NUREG-1437
Supplement 5

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 5

Regarding
Turkey Point Units 3 and 4

Final Report

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

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Regarding Turkey Point Units 3 and 4

Final Report

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Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental impacts of renewing nuclear power plant operating licenses (OLs) for a 20-year period in its *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, and codified the results in 10 CFR Part 51. The GEIS (and its Addendum 1) 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 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 & Light Company (FPL) to renew the OLs for Turkey Point Units 3 and 4 for an additional 20 years under 10 CFR Part 54. This SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action, and responses to comments received on Draft Supplement 5 to the GEIS.

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. In addition, the staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the Turkey Point OLs will not be greater than impacts identified for these issues in the GEIS. For each of these issues, the GEIS conclusion is that the impact is of SMALL[a] significance (except for collective offsite radiological impacts from the fuel cycle and high-level waste and spent fuel, which were not assigned a single significance level).

Each of the remaining 23 issues that applies to Turkey Point Units 3 and 4 is addressed 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 recommends that the Commission determine that the adverse environmental impacts of license renewal for Turkey Point Units 3 and 4 are not so great that preserving the

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

option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by 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.

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Executive Summary

By letter dated September 8, 2000, the Florida Power & Light Company (FPL) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Turkey Point Units 3 and 4 for an additional 20-year period. If the OLs are renewed, State regulatory agencies and FPL will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, then the plant must be shut down at or before the expiration dates of the current OLs, which are July 19, 2012, for Unit 3, and April 10, 2013, for Unit 4.

Under Section 102 of the National Environmental Policy Act (NEPA) (42 USC 4332), an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51, Subpart A. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2.[(a)]

Upon acceptance of the FPL application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping. The staff visited the Turkey Point site in December 2000 and held public scoping meetings on December 6, 2000, in Homestead, Florida. 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 for preparation of the draft Supplemental Environmental Impact Statement (SEIS) for Turkey Point Units 3 and 4 (issued on June 12, 2001). The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

Two public meetings were held in Homestead, Florida, on July 17, 2001, to describe the preliminary results of the NRC environmental review and answer questions to provide members of the public with information to assist them in formulating comments on the draft SEIS. All of the comments received on the draft SEIS were considered by the staff in developing the final document and are presented in Appendix A, Part 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.

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 OLs.

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

> "The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ['Temporary storage of spent fuel after cessation of reactor operations–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 shows that all of the following criteria are met:

(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 Turkey Point Units 3 and 4) and alternative methods of power generation. Based on projections made by the U.S. Department of Energy's (DOE's) Energy Information Administration (EIA), gas- and coal-fired generation appear to be the most likely power-generation alternatives if the power from Units 3 and 4 is replaced. These alternatives are evaluated assuming that the replacement power generation plant is located at either the Turkey Point site or some other unspecified alternate location in Florida. In addition, construction of new nuclear power generation capacity was evaluated at the Turkey Point site or an unspecified site 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 comments received during the scoping process or received on Draft Supplement 5 to the GEIS identified any new issue applicable to Turkey Point Units 3 and 4 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 Turkey Point Units 3 and 4.

FPL's license renewal application presents an analysis of the Category 2 issues plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the FPL analysis for each issue and has conducted an independent review of each issue. Five Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at Turkey Point. Four 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 Turkey Point Units 3 and 4 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 1972 *Final Environmental Statement Related to Operation of Turkey Point Plant.*

Twelve Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Four of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For all 12 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Turkey Point Units 3 and 4, 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 Turkey Point 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 Turkey Point Units 3 and 4. 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 Turkey Point Units 3 and 4 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.

Abbreviations/Acronyms

°	degree
µCi	microcurie(s)
µCi/ml	microcuries per milliliter
µGy	microgray(s)
µm	micrometer(s)
µSv	microsievert(s)
ac	acre(s)
AC	alternating current
ACC	averted cleanup and decontamination costs
ACS	American Cancer Society
AEA	Atomic Energy Act of 1954
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
AOC	present value of averted offsite property damage cost(s)
AOE	present value of averted occupational exposure (costs)
AOSC	present value of averted onsite cost(s)
APE	present value of averted public exposure (costs)
ATWS	anticipated transient without scram
BEIR	biological effects of ionizing radiation
Bq	becquerel(s)
BMT	basemat melt-through
Btu	British thermal unit(s)
C	Celsius
CCW	component cooling water
CDF	core damage frequency
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
CVCS	chemical and volume control system
CWA	Clean Water Act
DBA	design-basis accident
DCH	direct containment heating

DERM	Miami-Dade County Department of Environmental Resources Management
DG	diesel generator
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DPR	demonstration project reactor
DSM	demand-side management
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	Federal Aviation Administration
FAC	Florida Administrative Code
FCMP	Florida Coastal Management Program
FDCA	Florida Department of Community Affairs
FDEP	Florida Department of Environmental Protection
FDHR	Florida Division of Historic Resources
FDOH	Florida Department of Health
FERC	Federal Energy Regulatory Commission
FES	Final Environmental Statement
FFWCC	Florida Fish and Wildlife Conservation Commission
FGDL	Florida Geographic Data Library
FNAI	Florida Natural Areas Inventory
FPL	Florida Power & Light Company
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 (criterion)
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
gpm	gallon(s) per minute
ha	hectare(s)
HHSI	high heady safety injection
HLW	high-level waste
HPS	Hialean/Preston System
hr	hour(s)
Hz	Hertz
ICRP	International Commission on Radiological Protection
in.	inch(es)
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISFSI	independent spent fuel storage installation
ISLOCA	interfacing systems loss-of-coolant accident
kg	kilogram(s)
km	kilometer(s)
kV	kilovolt(s)
kV/m	kilovolt(s) per meter
kWh	kilowatt hour(s)
L	liter(s)
lb	pound(s)
LNG	liquefied natural gas
LNT	linear nonthreshold
LOCA	loss-of-coolant accident
LQ	linear quadratic
LWR	light-water reactor
m	meter(s)
m/s	meter(s) per second
m^3/d	cubic meters per day
m^3/s	cubic meter(s) per second
mA	milliampere(s)
MACCS2	MELCOR Accident Consequence Code System 2
MDWSD	Miami-Dade Water and Sewer Department
mi	mile(s)

mGy	milligray(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])
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
NASCAR	National Association for Stock Car Auto Racing
NCRP	National Council on Radiation Protection and Measurements
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)
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NWPPC	Northwest Power Planning Council
ODCM	Offsite Dose Calculation Manual
OL	operating license
PAR	passive autocatalytic recombiners
PDS	plant damage state
PM_{10}	particulate matter, 10 µm or less in diameter
ppt	part(s) per thousand
PRA	Probabilistic Risk Assessment
PRC	power replacement costs

PSA	Probabilistic Safety Assessment
PSD	prevention of significant deterioration
PSW	plant service water
PWR	pressurized water reactor
RAB	reactor auxiliary building
RAI	request for additional information
RCP	reactor coolant pump
RCS	Reactor Coolant System
REMP	radiological environmental monitoring program
RPHP	Radiation and Public Health Project
rms	root mean square
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
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
SFWMD	South Florida Water Management District
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
TB_q	terrabequerel(s)
UDB	urban development boundary
UFSAR	Updated Final Safety Analysis Report
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
U.S.	United States
USAF	United States Air Force
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
yr	year(s)

1.0 Introduction

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

The Florida Power & Light Company (FPL) operates Turkey Point Plant Units 3 and 4 in southern Florida under OLs DPR-31 and DPR-41, which were issued by the NRC. These OLs will expire in July 2012 for Unit 3 and April 2013 for Unit 4. On September 8, 2000, FPL submitted an application to the NRC to renew the Turkey Point Units 3 and 4 OLs for an additional 20 years under 10 CFR Part 54. 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 2000a) 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 Turkey Point Units 3 and 4 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 man's environment and the maintenance and enhancement of long-term productivity, and the irreversible or irretrievable commitment of resources). The final chapter also presents the staff's preliminary recommendation with respect to the proposed license renewal action.

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

- the preparers of the supplement
- the chronology of correspondence related to the NRC staff's review for this SEIS
- the organizations contacted during the development of this SEIS
- FPL's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and sent during the evaluation process)
- GEIS environmental issues that are not applicable to Turkey Point Units 3 and 4.

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

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

The GEIS included a determination of whether the analysis of the environmental issue could be applied to all plants, and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, **Category 1** issues are those that meet all of the following criteria:

- 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.

- 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).

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

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

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

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues were not categorized. The latter two issues, environmental justice and chronic effects of electromagnetic fields, are to be addressed in a plant-specific analysis. Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, and 75 apply to operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

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

the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

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

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

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

- consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered, or (2) relevant to mitigation
- consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives
- discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b)
- contain an analysis of any Category 1 issue unless there is new and significant 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 Turkey Point Units 3 and 4 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 Turkey Point Units 3 and 4 would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the licenses for Units 3 and 4 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 Turkey Point Units 3 and 4. This review was performed by personnel from FPL and its support organization that 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 2000a). The search for new information includes (1) review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) review of records of public comments; (3) review of environmental quality standards and regulations; (4) coordination with Federal, State, and local environmental protection and resource agencies; and (5) review of the technical literature. New information discovered by the staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of the issue that are not affected by the new information.

Chapters 3 through 7 discuss the environmental issues considered in the GEIS that are applicable to Turkey Point Units 3 and 4. At the beginning of the discussion of each set of issues, there is a table that identifies the issues to be addressed and lists the sections in the GEIS where the issue is discussed. Category 1 and Category 2 issues are listed in separate tables. For Category 1 issues for which there is no new and significant information, the table is followed by a set of short paragraphs that state the GEIS conclusion codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, followed by the staff's analysis and conclusion. For Category 2 issues, in addition to the list of GEIS sections where the issue is discussed, the tables list the subparagraph of 10 CFR 51.53(c)(3)(ii) that describes the analysis required and the SEIS sections where the analysis is presented. The SEIS sections that discuss the Category 2 issues are presented immediately following the table.

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts with the environmental impacts of alternatives. The evaluation of the FPL license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the Federal Register (FR; 65 FR 60693 [NRC 2000b]). The staff published a notice of intent to prepare an EIS and conduct scoping (65 FR 63636 [NRC 2000c]). Two public scoping meetings were held on December 6, 2000, in Homestead, Florida. Comments received during the scoping meetings were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Turkey Point Units 3*

and 4, Florida (NRC 2001). Comments that are applicable to this environmental review are presented in Part 1 of Appendix A.

The staff and its contractors retained to assist the staff visited the Turkey Point site on December 6 and 7, 2000, to gather additional information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping, and consulted with Federal, State, regional, and local agencies. A list of the organizations consulted is provided in Appendix D. Other documents related to Turkey Point Units 3 and 4 were also reviewed and are referenced.

The staff followed the review guidance contained in NUREG-1555, Supplement 1, in the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000a). The results of the staff evaluation are contained in this SEIS.

On June 22, 2001, the U.S. Environmental Protection Agency published the Notice of Availability of the draft SEIS (66 FR 33533). A 75-day comment period began on that date during which members of the public could comment on the preliminary results of the NRC staff's review. During this comment period, two public meetings were held in Homestead, Florida, on July 17, 2001. 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 Turkey Point Units 3 and 4 draft SEIS ended September 6, 2001. Comments made during the 75 day comment period, including those made at the two public meetings, are presented in Part 2 of Appendix A. The NRC responses to these comments are also provided.

This SEIS presents the staff's analysis that considers and weighs the environmental effects of the proposed renewal of the OL for Turkey Point Units 3 and 4, 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 decision-makers would be unreasonable.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OLs for Turkey Point Units 3 and 4 (as fossil-powered generating plants, Turkey Point Units 1 and 2 are outside the scope of this SEIS). The Turkey Point Plant is located in southern Florida on the shore of Biscayne Bay, approximately 40 km (25 mi) south of Miami, 13 km (8 mi) east of Florida City, 15 km (9 mi) southeast

of Homestead, and 16 km (10 mi) north of Key Largo. The plant has two Westinghouse-designed light-water reactors, each with a design rating for a net electrical power output of 693 megawatts electric (MW[e]). Plant cooling is provided by a closed network of canals that dissipate heat primarily to the air. Units 3 and 4 produce electricity to supply the needs of more than 250,000 homes. The current OL for Unit 3 expires on July 19, 2012, and for Unit 4 on April 10, 2013. By letter dated September 8, 2000, FPL submitted an application to the NRC (FPL 2000b) to renew these OLs for an additional 20 years of operation (i.e., until July 19, 2032, for Unit 3 and April 10, 2033, for Unit 4).

1.4 The Purpose and Need for the Proposed Action

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

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

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

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

1.5 Compliance and Consultations

FPL is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In its ER, 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 Turkey Point Units 3 and 4 license renewal. Authorizations and consultations most relevant to the proposed OL renewal action are summarized in Table 1-1. The full list of authorizations and consultations provided by FPL is 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 states that FPL is in compliance with applicable environmental standards and requirements for Turkey Point Units 3 and 4. The staff has also not identified any environmental issues that are both new and significant.

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

Agency	Authority	Requirement	Number	Permit Expiration or Consultation Date	Activity Covered
NRC	Atomic Energy Act, 10 CFR Part 50	Operating license	DPR-31 (Unit 3) DRP-41 (Unit 4)	July19, 2012 (Unit 3) April 10, 2013 (Unit 4)	Operation of Turkey Point Units 3 and 4
FWS and NMFS	Endangered Species Act, Section 7	Consultation	NA	Consultation initiated September 7, 1999	Operation during the renewal term
FDEP	Florida Statutes. Section 403.088	NPDES permit and FWPCA Section 401 certification	FL0001562	January 6, 2005	Permit for discharge of wastewater and once-through cooling water to the closed cycle recirculating cooling canal system. Section 1.E.15 of the permit states that the permit constitutes certification of compliance with §401 of the FWPCA.

Table 1-1. (contd)

Agency	Authority	Requirement	Number	Permit Expiration or Consultation Date	Activity Covered
FDEP	Florida Statutes, Chapter 403	Air emissions permit	0250003-002-AV	December 31, 2003	Emissions from diesel emergency generators, miscellaneous diesel engines, and other miscellaneous units
FDCA	Coastal Zone Management Act, Section 307	Consistency determination	FL200008-250606C	Letter from FDCA's FCMP to FPL dated October 4, 2000	Consistency of license renewal with the Florida Coastal Management Program
FDHR	National Historic Preservation Act, Section 106	Consultation	NA	Letter from FDHR to FPL, October 22, 1999	Impact on sites listed or eligible for listing in the National Register of Historic Places

FCMP - Florida Coastal Management Program.
FDCA - Florida Department of Community Affairs.
FDEP - Florida Department of Environmental Protection.
FDHR - Florida Division of Historic Resources.
FWPCA - Federal Water Pollution Control Act (also known as the Clean Water Act).
FWS - U.S. Fish and Wildlife Service.
NMFS - National Marine Fisheries Service.
NPDES - National Pollutant Discharge Elimination System.
NA - Not applicable.

1.6 References

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

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

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

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

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

Coastal Zone Management Act (CZMA). 16 USC 1451, et seq.

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

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

Florida Power & Light Company (FPL). 2000a. *Applicant's Environmental Report – Operating License Renewal Stage Turkey Point Units 3 and 4.* Miami, Florida.

Florida Power & Light Company (FPL). 2000b. *Application for Renewed Operating Licenses, Turkey Point Units 3 and 4.* Miami, Florida.

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

National Historic Preservation Act of 1966 (NHPA). 16 USC 470, et seq.

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

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). 2000a. *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). 2000b. "Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of License Nos. DPR-31 and DPR-41 for an Additional Twenty-Year Period." *Federal Register.* Vol. 64, No. 198, pp. 60693-60694 (October 12, 2000).

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

The Florida Power & Light Company's (FPL's) Turkey Point Plant is located on the shore of Biscayne Bay in Florida's South Miami-Dade County. The plant consists of four units. Units 3 and 4 are nuclear reactors and are the subject of this action. Units 1 and 2 are fossil-fuel units and are not covered by this action. Each nuclear reactor is a pressurized light-water reactor (LWR) with three steam generators producing steam that turns turbines to generate electricity. In addition to the nuclear and fossil-fuel units, the site features a 2711-ha (6700-ac) system of closed, recirculating cooling canals that all four units use for heat rejection. 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

Turkey Point Units 3 and 4 are located on 9700 ha (24,000 ac) of FPL-owned land in southern Florida (FPL 2000a). Figures 2-1 and 2-2 show the site location and features within 80 km and 10 km (50 mi and 6 mi), respectively. The site is surrounded by an exclusion area whose radius measures 1.27 km (0.79 mi) (FPL 2000a).

The region surrounding Turkey Point Units 3 and 4 was identified in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999)[a] as having a high population density. FPL refuels each Turkey Point nuclear unit on an 18-month schedule, when site employment increases by as many as 800 to 900 workers for temporary duty (30 to 40 days). FPL employs a work force of 730 to 775 permanent employees and about 185 contractor employees at Turkey Point Units 3 and 4. The plant is located approximately 40 km (25 mi) south of Miami. The nearest city limits are Florida City, approximately 13 km (8 mi) to the west, and Homestead, approximately 15 km (9 mi) to the northwest of the site. Key Largo is approximately 16 km (10 mi) south of Turkey Point Units 3 and 4.

The Turkey Point site is on the shore of a part of Biscayne Bay that, together with several miles of the shoreline north of the plant, compose the Biscayne National Park. The Biscayne National Park headquarters is located approximately 3.2 km (2 mi) north of Turkey Point Units 3 and 4, adjacent to the metropolitan Miami-Dade County Homestead Bayfront Park. The Everglades

(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.

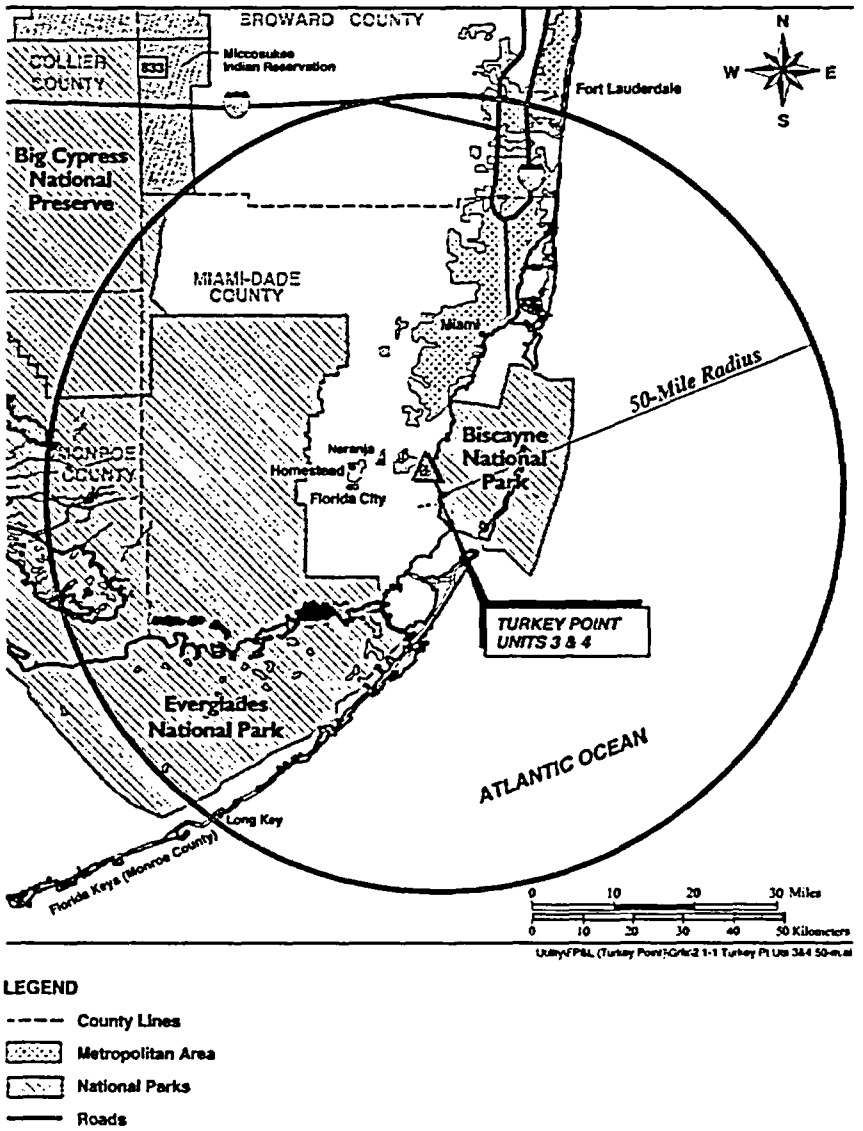

Figure 2-1. Location of Turkey Point Units 3 and 4, 80-km (50-mi) Region

National Park is approximately 24 km (15 mi) west of the site. Small portions of the Miccosukee Indian Reservation and the Big Cypress National Preserve are within 80 km (50 mi) of Turkey Point Units 3 and 4; portions of Broward and Monroe counties and a small portion of Collier County are also within 80 km (50 mi) of the plant. Monroe County encompasses portions of Everglades National Park and Big Cypress National Preserve as well as the Florida Keys.

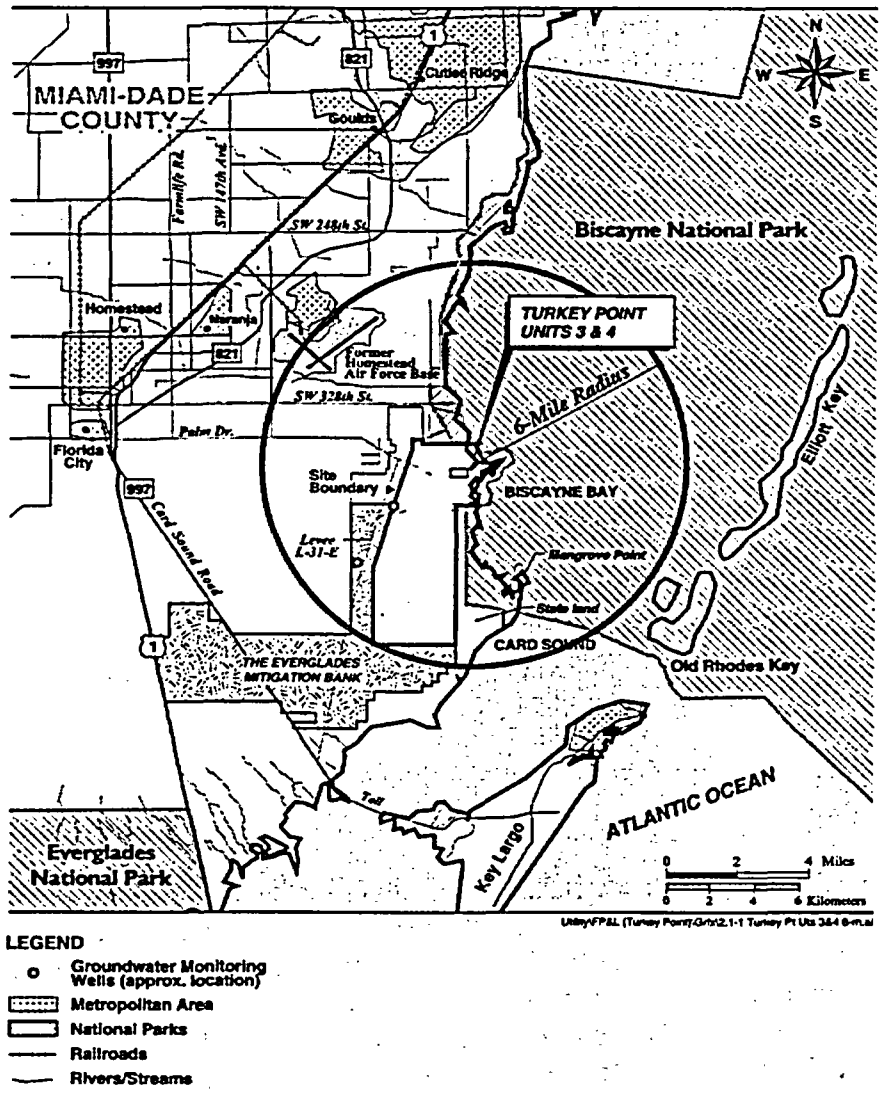

Figure 2-2. Location of Turkey Point Units 3 and 4, 10-km (6-mi) Region

Mangrove Point forms the dividing line between Biscayne Bay and Card Sound. The northern half of Mangrove Point is part of Biscayne National Park, and the southern half is State-owned.

Turkey Point was built on mangrove-covered tidal flats adjacent to Biscayne Bay. The land is low and swampy. Mangrove swamps extend inland approximately 5 to 6.5 km (3 to 4 mi). Most undeveloped portions of the site remain under 2 to 8 cm (1 to 3 in.) of water, even during low tide. The terrain is flat and rises gently from sea level at the shore to about 3 m (10 ft) above

mean sea level 13 to 15 km (8 to 10 mi) west of the site in Homestead. Across Biscayne Bay, about 8 to 13 km (5 to 8 mi) to the east, is a series of offshore barrier islands with a northeast-southwest orientation between the bay and the Atlantic Ocean.

The ground elevation at the site is typically less than 0.3 m (1 ft) above the mean sea level. The direction of surface drainage is to the east and south, toward Biscayne Bay and Card Sound. The area contains no lakes or perennial streams. Surface water runoff in the region is not naturally limited to confined watercourses such as rivers or streams; it also flows over the surface as a broad, shallow sheet called "sheet flow." Canal, levee, and road construction during this century has diverted much of this flow, thereby drying land areas for agricultural and other uses. Flood control levee L31-E, which has a crest elevation of approximately 2 m (7 ft) above sea level with a roughly north-south orientation, lies at the inland boundary of the FPL cooling canal system.

2.1.1 External Appearance and Setting

The 120-m (400-ft) stacks for fossil fuel Units 1 and 2 are distinctive features of the Turkey Point site and can be seem from a considerable distance. Another distinctive feature of the site is the 2700-ha (3.2-km by 8-km) (6700-ac [2-mi by 5-mi]) system of closed recirculating cooling canals that all four units use for heat rejection.

FPL currently does not have an independent spent fuel storage installation (ISFSI) located on the Turkey Point site.

The geology around Turkey Point site is fairly simple. The site lies within the Floridian Plateau, a partly submerged peninsula of the continental shelf whose edge is about 29 km (18 mi) offshore to the east. This peninsula is underlain by a thick 1200- to 4600-m (4000- to 15,000-ft) series of sedimentary rocks consisting of limestones and associated formations and range in age from Paleozoic to Recent. These are underlain by igneous and metamorphic basement rocks, primarily Pre-Cambrian granites. Examination of geologic structures indicates a lack of tectonic activity during the past 500,000 years. Because of the absence of structural deformation, faults are uncommon and there is no evidence of bedrock faults in the site area (AEC 1972).

The predominant surface feature is bedrock outcrop of Miami oolite, a deposit of permeable limestone extending to about 6 m (20 ft) below sea level, overlain by organic swamp soils varying from approximately 1.2 to 2.4 m (4 to 8 ft) thick. Pockets of silt and clay separate the organic soils and bedrock in some locations (AEC 1972).

2.1.2 Reactor Systems

Turkey Point Units 3 and 4 are shown in Figure 2-3. Each unit is a pressurized LWR with three steam generators, which produce steam that turns turbines to generate electricity. Each unit, designed and fabricated by the Westinghouse Electric Corporation (AEC 1972), is capable of an output of 2300 MW(t), with a corresponding gross electrical output of approximately 795 MW(e). Onsite electrical power usage amounts to slightly more than 100 MW(e), leaving each unit with a reliable net summer rating of 693 MW(e) (FPL 2000a).

Each reactor containment structure is approximately 64 m (210 ft) tall and 39 m (124 ft) in diameter. Each is a dry containment structure designed to withstand environmental effects and the internal pressure and temperature accompanying a postulated loss-of-coolant accident or steam-line break. Together with its engineered safety features, each containment structure is designed to adequately retain fission products that escape from the reactor coolant system. Turkey Point Units 3 and 4 are licensed for fuel that is slightly enriched uranium dioxide, up to 4.5 percent by weight uranium-235 (FPL currently uses a maximum of 4.45 percent enrichment). FPL operates the reactors at an average fuel discharge burnup of approximately 45,000 megawatt-days per metric ton uranium (MWd/MTU).

2.1.3 Cooling and Auxiliary Water Systems

Turkey Point Units 3 and 4 use three-loop cooling systems for heat dissipation. The primary loop is a sealed system that carries heat from the reactors to the steam generators. The secondary loop, which is also sealed, carries heat from the steam generators through the turbines to the condensers. The tertiary system carries heat from the condensers to a recirculating canal system where the heat is released to the environment. The temperature rise in the water from the recirculating canals across the condenser is about 10 C° (18 F°) during full power operation. The primary and secondary loops use treated freshwater; the tertiary loop uses saltwater.

FPL obtains about 0.044m^3/s (1.5 ft^3/s) of water from the Miami-Dade public water supply system's Newton water-treatment plant for uses related to Turkey Point Units 3 and 4. Most of this water is used as demineralizer makeup water for use in the primary and secondary cooling loops. A small fraction of the water is used as potable water and for fire protection. FPL does not withdraw either groundwater or surface water for makeup or potable water uses. Makeup water for the canal system comes from used process water (which is treated and released to the canal system), incident rainfall, stormwater runoff, and possibly groundwater infiltration. Sanitary wastewater is treated and then released to the groundwater through an injection well.

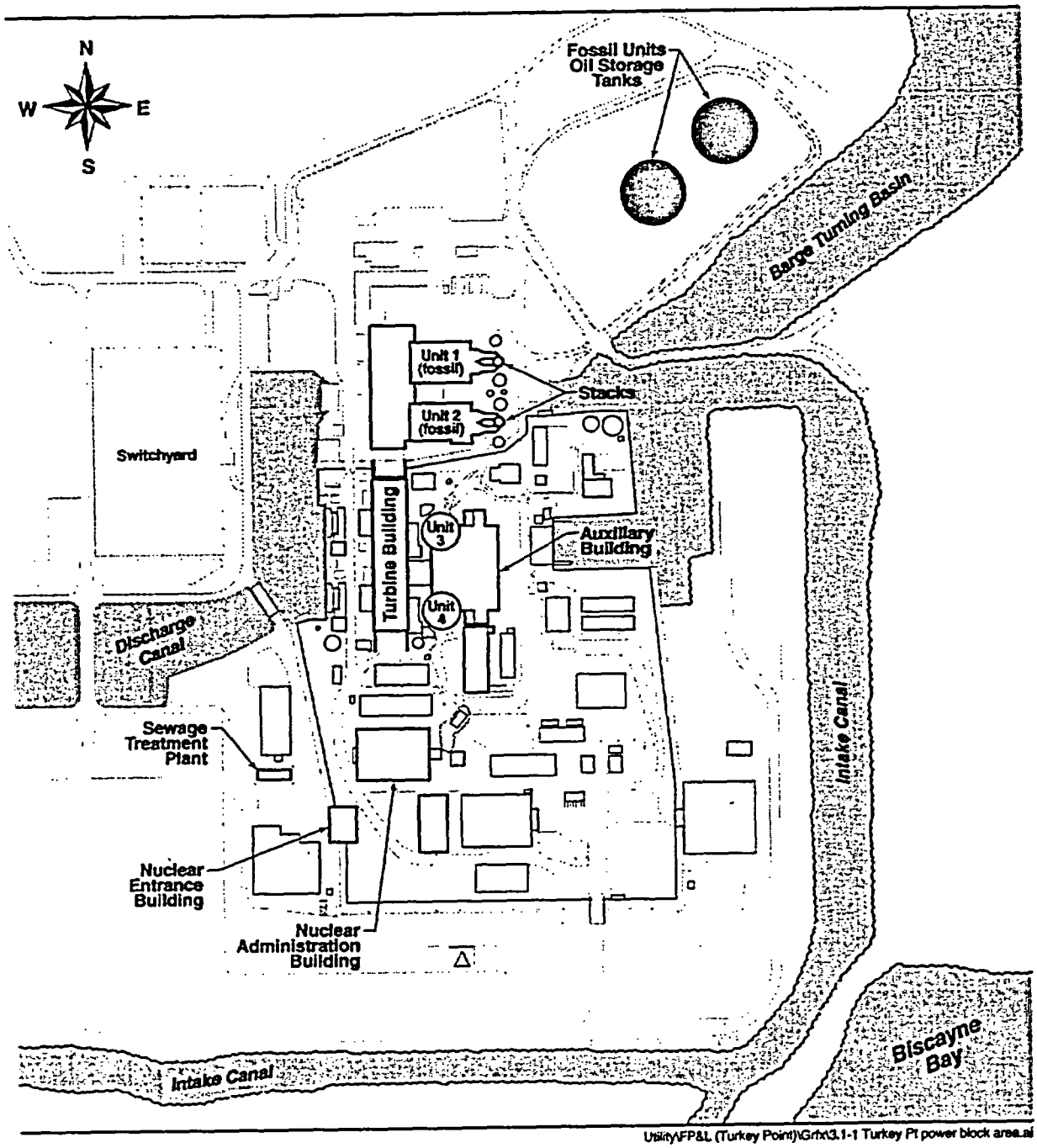

Figure 2-3. Turkey Point Site Powerblock Area

The cooling canal system, which services Turkey Point Units 1, 2, 3, and 4, covers about 2700 ha (6700 ac). It consists of 32 channels that carry warm water south from the plant and 8 channels that return water to the plant. The channels are about 60 m (200 ft) wide and have a water depth of 0.3 to 1 m (1 to 3 ft). They are separated by 27-m- (90-ft-) wide berms. In all, the total length of the channels is about 270 km (168 mi), and the effective water surface area is about 1560 ha (3860 ac). Flow in the cooling canal system attributable to Turkey Point Units 3 and 4 is about 82 m^3/s (1.3 million gpm). The closed canal system is shown in Figure 2-4.

Cooling water for the condenser is withdrawn from the closed cooling canal system. Traveling screens and strainers remove debris from the cooling water inflow. Large objects are prevented from entering the condenser first by bars with 7- to 10-cm (3- to 4-in.) on-center. These are raked periodically to remove trapped material, which is carted off for disposal. The water then flows through vertical traveling screens with a 2-cm (3/8-in.) mesh size to remove debris, which is routed to a collection basket. FPL does not use biocontrol chemicals in the circulating water system.

The canal system does not discharge directly to fresh or marine surface waters. However, an exchange of water between the canal system and groundwater is likely because the canals are unlined. An interceptor ditch is located along the west side of the canal system. During the dry season, when the natural groundwater gradient is from Biscayne Bay and Card Sound toward the Everglades, water is pumped from the interceptor ditch to the canal system to create an artificial groundwater gradient from the Everglades into the ditch. This prevents flow of hypersaline water from the cooling canals toward the Everglades. Maintenance of the cooling canal system includes mechanical removal of submerged, rooted marine plants on about a 3-year cycle and removal of terrestrial woody vegetation from the canal berms on a 10-year cycle.

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 Turkey Point Units 3 and 4 operation. These systems reduce radioactive liquid, gaseous, and solid effluents before they are released to the environment. The Turkey Point Units 3 and 4 waste disposal system meets the design objectives of 10 CFR Part 50, Appendix I, 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.

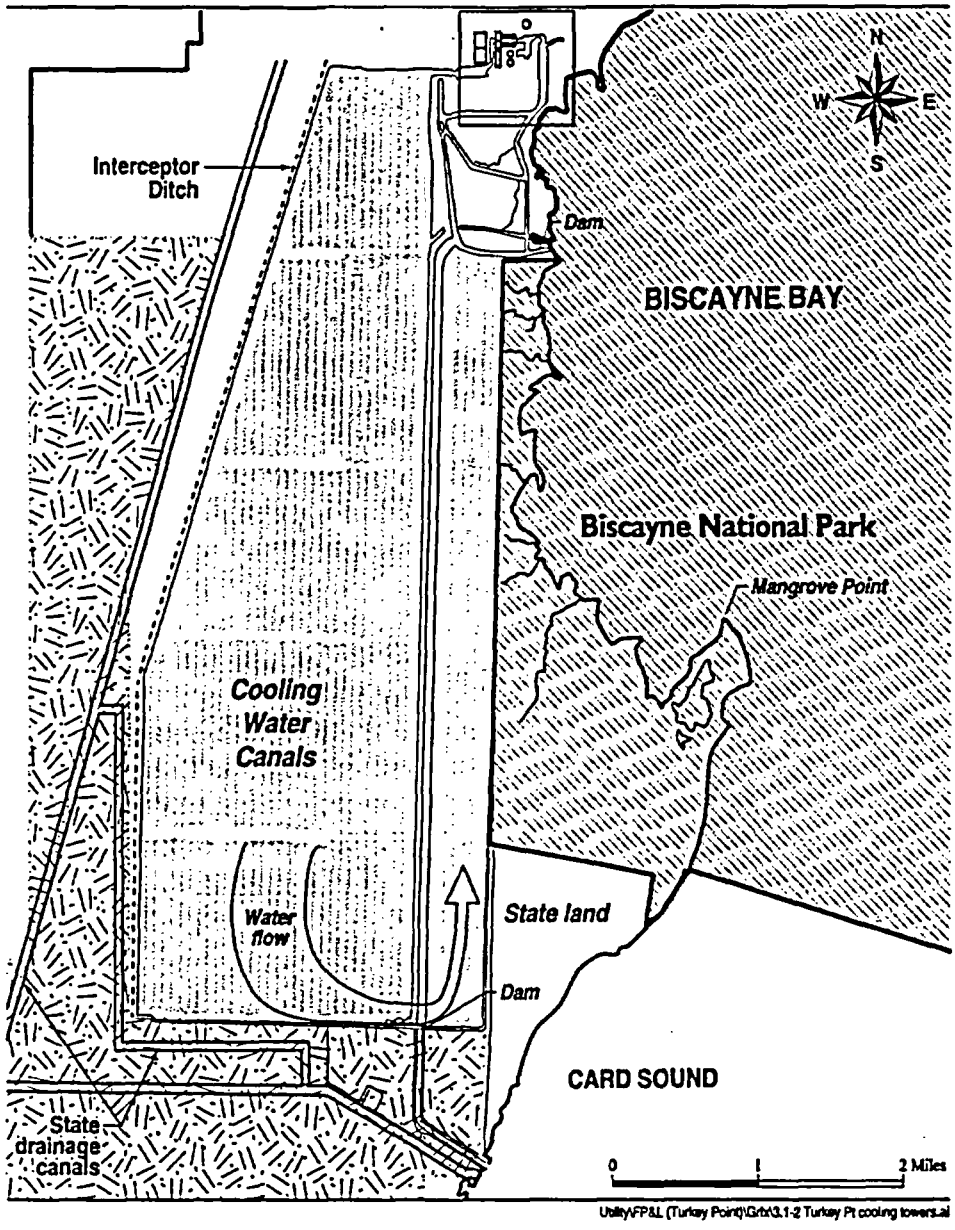

Figure 2-4. Turkey Point Site Cooling Canal System

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

Fuel rods that have exhausted a certain percentage of their fuel and are removed from the reactor core for disposal are called spent fuel. Turkey Point Units 3 and 4 currently operate on a staggered 18-month refueling cycle per unit, resulting in at least one refueling every year and two refuelings every third year. Spent fuel is stored onsite in the spent fuel pool in the Auxiliary Building (FPL 2000a).

The waste disposal system used for processing liquid, gaseous, and solid wastes is common to Units 3 and 4, with the exception of the reactor coolant drain tanks and reactor coolant drain tank pumps.

The Offsite Dose Calculation Manual (ODCM) describes the methods used for calculating radioactivity concentrations in the environment and the estimated potential offsite doses associated with liquid and gaseous effluents from Turkey Point Units 3 and 4 (FPL 1999a). The ODCM also specifies controls for release of liquid and gaseous effluents to ensure compliance with the following:

- The concentration of radioactive liquid effluents released from the site to the unrestricted area will not exceed 10 times the concentration specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained gases. For dissolved or entrained noble gases, the concentration shall not exceed 7.4 Bq/mL (2 E-04 μCi/mL).

- The dose or dose commitment per reactor to a member of the public from any radioactive materials in liquid effluents released to unrestricted areas shall be limited to (1) less than or equal to 15 μSv (1.5 mrem) to the total body and less than or equal to 50 μSv (5 mrem) to any organ during any calendar quarter, and (2) less than or equal to 30 μSv (3 mrem) to the total body and less than or equal to 100 μSv (10 mrem) to any organ during any calendar year.

- The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to (1) less than or equal to 5 mSv/yr (500 mrem/yr) to the total body and less than or equal to 30 mSv (3000 mrem/yr) to the skin

due to noble gases, and (2) less than or equal to 15 mSv/yr (1500 mrem/yr) to any organ due to iodine-131, iodine-133, tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days.

- The air dose per reactor to areas at and beyond the site boundary due to noble gases released in gaseous effluents shall be limited to (1) less than or equal to 50 μGy (5 mrad) for gamma radiation and less than or equal to 100 μGy (10 mrad) for beta radiation during any calendar quarter, and (2) less than or equal to 100 μGy (10 mrad) for gamma radiation and less than or equal to 200 μGy (20 mrad) for beta radiation during any calendar year.

- The dose to any individual member of the public from the nuclear facility operations will not exceed the maximum limits of 40 CFR Part 190 (<0.25 mSv [25 mrem]) and 10 CFR Part 20 (≤5 mSv [0.5 rem] in a year and ≤20 μSv [2 mrem] in any hour).

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

Potentially radioactive liquid wastes from the chemistry laboratory, containment sumps, floor drains, showers, and miscellaneous sources are collected in waste holdup tanks. Liquid from the reactor coolant loop drains, accumulators, and excess letdown are collected and transferred to the chemical and volume control system (CVCS). Liquids flow to the waste holdup tank by gravity, then are pumped to the waste monitor tank where the activity level of the liquid waste is determined and recorded prior to discharge through a radiation monitor (FPL 1999b).

Liquid requiring cleanup before being discharged to the environment is processed by the waste disposal demineralizer. The liquid from the waste disposal demineralizer is routed directly to one of the three radwaste facility waste monitor tanks. There are three discharge points from the units: steam generator blowdown from each unit and common radwaste monitor tank discharge. Liquid wastes in the waste monitor tanks are isolated and recirculated for at least one volume prior to sampling and discharge (FPL 1999b). Aliquots of representative pre-release samples from the waste disposal system are isotopically analyzed for gamma-emitting isotopes (FPL 2000b). The radiochemical analysis is the basis for recording the released activity; however, the radiation monitor provides surveillance over the operation by automatically closing the discharge control valve if the liquid activity level exceeds a preset value. The liquid effluents are a mixture from both Turkey Point Units 3 and 4. Therefore the measured releases from the common discharge point are apportioned equally to both Units 3 and 4. The dose limit per reactor is applied to the common discharge point when routine releases are made. This ensures that the dose limit of a single unit is not exceeded by the site (FPL 1999a).

The ODCM prescribes the alarm/trip setpoints for the liquid effluent radiation monitors, which are derived from 10 times the effluent concentration limits provided in 10 CFR Part 20, Appendix B, Table 2, Column 2. 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 1999a).

During 1999, there were 160 batch releases of liquid effluents for the 2 units in a total volume of 3500 m^3 (9.25 E+05 gal) of liquid. The liquid waste holdup capacity is approximately 130 m^3 (34,300 gal) in two waste holdup tanks, one located in the auxiliary building and one in the radwaste facility. The actual liquid waste generated is reported in the *Turkey Point Units 3 and 4 Annual Radioactive Effluent Release Report* (FPL 2000b).

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

Radioactive gaseous wastes at Turkey Point are created during plant operation from degassing reactor-coolant discharge to the CVCS, displacement of cover gases, miscellaneous equipment vents, relief valves, and sampling operation and gas analysis for hydrogen and oxygen in cover gases. Most of the gas received by the waste disposal system is cover gas displaced from the CVCS holdup tanks as they fill with liquid. Gaseous wastes are stored in decay tanks for natural decay and then released through the monitored plant vent. The cover gas is reused to minimize the number of tank releases. The wastes are monitored and released at a permissible rate and activity as prescribed by the ODCM (FPL 1999a).

The quantity of radioactivity contained in each gas decay tank is restricted (1) to ensure that if an uncontrolled release of the tank's contents were to occur, the resulting total body exposure to an individual at the exclusion area boundary would not exceed 5 mSv (0.5 rem), and (2) to control the concentration of potentially explosive gases to below flammability limits. There are six welded carbon steel tanks used to contain the compressed waste gases (hydrogen, nitrogen, and fission gases) until they decay and are ready to be vented to the atmosphere (FPL 1999b).

The radioactive gaseous wastes are released through four monitored release points: (1) a common plant vent via a stack above the containment building, (2) the Unit 3 spent fuel pit vent, and (3) the condenser air ejector vents from each unit. If primary-to-secondary leakage occurs, then there can also be unmonitored radioactive airborne releases from the secondary steam systems of each unit. The quantity of material released from these unmonitored releases is accounted for using specific procedures (FPL 1999a). Monitored releases employ the following techniques to determine the radioactivity in airborne releases: (1) gamma spectrum analysis for fission and activation gases, (2) removal of particulate material by filtration and subsequent gamma spectrum analysis for strontium-89 and -90 and gross alpha analysis, (3) absorption of

halogen radionuclides on a charcoal filter and subsequent gamma spectral analysis, and (4) analysis of water vapor in a gas sample for tritium using liquid scintillation techniques (FPL 2000b).

The ODCM prescribes alarm/trip setpoints for the monitor and control instrumentation to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20 for gaseous effluents (FPL 1999a).

In 1999, there were 10 batch releases from Turkey Point Unit 3 and 11 batch releases from Unit 4 (FPL 2000b). The number of releases may vary from year to year, but this number of releases is representative of those releases. FPL does not anticipate any increase in gaseous releases during the renewal period.

2.1.4.3 Solid Waste Processing

Solid wastes from Turkey Point Units 3 and 4 consist of spent resin, filters, sludge, evaporator bottoms, dry compressible waste, irradiated components (control rods, etc.), and other noncompressible waste (FPL 1999b). Solid wastes are packaged in containers for removal to a disposal facility.

Solid waste from Turkey Point Units 3 and 4 is transported to Oak Ridge, Tennessee, and consigned to a licensed processing facility for volume-reduction and decontamination activities. The material that remains after volume reduction is transported by the processor to Barnwell, South Carolina, or Clive, Utah, depending on the activity limits. The material shipped directly to Barnwell is processed by Chem-Nuclear Services, Inc., and buried.

Disposal and transportation are performed in accordance with the applicable requirements of 10 CFR Part 61 and Part 71, respectively. There are no releases to the environment from radioactive solid wastes created at Turkey Point Units 3 and 4.

In 1999, Turkey Point Units 3 and 4 made 16 shipments of solid waste with a volume of 55 m^3 (1942 ft^3) and a total activity of 31 TBq (834.3 Ci) (FPL 2000b). These shipments are representative of the shipments made in the past 5 years and are not expected to change appreciably during the license renewal period.

2.1.5 Nonradioactive Waste Systems

The FPL nonradioactive waste system consists of a contact stabilization treatment plant for sanitary waste (FPL 2000a) located west of the powerblock area. The treated wastewater is disposed of through an approximately 25-cm (10-in.)-diameter, 15-m- (50-ft-) deep underground

injection well located next to the treatment facility. The residual wet sludge is disposed of at the Miami-Dade Water and Sewer Department's South District Wastewater Treatment Facility. FPL reports the average daily flow, carbonaceous biological oxygen demand, total suspended solids, fecal coliform bacteria, pH, total residual chlorine, and nitrate concentrations to the Florida Department of Environmental Protection (FDEP).

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 conducted at Turkey Point 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 Turkey Point nuclear units on a staggered 18-month schedule, resulting in at least one refueling every year and two refuelings every third year (FPL 2000a). A third of the core is offloaded at each refueling. Up to an additional 800 to 900 workers are onsite during a typical 30- to 40-day outage. FPL provided an appendix in the Updated Final Safety Analysis Report (UFSAR) regarding the aging management review to manage the effects of aging on systems, structures, and components in accordance with 10 CFR Part 54 (FPL 1999b). Chapter 3 and Appendix B of the Turkey Point license renewal application describe the programs and activities that will manage the effects of aging during the license renewal period (FPL 2000c). 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 renewed licenses.

2.1.7 Power Transmission System

Turkey Point Units 3 and 4 share a switchyard and transmission lines with Turkey Point Units 1 and 2. Eight transmission lines leave the Turkey Point site in two 101-m- (330-ft-) wide corridors. Seven of the lines leave the site in the transmission corridor going north to the Davis substation. These lines, which were placed in service in 1967 for Turkey Point Units 1 and 2, are listed in the Final Environmental Statement (FES; AEC 1972). The eighth line leaves the plant going west to Florida City. It was constructed in 1990. Four additional lines were constructed to connect the Davis substations at Doral, Levee, and Flagami.

The transmission lines are shown in Figure 2-5. The northbound transmission lines share a common corridor where possible. As a result, the total corridor length of about 92 km (57 mi) is shorter than the total transmission line length of about 320 km (200 mi). Statistics associated

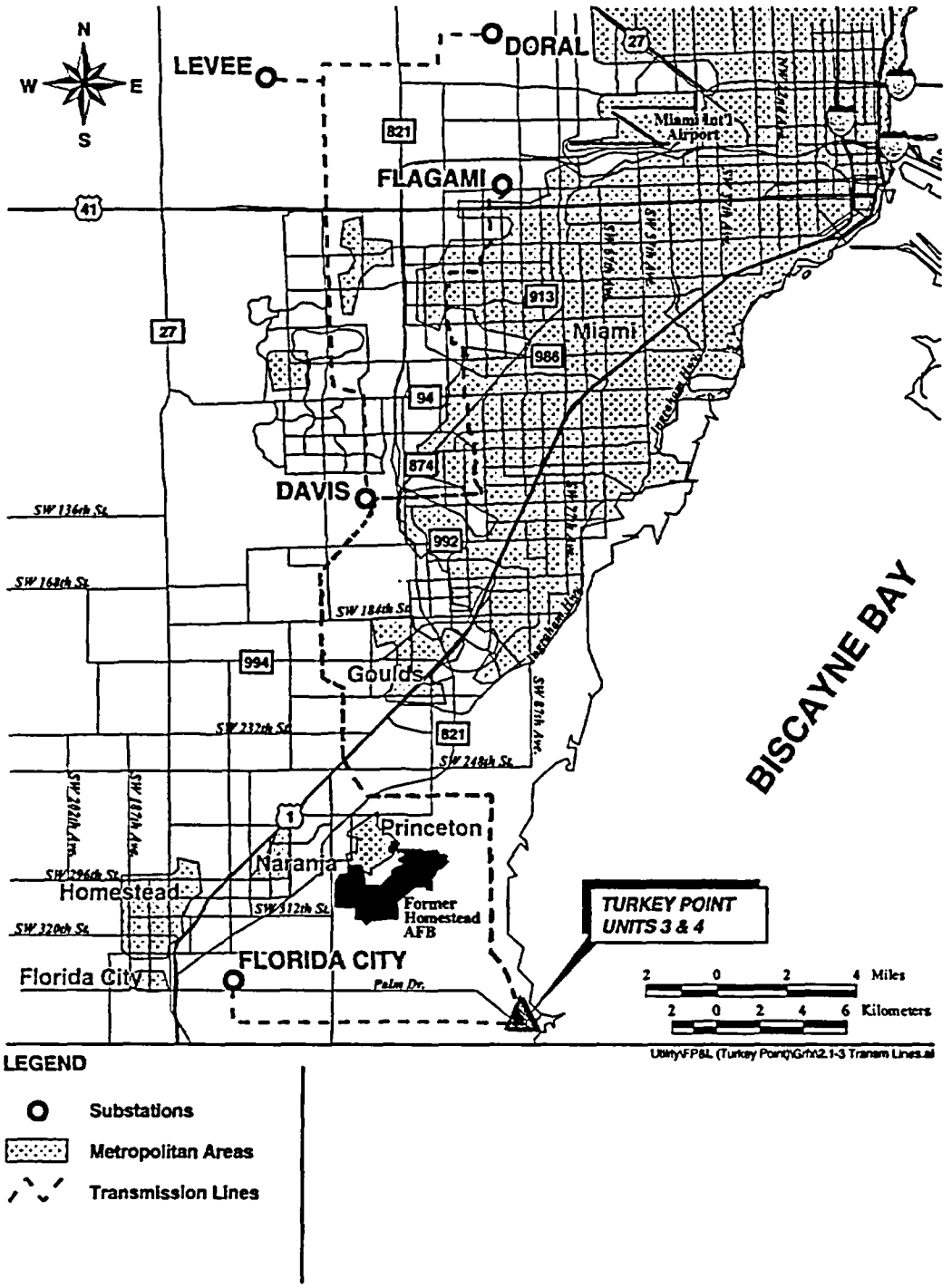

Figure 2-5. Turkey Point Transmission Lines

with the transmission lines are listed in Table 2-1. The statistics for the three substations north of the Davis substation (Flagami, Levee, and Doral) are only for the portions of the corridors north of the Davis substation; they do not include the distance from the Turkey Point switchyard to the Davis substation. Similarly, the statistics for the Doral substation are only from the point where the Levee and Doral lines separate. The statistics for the Levee line include the information for the corridor north of the Davis substation shared by the Levee and Doral lines.

FPL controls the Turkey Point transmission line corridors through a combination of ownership and easements. The corridors are maintained by a combination of trimming, mowing, and herbicide application. In wet areas, such as mangrove swamps, FPL maintains clearances by trimming trees at the 4.3-m (14-ft) level. Typically, this is only done at mid-span. Open, undeveloped areas are generally mowed about five times a year. These are the most common maintenance practices in the Florida City corridor and in the first 8 km (5 mi) of the Davis corridor. The remainder of the transmission line corridors are in areas of extensive agricultural land use. In these areas maintenance is generally limited to mowing at road crossings. Herbicides are used primarily to the control exotic species melaleuca (*Melaleuca leucodendron*) and Australian pine (*Casuarina equisetifolia*). FPL requires the use of State-licensed applicators for herbicides and only uses nonrestricted-use products.

Table 2-1. Turkey Point Transmission Line Corridors

Substation	Number of Lines	kV	Approximate Distance km	(mi)	Corridor	Corridor Width m	(ft)	Corridor Area hectares	(acres)
Davis	7	230	31	(19)	N	101	(330)	313	(773)
Flagami	2	230	21	(13)	N	101	(330)	212	(524)
Levee	1	230	21	(13)	N	101	(330)	212	(524)
Doral	1	230	11	(7)	N	101	(330)	111	(274)
Florida City	1	230	8	(5)	W	101	(330)	81	(200)
Total			92	(57)				929	(2295)

Source: FPL 2000a.

2.2 Plant Interaction with the Environment

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

2.2.1 Land Use

Turkey Point Units 3 and 4 are located on the shore of Biscayne Bay in Florida's South Miami-Dade County. The plant site is approximately 40 km (25 mi) south of Miami. The nearest incorporated city limits are Homestead, which is approximately 15 km (9 mi) northwest of the plant site, and Florida City, which is approximately 13 km (8 mi) west of the plant site. The nearest community to the south is Key Largo, which is in Monroe County and is approximately 48 km (30 mi) by road from the plant site.

Biscayne Bay is a shallow, subtropical lagoon. The bay is a fairly recent geological formation. Portions of the bay have been modified and dredged. Average depths range from approximately 2 to 3 m (6 to 10 ft), except in deeper dredged areas and main channels. The bay is elongated in shape and located in a north-south trending direction (FDEP 2000).

Turkey Point Units 3 and 4 and associated structures and features, including the cooling canal system, occupy approximately 3200 ha (8000 ac). Two fossil-fuel units, Turkey Point Units 1 and 2, are located adjacent to Units 3 and 4. The fossil-fuel units also use the cooling canal system.

The Miami-Dade County Comprehensive Development Master Plan (Miami-Dade County 2000a) classifies the plant site as being in Environmental Protection Subarea F (Coastal Wetlands and Hammocks). Electrical generation and transmission facilities are permitted in this subarea (Miami-Dade County 2000a).

The South Florida Regional Planning Council has stated that renewal of the Turkey Point Units 3 and 4 operating licenses (OLs) is generally consistent with the goals and policies of the Strategic Regional Policy Plan for South Florida, particularly those regarding land use, public facilities, emergency preparedness, and natural resources of regional significance (Hulsey 2000).

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 provide a certification that the proposed activity complies with the enforceable policies of the State's coastal zone program. All four Turkey Point Plant units are within the Florida coastal zone. The Florida Department of Community Affairs determined that renewal of the OLs for Turkey Point Units 3 and 4 is consistent with the Florida Coastal Management Program (Cantral 2000).

Land to the south and west of the site is in the Everglades Mitigation Bank where wetlands are created, restored, or enhanced to provide compensatory mitigation of wetland losses elsewhere. Under the joint Federally and State-operated mitigation bank program, lands can be publicly or privately owned. FPL owns the Everglades Mitigation Bank land, approximately 5300 ha (13,000 ac) of relatively undisturbed freshwater and estuarine wetlands. The U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency (EPA), the Natural Resources Conservation Service, the U.S. Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS) provide guidance on the use of the mitigation bank to satisfy mitigation requirements of Section 404 of the Federal Water Pollution Control Act (also known as the Clean Water Act [CWA]) permit program, the wetland conservation provisions of the Food Security Act, the National Environmental Policy Act (NEPA), and several other statutory provisions. The FDEP, the South Florida Water Management District (SFWMD), and Miami-Dade County guide the mitigation bank program within Florida pursuant to the Florida Mitigation Banking Rule and other State authorities.

2.2.2 Water Use

The Newton water-treatment plant of the Miami-Dade Water and Sewer Department (MDWSD) provides Turkey Point Units 3 and 4 with approximately 0.044 m^3/s (1.5 ft^3/s) of process (primarily demineralizer water makeup), potable, and fire-protection water. This water comes from the Biscayne Aquifer, which occurs at or close to the ground surface and extends to a depth of about 21 m (70 ft) below the surface.

The Newton water-treatment plant has a treatment capacity of 9.5 m^3/s (330 ft^3/s). The treatment capacity can be increased to its permitted capacity of 10.9 m^3/s (380 ft^3/s) with additional supply wells. In 1998, the average daily demand for water from the Newton plant was 7.5 m^3/s (260 ft^3/s), and the peak demand was 8.2 m^3/s (290 ft^3/s).

Treated waste-process water is discharged into the cooling canal system. Sanitary wastewater is processed in an onsite treatment plant and is discharged to groundwater through a 25-cm-(10-in.-) diameter, 15-m (50-ft) injection well. The average flow to the injection well is about 0.0015 m^3/s (0.053 ft^3/s).

No water is withdrawn by FPL from surface water or groundwater for use as makeup water for the cooling canal system and no surface water flows into the canals. Evaporative losses from the cooling canal system are replenished by rainfall, plant storm water runoff, and treated process wastewater, which ultimately comes from the municipal supply. There also may be exchange of water between the cooling canal system and the groundwater beneath the canal. The Environmental Report (ER; FPL 2000a) suggests that groundwater may contribute to replenishing the evaporative losses from the canal, while the FES (AEC 1972) considered the impacts of a flow from the canals to Card Sound via the Biscayne Aquifer of 4.3 m^3/s (150 ft^3/s). FPL maintains an interceptor ditch to the west of the cooling canal system to control the westward movement of water seeping from the cooling canal system at times when the natural seaward groundwater gradient does not exist.

2.2.3 Water Quality

In accordance with the CWA, the water quality of plant effluent discharges is regulated through the National Pollution Discharge Elimination System (NPDES). The FDEP is the State of Florida agency delegated by the EPA to issue discharge permits in Florida.

Recharge of groundwater at the Turkey Point site varies seasonally between surface recharge during the rainy season and saline recharge from the ocean during the dry season. As a result, there is a large seasonal variation in the salinity of the groundwater near the surface at the Turkey Point site. However, below about 12 m (40 ft) into the acquifer, relatively high salinity (greater than 28 ppt) exists year round. Florida classifies the groundwater in this area as G-III based on its salinity. This classification is used to identify groundwater that has no reasonable potential as a future source of drinking water due to high total dissolved solids (FAC 62-520.430).

The current NPDES permit No. FL0001562 (FPL 2000a, Appendix E) issued by the FDEP authorizes discharges from the Turkey Point Plant of anything other than sanitary waste to the closed-cycle cooling canal system and from the cooling canal system to Class G-III groundwater. The NPDES permit does not authorize FPL's Turkey Point Plant to discharge to surface waters of the State. Discharges of other waste water, other than sanitary wastes, are either discharged directly into the closed cooling canal system or indirectly through settling basins. The closed cooling canal system, contained entirely on the FPL site, is not considered a surface water of the State. The NPDES permit requires periodic monitoring of discharges to the cooling canal system, but the permit does not place discharge limits on any parameter related to water quality.

FPL also has a permit issued by the FDEP to operate its sewage treatment facility and discharge treated effluent directly to Class G-III groundwater through an injection well. The permit limits average daily flow to the well to 0.0015 m^3/s (0.053 ft^3/s), sets effluent limitations, and specifies monitoring requirements. An application has been submitted to renew this permit.

2.2.4 Air Quality

Turkey Point site has a subtropical climate with mild dry winters and long warm summers with abundant rainfall. Climatological records for Miami are generally representative of the Turkey Point site, although the proximity of Turkey Point to Biscayne Bay tends to moderate temperatures and alter precipitation amounts and timing.[(a)] The record for Miami indicates that the dry season lasts from November through April, and the wet season from May through October. Normal daily maximum temperatures for Miami range from about 24°C (75°F) in January to a high of about 32°C (89°F) in July and August. Normal minimum temperatures range from about 15°C (59°F) in January to about 25°C (77°F) in August. Normal monthly precipitation ranges from 5 to 8 cm (2 to 3 in.) in the dry season to 15 to 23 cm (6 to 9 in.) in the wet season.

Thunderstorms occur on almost half of the days from June through September. Sustained hurricane winds are expected at the site about once every 6 to 7 years, and gale force winds can be expected to affect the area about twice as often (FPL 1999b). 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 6×10^{-5} per year.

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. 1986). 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. Turkey Point site is located within the South Florida Intrastate Air Quality Control Region. This region is designated as in attainment or unclassified for all criteria pollutants in 40 CFR 81.310, although Miami-Dade and Broward counties are maintenance areas for ozone. The Everglades National Park is designated in 40 CFR 81.407 as a mandatory Class I Federal

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

area in which visibility is an important value. The park comes to within about 16 km (10 mi) from the Turkey Point site. The other Class I areas in Florida are more than 80 km (50 mi) from the site.

Diesel generators, and other activities and facilities associated with Turkey Point Units 3 and 4 emit various pollutants. Emissions from these sources are regulated under Air Operation Permit 0250003-002-AV issued by the FDEP. The current air emissions permit expires on December 31, 2003.

2.2.5 Aquatic Resources

Aquatic resources in the vicinity of the Turkey Point site are associated with portions of Biscayne Bay and Card Sound adjacent to the plant site and with the closed cooling canal system. Biscayne Bay and Card Sound are used for a variety of purposes, including navigation, recreation, tourism, and conservation. The cooling canal system is wholly within the owner-controlled area and is not open to public access. It is used solely for the purpose of heat dissipation from cooling water for the nuclear power facilities and adjacent fossil power facilities.

Biscayne Bay and Card Sound are shallow, subtropical marine waters located between the mainland and a parallel line of north-south trending islands that form the northern-most Florida Keys. These waters contain a rich variety of marine life, including seagrasses, sponges, mollusks, crustaceans (including crabs and lobsters), fish, sea turtles, and marine mammals. Biscayne Bay adjacent to the Turkey Point site is included in the Biscayne National Park, which includes the mainland shore, the bay, the keys, and offshore coral reefs (NPS 2000). The Intracoastal Waterway traverses Biscayne Bay and Card Sound, and a barge channel is maintained from the Intracoastal Waterway to the fossil-fuel power units at Turkey Point site.

Important species in Biscayne Bay and Card Sound include the mangrove forest on its eastern edge—one of the longest continuous stretches of mangroves left on the east coast of Florida. The lush seagrass beds provide food and refuge for approximately 70 percent of the area's recreationally and commercially important marine species. Seagrass beds are also a food resource for sea turtles and West Indian manatee (*Trichechus manatus*). Important seagrass species are shoal grass (*Halodule wrightii*), turtle-grass (*Thalassia testudinum*), and manatee-grass (*Syringodium filiforme*). Biscayne Bay and Card Sound are nursery areas for the spiny lobster (*Panulirus argus*), and the area from Cape Florida south through Card Sound is designated a Lobster Sanctuary by the State of Florida (FAC 68B-11). Highly desired game fish in Biscayne Bay and Card Sound include tarpon (*Megalops atlanticus*), snook (*Centropomus* spp.), red drum (redfish) (*Sciaenops ocellatus*), permit (*Trachinotus falcatus*), and sea trout (*Cynoscion* spp.) (NPS 2000; Cantillo et al. 2000).

The 2700-ha (6700-ac) cooling canal system supports a variety of aquatic species typical of a shallow, subtropical, hypersaline environment, including phytoplankton, zooplankton, marine algae, rooted plants, crabs, and estuarine fish. The applicant reports that the most abundant fish in the cooling canals are killifish (Family Cyprinidontidae) and other live-bearers (FPL 2000a). FPL employees also reported seeing game species, such as the common snook (*Centropomus undecimalis*) and tarpon (*Megalops atlanticus*), in the cooling canals. Although recreationally important in other areas, none of the fish or other marine life in the cooling canal system are available for recreational or commercial fishing. However, marine life in the cooling canal system supports a variety of wading birds and a resident population of the American crocodile (Crocodylus acutus) (FPL 2000a).

Within southern Biscayne Bay and Card Sound are 11 aquatic species that are protected under the Endangered Species Act (ESA) or are candidates for listing (Table 2-2). An additional species that historically occurred in this area has been proposed for listing as endangered (NMFS 2001). Of these, 10 are found in Biscayne Bay and Card Sound, but are not known or expected to be in the Turkey Point cooling canal system. These are Johnson's seagrass (*Halophila johnsonii*), the mangrove rivulus (*Rivulus marmoratus*) the small-toothed sawfish (*Pristis pectinata*), five species of sea turtles, the American alligator (*Alligator mississippiensis*), and the West Indian manatee. Johnson's seagrass occurs along the Florida coast from

Table 2-2. Federally Listed and Florida State-Listed Aquatic Species Potentially Occurring in Miami-Dade and Monroe Counties

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Halophila johnsonii	Johnson's seagrass	E	E
Rivulus marmoratus	mangrove rivulus	C	S
Pristis pectinata	small-toothed sawfish	C	--
Centropomus undecimalis	common snook	--	S
Chelonia mydas	green sea turtle	E	E
Erytmochelys imbricata	hawksbill sea turtle	E	E
Dermochelys coriacea	leatherback sea turtle	E	E
Lepidochelys kempii	Kemp's ridley sea turtle	E	E
Caretta caretta	loggerhead sea turtle	T	T
Trichechus manatus	West Indian manatee	E	E
Alligator mississippiensis	American alligator	T(S/A)	S
Crocodylus acutus	American crocodile	E	E

a) E = endangered, T = threatened, T(S/A) = threatened due to similarity of appearance, C = candidate for federal listing, S = Florida species of special concern, -- = no listing.

Sebastian Inlet to central Biscayne Bay at Virginia Key, Key Biscayne. This seagrass is not known to occur as far south as Turkey Point site (NMFS 2000). The mangrove rivulus (*Rivulus marmoratus*) is a fish that inhabits crab burrows in mangrove areas, and it could be present in mangrove areas fringing the plant site, but is unlikely to be present in the cooling canal system due to lack of habitat. The small-toothed sawfish inhabits inshore bars, seagrass beds, and mangrove areas, and is unlikely to occur in the cooling canals due to lack of habitat. The sea turtles are found in marine habitats that open to the sea, such as Biscayne Bay and Card Sound; but the cooling canal system is not a suitable habitat, and the shoreline adjacent to the plant site and cooling canal system lacks the beach habitats preferred by sea turtles for nesting. The American alligator, which is listed because of its similarity of appearance to the American crocodile, inhabits freshwater, such as the drainage canals and marshes to the east and south of the Turkey Point cooling canal system. The hypersaline environment of the cooling canal system is not suitable habitat for the American alligator.

The road and berm encircling the cooling canal system close the system to the entry of the West Indian manatee, although the SFWMD drainage canals to the south of the cooling canal system could provide potential habitat. Critical habitat for the West Indian manatee includes Biscayne Bay and Card Sound adjacent to Turkey Point site.

The cooling canal system is the home of a breeding population of American crocodiles. This population was discovered in the mid- to late-1970s soon after completion of the canal system in 1974. FPL manages the cooling canal system to provide suitable habitat for all life stages of the crocodile and maintains an active research and monitoring program. The crocodiles nest on the berms between the canals, and freshwater ponds on the berms are important juvenile rearing areas. Both juveniles and adults forage on the aquatic life in the canals. Crocodiles prefer the southern and southwestern portions of the cooling canal system. Crocodiles move freely between the cooling canal system and other suitable habitat on Key Largo and Florida Bay. The Turkey Point site is within the boundaries of the area designated as critical habitat of the American crocodile.

2.2.6 Terrestrial Resources

Prior to site construction, the eastern portion of the site was primarily dominated by red mangroves (*Rhizophora mangle*). The western portion of the site, where the canals are now located, was dominated by sawgrass (*Cladium jamaicensis*), cattails (*Typha latifolia*), and dwarf red mangrove, with scattered islands of black and white mangroves (*Avicennia germinans* and *Laguncularia racemosa*, respectively) and buttonwood (*Conocarpus erectus*) (AEC 1972). The areas immediately west of the cooling canal system are presently characterized as sawgrass marsh or wet prairie with islands of mangrove and hardwood hammocks (FPL 1995). Portions

of the site that were included in the original FES are now part of the Everglades Mitigation Bank that is owned and maintained by FPL under guidance from several Federal, State, and local governmental agencies.

The transmission lines are in two sets of corridors (Figure 2-5). The first runs west from the Turkey Point site for approximately 8 km (5 mi) then turns north to the Florida City substation along Palm Drive. The vegetation along this corridor is primarily sawgrass marsh and wet prairie that has been heavily invaded by Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*) (FPL 2000a). The other transmission corridor runs north from the Turkey Point site, through a tidal mangrove community, then primarily through agricultural and otherwise developed lands. Portions of the northern corridors pass through or near remnant patches of pine rockland, which was the dominant community type along the Miami ridge prior to European settlement and subsequent development. Pine rockland habitat is now extremely rare and harbors several Federally listed threatened or endangered plant species (FWS 1999).

Within Miami-Dade County, there are 16 terrestrial species protected under the ESA, and 7 species that are currently candidates for listing as endangered or threatened (Table 2-3). The candidate species do not have legal protection under the ESA, but because they could become listed prior to the end of the proposed license renewal term, they will be treated the same as the listed species in this Supplemental Environmental Impact Statement (SEIS).

In addition to the species protected under the Federal ESA, there are a very large number of species that are listed by the State of Florida as endangered, threatened, or of special concern. These include 84 species that are reported by the Florida Geographic Data Library (FGDL 2000), the applicants' field survey (Maus and Barlow 2001), or other documentation as occurring within approximately 8 km (5 mi) of the Turkey Point site or associated transmission lines (Table 2-4), and an additional 61 species reported by FGDL as occurring within Miami-Dade County but more than 8 km (5 mi) from the site or transmission lines (Table 2-5). None of the species listed in Table 2-4 or Table 2-5 are listed under the Federal ESA.

Of the Federally protected animal species, several are known to occur on or near the Turkey Point site. Eastern indigo snakes (*Drymarchon corais couperi*) have been observed on the Turkey Point site property, are occasionally observed in the surrounding areas, and are likely to occur within the transmission corridors (USAF 2000). These snakes are found in a variety of habitats, including pine flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammocks, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats. Eastern indigo snakes appear to prefer areas that consist of a mosaic of habitat types (FWS 1999).

Table 2-3. Terrestrial Species Listed as Endangered or Threatened by the FWS and Species that Are Candidates for FWS Listing as Threatened or Endangered that Occur or Potentially Occur Within Miami-Dade County, Florida

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Reptiles			
Drymarchon corais couperi	eastern indigo snake	T	T
Birds			
Ammodramus maritimus mirabilis	Cape Sable seaside sparrow	E	E
Charadrius melodus	piping plover	T	T
Haliaeetus leucocephalus	bald eagle	T	T
Mycteria americana	wood stork	E	E
Rostrhamus sociabilis plumbeus	snail kite	E	E
Sterna dougallii dougallii	roseate tern	T	T
Mammals			
Felis concolor coryi	Florida panther	E	E
Insects			
Heraclides arisodemus ponceanus	Schaus swallowtail butterfly	E	E
Plants			
Amorpha herbacea var. *crenulata*	crenulate lead-plant	E	E
Chamaesyce deltoidea ssp. *adhaerens*	hairy deltoid spurge	E	E
Chamaesyce deltoidea ssp. *deltoidea*	deltoid spurge	E	E
Chamaesyce garberi	Garber's spurge	T	E
Galactia smallii	Small's milk pea	E	E
Jacquemontia reclinata	beach jacquemontia	E	E

Table 2-3. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Polygala smallii	tiny polygala	E	E
Argythamnia blodgettii	Blodgett's wild-mercury	C	E
Brickellia eupatorioides var. *floridana* (= *B. mosieri*)	Florida thoroughwort brickell-bush	C	E
Chamaesyce pinetorum	pinelands spurge	C	E
Dalea carthagenensis var. *floridana*	Florida prairie clover	C	E
Digitaria pauciflora	few-flowered crabgrass	C	E
Linum carteri var. *carteri*	Carter's small-flowered flax	C	E
Linum arenicola	sand flax	C	E

(a) E = endangered, T = threatened, T(S/A) = threatened due to similarity of appearance, C = candidate for Federal listing, S = Florida species of special concern.

Sources: Based on FWS [http://verobeach.fws.gov] and FNAI [http://www.fnai.org] Internet Sites as of January 2001, and FGDL 2000.

Florida panthers (*Felis concolor coryi*) have been tracked via radio collars in the vicinity of the Turkey Point site at least as recently as the late 1980s (FPL 1995; USAF 2000). However, most of the existing very small population is located well to the northwest of the Turkey Point site in Big Cypress National Preserve. There are occasional unsubstantiated reports by transmission line maintenance workers of Florida panthers in the vicinity of FPL transmission lines in Miami-Dade County.

Wood storks (*Mycteria americana*) are common winter visitors to the cooling canal system and surrounding wetland areas, although they do not breed on the Turkey Point site itself. Wood stork rookeries are not located on the Turkey Point site or near the associated transmission lines. Bald eagles (*Haliaeetus leucocephalus*) are occasionally observed in the vicinity of the Turkey Point site, and were reported to nest on Arsenicker Keys in Biscayne Bay near the cooling canal system prior to Hurricane Andrew in 1992. Because the nest trees were destroyed during that hurricane, the eagles now occur primarily in Card Sound and Florida Bay south and southwest of the Turkey Point site.

Table 2-4. Terrestrial Species Listed by the State of Florida as Endangered, Threatened, or of Special Concern that Have Been Reported Within 8 km (5 mi) of the Turkey Point Site or Transmission Lines

Scientific Name	Common Name	State Status[a]
Reptiles		
Gopherus polyphemus	gopher tortoise	S
Pituophis melanoleucus mugitus	Florida pine snake	S
Tantilla oolitica	rim rock crowned snake	T
Birds		
Ajaia ajaja	roseate spoonbill	S
Aramus guarauna	limpkin	S
Columba leucocephala	white-crowned pigeon	T
Egretta caerulea	little blue heron	S
Egretta rufescens	reddish egret	S
Egretta thula	snowy egret	S
Egretta tricolor	tricolored heron	S
Eudocimus albus	white ibis	S
Falco peregrinus	peregrine falcon	E
Falco sparverius paulus	southeastern American kestrel	T
Haematopus palliatus	American oystercatcher	S
Pelecanus occidentalis	brown pelican	S
Rynchops niger	black skimmer	S
Speotyto cunicularia floridana	Florida burrowing owl	S
Sterna antillarum	least tern	T
Mammals		
Mustela vison mink	southern mink	T
Ursus americanus floridanus	Florida black bear	T
Plants		
Acrostichum aureum	golden leather fern	E

Table 2-4. (contd)

Scientific Name	Common Name	State Status[a]
Adiantum melanoleucum	fragrant maidenhair fern	E
Adiantum tenerum	brittle maidenhair fern	E
Alvaradoa amorphoides	Everglades leaf lace	E
Basiphyllaea corallicola	rockland orchid	E
Bourreria cassinifolia	little strongbark	E
Bletia purpurea	pink pine orchid	T
Byrsonima lucida	locustberry	E
Catopsis floribunda	many-flowered catopsis	E
Chamaecrista lineata var. *keyensis*	big pine partridge pea	E
Chamaesyce porteriana var. *porteriana*	Porter's broad-leaved spurge	E
Coccothrinax argentata	silver palm	E
Colubrina cubensis var. *floridana*	Cuban snake-bark	E
Crossopetalum ilicifolium	Christmas berry	E
Crossopetalum rhacoma	rhacoma	E
Eltroplectris calcarata	spurred neottia	E
Encyclia boothiana var. *erythronioides*	dollar orchid	E
Encyclia cochleata var. *triandra*	clamshell orchid	E
Eugenia confusa	tropical ironwood	E
Eupatorium villosum	villose fennel	E
Galeandra beyrichii	galeandra	E
Glandularia maritima	coastal vervain	E
Ilex krugiana	Krug's holly	E
Indigofera mucronata var. *keyensis*	decumbent indigo	E
Ipomoea microdactyla	wild potato morning glory	E
Ipomoea tenuissima	rocklands morning glory	E
Jacquemontia curtissii	pineland jacquemontia	E
Lantana canescens	small-headed lantana	E

Table 2-4. (contd)

Scientific Name	Common Name	State Status[a]
Lantana depressa var. *depressa*	Florida lantana	E
Lantana depressa var. *floridana*	Atlantic Coast Florida lantana	E
Leiphaimos parasitica	ghost plant	E
Linum carteri var. *smallii*	Carter's large-flowered flax	E
Lomariopsis kunzeana	holly vine fern	E
Microgramma heterophylla	climbing vine fern	E
Peperomia obtusifolia	blunt-leaved peperomia	E
Picramnia pentandra	bitter bush	E
Prunus myrtifolia	West Indian cherry	T
Pteris bahamensis	Bahama brake	E
Roystonea elata	Florida royal palm	E
Sachsia polycephala	Bahama sachsia	E
Schaefferia frutescens	yellowwood	E
Selaginella eatonii	Eaton's spikemoss	E
Sphenomeris clavata	wedgelet fern	E
Spiranthes costaricensis	Reichenbach's orchid	E
Spiranthes elata	tall neottia	E
Spiranthes torta	southern ladies' tresses	E
Stylosanthes calcicola	Everglade Key pencil-flower	E
I *Suriana maritima*	bay cedar	E
Swietenia mahagoni	West Indies mahogany	E
Tectaria fimbriata	fringed halberd fern	E
Tephrosia angustissima var. *corallicola*	rockland hoary-pea	E
Thelypteris reptans	creeping fern	E
Thelypteris sclerophylla	hard-leaved shield fern	E
Thrinax radiata	Florida thatch palm	E
I *Tillandsia balbisiana*	inflated wild pine	T

Table 2-4. (contd)

Scientific Name	Common Name	State Status[a]	
Tillandsia fasciculata	common wild pine	E	I
Tillandsia flexuosa	banded wild pine	E	
Tillandsia valenzuelana	soft-leaved wild pine	E	I
Tragia saxicola	pineland noseburn	E	
Trichomanes krausii	Kraus' bristle fern	E	
Tournefortia gnaphaloides	sea lavender	E	I
Tripsacum floridanum	Florida gama grass	E	
Vanilla phaeantha	brown-flowered vanilla	E	
Veronia blodgetii	Blodgett's ironweed	E	

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

Several species are occasional transients in the vicinity of the Turkey Point site, but are unlikely to use the area extensively or remain in the area for long because of the lack of suitable habitat. The Everglades snail kite (*Rostrhamus sociabilis plumbeus*) generally occurs farther inland, and critical habitat has been designated to the northwest of Miami (FWS 1999). This species feeds on specific species of freshwater snails that do not occur near the shore of Biscayne Bay or in the hypersaline conditions within the cooling canal system. Cape Sable seaside sparrows (*Ammodramus maritimus mirabilis*) are restricted to the vicinity of Shark River Slough and Taylor Slough within the Everglades to the west of the Turkey Point site. Designated critical habitat for the Cape Sable seaside sparrow is located approximately 8 km (5 mi) west of Homestead, Florida. Piping plovers (*Charadrius melodus*) winter on the beaches, sandflats, and mudflats of the Atlantic and Gulf coasts of Florida as well as the Florida Keys (FWS 1999). Critical wintering habitat for the piping plover has been proposed in the Keys south of the Turkey Point site and in Martin County north of the Turkey Point site (FWS 2000). Roseate terns (*Sterna dougallii dougallii*) are another strictly coastal species. They normally forage in shallow surf and nest on isolated beaches, rubble and spoil outcrops, or small islands (FWS 1999). Neither the piping plover nor the roseate tern are often seen very far inland from the ocean shore.

The Schaus swallowtail butterfly (*Heraclides arisodemus ponceanus*) historically occurred in hardwood hammocks from south Miami to lower Matacumbe Key. It is now primarily restricted to the upper and middle keys, especially between Elliot Key in Biscayne National Park and Key

Table 2-5. Additional Terrestrial Species Listed by the State of Florida as Endangered, Threatened, or of Special Concern that Have Been Reported in Miami-Dade County Beyond 8 km (5 mi) from the Turkey Point Site or Transmission Lines

Species	Common Name	State Status[a]
Birds		
Grus canadensis pratensis	Florida sandhill crane	T
Amphibians		
Rana capito	gopher frog	S
Mammals		
Eumops glaucinus floridanus	Florida mastiff bat	E
Podomys floridanus	Florida mouse	S
Plants		
Acacia choriophylla	tamarindillo	E
Actinostachys pennula	ray fern	E
Anemia wrightii	Wright's anemia	E
Argusia gnaphalodes	sea lavender	E
Aristolochia pentandra	Dutchman's pipe	E
Asplenium auritum	auricled spleenwort	E
Asplenium serratum	bird's nest spleenwort	E
Asplenium trichomanes-dentatum	slender spleenwort	E
Brassia caudata	spider orchid	E
Calyptranthes zuzygium	myrtle-of-the-river	E
Campyloneurum angustifolium	narrow-leaved strap fern	E
Catopsis berteroniana	powdery catopsis	E
Cheilanthes microphylla	southern lip fern	E
Cheiroglossa palmata	hand fern	E
Conradina grandiflora	large-flowered rosemary	E
Ctenitis sloanei	Florida tree fern	E
Cyrtopodium punctatum	cow-horned orchid	E

Table 2-5. (contd)

Species	Common Name	State Status[a]
Eleocharis rostellata	beaked spikerush	E
Epidendrum nocturnum	night-scented orchid	E
Eugenia rhombea	red stopper	E
Gossypium hirsutum	wild cotton	E
Govenia utriculata	sheathing govenia	E
Guaiacum sanctum	lignum-vitae	E
Guzmania monostachia	Fuch's bromeliad	E
Harrisia simpsonii	Simpson's prickly apple	E
Hippomane mancinella	manchineel	E
Hypelate trifoliata	white ironwood	E
Ionopsis utricularioides	delicate ionopsis	E
Jacquinia keyensis	joewood	T
Lechea divaricata	pine pinweed	E
Licaria triandra	Gulf licaria	E
Matelea floridana	Florida spiny-pod	E
Myrcianthes fragrans var. *simpsonii*	twinberry	T
Nephrolepsis biserrata	giant sword fern	T
Okenia hypogaea	burrowing four-o'clock	T
Oncidium floridanum	Florida oncidium	E
Passiflora multiflora	whitish passionflower	E
Peperomia humilis	terrestrial peperomia	E
Phoradendron rubrum	mahogany mistletoe	E
Polyrrhiza lindenii	ghost orchid	E
Ponthieva brittoniae	Bahama shadow-witch	E
Prescotia oligantha	small-flowered prescotia	E
Pseudophoenix sargentii	Florida cherry-palm	E
Pteroglossaspis ecristata	wild coco	T

Table 2-5. (contd)

Species	Common Name	State Status[a]
Rhipsalis baccifera	mistletoe cactus	E
Spiranthes polyantha	green ladies' tresses	E
Tectaria coriandrifolia	Hattie Bauer halberd fern	E
Tephrosia angustissima var. *angustissima*	devil's shoestring	E
Thelypteris augescens	abrupt-tipped maiden fern	T
Thrinax morrisii	brittle thatch palm	E
Tillandsia utriculata	giant wild pine	E
Trichomanes punctatum	Florida bristle fern	E
Vallesia antillana	pearl berry	E
Vanilla barbellata	worm-vine orchid	E
Vanilla mexicana	scentless vanilla	E
Zanthoxylum coriaceum	Biscayne prickly ash	E
Zephyranthes simpsonii	rain lily	T

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

Largo. The species has been released at the Deering Estate in Miami, but is otherwise not known to occur on the Florida mainland (FWS 1999) and suitable habitat is not known to occur in the vicinity of the Turkey Point site.

None of the Federally listed endangered or threatened plant species have been reported to occur on the Turkey Point site. However, at least one species (Garber's spurge [*Chamaesyce garberi*]) has been reported within the Everglades Mitigation Bank south of the Turkey Point site (FPL 2000a), and another (beach jacquemontia [*Jacquemontia reclinata*]) was also reported by FPL to inhabit the Everglades Mitigation Bank. However, other information indicates that the beach jacquemontia is normally only known from coastal barrier islands from Biscayne Bay to Palm Beach County.

A number of the Federally listed and candidate plant species in Table 2-3 occur primarily in pine rockland habitats. These species include the crenulate lead plant (*Amorpha herbacea* var. *crenulata*), deltoid spurge (*Chamaesyce deltoidea* ssp. *adhaerens* and ssp. *deltoidea*), Small's

milkpea (*Galactia smallii*), and tiny polygala (*Polygala smallii*). In addition, most of the Federal candidate plant species (Blodgett's wild mercury [*Argythamnia blodgettii*], Florida brickell-bush [*Brickellia eupatorioides* var. *floridana*], pinelands spurge [*Chamaesyce pinetorum*], few-flowered crabgrass [*Digitaria pauciflora*], Carter's small flowered flax [*Linum carteri* var. *carteri*], and sand flax [*Linum arenicola*]) reported in the vicinity of the Turkey Point site and associated transmission lines occur in pine rockland communities. Some of these species occur in other habitat types as well, such as wet prairies, freshwater marshes, dry prairies, and tropical hardwood hammocks.

Pine rockland communities primarily occurred along the Miami ridge from the Homestead area to what is now downtown Miami. Very few examples of this plant community remain because of agricultural and urban development. However, several of the small surviving patches that are known to harbor remnant populations of some of these species are located adjacent to or relatively near the Turkey Point site transmission corridors.

2.2.7 Radiological Impacts

FPL has conducted a Radiological Environmental Monitoring Program (REMP) around the Turkey Point site since 1969 (AEC 1972). The radiological impacts to workers, the public, and the environment have been carefully monitored, documented, and compared to the appropriate standards. The two-fold purpose of the REMP is to do the following:

- Provide representative measurements of radiation and radioactive materials in the exposure pathways and for the radionuclides that have the highest potential for 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.

In addition to the REMP description in the Annual Radiological Environmental Operating Report, the ODCM discusses a supplemental REMP sampling program that is agreed upon by the State of Florida Department of Health and Rehabilitative Services and FPL. This supplemental sampling program is not required by regulation, but is performed to provide a broader database for the REMP (FPL 1999b). The sampling under this supplemental program provides additional data, including data from sampling in the discharge canal.

Radiological releases are summarized in the annual reports titled *Annual Radiological Environmental Operating Report Turkey Point Plant – Units 3 & 4* (FPL 2000a) and *Annual*

Radioactive Effluent Release Report (FPL 2000b). The limits for all radiological releases are specified in the Turkey Point ODCM, and these limits are designed to meet Federal standards and requirements (FPL 1999b). The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment), atmospheric environment (airborne radioiodine, gross beta, and gamma), and terrestrial environment (vegetation) and direct radiation.

Review of historical data on releases and the resultant dose calculations revealed that the doses to maximally exposed individuals in the vicinity of Turkey Point site were a small fraction of the limits specified in the EPA's environmental radiation standards 40 CFR Part 190 as required by 10 CFR 20.1301(d). For 1999, dose estimates were calculated based on actual 1999 liquid and gaseous effluent release data (FPL 2000b). Calculations were performed using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM.

During 2000, Turkey Point Units 3 and 4 did not release any strontium-90 in the gaseous effluents. Liquid effluents containing radioactive materials, including strontium-90 and strontium-89 were released into the closed system cooling canals. The only time that strontium was released in the liquid effluents was during the second quarter: 0.12 MBq (3.2 E-06 Ci) of strontium-90 and 0.37 MBq (10 E-06 Ci) of strontium-89 (FPL 2001). For the second quarter of 2000, the total radioactive effluents were about 150 times **below** NRC regulatory limits (6.63 E-03 percent of applicable limits). The quantities of materials released in all effluents during 2000 are comparable to the quantities released in the past 5 years and the expected quantities in years to come, including the license renewal period.

FPL performs an assessment of radiation dose to the general public from radioactive effluents, assuming a visitor was at the child development center/fitness center for 10 hours a day, 5 days each week, for 50 weeks of the year, inhaling the gaseous effluents from both Turkey Point Units 3 and 4 (FPL 2000b). For 1999, the total body dose to an adult from inhalation was estimated to be 1.1 E-8 mSv (1.1 E-6 mrem) or 2.2E-7 percent of the annual limit of 5 mSv (500 mrem). For dose due to liquid effluents, FPL assumes a teenager stands on the bank of the cooling canal for 67 days per year and is exposed to direct radiation from the cooling canal sediments, which have deposits of radioactive materials from the effluent releases from both Turkey Point Units 3 and 4. For 1999, the estimate of dose to a teenager from this shoreline deposition was 5.9 E-6 mSv (5.9 E-4 mrem) or 0.04 percent of the annual limit of 0.03 mSv (3 mrem). Evaluation of doses from gaseous effluent releases from the two units for the same year resulted in an annual dose due to noble gases of 8.6 E-8 mGy (8.6 E-6 mrad) for gamma radiation and 2.9 E-7 mGy (2.9 E-5 mrad) from beta air dose. These are 8.6 E-5 percent and 1.4 E-4 percent, respectively, of the annual limit (see Section 2.1.4) (FPL 2000b). These

doses, which are representative of the doses from the past 5 years, are provided to demonstrate that the impact to the environment from radioactive releases from Turkey Point is small.[a]

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

2.2.8 Socioeconomic Factors

The staff reviewed the applicant's ER and information obtained from several county, city, and economic development staff during a site visit to Miami-Dade County from December 4 through 8, 2000. The following information describes the economy, population, and communities near the Turkey Point site.

2.2.8.1 Housing

Approximately 960 employees work at Turkey Point Units 3 and 4 (about 185 contract employees and approximately 775 permanent employees). Approximately 85 percent of these employees live in Miami-Dade County, seven percent live in Monroe County, seven percent live in Broward County, and the rest live in other locations (see Table 2-6). Table 2-7 presents a further breakdown of the residency, by city and county, of 730 permanent employees[b] at Turkey Point Units 3 and 4. Table 2-7 does not contain the residences of the contract employees. Given the predominance of FPL employees living in Miami-Dade County, the focus of this analyses is on Miami-Dade County.

FPL refuels each nuclear unit at the Turkey Point site on an 18-month cycle. During these refueling outages, site employment increases by as many as 800 to 900 temporary workers for 30 to 40 days. Most of these temporary workers are located in Homestead and Florida City.

(a) The doses are very small fractions of the 40 CFR Part 190 limits, i.e., annual dose equivalent not to exceed 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ of any member of the public.

(b) Although there are approximately 775 permanent employees for Turkey Point Units 3 and 4, FPL provided addresses for only 730.

Table 2-6. Turkey Point Units 3 and 4—Employee and Contract Employee Residence Information by County

County	Number of Personnel	Percent of Total Personnel
Miami-Dade	816	85
Monroe	67	7
Broward	67	7
Other	10	1
Total	960	100

Source: FPL 2000a.

Table 2-7. Turkey Point Units 3 and 4—Permanent Employee Residence Information by County and City

County and City[a]	Florida Power & Light Employees
MIAMI-DADE COUNTY	
Homestead	233
Florida City	30
Miami	327
Hialeah	3
Miami Beach	2
Opa Locka	1
Total Miami-Dade County	596
BROWARD COUNTY	
Hollywood	27
Fort Lauderdale	24
Other	4
Total Broward County	55
MONROE COUNTY	
Key Largo	45
Tavernier	17
Total Monroe County	62
Other Counties	17
Grand Total	730

(a) Addresses are for both unincorporated (counties) and incorporated (cities and towns) areas.

Source: NRC 2001.

Table 2-8 provides the number of housing units and housing unit vacancies for Miami-Dade, Broward, and Monroe counties for 1980 and 1990, the latest years for which information is available. Miami-Dade County has an urban development boundary (UDB) within which development is to take place, but otherwise does not have growth-management controls.

Table 2-9 contains data on population, estimated population, and annual growth rates for Miami-Dade, Broward, and Monroe counties. Monroe County contains the Florida Keys.

Table 2-8. Housing Units and Housing Units Vacant (Available) by County During 1980 and 1990

	1980	1990	Approximate Percentage Change
MIAMI-DADE COUNTY			
Housing Units	665,000	771,000	15.9
Occupied Units	610,000	692,000	13.4
Vacant Units	55,000	79,000	43.6
BROWARD COUNTY			
Housing Units	486,000	629,000	29.4
Occupied Units	418,000	528,000	26.3
Vacant Units	68,000	101,000	48.5
MONROE COUNTY			
Housing Units	38,000	46,000	21.1
Occupied Units	26,000	34,000	30.8
Vacant Units	12,000[a]	12,000[a]	0.0

(a) Values are the same due to rounding to the nearest thousands.
Sources: GEOSTAT 2001a and GEOSTAT 2001b.

Table 2-9. Population Growth in Miami-Dade, Broward, and Monroe Counties, Florida, 1980 to 2020

	Miami-Dade County		Broward County		Monroe County	
	Population	Annual Growth Percent[a]	Population	Annual Growth Percent	Population	Annual Growth Percent
1970	1,268,000	--	620,000	--	53,000	--
1980	1,626,000	2.5	1,018,000	5.1	63,000	1.9
1990	1,937,000	1.8	1,255,000	2.1	78,000	2.1
2000	2,253,000	1.5	1,623,000	2.6	80,000	0.25
2010	2,385,000	1.0	1,758,000	1.4	97,000	1.0
2020	2,587,000	0.9	1,927,000	1.2	106,000	0.9

(a) Annual percent growth rate is calculated over the previous decade.
-- = No data available.
Sources: Florida Legislature 2001a (population for the years 1970 to 1990 and 2010); FPL 2000a (population projections for 2020); and U.S. Census Bureau (USCB) 2001a (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**

Potable water for Miami-Dade County comes from the Biscayne Aquifer. The county sets strict criteria for maintaining the integrity of the aquifer (FPL 2000a). The MDWSD operates regional water supply systems that serve both incorporated and unincorporated areas of the county. MDWSD water-treatment plants produce 85 percent of the county's public water supply. In addition to MDWSD's regional system, 15 municipalities are franchised to operate water-distribution systems (including the cities of Homestead, Florida City, North Miami, and North Miami Beach) within a designated service area. The Hialeah/Preston, Alexander Orr, Jr., Florida City, and Homestead water-treatment systems provide about 87 percent of Miami-Dade County's water-treatment capacity. The remaining approximately 13 percent is provided by other suppliers within the county (Miami-Dade County 2000a). Table 2-10 summarizes the daily consumption and areas served by each water system within the county.

Table 2-10. Major Public Water Supply Systems in Miami-Dade County in December 1999

Water System	Source	Maximum Daily Capacity m^3/s (ft^3/s)	Average Daily Capacity m^3/s (ft^3/s)	Area Served
Hialeah/Preston	Biscayne Aquifer	7.6 (268)	7.1 (251)	North of Flager Street, Miami-Dade County
Alexander Orr, Jr.	Biscayne Aquifer	7.9 (277)	7.4 (263)	South of Flager Street, Miami-Dade County
Florida City	Biscayne Aquifer	0.14 (4.9)	0.12 (4.2)	Florida City
Homestead	Biscayne Aquifer	0.45 (15.9)	0.36 (12.7)	Homestead
Other	Biscayne Aquifer	2.15 (75.9)	1.89 (66.7)	Parts of South Miami-Dade County, North Miami and North Miami Beach

Source: Miami-Dade County 2000a.

MDWSD provides water to Turkey Point Units 3 and 4. The Miami-Dade system's Alexander Orr, Jr., Water Treatment Plant services the south and central parts of Miami-Dade County (the area south of Flager Street) except for the Florida City and Homestead areas. The Alexander Orr, Jr., plant is applying to treat up to approximately 10.86 m^3/s (383.7 ft^3/s), although its current (2000) permitted treatment capacity is capped at 9.51 m^3/s (335.7 ft^3/s) until additional supply wells are completed. The plant has a reserve treatment capacity of 1.67 m^3/s (58.83 ft^3/s). Plant staff do not consider the Alexander Orr, Jr., plant to be near its capacity at this time.

The Hialeah/Preston System (HPS) is the other, large regional water-treatment system. It serves the area north of Flager Street and is permitted to treat up to 9.83 m^3/s (345.9 ft^3/s). The plant has a reserve treatment capacity of 2.25m^3/s (79.4 ft^3/s) (Miami-Dade County 2000a). The Florida City municipal water-treatment plant can treat up to 0.118 m^3/s (4.17 ft^3/s). The plant is rated as having no additional treatment capacity available (Miami-Dade County 2000a).

In Homestead, the municipal water-treatment plant is permitted to treat up to 0.44 m^3/s (15.5 ft^3/s). In 1997, the plant had approximately 8.1 percent of its treatment capacity available (FPL 2000a). By 1999, the plant was operating at maximum treatment capacity (Miami-Dade 2000a).

- **Education**

In October 1999, there were 338,000 students attending Miami-Dade County's 292 mainstream public schools. This represents an increase of approximately 5600 students since October 1998. There was a total "enhanced"[(a)] program capacity of approximately 326,000 in October 1999, resulting in a system-wide enhanced utilization rate of 104 percent (Miami-Dade County 2000a).

There are 212 elementary schools (including 13 primary learning centers) in Miami-Dade County. These schools had an enrollment population of approximately 173,300 (October 1999) and an enhanced program capacity of approximately 171,400 for a system-wide enhanced program utilization rate of 101 percent (Miami-Dade County 2000a).

There are 51 middle schools in Miami-Dade County. They had an enrollment of approximately 77,000 (in October 1999) and an enhanced program capacity of approximately 75,000, resulting in a system-wide enhanced program utilization rate of 104 percent. Thirty-five, or approximately 69 percent, of the 51 middle schools were operating at or above their enhanced program capacity (Miami-Dade County 2000a).

There are 29 senior high schools in the county. In October 1999 the enrollment in the schools numbered approximately 87,000 students. The enhanced program capacity was approximately 80,000, resulting in a system-wide enhanced program utilization rate of approximately 109 percent. Twenty-two of the 29 high schools (or 76 percent) were operating at or above their enhanced program capacity (Miami-Dade County 2000a).

Among the county's 292 public schools, 189, or 65 percent, have enhanced program utilization rates in excess of 100 percent. There are 20 elementary schools, 6 middle schools, and 3 senior high schools in the south end of the county (generally the area south of Eureka Drive or South West 184th Street, which is an east-west road approximately 17 km [11 mi] north of the Turkey Point Plant) (Miami-Dade County 2000a). In terms of the areas surrounding the Turkey Point site (Florida City, Homestead, and surrounding Miami-Dade County south of Eureka Drive), enhanced program capacity rates for schools located to the east of U.S. Highway 1 and south of Eureka Drive are 96 percent each for elementary, middle, and senior high schools. For the area west of U.S. Highway 1 and south of Eureka Drive the enhanced program capacity rates are 100 percent (elementary),

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(a) Enhanced program capacity is a measure of crowding. Generally, but not always, an enhanced program value greater than 100 percent is indicative of crowding, and the higher the percent, the greater the crowding. Optimally, the number of students enrolled at a particular school facility should not exceed the number of permanent student stations (Miami-Dade County 2000a).

107 percent (middle) and 115 percent (senior) (Miami-Dade County 2000a). The higher enhanced program capacity rates, while not the highest in the county as a whole, may reflect the increased growth pressures in South Miami-Dade County[(a)] and potentially of re-building as a result of Hurricane Andrew (1992).

- **Transportation**

Miami-Dade County is served by Interstate 95 (I-95), which enters the county from the north and ends in downtown Miami. U.S. Highway 1 and the Florida Turnpike are also major highways that traverse the length of the county from north to south. U.S. Route 41 is a major east-west highway that traverses the middle of the county.

Road access to the Turkey Point site is via East Palm Drive (SW 344 Street). East Palm Drive is a two-lane road for approximately half of its length from the plant to Florida City, where it intersects with U.S. Highway 1 approximately 14 km (9 mi) from the Turkey Point site. Both East Palm Drive and U.S. Highway 1 are four-lane roads in the vicinity of the intersection.

There is a rail line through the Florida City/Homestead city limits, but there is no rail service to the Turkey Point site. Planned improvements include constructing the remaining portions of the South Miami-Dade Busway between SW 112th Avenue and SW 344th Street in Homestead between 2001 and 2005 (Miami-Dade County 2000a). Additional improvements (bus lane on U.S. Highway 1, new interchange on Florida Turnpike, east-west connector to the National Association for Stock Car Auto Racing [NASCAR] racetrack, and upgrade of Krome Avenue) are also planned.

2.2.8.3 Offsite Land Use

Miami-Dade County has a Comprehensive Development Master Plan and an accompanying land-use plan map (Miami-Dade County 2000b). The plan and map include an urban development boundary where urban development may occur through the year 2005. The cities of Florida City and Homestead and the former Homestead Air Force Base are within the UDB. The plan and map also include an urban expansion area where urban development between 2005 and 2015 is likely to be warranted. The plan and map designate various land-use categories including residential, industrial, agricultural, parks and recreation, open land, and environmental protection.

(a) South Miami-Dade County is defined as the portion of the county that is located south of 184th Street or Eureka Drive.

The cities of Florida City and Homestead are the only incorporated areas in South Miami-Dade County. Both cities have land-use plans and zoning codes.

Land use in South Miami-Dade County as of 1994 is shown in Table 2-11. The table covers the area south of Eureka Drive to the southern county boundary at the beginning of the Florida Keys. National park land is not included in the table.

All property within approximately an 8-km (5-mi) radius of the plant site is in unincorporated Miami-Dade County. Land immediately to the west of the plant site extending to U.S. Highway 1 is designated "Environmental Protection Subarea E (Southeast Wetlands)" in the Miami-Dade County Master Plan. The plan states that this area is low lying, poorly drained, flood prone, and is characterized predominantly by high-quality wetland communities. Accordingly, any land use or site alteration proposal will be carefully evaluated on a case-by-case basis by Federal, State, regional, and County agencies.

Table 2-11. Land Use in South Miami-Dade County, 1994

Land Use	Hectares	Acres	Percent of Total
Residential	6730	16,630	4.7
Commercial	532	1315	0.4
Industrial	361	893	0.2
Institutional	1676	4141	1.2
Recreation	718	1774	0.5
Transportation and utilities	4503	11,128	3.1
Agriculture	25,978	64,192	18.0
Open lands designated for environmental protection and not available for development	27,080	66,914	18.7
Open lands available for development	12,562	31,040	8.7
Water	64,265	158,798	44.5
Total	144,405	356,825	100.0

Source: USAF 2000.

There are two national parks and a national wildlife refuge close to the plant site. Biscayne National Park is immediately north and east of the Turkey Point site. Ninety five percent of the park's 73,450 ha (181,500 ac) are under water. The Biscayne National Park headquarters building is approximately 3.2 km (2 mi) north of the site. Everglades National Park is approximately 24 km (15 mi) west of the plant site. Everglades National Park consists of 610,660 ha (1,509,000 ac), including most of Florida Bay. The Crocodile Lake National Wildlife Refuge is approximately 16 km (10 mi) south of the plant site. The Big Cypress National Preserve is approximately 56 km (35 mi) northwest of the plant site.

The portions of Biscayne Bay north and south of Biscayne National Park are part of the Biscayne Bay Aquatic Preserve. The southern portion of the preserve includes Card Sound. The preserve was established by the Florida legislature in 1974 because it met the criteria established by the legislature for aquatic preserves. The criteria specify that state-owned submerged lands in areas that have exceptional biological, aesthetic, and scientific value be set aside forever as aquatic preserves or sanctuaries for the benefit of future generations (FDEP 2000).

The former Homestead Air Force Base is approximately 8 km (5 mi) northwest of the plant site. The base was realigned to Homestead Air Reserve Station in 1994. The base consisted of 1189 ha (2938 ac) at the time of realignment. The U.S. Air Force (USAF) recently determined that it will make available 290 ha (717 ac) at the former base to Miami-Dade County for mixed economic uses that could include commercial development as well as residential or recreational uses (66 FR 12930; March 1, 2001 [DOD 2001]). The USAF rejected a proposal for a civilian commercial airport at the former base (USAF 2000).

Land south and west of the plant site is in the Everglades Mitigation Bank. A mitigation bank is a wetland area that is created, restored, or enhanced for the purpose of providing compensatory mitigation of wetland loss elsewhere. The bank comprises approximately 5300 ha (13,000 ac) of relatively undisturbed freshwater and estuarine wetlands. FPL owns the land in the bank. The bank is independent of Turkey Point Units 3 and 4; continuation of the bank is not tied to renewal of the Turkey Point Units 3 and 4 OLs.

The Miccosukee Indian Reservation is approximately 76 km (48 mi) northwest of the plant site. The Big Cypress Seminole Indian Reservation is approximately 102 km (64 mi) northwest of the plant site.

2.2.8.4 Visual Aesthetics and Noise

The Turkey Point units, including Units 3 and 4 and supporting structures, can be seen and heard from the Biscayne National Park visitor center complex and from waters and lands within the park boundary. Visitors to the park would likely have difficulty separating the visual and

noise impacts originating from Units 3 and 4 from those originating from Units 1 and 2, which are fossil-fired units that are not being considered in this SEIS. The most visible features of the Turkey Point units are the emission stacks from Units 1 and 2.

All units are also visible from the park at night because of outside lighting used at the Turkey Point site and lighting used on the Units 1 and 2 emission stacks and the meteorological tower. There is no visible plume from Unit 3 and 4 operations because cooling towers are not used.

Noise from the Turkey Point units is detectable at some times by visitors in Biscayne National Park. Noise transmission is facilitated by the location of the Turkey Point units on Biscayne Bay (NPS scoping comments). The noise is most noticeable under calm wind conditions or when the wind is blowing lightly in a direction from the Turkey Point site to the park.

Vegetation and trees largely screen Turkey Point Units 3 and 4 and supporting structures from public view from locations west of the plant site. Noise from Turkey Point Units 3 and 4 is generally not an issue at locations to the west of the plant because of the setback from non-FPL property and because of intervening vegetation and trees.

2.2.8.5 Demography

Population was estimated from the Turkey Point site out to 80 km (50 mi) in 16-km (10-mi) annular rings. Population estimates for the 80-km (50-mi) area surrounding the site are based on information from the Updated Final Safety Analysis Report (FSAR) for Units 3 and 4 (FPL 1999b). NRC Guidance calls for the use of the most recent USCB decennial census data, which in the case of the Turkey Points site, was the 1990 census (USCB 1991).

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

  Table 2-12 presents the population distribution within 80 km (50 mi) of the Turkey Point site for population estimates in 10-year increments starting with 1990 and ending with 2010.

  The largest population centers within the 16-km (10-mi) area are the towns of Homestead and Florida City. The population of Homestead and Florida City for 2000 is 27,800 and 6900, respectively (Florida Legislature 2001b). Approximately 90 percent of Florida City's land area lies within 16 km (10 mi) of the plant. Most of the new, residential development within the 16-km (10-mi) radius occurs in sectors W and N within the 8-km to 16-km (5-mi to 10-mi) radius, principally on either side of U.S. Highway 1 from Homestead and Florida City to the south part of Miami's suburbs (FPL 1999b).

Table 2-12. Population Distribution in 1990, 2000, and 2010 Within 80 km (50 mi) of the Turkey Point Site

	0 to 16 km (0 to 10 mi)	16 to 32 km (10 to 20 mi)	32 to 48 km (20 to 30 mi)	48 to 64 km (30 to 40 mi)	64 to 80 km (40 to 50 mi)	Total
Total 1990	105,679	391,800	902,461	707,175	506,393	2,613,535
Total 2000	123,552	457,188	1,052,786	827,329	597,954	3,058,809
Total 2010	139,617	516,459	1,189,978	929,218	657,706	3,432,978

Source: FPL 1999b.

Miami is located generally to the north of the Turkey Point site beyond the 16-km (10-mi) radius from the plant site. Between 1980 and 1990, Miami experienced a population growth increase from approximately 347,000 (in 1980) (GEOSTAT 2001b) to 359,000 (in 1990)—an approximately 3 percent increase over the decade. The population increased to 369,000 by 2000, or by approximately 3 percent over 1990 (Florida Legislature 2001b).

Between 1990 and 2000 the greatest population growth (18.1 percent), within the 80-km (50-mi) radius around the Turkey Point site occurred in the 64-km (40-mi) to 80-km (50-mi) annulus. Growth in the rest of the area was approximately 17 percent.

The county planning department projects increased population growth for Miami south to the vicinity of Homestead and Florida City. This area of the county has relatively less expensive housing than other parts. There are several residential developments that have started in the vicinity of Homestead/Florida City, including Keys Gate, which was started in 1988 with 6200 units planned over a 12-year period. This development is located in the WNW sector within the 0- to 16-km (0- and 10-mi) annulus.

Between 2000 and 2010, the population increase in the 64-km to 80-km (40-mi to 50-mi) annulus is projected to be 10.0 percent, and 12.3 percent for the 48-km (30-mi) to 64-km (40-mi) annulus. The population in the remaining area is estimated to grow at approximately 13.0 percent.

Table 2-13 lists the projected age distribution of Miami-Dade County in 1999 compared to Florida's population. Miami-Dade County has a higher percentage of population in the 18- to 44-year age bracket and a lower percentage of population in the 65+ age bracket, with the remaining age brackets being slightly higher or lower percentages than Florida as a whole.

Table 2-13. Estimated Age Distribution of Population in 1999

	Miami-Dade County		Florida	
Age Group	**Number**	**Percentage**	**Number**	**Percentage**
Under 4	149,900	6.9	952,400	6.3
5-17	390,200	17.9	2,617,500	17.3
18-44	849,400	39.0	5,474,300	36.2
45-64	475,600	21.9	3,325,200	22.1
65 and over	310,600	14.3	2,741,800	18.1
Total	2,175,700	100.0	15,111,200	100.0

Sources: USCB 2001b.

- **Transient Population**

The transient population in the vicinity of the Turkey Point site can be identified as daily or seasonal. Daily transients are associated with places where a large number of people gather regularly, such as local businesses, industrial facilities, and schools. Table 2-14 presents information on the major employers and number of employees for facilities located within 16 km (10 mi) of the Turkey Point site.

Seasonal transients result from part-time residents who may reside in southern Florida during the winter months or pursue recreational activities there throughout the year. The daily and seasonal population associated with selected recreation within 16 km (10 mi) of the Turkey Point site is listed in Table 2-15.

Table 2-14. Major Employment Facilities Within 16 km (10 mi) of the Turkey Point Site

Firm	Number of Employees
City of Homestead	370
Homestead Air Reserve Station	623
Homestead Hospital	580
Florida Rock and Sand	175

Source: FPL 1999b and USAF 2000.

Table 2-15. Visitors to Major Events Within 16 km (10 mi) of the Turkey Point Site

Facility/Event	Peak One-Day Attendance 1988 Study	1990 Estimate[a]	1995 Estimate[a]
Biscayne National Park	1600	1680	1880
Homestead Bayfront Park and Marian	860	900	1015
Coral Castle	100	105	120
Homestead Frontier Days	16,500	17,340	19,440
Homestead MotorSports Complex	--	--	65,000

(a) Estimates based on the 1988 study (FPL 1999b).
Source: FPL 1999b.

The largest influx of seasonal residents is at Ocean Reef Club in Key Largo in Monroe County. The club is a private resort with 1200 single-family, multi-family, and tourist accommodations (FPL 1999b). There are a number of motel and private campground accommodations in and around Homestead/Florida City.

The Homestead MotorSports Complex, located approximately 8 km (5 mi) west of the Turkey Point site, hosts a number of events throughout the year. The complex has seating for 65,000 people. During early winter (January/February) the Homestead Frontier Days attracts about 19,440 visitors (FPL 1999b). In addition, as noted in Section 2.2.8.1, 800 to 900 temporary workers are associated with refueling at Turkey Point Unit 3 and 4 for 30 to 40 days once or twice a year.

- **Migrant Farm Labor**

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These employees may or may not have a permanent place of residence. Some migrant workers may follow the harvesting of crops through Florida, Georgia, and the Carolinas. Others may be permanent residents within the 80-km (50-mi) radius from the Turkey Point site, but travel from farm to farm harvesting crops.

Migrant workers can be members of minority or low-income populations. Migrant workers' travels, and the fact they can spend a significant amount of time in an area without being an actual resident, means they may be unavailable for census takers to count. If this occurs, these workers would be "under-represented" in minority and low-income population counts undertaken by the USCB (FPL 2000a).

The main agricultural crops grown within the 80-km (50-mi) radius of the Turkey Point site are citrus, row, and nursery crops. Migrant workers are frequently at these locations working or harvesting the crops. The U.S. Department of Agriculture (USDA) estimates that there were approximately 8700 hired farm workers (permanent and migrant) in Miami-Dade County (USDA 2001a). Approximately 12 percent of the total number of hired farm workers is migrant labor (USDA 2001b). As such, around 1040 migrant farm workers are present at any one time in Miami-Dade County, which is almost entirely within the 80-km (50-mi) circle.

There are 1576 farms in Miami-Dade County and 347 in Broward (USDA 2001b). Given the large geographic area of the two counties and the small number of estimated migrant workers, FPL concluded that migrant workers would be located throughout the counties at any given time and would not be concentrated in a single location. Hence, FPL did not expect the migrant farm worker population to materially change the population characteristics of any particular census tract (FPL 2000a).

2.2.8.6 Economy

From a historical perspective, two economic drivers have materially impacted the economy of southern Florida—tourism and in-migration of people to the area. More specifically, focusing on Miami-Dade County (all within the 80-km [50-mi] radius of the Turkey Point site), further breakdown and disparity of the economy of the county becomes more apparent. North of Eureka Drive (184th Street) is Miami and its suburbs. This area is largely developed. The area to the south of Eureka Drive is known as "South Miami-Dade County." This area is still relatively rural, agricultural, and largely undeveloped.

For Miami-Dade County as a whole, services and trade (wholesale and retail) in 1998 were the two largest contributing sources of employment in the county at approximately 33 and 26 percent, respectively. The third largest employment sector is government at approximately 14 percent (Beacon Council 2000a). Of the 10 largest employers in Miami-Dade County, FPL ranks sixth with approximately 3800 employees (Beacon Council 2000b), of which approximately 960 (permanent and contract) work at Turkey Point Units 3 and 4 (FPL 2000a). It is the second largest employer in South Miami-Dade County (USAF 2000) with an estimated annual economic impact of over $60 million.[a] In 1997, the latest year for which data were available, Miami-Dade County had a net out-migration of people of approximately 24,000 (Enterprise Florida 2000).

(a) Comment by Liz Thompson, FPL-Turkey Point Nuclear Plant at Scoping Meetings held December 6, 2000, Homestead, Florida.

South Miami-Dade County's economy cannot be discussed without recognizing the devastating impacts of Hurricane Andrew in September 1992. Hurricane Andrew was a Category 5 hurricane (Saffir-Simpson Scale) whose path went through South Miami-Dade County. The Turkey Point site and the cities of Florida City and Homestead were in its direct path. Homestead Air Force Base (located near Florida City/Homestead) was largely destroyed and not rebuilt. This cost approximately 6700 jobs. It is now an Air Force Reserve and Florida National Guard Station employing approximately 1100 full-time equivalent workers (USAF 2000).

The major economic impact of Hurricane Andrew, besides the tremendous physical damage, was the severe loss of the middle- and upper-income jobs in South Miami-Dade County. Most of the jobs now in the Florida City/Homestead area offer minimum to very low wages. With the closure of Homestead Air Force Base, FPL's Turkey Point site is the only employer providing higher-paying jobs in the immediate area. As such, it is a major contributor to the economic stability of the south part of the county. The payroll of Turkey Point Units 3 and 4 is $50 million annually and it purchases $3 to $4 million annually in local goods and services.[a]

The unemployment rate in 1999 for the county averaged 5.8 percent (Enterprise Florida 2000) compared to the Florida rate that averaged 3.9 percent (U.S. Department of Labor 2001). In South Miami-Dade County, the unemployment rate is approximately 9 percent at the end of 2000, down from 15 percent after Hurricane Andrew.[b]

In 1995, the percentage of persons below the poverty limit in Miami-Dade County was 23.6 percent, compared to 15.2 percent for Florida as a whole. For children the rate was 36.0 percent for the county, versus 24.1 percent for the State (USCB 2001c).

In 1993, the estimated percent of households in Homestead that were below the poverty level was 24.6 percent for Homestead.[c] This compares to Miami-Dade County at 25.4 percent and Florida at 16.0 percent (USCB 2001d). The median household income was approximately $25,500 (in 1993 dollars). This compares to the county at approximately $26,700 (in 1993 dollars) and the State at approximately $28,200 (1993 dollars) (USCB 2001e).

(a) Personal communication with Mary Finlan, Executive Director, Greater Homestead/Florida City Chamber of Commerce, December 5, 2000.

(b) Personal communication from Otis T. Wallace, Mayor, City of Florida City, December 8, 2000.

(c) Personal communication and data from Alicia M. Schreiber, Assistant City Manager, Homestead, Florida, December 2000.

Agriculture is declining in Miami-Dade County. There are approximately 1580 farms on 34,400 ha (85,100 ac) in Miami-Dade County (USDA 2001a). Most of this is concentrated in the southern part of the county. Farm income for Miami-Dade County declined from $175 million in 1994, to around $167 million in 1998 (about 4.4 percent). Agricultural income declined from about 0.42 percent of personal income in Miami-Dade County in 1994 to around 0.32 percent in 1998 (Bureau of Economic Analysis 2000). The number of farm proprietors declined from approximately 1700 in 1994, to around 1450 in 1998, or approximately 14.7 percent (Bureau of Economic Analysis 2000).

County planning officials expect the future area of growth for Miami-Dade County to be in the southern part (south of Eureka Drive). The southern part of the county is expected to be the growth area because it is largely undeveloped, mainly rural, and has the open spaces for economic development to occur. The costs of new development would be expected to be lower when compared to the northern, already-developed part of the county. In addition, Homestead has received an Empowerment Zone designation by the Federal government that is expected to aid in business development and job recruitment.[a]

Moderate growth forecasts for jobs in South Miami-Dade County predict an increase in jobs from approximately 42,000 (1995) to about 68,000 (2015), or a projected increase of approximately 28,000 jobs (or 61.9 percent) over the 20-year period. Employment in Miami-Dade County as a whole is projected to increase by about 156,000 jobs under the same moderate growth forecast. Population in the county (moderate growth forecast) is projected to increase from approximately 2.1 million (1995)[b] to around 2.5 million (2015), or approximately 19 percent over the 20-year period. South Miami-Dade County is projected to increase from approximately 163,000 (1995) to around 240,000 (2015) or approximately 47 percent. High growth forecasts for South Miami-Dade County show projected employment and population gains to be five times as large (USAF 2000).

The significance of these projections, if they materialize, is that the importance of Turkey Point Units 3 and 4 to South Miami-Dade as an employer may decline over time. The southern part of the county is slated to potentially achieve significant economic, population, and job growth over the next 15 years relative to the rest of the county. Even so, the disparity between the large population growth and somewhat smaller employment growth (although still significant in percentage terms when compared to the rest of the county) may be indicative of a trend for

(a) The purpose of the zone is to encourage business development and job creation in impoverished areas. Businesses locating to the zone receive special tax benefits.

(b) Approximately 2.25 million in 2000 (see Table 2-9).

South Miami-Dade County to become more of a bedroom community for the central and northern portions of the county (USAF 2000).

FPL is a property taxpayer in Miami-Dade County. FPL pays the tax on Turkey Point Units 3 and 4 to the county, public schools, SFWMD, and the Florida Inland Waterways Navigation System. Table 2-16 shows the total Miami-Dade County property tax revenues and the FPL contributions between 1995 and 1998 (FPL 2000a). Over the 4-year period, FPL contributions averaged 1.7 percent of the total property taxes collected in the county (FPL 2000a). Approximately 45 percent of the total property taxes in 1998 of Units 3 and 4 went in support of public schools.[a]

Table 2-16. Turkey Point Units 3 and 4 Contribution to County Property Tax Revenues and Operating Budget

Year	Total Miami-Dade County Property Tax Revenues ($)	Property Tax Paid to Miami-Dade County for Turkey Point Units 3 and 4 ($)	Percent of Total Property Taxes
1995	611,518,000	12,931,000	2.1
1996	608,922,000	9,951,000	1.6
1997	627,268,000	8,979,000	1.4
1998	653,096,000	10,140,000	1.6

Source: FPL 2000a.

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at the site of Turkey Point Units 3 and 4 and in the surrounding area.

2.2.9.1 Cultural Background

The region around the Turkey Point site is rich in prehistoric and historic Native American and historic Euroamerican resources. The southern Florida region has an archaeological sequence that extends back between about 12,000 to 13,000 years based on findings of fragmentary

(a) Personal communication with Herbert Parlato, Deputy Property Appraisor, Property Appraisal Office, Miami-Dade County, April 23, 2001.

human remains at a site in Sarasota County (Griffen 1988; Carr 1981). At that time, southern Florida's climate was markedly drier than it is today; it is estimated that the water table was as much as 26 m (85 ft) lower than it is now (Griffen 1988). During the Paleo-Indian era (from about 12,000 B.C. to 6500 B.C), inhabitants of southern Florida were probably low in numbers and were concentrated around scarce water resources that provided food and transportation routes. During the early Archaic period, southern Florida's climate began to be more mesic, and occupation of the area expanded. The earliest evidence of human occupation in the southeast Florida area may be from as long ago as 8000 B.C. based on fossils and artifacts from the Cutler Fossil Site (Milanich 1994; Leynes and Cullison 1998). By the Late Archaic period, human occupation of Miami-Dade County indicates a well-developed culture (Carr 1981). The Glade periods (500 B.C. to 1750 A.D.) were characterized by an extensive use of pottery and reliance on marine food resources, including marine mammals, turtles, shellfish, with some use of terrestrial plants and animals (Milanich and Fairbanks 1980). Agriculture was apparently practiced on a limited basis (Griffen 1988).

The first recorded European contact with aboriginal people of southern Florida occurred in 1513 when Spanish explorer Ponce de Leon landed on Florida's eastern coast. It is presumed that he encountered the Tequesta at a location near the mouth of the Miami River (Leynes and Cullison 1998). The Tequesta and other aboriginal peoples of Florida were severely impacted by fighting and diseases resulting from European contact. Diseases and direct conflict substantially reduced the Tequesta population, and the last of the Tequesta reportedly left southern Florida for Cuba in 1770 (Carr 1981).

After the disappearance of the Tequesta, Native American tribes and others began moving into southern Florida. Pressed by advancing colonization and other pressures, members of the Oconee and other tribes from Alabama and Georgia moved south to Florida (Leynes and Cullison 1998). Later joined by Creeks and fugitive slaves, this group became known as the Seminole. The Seminole moved to the southern Florida region after the Second Seminole War when surviving members of the tribe fled south to the Everglades to avoid relocation to Oklahoma and continued fighting with U.S. troops (Griffen 1988). The present-day Seminole are represented by two groups; the Seminole who are primarily Muskogee-speaking and the Mikasuki (Miccosukee) who are primarily Hichiti-speaking.

Survey maps at the State Library of Florida do not show any permanent settlement in the area surrounding the Turkey Point site. One map dating from 1835 shows the southeast coast of Florida as "Indian Hunting Grounds." Another set of survey maps states that the area around Turkey Point site was too swampy to survey.

Florida was granted statehood in 1845. White settlement of southern Florida began in the 1800s and was enhanced with draining of swampy areas beginning in 1906. A large influx of

people occurred in the 1920s era land boom. Following World War II, the population of southern Florida expanded substantially and agriculture, aviation, and tourism became major industries of the area.

2.2.9.2 Historic and Archaeological Resources at Turkey Point Site

Historic and archaeological site file searches were conducted at the Florida Department of State, Division of Historical Resources, the National Park Service Southeast Archaeological Center, and at Biscayne National Park. In addition, maps at the State Library of Florida were examined for information that would indicate the potential for historic and archaeological sites at or near Turkey Point site.

No historic or archaeological sites have been recorded on the Turkey Point site, although no cultural resource inventories have been completed for the plant site. An archaeological survey was conducted for the Everglades Mitigation Bank, which is adjacent to the Turkey Point site to the west and south. Areas most likely to contain historic or prehistoric cultural resources were identified through evaluations of several maps, photographs, and other information sources. No cultural resources were found in surveys of more than 100 target sites and 61 test excavations (Lewis and Davis 1996). In a letter dated September 11, 1996, the archaeologist for the Metro-Dade County Office of Community and Economic Development, Historic Preservation Division, concurred with the findings of the survey report (Carr 1996). There are no prehistoric or historic sites located along the Turkey Point site's boundary with Biscayne National Park.

The closest archaeological site to Turkey Point is the Snapper Creek Future Archaeological Zone, which is approximately 26 km (16 mi) north of the plant site. Other "probable archaeological sites" are located as close as approximately 32 km (20 mi) northwest of the plant site (Miami-Dade County 2000b).

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 Turkey Point Units 3 and 4. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparation of the SEIS.

Significant Federal activities in relatively close proximity to the Turkey Point site are the Biscayne and Everglades National Parks operated by the National Park Service and the former Homestead Air Force Base (see Section 2.2.8.3). The Federal Government is also participating in the Comprehensive Everglades Restoration Plan.

Biscayne National Park is immediately north and east of the plant site. Everglades National Park is approximately 24 km (15 mi) west of the plant site; the park preserves a large area of subtropical wetlands.

The former Homestead Air Force Base is also close to the plant site. The USAF and the Federal Aviation Administration prepared a supplemental EIS concerning the disposition of land at the former base, which is considered excess to the needs of the USAF and surplus to the needs of the Federal Government (USAF 2000). The proposed action in the EIS was to transfer the surplus property to Miami-Dade County for the development of a one-runway commercial airport. The Record of Decision, however, authorizes transfer of 290 ha (717 ac) at the former base to Miami-Dade County for mixed economic uses that could include commercial development as well as residential or recreational uses (66 FR 12930 [DOD 2001]). Development of a commercial airport will not be permitted. The USAF will retain the runway and airfield areas at the former base for its own use.

The wetlands in southern Florida are only approximately half their original size. During the dry season, there is insufficient freshwater for the natural system and for urban and agricultural consumers. The U.S. Army Corps of Engineers and other public and tribal agencies have collaborated to develop the Comprehensive Everglades Restoration Plan. The plan focuses on increasing storage of wet season waters so that more water is available during the dry season for public and tribal lands and for urban and agricultural users. The plan consists of 68 projects estimated to take 36 years and $7.8 billion to complete. Title VI of the Water Resources Development Act of 2000 approved the plan as a framework for changes that are needed to (1) restore, preserve, and protect the southern Florida ecosystem; (2) provide for the protection of water quality in, and the reduction of the loss of freshwater from, the Everglades; and (3) provide for the water-related needs of the southern Florida region. The Act authorizes appropriations for the plan's initial construction projects and their operation and maintenance. The Federal Government will pay half the costs of implementing the plan and public and tribal agencies the other half.

After reviewing the Federal activities in the vicinity of the Turkey Point site, 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 the SEIS.

NRC is required under Section 102 of the NEPA to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. NRC consulted with the U.S. Army Corps of Engineers, the FWS, and the National Park Service. Consultation correspondence is included in Appendix E. The National Park Service submitted written comments during the scoping process; their comments are reflected in this SEIS.

2.3 References

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

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

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

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

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

40 CFR 190. Code of Federal Regulations, Title 40, *Protection of 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 were 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 included a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

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

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

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

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

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

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

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

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

Table 3-1. Category 1 Issues for Refurbishment Evaluation

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

Category 1 and Category 2 issues related to refurbishment that are not applicable to Turkey Point because they are related to plant design features or site characteristics not found at Turkey Point are listed in Appendix F.

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Florida Power & 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

Table 3-2. Category 2 Issues for Refurbishment Evaluation

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

operation of Turkey Point Units 3 and 4 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 (ER; FPL 2000).

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 statement (AEC 1972; NRC 1981). In addition,

FPL 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 Turkey Point Units 3 and 4 beyond the end of the existing operating licenses. Therefore, refurbishment is not considered in this Supplemental Environmental Impact Statement.

3.1 References

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

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

Florida Power & Light Company (FPL). 2000. *Applicant's Environmental Report – Operating License Renewal Stage Turkey Point Units 3 and 4.* Miami, Florida.

U.S. Atomic Energy Commission (AEC). 1972. *Final Environmental Statement Related to Operation of Turkey Point Plant, Florida Power & Light Company.* Dockets No. 50-250 and 50-251, 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). 1981. *Final Environmental Statement Related to Steam Generator Repair at Turkey Point Plant, Units 3 & 4; Florida Power & Light Company.* Docket Nos. 50-250 and 50-251, NUREG-0743, Washington D.C.

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4.0 Environmental Impacts of Operation

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

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

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

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

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

Category 2 issues are those that did not meet one or more of the criteria 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 Turkey Point Plant. Section 4.1 addresses issues applicable to the Turkey Point Plant cooling canals. Section 4.2 addresses issues related to transmission lines and land use. Section 4.3 addresses the radiological impacts of normal operation. Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality. Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses new information that was raised during the scoping period. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in

(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.

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

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to Turkey Point Unit 3 and 4 cooling system operation during the renewal term are listed in Table 4-1. Florida Power & Light Company (FPL) stated in its Environmental Report (ER; FPL 2000a) that it is not aware of any new and significant information associated with the renewal of the Turkey Point Unit 3 and 4 operating licenses (OLs). The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2000a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

- 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, 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 during the renewal term beyond those discussed in the GEIS.

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

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

Table 4-1. Category 1 Issues Applicable to the Operation of the Turkey Point Units 3 and 4 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)	
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2
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
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
TERRESTRIAL RESOURCES	
Cooling pond impacts on terrestrial resources	4.4.4
HUMAN HEALTH	
Microbial organisms (occupational health)	4.3.6
Noise	4.3.7

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 including plant monitoring data and technical reports. Therefore, the staff concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the FPL ER, the staff's site visit, the scoping process, or its evaluation of other available information including the National Pollutant Discharge Elimination System (NPDES) permit for Turkey Point Units 3 and 4. 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, the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for Turkey Point Units 3 and 4. 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, the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for Turkey Point Units 3 and 4 and the ecological risk assessment study for the cooling canal system (ESE 2000). Therefore, the staff concludes that there are no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

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

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

  The condenser tubes at Turkey Point Units 3 and 4 are titanium, eliminating problems associated with copper alloys. Further, 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 available information, including the ecological risk assessment for the cooling canal system (ESE 2000). 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, 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, 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.

- 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, 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, 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, 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.

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

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

  The staff has not identified any significant new information during its independent review of the 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 impacts of the cooling canals during the renewal term beyond those discussed in the GEIS.

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

  "Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures."

  The staff has not identified any significant new information during its independent review of the 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 impacts of microbiological organisms during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the 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 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 Turkey Point Units 3 and 4 are discussed in the section that follows, and are listed in Table 4-2. Although the FPL ER identified only microbiological organisms (public health) as an applicable Category 2 issue, the staff determined that all the Category 2 issues pertaining to plants with cooling ponds are applicable to Turkey Point Units 3 and 4.

Table 4-2. Category 2 Issues Applicable to the Operation of the Turkey Point Units 3 and 4 Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.3.3	B	4.1.1
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
HUMAN HEALTH			
Microbiological organisms (public health)(plants using lakes or canals or cooling towers that discharge into a small river)	4.3.6	G	4.1.4

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For plants with cooling ponds, including the Turkey Point cooling canal system, entrainment of fish and shellfish in early life stages into cooling water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal.

The staff independently reviewed the Turkey Point ER (FPL 2000a), visited the site, and reviewed the applicant's NPDES Permit FL0001562, issued January 7, 2000, and in force until January 6, 2005 (FPL 2000a, Appendix E). The closed-loop, recirculating Turkey Point cooling canal system neither withdraws nor discharges surface water to any surface water of the United States or the State of Florida. Therefore, the staff concludes that impacts of entrainment on early life stages are limited to the cooling canal system, and there are no impacts from entrainment of fish and shellfish in early life stages on biotic resources of Biscayne Bay, Card Sound, or other waters.

A species list or faunal survey for the fish and shellfish of the cooling canal system is not available. Suitable spawning habitat for game species that favor ocean passes or open bays (FFWCC 1999), such as the common snook and tarpon, is not present in the closed canal system. The applicant states that game fish numbers in the cooling canal system have declined to very low numbers due to lack of spawning habitat. The applicant reports that the

predominant fish in the canals are killifish and other live-bearers (FPL 2000a). Any impacts on fish and shellfish populations within the cooling canal system from entrainment of early life stages would not impact recreational or commercial fishing because the cooling canal system is closed to fishing or other resource-based uses.

Based on this review, the staff concludes that the potential impacts of the cooling-water-intake system's entrainment of fish and shellfish in early life stages are SMALL, and mitigation is not warranted.

4.1.2 Impingement of Fish and Shellfish

For plants with once-through cooling systems, including the Turkey Point cooling canal system, impacts of fish and shellfish on debris screens of cooling-water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal.

The staff independently reviewed the Turkey Point ER (FPL 2000a), visited the site, and reviewed the applicant's NPDES Permit FL0001562, issued January 7, 2000 and in force until January 6, 2005 (FPL 2000a, Appendix E). The closed-loop, recirculating Turkey Point cooling canal system neither withdraws nor discharges surface water to the waters of the State. Therefore, the staff concludes that impacts from impingement of fish and shellfish are limited to fish and shellfish in the cooling canals and there are no impacts from impingement on fish and shellfish of Biscayne Bay, Card Sound, or other waters.

Impacts from impingement of fish and shellfish are limited to the populations of fish and shellfish residing in the cooling canal system. A species list or faunal survey for the fish and shellfish of the cooling canal system is not available. Suitable spawning habitat for game species that favor ocean passes or open bays (FFWCC 1999), such as the common snook and tarpon, is unlikely to occur in the closed canal system, although some gamefish spawning in the canals may still occur. The applicant reports that the dominant fish species in the cooling canal system are killifish and other live-bearers (FPL 2000a). The preferred habitat for these fish are shallows and aquatic vegetation, and individuals are not widely ranging. It is unlikely that populations of such species would be greatly affected by impingement in the intakes of the nuclear plants. Any impacts on fish and shellfish populations within the cooling canal system from impingement would not impact recreational or commercial fishing, because the cooling canals are closed to fishing or other resource-based uses.

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

4.1.3 Heat Shock

For plants with cooling ponds, including the Turkey Point cooling canal system, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal.

The staff independently reviewed the Turkey Point ER, visited the site, and reviewed the applicant's NPDES Permit FL0001562, issued January 7, 2000 and in force until January 6, 2005 (FPL 2000a, Appendix E). The closed-loop, recirculating Turkey Point cooling canal system neither withdraws nor discharges surface water to the waters of the State. Therefore, the staff concludes that any impacts from heat shock would be limited to the cooling canal system, and there would be no impacts from heat shock on biotic resources of Biscayne Bay, Card Sound, or other waters.

A species list or faunal survey for the fish and shellfish of the cooling canal system is not available. Suitable spawning habitat for game species that favor ocean passes or open bays (FFWCC 1999), such as the common snook and tarpon, is unlikely to occur in the closed canal system. The applicant reports that the dominant fish species in the cooling canals are killifish and other live-bearers (FPL 2000a). These hardy fish are known from a wide variety of habitats, including hypersaline and thermally challenged environments. It is unlikely that populations of these species would suffer other than minor impacts from heat shock.

Thus, the staff concludes that potential heat shock impacts resulting from operation of the plant's cooling water discharge system to the aquatic environment on or in the vicinity of the site are SMALL, and mitigation is not warranted.

4.1.4 Microbiological Organisms (Public Health)

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

All Turkey Point units use a closed-cycle cooling system that uses a series of shallow canals to cool the heated effluent and to recycle water for re-use. Although there is a potential for deleterious thermophylic microorganisms to be associated with the canals, the high temperature of the water as it is discharged to the canals, the salinity of the water, and high penetration of ultraviolet light provide an environment that is not conducive to the survival and reproduction of pathogenic microorganisms.

In addition, there are few if any potential pathways for significant human exposure to such organisms if they were to exist in the cooling system water. The plants do not use sprays or cooling towers that could produce respirable aerosols. Prohibitions against swimming and fishing in the cooling canals preclude direct contact and ingestion exposure routes.

FPL conducted an analysis of the potential public health impacts of microbiological organisms and submitted the results to the Florida Department of Health (FDOH) for review and comment (Hovey 1999a). FDOH concurred with the FPL conclusion and indicated "that there is minimal public health risk from the cooling canals at the Turkey Point Nuclear Plant" (Heber 1999).

The conditions associated with the Turkey Point cooling canal system are not favorable for survival and reproduction of pathogenic biological microorganisms, and the potential exposure pathways are limited. Analyses and evaluations conducted by FPL as published in the ER (FPL 2000a), including the results of consultation with the FDOH, indicate that the impact of deleterious microbiological organisms during continued operation of the plant during the renewal term are expected to be minimal. Consequently, the staff concludes that the potential impacts of microbiological organisms on public health are SMALL, and mitigation is not warranted.

4.2 Transmission Lines

The *Final Environmental Statement for Turkey Point Plant* (FES; AEC 1972) describes seven transmission lines that connect Turkey Point Units 3 and 4 with the transmission system. An additional transmission line was constructed in the early 1990s, and four other lines connect the Davis substation with other substations (Figure 2-5 and Table 2-1). These transmission corridors cover approximately 930 ha (2300 ac) over a total corridor length of approximately 92 km (57 mi). Tree trimming is normally only required at mid-span or when exotic species such as Australian pine invade the tower pads or corridor. Herbicides are used occasionally, primarily applied to individual trees or shrubs to prevent re-sprouting, although broadcast applications are used to control exotic grasses in some of the urban or suburban areas. FPL requires the use of State-licensed applicators for herbicides and only uses nonrestricted-use products. Regular mowing is normally also used for maintenance of corridors in suburban areas. FPL uses a computer database to prepare management prescriptions for each section of transmission line corridor 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 Turkey Point Units 3 and 4 are listed in Table 4-3. FPL stated in its ER that it is not aware of any new and significant information associated with the renewal of the Turkey Point Units 3 and 4 OLs. No significant new information has been identified by the staff

Table 4-3. Category 1 Issues Applicable to the Turkey Point 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

in its independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the GEIS concluded that the impacts are SMALL, and 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 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."

  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, consultation with the U.S. Fish and Wildlife Service (FWS) and the Florida Fish and Wildlife Conservation Commission

(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 FPL ER, 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 FPL ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any significant new information during its independent review of the FPL ER, 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 on flood plains and wetlands on the power line right-of-way during the renewal term beyond those discussed in the GEIS.

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

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

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

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

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

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

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

  "Ongoing use of power line 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 FPL ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts on use 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. Category 2 Issues Applicable to the Turkey Point Transmission Lines During the Renewal Term

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

4.2.1 Electromagnetic Fields—Acute Effects

In the GEIS (NRC 1996a), the staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC 1997) criteria, it is not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

There are four 230-kV transmission lines that connect the Turkey Point switchyard to the plant startup and main transformers and eight 230-kV transmission lines that leave the Turkey Point switchyard. These lines were constructed before the current (1997) NESC standard was adopted. Therefore FPL performed an analysis to confirm that the onsite and offsite lines conform to the current NESC clearance requirements for limiting electric shock hazard. The NESC requires that transmission lines be designed to limit the steady-state current due to electrostatic effects to 5 mA root mean square (rms).

The minimum vertical clearance to the roadbed of the lines between the plant and switchyard was calculated to be 11.6 m (38.1 ft) at a temperature of 49°C (120°F). Under these conditions, the EzEMF computer code (EzWare 1998) calculated the maximum electric field strength 1 m (3 ft) above the road to be 2.0 kV/m. Assuming a semi-tractor trailer centered under and perpendicular to the conductors, FPL determined the maximum steady-state short-circuit current to be 1.6 mA rms.

Using a similar approach for the offsite circuits, FPL found the maximum electric field strength to be 5.4 kV/m in the corridor between the Turkey Point site and the Davis substation. With the tractor trailer and a minimum clearance of 7.6 m (25 ft), this field strength corresponds to a short-circuit current of 4.32 mA.

The maximum steady-state short-circuit currents determined by FPL both onsite and offsite are within the NESC limit of 5 mA. Therefore, the staff concludes that the impact of the potential for electric shock is SMALL, and mitigation is not warranted.

4.2.2 Electromagnetic Fields—Chronic Effects

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

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

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

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

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Turkey Point Units 3 and 4 in regard to radiological impacts are listed in Table 4-5. FPL stated in its ER (FPL 2000a) that it is not aware of any new and significant information associated with

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

the renewal of the Turkey Point OLs. No significant new information has been identified by the staff in its independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

- 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 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 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 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 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. Refer to Section 4.7 for an evaluation of potential new and significant radiological impacts on human health.

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 2000a) that it is not aware of any new and significant information associated with the renewal of Turkey Point Units 3 and 4 OLs. No significant new information has been identified by the staff in their independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996a). For all of those issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

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

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

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

  The staff has not identified any significant new information during its independent review of the 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 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 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 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 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 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, 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.

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
	SOCIOECONOMICS		
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public Services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental Justice	Not Addressed	Not Applicable	4.4.6

4.4.1 Housing Impacts During Operations

In determining housing impacts, the applicant chose to follow Appendix C of the GEIS (NRC 1996a), which presents a population characterization method that is based on two factors, "sparseness" and "proximity" (GEIS Section C.1.4 [NRC 1996a]). Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80 km (50 mi). Each factor has categories of density and size (GEIS Table C.1), and a matrix is used to rank the population category as low, medium, or high (GEIS Figure C.1).

In 1990, the population living within 32 km (20 mi) of Turkey Points Units 3 and 4 was estimated to be approximately 391,800 (Table 2-12). This translates to around 240 persons/km^2 (625 persons/mi^2) living on the land area present within a 32-km (20-mi) radius of the Turkey

Point site.[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]).

In 1990, an estimated 2,613,500 people lived within 80 km (50 mi) of the Turkey Point site (Table 2-12), equating to a population density of around 260 persons/km^2 (665 persons/mi^2) on the available land area.[a] Applying the GEIS proximity measures (NRC 1996a), Turkey Point Units 3 and 4 are classified as Category 4 (i.e., having greater than or equal to 73 persons/km^2 [190 persons/mi^2]) within 80 km (50 mi) of the site. According to the GEIS, these sparseness and proximity scores identify the nuclear units as being located in a high-population area.

10 CFR Part 51, Subpart A, Appendix B, Table B-1 states that impacts on housing availability are expected to be of small significance at plants located in a high-population area where growth-control measures are not in effect. The Turkey Point site is located in a high-population area and Miami-Dade County is not subject to growth-control measures that would limit housing development. Based on the NRC criteria, FPL expects housing impacts to be SMALL during continued operations (FPL 2000a).

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 1996a). 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. Although FPL expects to perform these routine activities during scheduled outages, they assumed they would not add more than 60 total employees to their permanent staff during license renewal (FPL 2000a). This addition of 60 permanent workers, plus 124 indirect jobs (FPL 2000a), would result in an increased demand for a total of 184 housing units around the Turkey Point site (or 156 housing units for Miami-Dade County).[b] The demand for the existing housing units could be met with the construction of new or use of existing, unoccupied housing. In Miami-Dade County, jobs were projected to be approximately 1.2 million in 2000 (FPL 2000a) and the population at around 2.2 million in 2000 (USCB 2001). The increase in projected housing units would not create a discernible change in housing availability, change in rental rates or housing values,

(a) These numbers differ from those presented by FPL in the ER (FPL 2000a). In their calculations, 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. It was 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) This assumes 85 percent of the new hires reside in the county (see Section 2.2.8.1).

or spur new construction or conversion. As a result, FPL concludes that the impacts would be SMALL and mitigation measures would not be necessary (FPL 2000a).[a]

The staff reviewed the available information relative to housing impacts and FPL's conclusions. Based on this review, the staff concludes that the impact on housing during the license renewal period would be SMALL, and mitigation is not warranted.

4.4.2 Public Services—Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand, and thus there is no need to add capital facilities. Impacts are considered MODERATE if overtaxing 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 1996a).

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the Turkey Point Units 3 and 4 permitted withdrawal rate and actual use of water. FPL plans no refurbishment at Turkey Points Units 3 and 4, so plant demand would not change beyond current demands (FPL 2000a).

FPL assumed an increase of 60 employees during the license renewal period, the generation of 184 new jobs, and a net overall population increase of approximately 500 as a result of those jobs,[b] all of which would create SMALL impacts. The plant-related population increase would require an additional 0.0011 to 0.0018 m^3/s (0.039 to 0.064 ft^3/s) of potable water (FPL 2000a).[c] This amount is within the residual capacity of the Alexander Orr, Jr., Water Treatment Plant (see Table 2-10) that services Miami-Dade County south of Flager Street, and includes the Turkey Point site. For Florida City and Homestead, the increase in water consumption, assuming all 500 people were located in the two towns, is well within their residual capacity as well. The staff finds that the impact of increased water use is SMALL and mitigation is not warranted.

(a) The FPL estimate of 184 housing units (156 units for Miami-Dade County) is likely to be an extreme "upperbound" estimate. Most of the potentially new jobs would most likely be filled by existing area residents, thus creating no, or little, net demand for housing.

(b) Calculated by assuming that the average number of persons per household is 2.7 (185 jobs X 2.7 = 500) (FPL 2000a).

(c) Calculated assuming that the average American uses between 50 and 80 gallons of water for personal use per day; 500 people x 80 gallons per person/day = 40,000 gallons/day (.0018 m^3/s).

4.4.3 Offsite Land Use During Operations

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

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

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

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

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

FPL has identified a maximum of 60 additional employees during the license renewal term plus an additional 124 indirect jobs (total 184) in the community (FPL 2000a). Section 3.7.5 of the GEIS (NRC 1996a) 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, a population density of well over 23 persons/km^2 (60 persons/mi^2), and at least one urban area (Miami) with a population of 100,000 or more within 80 km (50 mi). 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 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. 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.

Miami-Dade County is the only local jurisdiction that taxes the Turkey Point Units 3 and 4 directly. FPL's tax payments to the county for Units 3 and 4 since 1995 constitute about 2 percent of the county's total property tax revenue and less than 0.5 percent of the county's total operating budget (Table 2-16). Additionally, the communities in the vicinity of the plant site have pre-established patterns of development and have provided adequate public services to support and guide development.

No adverse effects on offsite land use will occur that are related to the Everglades Restoration Project or other Federal action in the proposed project area. Consequently, the staff concludes that offsite land-use impacts are likely to be SMALL and would not require mitigation.

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 1999b for more discussion of this clarification). The issue is treated as such in this Supplemental Environmental Impact Statement (SEIS).

In the year 2000, most of the roadways within South Miami-Dade County were operating at acceptable levels of service (Miami-Dade County 2000). As discussed in Section 2.2.8.6, the area of population growth in Miami-Dade County is in the southern part. The high-growth projections for the southern part of the county indicate that the population could increase by 2015 by 47 percent to 250 percent (Section 2.2.8.6). Such growth could put tremendous pressure on the local transportation systems in the south end of the county, particularly the Florida Turnpike and U.S. Highway 1. Planned improvements in the southern part of the county include constructing the remaining portions of the South Miami-Dade Busway between SW 112th Avenue and SW 344th Street in Homestead between 2001 and 2005 (Miami-Dade County 2000). Additional road improvements are planned in the south part of the county through the year 2020.

However, none of this expected growth is due directly to increases in employment at the Turkey Point site. The permanent employment associated with Turkey Points Units 3 and 4 is currently 960 employees (FPL and contractors [FPL 2000a]). During periods of refueling, once or twice a year, up to an additional 800 to 900 workers are hired on a temporary basis. The "upper bound" potential increase in permanent staff during the license renewal term is 60 additional workers, or approximately 6 percent of the current permanent and contract work force of 960.

The level of access to the Turkey Point 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 (NHPA) requires that Federal agencies take into account the effects of their undertakings on historic properties. NRC representatives met with a representative of the Florida State Historic Preservation Officer (SHPO) on December 5, 2000 to explain the Turkey Point relicensing project and to obtain from the State relevant information about the area and recommended contacts for additional site-specific information. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Renewal of an OL is an undertaking that could potentially affect historic properties. Therefore, according to the NHPA, 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 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 this instance, there are no known historic or archeological resources at the Turkey Point site, and the Turkey Point Units 3 and 4 license renewal application for continued operations does not include proposals for future land-disturbing activities or structural modifications beyond routine maintenance at the plant. Consultation between the license renewal applicant and the Florida SHPO for this license renewal application was initiated in September 1999. In a letter dated October 22, 1999, the Florida SHPO stated that it was their opinion that the proposed relicensing would "...have no effect on any site listed, or eligible for listing in the National Register" (Matthews 1999).

Continued operation of Turkey Point Units 3 and 4 would have a beneficial effect on any potential unknown or undiscovered historic or archeological resources located in undisturbed areas for the duration of the license renewal period by protecting the natural landscape and vegetation and by providing restricted access to the plant.

Additional care should be taken during normal operational or maintenance conditions to ensure that potential 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 recreation, wildlife habitat enhancement, or maintaining/upgrading plant access roads throughout the plant site. The environmental impacts of activities undertaken by FPL are managed through the Environmental Protection Plan (Appendix B to each units' operating license) and the licensee's program to implement the requirements of 10 CFR 50.59, "Changes, tests, and experiments." Based on the staff's cultural resources analysis and consultation, the finding that FPL did not identify any major refurbishment activities related to the renewal of the Turkey Point Unit 3 and 4 OLs, and that operation will continue within the bounds of plant operations as evaluated in the FES (AEC 1972), it is the staff's conclusion that the potential impacts on historic and archaeological resources are expected to be SMALL, and mitigation is not 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 Letter 906, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues* (NRC 1999b).

The staff examined the geographic distribution of minority and low-income populations recorded during the 1990 Census (USCB 1991) within 80 km (50 mi) of Turkey Point Units 3 and 4, encompassing all of Miami-Dade County and parts of Broward and Monroe counties. The analysis was also supplemented by field inquiries to the planning department and social service agencies in Miami-Dade County.[(b)]

(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 1999b).

(b) Miami-Dade County was the focus of this inquiry because all except a small portion of the northwest part of the county lies within the 80-km (50-mi) radius of the Turkey Point site. The staff concluded that any findings of environmental justice issues in the county would warrant further field inquiries in Broward and Monroe counties. For reasons stated later in this section, further investigation was not warranted.

For the purpose of the staff's review, a minority population is defined to exist if the percentage of each minority and aggregated minority category within the census block groups potentially affected by the license renewal of Turkey Point Units 3 and 4 exceeds the corresponding 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[(a)] 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. For census block groups within Miami-Dade, Broward, and Monroe counties, the percentage of minority and low-income populations is compared to the percentage of minority and low-income populations in Florida.

FPL followed the convention of including the census tracts. They included the census tracts where at least 50 percent of their area lay within 80-km (50-mi) of Turkey Point Units 3 and 4 (FPL 2000a). Using this convention, the 80-km radius includes 362 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 a minority or low-income population (FPL 2000a). Because the 20 percentage points is a lower threshold, the 50 percent criteria was not needed.

The staff followed the convention of employing census block groups.[(b)] Figure 4-1 shows the distribution of minority populations (shaded areas) within the 80-km (50-mi) radius. Within the

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(a) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the 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).

(b) There are other small differences between the NRC and FPL method of identifying minority and low-income populations. NRC uses "families" below poverty while FPL uses "households" below poverty. A "household" consists of all the persons who occupy a housing unit (house or apartment), whether or not they are related to each other. A family is a group of two or more persons, related by birth, marriage, or adoption, who live together. All such related persons are considered members of one family (HHS 2001). NRC uses "Blacks" while FPL uses "non-Hispanic Blacks." Non-Hispanic Blacks are a subcategory of the Black category. Non-Hispanic Blacks are added to Hispanic Blacks to come up with the total Black population (NRC number). FPL included a census tract within the 80-km (50-mi) radius only if more than 50 percent of the geographic area of the tract falls within the 80-km (50-mi) radius. NRC includes the census block groups if any portion of the group falls within the 80-km (50-mi) radius. These small differences do not impact the overall findings of this section.

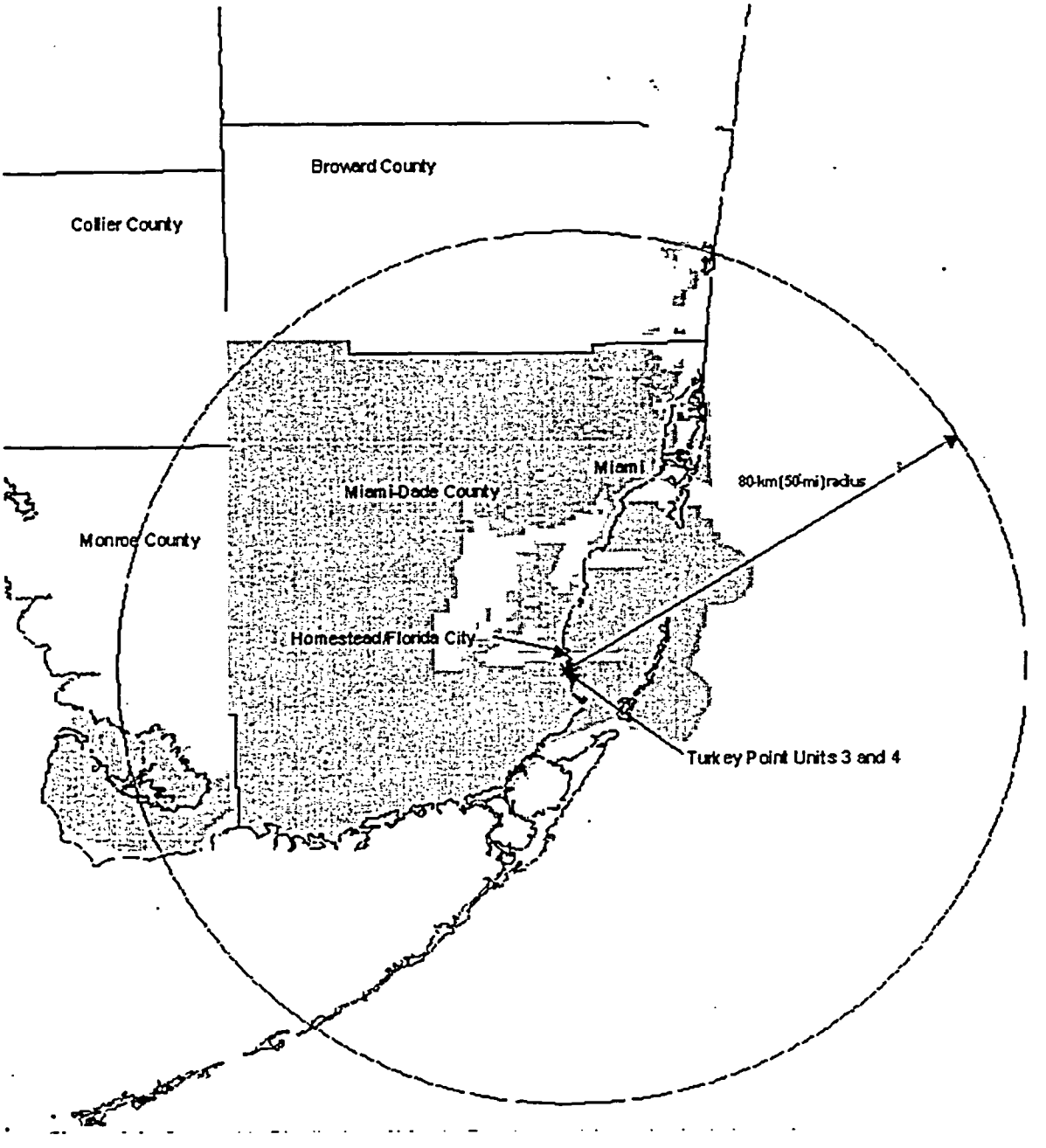

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of Turkey Point Site Based on Census Block Group Data[(a)]

(a) Note: Some of the census block groups extend into open water.

vicinity of the Turkey Point site, there is a large Hispanic minority population and a smaller Black minority population. In Figure 4-1, there is a large shaded area that covers most of the Florida Everglades in Miami-Dade County. This area, generally lying to the west of the Florida Turnpike, the cities of Homestead, Florida City, and Miami and extending to the boundaries of Broward County on the north and Collier and Monroe counties on the west, is one large census block group. Although the minority population characteristics are similar to other census block groups that are much smaller geographically, this large census block group has a very low population density. It could mistakenly give the impression that there is a large minority population when there is not because of the presence of the Everglades.

Most of the low-income population census block groups (Figure 4-2) in Miami-Dade County are concentrated in central Miami and just outside and to the south of the Miami metropolitan city limits. In Broward County, most of the census block groups are in Fort Lauderdale and along the Miami-Dade/Broward county line.

With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Based on staff guidance (NRC 1999b), air, land, and water resources within about 80 km (50 mi) of the Turkey Point 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 Turkey Point Units 3 and 4 license renewal can affect human populations are discussed in each associated section. The staff evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which the populations could be disproportionately high 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 Turkey Point Units 3 and 4 to minority and low-income populations would be SMALL, and no special mitigation actions are warranted.

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 Turkey Point Units 3 and 4 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 Turkey Point Units 3 and 4 OLs (FPL 2000a). The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2000a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS. For this

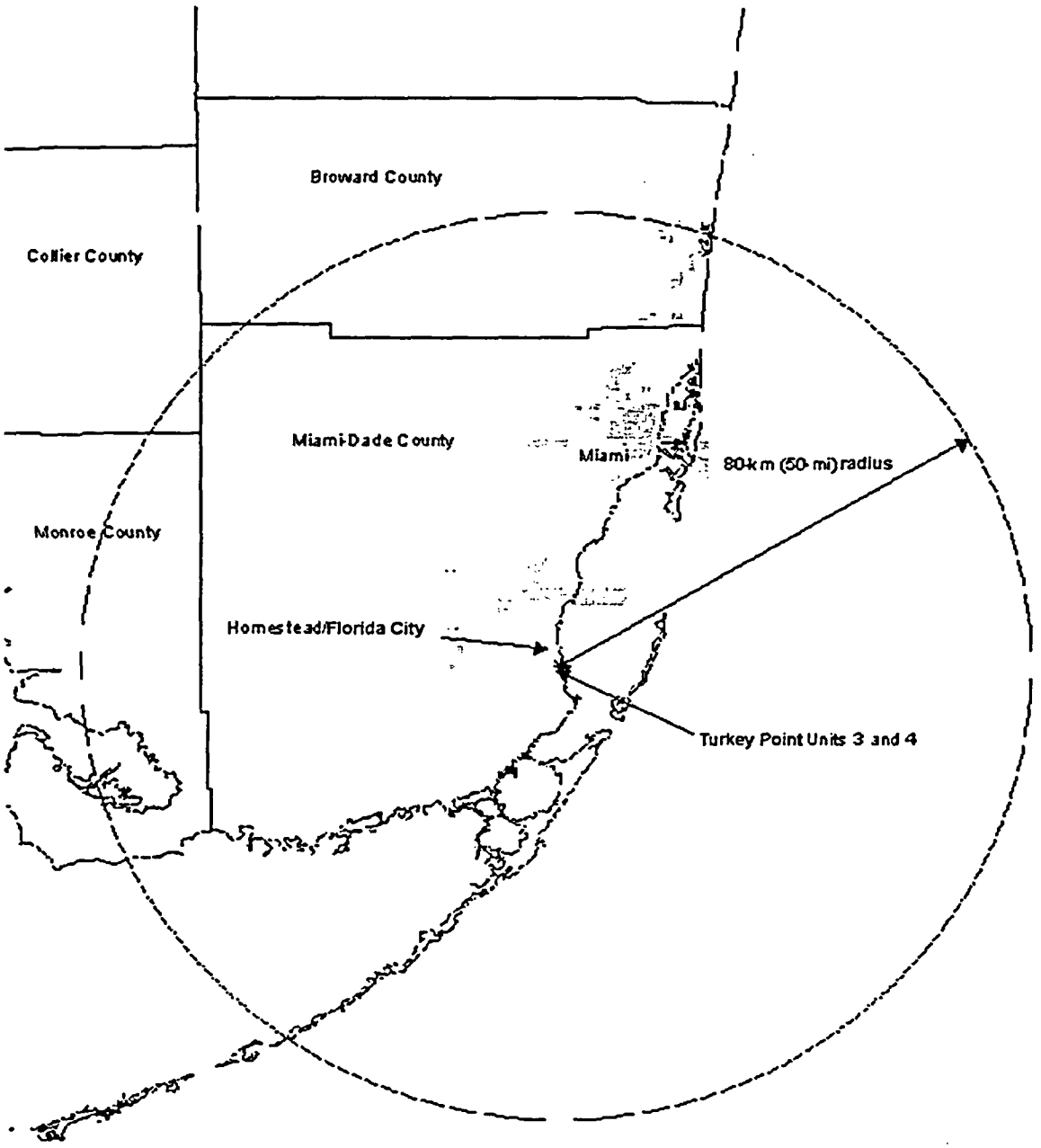

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of the Turkey Point Site Based on Census Block Group Data[a]

(a) Note: Some of the census block groups extend into open water.

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 <100 gpm).	4.8.1.1
Groundwater quality degradation (saltwater intrusion)	4.8.2.1
Groundwater quality degradation (cooling ponds in salt marshes)	4.8.3

issue, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, 10 CFR 51, follows.

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

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

  As discussed in Section 2.2.2, Turkey Point Units 3 and 4 groundwater use is less than 0.068 m^3/s (100 gpm). The staff has not identified any significant new information during its independent review of the 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.

- Groundwater quality degradation (cooling ponds in salt marshes). Based on information in the GEIS, the Commission found that

  "Sites with closed-cycle cooling ponds may degrade ground-water quality. Because water in salt marshes is brackish, this is not a concern for plants located in salt marshes."

  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 cooling ponds in salt marshes during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to groundwater use and quality for Turkey Point Units 3 and 4.

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.

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 Turkey Point site is discussed in Sections 2.2.5 and 2.2.6.

Assessment of potential impacts was initiated by FPL on September 7, 1999 with letters to FWS and National Marine Fisheries Service (NMFS) (Hovey 1999b; 1999c). Assessment of potential impacts on State species of concern was also initiated by FPL on September 7, 1999 with a letter to FFWCC (Hovey 1999d). The three letters requested information on any deficiencies, concerns, or data needed related to the consultation process. In response to FPL's letter, the FWS identified the requirement for consultation by the Federal action agency, identified recent studies by FPL on the American crocodile, described the importance of FPL's conservation activities on American crocodile recovery in south Florida, and provided a table of Federally listed and candidate species and designated critical habitats in south Florida by county (Slack 2000). The NMFS responded to FPL's letter with a conclusion that the proposed action is not

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

likely to affect species protected by the Endangered Species Act (ESA) under its purview (Hogarth 1999). The FFWCC responded to FPL's letter with a conclusion that the continued operation of Turkey Points Units 3 and 4 will not likely impact State-listed species (Lau 1999).

The staff began consultation with the FWS regarding threatened and endangered species and submitted a biological assessment on August 28, 2001 (Carpenter, 2001) concerning endangered and threatened species that could be affected by continued operation and maintenance of the Turkey Point Plant and associated transmission lines (see Appendix E). FWS concurred with the conclusion in the biological assessment that continued operation of the Turkey Point Plant is not expected to impact fish and wildlife resources (Ferrell, 2001). Therefore, it is the staff's conclusion that the impact on endangered, threatened, or candidate species of an additional 20 years of operation and maintenance of the Turkey Point Plant and associated transmission lines would be SMALL, and further mitigation is not warranted.

4.6.1 Aquatic Species

As described in Section 2.2.5, the distributions of Johnson's seagrass, the small-toothed sawfish, the five species of sea turtles, and the West Indian manatee do not include the Turkey Point cooling canal system or other areas impacted by operation of the nuclear plants. Aquatic threatened or endangered (or candidate) species that potentially could be impacted by operation of the cooling canals or maintenance of the transmission lines include the mangrove rivulus, the American alligator, and the American crocodile. Activities associated with exotic vegetation control within transmission line corridors could potentially affect the mangrove rivulus and the American alligator. The method of control used in mangrove areas is infrequent and involves selective physical removal of exotic trees. This activity could affect individuals of mangrove rivulus, but because the distribution of this fish is widespread but scattered, the population size of the species should not be threatened by these activities. Vegetation control along transmission corridors could disturb or temporarily displace adult and juvenile individuals of the American alligator in freshwater habitats, but is unlikely to permanently affect the local population.

Actions of continued operations that could affect the American crocodile population inhabiting the Turkey Point cooling canals include the following:

- continue to deny public access to the closed cooling canal system (beneficial effect)
- continue research and monitoring activities (small adverse effect outweighed by beneficial management practices)
- continue vegetation control, including exotic control (beneficial effect)
- continue maintenance of perched freshwater ponds on the berms (beneficial effect)
- continue hypersalinity of the ponds due to evaporation, offset by maintenance of freshwater ponds in the canal system (no effect).

A review of American crocodile status and risk assessment relative to Turkey Point cooling canal operations (both fossil and nuclear) (ESE 2000) concluded that the crocodile population in the Turkey Point cooling canals is growing and reproducing successfully, and that the presence of freshwater ponds provides nursery areas for juveniles. The study also concluded that chemicals of potential concern (COPCs) are equal to or less than concentrations from reference sites, and that mercury, polychlorinated biphenyls, and other COPCs have no observed or anticipated effect.

Continued closure of the cooling canal system to public access would continue to have a beneficial impact on the Turkey Point crocodile population by protecting nests, juveniles, and adults from disturbance. Disturbance of the crocodiles is limited to research and monitoring activities and canal maintenance activities. FPL has obtained state permits for research and carcass salvage. FPL actively maintains favorable habitats for crocodiles within the cooling canal system. Exotic vegetation is removed, nesting areas are monitored and protected, and freshwater ponds are created for juvenile rearing. Based on these considerations, the staff has determined that the continued operation of the Turkey Point Plant and the continued maintenance of the transmission lines will not adversely affect listed aquatic species.

4.6.2 Terrestrial Species

Federally listed terrestrial animal species that are known to occur at the Turkey Point site or along the transmission corridors include the eastern indigo snake, wood stork, and bald eagle. The indigo snake occurs infrequently in the area, and FPL maintains a permit from the FFWCC that allows handling and nonharmful capture of eastern indigo snakes to protect them from construction and maintenance activities. Wood storks winter in the vicinity of the Turkey Point

site, and are regular visitors to the cooling canal system. However, the nearest known nesting colony is at Corkscrew Swamp approximately 175 km (110 mi) northwest of the Turkey Point site. Bald eagles nest in the Arsenicker Keys southwest of the Turkey Point site and are occasional visitors to the canal system. There have been no reports of collisions or electrocutions of wood storks, bald eagles, or any other migratory birds along the electrical transmission lines associated with the Turkey Point site, and maintenance crews are trained to avoid listed species, such as the eastern indigo snake, and to report unusual occurrences such as bird collisions or electrocutions. Based on these considerations, the staff has determined that the continued operation of the Turkey Point Units 3 and 4 and the continued maintenance of the transmission lines is not likely to adversely affect the bald eagle, wood stork, or eastern indigo snake.

Six additional Federally listed threatened or endangered terrestrial animal species occur in Miami-Dade County: the piping plover, roseate tern, Cape Sable seaside sparrow, everglades snail kite, Florida panther, and Schaus swallowtail butterfly. These species either are not known to range within the vicinity of the Turkey Point site and associated powerlines, or only would be rare, incidental visitors. Therefore the staff determined that license renewal will have no effect on these six species.

There are 13 plant species of Federal concern (6 endangered or threatened and 7 candidate) that potentially occur within the transmission corridors, primarily in the vicinity of remnant pine rockland habitats. The only plant species listed in Table 2-3 that is not potentially affected by the Turkey Point site transmission corridors is the beach jacquemontia, because there are no known populations near the Turkey Point Site or associated transmission corridors. FPL commissioned a field survey of the transmission corridors during the spring of 2001 to determine if any of these species are present within the transmission corridors. None of the listed or candidate species were observed within the corridors. Furthermore, it is believed that the maintenance practices used within or near potential habitat areas (primarily mowing and weedy tree removal) are not likely to have an adverse effect on the listed species if they did inhabit the corridors, because these actions function to maintain an open canopy required by most of these species.

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

During the scoping period, comments indicated concern about the health effects from exposure to radiation from Turkey Point Units 3 and 4, the noise and aesthetic impacts of these Turkey Point units on National Park visitors, and the plants' ability to withstand the effects of severe weather. These issues are discussed in the following sections.

4.7.1 Evaluation of Potential New and Significant Radiological Impacts on Human Health

During the scoping and public comment period for the Turkey Point Units 3 and 4 draft SEIS, there were a number of comments about the studies related to strontium-90 radiation levels in deciduous (baby) teeth and use of these studies as "in-body" measurements of radioactive materials. The commenters alleged that the source of this material was the Turkey Point plant and implied that this is new and significant information, and therefore, should be considered in the environmental impact evaluation for Turkey Point Units 3 and 4, specifically with respect to public health. In the draft SEIS, this section addressed the comments obtained during the public scoping period. The section has been extensively revised in response to comments on the draft SEIS to (1) summarize the comments related to strontium-90 in deciduous teeth, and (2) discuss why the staff determined that strontium-90 in deciduous teeth and use of "in-body" measurements as a means to evaluate public health impacts from releases from nuclear power plants is not new and significant information.

The staff has evaluated whether any of the comments related to strontium-90 in the environment could be new and significant with respect to the conclusions in the GEIS. In 2000, a report titled *Strontium-90 in Deciduous Teeth as a Factor in Early Childhood Cancer* was published (Gould et al. 2000), alleging that there was an increase in cancer incidence due to strontium-90 released from nuclear power facilities. Elevated levels of strontium-90 in deciduous teeth was claimed in the report as the evidence for the increase in childhood cancer. Although the Gould report was not available at the time that the GEIS was written, the staff has determined that the report does not represent new information with regard to the Category 1 issues as evaluated in the GEIS, nor does it identify a significant departure from what was specifically documented in the GEIS with regard to public dose. This section refutes the claims by the Radiation and Public Health Project (RPHP) staff, who were the authors of the Gould report and provided comments on the draft SEIS. The staff has determined that the strontium-90 found in deciduous teeth in the vicinity of Turkey Point Units 3 and 4 is not due to releases from the plant, and that the operation of the Turkey Point Plant is not responsible for increased incidence of cancer in the area.

4.7.1.1 Summary of Comments

Following publication of the draft SEIS, there were additional comments, both written and at the public meeting, related to the subject of the work by Gould et al. and the RPHP comments (Mangano et al. 2001). The comments focused on five primary issues related to the discussion of the Gould study. The first issue was use of in-body measurement of radionuclides to determine public health effects. The second issue was use of strontium-90 to perform "in-body" measurement to evaluate the potential health risks from release of radioactive materials from

Turkey Point Units 3 and 4. The third major issue described was increased cancer incidence in southern Florida, near Turkey Point Units 3 and 4. The fourth issue was the assertion that the BEIR V Report of the National Academy of Sciences' committee on the Biological Effects of Ionizing Radiation (BEIR) concluded there is no safe exposure to radiation (National Resource Council 1990). Finally, a fifth major issue is the implication of a cause-and-effect relationship between reactor operation, catastrophic events, and perceived increase in cancer rates. Other comments on this subject not specifically related to RPHP are discussed in Appendix A, Part 2.

The discussion that follows explains the basis for the staff's conclusion that neither the public scoping comments nor the comments on the draft SEIS provide new and significant information related to the Category 1 radiological human health issues. The discussion (1) explains the source and amount of strontium-90 in the environment; (2) describes the NRC's basis for developing regulations related to protecting public health based on consensus standards by national and international organizations; (3) addresses the radiological monitoring programs at nuclear power reactors and specifically the program at Turkey Point Units 3 and 4; (4) explains why "in-body" measurement of radioactive materials is not used to determine public health impacts; (5) refutes the statements regarding cancer incidence discussed in the Gould report and public comments using a study performed by the Florida Department of Health; and (6) disputes the implication that radioactive effluents from nuclear reactors are the cause of perceived increases in cancer incidence near Turkey Point. Finally, the rationale for assigning radiological issues as Category 1 in the GEIS and the staff's evaluation of these issues for Turkey Point Units 3 and 4 are briefly discussed.

4.7.1.2 Strontium-90 in the Environment

There are three sources of strontium-90 in the environment: fallout from nuclear weapons testing, releases from the Chernobyl accident in the Ukraine, and releases from nuclear power reactors. By far the largest source of strontium-90 is from weapons testing fallout.

Both strontium-89 and strontium-90 were released to the atmosphere by above-ground explosions of nuclear weapons (United Nations Scientific Committee on the Effects of Atomic Radiation [UNSCEAR 2001]). Although the United States performed its last atmospheric test of a nuclear weapon in 1963, other countries continued to perform atmospheric testing of nuclear weapons until 1980 (UNSCEAR 2001). Strontium-89 has a half-life of 50.5 days, while the half-life of strontium-90 is 28.8 years. Consequently, virtually no strontium-89 currently remains in the soil from nuclear weapons testing (Eisenbud 1987). In contrast, strontium-90 remains in soils of the Northern Hemisphere at more than 50% of its peak levels in the 1960s (UNSCEAR 2000). Approximately 622 PBq (16.8 million Ci) of strontium-90 were produced and globally dispersed in atmospheric nuclear weapons testing.

Numerous measurements of the global disposition on strontium-90 and the occurrence of these and other fallout radionuclides in foodstuffs and the human body were made at the time the atmospheric tests were taking place. The worldwide average effective dose from ingesting strontium-90 (1945 to date) is 97 μSv (9.7 mrem). The worldwide average effective dose from inhaling strontium-90 (1945 to 1985) is 9.2 μSv (0.92 mrem). No statistically significant excess of biological effects due to strontium-90 exposures at levels characteristic of worldwide fallout has been demonstrated (NCRP 1991).

The other two sources of strontium-90 in the environment are from the Chernobyl accident in April 1986 when approximately 8 PBq (216,0000 Ci) of strontium-90 were released into the atmosphere, and strontium-90 released from nuclear power reactor operations. The total annual release of strontium-90 into the atmosphere from all U.S. nuclear power plants is typically 37 MBq (1/1,000th of a Ci). The amount of strontium-90 released into the environment from a nuclear facility is so low that the only chance of detecting strontium-90 is sampling the nuclear power plant effluents themselves. In addition to strontium-90, power reactors also release very small quantities of strontium-89.

Because of the extremely small amount of strontium-90 released from nuclear power plant effluents, it is unlikely that strontium-90 found in deciduous teeth would be from nuclear power plants. Without determining that there is strontium-89 in the teeth, it is impossible to tell where the strontium-90 is from. If there is no strontium-89 in the teeth, then it is unlikely that the strontium-90 is from a recent release from a nuclear reactor. The fact that the RPHP has failed to measure the strontium-89 to strontium-90 ratio in any deciduous teeth collected limits conclusions regarding the source of the internal contamination.

4.7.1.3 Regulatory Basis and Discussion of Risk

The evaluation of health effects from exposure to radiation, both natural and man-made, is an ongoing activity involving public, private, and international institutions. International and national organizations such as the International Commission on Radiological Protection (ICRP) and National Council on Radiation Protection and Measurements (NCRP) provide consensus standards developed from recent and ongoing research. NRC's regulatory limits for effluent releases and subsequent dose to the public are based on the radiation protection recommendations of these organizations. NRC provides oversight of all licensed commercial nuclear reactors to ensure that regulatory limits for radiological effluent releases and the resulting dose to the public from these releases are within the established limits. The regulations related to radiological effluents and dose to the public can be found in 10 CFR Part 20 and 10 CFR Part 50, Appendix I.

The National Academy of Sciences' Committee on the BEIR published its fifth report (BEIR V) just over a decade ago (National Research Council 1990). That report contains mathematical models that predict risk of radiation-induced cancers in human populations over and above the incidence of cancer that occurs in the absence of radiation exposure. The BEIR V committee chose a linear, nonthreshold (LNT) dose-response model for solid cancers and a linear-quadratic (LQ) model for leukemia.

The BEIR V report does not address what is safe or not safe; it merely evaluates excess cancer risk in terms of probabilities. ICRP Publication 60 (1991), however, does define safe in the sense of "acceptable risk," and this and similar definitions have been reaffirmed by the NCRP (NCRP 1993) and the U.S. Environmental Protection Agency (EPA 1987). These implicit definitions of "safe" are embodied in all U.S. radiation protection regulations, including those of the NRC.

There is no human activity without some risk, however slight, so "safe" does not mean "with no risk," but rather "safe" means "with an acceptably tiny risk." What risk is acceptable from society's standpoint is determined by the political process in the United States as spelled out recently, for example, by the U.S. Presidential/Congressional Commission on Risk Assessment and Risk Management[a] (Omenn et al. 1997).

4.7.1.4 Effluent Monitoring at Turkey Point

Regulatory Guide 1.21 recommends that "a quarterly analysis for strontium-89 and strontium-90 should be made on a composite of all filters from each sampling location collected during the quarter." The sensitivity is such that the analysis for radioactive material in particulate form should be sufficient to permit measurement of a small fraction of the activity, which would result in annual exposures of 0.15 mSv (15 mrem) to any organ of an individual, or 0.05 mSv (5 mrem) to the whole body, in an unrestricted area. Nuclear power plants, including Turkey Point Units 3 and 4, routinely release small amounts of radioactive material in their effluents. To demonstrate that the plant is within the regulatory limits, the plants monitor the radiological materials released to the environment and take frequent radiological samples around the plant site as well as analyze their effluent discharge. Both strontium-89 and strontium-90 can be found in power plant effluents in very small quantities. Each nuclear power plant in the United States is required to submit an annual report on effluent releases to the NRC. The report contains information about the types and quantities of radionuclides that are released to the environment, as well as the dose impact on the environment.

(a) Telephone 202.233.9537, fax 202.233.9540, internet http://www.riskworld.com.

Gaseous and liquid effluent releases are monitored at Turkey Point Units 3 and 4 to demonstrate that they are within regulatory limits. The licensee also has a Radiological Environmental Monitoring Program (REMP) that provides the procedures for monitoring releases to the environment. The results of this monitoring are provided to NRC in annual reports titled *Annual Radioactive Effluent Release Report* and *Annual Radiological Environmental Operating Report* (FPL 2000b and FPL 2000c). The effluent release program and the REMP were both reviewed for the preparation of the input to this SEIS. The releases of radionuclides to the environment, including strontium-90, are monitored as prescribed by FPL's *Offsite Dose Calculation Manual* (FPL 1999), and have been maintained well below regulatory limits. During 2000, Turkey Point Units 3 and 4 did not release detectable levels of strontium-90 in the gaseous effluents. Liquid effluents containing radioactive materials, including strontium-90 and strontium-89, were released into the closed system cooling canals. The only time radioactive strontium was released in detectable levels in the liquid effluents was during the second quarter and the releases were 0.12 MBq (3.2 E-06 Ci) of strontium-90 and 0.37 MBq (10 E-06 Ci) of strontium-89 (FPL 2000c). To put this value in perspective, for the second quarter of 2000, the total amount of radioactive effluents released from Turkey Point Units 3 and 4 were about 150 times **below** NRC regulatory limits (0.00663 percent of applicable limits). The quantity of gaseous and liquid materials released to the environment in 2000 are comparable to the quantities released in the past 5 years and the expected quantities released in years to come, including the license renewal period.

4.7.1.5 Use of "In-Body" Radionuclide Measurements to Assess Public Risk from Radiological Effluents from Turkey Point Units 3 and 4

Comments on the Turkey Point draft SEIS have stated or implied that the NRC should measure radioactive substances in persons living near nuclear power plants. Such measurements would be misleading and unwarranted for a variety of reasons:

- Radioactive substances may come from a variety of sources. In the case of strontium-90, the primary source has always been fallout from atmospheric weapons tests (UNSCEAR 2001). The comments on the SEIS that imply that strontium-90 measured in people near nuclear plants must have come from nuclear plants has no basis.

- Interpreting measurements of radioactive materials in people is difficult unless one knows what each individual was exposed to, when the exposures occurred, and by what routes they occurred (ingestion, inhalation, etc.). In particular for strontium-90, dietary contributions from foodstuffs produced out of the region must be considered. Finally, migration must be accounted for, because people may have lived and acquired radionuclides elsewhere than near a nuclear power plant.

- Substances in the human body are dynamic, not static. This includes radioactive and nonradioactive substances. The dynamic processes include intake of material; uptake to systemic circulation from the gastrointestinal tract, respiratory tract, or skin; translocation throughout the body system; retention over time; and elimination via excretion and radioactive decay. Thus, even in deciduous teeth, the time course of exposure leading to intake and all other dynamic processes must be considered to interpret measurements.

4.7.1.6 Increased Cancer Incidence in the Area of Turkey Point

Due to the concern from the issues regarding the increased cancer rates raised by RPHP, the Florida Department of Health chose to also look at the cancer rates using the same data used by RPHP. Staff from the Florida Bureau of Environmental Epidemiology interviewed the RPHP staff to determine the source of data and then performed their own calculations. They were unable to identify any unusually high rates of cancers, nor any systematic trend for some county rates to be higher than State or national levels. These rates fluctuate from year to year, and, in some situations, fluctuate widely due to a small number of cases in small populations (FDOH 2001). The documentation of the Bureau of Epidemiology calculations and interpretations is attached as part of the transcript in Appendix A, Part 2, of this SEIS.

4.7.1.7 Ability for Strontium-90 to Cause Cancer

One comment states that strontium-90 is "one of the most toxic radioactive chemical(s) produced by reactors." Strontium-90 is produced in roughly 5.8% of nuclear fissions in a reactor's fuel elements, and undergoes radioactive decay with a half-life of almost 29 years. Strontium-90, and its radioactive decay product yttrium-90, are not harmful unless they are near or inside the body. They are easily shielded if outside the body, resulting in no radiation exposure.

If ingested, strontium-90 tends to mimic calcium when it is in the body and therefore becomes concentrated in calcified tissues such as bones and teeth. If ingested in quantities that produce very large radiological dose rates (about thousand times higher than dose rates we all receive from natural background [Raabe 1994]), strontium-90 is known to increase the risk of bone cancer and leukemia in animals, and is presumed to do so in people. Below these dose rates, there is no evidence of any excess cancer. Compared to other radionuclides, both natural and human-made, strontium-90 is not the most toxic. For example, naturally occurring thorium 230 is 700 times more radiotoxic when inhaled.

4.7.1.8 Cause-and-Effect Relationship Between Radiological Releases from Turkey Point and Increased Incidence in Cancers in the Area

Comments on the Turkey Point draft SEIS have stated or implied that claimed statistical associations between cancer rates and reactor operations are cause-and-effect relationships. Many excellent scientific minds have addressed the question of when one can decide that an association is causal, that is, when two things that appear to be associated over time can lead one to deduce that one causes the other.

A simple counterexample helps illustrate this point. A college professor gives the following example of a causal inference: "In the winter, I wear galoshes. In the winter, I get colds. Therefore, galoshes cause colds." There's no argument that a strong statistical association exists between wearing galoshes and the health effect of colds. There is, however, an argument about whether galoshes *cause* colds. So, how does one go about addressing whether this association is really causation?

Here are some of the major factors to consider before inferring that a statistical association is a causal one (Hill 1965):

(1) Strength: Is a large effect observed, e.g., 32-fold lung cancer increase in heavy smokers?

(2) Consistency: Is the effect consistently observed across studies?

(3) Specificity: Does the effect occur in specific persons, for particular sites and types of disease?

(4) Temporality: Does exposure precede disease? Is there a suitable latent period between exposure and clinical symptoms?

(5) Biological Gradient: Is there a dose-response curve in which increasing dose leads to increasing response?

(6) Biological Plausibility: Is there a plausible biological mechanism for the observed association?

(7) Coherence: Does the cause-and-effect inference seriously conflict with generally known facts of the natural history and biology of the disease?

(8) Experiment: Does intervention reduce or prevent the association?

(9) Analogy: Do other, similar agents produce the effects?

Statistical association alone does not prove causation. The RPHP work fails to meet many of these criteria, even if the strontium-90 measurements were the result of the nuclear power plant operations. In particular, they fail to meet criteria 1, 2, 3, 4, and 6.

Epidemiology is the study of patterns of health and disease in human populations. In 1995, an international group of experts assembled to help determine how to use epidemiology studies for risk assessments. Their work has been published (Federal Focus Inc. 1996) and a non-copyrighted summary can be found on the internet at http://www.pnl.gov/berc/epub/risk/index.html.

A disease cluster is a group of cases of a disease that appears around the same time in a limited geographic or occupational area. A very readable, non-technical analysis of "the cancer-cluster myth" has been published in a popular magazine (Gawande 1999). Gawande explains why infectious disease clusters can and should spur immediate investigations and perhaps intervention by public health officials, and yet why non-infectious disease clusters rarely, if ever, are verified (see, for example, Neutra 1990 and Reynolds et al. 1996). For cancer, which has a significant latency between exposure and appearance of clinical symptoms, apparent clusters are very misleading because of migration and confounding sources of exposure.

4.7.1.9 Additional Discussion on Cancer

Information regarding the relationships between environmental exposure to radiation and cancer as stated in the Gould report were not substantiated. One form of cancer the Gould report linked to strontium-90 exposure is "the extremely rare form of childhood cancer known as rhabdomyosarcoma" (Gould et al. 2000). Rhabdomyosarcoma is not rare; indeed, it is the most common soft tissue sarcoma in children (American Cancer Society [ACS] 2001a), and is the fifth most common form of pediatric cancer (St. Jude Children's Research Hospital 2001). Furthermore, no association has been documented between the incidence of rhabdomyosarcoma and any environmental condition, including toxic substances, air or water pollution, or radiation exposure (ACS 2001a).

While the Gould report is correct with regard to the general increase in cancer incidence in the United States (Gould et al. 2000), this increase does not appear to be due to environmental causes other than cigarette smoking. The National Cancer Institute (NCI 2001) states that

> "It is true that a person's chance of developing cancer within his or her lifetime is almost twice as great today as it was half a century ago, which means that doctors are seeing more cases of cancer than they did in the past. However, this increase is caused largely by the

> facts that people are living longer and cancer is more prevalent in older people. When corrected for the increasing average age of the population, cancer rates in the United States have actually been stable or even falling slightly in the past several years. Much of the rise prior to that was due to cigarette smoking, a well established and avoidable cause of cancer."

The ACS (ACS 2001b) acknowledges that a dramatic increase in prostate cancer was noted between 1989 and 1992, but notes that this increase was apparent rather than real. They suggest that it was due to earlier diagnosis in men without any symptoms by increased use of prostate-specific antigen (PSA) blood test screening. They note that prostate cancer incidence rates have declined significantly since 1992 (ACS 2001b).

With regard to cancer clusters, especially breast cancer deaths, that are identified by the Gould report (Gould et al. 2000), detailed studies of this phenomenon have yet to substantiate relationships with environmental exposures, especially from nuclear power plants. Scientists from the NCI conducted and are conducting studies of breast cancer death clusters in the northeastern United States, the Washington D.C. area, and San Francisco. Primary factors driving the observed differences appear to be regional differences in the ages of mothers at first birth and mammography screening (Sturgeon et al. 1995).

At the request of Congress, the NCI conducted a study of cancer mortality rates around 52 nuclear power plants, including the Turkey Point Plant, nine DOE facilities, and one former commercial fuel reprocessing facility. The study covered the period from 1950 to 1984, and evaluated the change in mortality rates before and during facility operations. The study (Jablon, Hrubec, and Boice 1991) concluded the following:

> "From the evidence available, this study has found no suggestion that nuclear facilities may be linked causally with excess deaths from leukemia or from other cancers in populations living nearby."

Additionally, the ACS (ACS 2001c) has concluded that, although reports about cancer case clusters in such communities have raised public concern, studies show that clusters do not occur more often near nuclear plants than they do by chance elsewhere in the population. Likewise, there is no new evidence that links strontium-90 with increases in breast cancer, prostate cancer, or childhood cancer rates. The ACS recognizes that public concern about environmental cancer risks often focuses on risks for which no carcinogenicity has been proven or on situations where known carcinogen exposures are at such low levels that risks are negligible. "Ionizing radiation emissions from nuclear facilities are closely controlled and involve negligible levels of exposure for communities near such plants " (ACS 2001c).

4.7.1.10 Conclusion

In the GEIS, radiation exposure to the public during the license renewal term was considered a Category 1 issue (see Chapter 1 and Section 4.3 for a discussion of Category 1 issues and radiological impacts from normal operations). The GEIS determined that the risk to the public from continued operation of a nuclear plant would not increase during the license renewal term. Doses to members of the public from Turkey Point Units 3 and 4 emissions were specifically evaluated in Section 4.6 of the GEIS, using data from monitored emissions and ambient monitoring, and were found to be well within regulatory limits.

The staff extensively reviewed the Gould report, comments received during scoping, information provided by the RPHP, comments from concerned citizens at the public meetings held in July 2001 at Homestead, Florida, and written comments submitted by interested citizens, the industry, and other governmental agencies. The staff has concluded that the claims of elevated levels of childhood cancer in the vicinity of the plant caused by the release of strontium-90 during routine operations are unfounded and without scientific merit. According to an independent study by the State of Florida, there are no elevated levels of childhood cancer in the vicinity of the plant. Furthermore, environmental monitoring by the State of Florida as well as in-plant monitoring of effluent streams has established that there are no significant releases of strontium-90 from the plant. No causal relationship has been established between the levels of strontium-90 being reported by the RPHP in deciduous teeth and childhood cancer. Furthermore, there is almost unanimous consensus among the scientific community on the adequacy of current radiation protection standards.

The staff concludes that the information provided from the Gould report and subsequent scoping comments, and comments on the draft SEIS do not provide any information that can be considered new and significant with respect to the findings of the GEIS on the health effects to the public from radiological effluent releases due to the Turkey Point Units 3 and 4.

4.7.2 Evaluation of Turkey Point Noise and Aesthetic Impacts on National Park Visitors

The National Park Service submitted scoping comments calling attention to the environmental sensitivity of Biscayne National Park and the impacts of the Turkey Point site on the park and visitors to the park (Canzanelli 2000). Two impacts mentioned in the National Park Service's comments were noise and aesthetic impacts on visitors to the park. Noise impacts and aesthetic impacts during the license renewal term are classified as Category 1 issues with SMALL impacts in 10 CFR 51 Subpart A, Appendix B, Table B-1.

Biscayne National Park is immediately north and east of the Turkey Point site. The park was created by Congress in 1980. Previously, the lands and waters in the park were part of Biscayne National Monument, which was created by Congress in 1968. Biscayne National Park was established by Congress to "preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty" (16 USC 410gg). Congress has stated in the National Park Service Organic Act that the fundamental purpose of national parks is to "conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (16 USC 1).

Biscayne National Park existed prior to the development of the GEIS and the proximity of Turkey Point to the park does not constitute information that is new relative to the GEIS. The Turkey Point site consists of four units, two of which are unrelated to the proposed action. By comparison, Turkey Point Units 1 and 2, the fossil-fired units, have a greater aesthetic impact on Biscayne National Park than Units 3 and 4, the nuclear units that are the subject of this renewal. Additionally, the visual effect of a nuclear power plant on visitors to a park was considered in the GEIS. The case study in the GEIS, which analyzed aesthetic impacts of nuclear facilities at a sampling of sites, included an analysis of the aesthetic impacts from facilities located in close proximity to parks and other recreational areas. The NRC has carefully reviewed the National Park Service comments and evaluated this information in the following discussion.

Noise from operations at the nuclear Units 3 and 4, as well as fossil-fired Units 1 and 2, is detectable at some times by visitors in Biscayne National Park. Noise transmission is facilitated by the location of the Turkey Point units on Biscayne Bay. The noise is most noticeable under calm wind conditions or when the wind is blowing lightly in a direction from the Turkey Point site to the park. Section 4.3.7 of the GEIS points out that the principal sources of noise at a nuclear power plant are cooling towers (which are not present at the Turkey Point Plant), transformers, and loudspeakers. Other occasional sources of noise may include auxiliary equipment such as pumps and safety valves. The noise levels from Turkey Point Units 3 and 4 are not greater than from other nuclear power plants, and are less than those with cooling towers. In spite of the proximity of the Turkey Point Units 3 and 4 to Biscayne National Park, noise impacts are classified as SMALL for purposes of this SEIS. Noise from the Turkey Point Plant is often not detectable within the park because the noise is subsumed in overall ambient noise, which is predominantly wind noise. When the noise from the Turkey Point units is detectable within the park, it generally constitutes a low hum that is deemed sufficiently minor that it will neither destabilize nor noticeably alter the experience of a visitor to Biscayne National Park. The conclusions from the GEIS, therefore, apply.

The containment buildings and other structures associated with Turkey Point Units 3 and 4 are visible during the daylight hours from the Biscayne National Park visitor center complex and from waters and lands within the park boundary. Units 3 and 4 (as well as Units 1 and 2) are also visible from the park at night because of outside lighting used at the Turkey Point site. The National Park Service states in its scoping comments that the Turkey Point Plant can be seen at night as far east as the park's barrier islands, which are 11 km (7 mi) offshore. There is no visible steam plume from Unit 3 and 4 operations because cooling towers are not used. For the purpose of this SEIS, the aesthetic impact of Units 3 and 4 must be evaluated as an increment to the impact of Units 1 and 2. Units 1 and 2 and their associated structures use most of the lighting at the Turkey Point site. They also have the largest (oil storage tanks) and tallest (exhaust stacks) structures at the site. The staff concludes that operation of Units 3 and 4 will not materially alter the visual impact presented by power generation facilities at the Turkey Point site. Therefore, the aesthetic impact of Units 3 and 4 is classified as SMALL for purposes of this SEIS because the incremental impact of Units 3 and 4 is minor relative to Units 1 and 2.

The National Park Service recommended consideration of various mitigation measures to potentially reduce the noise and aesthetic impacts from Turkey Point Units 3 and 4 on visitors to Biscayne National Park. Such mitigation measures could include reduced use of outside loudspeakers, reduced night lighting at the plant and/or placement of light shielding, landscaping to reduce the visibility of onsite structures, and repainting of structures in natural tones that mirror the surrounding landscape and consequently are less obtrusive to the natural setting. However, because the impacts from operation of Units 3 and 4 are minor relative to the impacts from operation of Units 1 and 2, it has been determined that additional plant-specific mitigation measures solely for Units 3 and 4 are not likely to be sufficiently beneficial to warrant implementation. Moreover, it is not within NRC's regulatory authority to require implementation of these mitigation measures. Nevertheless, NRC has brought them to the attention of FPL and encouraged FPL to meet with National Park Service personnel to achieve consensus on measures that can reasonably be undertaken to mitigate the noise and aesthetic impacts of all Turkey Point units on visitors to Biscayne National Park.

For the reasons stated above, the information provided by the National Park Service in their scoping comments does not represent significant new information that would call into question the Commission's conclusion in the GEIS.

4.7.3 Evaluation of Potential New and Significant Plant Design Information

A number of comments received during the scoping period concerned the design of Turkey Point Units 3 and 4, and the plant's ability to withstand the effects of severe weather, including hurricanes more severe than Hurricane Andrew that occurred in 1992.

In order to receive NRC approval to operate a nuclear power plant, an applicant must submit a Safety Analysis Report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor as well as a comprehensive description of the proposed site. The SAR also discusses various hypothetical accident situations called design-basis accidents (DBAs) 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. The staff also conducts an analysis of the plant's interactions with the site, focusing on those site characteristics that could affect the safe operation of the facility; these characteristics include seismology, meteorology, geology, and hydrology.

The impact of hurricane force winds and storm surges on the Turkey Point Plant were analyzed as part of the original plant application and presented in the licensee's SAR. During the licensing review of the facility, the staff prepares a Safety Evaluation Report (SER) that documents the result of the safety review. The licensee's SAR and the staff's SER represents part of a plant's licensing basis, which must be met at all times during the operating life of the plant. Part of the licensing review of the facility is an evaluation of the facility to successfully protect against DBAs. The results of this analysis are documented in the facility SAR and SER, and are also discussed briefly in Section 5.1 of this SEIS. The earlier resolution of these issues make them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal.

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 Turkey Point plant in the GEIS (NRC 1996a). However, the GEIS 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, and that the risks from other external events, including severe natural phenomena (e.g., weather events) are adequately addressed by a generic consideration of internally initiated severe accidents. Weather events more severe than the plant's design basis have been addressed by the licensee in its individual plant examinations of internal and external events (IPE and IPEEE, respectively). These plant-specific risk studies provide baseline estimates of risk from internal and external events. In evaluating severe accident mitigation alternatives (SAMAs), a license renewal applicant uses risk profiles to identify potential means of further reducing risk through design alternatives that enhance the ability to prevent or mitigate core damage. Section 5.2 of this SEIS contains the staff's evaluation of SAMAs.

The impact of severe weather phenomena on the Turkey Point site is of concern to the safe operation of the facility and, if new information is identified that questions the adequacy of the design or operation of the facility, the licensee and the NRC staff have a responsibility to evaluate that information. During the licensing review of the facility, the staff evaluated the impact of severe weather on Turkey Point Units 3 and 4 and concluded that the design was adequate. Information regarding hurricanes and other natural phenomena and the environmental impacts that would result from their impact on Turkey Point Units 3 and 4, in the absence of some nexus to aging of systems, structures, and components within the scope of 10 CFR Part 54, is not considered new or significant information in the context of the GEIS.

4.7.4 Evaluation of Turkey Point Cooling Canal Impacts on Vegetation and Other Biota of Biscayne National Park

The National Park Service submitted scoping comments that asserted that the Turkey Point cooling canals have altered the natural environment by maintaining a hypersaline area that impedes the natural groundwater flow from the upland side of the canals to Biscayne Bay. They suggested that this has changed the biological community in the area east of the cooling canals to favor salt-tolerant species.

Since the mid-nineteenth century, water management activities in southern Florida have disrupted the natural groundwater flow in the Turkey Point area. As the U.S. Environmental Protection Agency (EPA) stated in their review of the environmental statement for the construction of the Turkey Point Plant (AEC 1972, Appendix E-10), "it is essential to note that the flow of surface water over the marsh area and through the mangrove fringe has not existed for over 30 years because of drainage canals and roads that serve as diversion dikes." Among these diversions is the L-31E canal and levee, which were built parallel to the shoreline of the bay in the 1960s and lie less than 0.4 km (1/4 mi) to the west of the Turkey Point cooling canal system (South Florida Water Management District 2001a). This canal blocks surface water and groundwater flow from inland areas to the bay, including the area of the Turkey Point cooling canal system (South Florida Water Management District 2001a).

Historical vegetation maps and photographs suggest that salt-tolerant vegetation existed in the area before the construction of the cooling canals (AEC 1972). The extent of the affected area may be increasing. A recent study of this area just south of the cooling canals (Ross et al. 1999) identifies several factors that may limit biological productivity in the region near the coast. These factors include wide seasonal fluctuation in salinity and moisture content resulting from natural variations in tides and storms, absence of freshwater input from upstream sources as a result of water management activities, phosphorus availability, and sporadic occurrence of natural disturbances such as periodic fires and freezes. The study also notes that rising sea level may be a factor.

The potential impacts of the Turkey Point cooling canals on Biscayne Bay and Card Sound were considered in detail in the FES related to operation of the Turkey Point Plant (AEC 1972). There is no indication of any impacts of the operation of the cooling ponds on Biscayne Bay or Card Sound exceeding the impacts considered in the FES, which were considered to be small.

The National Park Service suggests that the NRC should investigate ways to mitigate the postulated impacts of the cooling canals on groundwater flow to Biscayne Bay. It is likely that the impacts postulated by the National Park Service are not the result of Turkey Point cooling canals, but rather are due to water management implemented by the South Florida Water Management District that predate construction of the Turkey Point cooling canals (AEC 1972; South Florida Water Management District 2001a). There is a significant effort underway to restore southern Florida areas adversely impacted by earlier water management activities (South Florida Water Management District 2001b). These efforts include coordinated planning among diverse governmental agencies including the U.S. Army Corps of Engineers and the South Florida Water Management District. FPL has demonstrated a commitment to environment restoration in the area by establishing the South Dade Mitigation Bank in the area adjacent to the Turkey Point site. Agencies providing guidance in the mitigation bank program include the U.S. Army Corps of Engineers, the EPA, the Natural Resources Conservation Service, the FWS, the NMFS, the Florida Department of Environmental Protection, the South Florida Water Management District, and Miami-Dade County. FPL and others may wish to extend restoration efforts to the area of National Park Service concern. However, it would be inappropriate for the NRC to attempt to guide restoration efforts to that end.

For the reasons stated above, the information provided by the National Park Service in their scoping comments does not represent information that would call into question the Commission's conclusion that impacts on terrestrial resources from continued operations of cooling ponds are SMALL and that additional plant-specific mitigation measures are unlikely to be sufficiently beneficial to warrant implementation.

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 Turkey Point operation during the renewal term. Consequently, the staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL and that "plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation." NRC has identified certain mitiga-

tion measures that can reduce the aesthetic and noise impacts associated with Units 3 and 4 (Section 4.7.2) and brought these to FPL's attention.

Plant-specific environmental evaluations were conducted for 11 Category 2 issues applicable to Turkey Point operation during the renewal term and for environmental justice and chronic effects of electromagnetic fields. For all 11 issues and environmental justice, the staff concluded that the potential environmental impact of renewal term operations of Turkey Point would be of SMALL significance in the context of the standards set forth in the GEIS and that mitigation would not be warranted. For threatened and endangered species, the staff's conclusion is that the impact resulting from license renewal would be SMALL and further investigation 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 evaluation of this issue is required.

4.9 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."

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

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5.0 Environmental Impacts of Postulated Accidents

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

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

(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 not likely to be sufficiently beneficial to warrant implementation.

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

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

This chapter 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

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

DBAs are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in 10 CFR Part 50 and 10 CFR Part 100. The environmental impacts of DBAs are evaluated during the initial license process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license (OL). The results of these evaluations are found in license documentation such as the staff's Safety Evaluation Report (SER), the Final Environmental Statement (FES), the licensee's Final Safety Analysis Report (FSAR), and Section 5.1 of this SEIS. The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, design-basis events are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Turkey Point Units 3 and 4, is listed in Table 5-1. Florida Power &

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

Light (FPL) stated in its Environmental Report (ER; FPL 2000) that it is not aware of any new and significant information associated with the renewal of the Turkey Point Units 3 and 4 OLs. The staff has not identified any significant new information during its independent review of the FPL ER (FPL 2000), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS.

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. The GEIS 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.

Based on information in the GEIS, the Commission found that

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

The Commission has designated severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to Turkey Point Units 3 and 4, is listed in Table 5-2.

The staff has not identified any significant new information with regard to the consequences from severe accidents during its independent review of the FPL ER (FPL 2000), 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

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

mitigation alternatives (SAMAs) for Turkey Point Units 3 and 4. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

Title 10 of the Code of Federal Regulations, Section 51.53(c)(3)(ii)(L), requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously considered SAMAs for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant design and procedure changes with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for Turkey Point Units 3 and 4; therefore, the following sections address those alternatives.

5.2.1 Introduction

FPL submitted an assessment of SAMAs for Turkey Point Units 3 and 4 as part of the ER (FPL 2000). The assessment was based on the Turkey Point Probabilistic Safety Assessment (PSA) for total accident frequency (core damage frequency [CDF] and containment release frequency), and a supplemental analysis of offsite consequences and economic impacts for risk determination. While identifying and evaluating potential SAMAs, FPL took into consideration the insights and recommendations from several SAMA analyses for other plants, other NRC and industry documents discussing potential plant improvements, and documented insights provided by the plant staff. FPL considered 167 SAMAs and concluded that there are no SAMAs that are cost-beneficial associated with license renewal.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to FPL by letter dated January 31, 2001 (NRC 2001a). Key questions concerned the base case risk and its constituents, PSA model and changes, external events and their limited

inclusion in SAMAs, and potential design enhancements and their disposition. FPL submitted additional information in response to the staff's RAIs by letter dated March 30, 2001 (FPL 2001). These responses addressed the staff's concerns and reaffirmed the conclusions of the study.

An assessment of SAMAs for Turkey Point Units 3 and 4 is presented below.

5.2.2 Estimate of Risk for Turkey Point Units 3 and 4

FPL's estimates of offsite risk at Turkey Point Units 3 and 4 are summarized below. The summary is followed by an evaluation of FPL's risk estimates.

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 Turkey Point PSA model, which is an updated version of the individual plant examination (IPE), and (2) a supplemental analysis of offsite consequences and economic impacts for risk determination developed specifically for SAMA analyses. The Turkey Point PSA is considered to be a living plant risk model, incorporating new information on equipment performance, plant configuration changes, and refinements in PSA modeling techniques. It contains a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to determine containment performance during severe accidents. The baseline CDF for the purpose of SAMA evaluation is 1.62×10^{-5}/yr. A breakdown of the CDF is provided in Table 5-3. As shown in the table, transient initiators contribute about 39 percent, while loss-of-coolant accidents (LOCAs) contribute about 60 percent of the total internal events CDF. It is seen in Table 5-3 that containment bypass events (i.e., steam generator tube rupture [SGTR] and interfacing systems loss-of-coolant accident [ISLOCA]) make a minimal contribution to internal events CDF for Turkey Point, and the frequency associated with the largest release (i.e., ISLOCA) for Turkey Point is estimated to be about 6×10^{-8} per reactor year (ry). The station blackout (SBO) contribution to the transients is not explicitly provided in the submittal; however, the plant damage states for which both sprays and fan coolers have failed (mostly due to loss of power) is about 4.49×10^{-8}/ry. Anticipated transient without scram (ATWS) contributors are not explicitly provided in the submittal; however, based on the top 20 cutsets, ATWS contributes, at least, 1×10^{-6}/ry.

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 the public. Inputs for this analysis include plant/site-specific values for core radionuclide inventory, source term and release fractions, meteorological data,

Table 5-3. Turkey Point Core Damage Frequency (CDF)

Initiating Event	Frequency (per reactor year)
Transients	6.3×10^{-6}
Loss-of-coolant accident (LOCA)	9.8×10^{-6}
Steam generator tube rupture (SGTR)	1.7×10^{-8}
Interfacing system LOCA	6.2×10^{-8}
Total CDF from internal events	1.6×10^{-5}

projected population distribution, emergency response evacuation modeling, and economic data. The magnitude of the onsite impacts (in terms of clean-up and decontamination costs and occupational dose) is based on information provided in NUREG/BR-0184 (NRC 1997a).

FPL estimates the risk to the population within 80 km (50 mi) of the Turkey Point site, from internal initiators, to be 10.9 person-rem/yr. Table 5-4 shows the contributions to population dose by containment release mode. Late containment failure accounts for the majority of the population dose. This is primarily due to the dominance of the late containment failure frequency (i.e., about 9.05×10^{-6}/ry), which is about 56 percent of the total internal events CDF of 1.62×10^{-5}/ry, or 99 percent of the total release frequency of 9.14×10^{-6}/ry. (Note that about 44 percent of the postulated core melt scenarios at Turkey Point do not result in containment failure and the release of radioactivity.) The contribution of early containment failure, including containment bypass scenarios, is very small (about 0.5 percent of total internal events CDF or about 1 percent of total release frequency).

In response to an RAI, FPL (FPL 2001) explains that the dominant late containment failure sequences are due to the conservative assumptions made in the IPE/PSA with respect to exceeding the equipment qualification (EQ) limit for a short period of time causing the failure of

Table 5-4. Risk Profile

Containment Release Mode	Contribution to Population Dose (%)
Containment intact	0
Late containment failure	97.2
Early containment failure	0.1
Containment bypass	2.7

the containment heat removal systems (CHRSs). Plant damage states with successful containment spray but with hypothesized late containment failures are the result of noncondensible gas generation due to protracted core-concrete-interactions. Basemat melt-through (BMT) contributes about 25 percent (under dry and wet cavity conditions), and loss of containment integrity due to hydrogen burn contributes about 25 percent. FPL indicated (FPL 2001) that if the conservative assumptions (i.e., EQ-induced failure of CHRS and BMT, considering Severe Accident Management Guidelines [SAMGs]) were to be removed from the Level 2 analysis, the late containment failure contribution would be expected to drop from approximately 56 percent to 25 percent (due to hydrogen burn causing late containment failure).

5.2.2.2 Review of FPL's Risk Estimates

FPL's determination of offsite risk impacts at Turkey Point Units 3 and 4 is based on the Turkey Point PSA and a separate MACCS2 analysis. This review considered the following major elements:

- the Level 1 and 2 risk models
- the modifications to the PSA model
- 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 Turkey Point IPE is described in a staff report dated October 15, 1992 (NRC 1992). 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. Although the staff reviewed certain aspects of the IPE in more detail than others, it primarily focused on the licensee's ability to examine Turkey Point for severe accident vulnerabilities and not specifically on the detailed findings or quantification estimates. Overall, the staff believed that the Turkey Point 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. It is important to note that significant changes have been made to the Turkey Point risk model since the original IPE was completed and

reviewed by the NRC staff. These include both modifications to the models and changes due to plant modification, as discussed below.

A comparison of CDF profiles between the original IPE and the current PSA indicates that the estimate of the CDF for internal events has been reduced from 3.7×10^{-4} /ry to about 1.62×10^{-5}/ry (over a factor of 20 reduction). The lower values in the current PSA are attributed to plant and modeling improvements that have been implemented in Turkey Point since the IPE, as discussed below.

The original model documented in the 1991 Turkey Point IPE submittal had a CDF of 3.7×10^{-4}/ry. To address NRC comments, the model was revised and submitted to the NRC in 1992. The Turkey Point PSA model was updated in 1993, 1995, and 1997 to incorporate plant and modeling changes. The CDF for the 1997 update was 6.12×10^{-5}/ry. Plant upgrades incorporated in the 1997 revised model included modifications to the service water system, standby steam generator feedwater pump (from motor-driven to diesel-driven) and instrument air system upgrade. Major modeling changes included time-dependent recovery of offsite power, more consistent recovery actions (use of rule-based recovery), and data updates. In 1999, the 1997 Turkey Point PSA model was modified to account for several plant features that have significant impact on the benefit calculations, but were not included in the plant risk model. The modified baseline CDF is 1.62×10^{-5}/ry. This CDF was used to evaluate SAMAs related to component cooling water (CCW) performance, reactor coolant pump (RCP) seal LOCA, secondary heat removal, and equipment ventilation, and takes credit for the following features:

- cross-tie of the Unit 3 and Unit 4 CCW systems reducing the loss of CCW initiator frequency and allowing recovery post-accident
- alternate feedwater sources for the steam generators, including cross-tie via the opposite unit main feedwater and condensate supply systems
- revised dependency on reactor auxiliary building (RAB) ventilation to reflect that only residual heat-removal pumps require RAB fans
- revised common cause start and run failure beta factors for high head safety injection (HHSI) pumps based on INEL-94/0064, Volume 6, and
- revised likelihood for RCP seal LOCA upon loss of seal cooling (partially due to the new O-ring for the RCPs).

The present CDF value of 1.62×10^{-5}/ry is lower than most of the original IPE values estimated for other pressurized water reactors (PWRs) with large dry containments, although many of these have similarly been reduced due to modeling and hardware changes since submitting

their IPEs. Figure 11.6 of NUREG-1560 (NRC 1997b) shows that the IPE-based total internal events CDF for Westinghouse 3-loop plants ranges from 6×10^{-5} to 4×10^{-4}/ry.

As noted in Table 5-3, the CDFs for SGTR and ISLOCA were very low. In an RAI (NRC 2001) the staff requested an explanation of why these values were so low, when compared both with the original IPE values for Turkey Point Units 3 and 4 and with corresponding values for similar plants. According to the FPL response (FPL 2001), the CDF reduction for SGTR was primarily based on crediting the redundant and diverse secondary heat removal mechanisms. The SGTR Emergency Operating Procedure (EOP) provides detailed guidance on bringing the reactor to stable conditions. Additional SAMGs supplement the EOP, which in combination with the additional and diverse means for decay heat removal, make the CDF for SGTR low. The frequency of an ISLOCA initiating event was calculated to be 6.2×10^{-6}/ry. It was estimated that the probability of failing to prevent the ISLOCA sequence from proceeding to core damage was 0.01 (given that 6 hours is available to use the other unit HHSI), resulting in an ISLOCA CDF of 6.2×10^{-8}/ry. This improvement was based on taking credit for proceduralized operator actions and the shared HHSI system if available. The staff recognizes (NRC 1997b) that, in general, the contributions to total CDF from either SGTRs or ISLOCAs are relatively small for Westinghouse 3-loop PWRs. Further, the staff concludes, based on the points raised by FPL above, that the contributions from these initiators to core damage and risk for Turkey Point Units 3 and 4 are low, relative to other contributors.

FPL submitted an IPE of external events (IPEEE) by letter dated June 24, 1994 (FPL 1994). FPL did not identify any fundamental weaknesses or vulnerabilities to severe accident risk with regard to the external events related to seismic, fire, high winds, floods, transportation and nearby facility accidents, and other external hazards. In a Technical Evaluation Report, the NRC's contractor concluded that the IPEEE met the intent of Supplement 4 to Generic Letter 88-20 (ERI 1998). However, FPL used margins-type methodologies rather than PSA for addressing external events. Therefore, FPL chose to capture the potential risk benefits associated with external events by doubling the calculated benefits for a given SAMA. In the responses to the RAIs, FPL states that the CDF contribution from external events reported in the IPEEE submittal (tornado, transportation and nearby facilities and others) is estimated to be less than 7.0×10^{-7}/ry. FPL further argues that the PSA model used for the SAMA would make the risk contribution from these external events even lower due to a smaller seal LOCA probability (partially due to new seal O-rings for the RCPs) and the capability to cross-tie CCW from the opposite unit that was not credited in the Turkey Point IPEEE submittal. Even though the FPL approach in doubling of CDF to account for the calculated benefits for external events would provide a numerically reasonable estimate of the potential impact of external events, this approach fails to capture the benefits that could result from specific SAMAs that would be aimed at particular external events. Nevertheless, since the staff believes the search for external events vulnerabilities as part of the Turkey Point IPEEE did not identify any risk

contributors that would benefit from potential SAMAs, the staff considers the present FPL approach to be adequate.

The Turkey Point Level 2 IPE submittal (FPL 1991) that was reviewed by NRC in 1992 has been modified recently to account for changes in the plant damage state frequencies, resulting from the Level 1 PSA modifications discussed earlier in this section, and changes brought about by additional research since the original Level 2 IPE was completed. This research includes the NRC studies on resolution of the direct containment heating (DCH) issue for Westinghouse PWRs (NRC 1996b), the steam explosions-induced containment failure issue (FPL 2001; NRC 1989), and other issues related to high pressure scenarios (i.e., induced SGTR and vessel thrust forces). The revision in the Level 2 PSA model as a result of the aforementioned changes, results in low probabilities of early containment failure modes and insignificant contributions to the overall risk. The staff concludes that the use of the FPL Level 2 model provides a sufficiently detailed characterization of containment response to support a license renewal SAMA analysis.

The process used by FPL to extend the containment performance (Level 2) portion of the PSA to an assessment of offsite consequences (Level 3 PSA) was reviewed. This included consideration of the source terms used to characterize fission product releases for each of 47 containment release modes and consideration of the major inputs and assumptions used in the offsite consequence analyses. FPL used the severe accident source terms presented in the Turkey Point Units 3 and 4 IPE for each of 47 containment release modes. The source terms were incorporated as input to the NRC-developed MACCS2 code. For radionuclides not reported in the IPE, fraction values were set to zero.

The release input parameters used in the Level 3 quantification as required for MACCS2 calculations were defined for Turkey Point. In general, it is assumed that the time (after accident initiation) when the accident reaches general emergency conditions, or when personnel can reliably predict that general emergency conditions will be attained, is about 4.9, 3, 2, and 10 hours, for late containment failure, early containment failure, ISLOCA, and SGTR scenarios, respectively. Early releases (including bypass sequences) are assumed to be more energetic as compared with other releases. All releases are assumed to be elevated (i.e., at a height of 30 m [99 ft]), and the assumed release time varies from about 4.9 hours (after scram) for early releases, to 24 hours for late releases. These assumptions are, for the most part, consistent with those of other studies, including NUREG-1150 (NRC 1990). Sensitivity calculations were also performed to assess the impact of releases due to inclusion of radionuclides not considered as part of the original IPE source term calculations (i.e., ruthenium, lanthanum, cerium, and barium). These sensitivity analyses (FPL 2001) showed an increase in the benefits (increase in risk-reduction potential) of about $3000 (from $801,500 to $804,500) when these radionuclides were added to the analysis with release fractions of 1.0×10^{-3} for key release modes. Thus, the impact is small.

The MACCS2 input used site-specific meteorological data processed from hourly measurements for one full year (1998). These data were collected at the site meteorological tower.

The staff (NRC 2001) requested information on the impact of the Turkey Point Units 3 and 4 power uprate and 18-month cycle burn-up on the radiological activity used in the risk analysis. In response, FPL (FPL 2001) stated that a comparison of the major core inventory reported in the MACCS2 end-of-cycle inventory for a 3412 MW(t) plant with the plant-specific estimates for the Turkey Point Units 3 and 4 power uprate conditions, shows an increase of less than 25 percent in the estimated baseline risk. On this basis, the staff concludes that this increase would need to be accounted for among the SAMA candidates that are not eliminated by qualitative screening.

The population distribution used as input to the MACCS2 analysis is based on 1990 census data. Population growth within a 80-km (50-mi) radius of the site was projected out to 2025 by using the computer program SECPOP90 (NRC 1997c). Projections were benchmarked with 1998 county-wide population estimates.

Evacuation modeling is based on a site-specific evacuation plan developed by FPL. It is assumed that the people within the evacuation zone (extending out to 16 km [10 mi] from the plant) would move at an average speed of approximately 12 m/s with a delayed start time of 5130 seconds. It is assumed that people beyond the 16-km (10-mi) radius would continue their normal work activities unless the 50 and 25 rem whole-body effective dose equivalent in 1 week limits are predicted to be exceeded. In these cases, relocation is assumed to occur after half a day and one day, respectively. A sensitivity analysis was performed that assumes that only 95 percent of the people within the evacuation zone would participate in the evacuation. The remaining 5 percent are assumed to go about their normal activities. This assumption is conservative relative to the NUREG-1150 study (NRC 1990), which assumes evacuation of 99.5 percent of the population within the emergency planning zone. It was further assumed in this sensitivity analysis that the evacuation speed was 1.0 m/s (3 ft/s) and that the evacuation delay time is 2 hours. The result is less than a 1-percent change in population dose and evacuation costs. Accordingly, the evacuation assumptions and analysis are deemed reasonable and acceptable for the purposes of SAMA evaluation.

Much of the site-specific economic data was provided by SECPOP90 (NRC 1997c) and used in the MACCS2 analyses. SECPOP90 contains a database extracted from U.S. Census Bureau (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. These regional economic values were updated to 1997 using the Consumer Price Index and other data from the USCB and the Department of Agriculture.

Although some of the economic parameter values were based on values quoted in NUREG-1150 (NRC 1990), some were revised with more recent and/or site-specific data.

The SAMA analyses did not explicitly include the impact of uncertainties associated with severe accident risk at Turkey Point. In response to RAIs, FPL provided the results of the most recent PSA model for Turkey Point (NRC 2001) that demonstrate the uncertainties in the calculated CDF range from about 27 percent of the mean internal events CDF at the 5th percentile to about 2.5 times the mean internal events CDF at the 95th percentile (i.e., an order of magnitude spread in the calculated internal events CDF). The SAMA baseline CDF of 1.62×10^{-5}/ry corresponds to the 88th percentile of the latest CDF distribution (FPL 2001). In response to RAIs, FPL indicated that other factors that offset the higher CDF associated with higher failure rates, as reflected by the upper bounds of uncertainties, include modeling uncertainties and the cost estimates. In the response to an RAI on uncertainties, FPL argued that additional credit for severe accident management guidance "could have been taken to reduce the likelihood of containment failure and fission product release. Plant specific implementation of SAMA candidates may be complicated by space limitations, outage cost, regulatory requirements, seismic, fire and other considerations. These factors overestimate the benefit or underestimate the cost. It is concluded that the effect of considering these uncertainties associated with the SAMA cost-benefit estimate would, in effect, offset the uncertainties associated with the CDF estimates, thus making the conclusions robust. No SAMA candidates are considered cost-beneficial even when a higher-confidence CDF is used." (FPL 2001)

Consistent with NUREG/BR-0184, sensitivity studies performed using a 3-percent discount rate (versus the 7-percent rate used in the baseline analysis) show an increase in the benefits of potential SAMAs; however, this does not alter the ER conclusions on the unfavorable cost-benefit ratios for the considered severe accident management alternatives.

The staff concludes that the methodology used by FPL to estimate the CDF and offsite consequences for Turkey Point provides an acceptable basis from which to proceed with an assessment of the risk-reduction potential for candidate SAMAs. Further, the risk results that were calculated for Turkey Point are consistent with risk results for other nuclear power plants, when adjusted for differences in population, weather, and the magnitude and frequency of radiological releases. Accordingly, the staff bases 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 consisted of the following three elements:

- a review of the Turkey Point IPE submittal and the updated PSA
- reviews of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants and advanced light water reactor plants
- reviews of other NRC and industry documentation discussing potential plant improvements.

FPL's initial list of 167 candidate improvements was extracted from the process and is reported in Table F.2-1 in Appendix F of the ER (FPL 2000).

FPL performed a qualitative screening on the initial list of 167 SAMAs using the following criteria:

- The SAMA is not applicable to Turkey Point, either because the enhancement is only for boiling water reactors, the Westinghouse AP600 design, or pressurized water reactor ice condenser containments, or it is a plant-specific enhancement that does not apply at Turkey Point (Screening Criterion A), or
- The SAMA has already been implemented at Turkey Point (or the design meets the intent of the SAMA, as determined by plant review of each SAMA) (Screening Criterion B).

Based on the qualitative screening, 91 SAMAs were eliminated, leaving 76 subject to the final screening and evaluation process. Of the 91 SAMAs eliminated, 64 were eliminated because they had already been implemented at Turkey Point (or the design met the intent of the SAMA). The 76 remaining SAMAs are listed in Table F.2-2 of Appendix F of the ER (FPL 2000). The final screening process involves identifying and eliminating those SAMAs whose cost exceeded twice their benefit.

5.2.3.2 Staff Evaluation

FPL's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. (This is reasonable, because external events only contribute a small amount to the total CDF.) The list of 76 SAMAs generally addressed the accident categories that are dominant CDF contributors (transients and small break LOCAs) or issues that tend to have a large impact on a number of accident sequences at Turkey Point Units 3 and 4. The preliminary review of FPL's SAMA identification process raised some concerns that plant-specific risk contributors were not adequately assessed. The staff requested (NRC 2001) additional plant-

specific risk information (dominant minimal cutsets) to determine if any significant SAMAs might have been overlooked. Further, the staff requested specific information about the final SAMA candidates including the 16 SAMAs that were based on the Turkey Point plant-specific risk profile as modeled in the current PSA. Based on the initial submittal and the responses to the RAIs, it is the staff's opinion that FPL made a reasonable effort to search for potential SAMA candidates, using the knowledge and experience of its Probabilistic Risk Assessment (PRA) personnel; reviewing insights from the IPE, IPEEE, and other plant-specific studies; and reviewing plant improvements in previous SAMA analyses. The potential SAMA candidates included a balance of both hardware and procedural alternatives.

It is important to note that as a follow-up to IPE/IPEEE process, FPL has identified five potential enhancements to the plant's accident management capability, that were subsequently implemented, and were considered in more detail in the updated PSA as described below (FPL 2001):

- Replenishment of Refueling Water Storage Tank (RWST): This enhancement has been proceduralized in the Turkey Point EOP for loss of emergency coolant recirculation. In addition, the units can also share the high head safety injection systems, meeting the intent of RWST replenishment to prolong the injection for LOCAs by taking steps allowing use of the postulated nonaccident unit's RWST inventory.

- Primary System Depressurization: Procedures exist to use the sprays, auxiliary spray or pressure-operated relief values in the pressurizer to depressurize the Reactor Coolant System (RCS), under high pressure accident conditions. For beyond design basis severe accidents, a Severe Accident Guideline (SAG) has been developed that provides guidance for RCS depressurization to prevent high RCS pressure at a postulated vessel breach.

- AC Power Recovery: The importance of AC power recovery has been highlighted in the Turkey Point operator training. Hurricane procedures also emphasize the importance of verifying the performance of diesel generators (DGs). A more detailed time-dependent recovery analysis varying the mission time and the time to recover offsite power also allows more realistic quantification of the risk related to the loss of offsite power and SBO scenarios.

- Cross-connection of Component Cooling Water (CCW): This enhancement has been implemented at Turkey Point by providing specific steps in the applicable Off-Normal Operating Procedure to cross-connect the CCW between the two units. This action is also highlighted during operator training at Turkey Point.

- Manual Actuation of Containment Spray (Cavity Flooding): This enhancement has already been implemented at Turkey Point. A SAG has been developed in order to provide guidance for injecting water to the containment from a variety of sources including containment spray.

These enhancements were not included in the SAMA candidate identification process for Turkey Point Units 3 and 4 (FPL 2001) because they had been implemented at the facility.

The staff notes that the set of SAMAs submitted is not all inclusive, because 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 Turkey Point Units 3 and 4.

5.2.4 Risk-Reduction Potential of Design Improvements

FPL evaluated each of the 76 SAMAs remaining after the screening using a bounding technique. Each SAMA was assumed to completely eliminate all sequences that the specific enhancement was intended to address. Table 5-5 lists these bounding analyses, the respective assumptions, and the applicable SAMAs. FPL doubled the maximum benefit (based on the internal risk) to account for any unmodelled risk reduction that could also occur in external events, because there is no external events PSA model for Turkey Point Units 3 and 4. If the implementation costs were greater than two times the benefit, then the SAMA was screened from further consideration. The staff considers the use of a factor of two to implicitly account for the risk benefits associated with both internal and external events to be appropriate for the Turkey Point site.

The initial submittal (FPL 2000) did not give sufficient information regarding the actual risk reduction for the candidate SAMAs. For a given SAMA, all FPL provided was that the risk reduction was less than a given amount. Thus the staff could not determine how close the risk reduction was to the "less-than-value." The staff requested more specific information in the RAIs (NRC 2001). FPL responded (FPL 2001) with a summary of the key risk-reduction attributes for each of the cases (see Table 5-5), including the total benefit that would be achieved from implementing the SAMA.

Table 5-5. SAMA Cost-Benefit Screening Analysis

Analysis Case and Description	SAMA	Total Benefit (Bounding)	Estimated Cost	Screening Conclusion
	SAMAs Requiring Hardware Modifications that Exceed 2 x MAB			
Qualitative Assessment	33, 34, 35, 38, 39, 46, 53, 87, 115, 167	<$802K (MAB)	>2 x Benefit	Screened out
	SAMAs Requiring Plant Hardware Modifications			
SEALCSF Eliminate all contribution from RCP seal LOCAs	7, 8, 9, 10, 11, 12, 13, 15, 16, 165	<$31K	>2 x Benefit	Screened out
No LOG (see Note 1) Eliminate all loss of grid events	47, 71, 75, 76 Comment: Industry estimates for 71 are $10M, and for 75 are $1M/mile	<$49K	>2 x Benefit	Screened out
SGCRVLP2 Eliminate all contribution from containment spray failure	31, 32, 48	<$177K	>2 x Benefit	Screened out
CI-OK Eliminate all contribution from early containment failure	88, 96, 157, 161	<$17K	>2 x Benefit	Screened out
SGFCSF Eliminate secondary decay heat removal failures	No SAMA identification numbers for this case			
HHDDPCSF Added two diesel-driven HHSI pumps (one for each unit)	117, 118, 124, 126,	<$131K	>2 x Benefit	Screened out

Table 5-5. (contd)

Analysis Case and Description	SAMA	Total Benefit (Bounding)	Estimated Cost	Screening Conclusion
NO-ISLOCA (see Note 2) Eliminate all contribution from ISLOCA	89, 90, 91, 92, 95, 96, 159, 160, 161 Comment: SAMAs 96 and 161 are also considered by base case CI-OK	<$17K	>2 x Benefit	Screened out
	SAMAs Requiring Procedure Modifications			
RABCSF Eliminate all contribution from failure of RAB ventilation	25	<$15.3K	>2 x Benefit	Screened out
NO-SGTR (Note 1) Eliminate all contribution from SGTR	79, 80, 81, 82, 83, 84, 85	<$1K	>2 x Benefit	Screened out
EDG5 Installation of another DG	57 Comment: Industry estimates installation of DG to be $431K - $25M	<$72K	>2 x Benefit	Screened out
OPERCSF Further increased operator training for critical human interactions	121	<$67K	>2 x Benefit	Screened out
OperCSI Provide capability to auto realign from injection mode to recirc mode	131	<$56K	~$450K	Screened out
	SAMAs Utilizing PRA (CDF or RRW (see Note 3)) as Argument for Elimination			
CDF <5E-07 or RRW = 1	59, 67, 97, 98, 99, 144, 148, 151, 156	~$0	>2 x Benefit	Screened out
RRW = 1.001, 1.005	135, 140	<$4.1K	>2 x Benefit	Screened out

Table 5-5. (contd)

Analysis Case and Description	SAMA	Total Benefit (Bounding)	Estimated Cost	Screening Conclusion
RRW = 1.008, 1.009	111, 123	<$8.1K	>2 x Benefit	Screened out
RRW = 1.016	134	<$13K	>2 x Benefit	Screened out
CDF contribution of <0.5%	152	<$4.1K	>2 x Benefit	Screened out
CDF contribution of <2%	129, 149	<$16.4K	>2 x Benefit	Screened out
CDF contribution of <2.5%	155	<$20.1K	>2 x Benefit	Screened out
CDF contribution of ~5%	146	<$41K	>2 x Benefit	Screened out
CDF contribution of 8.5%	101	<$68.2K	~$580K	Screened out

Note 1: Requires both plant hardware and procedure modifications.
Note 2: NO-ISLOCA SAMAs 89, 90, 91, 92, 95 require both plant hardware and procedure modifications
Note 3: RRW is the ratio of baseline risk to the risk calculated assuming complete elimination of the risk contribution addressed by the SAMA. Thus, a no-impact SAMA has a RRW of 1, and the relative impact of a SAMA is measured by RRW - 1.

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 is reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized).

5.2.5 Cost Impacts of Candidate Design Improvements

FPL estimated the costs of implementing each SAMA through the application of engineering judgment, estimates from other licensees' submittals, and site-specific cost estimates. The cost estimates conservatively excluded the cost of replacement power during extended outages required to implement the modifications, and they did not 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 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. In response to the staff request for more specific cost information in the RAIs (NRC 2001), FPL (FPL 2001) provided a detailed cost breakdown for a digital feedwater control system (totaling $580,000) as an example.

The cost estimate minimums that are implied in Table F.2-2 of Appendix F of the ER (FPL 2000) were compared 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. The FPL estimates were found to be consistent and reasonable for the SAMAs under consideration.

5.2.6 Cost-Benefit Comparison

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

5.2.6.1 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 1997a). The guidance involves determining the net value for each SAMA according to the following formula:

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

where

$APE	=	present value of averted public exposure ($)
$AOC	=	present value of averted offsite property damage costs ($)
$AOE	=	present value of averted occupational exposure ($)
$AOSC	=	present value of averted onsite costs ($)
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 ($2000 per person-rem)
x present value conversion factor (10.88, based on a 20-year period with a 7-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997a), 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 the initial screening, FPL calculated an APE of $234,207.

Averted Offsite Property Damage Costs (AOCs)

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.

FPL cited an annual offsite economic risk of $22,850 based on the Level 3 risk analysis. This value, which corresponds to the frequency-weighted sum of the base offsite economic costs in Table F.1-5 of the ER (FPL 2000), appears to be higher than values for other sites and those presented in NUREG/BR-0184 (NRC 1997a). This higher value is primarily due to the relatively high population in the 80-km (50-mi) radius zone around the plant.

For the purposes of the initial screening, FPL calculated an AOC of $245,932.

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 based on information provided in Section 5.7.3 of NUREG/BR-0184 (NRC 1997a). 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 NUREG/BR-0184 in conjunction with a monetary equivalent of unit dose of $2000 per person-rem, a real discount rate of 7 percent, and a time period of 20 years to represent the license-renewal period.

For the purposes of the initial screening, FPL calculated an AOE of $6,153.

Averted Onsite Costs (AOSC)

The AOSCs 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 NUREG/BR-0184 (NRC 1997a).

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

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

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in NUREG/BR-0184 (NRC 1997b) as $\$1.5 \times 10^9$ (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 the initial screening, FPL calculated an ACC of $188,082.

Averted power replacement costs PRCs are calculated using the following formula:

PRC = 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 the purposes of the initial screening, FPL calculated an PRC of $127,818.

Thus, the total estimated present dollar value equivalent for severe accidents at Turkey Point Units 3 and 4 is about $802,000.

FPL Results

Of the 76 SAMAs considered, 75 were eliminated because the estimated costs were expected to exceed twice the total benefit. As discussed in Section 5.2.6.2 of this report, the remaining SAMA required additional analysis by the staff to demonstrate that the estimated costs would be expected to sufficiently exceed the estimated benefit so that it could be eliminated. The benefit was determined by assuming all risk for relevant internal events is eliminated. FPL doubled this value to bound additional benefits that might result for external events. The end result was that no SAMA candidates were found to be cost-beneficial.

FPL performed several sensitivity analyses to evaluate the impact of parameter choices on the analysis results. The sensitivity analyses included the calculation of candidate SAMA benefits using a 3-percent discount rate. There were no changes in the conclusions that resulted from the sensitivity assessments.

5.2.6.2 Staff Evaluation

The cost-benefit analysis performed by FPL was based primarily on NUREG/BR-0184 (NRC 1997a) and was executed appropriately. The staff believes that the candidates assessed have costs that are considerably higher than the associated benefits. One of the 76 candidates considered (a SAMA for hydrogen burn control) required additional analysis by the staff to demonstrate that the estimated costs would be expected to sufficiently exceed the estimated benefit so that it could be eliminated.

The staff specifically asked about the costs and benefits of using passive autocatalytic recombiners (PARs) for hydrogen control (NRC 2000). The motivation for this request was that PARs are being considered for hydrogen control at other nuclear power plants and that the FPL assessment for Turkey Point Units 3 and 4 indicates an opportunity to consider hydrogen burn mitigation because the conditional probability for containment failure from a hydrogen burn is large, about 25 percent given a core damage event. An effective system of PARs could reduce this percentage considerably. The potential risk-reduction benefit of PARs is estimated by the staff to be about $120,000, considering internal events only. (Including external events and assuming the factor of two used by FPL [FPL 2000] to account for external events, this benefit value increases to $240,000.) The value of $120,000 was derived by subtracting from the value calculated by FPL for the total risk benefit of about $800,000 (internal events) those contributions to the total risk benefit that would not be affected by the mitigation of core damage events, namely about $320,000 (e.g., onsite economic costs), thus yielding $480,000. About 25 percent of this value would be the benefit for the risk reduction from preventing containment failure from hydrogen burns, yielding $120,000. Doubling that to account for external events yields about $240,000 of benefit. (This benefit might be adjusted upward by up to 25 percent when considering the higher burnup of contemporary fuel cycles, and the resulting increased risk.) With the cost of a single PAR estimated at $45,000, a more detailed assessment may be warranted.

The staff considered both the response to the RAI and NRC analysis of similar issues in addressing the costs and the contribution of PARs to risk reduction. Based on the FPL response to an RAI, it appears that the contribution to late containment failure is overly conservative because actions associated with the SAMGs and the likelihood of a wet cavity were not credited in the FPL analysis. FPL stated that although "the estimated cost of the autocatalytic recombiner seems attractive, when additional requirements such as design, qualification, installation, testing, maintenance, procedures and training are included, the cost is expected to be substantially higher." The staff agrees that the total cost, especially when considering multiple PAR units, would be substantially higher.

The staff has assessed and reviewed the role of hydrogen (and carbon monoxide) burns on late containment failures for other nuclear power plants with large-dry containments. Typically, hydrogen burns play a small role in late containment failure. As an example, the staff modeled the contribution of hydrogen combustion to containment failure for units with large dry containments as part of the NUREG-1150 study (NRC 1990). Table A.4-5 of NUREG/CR-4551 (NRC 1993) shows that the contribution of hydrogen combustion to late containment failure for the Zion plant is less than 0.1 percent.

When considering the realistic total costs of installation, training, and maintenance, it is the staff's opinion that the costs will be higher than the $120,000 to $240,000 range of the PAR benefit and considerably higher than the staff's estimate of PAR benefit for a typical PWR with a large, dry containment. Further the staff agrees with FPL that accounting for the wet cavity and accident mitigation actions in the SAMGs would reduce the probability of late containment failure and reduce the associated $120,000 to $240,000 range of risk-reduction benefits. This "accounting" would also bring Turkey Point Units 3 and 4 more in line with the results of other Level 2 PSAs for similar large-dry containment PWRs.

The staff concludes that PARs do not appear to be cost beneficial for Turkey Point Units 3 and 4. Therefore, it would not need to be implemented as part of license renewal pursuant to 10 CFR Part 54.

5.2.7 Conclusions

FPL compiled a list of 167 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 living PSA model. A qualitative screening removed SAMA candidates(1) that did not apply to Turkey Point Units 3 and 4 due to design differences, or (2) for which the SAMA had already been implemented at Turkey Point Units 3 and 4 (or the design meets the intent of the SAMA, as determined by plant review of each SAMA). A total of 64 SAMA candidates were eliminated because they had already been implemented at Turkey Point (or the design meets the intent of the SAMA, as determined by plant review of each SAMA) and 27 others were eliminated because they are not applicable to Turkey Point Units 3 and 4. Only 76 SAMA candidates remained after this screening process.

Using guidance in NUREG/BR-0184 (NRC 1997a), the FPL current PSA model and a Level 3 analysis developed specifically for SAMA evaluation, a maximum attainable benefit of about $802,000 was calculated. The PSA results used in the FPL SAMA analysis were calculated using internal event results only. Because Turkey Point Units 3 and 4 do not have an external events PSA model to account for the potential impact of external events on the results of the SAMA evaluations, FPL doubled the benefits for the purposes of comparison to the costs.

The staff reviewed the FPL analysis and concluded that the methods used and the implementation of those methods were sound.

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 Turkey Point Units 3 and 4 PSA and the fact that Turkey Point 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."

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U.S. Nuclear Regulatory Commission (NRC). 1996b. *Resolution of the Direct Containment Heating Issue for all Westinghouse Plants with Large Dry Containments or Subatmospheric Containments.* NUREG/CR-6338, Washington, D.C.

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

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

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). 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.* NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2001. Letter from U.S. NRC to T. F. Plunkett, Florida Power & Light Company. Subject: "Request for Additional Information Related to the Staff's Review of Severe Accident Mitigation Alternatives for Turkey Point Units 3 and 4 (TAC Nos. MA9440 and MA9944) (January 31, 2001).

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

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

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

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

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

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

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

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and are applicable to Turkey Point Units 3 and 4. 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 Reactor." The

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

GEIS also addresses the impacts from radon-222 and technetium-99. There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to Turkey Point Units 3 and 4 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

Table 6.1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
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 & Light Company (FPL) stated in its Environmental Report (ER; FPL 2000) that it is not aware of any new and significant information associated with the renewal of the Turkey Point Units 3 and 4 operating licenses. No new and significant information has been identified by the staff in the review process and in the staff's independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

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

  The staff has not identified any new and significant information during its independent review of the FPL ER (FPL 2000), 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). In the GEIS, the staff concluded that

  "The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem [148 person Sv], or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the 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 FPL ER (FPL 2000), 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 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."

The staff has not identified any new and significant information during its independent review of the FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 Sec. 51.52."

  Turkey Point Units 3 and 4 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 FPL ER (FPL 2000), 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."

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

Florida Power & Light Company (FPL). 2000. *Applicant's Environmental Report – Operating License Renewal Stage Turkey Point Units 3 and 4.* Miami, Florida.

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

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste.* 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, which result from continued plant operation during the renewal term were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[a] The GEIS included a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

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

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

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

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required 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 Turkey Point Units 3 and 4.

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B that are applicable to Turkey Point Units 3 and 4 decommissioning following the renewal term are listed in Table 7-1. Florida Power & Light Company (FPL) stated in its Environmental Report (ER; FPL 2000) that it is aware of no new and significant information regarding the environmental impacts of Turkey Point Units 3 and 4 license renewal. The staff has not identified any new and significant information during its independent review of the FPL ER (FPL 2000), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes

(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.

that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the staff concluded in the GEIS that the impacts are SMALL, and 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 Turkey Point Units 3 and 4 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), 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 FPL ER (FPL 2000), the staff's site visit, the scoping process, or its evaluation of other available information. Although the nuclear plants would close, continued operation of the cooling canal system will be needed to support the Turkey Point fossil plants. 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 FPL ER (FPL 2000), 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 & Light Company (FPL). 2000. *Applicant's Environmental Report – Operating License Renewal Stage Turkey Point Units 3 and 4.* Revision 1, 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.