existing area residents, thus creating no, or little, net demand for housing.

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the St. Lucie Units 1 and 2 permitted withdrawal rate and actual use of water. FPL plans no refurbishment at St. Lucie Units 1 and 2, so plant demand would not change beyond current demands (FPL 2001a).

In the ER FPL assumed, for the purposes of impact analysis only, an increase of 60 license renewal employees, the generation of 138 new jobs, and a net overall population increase of approximately 339 as a result of those jobs.[(a)] The plant-related population increase would require an additional 64 to 102 m^3/d (1.7×10^{-2} to 2.7×10^{-2} MGD) of water (FPL 2001a). Using the GEIS assumption of 60 additional workers per unit, the FPL estimates would be doubled. However, both estimates are within the total residual capacity of all water treatment plants greater than 3.8×10^3 m^3/d (1 MGD) serving Martin and St. Lucie counties (see Table 2-8). Thus, the staff concludes that the impact of increased water use resulting from the potential increase in employment is SMALL, and mitigation is not warranted.

The staff reviewed the available information relative to impacts on public utility services. Based on this review, the staff concludes that the impacts on public utility services during the license renewal period would be SMALL, and additional mitigation is not warranted.

4.4.3 Offsite Land Use During Operations

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

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

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

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

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

For the purpose of impact analysis, FPL has identified a maximum of 60 additional staff who could be employed during the license renewal term plus an additional 78 indirect jobs (total 138) in the community (FPL 2001a). As noted previously, the GEIS assumes a total of 120

(a) Calculated by assuming that the average number of persons per household is 2.46 in the State of Florida (138 jobs x 2.46 = 339) (USCB 2000).

additional staff for the entire plant, or 276 total jobs and households in the community. Section 3.7.5 of the GEIS (NRC 1996) states that if plant-related population growth is less than 5 percent of the study area's total population, offsite land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km^2 (60 persons/mi^2), and at least one urban area with a population of 100,000 or more within 80 km (50 mi). In this case, population growth will be less than 5 percent of the area's total population, the area has established patterns of residential and commercial development (see Table 2-9), a population density of well over 23 persons/km^2 (60 persons/mi^2), but no urban area with a population of 100,000 or more within 80 km (50 mi). However, the combined populations of the cities of Port St. Lucie and Fort Pierce, which share a common boundary, exceed 100,000 (see discussion under Section 2.2.8.5, Demography). 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. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven land-use impacts during the license renewal term should consider (1) the size of the plant's tax payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant's tax payments are projected to be small relative to the community's total revenue, tax-driven land-use changes during the plant's license renewal term would be small, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdictions revenue, the significance level would be SMALL (NRC 1996). 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.

St. Lucie County is the only local jurisdiction that receives personal and real property tax payments for St. Lucie Units 1 and 2. FPL's tax payments to the county for Units 1 and 2 averaged about 9.2 percent of the county's total property tax revenue over the 5 years between 1996 and 2000 (see Table 2-11). Both St. Lucie and Martin counties are operating under the State-required Growth Management Policy Plan and an established Urban Service Boundary (USB) requiring that adequate public services be provided to support new development. It is the policy of both counties that development is not to take place outside the USB. In combination, these two factors (lack of growth directly related to the presence of St. Lucie Units 1 and 2 and directed growth to stay within the USB) are expected to result in SMALL land-use impacts from taxes derived from St. Lucie.

No adverse effects on offsite land use will occur because of license renewal. Consequently, the staff concludes that tax revenue changes resulting from license renewal are likely to result in SMALL offsite land-use impacts.

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.

In 2002, most of the roadways within Martin and St. Lucie counties were operating at acceptable levels-of-service (LOS). As discussed in Section 2.2.8.2, both Martin and St. Lucie counties have as public policy the targeting of growth within the USB. Interstate 95 (I-95), State Road 70 (SR-70), the Florida Turnpike, and U.S. Highway 1 (US-1) serve as the main transportation routes for both counties and can be crowded during the busiest times of the day, particularly US-1 in Fort Pierce, Port St. Lucie, and Stuart. State Road A1A, providing access to the St. Lucie site on Hutchinson Island, carries a LOS designation of "A" in the vicinity of the site. North and south of the site, State Road A1A carries an LOS designation of "B" (FPL 2001a). Personal observations by staff during the site visit (April 1 to 5, 2002) showed State Road A1A to be relatively uncongested except during shift changes at St. Lucie Units 1 and 2 and at the southern and northern terminus of the road near Stuart/Port St. Lucie and Fort Pierce, respectively.

St. Lucie and Martin counties experienced approximately 2.4 percent annual population growth over the last decade (see Table 2-7). The growth is not related directly to the presence of the St. Lucie Units 1 and 2. St. Lucie and Martin counties do not have growth-control measures that limit housing. Both counties are expected to grow about 20 percent in population over the next decade (Table 2-7). Land-use projections for both counties show that new residential, commercial, and industrial development is expected to take place east of the I-95 and Florida Turnpike corridors.

However, none of this expected growth is due directly to increases in employment at the St. Lucie site. St. Lucie Units 1 and 2 currently employ 929 workers (see Table 2-5) (FPL 2001a). During periods of refueling, once or twice a year, an additional 575 to 870 temporary workers are hired. The upper-bound potential increase in permanent staff during the license renewal term as set in the GEIS is 120 additional workers, or approximately 13 percent of the current permanent work force. The level of access to the St. Lucie site is over secondary, as opposed to primary, roads. Based on these facts, FPL concluded that the impacts on transportation during the license renewal term would be SMALL, and no mitigative measures would be warranted.

The staff reviewed FPL's assumptions and resulting conclusions. The staff concludes that any impact of FPL on transportation service degradation is likely to be SMALL and would not require mitigation.

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 in 36 CFR Part 800. Under the regulations, the NRC is to make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office (SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

In April 2001, FPL wrote to the Florida SHPO, requesting comments on the St. Lucie Units 1 and 2 license renewal process. In this letter, FPL determined that the continued operation of St. Lucie will have no impact on historic properties (FPL 2001b). In a response dated May 22, 2001, the Florida SHPO stated that the license renewal was not an undertaking that would affect historic properties (SHPO 2001).

However, the Florida SHPO cautioned that there was a moderate to high likelihood for the presence of significant prehistoric archaeological sites in the currently undeveloped portions of the St. Lucie site, as evidenced by the presence of the archaeological remains along Blind Creek at the northern end of the site boundary. Major refurbishment of the St. Lucie plant 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 St. Lucie Units 1 and 2, 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.

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 the plant itself, but also land management-related actions such as recreational improvements, wildlife habitat enhancement, or maintaining/upgrading plant access roads through the plant site and on transmission line rights-of-way.

Based on the staff's cultural resources analysis and consultation, the claims made by the licensee that major refurbishment activities will not be undertaken related to the renewal of the

St. Lucie Units 1 and 2 OLs, and the fact that operation will continue within the bounds of plant operations as evaluated in the FES (AEC 1973, 1974), the staff concludes that the potential impacts on historic and archaeological resources are SMALL, and no additional mitigation is warranted.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy that requires Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its actions on minority[(a)] or low-income populations. The memorandum accompanying Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969 (NEPA). The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although the Executive Order is not mandatory for independent agencies, the NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (NRC 2001).

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of the St. Lucie site, employing the 1990 census (USCB 1991) for low-income populations[(b)] and the 2000 census (USCB 2000) for minority populations. The populations within an 80-km (50-mi) radius of St. Lucie encompassed parts of 9 counties. The staff supplemented its analysis by field inquires to county planning departments, social service agencies, agricultural extension personnel in St. Lucie and Martin counties, and a private social service agency in St. Lucie County.

For the purpose of the staff's review, a minority population is defined to exist if the percentage of each minority, or aggregated minority category within the census block groups[(c)] potentially affected by the license renewal of St. Lucie Units 1 and 2, exceeds the corresponding

(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).

(b) Note that the Census Bureau plans release of income statistics from the 2000 Census during the Summer of 2002. Until then, only 1990 Census data on income are available.

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

percentage of minorities in the entire State of Florida 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 exceeds the corresponding percentage of low-income population in the entire State of Florida by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent.

FPL used 1990 census data for identifying minority and low-income populations within 80 km (50 mi) of the St. Lucie site. FPL also followed the convention of employing census tracts, as opposed to census block groups, and included tracts if 50 percent or greater of their area lay within the 80-km (50-mi) radius of St. Lucie (FPL 2001a). Using this convention, the 80-km (50-mi) radius includes 194 census tracts. The "more than 20 percentage points" above the comparison area criterion was used to determine whether a census tract should be counted as containing minority or low-income populations (FPL 2001a). Because the 20 percentage points criterion is a lower threshold, the 50 percent criterion was not used. Twenty-four of the census tracts qualify for the minority designation, and 7 census tracts for the low-income population.

The staff followed the convention of employing census block groups and counts of individuals in minority or low-income status. Figure 4-1 shows the distribution of minority populations (shaded areas) within the 80-km (50-mi) radius. Minority populations are present in most of the counties within the 80-km (50-mi) radius of the St. Lucie site, particularly in the agricultural areas of the counties around Lake Okeechobee.

Data from the 1990 census characterize low-income populations within the 80-km (50-mi) radius of the St. Lucie site (USCB 1991). Applying the NRC criterion of "more than 20 percent greater," the census block groups containing low-income populations were identified. Figure 4-2 shows the locations of the low-income populations within 80 km (50 mi) of the St. Lucie site. Census block groups containing low-income populations are concentrated in Gifford (Indian River County), Fort Pierce (St. Lucie County), Pahokee (Palm Beach County near Lake Okeechobee), the agricultural areas around Lake Okeechobee, and Hobe Sound (Martin County).

With the locations of minority and low-income populations identified, the staff evaluated 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 (NRC 2001), air, land, and water resources within 80 km (50 mi) of the St. Lucie site were examined. Within that area, a few potential environmental impacts could affect human populations; all of these were considered SMALL for the general population.

The pathways through which the environmental impacts associated with St. Lucie Units 1 and 2 license renewal can affect human populations are discussed in each associated section. The

staff found no unusual resource dependencies or practices such as subsistence agriculture, hunting, or fishing through which minority and/or low-income populations could be disproportionately highly and adversely affected. 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 St. Lucie Units 1 and 2 to minority and low-income populations would be SMALL, and no special mitigation actions are warranted.

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of the St. Lucie Site Based on Census Block Group Data[(a)]

(a) Note: Some of the census block groups extend into Lake Okeechobee.

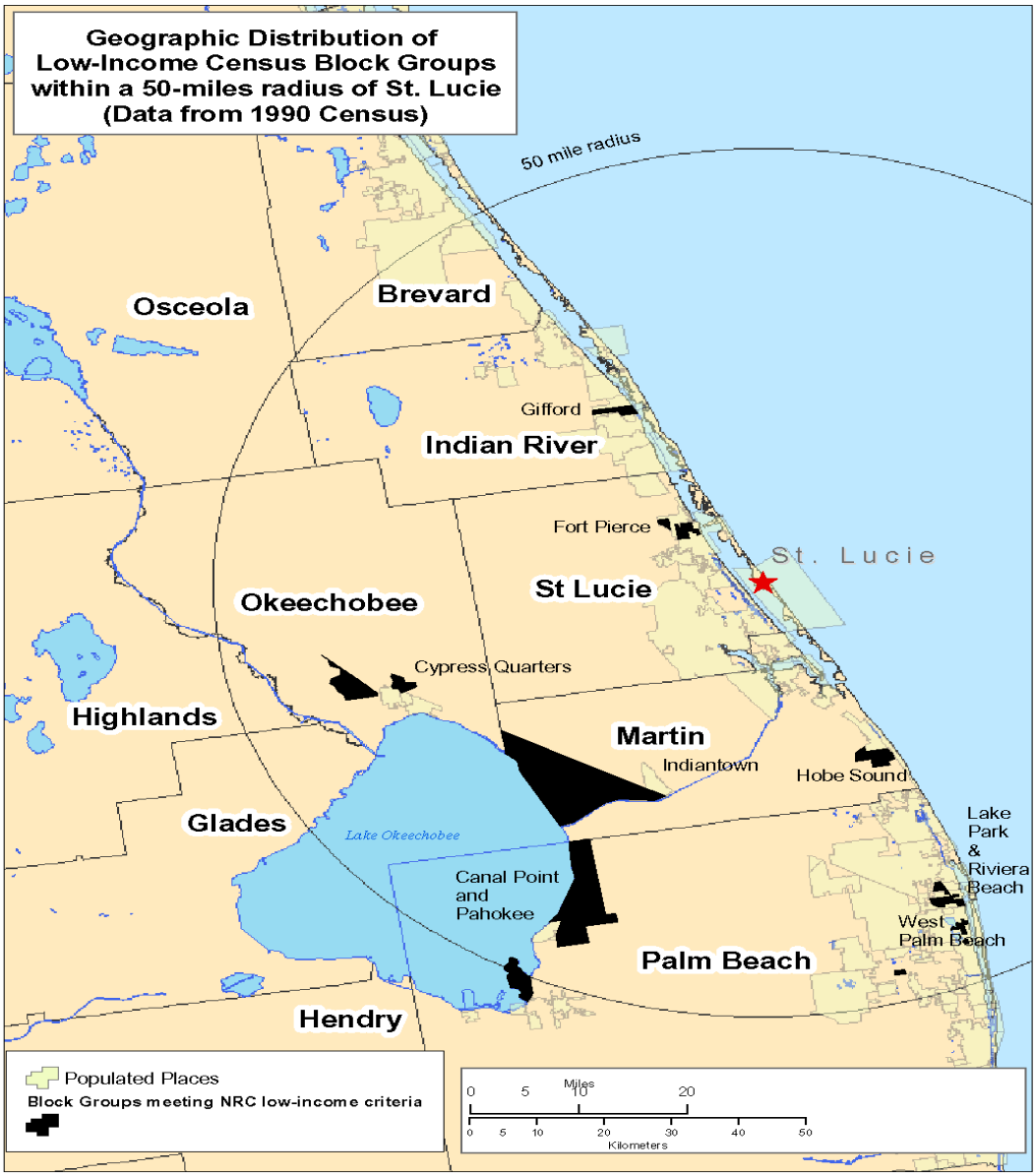

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of the St. Lucie Site Based on Census Block Group Data[(a)]

(a) Note: Some of the census block groups extend into Lake Okeechobee.

4.5 Groundwater Use and Quality

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to St. Lucie Units 1 and 2 groundwater use and quality are listed in Table 4-8. FPL stated in its ER that it is not aware of any new and significant information associated with the renewal of the St. Lucie 1 and 2 OLs (FPL 2001a). The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2001a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently benefical to be warranted.

Table 4-8. Category 1 Issues Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
GROUNDWATER USE AND QUALITY	
Groundwater use conflicts (potable and service water; plants that use <100gpm.	4.8.1.1
Groundwater quality degradation (saltwater intrusion)	4.8.2.1

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 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 ground-water use conflicts.

As discussed in Section 2.2.2, groundwater use by St. Lucie Units 1 and 2 is less than 0.068 m^3/s (100 gpm). The staff has not identified any significant new information during its independent review of the FPL ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no groundwater-use conflicts during the renewal term beyond those discussed in the GEIS.

- Groundwater quality degradation (saltwater intrusion). Based on information in the GEIS, the Commission found that

  > Nuclear power plants do not contribute significantly to saltwater intrusion.

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

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 4-9 and discussed in Sections 4.6.1 through 4.6.3.

Table 4-9. 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

The NRC determined that impacts to threatened or endangered species were a Category 2 issue because the status of species is reviewed on an ongoing basis, and site-specific assessment is required to determine whether any identified species could be affected by refurbishment activities or continued plant operations through the renewal period. 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 the St. Lucie site is discussed in Sections 2.2.5 and 2.2.6.

4.6.1 Aquatic Species

Sections 2.2.5.1 and 2.2.5.2 of this supplement discuss aquatic habitats at St. Lucie Units 1 and 2. Section 2.2.5.3 presents a list of Federally threatened or endangered species and State species of special concern that may occur at St. Lucie Units 1 and 2. In this section, the environmental consequences of the plant operation to sea turtles, manatees, whales, three species of fish, and Johnson's seagrass are assessed.

4.6.1.1 Turtles

During the almost 20 years of commercial operation of St. Lucie Units 1 and 2, the only notable effect of the facility's operation on protected species has been related to sea turtles that have entered the intake canal. Soon after startup of St. Lucie Unit 1, in 1976, sea turtles were discovered in the intake canal (Ecological Associates 2000; NRC 1982b). These turtles entered the offshore velocity cap intake and were swept through the intake pipe into the canal. A program was initiated to capture the turtles from the intake canal and return them to the ocean. In 1978, a large-mesh (20-cm [8-in.]) barrier net was deployed in the canal to capture turtles before they transited the entire intake canal, entered the intake wells, and became impinged on the traveling intake screens. A biological assessment and Endangered Species Act Section 7 consultation was completed in 1982 (NRC 1982b) to address turtle entrapment in light of the pending construction and operation of St. Lucie Unit 2. At that time, the turtle entrapment history at St. Lucie Unit 1 was approximately 150 turtles per year from 1976 to 1981. Mortality rates for loggerhead (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) for this period were 14.6 percent and 8.9 percent, respectively. Projecting mortality losses to include operation of St. Lucie Unit 2, the biological assessment indicated that turtle losses at St. Lucie Units 1 and 2 would represent 0.1 percent (loggerhead sea turtles) to 0.03 percent (green sea turtles) of the respective adult Caribbean populations. It was concluded that no impact to the population of either species would be expected (NRC 1982b). The assessment made several recommendations for enhancement of the ongoing capture-release and beach-nest monitoring programs.

During 1995, in response to an increase in the number of sea turtles that had entered the intake canal, particularly green sea turtles, the NRC reinitiated the Endangered Species Act Section 7 consultation process with the National Marine Fisheries Service (NMFS). During this process, construction of a new, smaller mesh barrier east of the large mesh barrier was identified as appropriate, and construction of this small-mesh (13-cm [5-in.]) barrier net was completed in January 1996. The size of the mesh was selected to be smaller than any of the green sea turtles that had entered the intake canal during the first half of 1995. The new net was located halfway between the old 20-cm (8-in.) mesh barrier net and the intake headwall, thus confining sea turtles that entered the intake canal to a smaller area and facilitating their safe capture and release. The new net is anchored along the bottom of the canal and held up by an aerial wire strung between towers on the sides of the canal. The net is inspected and maintained regularly.

As a result of the 1995 consultation, the NMFS issued a biological opinion (NMFS 1997). In the biological opinion, the NMFS concluded that the continued operation of St. Lucie Units 1 and 2 is not likely to jeopardize the existence of the sea turtle species. To increase protective measures for the turtles, NMFS included an incidental take statement in the biological opinion. This statement specified the permissible annual mortality level of sea turtles entering the intake

canal. The requirements of the incidental take statement were incorporated as part of the St. Lucie Units 1 and 2 OLs. If the annual mortality level criteria were exceeded, a new Section 7 consultation would be required.

In November 1999, the NRC formally requested that the Section 7 process be initiated after St. Lucie Units 1 and 2 exceeded the NMFS's anticipated incidental take of green turtles per year established in the incidental take statement of the 1997 biological opinion. In March 2000, FPL submitted a report to NMFS analyzing the physical and ecological facts influencing sea turtle entrainment levels during the period 1976 through 1998 (Ecological Associates 2000). In May 2001, the NMFS issued its biological opinion and revised the incidental take statement. The biological opinion reiterates the previous conclusions and states:

> It is NMFS' biological opinion that the continued use of St. Lucie Nuclear Power Plant's circulating seawater cooling system is not likely to jeopardize the continued existence of the endangered green, leatherback, hawksbill, and Kemp's ridley sea turtles or the threatened loggerhead sea turtle (NMFS 2001).

The NMFS specified that the annual incidental capture could be up to 1000 turtles with that number being in any combination of the 5 species found in the area. The permissible annual mortality of entrapped green and loggerhead sea turtles that is causally related to plant operation for the next 10 years is greater than or equal to 1 percent of the total combined number of green and loggerhead sea turtles captured, rounded up to the next whole turtle. The permissible mortality for the other three species of sea turtles found in the area are two Kemp's ridley turtles (*Lepidochelys kempi*) per year and one hawksbill (*Eretmochelys imbricata*) or leatherback turtle (*Dermochelys coriacea*) every 2 years for the next 10 years. Some of the terms and conditions of the previous opinion were also revised. Specifically, there are additional requirements for the intake canal capture-and-release program. Citing the loss rate on flipper tags and the scarring that can result, the NMFS now requires all turtles captured in the intake canal to be tagged with a passive integrated transponder tag. Those turtles not exhibiting flipper scarring and damage also will be flipper-tagged so data can continue to be collected on loss rates. Additionally, FPL biologists must notify staff from the Florida Sea Turtle Stranding and Salvage Network of any sick or injured turtles within 30 minutes of discovery so the turtles can receive proper attention. The NMFS again stipulated that if the incidental take statement requirements are "greater than" rather than "greater than or equal to," then a new Section 7 consultation is required (NMFS 2002a).[(a)]

In addition to the take restrictions, FPL has a program in place at St. Lucie Units 1 and 2 to mitigate the effects on sea turtles that enter the intake canal. This program includes recovery

(a) This clarification was an error, which was corrected in subsequent correspondence (see last paragraph of 4.6.1.1 and NMFS [2002b].

of turtles from the intake canal and release to the ocean, beach-nest monitoring, beach-stranding monitoring, and compliance with facility lighting restrictions to protect turtles. The canal-monitoring program is based on the protection afforded by barrier nets in the canal. This system of barriers restricts turtles to the eastern end of the canal, where capture efficiency is greatest and residency time is reduced. The canal and barrier nets are normally monitored 7 days a week, 8 to 12 hours per day, by onsite biologists. In addition to entanglement nets, which are used only in daylight hours and under continual surveillance, turtles are removed by dip nets and hand captured by divers. These captures reduce residence time for turtles in the canal. FPL constantly evaluates its netting program to minimize trauma to turtles and to maximize capture efficiency. Captured turtles are identified, measured, weighed, tagged, and examined for health condition (Ecological Associates 2000). Healthy turtles are released to the ocean the day of capture. Sick or injured turtles are sent to rehabilitation facilities determined by the FFWCC. Dead turtles are processed similarly and, if in fresh condition, necropsied. Additional mitigation carried out by FPL includes performance of sea turtle nesting surveys, participation in the Sea Turtle Stranding and Salvage Network, and sponsorship of educational public sea turtle walks. FPL has also created a vegetative light screen and uses shielded security lighting to prevent direct lighting of the beach. This is done to avoid disorientation of turtle hatchlings and discouragement of females from nesting near the St. Lucie site. FPL also participates in a 24-hour, on-call (beach) stranding monitoring program (FPL 1995).

The increase in the number of sea turtles entering the intake canal at St. Lucie Units 1 and 2 over the operating history of the plant is likely due to an increase in turtle abundance in the area (NMFS 1997). NMFS acknowledged that protective measures have been refined and enhanced over the years. Improvements to the canal capture program have included improvements to the barrier net and capture techniques, and leaving the entanglement nets in the water for longer time intervals. The turtle barrier net installed in 1996 greatly restricts the movement of turtles within the intake canal and facilitates their capture and removal. Since 1996, mortality rates have been less than 1 percent for loggerhead and green sea turtles (NMFS 1997).

At the initiation of the process to prepare this SEIS, NRC staff contacted the NMFS to informally consult on the status of protected species in the vicinity of St. Lucie Units 1 and 2. In a letter dated June 3, 2002 (NRC 2002c), the NRC staff informed NMFS that the licensee had requested a renewal of the OL for St. Lucie Units 1 and 2. Based on the existence of the May 4, 2001, biological opinion, the NRC staff believed that no additional consultation is necessary at this time related to the license renewal effort. NMFS responded in a letter dated July 30, 2002, (NMFS 2002b) stating that “consultation should be reinitiated if take is greater than or equal to that of the May 4, 2001, Opinion.” The letter also states that with respect to the St. Lucie license renewal application, "...NOAA Fisheries does not believe additional consultation is required at this time.” By letter dated August 23, 2002 (NRC 2002d), the NRC staff requested reinitiation of consultation with NMFS regarding the incidental capture of green

and loggerhead turtles at St. Lucie Units 1 and 2. On February 10, 2003 (NRC 2003) the NRC staff summarized the circumstances surrounding the 6 mortalities in 2001 and described modifications and improvements in the intake canal made by the licensee to prevent a reoccurrence of the high 2001 mortality rate. The NRC staff concluded that the elevated mortality rate during 2001 was an unusual occurrence primarily resulting from severe weather and a block net system that could not cope with the unusually high debris loading present in the water column. Modifications to the canal and block net system made by the licensee in the Fall of 2002 should minimize or prevent future episodes of higher than expected mortality. As discussed above, the NRC has a long history of Section 7 consultations with NMFS at the St. Lucie plant and expects the consultation interactions to continue throughout the operating life of the facility.

4.6.1.2 Mammals

Six species of protected mammals (five species of whales and the Florida manatee) occur in vicinity of the St. Lucie site. There have been five occasions when manatees have entered in the intake canal. During 1991, FPL coordinated capture efforts with the FWS and FDEP (predecessor to the FFWCC). After capture, the animals underwent evaluation and rehabilitation and were released to the wild. Except for the first manatee, the animals were removed from the canal within a day of each first sighting. Two of these animals were taken to rehabilitation facilities before their release. One was treated for deep boat propeller wounds it incurred before entering the canal, and one appeared to be a small calf separated from its mother. None of the manatees appeared to have been harmed or to have died as a result of entering the intake canal. FPL procedures require coordination with the FFWCC on the capture and evaluation of entrapped manatees. FPL assists the FFWCC, as needed, in transporting ill or injured animals to approved rehabilitation facilities and in releasing animals that have entered the intake canal back to the wild (Ecological Associates 2001).

In addition to potential impacts from the water intake system, the attraction to or contact with the warm waters discharged from the plant need to be considered. The discharge canal transports the heated cooling water to two discharge pipes. The pipes transport water beneath the beach and dune system back to the Atlantic Ocean. The pipes extend about 460 m (1500 ft) and 1040 m (3400 ft) offshore and terminate in a Y-port and a multiport diffuser. The discharge of heated water through the Y-port and multiport diffusers ensures distribution over a wide area and rapid and efficient mixing with ambient waters (FPL 1996; Foster Wheeler 2000). Modeling studies presented by the U.S. Atomic Energy Commission (AEC) and NRC in the operating stage FESs indicate that the areas of the thermal plumes to the 1.1°C (2°F) isotherm from the St. Lucie Units 1 and 2 diffusers under typical conditions would be about 73 ha (180 ac) and 71 ha (175 ac), respectively (AEC 1973; NRC 1982a). Considering that some of the manatee captures have occurred during summer months, there seems to be no compelling

evidence to infer that manatees congregate at, or are attracted to, the warm water discharges from St. Lucie Units 1 and 2.

The manatee inhabits the Indian River Lagoon and Atlantic coastal waters off Hutchinson Island, although preferred habitats are in the Indian River Lagoon and other inland waterways. The entire inland section of water known as the Indian River is designated as critical habitat for the manatee (50 CFR 17.108). Manatees are mostly found where food sources are abundant. They do occasionally travel up and down the coast near shore. Water is not withdrawn or discharged to the Indian River for normal operations at St. Lucie Units 1 and 2, and there is little attached vegetation in the nearshore environment adjacent to the plant. Manatees are present in the area known as Big Mud Creek within the plant boundaries. This area has been closed to public access due to NRC security concerns, and any boats that are operated within Big Mud Creek are required to travel at idle speed and produce no wake.

Five manatees have entered the offshore intake structures and were entrapped in the intake canal since 1990 (personal communication Tom Abbatiello, March 20, 2003). FPL, FWS, and the FDEP worked together to capture and remove the manatees. Two of the animals were taken to marine mammal care and rehabilitation facilities before release; none of the manatees sustained injuries because of entrainment or residency in the intake canal. One animal apparently sustained a prop injury and the other was a calf separated from its mother. There have been no mortalities to manatees resulting from entrainment at St. Lucie Units 1 and 2.

There are procedures in place for FPL to coordinate capture and evaluation of entrapped manatees with FWS. FPL assists FWS in transporting ill or injured animals to approved rehabilitation facilities and releasing entrapped animals back into the wild.

While manatees also inhabit the freshwater environs near St. Lucie Units 1 and 2, this habitat is not a designated manatee protection area and is not where the offshore intakes are located. In designating manatee protection areas throughout peninsular Florida, FWS considered the needs of the species on an ecosystem level in order to address life requirements of the manatee and to progress toward recovery of the species. Indian River was considered by FWS as a potential manatee protection area. The FWS has stated that the Indian River may warrant further consideration, particularly if manatees do not make satisfactory progress toward recovery. However, the Indian River was not included in FWS' most recent designation of manatee protection areas (FWS 2002b).

Five species of whales are known to occur in the vicinity of the St. Lucie site. Because of their size and habits, adult whales are unlikely to be entrained with cooling water. Additionally, whales do not appear to be attracted to the thermal discharges. The only incident involving a whale at the St. Lucie plant occurred in March 1982, when a right whale became entangled in

gill nets used to monitor offshore fish populations. The whale was untangled and released, unharmed.

4.6.1.3 Johnson's Seagrass

Johnson's seagrass is found in the Indian River Lagoon, most often near inlets. Major threats to Johnson's seagrass include loss of habitat through dredge and fill activities and degradation of water clarity. Due to turbulence and sediment instability, it is unlikely that Johnson's seagrass could inhabit the nearshore waters off Hutchinson Island. Water depths and anoxic bottom conditions probably preclude its presence in the dredged channel of Big Mud Creek. Consequently, the species is not likely to suffer thermal or other impacts associated with operators of St. Lucie Units 1 and 2 (Ecological Associates 2001).

4.6.1.4 Fish

There are no Federally protected fish species in the vicinity of St. Lucie Units 1 and 2; however, there are three State-protected species. The Atlantic sturgeon (*Acipenser oxyrhynchus*) occurs in the Atlantic Ocean near the plant, but they have not been collected in any of the impingement samples at the plant (FPL 2001a). Rivulus (*Rivulus marmoratus*) occurs along the margins of the wetlands onsite. Because plant operations are not expected to involve the loss of wetlands, there should be no impacts to rivulus populations (St. Lucie County 2002). The common snook (*Centropomus undecimalis*) is a highly prized recreational species common to the Indian River Lagoon and nearshore ocean water adjacent to the plant. FPL coordinates the removal and assessment of snook with the appropriate wildlife agencies and assists in their return to the ocean. This program reduces the extent of impacts to snook entrained at St. Lucie Units 1 and 2.

4.6.2 Terrestrial Species

There are a number of Federally listed threatened or endangered terrestrial species in St. Lucie County (Table 2.3), but none has been observed to regularly inhabit the immediate vicinity of St. Lucie Units 1 and 2. However, eastern indigo snakes (*Drymarchon corias couperi*) are assumed to be present at or near the site because they have been observed on Hutchinson Island and gopher tortoise burrows are present within the boundaries of the St. Lucie site. Eastern indigo snakes often use abandoned gopher tortoise burrows as dens and are often found in areas with plentiful gopher tortoise burrows. FPL has a program to train personnel involved with site and transmission line right-of-way maintenance to recognize and avoid indigo snakes in the field. Southeastern beach mice (*Peromyscus polionotus neveiventris*) could be present near the plant site, but they have not been found during any recent surveys on Hutchinson Island and may have been extirpated from the island. Other species such as the wood stork (*Mycteria americana*) and the bald eagle (*Haliaeetus leucocephalus*) are occasional

visitors to the plant vicinity. There have been no reported collisions or electrocutions of wood storks, bald eagles, or any other birds at the St. Lucie site or along the transmission lines.

Several Federally listed threatened or endangered species may be present in the vicinity of the St. Lucie transmission line right-of-way. The Florida scrub jay (*Aphelocoma coerulescens*) inhabits the transmission line right-of-way on the eastern edge of the Savannas State Preserve. The Audubon's crested caracara (*Polyuborus plancus audubonii*), Everglades snail kite (*Rostrhamus sociabilis*), and American alligator (*Alligator mississippiensis*) occasionally may be present in the transmission line right-of-way. Plant species potentially occurring near the transmission line right-of-way include the fragrant prickly apple (*Harrisia [Cereus] eriophorus*) and the four-petal paw paw (*Asimina tetramera*). The transmission line right-of-way maintenance practices employed by FPL are likely to have little or no detrimental impact on the species potentially present in or near the transmission line rights-of-way, and in some cases the maintenance practices may be beneficial. For instance, thinning of the larger trees on the east side of the Savannas State Reserve may help to maintain the open shrubby habitat preferred by the Florida scrub jay.

Interactions with FWS were initiated by FPL in April 2001 (FPL 2001c), and an informal consultation with FWS was initiated in February 2002 by the NRC with a request for information concerning which species are potentially present in the vicinity of St. Lucie Units 1 and 2 (NRC 2002a). The FWS responded to NRC with a list of species potentially present in the vicinity of the site in March 2002 (FWS 2002a). NRC staff met with representatives from FWS in December 2001 and April 2002 to discuss potential impacts to threatened or endangered species from continued operation of St. Lucie Units 1 and 2. Correspondence related to this informal consultation is provided in Appendix E.

The staff evaluated the potential impacts of continued operation of St. Lucie Units 1 and 2 for an additional 20-year license term to Federally listed threatened or endangered species and sent this evaluation to the FWS in July 2002 (NRC 2002b). This biological assessment is included in Appendix E of this SEIS. In its evaluation, the staff concluded that the proposed license renewal was not likely to adversely affect the eastern indigo snake, bald eagle, wood stork, southeastern beach mouse, Florida scrub jay, four-petal paw paw, and fragrant prickly apple. License renewal was determined to have no effect on Audubon's crested caracara, Everglades snail kite, Lakela's mint (*Dicerandra immaculate*), tiny milkwort (*Polygala smallii*), American alligator, or any other Federally listed threatened or endangered terrestrial species. FWS concurred with these conclusions in October 2002 (FWS 2002c). Copies of correspondence related to this consultation are provided in Appendix E.

State of Florida-listed threatened, endangered, or other species of concern (Table 2-3) were not specifically considered within the NRC's June 2002 evaluation. The staff has determined that the generic conclusions regarding transmission line maintenance impacts on wildlife and

wetlands, bird collisions with power lines, the effects of electromagnetic fields, and plant and cooling system operation effects on wildlife and native vegetation are applicable to the State-listed species, and therefore the potential impacts are SMALL, and additional mitigation measures are not warranted.

4.6.3 Conclusion

The staff has reviewed the available information including that provided by the applicant, the FWS, the FFWCC, the scoping process, and other public information sources. Using this information, the staff evaluated the potential impacts to threatened or endangered species that could be affected by continued operation and maintenance of St. Lucie Units 1 and 2 and associated transmission lines. It is the conclusion of the staff that the potential impacts to Federally listed threatened or endangered species of an additional 20-year license term for operation of St. Lucie Units 1 and 2 are SMALL.

During the course of its evaluation, the staff considered mitigation measures for continued operation of St. Lucie Units 1 and 2 along with cumulative impacts of past, current, and future activities at the site. Based on this evaluation, the staff expects that mitigation measures currently in place concerning sea turtle protection and recovery are appropriate and no additional mitigation measures are warranted. Additionally, the staff expects that FPL will continue to maintain the transmission line right-of-way on the eastern edge of the Savannas State Preserve as it has since constructing the transmission line, and that these maintenance procedures will continue to provide or enhance habitat for the Florida scrub jay and other threatened or endangered species potentially present in that area. This will provide adequate mitigation for potential impacts to terrestrial threatened or endangered species, and no additional mitigation measures are 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 the public scoping process and meetings and comments on the Draft SEIS, to identify issues with significant new information. Processes for identification and evaluation of new information are described in Section 1.2.2.

4.8 Summary of Impacts of Operations During the Renewal Term

Neither FPL 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 operation of St. Lucie Units 1 and 2 during the renewal term. Consequently, the staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 11 Category 2 issues applicable to the operation of St. Lucie Units 1 and 2 during the renewal term and for environmental justice and chronic effects of electromagnetic fields. For all 10 Category 2 issues and environmental justice, the staff concluded that the potential environmental impact of renewal term operations of St. Lucie Units 1 and 2 would be of SMALL significance in the context of the standards set forth in the GEIS and that additional mitigation would not be warranted. For threatened or endangered species, the staff's conclusion is that the impact resulting from license renewal would be SMALL and further mitigation is not warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is possible.

4.9 References

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

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

50 CFR 17. Code of Federal Regulation, Title 50, *Wildlife and Fisheries*, Part 17, "Endangered and Threatened Wildlife and Plants."

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

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

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

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

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

5.1 Postulated Plant Accidents

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

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

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.

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

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

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, design-basis events are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to St. Lucie Units 1 and 2, is listed in Table 5-1. The early resolution of the DBAs

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

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.

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.

Florida Power and Light Company (FPL) stated in its Environmental Report (ER; FPL 2001) that it is not aware of any new and significant information associated with the renewal of the St. Lucie Units 1 and 2 OLs. The staff has not identified any significant new information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to DBAs beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, 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 FESs and were not specifically considered for the St. Lucie site in the GEIS (NRC 1996). However, in the GEIS, the staff did evaluate existing impact assessments performed by NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from 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 St Lucie Units 1 and 2, is listed in Table 5-2.

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

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

The staff has not identified any significant new information with regard to the consequences from severe accidents during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of 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 St. Lucie Units 1 and 2. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for St. Lucie Units 1 and 2; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

FPL submitted an assessment of SAMAs for St. Lucie as part of the ER (FPL 2001). This assessment was based on the current St. Lucie Probabilistic Safety Assessment (PSA), a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System (MACCS), and insights from the St. Lucie Individual Plant Examination of External Events (IPEEE) (FPL 1994). In identifying and evaluating potential SAMAs, FPL considered several SAMA analyses for other plants and advanced light-water reactor designs, including Watts Bar, Calvert Cliffs, Oconee, Turkey Point, and CE System 80+, and other documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a). FPL identified and evaluated 169 potential SAMA candidates. This list was reduced to 50 unique SAMA candidates by eliminating SAMAs that either were not applicable to St. Lucie or were already implemented at the plant. FPL assessed the costs and benefits associated with each of the potential SAMAs and concluded that none of the candidate SAMAs evaluated would be cost-beneficial for St. Lucie.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to FPL by letter dated May 7, 2002 (NRC 2002a). Key questions concerned: differences between the PSA used for the SAMA analysis and earlier risk assessments for St. Lucie, the potential impact of uncertainties and external event initiators on the study results, detailed information on several candidate SAMAs, and the applicability of some SAMAs proposed at another Combustion Engineering plant. FPL submitted additional information on June 25, 2002, in response to the RAIs (FPL 2002a). In these responses, FPL included supplemental tables showing the impacts of uncertainties, risk reduction worth importance measures, results of sensitivity analysis, and additional information on specific SAMAs. FPL provided further information during a teleconference on July 15, 2002, clarifying the remaining issues (NRC 2002b). In these responses, FPL provided additional information on its use of importance analysis and cut set information, on regional population projections, and on use of the MAAP code in its consequence assessment. FPL's responses addressed the staff's concerns and reaffirmed that none of the SAMAs would be cost-beneficial.

An assessment of SAMAs for St. Lucie is presented below.

5.2.2 Estimate of Risk for St. Lucie Units 1 and 2

FPL's estimates of offsite risk at St. Lucie are summarized in Section 5.2.2.1. The summary is followed by the staff's review of FPL's risk estimates in Section 5.2.2.2.

5.2.2.1 FPL's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the St. Lucie Level 1 and 2 PSA model, which is an updated version of the St. Lucie Individual Plant Examination (IPE) (FPL 1993), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PSA model) developed specifically for the SAMA analysis. The St. Lucie PSA, dated April 2001, is indicated in the ER (FPL 2001) to be more advanced than the St. Lucie IPE submittal of 1993 (FPL 1993) and is considered a "living" plant risk model that reflects periodic updates to incorporate (1) additional data on equipment performance, (2) changes in plant configuration, and (3) PSA model refinements.

The baseline core damage frequencies (CDFs) for the purpose of the SAMA evaluation are approximately 3.0×10^{-5} per reactor-year (ry) and 2.4×10^{-5}/ry for St. Lucie Units 1 and 2, respectively. These CDFs are based on the risk assessment for internally initiated events, including internal floods. These values represent only small changes from the original IPE CDF values of 2.3×10^{-5}/ry and 2.6×10^{-5}/ry for St. Lucie Units 1 and 2, respectively. Although FPL did not include the contribution of risk from external events within the St. Lucie risk estimates, it did account for the potential risk reduction benefits associated with external events by applying a factor of 2 margin in the SAMA screening process. It is FPL's position that this approach is conservative because the external events contributions to core damage are small relative to the internal events contributions (FPL 2001). This is discussed further in Section 5.2.2.2.

The breakdown of CDFs is provided in Table 5-3. It is noted that the total CDFs in Table 5-3 are slightly different than the total CDFs given above. This is because the values are based on the use of a top event model, which was also used for the purpose of screening SAMAs. The top event model accounts for 95 percent of the CDF for Unit 1 and 99 percent of the CDF for Unit 2. As shown in Table 5-3, containment bypass events (i.e., interfacing system loss-of-coolant accident [ISLOCA] and steam generator tube rupture [SGTR]) contribute about 13 percent and 24 percent to the total internal events CDF for Units 1 and 2, respectively. Transients (including loss-of-offsite power [LOOP] and anticipated transient without scram [ATWS]) contribute about 35 percent and 20 percent, respectively. The contribution of loss-of-coolant accidents (LOCAs) to the total CDFs is large at both plants (29 percent and 32 percent, respectively). The station blackout (SBO) contribution to the transients was not explicitly provided in the submittal; however, in response to a RAI, FPL stated that the LOOP sequences are predominantly SBO sequences (FPL 2002a). The CDFs that were used in the SAMA analysis and that are cited here are best-estimate values. The uncertainty analysis for the updated PSA indicates 95 percent confidence level (upper) CDF values of 6.15×10^{-5}/ry and 6.11×10^{-5}/ry for Units 1 and 2, respectively. The impact of this uncertainty on the SAMA analysis is discussed in Section 5.2.6.2.

Table 5-3. St. Lucie Core Damage Frequency[a]

Initiating Event	Frequency (per reactor-year)		% Contribution to CDF	
	Unit 1	**Unit 2**	**Unit 1**	**Unit 2**
Loss of Offsite Power (LOOP)/Station Blackout (SBO)	4.63×10^{-6}	2.67×10^{-6}	16	11
Transients	4.55×10^{-6}	1.84×10^{-6}	16	8
Anticipated Transient Without Scram (ATWS)	8.23×10^{-7}	3.31×10^{-7}	3	1
Loss-of-Coolant Accident (LOCA)	8.22×10^{-6}	7.82×10^{-6} [b]	29	32[b]
Interfacing Systems LOCA (ISLOCA)	2.89×10^{-6}	5.64×10^{-6}	10	23
Steam Generator Tube Rupture (SGTR)	9.58×10^{-7}	2.78×10^{-7}	3	1
Internal floods	5.00×10^{-7}	5.00×10^{-7}	2	2
Others	6.03×10^{-6}	5.22×10^{-6} [b]	21	22[b]
Total CDFs (from internal events)	**2.86×10^{-5}**	**2.43×10^{-5}**	**100**	**100**

(a) CDF calculated using a single top event model that included all plant damage states and containment bypass sequences.

(b) The Unit 2 LOCA value, originally provided in the FPL RAI responses (FPL 2002a), was in error and subsequently corrected in a communication with NRC (FPL 2002b).

The major difference in the CDFs for St. Lucie Units 1 and 2 is attributed to the following:

- Unit 2 has larger power-operated relief valves (PORVs), thus only one PORV is required for once-through cooling. This is the main reason Unit 1 has a larger SGTR CDF than Unit 2.

- Unit 2 has a larger capacity condensate storage tank than Unit 1. Thus, Unit 1 has a slightly higher contribution from long-term decay heat removal related scenarios such as transients.

- The Unit 2 shutdown cooling line has one more configuration of an ISLOCA path due to crosstie capability. This increases the ISLOCA frequency for Unit 2.

The CDF results were obtained using two cases for 4.16-kV AB-bus alignment. Case 1 is when the AB-bus is aligned to the A-bus, and Case 2 is when the AB-bus is aligned to the B-bus. FPL states that the SAMA evaluation uses the most conservative cases for the baseline risk model, which are Case 2 for Unit 1 and Case 1 for Unit 2 (FPL 2001).

The Level 2 PSA model is based on the containment event tree and source terms from the IPE (FPL 1993). The conditional probabilities associated with each release category are provided in Table E.1-1 of the ER (FPL 2001). The fission product release fractions and characteristics for each release category are provided in Table E.2-1 of the ER.

The offsite consequences and economic impact analyses use the MELCOR Accident Consequence Code System 2 (MACCS2) code, Version 1.12, to determine the offsite risk impacts on the surrounding environment and public. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release fractions, meteorological data, projected population distribution, emergency response evacuation modeling, and economic data.

FPL estimated the dose to the population within 80 km (50 mi) of the St. Lucie site to be approximately 0.15 person-Sv (15 person-rem) per year for Unit 1 and 0.14 person-sievert (14 person-rem) per year for Unit 2. The breakdown of the total population dose by containment release mode is summarized in Table 5-4. ISLOCAs dominate the population dose risk at St. Lucie. The ISLOCAs are followed in contribution by late containment failure.

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

Containment Release Mode	Population Dose Person-Sv (Person-Rem) Per Year	
	Unit 1	Unit 2
SGTR (steam generator tube rupture) (Late and Early)	0.009 (0.9)	0.001 (0.1)
Interfacing Systems LOCAs (loss-of-coolant accidents)	0.087 (8.7)	0.113 (11.3)
Early containment failure	~0 (~0.0)	~0 (~0.0)
Late containment failure	0.057 (5.7)	0.026 (2.6)
No containment failure	0.0 (0.0)	0.0 (0.0)
Total	0.153 (15.3)	0.14 (14.0)

5.2.2.2 Review of FPL's Risk Estimates

FPL's determination of offsite risk at St. Lucie 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 1994 IPEEE submittals (FPL 1993, 1994)

- the major modifications to the IPE model that have been incorporated in the St. Lucie PSA

- the MACCS2 analyses performed to translate fission product release frequencies from the Level 2 PSA model into offsite consequence measures.

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

The staff's review of the St. Lucie IPE is described in an NRC report dated July 21, 1997 (NRC 1997b). In that review, the staff evaluated the methodology, models, data, and assumptions used to estimate the CDF and characterize containment performance and fission product releases. The staff concluded that FPL's analysis met the intent of Generic Letter 88-20 (NRC 1988); that is, the IPE was of adequate quality to be used to look for design or operational vulnerabilities. The staff's review primarily focused on the licensee's ability to examine St. Lucie Units 1 and 2 for severe accident vulnerabilities and not specifically on the detailed findings or quantification estimates. Overall, the staff concluded that the St. Lucie IPE was of adequate quality to be used as a tool in searching for areas with high potential for risk reduction and to assess such risk reductions, especially when the risk models are used in conjunction with insights, such as those from risk importance, sensitivity, and uncertainty analyses.

A comparison of risk profiles between the original IPE, which was reviewed by the NRC staff, and the PSA used in the SAMA analysis indicates a small increase in the St. Lucie Unit 1 CDF and small decrease in the St. Lucie Unit 2 CDF. The specific changes to the St. Lucie PSA include (FPL 2001):

- Changed to a "one-top" model rather than solving individual sequences.

- Updated software to allow use of a recovery rule file that allows automatic application of recovery rules consistently to every appropriate cut set.

- Refined common-cause failure modeling by the use of a basic event for common causes only. The original model normally used an "A" train event with the common-cause factor. This practice overemphasized the importance of the "A" train components, because all common-cause failures were tied to "A" (and none to "B" train components).

- Added test and maintenance basic events for various components as further improvements to the model.

- Improved treatment of reactor coolant pump (RCP) seal failures depending on operator action or failure to act, according to the latest Combustion Engineering Owners Group (CEOG) information.

- Updated LOCA and Main Steam Line Break initiating event frequencies per the latest CEOG methodologies.

- Updated the Unit 2 ISLOCA analysis to reflect a Unit 2 design change. This change increased the calculated probability of ISLOCA while reducing the probability of pressure locking of the shutdown cooling isolation valves (which would prevent the use of shutdown cooling).

The changes from the IPE version to the current April 2001 version appear to be reasonable and have a relatively small effect on PSA results.

In an RAI, the staff questioned whether the current St. Lucie PSA has been subjected to peer review (NRC 2002a). In response to the RAI, FPL noted that the PSA conforms to the FPL Quality Assurance Program procedures and the FPL Reliability and Risk Assessment Group standards. Further, the Level 1 model was compared to the CEOG plants via the CEOG PSA subcommittee cross comparison project (FPL 2002a). While these activities do not constitute a thorough external peer review, they do enhance the quality of a PSA.

The IPE and updated CDF values for the two FPL units are lower than most of the original IPE values estimated for other pressurized water reactors (PWRs) with a large dry containment. Figure 11.6 of NUREG-1560 shows that the IPE-based total internal events CDF for Combustion Engineering plants ranges from 1×10^{-5} to 3×10^{-4}/ry (NRC 1997a). While it is recognized that other plants have reduced the values for CDF subsequent to the IPE submittals, due to modeling and hardware changes, the CDF results for St. Lucie confirm that the overall risks from these units are lower than or comparable to other plants of similar vintage and characteristics.

FPL submitted an IPEEE by letter dated December 15, 1994 (FPL 1994), in response to Supplement 4 of Generic Letter 88-20 (NRC 1999). FPL did not identify any fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events related to seismic, fire, or other external events. The St. Lucie hurricane, tornado, and high winds analyses show that the plant is adequately designed or procedures exist to cope against the effects of these natural events. Additionally, the St. Lucie IPEEE demonstrated that transportation and nearby facility accidents were not considered to be significant vulnerabilities at the plant. However, a number of areas were identified for improvement in both the seismic and fire areas. In a letter dated January 25, 1999 (NRC 1999), the staff concluded that the submittal

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

The ER (FPL 2001) acknowledges that the methods used for the St. Lucie IPEEE do not provide the means to determine the numerical estimates of the CDF contributions from seismic initiators (i.e., the seismic IPEEE uses a reduced scope margins method emphasizing plant walkdown) and fire initiators (i.e., the fire IPEEE uses the Fire Vulnerability Evaluation method). However, the risk associated with external events at St. Lucie is very low. The IPEEE fire CDF estimates are considered by FPL to be extremely conservative and overestimate the fire risk for screening purposes (FPL 2001). FPL states in the ER that recent preparatory work in support of OL amendments to extend the allowed outage time (AOT) for emergency diesel generators (EDGs) has refined and revised the fire risk estimates for the cable spreading rooms and the control rooms, and the current estimates are now about two orders of magnitude lower than reported in the original St. Lucie IPEEE (FPL 1994). Furthermore, as part of the OL amendment, FPL committed to perform several actions that would ensure low risk due to external and internal fire events for each unit if an EDG is to be removed from service for maintenance for an extended AOT (i.e., more than 72 hours) during Modes 1, 2, and 3. In addition, the submittal states that improvements continue to be made in St. Lucie Units 1 and 2 fire protection features as a result of ongoing (10 CFR Part 50) Appendix R evaluations. Accordingly, the staff finds that the FPL fire assessment is adequate for the purpose of the SAMA review and that the fire vulnerabilities at St. Lucie are not major contributors to plant risk.

Because of the small expected contribution of external events to the overall risk profile for St. Lucie, the risk reduction estimates for the SAMAs were evaluated based on consideration of the internal events risk profile. However, in the SAMA screening process described in Section 5.2.3.1, FPL screened out SAMAs from further consideration only if their implementation cost would be much greater than twice the estimated benefit (based on internal events). This provides a factor of two margin in the analysis. The contribution of external events to total risk would be bounded by this factor of two if (1) the total contribution from external events is a small fraction of the contribution from internal events, and (2) there are no external event vulnerabilities that can be eliminated or mitigated by cost-effective SAMAs. FPL presents an adequate case that the external risk contribution is relatively small. FPL also states that a search for SAMAs yielded no SAMA that would provide redundancy to plant safe shutdown capabilities in order to reduce the external event contribution. Accordingly, the staff concludes that FPL's consideration of external events within the SAMA analysis is acceptable.

The staff reviewed the process used by FPL to extend the containment performance (Level 2) portion of the PSA to an assessment of offsite consequences (essentially a Level 3 PSA). This included consideration of the source terms used to characterize fission product releases for each containment release category and the major input assumptions used in the offsite consequence analyses. The MACCS2 code was used to estimate offsite consequences.

Plant-specific input to the code includes the St. Lucie reactor core radionuclide inventory, emergency evacuation modeling, release category source terms from the St. Lucie IPE, site-specific meteorological data, and projected population distribution within a 80-km (50-mi) radius for the year 2025. This information is provided in Appendix E.2 of the ER (FPL 2001).

The applicant used source term release fractions for 48 different release modes defined for the St. Lucie site. Forty-five of the release modes were previously identified in the St. Lucie IPE. Three additional containment bypass release modes were added: two SGTR cases and one ISLOCA case. The staff reviewed FPL's source term estimates for the major release categories and, with the exception of SGTR noted below, found the release fractions to be consistent with those of like plants and of expected magnitudes when considering early versus late containment failures and rupture versus leak-type failures. The staff questioned FPL regarding the release fractions for SGTR events, which were relatively low and did not include tellurium releases (NRC 2002a). FPL indicated that large amounts of radionuclides (including all tellurium) are retained in the intact containment after vessel failure, thus mitigating release to the environment (FPL 2002a). The staff finds this explanation to be reasonable, and further notes that since the SGTR contribution to CDF is relatively low for St. Lucie (3 percent for Unit 1 and 1 percent for Unit 2), higher release fractions for the SGTR sequences than those estimated by FPL would not have a significant impact on the plant risk. The staff concludes that the assignment of source terms is acceptable for use in the SAMA analysis.

The applicant used site-specific meteorological data processed from hourly measurements for the 1999 calendar year as input to the MACCS2 code. Supplementary information derived from meteorological data obtained from the National Climatic Data Center of the National Oceanographic and Atmospheric Administration (NOAA) for Vero Beach Airport was used where data were missing in the source file. A sensitivity analysis was performed using meteorological data from 1998. The impact on population dose was a 10 percent decrease. Therefore, the staff considers use of the 1999 data in the base case to be conservative.

The population distribution the applicant used as input to the MACCS2 analysis was initially prepared using the computer program SECPOP90 (NRC 1997c). The output from SECPOP90 is a file based on a reference database for the specified site. The applicant extrapolated population projections from the years 1990 and 2015 to year 2025 using the U.S. Census Bureau (USCB) data. The MACCS2 calculations were based on the population in year 2025 because 2025 was the latest data produced by the USCB and because 2025 is the midterm year for the Unit 1 license renewal period. It is noted that the midterm year for the license renewal period for Unit 2 would be 2033. If a year later than 2025 were used, it is expected that the population dose would increase proportionately with the projected increase in population. Based on information provided in Section 2.5 of the ER, the population in two areas surrounding the plant is expected to increase at an average rate of 1.5 percent per year. If the

year 2033 was chosen for the population projection, an increase in the population (over the base case year 2025 population dose) of approximately 13 percent would be expected. The applicant, in Section E.2.4.2 of the ER (FPL 2001), presents sensitivity analyses that show a 2.5 percent and 10 percent increase in population results in approximately a 3 percent and 11 percent increase in the population dose. Thus, the population dose estimates for Unit 2 would be approximately 15 percent higher if the dose estimates were based on the population in 2033 rather than 2025. FPL pointed out that other conservative aspects of the analysis more than compensate for this apparent non-conservatism (NRC 2002b). The staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending out 16 km (10 mi) from the plant. It was assumed that 100 percent of the population would move at an average speed of approximately 1.8 m/s (6 ft/s) with a delayed start time of 7,200 seconds with no sheltering. The results of a sensitivity analysis presented in Section E.2.4.2 of the ER (FPL 2001) show that if only 95 percent of the people within the evacuation zone would participate in the evacuation, there would be only about a 1 percent increase in population dose. This assumption is conservative relative to the NUREG-1150 study (NRC 1990), which assumed evacuation of 99.5 percent of the population within the emergency planning zone. Additionally, a sensitivity analysis was performed in which the evacuation speed was reduced to approximately 0.3 m/s (1 ft/s). This resulted in an increase in population dose of about 2 percent. Accordingly, the evacuation assumptions and analysis are deemed reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data were provided by SECPOP90 (NRC 1997c) and used in the MACCS2 analyses. SECPOP90 contains a database extracted from USCB CD-ROMs (1990 census data), the 1992 Census of Agriculture CD-ROM Series 1B, the 1994 U.S. Census County and City Data Book CD-ROM, the 1993 and 1994 Statistical Abstract of the United States, and other minor sources. These regional economic values were updated to 1999 for nine Florida counties within 80 km (50 mi) of the plant. The staff questioned whether FPL made any adjustments to the analysis to account for higher economic areas in the vicinity of the plant such as resorts (NRC 2002a). In response, FPL stated that the site file prepared for St. Lucie contained updated values (from 1999) for each county including contributions from resort areas (FPL 2002a).

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

5.2.3 Potential Design Improvements

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

5.2.3.1 Process for Identifying Potential Design Improvements

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

- review of plant-specific improvements identified in the St. Lucie Units 1 and 2 IPE and IPEEE
- 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 (NRC 1997a), and review of the top 100 cut sets of the updated Level 1 PSA.

Based on this process, an initial list of 169 candidate SAMAs was identified, as reported in Table E.3-1 in Appendix E to the ER (FPL 2001).

FPL performed a qualitative screening of the initial list of SAMAs. SAMAs were eliminated from further consideration at St. Lucie if the SAMA enhancement was for a boiling water reactor, the Westinghouse AP600 design, an ice condenser containment, or for a plant-specific application not applicable to St. Lucie. SAMAs were also eliminated from further consideration if the SAMA had already been implemented at St. Lucie or the plant design meets the intent of the SAMA.

Based on the qualitative screening, 119 SAMAs were eliminated leaving 50 for further evaluation. Of the 119 SAMAs, 29 were eliminated because they were not applicable to St. Lucie, and 90 were eliminated because they already had been implemented at St. Lucie (or the design met the intent of the SAMA). The 50 remaining SAMAs are listed in Table 4.15-2 of the ER (FPL 2001) and were subjected to a final screening and evaluation process.

The final screening process was conducted in two steps: (1) identifying and eliminating those SAMAs whose cost exceeded the maximum attainable benefit (MAB) approximated at $1,382,000, and (2) performing a benefits analysis on the remaining SAMAs. Of the 50 SAMAs, 29 were screened from further evaluation because the SAMA was estimated to have a

single unit cost of implementation that exceeded the MAB of $1,382,000. Each of the 21 remaining SAMAs was further evaluated and subsequently eliminated, as described in Sections 5.2.4 and 5.2.6 below.

5.2.3.2 Staff Evaluation

FPL's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF contributors or issues that tend to have a large impact on a number of accident sequences at St. Lucie Units 1 and 2.

The preliminary review of FPL's SAMA identification process raised some concerns regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific risk contributors. The staff also requested specific information about several of the final SAMA candidates. The staff requested clarification regarding the portion of risk represented by the top 100 cut sets and whether an importance analysis was used to confirm the adequacy of the SAMA identification process. A review of the importance ranking of basic events in the PSA has the potential to identify SAMAs that may not be apparent from a review of the top cut sets. In response to the RAI, FPL stated that the top 100 cut sets examined account for about 55 percent of the CDF for Unit 1 and about 68 percent of the CDF for Unit 2 (FPL 2002a). In a follow-up teleconference, FPL clarified that although it did not specifically use the importance measures (risk reduction worth [RRW]) to identify potential SAMAs, it performed a supplementary review of the importance measures, which did not reveal any new SAMAs. FPL indicated that the risk significant basic events are contained in the top 100 cut sets, particularly SGTR and ISLOCA.

The staff questioned FPL about considering lower cost alternatives to a couple of the SAMAs evaluated (NRC 2002a). In response to the RAI, FPL stated that either the design and modification costs for "lower cost alternatives" were prohibitive or the reduction in risk was insufficient to warrant the implementation (FPL 2002a). The staff also questioned FPL about six SAMAs that were proposed at another Combustion Engineering plant and whether those SAMAs might be applicable to St. Lucie (NRC 2002a). In response to the RAI, FPL noted that four of the six planned SAMAs were related to SBO or LOOP. These SAMAs would provide less risk reduction benefit for St. Lucie because St. Lucie is equipped with four EDGs and has cross-tie capability. As for the other two planned SAMAs, one is already addressed by the St. Lucie emergency operating procedures network, and the other involving an improvement to refueling water tank level indication is not applicable because the recirculation actuation system at St. Lucie does not depend on instrument air.

The staff notes that the set of SAMAs submitted is not all-inclusive, since additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of

the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that FPL used a systematic and comprehensive process for identifying potential plant improvements for St. Lucie Units 1 and 2. While explicit treatment of external events in the SAMA identification process was limited, it is recognized 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 Design Improvements

FPL evaluated the risk-reduction potential of the 21 remaining SAMA candidates that were applicable to St. Lucie. Each SAMA evaluation was performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit and are conservative. FPL used two types of evaluations to determine the benefit of the SAMAs: model re-quantification and importance measure analysis. Some of the SAMAs were evaluated by making simple bounding changes to one or more system models and re-quantifying the full model. Some of the SAMAs were more quickly evaluated by examining importance measures such as RRW. In such cases, it was assumed that the benefit is approximately proportional to the reduction in CDF.

For many of the SAMAs, the CDF reduction was estimated from a model (referred to as PDS TOP), which used a single top event that included all plant damage states (PDSs) and containment bypass sequences. This resulted in a manageable number of cut sets and accounted for about 95 percent of the total baseline CDF for Unit 1 and about 99 percent of the total baseline CDF for Unit 2. For specific cases such as SGTR and ISLOCA, full-risk model cases were used.

Seven SAMA evaluation scenarios were developed to accomplish this effort (Cases 1 through 4 plus three cases addressing elimination of ISLOCA, SGTR, and high-pressure safety injection failures). Each of the 21 SAMAs were binned into one of the seven scenarios. (Note that although Case 2 was defined and quantified, all of the SAMAs applicable to this case were screened out prior to the final evaluation. Thus, none of the 21 SAMAs were assigned to this case). Table 5-5 lists the evaluation scenario performed to estimate the risk reduction for each of the 21 SAMAs, the estimated risk reduction in terms of percent-reduction in CDF and person dose, and the estimated total benefit (present value) of the averted risk. The determination of the benefits for the various SAMAs is discussed in Section 5.2.6.

In response to an RAI, FPL considered the uncertainties associated with the calculated CDF, and it was found that if the 95th percentile value of the CDF were to be used in the cost-benefit

Table 5-5. SAMA Cost-Benefit Screening Analysis

Evaluation Scenario and Applicable SAMAs	Assumptions	% Risk Reduction (Unit 1/Unit2) CDF	% Risk Reduction (Unit 1/Unit2) Population Dose	Total Benefit in $ (Unit 1/Unit2)	Cost (2001 dollars)
Case 1 48-Install a passive containment spray system (CSS)	The containment spray system will be perfectly reliable, thus eliminating those PDSs representing loss of sprays. The logic for CSS injection and recirculation is removed from the fault tree.	0.2 / 0.2	22 / 13	200,400 / 112,200	$20M
Case 2 None	The reactor coolant pump (RCP) seal LOCA does not occur, and the operator does not fail to secure the RCPs. A few logic changes are imposed on the baseline model.	14 / 19	6 / 8	129,700 / 145,700	
Case 3 123-Upgrade chemical and volume control system (CVCS) to mitigate small-small loss-of-coolant accident (LOCA)	Small-small LOCA does not occur. A few logic changes are imposed on the baseline model.	23 / 27	11 / 12	225,300 / 216,600	>>2 x Benefit
Case 4 8-Eliminate RCP thermal barrier dependence on component cooling water (CCW) such that a loss of CCW does not result directly in core damage	The RCP seal LOCA does not occur. A few logic changes are imposed on the baseline model.	5 / 6	2 / 3	44,300 / 50,100	8 - >>2 x Benefit
10-Create an independent RCP seal injection system, with dedicated diesel					10 - >>2 x Benefit
11-Create an independent RCP seal injection system without dedicated diesel					11 - >>2 x Benefit
12-Use existing hydro test pump for RCP seal injection					12 - >>2 x Benefit
16-Prevent charging pump flow diversion from the relief valves					16 - >>2 x Benefit

Table 5-5. (cont'd)

Evaluation Scenario and Applicable SAMAs	Assumptions	% Risk Reduction (Unit 1/Unit 2) CDF	Population Dose	Total Benefit in $ (Unit 1/Unit2)	Cost (2001 dollars)
No ISLOCA	ISLOCA will be eliminated. PDSs that represent ISLOCA are set to zero to represent the impact of eliminating the event	10 / 23	26 / 55	251,500 / 487,400	
89-Install additional instrumentation for interfacing systems LOCA (ISLOCA) sequences					89 - $2.3M
90-Increase frequency of valve leak testing					90 - >>2 x Benefit
95-Ensure all ISLOCA releases are scrubbed					95 - >>2 x Benefit
96-Add redundant and diverse limit switch to each containment isolation valve					96 - >>2 x Benefit
159-Provide auxiliary building (AB) vent/seal structure					159 - >>2 x Benefit
160-Add charcoal filters on the AB exhaust					160 - >>2 x Benefit
No SGTR	All SGTRs will be eliminated. PDSs that represent SGTR (i.e., SGTR1 and SGTR2) are set to zero.	4 / 1	14 / 2	111,300 / 12,600	
80-Improve instrumentation to detect SGTR, or add systems to scrub fission product releases					80 - $9.5M
81-Add other SGTR coping features					81 - >>2 x Benefit
82-Increase secondary-side pressure capacity such that an SGTR would not cause the relief valves to lift					82 - >>2 x Benefit
83-Replace steam generators (SGs) with new design					83 - $100M
85-Establish a maintenance practice that inspects 100% of the tubes in an SG					85 - $500K - $750K per inspection
HPSI	Eliminate HPSI failures	18 / 20	18 / 20	249,100 / 242,400	
13-Replace emergency core cooling system pump motors with air-cooled motors					13 - >>2 x Benefit
117-Provide an additional high-pressure safety injection (HPSI) pump with independent diesel					117 - >>2 x Benefit
118-Install an independent alternating current (AC) HPSI system					118 - >>2 x Benefit

analysis, instead of the best-estimate CDF value, the benefits would be about a factor of 2 greater.

The staff has reviewed FPL'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 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 FPL's risk-reduction estimates.

5.2.5 Cost Impacts of Candidate Design Improvements

FPL estimated the costs of implementing the 50 SAMAs, which were not initially screened out, through the application of engineering judgment, estimates from other licensees' submittals, and site-specific cost estimates. The cost estimates conservatively did not include the cost of replacement power during extended outages required to implement the modifications, nor did they include contingency costs associated with unforeseen implementation obstacles. Estimates based on modifications implemented or estimated in the past were presented in terms of dollar values at the time of implementation and were not adjusted to present-day dollars. The depth of analysis performed varied depending on the magnitude of the expected benefit. For most of the SAMAs considered, the cost estimates were sufficiently greater than the benefits calculated such that no detailed evaluation was required. Detailed cost estimating was only applied in those situations in which the benefit is significant and application of judgment would be questioned. The minimum cost of making a procedural change (including training) was estimated at $30,000. The minimum hardware modification package was assumed to be $70,000.

The staff reviewed the bases for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates (presented in Table 4.15-2 of 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 screened from further consideration on the basis that the expected implementation cost would be much greater than twice the estimated risk-reduction benefit. This is reasonable for the SAMAs considered given the relatively small estimated benefit for the SAMAs (a maximum benefit of about $250,000), and the large implementation costs typically associated with major hardware changes and hardware changes that impact safety-related systems. In previous SAMA evaluations the implementation costs for such hardware changes were generally estimated to be $1 million or more. Where specific cost estimates were provided in the ER (FPL 2001), these were typically obtained from previous licensees' ERs or from other industry submittals, most of which have been previously reviewed by the NRC. Accordingly, the cost estimates were found to be consistent with previous estimates. The staff concludes that the cost estimates are sufficient and appropriate for use in the SAMA evaluation.

5.2.6 Cost-Benefit Comparison

FPL's cost-benefit analysis and the staff's review are described in the following sections.

- **FPL Evaluation**

The methodology used by FPL was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997d). The guidance involves determining the net value for each SAMA according to the following formula:

Net Value = (APE + AOC + AOE + AOSC) - COE

where,

APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted onsite costs ($)
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. FPL's derivation of each of the associated costs is summarized below.

Averted Public Exposure (APE) Costs

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/ry)
x monetary equivalent of unit dose ($2,000 per person-rem)
x present value conversion factor (10.76 based on a 20-year period with a 7-percent
discount rate).

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

potential future losses to present value. For the purposes of initial screening, FPL calculated an APE of approximately $330,000 for the 20-year license renewal period, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

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

For the purposes of initial screening, which assumes all severe accidents are eliminated, FPL calculated an annual offsite economic risk of $42,542 based on the Level 3 risk analysis. This results in a discounted value of approximately $458,000 for the 20-year license renewal period.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

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

FPL derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997d). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $2,000 per person-rem, a real discount rate of 7 percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents are eliminated, FPL calculated an AOE of approximately $11,400 for the 20-year license renewal period.

Averted Onsite Costs (AOSC)

Averted onsite costs (AOSC) include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. FPL derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997d).

FPL divided this cost element into two parts – the onsite cleanup and decontamination costs, also commonly referred to as averted cleanup and decontamination costs, and the replacement power cost.

Averted cleanup and decontamination costs (ACCs) were calculated using the following formula:

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

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $1.5 billion (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents are eliminated, FPL calculated an ACC of approximately $347,000 for the 20-year license renewal period.

Long-term replacement power costs (RPCs) were calculated using the following formula:

RPC = Annual CDF reduction
x present value of replacement power for a single event
x factor to account for remaining service years for which replacement power is required
x reactor power scaling factor.

For conservatism, FPL based its calculations on the 910-MWe reference plant in NUREG/BR-0184, and did not scale down for the 800-MWe output of St. Lucie. For the purposes of initial screening, which assumes all severe accidents are eliminated, FPL calculated an RPC of approximately $236,000 for the 20-year license renewal period.

Using the above equations, FPL estimated the total present dollar value equivalent associated with completely eliminating severe accidents at St. Lucie to be about $1,382,000 for each unit.

FPL's Results

If the single unit implementation costs were greater than the MAB of $1.38 million, then the SAMA was screened from further consideration. Twenty-nine SAMAs were screened from further consideration in this way. A more refined look at the costs and benefits was performed for the remaining 21 SAMAs. If the expected cost for one of the 21 SAMAs exceeded twice the calculated benefit, the SAMA was considered not to be cost-beneficial. The cost-benefit results

for the individual analysis of the 21 SAMA candidates are presented in Table 5-5. As a result, all 50 SAMAs that were evaluated were eliminated because the cost was expected to exceed the estimated benefit.

FPL performed sensitivity analyses to evaluate the impact of parameter choices on the analysis results (FPL 2001, 2002a). The sensitivity analyses included the calculation of candidate SAMA benefits using a 3-percent discount rate as recommended in NUREG/BR-0184 (NRC 1997d). This sensitivity case resulted in less than a factor of 1.4 increase in the benefit calculation. Thus, the FPL conclusion that none of the candidate SAMAs would be cost-beneficial remains unchanged.

- **Staff Evaluation**

The cost-benefit analysis performed by FPL was based primarily on NUREG/BR-0184 (NRC 1997d) and was executed appropriately.

In response to an RAI, FPL considered the uncertainties associated with the calculated CDF (see Table 5-6 below). The uncertainty values provided are for "parameter value" uncertainties. The calculated CDF used for the uncertainty analysis is based on the PDS TOP model whereby approximately 95 percent (99 percent for Unit 2) of the baseline CDF is captured. The best-estimate CDFs calculated using the PDS TOP model are 2.86×10^{-5}/ry and 2.43×10^{-5}/ry for Units 1 and 2, respectively. If the 95th percentile values of the CDF were used in the cost-benefit analysis instead of the best-estimate CDF values cited above, the estimated benefits of the SAMAs would increase by about a factor of two. However, a more detailed examination by FPL found that the initial conclusion (that none of the candidate SAMAs evaluated would be cost-beneficial for St. Lucie) would still be valid (FPL 2002a).

Table 5-6. Uncertainty in the Calculated CDF for St. Lucie Units 1 and 2

	CDF (per reactor-year)	
Percentile	**Unit 1**	**Unit 2**
5th	8.21×10^{-6}	9.64×10^{-6}
50th	1.52×10^{-5}	1.73×10^{-5}
95th	6.15×10^{-5}	6.11×10^{-5}

In addition, FPL performed sensitivity analyses to address assumptions made in other parts of the cost-benefit analysis, including variations in discount rate, weather, percent of population evacuating, evacuation speed, population, and source terms. None of these parametric variations were found to have a significant impact on results.

The staff concludes that the costs of the 50 candidate SAMAs assessed would be higher than the associated benefits. This conclusion is upheld despite a number of uncertainties and non-quantifiable factors in the calculations summarized as follows:

- Uncertainty in the internal events CDF was not explicitly included in the calculations, which employed best-estimate values to determine the benefits. The 95-percent confidence level for internal events CDF is approximately 2 times the best-estimate CDF. However, the results of the cost-benefit analysis show that all of the SAMAs evaluated would cost much more than twice the associated benefit. Therefore, consideration of CDF uncertainty is not expected to alter the conclusions of the analysis.

- External events were similarly not included in the St. Lucie risk profile. However, given that the expected external events contribution to CDF is small, and the observation that there are no particular vulnerabilities in the external event risk profile at St. Lucie, any additional benefits that might accrue due to external events would fall within the factor of 2 margin used in the screening analysis.

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

- A number of sensitivity calculations were performed with respect to the discount rate (as low as 3 percent) and various MACCS2 parameters, including evacuation percentage and speed, meteorological data, population distribution, and source terms. The results of these calculations showed that none of the risk benefits were increased by more than a factor of 1.2. Since this is less than the margin between cost and benefit for the SAMAs considered, the uncertainties in these parameters would not alter the conclusions.

5.2.7 Conclusions

FPL compiled a list of 169 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 FPL IPE, IPEEE, and current PSA model. A qualitative screening removed SAMA candidates that (1) did not apply to St. Lucie Units 1 and 2 due to design differences, or (2) the SAMA had already been implemented at St. Lucie (or the design meets the intent of the SAMA, as determined by plant review of each SAMA). A total of 119 SAMA candidates were eliminated based on the above criteria, leaving 50 SAMA candidates for further evaluation.

Using guidance in NUREG/BR-0184 (NRC 1997d), the current PSA model, and a Level 3 analysis developed specifically for SAMA evaluation, a maximum attainable benefit of about $1,382,000 was calculated, representing the total present dollar value equivalent associated with completely eliminating severe accidents at St. Lucie. Twenty-nine of the 50 SAMAs were screened from further evaluation because their single unit implementation costs were greater than this maximum attainable benefit. Each of the remaining 21 SAMAs was eliminated because their implementation cost exceeded twice the estimated benefit for that specific SAMA. The factor of two was used to account for uncertainties in the analysis and the potential impact of external events on the results of the SAMA evaluations. The end result was that no SAMA candidates were found to be cost-beneficial.

The staff reviewed the FPL analysis and has preliminarily 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 inherently small baseline risks support the general conclusion that the SAMA evaluations performed by FPL are reasonable and sufficient for the license renewal submittal. The unavailability of a seismic and fire PSA model precluded a quantitative evaluation of the SAMAs specifically aimed at reducing risk of these initiators; however, significant improvements have been realized as a result of the IPEEE process at St. Lucie that would minimize the likelihood of identifying cost-beneficial enhancements in this area.

Based on its review of the FPL SAMA analyses, the staff concurs 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 St. Lucie PSA and the fact that St. Lucie has already implemented many plant improvements identified from the IPE and IPEEE process.

5.3 References

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

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

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

10 CFR 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, “Reactor Site Criteria.”

Florida Power and Light Company (FPL). 1993. Letter from D. A. Sager (FPL) to Document Control Desk (NRC). Subject: Generic Letter 88-20, St. Lucie Units 1 and 2, Summary Report of Individual Plant Examination for Severe Accident Vulnerabilities, December 9, 1993.

Florida Power and Light Company (FPL). 1994. Letter from D. A. Sager (FPL) to Document Control Desk (NRC). Subject: Generic Letter 88-20, St. Lucie Units 1 and 2, Supplement 4, Individual Plant Examination of External Events for Severe Accident Vulnerabilities Report, December 15, 1994.

Florida Power and Light Company (FPL). 2001. *Applicant's Environmental Report–Operating License Renewal Stage, St. Lucie Units 1 and 2*. Docket Nos. 50-335 and 50-389, Miami, Florida.

Florida Power and Light Company (FPL). 2002a. Letter from D. E. Jernigan (FPL) to Document Control Desk (NRC). Subject: Response to Request for Additional Information Related to the Staff's Review of Severe Accident Mitigation Alternatives for St. Lucie Units 1 and 2, June 25, 2002.

Florida Power and Light Company (FPL). 2002b. Letter from D. E. Jernigan (FPL) to Document Control Desk (NRC). Subject: Supplemental Response to NRC Request for Additional Information Related to the Staff's Review of Severe Accident Mitigation Alternatives for St. Lucie Units 1 and 2. August 26, 2002. ML022410053.

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U.S. Nuclear Regulatory Commission (NRC). 1997a. *Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance*. NUREG-1560, Washington, D.C.

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U.S. Nuclear Regulatory Commission (NRC). 1997c. *SECPOP90: Sector Population, Land Fraction, and Economic Estimation Program*. NUREG/CR-6525, Washington, D.C.

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

U.S. Nuclear Regulatory Commission (NRC). 1988. Subject: Generic Letter 88-20, Individual Plant Examination for Severe Accident Vulnerabilities, November 23, 1988.

U.S. Nuclear Regulatory Commission (NRC). 1999. Letter from W. C. Gleaves (NRC) to T. F. Plunkett (Florida Power and Light Company). Subject: Generic Letter 88-20, Supplement 4, Individual Plant Examination for External Events for Severe Accident Vulnerabilities - St. Lucie Plant, Unit Nos. 1 and 2, January 25, 1999.

U.S. Nuclear Regulatory Commission (NRC). 2002a. Letter from M. T. Masnik (NRC) to J. A. Stall (FPL). Subject: Request for Additional Information Related to the Staff's Review of Severe Accident Mitigation Alternatives for St. Lucie Units 1 and 2, May 7, 2002.

U.S. Nuclear Regulatory Commission (NRC). 2002b. Memo to file from M. T. Masnik (NRC). Subject: Telecommunication with Florida Power and Light Company to Discuss Information Provided to the NRC Staff in FPL Response to NRC Request for Additional Information dated June 25, 2002, July 29, 2002.

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 characteristic.

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

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

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

Category 2 issues are those that do not meet one or more of the criteria 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 CFR Part 51, Subpart A, Appendix B, and are applicable to St. Lucie Units 1 and 2. The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power

(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.

Reactor." The staff also addresses the impacts from radon-222 and technetium-99 in the GEIS. 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 St. Lucie Units 1 and 2 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 high level waste [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)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2; 6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6;6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

Florida Power and Light Company (FPL) stated in its Environmental Report (ER; FPL 2001) that it is not aware of any new and significant information associated with the renewal of the St. Lucie Units 1 and 2 operating licenses. The staff has not identified any significant new information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping

process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For 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 of 10 CFR 51, for each of these issues follows:

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

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

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

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

> For the high level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of 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 Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 [DOE 1980]. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a 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, EPA's generic repository standards in 40 CFR part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1,000 premature cancer deaths world-wide 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 issued in 1996, the U.S. Environmental Protection Agency (EPA) has published radiation protection standards for Yucca Mountain, Nevada, at 40 CFR Part 197, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada," on June 13, 2001 (66 FR 32132). The Energy Policy Act of 1992 (42 USC 10101 et seq.) directs that the NRC adopt these standards into its regulations for reviewing and licensing the repository. The NRC published its regulations at 10 CFR Part 63, on November 2, 2001 (66 FR 55792). These standards include the following: (1) a 0.15-mSv/yr (15-mrem/yr) dose limit for members of the public during the storage period prior to repository closure, (2) a 0.15-mSv/yr (15-mrem/yr) dose limit for the reasonably maximally exposed individual for 10,000 years following disposal, (3) a 0.15-mSv/yr (15-mrem/yr) dose limit for the reasonably maximally exposed individual as a result of a human intrusion at or before 10,000 years after disposal, and (4) a groundwater protection standard that states for 10,000 years of undisturbed performance after disposal, radioactivity in a representative volume of groundwater will not exceed (a) 0.19 Bq/L (5 pCi/L) (radium-226 and radium-228), (b) 0.56 Bq/L (15 pCi/L) (gross alpha activity), and (c) 0.04 mSv/yr (4 mrem/yr) to the whole body or any organ (from combined beta and photon-emitting radionuclides).

On February 15, 2002, subsequent to receipt of a recommendation by Secretary Abraham, 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 high-level nuclear waste. This change in regulatory status does not cause the staff to change its position with respect to the impact of spent fuel and HLW disposal. The staff still considers the Category 1 classification in the GEIS appropriate.

The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts 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 during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological

impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  > The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

  > The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of

mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Onsite spent fuel. Based on information in the GEIS, the Commission found that

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

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

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

  > No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

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

  > The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4—Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.

St. Lucie Units 1 and 2 meet the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

6.2 References

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

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

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

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

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

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

Florida Power and Light Company (FPL). 2001. *Applicant's Environmental Report – Operating License Renewal Stage St. Lucie Units 1 and 2*. Docket Nos. 50-335 and 50-389, Miami, Florida.

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

National Environmental Policy Act of 1969 (NEPA). 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.

7.0 Environmental Impacts of Decommissioning

Environmental issues associated with decommissioning that 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 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. There are no Category 2 issues related to decommissioning.

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to St. Lucie Units 1 and 2 decommissioning following the renewal term are listed in Table 7-1. Florida Power and Light Company (FPL) stated in its Environmental Report (ER; FPL 2001) that it is aware of no new and significant information regarding the environmental impacts of St. Lucie Units 1 and 2 license renewal. The staff has not identified any significant new information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of

(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.

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

Table 7-1. Category 1 Issues Applicable to the Decommissioning of St. Lucie Units 1 and 2 Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation Doses	7.3.1; 7.4
Waste Management	7.3.2; 7.4
Air Quality	7.3.3; 7.4
Water Quality	7.3.4; 7.4
Ecological Resources	7.3.5; 7.4
Socioeconomic Impacts	7.3.7; 7.4

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

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

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no radiation doses associated with decommissioning following license renewal beyond those discussed in the GEIS.

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

  > Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of

other available information. Therefore, the staff concludes that there are no impacts of solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

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

  > Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of license renewal on air quality during decommissioning beyond those discussed in the GEIS.

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

  > The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of the license renewal term on water quality during decommissioning beyond those discussed in the GEIS.

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

  > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of the license renewal term on ecological resources during decommissioning beyond those discussed in the GEIS.

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

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

  The staff has not identified any new and significant information during its independent review of the ER (FPL 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of license renewal on the socioeconomic impacts of decommissioning beyond those discussed in the GEIS.

7.1 References

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

Florida Power and Light Company (FPL). 2001. *Applicant's Environmental Report – Operating License Renewal Stage, St. Lucie Units 1 and 2*. Docket Nos. 50-335 and 50-389, Miami, Florida.

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 to Operating License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of the operating licenses (OLs) (i.e., the no-action alternative); the potential environmental impacts from electric generating sources other than St. Lucie Units 1 and 2; the possibility of purchasing electric power from other sources to replace power generated by St. Lucie and the associated environmental impacts; the potential environmental impacts from a combination of generating and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by St. Lucie Units 1 and 2. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

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

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

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

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 (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (10 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative

(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.

refers to a scenario in which the NRC would not renew the OLs for St. Lucie Units 1 and 2, and Florida Power and Light Company (FPL) would then decommission St. Lucie Units 1 and 2 when plant operations cease.

FPL will be required to comply with NRC decommissioning requirements whether or not the OLs are renewed. If the St. Lucie Units 1 and 2 OLs are renewed, decommissioning activities will not be avoided but may be postponed for up to an additional 20-year period. If the OLs are not renewed, FPL 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 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 associated with the no-action alternative are summarized in Table 8-1. Implementation of the no-action alternative would also have certain positive impacts in that adverse environmental impacts associated with current operation of St. Lucie Units 1 and 2; for example, 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 St. Lucie Units 1 and 2 OLs 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 St. Lucie Units 1 and 2, or (4) some combination of these options. This replacement power would produce additional environmental impacts as discussed in Section 8.2.

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.
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 (LLW) waste will be disposed of in licensed facilities. A permanent disposal facility for high-level waste (HLW) is not currently available.
Human Health	SMALL	Radiological doses to workers 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	Decrease in employment in St. Lucie and surrounding counties and tax revenues in St. Lucie County.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Impacts primarily confined to land used during plant operations. No impact to undisturbed land expected. Land occupied by Units 1 and 2 would likely be retained by FPL for other corporate purposes.
Environmental Justice	SMALL	Some loss of employment opportunities and social programs is expected.

8.1.1 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 St. Lucie site would likely be retained by FPL for other corporate purposes. Eventual sale or transfer of the site, however, could result in changes to land use. Notwithstanding this possibility, the impacts of the no-action alternative on land use are considered SMALL.

8.1.2 Ecology

At the St. Lucie site, impacts on aquatic ecology could result from removal of in-water pipes and structures or the filling of the intake and discharge canals. 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 result in relatively short-term impacts that can be mitigated using best management practices. The land is expected to recover naturally. Overall, the ecological impacts associated with the no-action alternative are considered SMALL.

8.1.3 Water Use and Quality

Cessation of plant operations would result in a significant 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 the no-action alternative are considered SMALL.

8.1.4 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 the no-action alternative are considered SMALL.

8.1.5 Waste

Decommissioning activities would result in the generation of radioactive and nonradioactive waste. The volume of low-level radioactive waste (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 (HLW) 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 the no-action alternative are considered SMALL.

8.1.6 Human Health

Radiological doses to occupational workers during decommissioning activities are estimated to average approximately 5 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 the no-action alternative activities are considered SMALL.

8.1.7 Socioeconomics

If St. Lucie Units 1 and 2 ceased operation, 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. The 929 employees (see Table 2-5) working at St. Lucie Units 1 and 2 reside in a number of Florida counties including St. Lucie, Martin, Indian River, and Palm Beach (FPL 2001). Tax-related impacts would occur in St. Lucie County. In 2000, FPL paid property taxes for the St. Lucie plant to St. Lucie County in the amount of $18,888,240 (Table 2-11). This payment represented approximately 8.5 percent of total property tax revenues in St. Lucie County and approximately 7.9 percent of total revenues from all sources for St. Lucie County.

The no-action alternative (plant closure) would result in the loss of the taxes attributable to St. Lucie Units 1 and 2 as well as the loss of plant payrolls 20 years earlier than if the OLs were renewed. There would also be an adverse impact on housing values and the local nearby economy if St. Lucie Units 1 and 2 were to cease operations.

FPL employees working at St. Lucie Units 1 and 2 currently contribute time and money toward community involvement, including schools, churches, charities, and other civic activities. It is likely that with a reduced presence in the community following decommissioning, community involvement efforts by FPL and its employees in the region would be less.

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 work force 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 is less than 10 percent of the tax revenue of a local jurisdiction, the socioeconimic impacts associated with the loss of the plant's tax revenue as a result of plant closure is considered SMALL. The property taxes that FPL pays for St. Lucie Units 1 and 2 constitute less than 10 percent of total revenue of St. Lucie County; consequently, the socioeconomic impacts resulting from loss of this revenue are considered SMALL.

Employees at St. Lucie constitute approximately 0.6 percent of total employment in St. Lucie County and approximately 0.5 percent of total employment in Martin County. Loss of these jobs is considered to have a SMALL socioeconomic impact.

Overall, the staff concludes that the socioeconomic impacts associated with the no-action alternative would be SMALL.

8.1.8 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 may be detectable offsite; however, the impact is unlikely to be of large significance. Overall, the aesthetic impacts associated with the no-action alternatives are considered SMALL.

8.1.9 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 FPL 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.

8.1.10 Environmental Justice

Current operations at St. Lucie Units 1 and 2 have no disproportionate impacts on the minority and low-income populations of St. Lucie and surrounding counties. Closure of St. Lucie Units 1 and 2 would result in decreased employment opportunities and tax revenues in St. Lucie County and surrounding counties, with possible negative and disproportionate impacts on minority or low-income populations. However, because St. Lucie Units 1 and 2 are located in a relatively urban area with many employment opportunities, the environmental justice impacts under the no-action alternative are considered SMALL.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by St. Lucie assuming that the OLs for Units 1 and 2 are 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 generation at an alternate site (Section 8.2.1)
- natural-gas-fired generation at an alternate site (Section 8.2.2)
- nuclear generation at an alternate site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated by St. Lucie Units 1 and 2 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 St. Lucie Units 1 and 2 are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

The St. Lucie site is not considered in this SEIS as a site for alternative power generation principally because there is insufficient suitable land at the site to construct an alternative generation source to replace St. Lucie generating capacity while St. Lucie Units 1 and 2 continue to operate. Additionally, there is no rail or natural gas service to or near the St. Lucie site.

The St. Lucie site is approximately 457 ha (1130 ac). FPL does not own additional land that is contiguous with the St. Lucie site. The principal land that could potentially be used for new power generation is an approximately 32-ha (80-ac) parcel west of the intake canal and south of the electric power transmission lines. This parcel could not accommodate a coal-fired plant or a new nuclear plant, but could potentially accommodate a completed natural gas

combined-cycle[(a)] plant to replace St. Lucie Units 1 and 2. However, there are several obstacles that make siting on the parcel impractical. First, the completed combined-cycle plant would occupy approximately 26 ha (65 ac) or roughly 80 percent of the available land (FPL 2001). During the construction process it is unlikely there would be sufficient laydown area available within the parcel for construction and plant equipment. Second, it is not clear that the existing barge slip on the St. Lucie site could be used to bring equipment to the site because the transmission lines are between the slip and the parcel. If the existing barge slip could not be used, dredging in environmentally sensitive areas of the Indian River could be necessary. Third, a gas pipeline would have to be constructed from the mainland across Indian River to Hutchinson Island to provide the natural gas necessary for plant operation. Finally, the west and south sides of the parcel are bordered by mangroves and alteration of the mangroves to accommodate construction of a power plant would face regulatory obstacles. Mangroves provide many beneficial functions including trapping and cycling various organic materials, chemical elements, and important nutrients in the coastal ecosystem; providing one of the basic food chain resources for marine organisms; providing physical habitat and nursery grounds for a wide variety of marine organisms, many of which have important recreational or commercial value; and serving as storm buffers by reducing wind and wave action in shallow shoreline areas (FDEP 2002). Alteration of mangroves is restricted under Florida law. Removal of mangroves or cutting that results in the death or defoliation of mangroves is prohibited under the 1996 Florida Mangrove Trimming and Preservation Act unless a permit is obtained from the Florida Department of Environmental Protection (FDEP) or a local agency that has been delegated authority from FDEP to issue permits (Florida Statutes, Section 403.9328).

The FPL land north of the St. Lucie discharge canal and Big Mud Creek is a red mangrove swamp and also includes the 5-ha (13-ac) Blind Creek Pass Park, which is leased by FPL to St. Lucie County. The FPL land south of the intake canal also has mangroves and includes the 10-ha (24-ac) Walton Rocks Park, which is also leased by FPL to St. Lucie County. Both parcels of land are bisected by State Road A1A. The staff assumed that construction of a new generating source on these lands would be impractical or impossible because of the condition of the land and restrictions under the Florida Mangrove Trimming and Preservation Act. For all of the preceding reasons, the staff assumed that construction of a power plant to replace St. Lucie Units 1 and 2 would occur at an alternate Florida site.

FPL's *Ten Year Power Plant Site Plan* (FPL 2002) identifies four preferred and four potential sites in Florida for new power-generating facilities. All of the sites are owned by FPL and all have existing generating plants except the property in St. Lucie County, which has a substation. The four preferred sites are: (1) a site 6 km (4 mi) east of Tice in Lee County, (2) property within the city limits of Debary in Volusia County, (3) a site in unincorporated Manatee County

(a) 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.

approximately 8 km (5 mi) east of the community of Parrish, and (4) a site 11 km (7 mi) northwest of Indiantown in Martin County. The Martin County site is the closest preferred site to St. Lucie. There are four additional potential sites in the plan: (1) a site in Brevard County near the city of Port St. Johns, (2) a site in Palm Beach County within the city limits of Riviera Beach, (3) a site in Broward County at Port Everglades within the city limits of Fort Lauderdale, and (4) a site in unincorporated St. Lucie County approximately 8 km (5 mi) west of the community of White City. The potential site in St. Lucie County is the closest of the designated preferred and potential sites to the St. Lucie plant. This SEIS has been prepared taking into account FPL's preferred and potential sites, but not being limited to these particular sites.

Each year the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. In its *Annual Energy Outlook 2002*, EIA projects that combined-cycle or combustion turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electric-generating capacity through the year 2020 (DOE/EIA 2001a). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet base-load[(a)] requirements. Coal-fired plants are projected by EIA to account for approximately 9 percent of new capacity during this period. Coal-fired plants are generally used to meet base-load requirements. Renewable energy sources, primarily wind, geothermal, and municipal solid waste units, are projected by EIA to account for the remaining 3 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 new generation capacity in the United States through the year 2020 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 through the year 2020 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 St. Lucie Units 1 and 2 is considered in the SEIS for reasons stated in Section 8.2.3. NRC established a New Reactor Licensing Project Office in 2001 to prepare for and manage future reactor and site licensing applications (NRC 2001).

(a) A base-load 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 base-load generation; i.e., these units generally run near full load.

If an alternative generating technology were selected to replace power generated by St. Lucie Units 1 and 2, Units 1 and 2 would be decommissioned. Environmental impacts associated with decommissioning are discussed in Section 8.1 and are not otherwise addressed in Section 8.2.

8.2.1 Coal-Fired Generation

Environmental impact information for a replacement coal-fired power plant using closed-cycle cooling with cooling towers is presented in Section 8.2.1.1 and using once-through cooling in Section 8.2.1.2.

The staff assumed construction of four 400-megawatt electric [MW(e)] units,[(a)] which is consistent with FPL's Environmental Report (ER) for St. Lucie Units 1 and 2 (FPL 2001). This assumption will slightly understate the impacts of replacing the 1678 MW(e) from St. Lucie Units 1 and 2.

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the FPL ER (FPL 2001). 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).

Coal and lime or limestone for a coal-fired plant would most likely be delivered to the plant site by railroad. Barge delivery of coal and lime/limestone is potentially feasible for a coastal site or a site on a navigable river with a protected dock. FPL estimates that the plant would consume approximately 4.9 million metric tonnes (MT) (5.4 million tons) of coal annually (FPL 2001). Lime[(b)] or limestone is used in the scrubbing process for control of sulfur dioxide emissions. FPL estimates that 245,000 MT (270,000 tons) of limestone would be used annually for flue gas desulfurization (FPL 2001). A coal slurry pipeline is also a technically feasible coal delivery option; however, the associated cost and environmental impacts make a slurry pipeline an unlikely transportation alternative. Construction of a new electric power transmission line to connect to existing lines and a rail spur to the plant site may be needed.

The coal-fired plant is assumed to use tangentially fired, dry-bottom boilers and consume bituminous, pulverized coal with an ash content of approximately 8 percent by weight

(a) The units would have a rating of 424 gross MW and 400 net MW. The difference between "gross" and "net" is electricity consumed on the plant site.
(b) 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 out and is removed in sludge form.

(FPL 2001). The FPL ER assumes a heat rate of 2.9 J fuel/J electricity (9800 Btu/kWh) and a capacity factor of 0.9.[(a)]

8.2.1.1 Closed-Cycle Cooling System

The overall impacts of the coal-fired generating system using a closed-cycle cooling system with cooling towers are discussed in the following sections and summarized in Table 8-2. The extent of impacts will depend on the location of the particular site selected.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation Using Closed-Cycle Cooling at an Alternate Florida Site

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Uses up to 467 ha (1155 ac) for power block; coal handling, storage, and transportation facilities; infrastructure facilities; and waste disposal. Additional land impacts for coal and limestone mining. Possible impacts of up to 380 ha (940 ac) for electric power transmission line, rail spur, and cooling-water intake and discharge pipelines.
Ecology	MODERATE to LARGE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and electric power transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged, the constituents in the discharged water, and the characteristics of the surface-water body. Discharges would be regulated by FDEP.

(a) Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (Btu) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of fuel burned for electric generation by the resulting net kWh generation. 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.

Table 8-2. (cont'd)

Impact Category	Impact	Comments
Air Quality	MODERATE	Sulfur oxides • 15,200 MT/yr (16,700 tons/yr) Nitrogen oxides • 1840 MT/yr (2030 tons/yr) Particulates • 196 MT/yr (216 tons/yr) of total suspended particulates, which would include 45 MT/yr (50 tons/yr) of PM_{10} Carbon monoxide • 1230 MT/yr (1350 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials – mainly uranium and thorium
Waste	MODERATE	Total waste volume would be approximately 900,000 MT/yr (1 million tons/yr) of ash, spent catalyst, and scrubber sludge requiring approximately 280 ha (680 ac) for disposal during the 40-year life of the plant.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.
Socioeconomics	MODERATE to LARGE	Construction impacts depend on location, but could be LARGE if plant is located in a rural area. St. Lucie County would experience loss of Units 1 and 2 tax base and employment, but impacts are likely to be SMALL. Impacts during operation would be SMALL. Transportation impacts associated with construction workers could be MODERATE to LARGE. For rail transportation of coal and lime/limestone, the impact is considered MODERATE to LARGE. For barge transportation, the impact is considered SMALL.
Aesthetics	MODERATE to LARGE	Impact would depend on the site selected and the surrounding land features. Power block, exhaust stacks, cooling towers, and cooling tower plumes will be visible from nearby areas. If needed, a new electric power transmission line could have a LARGE aesthetic impact. Noise impact from plant operations and intermittent sources such as rail transportation of coal would be MODERATE.
Historic and Archaeological Resources	SMALL	Alternate location would necessitate cultural resource studies.
Environmental Justice	SMALL	Impacts at alternate site vary depending on population distribution and makeup. St. Lucie County would lose tax revenue and jobs, however, the impacts on minority and low-income populations would likely be SMALL.

- **Land Use**

The coal-fired generation alternative would necessitate converting approximately 467 ha (1155 ac) to industrial use for the power block; infrastructure and support facilities; coal storage and handling; and landfill disposal of ash and scrubber sludge (FPL 2001). Spent selective catalytic reduction (SCR) catalyst (used for control of nitrogen oxide [NO_x] emissions) would be disposed of offsite. Disposal of ash and sludge over a 40-year plant life would require approximately 280 ha (680 ac) of the 467 ha (FPL 2001). Additional land could be needed for an electric power transmission line, a rail spur, and/or pipelines to supply cooling-water intake and discharge. The FPL ER (FPL 2001) assumes that these activities could impact up to 380 ha (940 ac). 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). A replacement coal-fired plant for St. Lucie Units 1 and 2 would be 1600 MW(e) and would affect proportionately more land. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for St. Lucie Units 1 and 2. In the GEIS, the staff estimated 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 (NRC 1996).

The impact of a coal-fired generating unit on land use is best characterized as MODERATE to LARGE. The impact would definitely be greater than the alternative of renewing the OLs.

- **Ecology**

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. Use of cooling makeup water from a nearby surface-water body could have adverse aquatic resource impacts. If needed, construction and maintenance of an electric power transmission line and a rail spur would have ecological impacts. There would be some impact on terrestrial ecology from cooling tower drift. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE and would be greater than renewal of the St. Lucie Units 1 and 2 OLs.

- **Water Use and Quality**

Cooling water would likely be withdrawn from a surface-water body. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary

wastewater may also be discharged. All discharges would be regulated by FDEP through a National Pollution Discharge Elimination System (NPDES) permit. Use of groundwater for a coal-fired plant at an alternate site is a possibility. Groundwater withdrawal could require a permit. There would be a consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation would likely occur during construction (NRC 1996). Overall, impacts are considered SMALL to MODERATE.

- **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), NO_x, particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

A new coal-fired generating plant would likely need a prevention of significant deterioration (PSD) 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 60, Subpart Da. The standards establish emission limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (SO_2) (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

The U.S. Environmental Protection Agency (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 for criteria pollutants[(a)] under the Clean Air Act. All of the FPL preferred and potential power plant sites (FPL 2002) are in areas that are designated as attainment or unclassified for criteria pollutants.

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 man-made air pollution. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a state, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure that there is no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308[d][1]). If a new coal-fired power station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Mandatory Class I Federal areas in Florida are Everglades National Park, Chassahowitzka National Wildlife Refuge, and St. Marks National Wildlife Refuge (40 CFR 81.407).

(a) Criteria pollutants under the Clean Air Act are ozone, carbon monoxide, particulates, SO_2, lead, and NO_x. Ambient air quality standards for criteria pollutants are set forth in 40 CFR Part 50.

Impacts for specific pollutants are as follows:

- Sulfur oxides. 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. 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 since a nuclear power plant releases almost no SO_2 during normal operations.

  FPL estimates that by using the best technology to minimize SO_2 emissions, the total annual stack emissions would be approximately 15,200 MT (16,700 tons) of SO_2 (FPL 2001). FPL states in its ER that an alternative coal-fired plant would use wet limestone flue-gas desulfurization technology (FPL 2001).

- Nitrogen oxides. 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 standard for such plants at 40 CFR 60.44a(d)(1), which limits the discharge of any gases that contain NO_x (expressed as NO_2) to 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

  FPL estimates that by using low-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 1840 MT (2030 tons) (FPL 2001). Regardless of the control technology, this level of NO_x emissions would be greater than the OL renewal alternative since a nuclear power plant releases almost no NO_x during normal operations.

- Particulates. FPL estimates that the total annual stack emissions of particulates would include approximately 196 MT (216 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 micrometer [μm] up to approximately 45 μm). The 196 MT (216 tons) would include approximately 45 MT (50 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 (FPL 2001). In

addition, coal-handling equipment would introduce fugitive particulate emissions. Particulate emissions would be greater under the coal alternative than the OL renewal alternative since a nuclear plant releases few particles during normal operations.

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. FPL estimates that total carbon monoxide emissions would be approximately 1230 MT (1350 tons) per year (FPL 2001). This level of emissions is greater than the OL renewal alternative.

- Hazardous air pollutants including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). The EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000b). 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 2000b). 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 2000b).

- 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 (for 1982) is that a typical coal-fired plant has an annual release of approximately 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

- Carbon dioxide. A coal-fired plant would have unregulated carbon dioxide emissions that could contribute to global warming.

- Summary. The GEIS analysis did not quantify emissions from coal-fired power plants but implied that air 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.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent SCR catalyst, and scrubber sludge. Four 400-MW(e) coal-fired plants would annually generate approximately 390,000 MT (430,000 tons) of ash and 532,000 MT (586,000 tons) of scrubber sludge (FPL 2001). Approximately 10 percent of the ash would be bottom ash that could be used beneficially (e.g., road base, fill, asphalt, and road surfacing) (FPL 2001). The remaining 90 percent of the ash would be fly ash. The fly ash and scrubber sludge would be disposed of in a landfill. Spent SCR catalyst would be regenerated or disposed of offsite. 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.

In May 2000, the EPA issued a “Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels” (EPA 2000b). The EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could 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, EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of the Resource Conservation and Recovery Act.

Construction-related debris would be generated during construction activities.

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

- **Human Health**

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risks from coal and lime/limestone transportation, worker and public risks from disposal of coal combustion wastes, and public risks from 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 from a coal-fired plant, but the GEIS does 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 discussed previously, the EPA has recently concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal at a newly constructed coal-fired plant are characterized as SMALL.

- **Socioeconomics**

If a coal-fired power plant were built at an alternate site to replace power produced by St. Lucie Units 1 and 2, the communities around the St. Lucie site would experience the impact of St. Lucie operational job loss and St. Lucie County would lose tax base. These losses would have SMALL socioeconomic impacts, given the fact that St. Lucie provides less than or equal to 10 percent of the total revenue in St. Lucie County (see Section 8.1.7).

During construction of the new coal-fired plant, communities near the construction site would experience demands on housing and public services that could have MODERATE to LARGE impacts. After construction, the nearby communities would be impacted by the loss of the construction jobs. FPL estimates that the completed coal plant would employ approximately 250 to 300 workers (FPL 2001). Construction of the coal-fired alternative would take approximately 5 years. The coal-fired plant would provide a new tax base for the local

jurisdiction. 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 work force would need to move to the area to work (NRC 1996). Socioeconomic impacts at a rural site could be LARGE. Transportation-related impacts associated with commuting construction workers at an alternate site are site-dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL.

Coal and lime/limestone would likely be delivered to an alternate site by rail, although barge delivery is feasible for an alternate coastal location or a site on a navigable river. Socioeconomic impacts associated with rail transportation would likely be MODERATE to LARGE. For example, there would be delays to highway traffic as trains pass and there could be negative impacts on the value of property close to the train tracks. Barge delivery of coal and lime/limestone would likely have SMALL socioeconomic impacts.

Overall, socioeconomic impacts are characterized as MODERATE to LARGE.

- **Aesthetics**

The four coal-fired power block units would be as much as 61 m (200 ft) tall and be visible from offsite during daylight hours. The four exhaust stacks would be as much as 180 m (600 ft) high. The stacks would likely be highly visible in daylight hours for distances greater than 16 km (10 mi). Cooling towers and associated plumes would also have an aesthetic impact. Natural draft towers could be up to 160 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high. The stacks would be visible from parks, other recreational areas, and wildlife refuges in the vicinity of the plant. The power block units and associated stacks and cooling towers would also be visible at night because of outside lighting. The U.S. Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 61 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). Visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting, provided the lighting meets FAA requirements, and appropriate use of shielding. Overall, the coal-fired units and the associated exhaust stacks and cooling towers would likely have a MODERATE to LARGE aesthetic impact. There would also be an aesthetic impact that could be LARGE if construction of a new electric power transmission line is needed.

Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. 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. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the rail route, the impacts of noise on residents in the vicinity of the facility and the rail line are considered MODERATE. Noise associated with barge transportation of coal and lime/limestone would be SMALL. Noise and light from the plant would be detectable offsite. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants.

Overall, the aesthetic impacts associated with locating a coal-fired plant at an alternate Florida site can be categorized as MODERATE to LARGE.

- **Historic and Archaeological Resources**

A cultural resources 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, 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 can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

Environmental impacts on minority and low-income populations associated with a replacement coal-fired plant built at an alternate Florida site would depend upon the site chosen and the nearby population distribution. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of St. Lucie Units 1 and 2 would result in the loss of approximately 929 operating jobs. Resulting economic conditions could reduce employment prospects for minority

or low-income populations. However, St. Lucie Units 1 and 2 are located in a relatively urban area with many employment possibilities. St. Lucie County would also experience a loss of property tax revenue, which could affect its ability to provide services and programs. However, these losses would likely have SMALL environmental justice impacts given the moderate proportion of the tax base in St. Lucie County attributable to St. Lucie Units 1 and 2 (see Section 8.1.7). Overall, impacts are expected to be SMALL.

8.2.1.2 Once-Through Cooling System

The environmental impacts of constructing a coal-fired generation system at an alternate Florida site using once-through cooling are similar to the impacts for a coal-fired plant using a closed-cycle system. However, there are some environmental 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 Florida Site with Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impact would depend on ecology at the site. No impact to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impact to aquatic ecology.
Surface-Water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Reduced aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Less land impacted
Environmental Justice	No change

8.2.2 Natural-Gas-Fired Generation

The environmental impacts of a natural-gas-fired plant using combined-cycle combustion turbines are examined in this section for an alternate Florida site. The impacts of a plant with a closed-cycle cooling system with cooling towers are discussed in Section 8.2.2.1 and

summarized in Table 8-4. The impacts of a plant with once-through cooling are discussed in Section 8.2.2.2.

The availability of natural gas in Florida is discussed in the Florida Public Service Commission's (FPSC's) *Review of Electric Utility 2001 Ten-Year Site Plans* (FPSC 2001). Currently, natural gas is supplied to Florida by the Florida Gas Transmission Company. Capacity enhancements will increase the company's pipeline capacity to 57 million m^3/day (2.0 billion ft^3/day) by 2003. The Gulfstream Natural Gas System pipeline, being constructed by subsidiaries of Williams Companies and Duke Energy, is expected to be completed in late 2002 and will bring an additional capacity of approximately 34 million m^3/day (1.2 billion ft^3/day) to Florida. The pipeline originates offshore near the Mississippi-Alabama border, extends across the Gulf of Mexico, comes ashore near Port Manatee, Florida, and terminates in Palm Beach County, Florida.

Together, Florida Gas Transmission Company and the Gulfstream pipeline should have sufficient natural gas capacity to meet the projected Florida demand of 79 million m^3/day (2.8 billion ft^3/day) in 2010.

For construction at an alternate site, a new pipeline would need to be constructed from the plant site to a supply point where a firm supply of gas would be available.

The staff assumed that a replacement natural-gas-fired plant would use combined-cycle combustion turbines (FPL 2001). FPL estimates that the plant would consume approximately 2.86 billion m^3 (101 billion ft^3) of natural gas annually (FPL 2001). The following additional assumptions are made for the natural-gas-fired plant (FPL 2001):

- three 596-MW(e) units, each consisting of two 170-MW combustion turbines and a 256-MW heat recovery boiler
- natural gas with an average heating value of 37 MJ/m^3 (1019 Btu/ft^3) as the primary fuel
- heat rate of 2.1 J fuel/J electricity (7150 Btu/kWh)
- capacity factor of 0.9.

Unless otherwise indicated, the assumptions and numerical values used throughout this section are from the FPL ER (FPL 2001). 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).

Table 8-4. Summary of Environmental Impacts of Natural-Gas-Fired Generation Using Closed-Cycle Cooling at an Alternate Florida Site

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	30 ha (75 ac) for power block, switchyard, cooling towers, and infrastructure support facilities. Additional impact of up to 425 ha (1050 ac) for electric power transmission line, natural gas pipeline, and cooling-water intake/discharge pipelines.
Ecology	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and possible electric power transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface water body. Discharge of cooling tower blowdown will have impacts.
Air Quality	MODERATE	Sulfur oxides • 150 MT/yr (165 tons/yr) Nitrogen oxides • 607 MT/yr (669 tons/yr) Carbon monoxide • 1402 MT/yr (1545 tons/yr) PM_{10} particulates • 89 MT/yr (98 tons/yr) Some hazardous air pollutants
Waste	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.
Human Health	SMALL	Impacts considered to be minor.
Socioeconomics	MODERATE	During construction impacts would be MODERATE. Up to 700 additional workers during the peak of the 3-year construction period. St. Lucie County would experience loss of the tax base and employment associated with St. Lucie Units 1 and 2 with potentially SMALL impacts. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	MODERATE to LARGE	MODERATE impact from plant, stacks, and cooling towers and associated plumes. Additional impact that could be LARGE if a new electric power transmission line is needed.
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts at alternate site vary depending on population distribution and makeup at site. St. Lucie County would lose tax revenue and jobs, however the impacts on minority and low-income populations would likely be SMALL.

8.2.2.1 Closed-Cycle 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.

- **Land Use**

The natural-gas-fired alternative would necessitate converting approximately 30 ha (75 ac) to industrial use for the power block, cooling towers, and infrastructure and support facilities (FPL 2001). Additional land would likely be impacted for construction of an electric power transmission line, natural gas pipeline, and water intake/discharge pipelines to serve the plant. The FPL ER assumes that these activities could impact up to 425 ha (1050 ac) (FPL 2001). For any new natural-gas-fired power plant, additional land would be required for natural gas wells and collection stations. In the GEIS, the staff estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Proportionately more land would be needed for a natural-gas-fired plant replacing the 1678 MW(e) from St. Lucie. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for St. Lucie. NRC staff stated in the GEIS (NRC 1996) that approximately 400 ha (1000 ac) would be affected for mining and processing the uranium during the operating life of a 1000-MW(e) nuclear power plant. Overall, land-use impacts for a natural-gas-fired plant would be MODERATE to LARGE.

- **Ecology**

There would be ecological land-related impacts associated with siting of the gas-fired plant. If needed, there would also be temporary ecological impacts associated with bringing a new underground gas pipeline and/or electric power transmission line to the site. Ecological impacts 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. Ecological impacts to the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Cooling makeup water intake and discharge could have aquatic resource impacts. There would be some impact on terrestrial ecology from cooling tower drift. Overall, the ecological impacts are considered MODERATE to LARGE.

- **Water Use and Quality**

The impact on the surface water would depend on 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 Florida. There would be a consumptive use of water due to

evaporation from the cooling towers. A natural-gas-fired plant sited at an alternate site may use groundwater. Groundwater withdrawal impacts are considered SMALL.

Water-quality impacts from sedimentation during construction of a natural-gas-fired plant were characterized in the GEIS as SMALL (NRC 1996). NRC staff also noted in the GEIS that operational water-quality impacts would be similar to, or less than, those from other generating technologies.

Overall, water use and quality impacts at an alternate Florida site are considered SMALL to MODERATE.

- **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.

A new gas-fired generating plant would likely need a PSD 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.

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 areas designated as attainment or unclassified under the Clean Air Act. All of the FPL preferred and potential power plant sites (FPL 2002) are in areas that are designated as attainment or unclassified for criteria pollutants.

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 man-made air pollution. In addition, EPA regulations provide 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 those days on which visibility is most impaired over the period of the implementation plan and ensure that there is no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308[d][1]). If a new natural-gas-fired power station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Mandatory Class I Federal areas in Florida are Everglades National Park, Chassahowitzka National Wildlife Refuge, and St. Marks National Wildlife Refuge (40 CFR 81.407).

FPL estimates that a natural-gas-fired plant equipped with appropriate pollution control technology would have the following emissions (FPL 2001):

- sulfur oxides – 150 MT/yr (165 tons/yr)
- nitrogen oxides – 607 MT/yr (669 tons/yr)
- carbon monoxide – 1402 MT/yr (1545 tons/yr)
- PM_{10} particulates – 89 MT/yr (98 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 EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal- and oil-fired plants, EPA did not determine that regulation of 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.

Impacts of emissions from a gas-fired plant 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 an alternate Florida site is considered MODERATE.

- **Waste**

The only significant waste generated at a natural gas-fired plant would be spent SCR catalyst, which is used for control of NO_x emissions. The spent catalyst, estimated to be approximately 31 m^3/yr (1100 ft^3/yr), would be regenerated or disposed of offsite. The 31 m^3/yr estimate was scaled by the staff from a comparable number in the ER for McGuire Nuclear Station Units 1 and 2 prepared by Duke Energy corporation (Duke 2001). In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in few combustion by-products because of the clean nature of the fuel. Other than spent SCR catalyst, waste generation at an operating gas-fired plant would be largely limited to typical office wastes. Construction-related debris would be generated during construction activities. Overall, the waste impacts are characterized as SMALL for a newly constructed natural-gas-fired plant.

- **Human Health**

In the GEIS, the staff identified cancer and emphysema as potential health risks from natural-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. For a plant sited in Florida, NO_x emissions would be regulated by FDEP. Human health effects are not expected to be detectable or are expected to be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of a newly constructed natural gas-fired plant are considered SMALL.

- **Socioeconomics**

Construction of a natural-gas-fired plant would take approximately 3 years. Peak employment could be up to 700 workers (FPL 2001). The staff assumed that construction would take place while St. Lucie continues operation and would be completed by the time St. Lucie permanently ceases operations. During construction, the communities immediately surrounding the plant site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from more distant communities. After construction, the communities would be impacted by the loss of jobs. The current St. Lucie work force (929 workers) would decline through a decommissioning period to a minimal maintenance size. The new natural-gas-fired plant would provide a new tax base at an alternate Florida site and provide approximately 125 permanent jobs (FPL 2001). Siting at an alternate Florida site would result in the loss of the nuclear plant tax base in St. Lucie County and associated employment. These losses would have SMALL socioeconomic impacts, given the moderate (10 percent) proportion of the tax base in St. Lucie County attributable to St. Lucie (see Section 8.1.7).

In the GEIS, the staff concluded that socioeconomic impacts from constructing a natural-gas-fired plant would not be very noticeable and that the small operational work force would have the lowest socioeconomic impacts of any nonrenewable technology (NRC 1996).

Compared to the coal-fired and nuclear alternatives, the smaller size of the construction work force, the shorter construction time frame, and the smaller size of the operations work force would mitigate socioeconomic impacts.

Transportation impacts associated with construction personnel commuting to the plant site would depend on the population density and transportation infrastructure in the vicinity of the site. The impacts can be classified as MODERATE. Impacts associated with operating personnel commuting to the plant site would be SMALL. Overall, socioeconomic impacts from construction of a natural-gas-fired plant would be MODERATE.

Alternatives

- **Aesthetics**

The turbine buildings, exhaust stacks (approximately 61 m [200 ft] tall), cooling towers, and the plume from the cooling towers would be visible from offsite during daylight hours. The gas pipeline compressors also would be visible. Noise and light from the plant would be detectable offsite. If a new electric power transmission line is needed, the aesthetic impact could be as much as LARGE. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with a replacement natural-gas-fired plant at an alternate Florida site are categorized as MODERATE to LARGE, with site-specific factors determining the final categorization.

- **Historic and Archaeological Resources**

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, 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). Impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

- **Environmental Justice**

Environmental impacts on minority and low-income populations associated with a replacement natural-gas-fired plant built at an alternate Florida site would depend upon the site chosen and the nearby population distribution. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of St. Lucie would result in the loss of approximately 929 operating jobs. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, St. Lucie is located in a relatively urban area with many employment possibilities. St. Lucie County would also experience a loss of property tax revenue, which could affect its ability to provide services and programs. However, these losses would likely have SMALL environmental justice impacts, given the moderate proportion of the tax base in St. Lucie County attributable to St. Lucie (see Section 8.1.3). Overall, impacts are expected to be SMALL.

8.2.2.2 Once-Through Cooling System

The environmental impacts of constructing a natural-gas-fired generation system at an alternate Florida location using a once-through cooling system are similar to the impacts for a natural gas-fired plant using closed-cycle cooling with cooling towers. However, there are some environmental 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 with Once-Through Cooling at an Alternate Florida Site

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impact would depend on ecology at the site. No impact to terrestrial ecology from cooling tower drift. Increased water withdrawal and possible greater impact to aquatic ecology.
Surface Water Use and Quality	No discharge of cooling tower blowdown containing dissolved solids. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Reduced aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Less land impacted
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 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). 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 the NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent volatility in prices of natural gas and electricity have made new nuclear power

plant construction more attractive from a cost standpoint. Additionally, Entergy Nuclear, a subsidiary of Entergy Corporation, announced that it will prepare an application for an early site permit for a new advanced nuclear power plant under the procedures in 10 CFR Part 52, Subpart A (Entergy Corporation 2002). For the preceding reasons, construction of a new nuclear power plant at an alternate Florida site using both closed- and open-cycle cooling is considered in this section. The staff assumed that the new nuclear plant would have a 40-year lifetime.

The NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of St. Lucie, which has a capacity of 1678 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 NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using closed-cycle cooling with cooling towers is presented in Section 8.2.3.1 and using once-through cooling in Section 8.2.3.2.

8.2.3.1 Closed-Cycle 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 will depend on the location of the particular site selected.

- **Land Use**

Land-use requirements at an alternate Florida site would be approximately 200 to 400 ha (500 to 1000 ac) (NRC 1996). Additional land could be needed for an electric power transmission line, a rail spur to bring construction materials to the plant site, and/or pipelines to supply cooling-water intake and discharge. For an alternative coal-fired plant, the FPL ER (FPL 2001) estimates that these activities could impact up to 380 ha (940 ac). A similar land impact is likely for a nuclear plant. Depending particularly on transmission line routing, siting a new nuclear plant at an alternate Florida site could result in MODERATE to LARGE land-use impacts.

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 St. Lucie.

- **Ecology**

A new nuclear plant 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. Intake and discharge of cooling water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of an electric power transmission line would have ecological impacts. There would be some impact on terrestrial ecology from cooling tower drift. Overall, the ecological impacts at an alternate Florida site would be MODERATE to LARGE.

- **Water Use and Quality**

Cooling water would likely be withdrawn from a surface-water body. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by FDEP through a NPDES permit. Use of groundwater for a nuclear plant at an alternate site is a possibility. Groundwater withdrawal could require a permit. There would be a consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation would likely occur during construction (NRC 1996). Overall, impacts are considered SMALL to MODERATE.

- **Air Quality**

Construction of a new nuclear plant would result in fugitive emissions during the construction process. Exhaust emissions would come from vehicles and motorized equipment during the construction process and after operation commences. An operating nuclear plant would have minor air emissions associated with diesel generators. These emissions would be regulated by FDEP. Overall, emissions and associated impacts are considered SMALL.

- **Waste**

The waste impacts associated with operation of a nuclear power plant are set forth in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. In addition to the impacts shown in Table B-1, construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts are considered SMALL.

Table 8-6. Summary of Environmental Impacts of New Nuclear Generation Using Closed-Cycle Cooling at an Alternate Florida Site

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Requires approximately 200 to 400 ha (500 to 1000 ac) for the plant. Up to 380 ha (940 ac) for a new electric power transmission line, rail spur, and cooling-water intake/discharge pipelines.
Ecology	MODERATE to LARGE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and electric power transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface-water body. Discharges would be regulated by FDEP.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amounts of emissions from diesel generators, vehicles, and possibly other sources during operation.
Waste	SMALL	Waste impacts for an operating nuclear power plant are set forth in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Debris would be generated and removed during construction.
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set forth in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
Socioeconomics	MODERATE to LARGE	During construction, impacts would be MODERATE to LARGE. Up to 2500 workers during the peak of the 5-year construction period. Operating work force assumed to be similar to St. Lucie. Impacts at a rural location could be LARGE. St. Lucie County would experience loss of tax base and employment with SMALL impacts. Transportation impacts associated with commuting construction workers could be MODERATE to LARGE. Transportation impacts during operation would be SMALL to MODERATE.
Aesthetics	MODERATE to LARGE	Containment buildings, cooling towers, and the plumes from cooling towers would be visible from offsite. No exhaust stacks 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. Potential LARGE impact if a new electric power transmission line is needed.

Table 8-6. (cont'd)

Impact Category	Impact	Comment
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts will vary depending on population distribution and makeup at the site. St. Lucie County would lose tax revenue and jobs, however, impacts on minority and low-income populations would likely be SMALL.

- **Human Health**

Human health impacts for an operating nuclear power plant are set forth in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Overall, human health impacts are considered SMALL.

- **Socioeconomics**

The construction period and the peak work force associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantified data, the staff assumed a construction period of 5 years and a peak work force of 2500. The staff assumed that construction would take place while the existing St. Lucie units continue operation and would be completed by the time St. Lucie permanently ceases operations. During construction, the communities surrounding the plant site would experience demands on housing, transportation, and public services that could have MODERATE to LARGE impacts. These impacts would be tempered by construction workers commuting to the site from more distant communities. In the GEIS, the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction work force would need to move to the area to work (NRC 1996). Socioeconomic impacts at a rural site could be LARGE. After construction, the communities would be impacted by the loss of the construction jobs. The replacement nuclear units are assumed to have an operating work force comparable to the 929 workers currently working at St. Lucie. Transportation impacts related to commuting of plant operating personnel are considered SMALL to MODERATE. The communities around St. Lucie would experience the impact of St. Lucie operational job loss and St. Lucie County would experience the loss of tax base. However, the socioeconomic impacts would likely be SMALL (see Section 8.1.7).

- **Aesthetics**

The containment buildings for a replacement nuclear power plant, other associated buildings, the cooling towers, and the plume from the cooling towers would be visible during daylight

hours. Natural draft towers could be up to 160 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact. Visual impacts of buildings and structures could be mitigated by landscaping and selecting a color that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. There would also be a significant aesthetic impact if a new electric power transmission line were needed. No exhaust stacks would be needed.

Noise from operation of a replacement nuclear power plant would potentially be audible offsite in calm wind conditions or when the wind is blowing in the direction of the listener. Mitigation measures, such as reduced or no use of outside loudspeakers, could be employed to reduce noise level and keep the impact SMALL to MODERATE.

Overall, the aesthetic impacts can be categorized as MODERATE; however, the impact could be LARGE if a new electric power transmission line is needed to connect the plant to the power grid.

- **Historic and Archaeological Resources**

A cultural resources 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, 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 can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

Environmental impacts on minority and low-income populations associated with a replacement nuclear plant built at an alternate Florida site would depend upon the site chosen and the nearby population distribution. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of St. Lucie would result in the loss of approximately 929 operating jobs. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, St. Lucie is located in a relatively urban area with many employment possibilities. St. Lucie County would experience a loss of property tax revenue that could affect its ability to provide services and programs. However, these losses would likely have SMALL environmental justice impacts, given the moderate (10 percent) proportion of the tax base in

St. Lucie County attributable to the St. Lucie plant (see Section 8.1.7). Overall, impacts are expected to be SMALL.

8.2.3.2 Once-Through Cooling System

The environmental impacts of constructing a nuclear power plant at an alternate Florida site using once-through cooling are similar to the impacts for a nuclear power plant using closed-cycle cooling with cooling towers. However, there are some 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 New Nuclear Generation Using Once-Through Cooling at an Alternate Florida Site

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impact would depend on ecology at the site. No impact to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impact to aquatic ecology.
Surface Water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Reduced aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Less land impacted
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 St. Lucie Units 1 and 2 OLs. FPL currently purchases power from other generators. Overall, Florida is a net importer of electricity.

FPL includes future power purchases in its *Ten Year Power Plant Site Plan* (FPL 2002). The Plan indicates how FPL will meet customers' energy needs through existing generation, customer demand-side options, short-term purchase power transactions, and new generating resources constructed by FPL. The 2002 Plan shows power purchases of 2403 MW for the

summer of 2002, dropping to 1757 MW for the summers of 2005 and 2006, and then decreasing further to 382 MW in the summers of 2010 and 2011 (FPL 2002). FPL purchases additional capacity in the short-term power market as necessary.

Imported power from Canada or Mexico is unlikely to be available for replacement of St. Lucie capacity. In Canada, 62 percent of the country's electricity 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 capacity is projected to increase by 2020, but its share of electric power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (DOE/EIA 2002). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 47.9 billion kWh in year 2000 to 66.1 billion kWh in year 2005 and then gradually decrease to 47.4 billion kWh in year 2020 (DOE/EIA 2001a). On balance, it appears unlikely that electricity imported from Canada or Mexico would be able to replace the St. Lucie capacity.

If power to replace St. Lucie capacity were to be purchased from sources within the United States or a foreign country, the generating technology likely would 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 impacts associated with the purchased electrical power alternative to renewal of the St. Lucie OLs. Under the purchased power alternative, the environmental impacts of imported power would still occur, but would be located elsewhere within the region, nation, or another country.

If implemented, the purchase power alternative could necessitate adding as much as 500 km (300 mi) of electric power transmission lines to import power to central Florida (FPL 2001). Assuming a 110-m (350-ft) right-of-way, the lines could impact up to 5140 ha (12,700 ac) and have MODERATE to LARGE land-use and aesthetic impacts.

8.2.5 Other Alternatives

Other generation technologies are discussed in the following sections.

8.2.5.1 Oil-Fired Generation

The EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States through the year 2020 because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). Oil-fired operation is more expensive than coal, natural gas, or nuclear generation alternatives. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than other generation alternatives. 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 49 ha (120 ac) (NRC 1996). Operation of oil-fired plants would have environmental impacts

(including 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 Florida is in a wind power Class 1 region (average wind speeds at 9-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 2002a). 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 2002a]). Wind turbines typically operate at a 25 to 35 percent capacity factor compared to 80 to 95 percent for a base-load plant (NWPPC 2000). As of December 31, 2000, there were no grid-connected wind power plants in Florida (NREL 2001). Ten offshore wind power projects are currently operating in Europe, but none have been developed in the United States. The European plants together provide approximately 170 MW, which is far less than the electrical output of St. Lucie (British Wind Energy Association 2002). For the preceding reasons, the staff concludes that locating a wind-energy facility on or near the St. Lucie site or offshore as a replacement for St. Lucie generating capacity 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 heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies, photovoltaic and thermal, cannot currently 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 (NRC 1996), 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 base-load 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 (55 mi^2) per 1000 MW(e) for photovoltaic (NRC 1996) and approximately 5700 ha (22 mi^2) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric system would fit at the St. Lucie site, and both would have large environmental impacts at an alternate site.

The St. Lucie site receives approximately 4 to 5 kWh of direct normal 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 2000). 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 base-load alternative to renewal of the St. Lucie OLs. Some onsite-generated solar power, e.g., from

rooftop photovoltaic applications, may substitute for electric power from the grid. Implementation of solar generation on a scale large enough to replace St. Lucie would likely result in LARGE environmental impacts.

8.2.5.4 Hydropower

Florida has an estimated 43 MW of undeveloped hydroelectric resource (INEEL 1998). This amount is significantly less than needed to replace the 1678 MW(e) capacity of St. Lucie. As stated in Section 8.3.4 of the GEIS, hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about land requirements, destruction of natural habitat, and alteration of natural river courses. EIA states that potential sites for hydroelectric dams have already been largely established in the United States, and environmental concerns are expected to prevent the development of any new sites in the future (DOE/EIA 2002). In the GEIS, the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e) (NRC 1996). Replacement of St. Lucie generating capacity would require flooding more than this amount of land. Due to the relatively low amount of undeveloped hydropower resource in Florida and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace St. Lucie, the staff concludes that local hydropower is not a feasible alternative to renewal of the St. Lucie OLs. Any attempts to site hydroelectric facilities large enough to replace St. Lucie 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 base-load power where available. However, geothermal technology is not widely used as base-load 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 St. Lucie. The staff concludes that geothermal energy is not a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.6 Wood Waste

A wood-burning facility can provide base-load power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent energy conversion efficiency (NRC 1996). The energy conversion efficiency of a conventional fossil-fired plant is on the order of 35 percent. 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.

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a base-load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and relatively low energy conversion efficiency, the staff has determined that wood waste is not a feasible alternative to renewing the St. Lucie OLs.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate 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 2001b). 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 -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 alternatives such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills with lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001b).

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 1678-MW(e) base-load capacity of St. Lucie and, consequently, would not be a feasible alternative to renewal of the St. Lucie OLs.

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 crops, crops converted to a liquid fuel such as ethanol, and crops (including wood waste) that have been converted to a gas. In the GEIS, the staff stated 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 base-load plant such as St. Lucie (NRC 1996). For these reasons, such fuels do not offer a feasible alternative to renewal of the St. Lucie OLs.

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. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. These are commercially available today at a cost of approximately $4500 per kW of installed capacity (DOE 2002b). 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. DOE has a performance target that by 2003, two second-generation fuel cell technologies using molten carbonate and solid oxide technology, respectively, will be commercially available in sizes up to approximately 3 MW at a cost of $1000 to $1500 per kW of installed capacity (DOE 2002b). For comparison, the installed capacity cost for a natural-gas-fired combined-cycle plant is approximately $456 per kW (DOE/EIA 2001a). 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. At the present time, however, fuel cells are not economically or technologically competitive with other alternatives for base-load electricity generation. Fuel cells are, consequently, not a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.10 Delayed Retirement

FPL has no current plans to retire any existing generating units. For this reason, delayed retirement of FPL generating units would not be a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.11 Utility-Sponsored Conservation

FPL has developed residential, commercial, and industrial programs to reduce both peak demands and daily energy consumption. These programs are commonly referred to as demand-side management (DSM). FPL's DSM programs through 2001 have resulted in a cumulative summer peak reduction of approximately 2790 MW at the meter (FPL 2002). FPL's additional incremental summer peak reduction goals attributable to DSM programs are 269 MW at the meter for 2002 increasing to 765 MW by 2009 (FPL 2002). These goals have been approved by the Florida Public Service Commission (FPL 2001).

FPL's current DSM program includes the following components (FPL 2002):

- Residential Conservation Service – This is an energy audit program designed to assist residential customers in understanding how to make their homes more energy-efficient through the installation of conservation measures and practices.

- Residential Building Envelope – This program encourages the installation of energy-efficient ceiling insulation in residential dwellings that use whole-house electric air conditioning.

- Duct System Testing and Repair – This program encourages demand and energy conservation through the identification of air leaks in whole-house air conditioning duct systems and the repair of those leaks by qualified contractors.

- Residential Air Conditioning – This program is designed to encourage customers to purchase higher-efficiency central cooling and heating equipment.

- Residential Load Management (On Call) – This program offers load control of major appliances and household equipment to residential customers in exchange for monthly electric bill credits.

- New Construction (BuildSmart) – This program encourages the design and construction of energy-efficient homes that cost-effectively reduce FPL's coincident peak demand and energy consumption.

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- Business Energy Evaluation – This program encourages energy efficiency in both new and existing commercial and industrial facilities by identifying DSM opportunities and providing recommendations to the customer.

- Commercial/Industrial Heating, Ventilating, and Air Conditioning – This program encourages the use of high-efficiency heating, ventilating, and air conditioning systems in commercial and industrial facilities.

- Commercial/Industrial Efficient Lighting – This program encourages the installation of energy-efficient lighting measures in commercial and industrial facilities.

- Business Custom Incentive – This program encourages commercial and industrial customers to implement unique energy conservation measures or projects not covered by other FPL programs.

- Commercial/Industrial Load Control – This program reduces peak demand by controlling customer loads of 200 kW or greater during periods of extreme demand or capacity shortages in exchange for monthly electric bill credits.

- Commercial/Industrial Building Envelope – This program encourages the installation of energy-efficient building envelope measures such as window treatments and roof/ceiling insulation.

- Business on Call – This program offers load control of central air conditioning units to small, non-demand-billed and medium, demand-billed commercial and industrial customers in exchange for monthly electric bill credits.

FPL's DSM program also includes a variety of research and development activities (FPL 2002).

Historic and projected reduction in generation needs as a result of DSM programs have been credited in the FPL *Ten Year Power Plant Site Plan 2002-2011* (FPL 2002) to meet part of FPL's projected customer demand. Because these DSM savings are part of the long-range plan for meeting projected demand, they are not available offsets for St. Lucie. Therefore, the conservation option is not considered a reasonable replacement for the OL renewal alternative.

8.2.6 Combination of Alternatives

Even though individual alternatives might not be sufficient on their own to replace St. Lucie capacity due to the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective.

As discussed in Section 8.2, St. Lucie has a combined average net capacity of 1678 MW(e). For the natural-gas combined-cycle alternative, FPL assumed three 596-MW units in its ER

(FPL 2001) as potential replacements for the two St. Lucie nuclear units. The staff also assumed three 596-MW units as potential replacements for the two St. Lucie units in Section 8.2.2.

There are many possible combinations of alternatives. Table 8-8 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of 1192 MW(e) of combined-cycle natural-gas-fired generation (two 596-MW units) at an alternate Florida site using closed-cycle cooling, 298 MW(e) purchased from other generators, and 298 MW(e) gained from additional DSM measures. The impacts associated with the combined-cycle natural-gas-fired units are based on the gas-fired generation impact assumptions discussed in Section 8.2.2, adjusted for the reduced generating capacity. While the DSM measures would have few environmental impacts, operation of the new natural-gas-fired plant would result in increased emissions (compared to the OL renewal alternative) and other environmental impacts. The environmental impacts associated with power purchased from other generators 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 St. Lucie OLs.

Table 8-8. Summary of Environmental Impacts for an Assumed Combination of Generating and Acquisition Alternatives

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	20 ha (50 ac) for power block, offices, roads, and parking areas. Additional impact for construction of an underground natural gas pipeline, electric power transmission line, and cooling-water intake/discharge pipelines.
Ecology	MODERATE 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; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface-water body. Discharge of cooling tower blowdown will have impacts.
Air Quality	MODERATE	Sulfur oxides: 100 MT/yr (110 tons/yr) Nitrogen oxides: 406 MT/yr (448 tons/yr) Carbon monoxide: 939 MT/yr (1035 tons/yr) PM_{10} particulates: 59 MT/yr (65 tons/yr)

		Some hazardous air pollutants.
Waste	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.
Human Health	SMALL	Impacts considered to be minor.
Socioeconomics	MODERATE	Construction impacts depend on location, but could be significant if location is in a rural area. St. Lucie County would experience loss of tax base and employment with potentially SMALL impacts. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	MODERATE to LARGE	MODERATE impact from plant, stacks, and cooling towers and associated plumes. Additional impact that could be LARGE if a new electric power transmission line is needed.
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts vary depending on population distribution and makeup at site. St. Lucie County would lose tax revenue and jobs; however, the impacts on minority and low-income populations would likely be SMALL.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the St. Lucie OLs, are SMALL for all impact categories (except collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned). 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 result in decommissioning St. Lucie Units 1 and 2 and would have SMALL environmental impacts for all impact categories. 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 St. Lucie Unit 1 and 2 OLs would likely be replaced by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than St. Lucie, or (4) some combination of these options. This replacement power would produce additional environmental impacts as discussed in Section 8.2.

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 impacts resulting from construction of any new facility would be greater than the impacts of continued operation of St. Lucie. The impacts of purchased electrical 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 OLs for St. Lucie.

8.4 References

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

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

10 CFR 50. Code of Federal Regulations, Title 40, Protection of Environment Part 50, "National Primary and Secondary Ambient Air Quality Standards."

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

10 CFR 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 50. Code of Federal Regulations, Title 40, Protection of Environment, Part 50, "National Primary and Secondary Ambient Air Quality Standards.

40 CFR 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

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

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