CHAPTER 9
ALTERNATIVES TO THE PROPOSED ACTION

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ACRONYMS AND ABBREVIATIONS

%g	percent of gravity
°C	degree Celsius
°F	degree Fahrenheit
AAA	American Automobile Association
ac.	acre
ac/MWe	acre per megawatt electric
ACC	acid copper chromate
AFV	Alternative Fuel Vehicle
AP1000	Westinghouse Electric Company, LLC, AP1000 Reactor
APWRA	Altamont Pass Wind Resource Area
BMP	best management practice
BTA	best technology available
CAAA	Clean Air Act Amendment
CBD	Center for Biological Diversity
CCA	chromated copper arsenate
CCS	carbon capture and storage
CERP	Comprehensive Everglades Restoration Plan
CF	counterflow
CFBC	Cross Florida Barge Canal
CFR	Code of Federal Regulations
CFS	chemical feed system
CO	carbon monoxide
CO_2	carbon dioxide

ACRONYMS AND ABBREVIATIONS (CONTINUED)

CO_2eq	carbon dioxide equivalent
COL	Combined License
COLA	Combined License Application
CREC	Crystal River Energy Complex
CT	combustion turbine
CWA	Clean Water Act
CWIS	cooling water intake structure
CWS	circulating water system
DCD	Westinghouse Electric Company, LLC, AP1000 Design Control Document for the certified design as amended
DOE	U.S. Department of Energy
DSM	demand-side management
DTS	demineralized water treatment system
EIA	Energy Information Administration
EPACT	Energy Policy Act of 2005
EPAct 1992	Energy Policy Act of 1992
EPRI	Electric Power Research Institute
ER	Environmental Report
ESRP	Environmental Standard Review Plan
F.A.C.	Florida Administrative Code
F.S.	Florida Statutes
FBC	fluidized bed combustor
FDEP	Florida Department of Environmental Protection

ACRONYMS AND ABBREVIATIONS (CONTINUED)

FEECA	Florida Energy Efficiency and Conservation Act
FERC	Federal Energy Regulatory Commission
FGDL	Florida Geographic Data Library
FNAI	Florida Natural Areas Inventory
FPL	Florida Power and Light Company
FPS	fire protection system
FPSC	Florida Public Service Commission
FRCC	Florida Reliability Coordinating Council
FSAR	Final Safety Analysis Report
ft.	foot
ft/sec	foot per second
ft^3/sec	cubic foot per second
FWPCA	Federal Water Pollution Control Act
gCO^2eq/kWh	gram of carbon dioxide equivalent per kilowatt hour
GEIS	Generic Environmental Impact Statement
GIS	Geographic Information System
gpd/ft	gallon per day per foot
gpm	gallon per minute
gpm/ft	gallon per minute per foot
gpm/ft^2	gallon per minute per square foot
GTG	gas turbine generator
ha	hectare
ha/MWe	hectare per megawatt electric

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Hg	mercury
IGCC	integrated gasification-combined cycle
IPP	Independent Power Producer
IOU	investor-owned utility
in. HgA	inch of mercury absolute
KBWSP	Kissimmee Basin Water Supply Plan
km	kilometer
km^2	square kilometer
kV	kilovolt
kW	kilowatt
kWe	kilowatt electric
kWh	kilowatt hour
l/s	liter per second
$l/s/m^2$	liter per second per square meter
LCFS	LNP to proposed Central Florida South Substation
LCR	LNP to CREC 500-kV switchyard
LNP	proposed Levy Nuclear Plant Units 1 and 2
LPC	LNP to proposed Citrus Substation
m	meter
m^3/s	cubic meter per second
mfl	minimum flow level
mi.	mile
$mi.^2$	square mile

ACRONYMS AND ABBREVIATIONS (CONTINUED)

MSA	Metropolitan Statistical Area
MSW	municipal solid waste
MW	megawatt
MWe or MW(e)	megawatt electric
N/A	not applicable
NEPA	National Environmental Policy Act of 1969
NERC	North American Electric Reliability Corporation
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
OFW	Outstanding Florida Water
PE	probability of exceedance
PEF	Florida Power Corporation doing business as Progress Energy Florida, Inc.
PGA	peak ground acceleration
pH	hydrogen ion concentration
PM	particulate matter
PPE	Plant Parameter Envelope
PPSA	Power Plant Siting Act
PTC	Production Tax Credit

ACRONYMS AND ABBREVIATIONS (CONTINUED)

PV	photovoltaic
PWR	pressurized water reactor
PWS	potable water system
ROI	Region of Interest
ROW	right-of-way
RTO	Regional Transmission Organization
RWS	raw water system
SCA	Site Certification Application
SEGS	Solar Electric Generating System
SERC	Southeastern Electric Reliability Corporation
SFWMD	South Florida Water Management District
SHPO	State Historic Preservation Officer
SJRWMD	St. Johns River Water Management District
SO_2	sulphur dioxide
SO_x	sulphur oxide
SRWMD	Suwannee River Water Management District
STAR Group	STAR Group, LLPC
SWFWMD	Southwest Florida Water Management District
SWS	service water system
TES	thermal energy storage
TYSP	Ten-Year Site Plan
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

ACRONYMS AND ABBREVIATIONS (CONTINUED)

USGS	U.S. Geological Survey
UtiliPoint	UtiliPoint International
W(hr)/m^2/day	watt hour per square meter per day
Westinghouse	Westinghouse Electric Company, LLC
XF	crossflow

9.0 ALTERNATIVES TO THE PROPOSED ACTION

This chapter identifies alternatives to the proposed action (construction and operation of the proposed Levy Nuclear Plant Units 1 and 2 [LNP]) in four ways: (1) it identifies the impact of the no-action alternative; (2) reviews possible energy resources that could be used as alternatives to the proposed action; (3) identifies alternative sites; and (4) evaluates alternative plant and transmission systems for heat dissipation, circulating water, and power transmission at the LNP.

9.1 NO-ACTION ALTERNATIVE

The no-action alternative is a scenario under which the U.S. Nuclear Regulatory Commission (NRC) denies the Combined License Application (COLA), the LNP is not constructed, and no other generating station, either nuclear or non-nuclear, is constructed and operated. NUREG-1555 provides the following definition of the no-action alternative:

> The no-action alternative would result in the facility not being built, and no other facility would be built or other strategy implemented to take its place. This would mean that the electrical capacity to be provided by the project would not become available.

The most significant effect of the no-action alternative would be the loss of the potential 2200 megawatts electric (MWe)[a], which could lead to a reduced ability of existing power suppliers to maintain reserve margins and supply lower-cost power to customers. Chapter 8 of this Environmental Report (ER) describes the evaluation of the need for power and discusses the demand for electricity in the Florida Power Corporation doing business as Progress Energy Florida, Inc. (PEF) service territory, which is anticipated to grow by more than 25 percent in the next decade. Also discussed in ER Chapter 8 are the projected baseload demands and the potential effect of the no-action alternative on PEF's ability to provide safe, reliable baseload power within its service territory to meet the projected demand obligations of additional baseload power. In addition, another outcome of the no-action alternative would be a lack of needed electrical supplies.

The options outlined above are not optimal from the standpoint of the cost of operation or the cost of supplied power. PEF's fuel supply within the Region of Interest (ROI) could become increasingly dependent on fossil fuel power generation and other alternatives. Without additional capacity, the region would not only remain heavily dependent on fossil fuel power generation, but it would not recognize the role of fuel diversity in the overall reliability of the state's power system, as discussed in ER Section 8.4. If PEF took no action at all to meet

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a. The alternatives are evaluated for 2200 MWe of generated baseload electrical power. The actual baseload output of an AP1000 power generating facility will depend on the final design, but will be at least 1000 MWe, as described in ER Chapters 1 and 3.

growth demands, the ability to supply low-cost, reliable power to their customers would be impaired.

In addition to the benefits described in ER Section 10.4, additional benefits of the construction and operation of the LNP include economic and tax impacts to the surrounding region that are described in ER Subsections 4.4.2.1, 4.4.2.2, 5.8.2.1, and 5.8.2.2. Under the no-action alternative, none of the benefits of the proposed action as described in this ER would be realized.

Under the no-action alternative, the predicted impacts from the project would not occur at the site. Those impacts would result primarily from the construction of the facilities and would include land use, ecological, socioeconomic, and water-related impacts, as summarized in Table 4.6-1. Potential Impacts from operation are summarized in Table 5.10-1. The benefits of implementing the no-action alternative would include avoiding the construction impacts as described in the sections referenced above.

Under the no-action alternative, the increased need for power would need to be met by means that involve no new generating capacity. ER Section 9.2 reviews possible energy resources that could be used as alternatives to the proposed action. Non-nuclear alternative sources of new power generating capacity are discussed in ER Subsections 9.2.2 and 9.2.3.

9.2 ENERGY ALTERNATIVES

This section examines the potential environmental impacts associated with alternative power generating sources other than the LNP. Energy alternatives considered include:

- The purchase of electric power from other sources to replace power that would have been generated by the LNP.
- A combination of new generating capacity and conservation measures.
- Other generation alternatives that were deemed not to be viable replacements for the LNP.

The Levy County location was chosen based on an assessment of the major siting criteria: land, access to sufficient quantities of water (from the Gulf of Mexico) and access to the electric transmission system, as well as an overall evaluation of environmental considerations. The proximity of the site to the Crystal River Energy Complex (CREC), an existing power generating facility with one nuclear and four coal-fueled units owned by PEF, would also provide opportunities for efficiencies in shared support functions. (Reference 9.2-001)

Alternatives that do not require new power generating capacity were evaluated, and are discussed in ER Subsection 9.2.1. These include passive measures such as energy conservation and demand-side management (DSM).

Alternative energy supplies such as wind, geothermal, oil, natural gas, hydropower, municipal solid wastes (MSWs), coal, photovoltaic (PV) cells, solar power, wood waste/biomass, energy crops, and integrated gasification-combined cycle (IGCC), as well as any reasonable combination of these alternatives were also analyzed. These alternatives are discussed in ER Subsection 9.2.2.

In ER Subsection 9.2.2, some of the alternatives that require new generating capacity were eliminated from further consideration based on their availability in the region, overall feasibility, and environmental consequences. In ER Subsection 9.2.3, the alternatives that were not eliminated based on these factors are investigated in further detail relative to specific criteria such as environmental impacts, reliability, and economic costs.

9.2.1 ALTERNATIVES THAT DO NOT REQUIRE NEW GENERATING CAPACITY

This subsection provides an assessment of the economic and technical feasibility of meeting the demand for energy without constructing new generating capacity. Specific elements include the following:

- Initiating energy conservation measures (including implementing DSM actions).
- Reactivating or extending the service life of existing power generating facilities within the power system.
- Purchasing power from other utilities or power generators.
- A combination of these elements that would be equivalent to the output of the LNP, and would therefore, replace its need.

The alternative of electric power generating capacity through the combination of purchased power and the reactivation or extended service life of power generating facilities within the PEF service territory is not feasible due to the insufficient capacity of purchasing power from other utilities or power generators. Also, the lack of inventory of deactivated power generating facilities or the possibility of extending the service life of a facility scheduled for deactivation in the future is also not feasible.

A description of the power system, factors associated with the power demand and supply, and an assessment of the need for power is provided in ER Chapter 8.

9.2.1.1 Initiating Conservation Measures

Under the Energy Policy Act of 2005 (EPACT), a rebate program was established for dwellings and small businesses that install renewable systems in their buildings. The rebate was set at $3000 or 25 percent of the expenses,

depending on which is less. EPACT authorized $150 million for 2006 and up to $250 million for 2010. According to EPACT, renewable energy sources included geothermal, biomass, solar, wind, or any other renewable energy used to heat, cool, or produce electricity for a dwelling. (Reference 9.2-002)

Historically, state regulatory bodies have required regulated utilities to institute programs designed to reduce demand for electricity. DSM has shown great potential in reducing peak-load usage. According to the U.S. Department of Energy (DOE), Energy Information Administration (EIA), in 2006 peak-load usage was reduced by 27,240 MWe. This reduction is 6.0 percent greater than that of the 25,710-MWe reduction in 2005. (Reference 9.2-003). However, DSM costs increased by 6.8 percent over the same period of time (Reference 9.2-004). Although DSM has shown great potential in reducing peak-load usage, it does not satisfy the baseload need that will be satisfied by the LNP. Additional information regarding energy efficiency and substitutions is provided in ER Subsection 8.2.2.2, and the assessment of need for power is discussed in more detail in ER Section 8.4.

Probably the most significant efficiency investments in terms of value for PEF are ones that concentrate energy savings during high use and high price periods. Not only are the avoided energy costs greater, but also the value of the capacity is considerable. Furthermore, in some circumstances, such efficiency investments can avoid costly investments in distribution and transmission upgrades. Finally, such investments can have reliability advantages. More efficient air conditioning is perhaps the best example of a “peak baseload efficiency investment”—one that reduces load in periods highly coincident with system peaks.

PEF has taken steps to put residential, commercial and industrial energy efficiency and load management programs in place for reducing peak load demand through its Energy Wise program (Reference 9.2-046). The Residential Energy Management program is a voluntary customer direct load control program that commenced in 1981 and was modified in 1995, 2000, and 2004. Peak demand is reduced by PEF using radio controlled switches installed on the customer’s premises to turn off selected electrical equipment. These controlled interruptions are at PEF's option, during specified time periods, and coincident with hours of peak demand. The Commercial/Industrial Energy Management Program is a voluntary customer direct load control program that is restricted to existing customers as of July 20, 2000. Peak demand is reduced by PEF using radio controlled switches installed on the customer’s premises to turn off central cooling and chiller systems during specified time periods and coincident with hours of peak demand. As with the Residential Energy Management Program, participants receive credits on their electricity bills. The Interruptible Service Program is a voluntary customer direct load control program that commenced in its present form in 1996. The program is available throughout the entire territory served by PEF to any non-residential customer who is willing to have their power interrupted by PEF.

ER Chapter 8 points out that the Florida Energy Efficiency and Conservation Act (FEECA) of 1980 requires the Florida Public Service Commission (FPSC) to

adopt goals to increase the efficiency of energy consumption, increase the development of cogeneration, and reduce and control the growth rates of electric consumption and weather-sensitive peak demand. PEF has been participating in these programs since 1981 and has been a national leader in developing and implementing conservation and DSM programs. PEF participates in the FPSC's goal setting process to propose, establish, and gain approval for the company's demand-side programs, which include program measures for energy efficiency, direct load control, and standby generation in the residential, commercial and industrial sectors. PEF's current portfolio of programs was most recently reviewed and approved by the FPSC in 2007.

In addition, ER Chapter 8 also states that the FPSC approved PEF's DSM Plan for meeting its energy conservation goals established by the FPSC. The DSM Plan consists of a portfolio of individual DSM programs that include direct load control and standby generator programs in the residential, commercial and industrial sectors. The cost effectiveness of the demand-side measures included in this portfolio hinges largely on energy savings achieved during high use and high price periods. As new measures are developed and added to the system over time, the program contributions increase in helping limit the potential demand during peaking periods. During these peak periods, some of the energy requirements are mitigated and some of the energy requirements shift into high intermediate use periods. There is little significant load shifting or load reduction into the baseload demand periods, compared with the percentage of load that can be impacted during peak periods. Given the relationship between peak and baseload impacts, it would be reasonable to assume that baseload needs tend to grow at a proportionately higher rate than peak loads, given PEF's evolving demand profile over time. While PEF continues to plan for future resources accounting for both peak demand periods and energy demand profiles, it is (and conservative) to assume that increasing peak demand will remain a practical surrogate for increasing baseload for the foreseeable future.

9.2.1.1.1 Conservation Programs

Energy efficiency plays a vital role in addressing Florida's future energy needs, and it is part of PEF's balanced approach to managing growth. In June of 2007, PEF launched a comprehensive awareness campaign designed to educate customers about the importance and benefits of energy efficiency. PEF's new "Save the Watts" campaign will provide simple, low-cost suggestions for customers to reduce energy use and to save money on their energy bills. The campaign promotes and encourages home energy checks, and offers additional ways customers can save money through participation in any of the company's more than 100 energy-efficiency programs and measures. (Reference 9.2-005)

In early 2007, PEF expanded its energy-efficiency programs by adding 39 new measures. By taking advantage of a combination of existing and new measures, residential customers could save 37 percent on their annual energy costs. The new measures include the EnergyWise program and the Neighborhood Energy Saver program. (Reference 9.2-005)

DSM programs encourage customers, businesses, contractors, and builders to use electricity more wisely and to adopt renewable energy technology. Since 1981, PEF customers have saved nearly $825 million in energy costs and eliminated nearly 7 million tons of carbon dioxide (CO_2) through participation in these programs. In addition to eliminating the need for 17 peaking power generating facilities, energy-efficiency programs have also averted the production of more than 10 billion kilowatt hours (kWh) of electricity. (Reference 9.2-005)

PEF offers a number of "Home Energy Check" programs, which include online and in-person residential energy evaluations. The Progress Energy website also features online energy saving tips which educate customers about the biggest household energy wasters and show how a few simple actions can increase efficiency. (Reference 9.2-006)

PEF also offers an "Energy Efficient New Home Construction Program" (also called "Home Advantage"). This program encourages the construction of homes that implement a variety of energy-saving measures. As part of this program, Energy Star homes can be constructed, and these homes use at least 15 percent less energy than required by the national Model Energy Code. (Reference 9.2-007)

PEF also offers energy saving programs and incentives to businesses. Similar to PEF's "Home Energy Check," the "Business Energy Check" is a tool businesses can use to identify opportunities to reduce their energy costs. (Reference 9.2-008)

DSM measures have proven to reduce energy usage; however, they do not satisfy the 2200 MWe of baseload output proposed to be generated by the LNP.

9.2.1.2 Reactivating or Extending Service Life of Existing Facilities

Retired fossil fuel power generating facilities and fossil fuel power generating facilities slated for retirement tend to be ones that are old enough to have difficulty in economically meeting today's restrictions on air contaminant emissions. In the face of increasingly stringent environmental restrictions, delaying retirement or reactivating power generating facilities would require major construction to upgrade or replace facility components. Currently, there are no deactivated power generating facilities with the potential for future operation. PEF currently has only two power generating facilities (Bartow, 444 MWe, Pinellas County; and Suwannee River, 129 MWe, Suwannee County) scheduled for retirement that may be available for service life extension. PEF's future power generation addition planning efforts include uprates of 37 MW and 129 MW to the CREC nuclear unit No. 3 in 2009 and 2011, respectively (Reference 9.2-009). However, solely extending the service life of this facility without construction of the LNP would not meet or fulfill PEF's Ten-Year Site Plan (TYSP). Both extending the service life of the CREC facility and construction of the LNP are part of PEF's future baseload generation capacity. Therefore, extending the service life of the CREC facility alone is not a feasible alternative to the LNP.

9.2.1.3 Purchasing Power from Other Utilities or Power Generators

PEF purchases approximately 1300 MWe of capacity from 16 qualifying facilities and two investor-owned utilities (IOU). Altogether, these purchased power resources account for approximately 11.5 percent of PEF's generation resources, providing a significant amount of diversity in supply. (Reference 9.2-009) Purchased power, where the regulated utilities purchase power from non-utilities or merchant plants outside the state, was approximately 3.0 percent of the total energy resources in 2004 and is projected to be 1.5 percent in 2014. Because these contracts are part of PEF's current and future capacity and no substantial new capacity additions from facilities are foreseen in the non-utility generation sector, PEF does not consider such power purchases a feasible option for the purchased-power alternative.

PEF assumes that the generating technology used to produce purchased power would be one of those that the NRC analyzed in its Generic Environmental Impact Statement (GEIS) (NUREG-1437, Volume 1). For this reason, PEF is adopting by reference the GEIS description of the alternative generating technologies as representative of the purchased-power alternative. Of these technologies, facilities fueled by coal and combined-cycle facilities fueled by natural gas are the most cost effective for providing baseload capacity. Given the amount of potential electricity to be generated by the LNP, PEF believes that it is reasonable to assume that new capacity would have to be built for the purchased-power alternative.

As discussed in ER Chapter 8, PEF projects that approximately 0.1 percent of its net energy will be purchased or sold within the Florida Reliability Coordinating Council (FRCC) region. While at the same time, about 1.3 percent of its net energy purchased or sold will be imported from outside the state and another 2.3 percent of its net energy purchased or sold will be derived from qualifying facility purchased power.

PEF is interconnected with 22 municipal and nine rural electric co-operative systems within the State of Florida. PEF is also interconnected with Southern Company, Tampa Electric Company, Florida Power and Light Company (FPL), Orlando Utility Commission, City of Tallahassee, Gainesville Regional Utilities, Lakeland Electric, New Smyrna Beach and Reedy Creek Improvement District (Reference 9.2-042).

Additionally, the FRCC currently has agreements in place for importing electricity from the Southeast Electric Reliability Council (SERC) to ensure that FRCC or the North American Electric Reliability Council (NERC) reliability criteria are not violated. Currently, there are 1552 megawatts (MW) of generation owned or under firm contract that are available to be imported into the region. These firm resources account for about 5 percent of the Reserve Margin. FRCC utilities own about 858 MW of the 1552 MW that are dispatched out of the southern subregion of SERC. This firm capacity has firm transmission service to ensure deliverability into the FRCC region. There are no firm long-term sales to other regions (Reference 9.2-043).

The FPSC has considered the need for fuel diversity in the evaluation of utility generation expansion plans as part of PEF's annual Ten-Year Site Plan review process. In 2006, the Florida Legislature amended Section 403.519, Florida Statutes (F.S.), to require the FPSC to specifically consider the need for fuel diversity on a utility's system when evaluating a petition for need. Additionally, Section 403.519(4)(b), F.S., directs the FPSC to take into account not only the need for fuel diversity, but also the reduction of Florida's dependence on natural gas and fuel oil.

The FPSC stated that there are no renewable energy sources and technologies or conservation measures taken by or reasonably available to PEF that might mitigate the need for LNP. Additionally, the FPSC indicates that PEF evaluates cost-effectiveness of renewable energy projects in accordance with Rules 25-17.200 through 25-17.310, Florida Administrative Code (F.A.C.). The cost of the energy must be at or below the avoided cost to produce the energy. Renewable attributes such as renewable energy credits and tax credits are not included in the payments and may represent an additional revenue resource for the renewable resource. PEF has over 173 MW of renewable power from purchased power contracts.

The FPSC acknowledged that other renewable alternatives such as solar, wind, and wave energy have not yet become cost-effective, and these technologies are highly dependent upon intermittent natural energy sources that can be valuable energy resources but cannot be depended upon to produce firm capacity. As windmill and transmission technologies improve, these technologies may unlock the potential of wind energy in Florida. In the foreseeable future, however, wind-powered generation is not economical or feasible in Florida. Florida has only marginal wind resources that are located along the coastline. There may be sufficient wind resources off-shore in Florida, but transmitting energy from off-shore sources is, among other things, still very expensive and often impractical. (Reference 9.2-044)

Florida has adopted an energy strategy for the State that places a high priority on the promotion of renewable energy production. The FPSC also noted that PEF continues to search for other sources of renewable energy through a cooperative process between developers and PEF in order to bring such projects to fruition. The FPSC states that PEF continues to look for ways to expand its inventory of renewable energy sources and technologies. (Reference 9.2-044) For example, PEF purchases more than 800 MW from a number of qualifying facilities. They utilize various fuel sources, including biomass, waste heat from agricultural processes and municipal solid waste (Reference 9.2-045). As part of its ongoing support for renewable energy and developing technologies, ER Chapter 8 states that PEF has signed a long-term contract with the Biomass Investment Group to purchase the energy output (130 MW) generated by a unique energy source, the nation's largest biomass plant to be built in central Florida. The project is expected to reduce carbon emissions by more than 20 million tons over the 25-year life of the contract compared to coal. In addition, PEF signed a purchase-power agreement with Vision Power Systems to purchase 40 MW of electricity

from biomass resources beginning in 2010 and an agreement with Horizon Energy Group to purchase up to 60 MW of electricity generated from municipal solid waste, using an advanced gasification process (Reference 9.2-045).

9.2.2 ALTERNATIVES THAT REQUIRE NEW GENERATING CAPACITY

The GEIS provides the following information:

> While many methods are available for generating electricity, and a huge number of combinations or mixes can be assimilated to meet a defined generating requirement, such expansive consideration would be too unwieldy to perform given the purposes of this analysis. Therefore, NRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable.

Alternative energies considered include the following:

- Wind
- Geothermal
- Hydropower
- Solar Power
  - Concentrating Solar Power Systems
  - PV Cells
- Wood Waste
- MSW
- Energy Crops
- Petroleum Liquids (Oil)
- Fuel Cells
- Coal
- Natural Gas
- IGCC

Each of the alternatives will be discussed in more detail in later subsections, with an emphasis on coal, natural gas, solar energy, and wind energy. As a

renewable resource, solar and wind energies, alone or in combination with one another, have gained increasing popularity over the years due to increasing concerns for greenhouse gas emissions. Also, air emissions from solar and wind power generating facilities are much smaller than fossil fuel power generating facility air emissions. Although the use of coal and natural gas has undergone a slight decrease in popularity, they are still two of the most widely used fuels for producing electricity.

The current mix of power generation options in Florida is one indicator of the feasible choices for electric power generation technology within the state. PEF evaluated Florida's electric generation capacity and utilization characteristics. "Capacity" is the categorization of the various installed technology choices in terms of its potential output. "Utilization" is the degree to which each choice is actually used.

This subsection identifies alternatives that PEF has determined are not feasible and the basis for this determination. This COLA is premised on the installation of a facility that would serve as a baseload resource and that any feasible alternative would also need to be able to generate equivalent baseload power. In performing this evaluation, PEF relied heavily upon the GEIS.

The GEIS is useful for analyzing alternative sources because the NRC has already made determinations regarding these potential alternative technologies. Based on these determinations, the NRC is able to consider the relative environmental consequences of an action. To generate the reasonable set of alternatives used in the GEIS, the NRC included commonly known generation technologies and consulted various state energy plans to identify the alternative generation sources typically being considered by state authorities across the country. From this review, the NRC had established a reasonable set of alternatives to be examined. These alternatives include the energy sources listed at the beginning of this subsection, as well as delayed retirement of existing non-nuclear power generating facilities. The NRC has considered these alternatives pursuant to its statutory responsibility under the National Environmental Policy Act of 1969 (NEPA). Although the GEIS is for license renewal, the alternatives analysis in the GEIS can be compared to the proposed action (construction and operation of the LNP) to determine if the alternative represents a reasonable alternative to the proposed action.

Each of the alternatives are assessed and discussed in the subsequent subsections relative to the following criteria:

- Is the alternative energy conversion technology mature and proven, and will it be available in the ROI within the life of the Combined License (COL)?

- Does the alternative energy source provide baseload-generating capacity equivalent to the capacity and to the same level as the LNP?

- Do the costs of an alternative energy source exceed the costs that make it economically impractical?
- Is the alternative energy source environmentally preferable to the LNP?

Each of the potential alternative technologies considered in this analysis are consistent with national policy goals for energy use and are not prohibited by federal, state, or local regulations.

Based on one or more of the above criteria, several of the alternative energy sources were considered not technically or economically feasible after a preliminary review and were not considered further. Alternatives that were considered to be technically and economically feasible are assessed in greater detail in ER Subsection 9.2.3.

Throughout this chapter, environmental impacts of the alternatives are assessed using the NRC three-level standard of significance: SMALL, MODERATE, or LARGE. This standard of significance was developed using the Council on Environmental Quality guidelines set forth in the footnotes to Table B-1 of 10 Code of Federal Regulations (CFR) 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. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered SMALL.
- **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 any important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the GEIS, NUREG-1437, Volumes 1 and 2.

See Table 9.2-1 for impacts associated with various impact categories.

9.2.2.1 Wind

In general, wind Class 1, 2, and 3 sites are areas with wind power density and speeds too small for large-scale wind farms. Wind Classes 4 and above have wind power densities and speeds large enough for wind energy production with current technology.

As a result of advances in technology and the current level of financial incentive support, a number of additional areas with slightly lower wind resources (Class 3+) may also be suitable for wind development. These would, however,

operate at an even lower annual capacity factor and output than used by National Renewable Energy Laboratory (NREL) for Class 4 sites.

The following information is provided in the Florida Department of Environmental Protection's (FDEP's) *Florida's Energy Plan* (Reference 9.2-010):

> A recent study funded by the U.S. Department of Energy's Wind Powering America program concluded that Florida's onshore wind resources traditionally considered "marginal to good" could now be "fair to excellent." In addition, utility scale wind power generation appears to be economically viable at certain offshore and at direct coastal sites within view of the Atlantic Ocean and Gulf of Mexico.
>
> The study further suggests that large utility-scale wind power generation is unlikely to be economically viable at inland sites more than a few hundred yards from the coastline anywhere within Florida today, with the possible exception of outer Cape Canaveral, the Panama City Beach region and the lower Florida Keys.

In any wind power generating facility, the land use could be significant. Wind turbines must be sufficiently spaced to maximize capture of the available wind energy. If the turbines are too close together, one turbine can impact the efficiency of another turbine. A 2-MWe turbine requires only approximately 0.10 hectares (ha) (0.25 acres [ac.]) of dedicated land for the actual placement of the wind turbine, leaving landowners with the ability to utilize the remaining acreage for some other uses that do not impact the turbine, such as agricultural use. For illustrative purposes, if all of the resources in Class 3 and 4 sites were developed using 2-MWe turbines, with each turbine occupying 0.10 ha (0.25 ac.), 9000 MWe of installed capacity would utilize 455 ha (1125 ac.) just for the placement of the wind turbines alone. Based upon the NERC capacity factor, the aforementioned project would have an average output of 1530 MWe (approximately 0.30 hectares per megawatt electric [ha/MWe] [0.73 acres per megawatt electric {ac/MWe}]). This is a conservative assumption because Class 3+ sites will have a lower percentage of average annual output.

If a Class 3+ site was available and developed using 2-MWe turbines within the ROI, approximately 12,800 MWe of installed capacity would be needed to produce 2200 MWe of baseload output. This would encompass a footprint area of approximately 648 ha (1600 ac.), which is more than five times the land area needed for the LNP plant site (primary location of the two reactors and ancillary power production support facilities, which is approximately 121 ha (300 ac.) near the center of the LNP site). This does not include supporting infrastructure for wind farms such as access roads, which would require considerable additional area. Therefore, land use impacts would be MODERATE. Even if there was enough land area to develop wind turbines, the LNP site is a Class 1 or Class 2 site; therefore, it would not be reasonable to construct a wind power generating facility at the site (Reference 9.2-011).

Although wind technology is considered mature, technological advances may make wind a more economic choice for developers than other renewable sources (Reference 9.2-012). Technological improvements in wind turbines have helped reduce capital and operating costs. In 2000, wind power was produced in a range between $0.03 and $0.06/kWh, depending on wind speeds. By 2020, wind power generating costs are projected to fall between $0.03 and $0.04/kWh (Reference 9.2-013).

As an example of cost, a wind power generating facility that has an installed capacity of 75 MWe can produce power at a levelized rate of $0.049/kWh. With the Federal Production Tax Credit (PTC), the cost is reduced to a range between $0.027 and $0.035/kWh. The PTC primarily reduced the tax burden and operating costs for wind power generating facilities, which was vital to the financing of facilities. The PTC has been renewed in the EPACT and should be part of the "competitiveness analysis." However, the PTC is scheduled to expire on December 31, 2008. In a recent U.S. Senate vote on February 6, 2008, the Amendment (Senate Amendment 3983) to the Economic Stimulus Bill (House of Representatives 5140) that would have extended the PTC for an additional year was not passed.

The following information can provide some unique insights into the viability of the wind resource:

- The distance from transmission lines at which a wind developer can profitably build depends on the cost of the specific project. Consider, for example, the cost of construction and interconnection for a 115-kilovolt (kV) transmission line that would connect a 50-MWe wind farm with an existing transmission and distribution network. In 1995, the EIA estimated the cost of building a 115-kV line to be $130,000 per (1.6 kilometers [km]) mile (mi.), excluding right-of-way (ROW) costs (Reference 9.2-014). This amount includes the cost of the transmission line itself and the supporting towers. It also assumes relatively ideal terrain conditions, including fairly level and flat land with no major obstacles or mountains — more difficult terrain would raise the cost of erecting the transmission line. In addition to the construction, operating, and maintenance costs for wind farms, there are costs for connection to the transmission grid. In 1993, the cost of constructing a new substation for a 115-kV transmission line was estimated at $1.08 million, and the cost of connection for a 115-kV transmission line with a substation was estimated to be $360,000. The further a wind energy development project is from transmission lines, the higher the cost of connection to the transmission and distribution system. (Reference 9.2-015)

- Any wind project would have to be located where the project would produce economical generation, and that location may be far removed from the nearest possible connection to the transmission system. A location far removed from the power transmission grid might not be economical, as new transmission lines would be required to connect the wind farm to the distribution system. Existing transmission infrastructure

may need to be upgraded to handle the additional supply. Soil conditions and the terrain must be suitable for the construction of the towers' foundations. Finally, the choice of a location may be limited by land use regulations and the ability to obtain the required permits from local, regional, and national authorities.

- Another consideration on the integration of wind capacity into the electric utility system is the variability of wind energy generation. Wind power generating facilities must be located at sites with specific characteristics to maximize the amount of wind energy captured and electricity generated (Reference 9.2-013). Additionally, for transmission purposes, wind generation is not considered "dispatchable," meaning that the generator can control output to match load and economic requirements. Because the resource is intermittent (or not available all of the time), wind by itself is not considered a firm source of baseload capacity. The inability of wind alone to be a dispatchable, baseload producer of electricity is inconsistent with the objectives for the LNP.

Finally, in addition to the land requirements posed by large facilities, wind power generating facilities have the following potential environmental impacts:

- Some people consider large-scale commercial wind farms to be an aesthetic problem. Local residents near the wind farms may lose what they consider their pristine scenic viewshed of the area.

- High-speed wind turbine blades can be noisy, although technological advancements continue to lessen this problem.

- Wind power generating facilities sited in areas of high bird use can expect to have fatality rates higher than those expected if the facility were not there.

Because the LNP will be located away from heavily populated areas, impacts such as aesthetics and noise are expected to be SMALL.

The Center for Biological Diversity (CBD) supports wind energy as an alternative energy source and as a way to reduce environmental degradation. However, wind power generating facilities, such as the Altamont Pass Wind Resource Area (APWRA) in California, are causing mortality rates in raptor populations to increase, as a result of turbine collisions and electrocution on power lines. The APWRA kills an estimated 880 to 1300 birds of prey each year. (Reference 9.2-016)

Many renewable resources like wind are intermittent. Storing energy from the renewable source allows supply to more closely match demand. For example, a storage system attached to a wind turbine could store energy captured at any time, and then dispatch that energy into the higher-priced midday market. (Reference 9.2-017)

With the inability of wind energy to generate baseload power, the projected land use impacts of development of Class 3 and Class 4 sites, the cost factors in construction, operation, and transmission connections, and the environmental impacts associated with development, a wind power generating facility alone is not a feasible alternative to the LNP.

Offshore wind farms are another source for wind energy production along the coasts of Florida; however, more than half the shore lines along the Florida coasts have been designated as Marine Protected Areas, making it difficult to site offshore wind farms directly off the coast. A 130-turbine wind farm evaluated for the west coast inner-shelf determined that an average of 169 MWe could be produced. Based on the 2200 MWe of baseload capacity projected for the LNP, it would take an approximate 1760-turbine wind farm to produce the equivalent baseload capacity (Reference 9.2-018). Based on the concerns for an offshore wind farm possibly located in a Marine Protected Area and the large area needed for equivalent LNP baseload capacity, offshore wind farms are non-competitive with a nuclear power generating facility at the LNP site.

9.2.2.2 Geothermal

As shown in Figure 8.4 of the GEIS, geothermal power generating facilities could be located in the western continental United States, including Alaska and Hawaii, where hydrothermal reservoirs are prevalent; however, geothermal resources do not exist in Florida.

Based on the hottest known geothermal regions of the United States, Florida is not a candidate for geothermal energy and could not produce the proposed 2200 MWe of baseload energy (Reference 9.2-019). Florida does not have sufficient resources to use geothermal technologies (Reference 9.2-020). Therefore, a geothermal energy source is simply not available in the ROI, and a geothermal power generating facility is a non-competitive alternative to a nuclear power generating facility at the LNP site.

9.2.2.3 Hydropower

The GEIS estimates land use of 400,000 ha (1 million ac.) per 1000 MWe generated by hydropower. Based on this estimate, a hydropower generating facility would require flooding more than 900,000 ha (2.20 million ac.) of land to produce a baseload capacity of 2200 MWe, resulting in a LARGE impact on land use. Further, operation of a hydropower generating facility would alter aquatic habitats above and below the dam, which would impact existing aquatic species.

The Federal Energy Regulatory Commission (FERC) is required to take environmental issues into consideration when renewing or granting licenses for hydropower. Many environmentalists oppose hydropower dams due to the constraint it puts on migrating fish species in the area. Also, new dams receive opposition from local communities who may be displaced by flooding the new reservoir or who may use the current river system for recreational activities.

According to the FDEP's *Florida's Energy Plan*, "Hydroelectric units at two sites in northwest Florida, one utility-owned and one operated by the Federal government, supply approximately 50 MWe of renewable capacity. Hydroelectric generation accounts for less than 0.1 percent of Florida's generation mix. There are no planned new units due to the absence of a feasible location, as Florida's flat terrain does not lend itself to hydroelectric power." (Reference 9.2-010) Therefore, a hydropower generating facility is non-competitive with a nuclear power generating facility at the LNP site.

9.2.2.4 Solar Power

Solar energy is dependent on the availability and strength of sunlight (strength is measured as kWh per square meter). Solar power is considered an intermittent source of energy. Solar energy combined with fossil fuels is a viable power generation alternative. However, solar power generating facilities combined with fossil fuel power generating facilities would have higher costs than a nuclear power generating facility at the LNP site, along with additional construction impacts and only moderately less significant environmental impacts compared to fossil fuel alternatives.

Solar technologies may provide a fuel-saving companion to a baseload source. These technologies can be divided into two groups. The first group concentrates the sun's energy to drive a heat engine (concentrating solar power systems). The other group of solar power technologies directly converts solar radiation into electricity through the photoelectric effect by using PV cells.

Construction of solar power generating facilities has substantial impacts on wildlife habitat, land use, and aesthetics. As stated in the GEIS, land requirements are high: 14,000 ha (35,000 ac.) per 1000 MWe for PV and approximately 6000 ha (14,000 ac.) per 1000 MWe for solar thermal systems. This would require a footprint of approximately 28,600 ha (71,500 ac.) for PV and 13,200 ha (33,000 ac.) for solar thermal systems to produce a 2200-MWe baseload capacity. Both of these are much too large to construct at the LNP site.

In order to discuss the availability of solar resources in Florida, two collector types must be considered: concentrating collectors and flat-plate collectors. Concentrating collectors are mounted to a tracker, which allows them to face the sun at all times of the day. In Florida, approximately 4000 to 4500 watt hours per square meter per day (W[hr]/m^2/day) can be collected using concentrating collectors. Flat-plate collectors are usually fixed in a tilted position to best capture direct rays from the sun and also to collect reflected light from clouds or off the ground. In Florida, approximately 5000 to 5500 W(hr)/m^2/day can be collected using flat-plate collectors. (Reference 9.2-020)

9.2.2.4.1 Concentrating Solar Power Systems

Concentrating solar power generating facilities only perform efficiently in high-intensity sunlight locations, specifically the arid and semi-arid regions of the world (Reference 9.2-021). This does not include Florida.

Concentrating solar power generating facilities produce electric power by converting the sun's energy into high-temperature heat using various mirror configurations. The heat is then channeled through a conventional generator, via an intermediate medium, such as water or salt. Concentrating solar power generating facilities consist of two parts: one that collects the solar energy and converts it into heat and another that converts heat energy into electricity.

Concentrating solar power generating facilities can be sized for "village" power (10 kilowatts electric [kWe]) or grid-connected applications (up to 100 MWe). Some systems use thermal energy storage (TES), setting aside heat transfer fluid in its hot phase during cloudy periods or at night. These attributes, along with solar-to-electric conversion efficiencies, make concentrating solar power an attractive renewable energy option in the southwest part of the United States and other Sunbelt regions worldwide. (Reference 9.2-022) Others can be combined with natural gas. This type of combination is discussed in ER Subsection 9.2.3.3.

There are three kinds of concentrating solar power generating facilities: troughs, dish/engines, and power towers. They are classified by how they collect solar energy (Reference 9.2-022).

While concentrating solar power technologies currently offer the lowest-cost solar electricity for large-scale power generation, these technologies are still in the demonstration phase of development and cannot be considered competitive with fossil fuel- or nuclear-based technologies (Reference 9.2-012).

9.2.2.4.2 "Flat Plate" Photovoltaic Cells

The second main method for capturing the sun's energy is through the use of PV cells. A typical PV or solar cell might be a square that measures approximately 10 centimeters (4 inches) on a side. A cell can produce approximately 1 watt of power.

PV solar technology can convert approximately 15 percent of the sunlight's energy into electricity (Reference 9.2-023). On average in Florida, solar energy can produce 4.5 to 5.5 kilowatt hours per square meter per day and can achieve slightly higher production in the summer. This value is highly dependent on the time of year, weather conditions, and obstacles that may block the sun. (Reference 9.2-020)

Currently, PV solar power is not competitive with other methods of producing electricity for the open wholesale electricity market. When determining the cost of solar power generating facilities, the totality of the system must be examined. There is the price per watt of the solar cell, price per watt of the module (whole panel), and the price per watt of the entire system. It is important to remember that all systems are unique in their quality and size, making it difficult to make broad generalizations about price. The average price of modules (dollars per peak watt) increased 9 percent, from $3.42 in 2001 to $3.74 in 2002. The average price of PV cells decreased 14 percent, from $2.46 in 2001 to $2.12 in 2002 (Reference 9.2-024). The module price, however, does not include the

costs of design, land, support structure, batteries, an inverter, wiring, and lights and appliances. With all of these included, a full system can cost anywhere from $7 to $20 per watt (Reference 9.2-025). Costs of PV cells in the future may be expected to decrease with improvements in technology and increased production. Optimistic estimates are that costs of grid-connected PV systems could drop to $2275/kWe and to $0.15 /kWh by 2020 (Reference 9.2-013). These costs would still be substantially in excess of the costs of power from a nuclear power generating facility. Therefore, a PV solar power generating facility is non-competitive with a nuclear power generating facility at the LNP site.

Environmental impacts of solar power generating facilities can vary based on the technology used and the site-specific conditions. Possible impacts include the following:

- Land use and aesthetics are the primary environmental impacts of solar power.

- Land requirements for each of the individual solar energy technologies are large. The land required for the solar generating technologies discussed here ranges from 1 ha to 4.9 ha/MWe (2.5 to 12 ac/MWe). In addition, this land use is pre-emptive; land used for solar power generating facilities would not be available for other uses such as agriculture.

- Depending on the solar technology used, there may be thermal discharge impacts. These impacts are anticipated to be SMALL. During operation, PV and solar thermal power generating facilities produce no air pollution, little or no noise, and require no transportable fuels.

- There are environmental impacts of PV related to manufacture and disposal. The process to manufacture PV cells is similar to the production of a semiconductor chip. Chemicals used in the manufacture of PV cells include cadmium, zinc, copper, and various other heavy metals. (Reference 9.2-026) There is some concern that landfills containing manufacturing wastes or discarded PV cells could leach cadmium, mercury, and lead into the environment in the long term. Generally, PV cells are sealed and the risk of release is considered slight; however, the long-term impact of these chemicals in the environment is unknown.

- Another environmental consideration with solar technologies is the lead-acid batteries that are used with some systems. On average, a lead-acid battery will last 3 years. Because lead is relatively inexpensive, it is more economical to manufacture new batteries as opposed to extracting the lead from old batteries (Reference 9.2-027). This may become a long-term concern as discarded batteries in landfills could leach lead into the environment.

In 2005, concentrating solar power systems had a benchmark cost of $0.12 to $0.14/kWh with a target cost of $0.035 to $0.06/kWh by 2025 (Reference 9.2-028); however, concentrating solar power generating facilities are still in the demonstration phase of development and are not competitive with nuclear-based technologies. PV cell technologies are increasing in popularity as costs slowly decrease; however, a supplemental energy source would be needed to meet the LNP baseload capacity, and the large estimate of land required would make this alternative infeasible.

Therefore, based on the lack of information regarding large-scale systems able to produce the proposed 2200-MWe baseload capacity and the large land area footprint needed for construction, “flat plate” PV cell and concentrating solar power generating facilities are non-competitive with a nuclear power generating facility at the LNP site.

9.2.2.5 Wood Waste (and Other Biomass)

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem. However, the largest wood waste power generating facilities are 40 to 50 MWe in size. This would not meet the proposed 2200-MWe baseload capacity.

Nearly all of the wood waste power generating facilities in the United States use steam turbine conversion technology. The technology is relatively simple to operate and it can accept a wide variety of biomass fuels. However, at the scale appropriate for biomass, the technology is expensive and inefficient. Therefore, the technology is relegated to applications where there is a readily available supply of low, zero, or negative cost-delivered feedstocks.

Construction of a wood waste power generating facility would have an environmental impact similar to that of a coal power generating facility. Although, facilities using wood waste for fuel would be built on smaller scales. Like coal power generating facilities, wood waste power generating facilities require large areas for fuel storage, processing, and waste (ash) disposal. Additionally, operation of wood waste power generating facilities has environmental impacts on the aquatic environment and air.

According to the FDEP’s *Florida’s Energy Plan*, “Florida’s utilities purchase 506 megawatts of non-utility generator capacity fired by municipal solid waste, wood and wood waste, and waste heat. The scheduled expiration of contracts during the planning horizon will reduce the amount of firm renewable capacity to 167 megawatts by 2014, a decrease of 339 megawatts.” (Reference 9.2-010). However, these contracts may be re-negotiated, and the original purchased power supply may be maintained.

Biomass fuel can be used to co-fire with a coal power generating facility, decreasing cost from $0.023 to $0.021/kWh. This is only cost effective if biomass fuels are obtained at prices equal to or less than coal prices. In today's direct-fired biomass power generating facilities, generation costs are approximately $0.09/kWh. (Reference 9.2-029)

PEF entered into long-term contracts with Biomass Energy Group (116 MW) using an energy crop, E-grass, as its fuel source and Biomass Gas & Electric, LLC (BG&E) (150 MW) using gasification (that is, firing gas from wood products) to create electricity from clean, renewable energy sources (Reference 9.2-009). Because of the lack of resources and size of current wood waste power generating facilities, wood waste and biomass power generating facilities are non-competitive with a nuclear power generating facility at the LNP site.

9.2.2.6 Municipal Solid Waste

The initial capital costs for MSW power generating facilities are greater than those of comparable steam turbine technology at wood waste power generating facilities. This is due to the need for specialized waste separation and handling equipment.

The decision to burn MSW to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near future; however, it is unlikely that many landfills will begin converting waste to energy due to the numerous obstacles and factors that may limit the growth in MSW power generation. Chief among them are environmental regulations and public opposition to siting MSW power generating facilities.

Estimates suggest that the overall level of construction impacts from an MSW power generating facility should be approximately the same as that for a coal power generating facility. Additionally, MSW power generating facilities have the same or greater operational impacts, including impacts on the aquatic environment, air, and waste disposal. Some of these impacts would be MODERATE, but still larger than the proposed action.

As noted in ER Subsection 9.2.2.5, a portion of the Florida utilities' purchase of 506 MWe of non-utility generator capacity is from MSW. (Reference 9.2-010) Incineration can be implemented as an MSW-reduction method, generating energy and reducing the amount of waste by up to 90 percent in volume and 75 percent in weight (Reference 9.2-030).

The United States has approximately 89 operational MSW power generating facilities, generating approximately 2500 MWe, or around 0.3 percent of total national power generation. This comes to approximately 28 MWe per MSW power generating facility, which would not meet the proposed 2200-MWe baseload capacity of the LNP. Economic factors have limited new construction. Burning MSW produces nitrogen oxides (NO_x), sulphur dioxide (SO_2), and trace amounts of toxic pollutants, such as mercury compounds and dioxins. Power

generating facilities fueled by MSW, much like those fueled by fossil fuels, require land for equipment and fuel storage. The non-hazardous ash residue from the burning of MSW is typically deposited in landfills. (Reference 9.2-031) For these reasons, an MSW power generating facility is non-competitive with a nuclear power generating facility at the LNP site.

9.2.2.7 Energy Crops

In addition to wood and MSW fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive), and gasifying energy crops (including wood waste). None of these technologies have progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload capacity of 2200 MWe.

As noted in ER Subsection 9.2.2.5, PEF entered into a long-term contract with Biomass Energy Group (116 MW) using an energy crop, E-grass, as its fuel source (Reference 9.2-009).

The NRC suggests in NUREG-1427, Volume 1, that the overall construction and operation impacts from a power generating facility fueled by energy crops would be identical to those from a wood waste power generating facility. These systems have LARGE impacts on land use, due to the acreage needed to grow the energy crops.

The following information is provided in the FDEP's *Florida's Energy Plan* (Reference 9.2-010):

> The demand for ethanol is driven largely by the federal Energy Policy Act of 1992 (EPAct 1992), which required that public and private vehicle fleets operated within selected Metropolitan Statistical Areas (MSA) acquire and operate Alternative Fuel Vehicles (AFV). Florida contains nine designated MSAs in which the EPAct 1992 AFV standards apply. There are seven ethanol fueling stations in Florida, all of which are restricted for private fleet usage for EPAct 1992 compliance. The demand for ethanol-based fuels is expected to grow in coming years as at least one major automobile manufacturer (Ford Motor Company) has announced plans to increase production of AFVs by 2010.
>
> Florida currently has no operational ethanol plants in the state. Florida meets this demand for ethanol by imports from refineries outside of the state. Ethanol stations are subject to fire and building code requirements, regulated by the National Fire Protection Association and the Florida Department of Community Affairs respectively. Depending upon the size of the facility, additional permits for storm and wastewater and air emission permits may be required from [F]DEP.

Florida already imports ethanol for its ethanol fueling stations. It does not have the resources to use ethanol as an electricity generating source; therefore, a

power generating facility fueled by energy crops is non-competitive with a nuclear power generating facility at the LNP site.

9.2.2.8 Petroleum Liquids (Oil)

From 2002 to 2006, petroleum costs almost doubled, increasing by approximately 90 percent. Between 2004 and 2005, the average cost of petroleum increased by 51 percent (Reference 9.2-032). Nonetheless, from 2006 to 2007, production of electricity by power generating facilities fueled by oil increased by approximately 2 percent in Florida (Reference 9.2-033). In the GEIS, NRC staff estimated that construction of a 1000-MWe oil power generating facility would require approximately 50 ha (120 ac.) of land. Operation of these facilities would have environmental impacts, including impacts on the aquatic environment and air, which would be similar to those from a coal power generating facility.

Power generating facilities fueled by oil have one of the largest carbon footprints of all the power generating systems analyzed. Conventional oil power generating facilities result in emissions of greater than 650 grams of carbon dioxide equivalent per kilowatt hour (gCO_2eq/kWh). This is approximately 130 times higher than the carbon footprint of a nuclear power generating facility (approximately 5 gCO_2eq/kWh). Future developments, such as carbon capture and storage (CCS) and co-firing with biomass, have the potential to reduce the carbon footprint of oil-fired power generation. (Reference 9.2-034)

The economics, apart from fuel price, of power generating facilities fueled by oil are similar to those of facilities fueled by natural gas. Distillate oil can be used to run gas turbines in a combined-cycle system; however, the cost of distillate oil usually makes this combined-cycle system much less competitive where gas is available. Oil-fired power generation has experienced a significant decline since the early 1970s. Increases in world oil prices have forced utilities to use less expensive fuels; however, oil-fired power generation is still important in certain regions of the United States. Based on the above information, a power generating facility fueled by oil is non-competitive with a nuclear power generating facility at the LNP site.

9.2.2.9 Fuel Cells

Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, but progress has been slow. Today, the most widely marketed fuel cells cost approximately $4500/kilowatt (kW) of installed capacity. By contrast, a diesel generator costs $800 to $1500/kW of installed capacity, and a natural gas turbine can cost even less. The DOE has launched an initiative, the Solid State Energy Conversion Alliance, to bring about dramatic reductions in fuel cell cost. The DOE's goal is to cut costs to as low as $400/kW of installed capacity by the end of this decade, which would

make fuel cells competitive for virtually every type of power application. (Reference 9.2-035)

As market acceptance and manufacturing capacity increase, natural gas-fueled fuel cell power generating facilities in the 50- to 100-MWe range are projected to become available. This will not meet the proposed 2200-MWe baseload capacity of the LNP.

Currently, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. A fuel cell power generating facility is a non-competitive alternative to a nuclear power generating facility at the LNP site.

9.2.2.10 Coal

Coal power generating facilities provide the majority of electric power generating capacity in the United States. In 2000, they accounted for approximately 52 percent of the electric utility industry's total generation, including co-generation (Reference 9.2-036). According to the EIA, in 1990, more than 85 percent of all U.S. energy consumption for all purposes, including electricity, transportation, and heat, was supplied by petroleum, natural gas, and coal (Reference 9.2-037).

The FDEP's *Florida's Energy Plan* provides the following information (Reference 9.2-010):

> The United States has abundant low-cost coal reserves, and the price of coal for electric generation is likely to increase at a relatively slow rate. Even with recent environmental legislation, new coal capacity is expected to be an affordable technology for reliable, near-term development and for potential use as a replacement technology for nuclear power plants.
>
> The environmental impacts of constructing a typical coal-fired steam plant are well known because coal is the most prevalent type of central generating technology in the United States. The impacts of constructing a 1000-MW(e) coal plant at a greenfield site can be substantial, particularly if it is sited in a rural area with considerable natural habitat. An estimated 700 ha (1700 acres) would be needed, and this could amount to the loss of about 8 [square kilometers] km^2 (3 square miles [$mi.^2$]) of natural habitat and/or agricultural land for the plant site alone, excluding that required for mining and other fuel cycle impacts.

Coal power generation increased substantially during the 1980s in response to the oil price increases of the 1970s. Coal power generating facilities have traditionally been operated based on low forecasts of coal prices relative to oil or natural gas. However, coal power generating facilities are capital-intensive. Stricter environmental regulations may lead to increased capital investments at coal power generating facilities. In 2004, the state's utilities forecasted increases in coal-fired capacity of approximately 1100 MWe from the previous year's

forecast of new coal capacity to be added. The 2005 forecast estimated 3786 MWe of new coal capacity over the next ten years. (Reference 9.2-010)

A coal power generating facility's cost usually averages approximately $0.023/kWh. However, co-firing with inexpensive biomass fuel can decrease the cost to $0.021/kWh. This is only cost effective if biomass fuels are obtained at prices equal to or less than coal prices. (Reference 9.2-029)

Low-cost coal reserves are plentiful, and coal power generating facilities are able to produce the baseload capacity needed for the LNP site; therefore, a coal power generating facility is considered a competitive alternative to a nuclear power generating facility at the LNP site. This is assessed further in ER Subsection 9.2.3.

9.2.2.11 Natural Gas

The following information about natural gas power generation is provided in the FDEP's *Florida's Energy Plan* (Reference 9.2-010):

> Florida's utilities continue to project a substantial increase in natural gas-fired generation. Natural gas-fired generation, currently at 29.9 percent of total statewide energy consumption, is expected to increase to 44.4 percent over the next ten years. Of the approximately 19,100 megawatts in gross capacity additions projected in the state over the 2014 planning horizon, nearly 15,300 megawatts is anticipated to come from gas-fired capacity in the form of new combined cycle and combustion turbine (CT) units. Natural gas consumption forecasts do not include usage from proposed new Independent Power Producer (IPP) generating units.

The GEIS provides the following information:

> Most environmental impacts of constructing natural gas-fired plants should be approximately the same for steam, gas-turbine and combined-cycle plants. These impacts, in turn, generally will be similar to those of other large central generating stations. Land-use requirements for gas-fired plants are small at 45 ha (110 acres) for a 1000-MW(e) plant; thus land-dependent ecological, aesthetic, erosion, and cultural impacts should be small unless site-specific factors should indicate a particular sensitivity for some environmental resource. Siting at a greenfield location would require new transmission lines and increased land-related impacts, whereas co-locating the gas-fired plant with the retired nuclear plant would help reduce land-related impacts. Socioeconomic impacts should not be very noticeable because the highest peak work force of 1200 for steam plants is small for a central generating technology, and gas-fired plants are not usually sited in remote areas where community impacts would be most adverse. Also, gas-fired plants, particularly combined cycle and gas turbine, take much less time to construct than other plants.

Based on the well-known technology, fuel availability, and generally understood environmental impacts associated with constructing and operating a natural gas power generating facility, it is considered a competitive alternative and is examined further in ER Subsection 9.2.3.

9.2.2.12 Integrated Gasification Combined Cycle

IGCC is an emerging, advanced technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is substantially cleaner than conventional pulverized coal power generating facilities because major pollutants can be removed from the gas stream prior to combustion.

The IGCC alternative generates substantially less solid waste than the pulverized coal-fired alternative. The largest solid waste stream produced by IGCC installations is slag, a black, glassy, sand-like material that is potentially a marketable byproduct. Slag production is a function of ash content. The other large-volume byproduct produced by IGCC power generating facilities is sulphur, which is extracted during the gasification process and can be marketed rather than placed in a landfill. IGCC units do not produce ash or scrubber wastes.

At present, however, IGCC technology still has insufficient operating experience for widespread expansion into commercial-scale utility applications. Each major component of IGCC has been broadly utilized in industrial and power generation applications. But the integration of coal gasification with a combined cycle power block to produce commercial electricity as a primary output is relatively new and has been demonstrated at only a handful of facilities around the world, including five in the United States. Experience has been gained with the chemical processes of gasification, coal properties and their impact on IGCC design, efficiency, economics, etc.

However, system reliability is still relatively lower than conventional pulverized coal power generating facilities. There are problems with the integration between gasification and power production. For example, if there is a problem with gas cleaning, unclean gas can cause various types of damage to the gas turbine. (Reference 9.2-038)

Based on a Tampa IGCC unit, the DOE estimates indicate that overnight capital costs for coal-fired IGCC power generating facilities could be upwards of $1300/kW (Reference 9.2-038). The production cost of electricity from a coal-fired IGCC power generating facility is estimated to be approximately $0.033 to $0.045/kWh.

Because IGCC technology currently is not cost effective and requires further research to achieve an acceptable level of reliability, an IGCC power generating facility is a non-competitive alternative to a nuclear power generating facility at the LNP site.

9.2.3 ASSESSMENT OF REASONABLE ALTERNATIVE ENERGY SOURCES AND SYSTEMS

In its 2008 TYSP, PEF identified a broad suite of strategies to address power supply needs for the future. ER Subsection 9.2.2 discusses the pertinent options addressing the particular need for power to be fulfilled by the LNP. ER Subsection 9.2.3 further evaluates the environmental effects from the reasonable alternatives to the proposed action. For the reasons discussed, these alternatives are: coal power generation, natural gas power generation, and a combination of alternatives. The environmental impacts discussed in this subsection and summarized in Table 9.2-1 are general in nature and representative of the alternate energy sources. In cases where the overall environmental impacts of the alternative energy were not deemed preferable, costs of the alternative were not evaluated in detail. Overall, environmental justice impacts would depend upon the nearby population distribution and the location of the sites chosen. Construction activities would offer new employment possibilities, but could have negative impacts on the availability and cost of housing, which could disproportionately affect minority and low income populations.

9.2.3.1 Coal-Fired Generation

The NRC evaluated environmental impacts from coal-fired generation alternatives in the GEIS and concluded that construction impacts could be substantial, due in part to the large land area required (700 ha [1700 ac.] for a 1000-MWe coal power generating facility) and the large workforce needed. The NRC identified major adverse impacts from operations such as human health concerns associated with air emissions, waste generation, and losses of aquatic biota due to cooling water withdrawals and discharges.

9.2.3.1.1 Air Quality

The air quality impacts of coal power generation are considerably different from those of nuclear power. A coal power generating facility would emit SO_2 (as sulphur oxides [SO_x] surrogate), NO_x, particulate matter (PM), and carbon monoxide (CO), all of which are regulated pollutants. Air quality impacts from fugitive dust, water quality impacts from acidic runoff, and aesthetic and cultural resource impacts are all potential adverse consequences of coal mining.

Air emissions were estimated for a coal power generating facility based on the emission factors contained in the U.S. Environmental Protection Agency's (USEPA) *AP 42* (Reference 9.2-039). The emissions from this facility are based on a power generation capacity of 2200 MWe.

The coal power generating facility assumes the use of bituminous coal fired in a circulating fluidized bed combustor (FBC). The sulphur content of the coal was assumed to be 2 percent by weight. Emissions control included the use of lime in the combustor unit, a wet scrubber system to control acid gas emissions, selective catalytic reduction to minimize NO_x emissions, and a baghouse to

control PM. Table 9.2-2 summarizes the air emissions produced by a 2200-MWe coal power generating facility.

Coal power generating facilities have the largest carbon footprint of all the power generation systems analyzed. Conventional coal power generating facilities result in emissions of greater than 1000 gCO_2eq/kWh. This is approximately 200 times higher than the carbon footprint of a nuclear power generating facility (approximately 5 gCO_2eq/kWh). Lower emissions can be achieved by using new gasification power generating facilities (less than 800 gCO_2eq/kWh), but this is still an emerging technology and not as widespread as proven combustion technologies. Future developments, such as CCS and co-firing with biomass, have the potential to reduce the carbon footprint of coal power generation. (Reference 9.2-034)

Operating impacts of new coal power generating facilities would be substantial for several resources. Concerns over adverse human health effects from coal combustion have led to important federal legislation in recent years, such as the Clean Air Act Amendments (CAAA). Although the situation appears to be improving, health concerns remain. Air quality would be impacted by the release of CO_2, regulated pollutants, and radionuclides. Public health risks, such as cancer and emphysema, are considered likely results. CO_2 has been identified as a leading cause of global warming. SO_2 and NO_x have been identified with acid rain. Substantial solid waste, especially fly ash and scrubber sludge, would be produced and would require constant management. Losses to aquatic biota would occur through impingement and entrainment and discharge of cooling water to natural water bodies. Socioeconomic benefits can be considerable for surrounding communities in the form of several hundred jobs, substantial tax revenues, and revenue generated by purchases for power generating facility construction and maintenance, as well as purchases made within the surrounding communities by the power generating facility employees.

In the GEIS, the NRC implies that air emission impacts from fossil fuel generation are greater than nuclear power generating facility air emission impacts. The NRC notes that human health effects from coal combustion are also greater. The NRC also mentions global warming and acid rain as potential impacts. Therefore, air impacts would be MODERATE to LARGE.

9.2.3.1.2 Waste Management

Coal power generating facilities would produce substantial solid waste (especially fly ash and scrubber sludge), which would require constant management. With proper placement of the LNP, coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources.

An estimated 8900 ha (22,000 ac.) of land for mining coal and disposing waste could be committed to supporting a coal power generating facility during its operational life.

As a result of the above mentioned factors, waste management impacts would be MODERATE.

9.2.3.1.3 Other Impacts

Construction of a 1000-MWe coal power generating facility could affect as much as 700 ha (1700 ac.) of land and associated terrestrial habitat. Additional land would be needed for waste disposal. As a result, land use impacts would be MODERATE.

Impacts to aquatic resources and water quality would be minimized but could be characterized as MODERATE due to the coal power generating facility's use of a new cooling water system. Losses to aquatic biota would occur through impingement and entrainment and discharge of cooling water to natural water bodies.

New power generating facility structures and tall stacks potentially visible for 64 (km) (40 mi.) in a relatively non-industrialized area would need to be constructed, along with a possible cooling tower and associated plumes. As a result, aesthetic impacts would be LARGE.

Ecological resources impacts would be MODERATE as a result of the permanent impact to wetlands within the project footprint. There are also approximately 402.1 ha (993.6 ac.) of wetlands in the 1257-ha (3105-ac.) project area, which may be temporarily or permanently impacted.

Construction is not expected to adversely affect the regional population of any protected plant or animal species. Native habitats on the LNP site have been significantly altered through silvicultural operations, and mobile-listed species are likely to preferentially use less disturbed habitats on adjacent conservation lands. Impacts on threatened and endangered species would be SMALL

Cultural resources impacts would be SMALL as a result of siting a coal power generating facility in an area already disturbed by silvicultural operation.

Positive socioeconomic impacts would result from the approximate 250 people needed to operate the coal power generating facility, and several hundred ancillary mining jobs. Additional tax revenues would also be associated with the coal mining. As a result, socioeconomic beneficial impacts would be MODERATE.

As a result of increased safety technologies, accident impacts would be SMALL.

As a result of increased air emissions and public health risks, human health impacts would be MODERATE.

As discussed in ER Subsection 4.4.3, analysis of census data indicates that no disproportionate impacts on low income or minority populations in the region (as defined by the U.S. Department of Health and Human Services) will occur.

Positive impacts from construction of a coal power generating facility include the potential for job opportunities to minority and/or low income populations. Therefore, no disproportionately high or adverse impacts on minority or low income populations would be anticipated as a result of construction. Environmental justice impacts would be SMALL.

9.2.3.1.4 Summary

In order for a coal power generating facility constructed on the LNP site to be competitive with a nuclear power generating facility on the same site, the coal facility would need to generate power in excess of 2200 MWe. The nuclear facility requires a dry-land footprint of 120 ha (300 ac.), whereas the coal facility would require a dry-land footprint of 700 ha (1700 ac.). Therefore, a 2200-MWe coal power generating facility would not be viable with the land area currently available at the LNP site.

9.2.3.2 Natural Gas Generation

Most environmental impacts of constructing natural gas power generating facilities would be approximately the same for steam, gas-turbine, and combined-cycle power generating facilities. These impacts might be similar to those of other large central generating stations. The environmental impacts of operating natural gas power generating facilities are generally less than those of other fossil fuel technologies of equal power generation capacity. Consumptive water use is about the same for steam power generating facilities as for alternate power generation technologies. Water consumption is likely to be less for natural gas power generating facilities.

9.2.3.2.1 Air Quality

Natural gas is a relatively clean-burning fossil fuel. Also, because the heat recovery steam generator does not receive supplemental fuel, the combined-cycle operation is highly efficient (56 percent compared to 33 percent for the coal-fired alternative). Therefore, the natural gas power generation alternative would release similar types of emissions, but in lesser quantities than the coal alternative. Control technology for natural gas-fired turbines focuses on the reduction of NO_x emissions.

Generally, air quality impacts for all natural gas technologies are less than for other fossil fuel technologies because fewer pollutants are emitted, and SO_2, a contributor to acid precipitation, is not emitted at all.

Air emissions were estimated for a natural gas power generating facility based on the emission factors contained in the USEPA's *AP 42* (Reference 9.2-039). The emissions from this facility are based on a power generation capacity of 2200 MWe.

Current natural gas power generation has a carbon footprint around half that of coal (approximately 500 gCO_2eq/kWh) because natural gas has a lower carbon

content than coal. This is approximately 100 times higher than the carbon footprint of a nuclear power generating facility (approximately 5 gCO_2eq/kWh). Like power generating facilities fueled by coal, those fueled by natural gas could co-fire biomass to reduce carbon emissions in the future. (Reference 9.2-034)

The natural gas power generating facility assumes the use of a combined-cycle gas turbine generator (GTG). Water injection is used to control NO_x emissions. Table 9.2-2 summarizes the air emissions produced by a 2200-MWe natural gas power generating facility. Based on emissions generated from a natural gas power generating facility, air quality impacts would be MODERATE.

9.2.3.2.2 Waste Management

Natural gas power generation would result in almost no waste generation, producing minor (if any) impacts; therefore, impacts associated with waste management would be SMALL.

9.2.3.2.3 Other Impacts

Construction of the natural gas power generating facility's power block would disturb approximately 24 ha (60 ac.) of land and associated terrestrial habitat, and 4 ha (10 ac.) of land would be needed for pipeline construction. As a result, land use impacts would be SMALL.

There are potential impacts to aquatic biota through impingement and entrainment and increased water temperatures in receiving water bodies. Water consumption is likely to be less for gas turbine power generating facilities. As a result, water quality impacts would be SMALL.

A new turbine building and exhaust stacks would need to be constructed. A closed-cycle cooling alternative could also introduce plumes. As a result, aesthetic impacts would be MODERATE.

Ecological resources impacts would be MODERATE as a result of the permanent impact to wetlands within the project footprint. There are approximately 402.1 ha (993.6 ac.) of wetlands in the 1257-ha (3105-ac.) project area, a portion of which may be temporarily or permanently impacted within the construction footprint.

Construction is not expected to adversely affect the regional population of any protected plant or animal species. Native habitats on the LNP site have been significantly altered through silviculture operations, and mobile-listed species are likely to preferentially use less disturbed habitats on adjacent conservation lands. Impacts on threatened and endangered species would be SMALL.

Historic and cultural resources impacts would be SMALL as a result of siting a natural gas power generating facility in an already disturbed area where another power generating facility is already located.

Socioeconomic impacts would result from the approximate 150 people needed to operate a natural gas power generating facility, as estimated in the GEIS. As a result, socioeconomic impacts would be SMALL.

Due to increased safety technologies, accidents and human health impacts would be SMALL.

As discussed in ER Subsection 4.4.3, analysis of census data indicates that no disproportionate impacts on low income or minority populations in the region (as defined by the U.S. Department of Health and Human Services) will occur. Positive impacts from construction of a natural gas power generating facility include the potential for job opportunities to minority and/or low income populations. Therefore, no disproportionately high or adverse impacts on minority or low income populations would be anticipated as a result of construction. Environmental justice impacts would be SMALL.

9.2.3.2.4 Summary

A power generating facility fueled by natural gas at the LNP site would require less land area than a facility fueled by coal, but more land area than a nuclear power generating facility. The natural gas power generation alternative alone would require 45 ha (110 ac.) of land for a 1000-MWe generating capacity. An additional 1500 ha (3600 ac.) of land would be required for wells, collection stations, and pipelines to bring the natural gas to the power generating facility. Air quality would be lower and the carbon footprint larger than those of a nuclear power generating facility. Human health risks are higher for a natural gas power generating facility compared to those of a nuclear power generating facility. Therefore, constructing a natural gas power generating facility would not be an environmentally preferable alternative for the LNP site.

9.2.3.3 Combination of Alternatives

The LNP will have a baseload capacity of approximately 2200 MWe. Any alternative or combination of alternatives would be required to generate the same baseload capacity.

Because of the intermittent nature of the resource and the lack of cost-effective technology, wind and solar power generation are not sufficient on their own to generate the equivalent baseload capacity or output of the LNP, as discussed in ER Subsections 9.2.2.1 and 9.2.2.4. As shown in ER Subsections 9.2.3.1 and 9.2.3.2, fossil fuel power generating facilities generate baseload capacity, but related environmental impacts are greater than those of a nuclear power generating facility.

A combination of alternatives may be possible, but should be sufficiently complete, competitive, and viable to provide the NRC with appropriate comparisons to the LNP.

9.2.3.3.1 Determination of Alternatives

Many possible combinations of alternatives could theoretically satisfy the baseload capacity requirements of the LNP. Some combinations can include renewable sources, such as wind and solar energies. Wind and solar energies do not, by themselves, provide a reasonable alternative energy source to the baseload power to be produced by the LNP. However, wind and solar energies, in combination with fossil fuel power generation, may be a reasonable alternative to nuclear power generation produced by the LNP.

The LNP will operate as a rate-regulated part of a traditional vertically-integrated utility. Therefore, when examining combinations of alternatives to the LNP, the ability to generate baseload power must be the determining factor when analyzing the suitability of the combination. This subsection reviews the ability of a combination alternative to have the capacity to generate baseload power equivalent to the LNP.

When examining a combination of alternatives that would meet the business objectives similar to those of the LNP, any combination that includes a renewable power source (either all or part of the capacity of the LNP) must be combined with a fossil fuel power generating facility that has equivalent generating capacity to the LNP. This combination would allow the fossil fuel portion of the combination alternative to produce the needed power if the renewable resource is unavailable and to be displaced when the renewable resource is available. For example, if the renewable portion is some amount of potential wind power generation and that resource became available, then the output of the fossil fuel power generation of the combination alternative could be lowered to offset the increased generation from the renewable portion. This power generating facility, or facilities, would satisfy business objectives similar to those of the LNP because it would be capable of supporting fossil fuel baseload power.

CO_2 is the principal greenhouse gas from power generating facilities that combust solid or liquid fuels. If the source of the carbon is biomass or derived from biomass (ethanol), then the impact is carbon neutral. If the source of the carbon is fossil fuel, then there is a net increase in atmospheric CO_2 concentrations.

Coal and natural gas power generating facilities have been examined as having environmental impacts that are equivalent to or greater than the impacts of the LNP. Based on the comparative impacts of these two technologies, as shown in Table 9.2-1, it can be concluded that a natural gas power generating facility would have less of an environmental impact than a comparably sized coal power generating facility. In addition, the operating characteristics of natural gas power generation are more amenable to the kind of load changes that may result from inclusion of renewable generation, such that the baseload generation output of 2200 MWe is maintained. “Clean Coal” power generation technology could decrease the air pollution impacts associated with burning coal for power. Demonstration projects show that clean coal programs reduce NO_x, SO_x, and particulate emissions. However, the environmental impacts from burning coal

using these technologies, if proven, are still greater than the impacts from natural gas. (Reference 9.2-040) Therefore, for the purpose of comparing the impacts from a combination of alternatives to the LNP, a power generating facility equivalent to the LNP will be used in the environmental analysis of combination alternatives. The analysis accounts for the reduction in environmental impacts from a natural gas power generating facility when generation from the facility is displaced by the renewable resource. Additionally, the renewable portion of the combination alternative would be any combination of renewable resources that could produce power equal to or less than the LNP at a point when the resource was available. This combination of renewable energy and natural gas power generation represents a viable mix of non-nuclear alternative energy sources.

Many types of alternatives can be used to supplement wind energy, notably solar energy. PV cells are another source of solar energy that would complement wind power generation by using the sun during the day to produce energy, while wind turbines use windy and stormy conditions to generate power. Wind and solar power generating facilities in combination with fossil fuel power generating facilities (coal, petroleum) could also be used to generate baseload power. However, wind and solar power generating facilities in combination with fossil fuel power generating facilities would have equivalent or greater environmental impacts relative to a nuclear power generating facility at the LNP site. Similarly, wind and solar power generating facilities in combination with fossil fuel power generating facilities would have costs higher than a nuclear power generating facility at the LNP site. Therefore, wind and solar power generating facilities in combination with fossil fuel power generating facilities are non-competitive with a nuclear power generating facility at the LNP site.

9.2.3.3.2 Environmental Impacts

The environmental impacts associated with a natural gas power generating facility sized to produce power equivalent to the LNP are discussed in ER Subsection 9.2.3.2 and subsequent subsections. Depending on the level of potential renewable output included in the combination alternative, the level of impact of the natural gas portion will be comparably lower. If the renewable portion of the combination alternative were not enough to displace the power produced by the natural gas power generation, then there would be some level of impact associated with the natural gas power generating facility. Consequently, if the renewable portion of the combination alternative were enough to fully displace the output of the natural gas portion, then, when the renewable resource is available, the output of the natural gas power generating facility could be eliminated, thereby eliminating its operational impacts. Determination of the types of environmental impacts of these types of “hybrid” power generating facilities or combination of facilities can be surmised from analysis of past projects.

For instance, in 1984, Luz International, Ltd. built the Solar Electric Generating System (SEGS) plant in the California Mojave Desert. The SEGS technology consists of modular parabolic-trough solar collector systems, which use oil as a heat-transfer medium. One unique aspect of the Luz technology is the use of a natural gas-fired boiler as an oil heater to supplement the thermal energy from

the solar field or to operate the plant independently during evening hours. SEGS I was installed at a total cost of $62 million (approximately $4500/kW) and generates power at $0.24/kWh (in 1988 real levelized dollars). The improvements incorporated into the SEGS III-VI plants (approximately $3400/kW) reduced generation costs to approximately $0.12/kWh, and the third-generation technology, embodied in the 80-MWe design at an installed cost of $2875/kW, reduced power costs still further, $0.08 to $0.10/kWh. Because solar energy is not a concentrated source, the dedicated land requirement for the Luz plants (2 ha/MWe [5 ac/MWe]) is large compared to conventional plants). (Reference 9.2-041) Parabolic trough plants require a significant amount of land; typically, the use is pre-emptive because parabolic troughs require the land to be graded level. Approximately 3 ha/MWe (5ac/MWe) is necessary for concentrating solar power technologies such as trough systems.

The environmental impacts associated with solar and wind power generating facilities equivalent to the LNP are discussed in ER Subsections 9.2.2.1 and 9.2.2.4. It is reasonable to expect that the impacts associated with an individual unit of a smaller size would be similarly scaled. If the renewable portion of the combination alternative is unable to generate an equal amount of power as the LNP, then the combination alternative would have to rely on the natural gas portion to meet the equivalent capacity of the LNP. Consequently, if the renewable portion of the combination alternative has a potential output that is equal to that of the LNP, then the impacts associated with the natural gas portion of the combination alternative would be lower, but the impacts associated with the renewable portion would be greater. The greater the potential output of the renewable portion of the combination alternative, the closer the impacts would approach the level of impacts associated with the LNP. The natural gas power generating facility alone has impacts that are larger than the LNP (see Table 9.2-1); some environmental impacts of renewable sources are also greater than or equal to the LNP. The combination of a natural gas power generating facility and wind and/or solar power generating facilities would have environmental impacts that are equal to or greater than those of a nuclear power generating facility.

All of the potential environmental impacts from a nuclear power generating facility at the LNP site and all of the potential impacts from a natural gas power generating facility would be SMALL, except for air quality impacts from a facility fueled by natural gas (which would be MODERATE). Potential air quality impacts from the use of wind and/or solar power generating facilities in combination with a natural gas power generating facility would be SMALL, and therefore, would be equivalent to the air quality impacts from a nuclear power generating facility.

All of the potential environmental impacts of a nuclear power generating facility at the LNP and all of the potential impacts from wind and/or solar power generating facilities would be SMALL, except for land use and aesthetic impacts from wind and/or solar power generating facilities (which would range from MODERATE to LARGE). The use of a natural gas power generating facility in combination with wind and/or solar power generating facilities would reduce the land usage and aesthetic impacts from the wind and solar facilities. However, at best, those

impacts would be SMALL, and therefore would be equivalent to the land use and aesthetic impacts from a nuclear power generating facility.

Therefore, the combination of wind and/or solar power generating facilities with a natural gas power generating facility is not competitive to a nuclear power generating facility at the LNP site.

9.2.3.3.3 Summary

Wind and/or solar power generating facilities in combination with a natural gas power generating facility could be used to generate baseload power and would serve the purpose of the LNP. However, this combination would have equivalent or greater environmental impacts than a nuclear power generating facility at the LNP site. Additionally, this combination would have higher costs and larger land requirements than a nuclear power generating facility at the LNP site. Therefore, wind and/or solar facilities in combination with a natural gas power generating facility is not environmentally preferable to a nuclear power generating facility at the LNP site.

9.2.4 CONCLUSION

PEF has determined that neither a power generating facility fueled by coal, nor one fueled by natural gas, nor a combination of alternatives, including wind and/or solar power generating facilities, would provide an appreciable reduction in overall environmental impacts relative to a nuclear power generating facility. Furthermore, each of these types of alternatives, with the possible exception of the combination alternative, would entail a significantly greater environmental impact on air quality than would a nuclear power generating facility. However, to achieve a SMALL air quality impact in the combination alternative, a MODERATE to LARGE impact on land use would result. Therefore, PEF concludes that neither a power generating facility fueled by coal, nor one fueled by natural gas, nor a combination of alternatives, would be environmentally preferable to a nuclear power generating facility at the LNP site. Furthermore, these alternatives would have higher economic costs, and those costs would ultimately be borne by the rate-payers.

Additionally, the FPSC stated that the two main components of retail rates are base rates and fuel costs. Base rates are relatively stable. Fuel costs are passed through to retail customers through PEF's fuel adjustment clause. Since fuel costs are more volatile, they are adjusted annually to reflect actual costs. Evidence indicates that as PEF's system has become more reliant on natural gas for energy generation, retail rates have increased and fuel costs have become a greater portion of rates.

The FPSC further notes that if PEF continues becoming more reliant on natural gas, then its ratepayers may experience higher rates in the future with the majority of costs to be recovered through PEF's fuel adjustment charge. Consequently, FPSC states that having a diverse fuel mix could serve as a hedge against fuel price volatility.

Additionally, the FPSC acknowledges that Section 403.519(4)(b), F.S., suggests that there is the need for more fuel diversity, as well as a reduction of Florida's reliance on natural gas and fuel oil. The addition of LNP will serve to reduce PEF's future dependence on natural gas and fuel oil.

The FPSC suggests that the addition of LNP will increase the percentage of total nuclear generation on PEF's system, which will give PEF's customers a more diversified, price-stable fuel portfolio. The FPSC further suggests that without LNP, PEF will rely on more volatile-priced fossil fuels for 85 percent of its energy generation. Moreover, gas and oil will contribute over 60 percent of the total energy generated, including some around-the-clock baseload energy generation. (Reference 9.2-044)

As part of the economic evaluation of LNP, the FPSC notes that PEF forecasted the prices of natural gas, residual fuel oil, coal, and distillate fuel oil and that the forecast period extends out to the year 2066. The differential between forecasted natural gas and nuclear fuel prices is a key driver in the selection of PEF's future generation options.

The FPSC indicates that PEF's basic fossil fuel forecasts are its medium price forecasts. PEF relied upon two economic and energy forecasting firms, PIRA Energy Group and Global Insight, to provide the basic price forecast. The natural gas and oil price forecast period is through 2020 for PIRA and 2026 for Global Insight. Beyond these periods, PEF employed a price escalator for the forecasts.

For residual oil, natural gas, and coal, PEF developed high and low price forecasts based on the 90 percentile above and below the basic, mid-reference fuel price forecast. The high and low price forecasts specify a range that allows for possible price outcomes and the uncertainty of price forecasts in the economic analysis. Although PEF provided high and low price forecasts in this filing, PEF expects that the high price forecast is more likely than the low price forecast, because of the potential impacts of changes in environmental policy.

The FPSC states that PEF's fuel price forecasts are reasonable for purposes of evaluating its expansion plans. The forecast not only relies on two recognized consultants but also compares its forecast to the forecast in the Annual Energy Outlook published by the Energy Information Administration. The FPSC also notes that PEF's fossil fuel price forecast is conservative in comparison with various third-party forecasts. Higher forecasted gas prices cause the planned nuclear units to be more cost-effective in the economic analysis.

The FPSC points out that the nuclear fuel price forecast provided by PEF is based on projections by market consultants who study nuclear fuel supply and demand worldwide and the forecast covers the four steps needed to make nuclear fuel: uranium mining, conversion, enrichment, and fabrication. The FPSC also notes that PEF expects nuclear fuel prices to be less volatile than fossil fuel prices and expects this trend to continue.

Additionally, the FPSC acknowledges that PEF included a reasonable level of

environmental compliance costs associated with LNP. The major air emission effluents considered for a power generating unit are SO_2, NO_x, mercury (Hg), and CO_2. The FPSC points out that, in its need filing, PEF included the compliance costs of all four major air emissions in its economic analysis. The environmental compliance cost estimates were used to form each scenario by establishing the system emissions of air effluent and applying the forecast allowance price to the total emission. When the economic results for the scenarios were compared, the differential production costs, including fuel and environmental compliance costs, were calculated to establish the appropriate economic benefits of all of the scenarios analyzed.

The FPSC believes that since nuclear generation is a non-carbon emitting generation source, an increase of future environmental compliance costs associated with CO_2 would also increase the overall cost-effectiveness of the LNP. The FPSC further states that it compared the environmental inputs (the SO_2, NO_x, Hg and CO_2 emission allowance price projections) with the cost-effectiveness analysis of LNP and found that the SO_2, NO_x, and Hg allowance price projections used by PEF are reasonable. The FPSC also found that the CO_2 price projections used in the cost-effective analysis represent a reasonable range of forecasts based upon CO_2 compliance cost studies available to PEF at the time that the cost-effective analysis was undertaken. (Reference 9.2-044)

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Table 9.2-1 (Sheet 1 of 2)
Impacts Comparison Table

Impact Category	Proposed Action (LNP)	Coal-Fired Power Generation	Gas-Fired Power Generation	Combinations of Alternatives
Land Use	**SMALL**	**MODERATE**	**SMALL**	**SMALL to MODERATE**
Air Quality	**SMALL**	**MODERATE to LARGE**	**MODERATE**	**SMALL to LARGE**
Water Use and Quality	**SMALL**	**MODERATE**	**SMALL**	**SMALL to MODERATE**
Ecology	**SMALL to MODERATE**	**MODERATE**	**MODERATE**	**MODERATE**
Waste Management	**SMALL**	**MODERATE**	**SMALL**	**SMALL to MODERATE**
Socioeconomics	**SMALL**	**MODERATE**	**SMALL**	**SMALL to MODERATE**
Human Health	**SMALL**	**MODERATE**	**SMALL**	**SMALL TO MODERATE**
Historic and Cultural Resources	**SMALL**	**SMALL**	**SMALL**	**SMALL**
Environmental Justice	**SMALL**	**SMALL**	**SMALL**	**SMALL**

Table 9.2-1 (Sheet 2 of 2)
Impacts Comparison Table

Impact Category	Proposed Action (LNP)	Coal-Fired Generation	Gas-Fired Generation	Combinations of Alternatives
Aesthetics	**SMALL**	**LARGE**	**MODERATE**	**SMALL to LARGE**
Threatened and Endangered Species	**SMALL**	**SMALL**	**SMALL**	**SMALL**
Accidents	**SMALL**	**SMALL**	**SMALL**	**SMALL**

Notes:

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

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

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

Table 9.2-2
Air Emissions from Alternative Power Generation Facilities

Fuel	Coal	Natural Gas
Combustion Facility	Circulating FBC	Combined-Cycle GTG
Generation Capacity	2200 MWe	2200 MWe
Annual Air Pollutant Emissions		
SO_2	571 metric tons (629 tons)	24 metric tons (26 tons)
NO_2	1009 metric tons (1112 tons)	909 metric tons (1002 tons)
CO	6051 metric tons (6671 tons)	210 metric tons (231 tons)
PM	29 metric tons (32 tons)	46 metric tons (51 tons)
PM – less than 10 microns	21 metric tons (23 tons)	33 metric tons (36 tons)
CO_2eq	2,379,048 metric tons (2,622,986 tons)	776,699 metric tons (856,338 tons)

Notes:

CO = carbon monoxide
CO_2eq = carbon dioxide equivalent
FBC = fluidized bed combustor
GTG = gas turbine generator
MWe = megawatt electric
NO_2 = nitrogen dioxide
PM = particulate matter
SO_2 = sulphur dioxide

Source: Reference 9.2-038

9.3 SITE SELECTION PROCESS

In accordance with NUREG-1555, Environmental Standard Review Plan (ESRP) 9.3, this section identifies and compares alternatives to the proposed site for the construction and operation of the LNP. The objective of this evaluation is to verify that there are no environmentally preferred sites that are “obviously superior” to the proposed site for the construction and operation of the LNP.

9.3.1 SITE COMPARISON AND SELECTION PROCESS

The components of the site comparison process, as defined in ESRP 9.3, include the ROI, candidate areas, potential sites, candidate sites, alternative sites, and proposed site. The components are defined as follows:

- The ROI is the largest area considered and is the geographic area within which sites suitable for the size and type of nuclear power generating facility proposed by the applicant are evaluated. The basis for an ROI can be the state in which the proposed site is located, or the relevant service area for the proposed facility.

- Candidate areas refer to one or more areas within the ROI that remain after unsuitable areas (for example, due to high population, lack of water, fault lines, distance to transmission lines) have been removed. These can initially be determined with reconnaissance level information.

- Potential sites are locations within candidate areas. Whether or not a potential site is evaluated further depends on criteria such as general safety issues, environmental criteria, transmission capability, and market analysis.

- Candidate sites are those potential sites that are within the ROI and that are considered in the comparative evaluation of sites to be among the best that can reasonably be considered for the siting of a nuclear power generating facility. The candidate sites include the proposed site and the alternative sites. These are sites that would be expected to be granted construction permits and operating licenses. Candidate sites are chosen from the list of potential sites using a defined site selection methodology.

  ESRP 9.3 provides the following information regarding minimum criteria for an area to be considered a candidate site:

  - Consumptive use of water should not cause significant adverse effects on other users.

  - The proposed action should not jeopardize Federal, State, and affected Native American tribal listed threatened, endangered, or candidates species or result in the destruction or adverse modification of critical habitat.

- There should not be any potential significant impacts to spawning grounds or nursery areas of populations of important aquatic species on Federal, State, and affected Native American tribal lists.

- Discharges of effluents into waterways should be in accordance with Federal, State, regional, local, and affected Native American tribal regulations and would not adversely affect efforts to meet water-quality objectives.

- There would be no preemption of or adverse effects on land specially designated for environmental, recreational, or other special purposes.

- There would not be any potential significant impact on terrestrial and aquatic ecosystems, including wetlands, which are unique to the resource area.

- There are no other significant issues that preclude the use of the site.

- Alternative sites are those candidate sites that are specifically compared to the proposed site to determine if there is an obviously superior site for the location of the new nuclear power generating facility.

- The proposed site is the candidate site that is submitted to the NRC by the applicant as the proposed location for a nuclear power generating facility.

The site comparison process, as defined in ESRP 9.3, first evaluates the ROI and identifies candidate areas. Within the candidate areas, potential sites are chosen. From the potential sites, candidate sites are chosen and evaluated. Candidate sites include the proposed site and the alternative sites. Next, the alternative sites are compared to the proposed site to determine if there are environmentally preferred sites among the alternative sites. The basic constraints and limitations of the site selection process are the currently implemented rules, regulations, and laws within the federal, state, and local agency levels. These provide a comprehensive basis and an objective rationale under which this selection process is performed.

The review of alternative sites consists of a two-part sequential test for whether a site is obviously superior to the proposed site. The first stage of the test determines whether there are environmentally preferred sites among the alternative sites. During this stage, the standard is one of “reasonableness,” considering whether the applicant has performed the following:

- Identified reasonable alternative sites.

- Evaluated the likely environmental impacts of construction and operation at these sites.

- Used a logical means of comparing sites that lead to the applicant's selection of the proposed site.

The second stage of the alternative site review process considers economics, technology, and institutional factors among the environmentally preferred sites to determine if any are obviously superior to the proposed site. If there is no environmentally preferred or obviously superior site, the proposed site prevails. If any environmentally preferred sites are identified after the review process, the estimated "costs" (environmental, socioeconomic, cost, construction time, and others identified in NUREG-1555) of the new nuclear power generating facility at the proposed site and the environmentally preferred alternative sites are compared. The results of this benefit-cost balance are used to determine if any environmentally preferred site can be shown to be obviously superior to the applicant's proposed site.

As indicated in ESRP 9.3, "The criterion for making this determination is that one or more important aspects, either singly or in combination, of a reasonably available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site, and the alternative site does not have offsetting deficiencies."

PEF followed the NUREG-1555 site comparison and selection process in order to select a proposed site as the geographic location for the PEF COLA. The PEF site selection process is discussed in the following subsection.

9.3.2 PROGRESS ENERGY FLORIDA SITE SELECTION PROCESS OVERVIEW

This subsection provides an overview of the site selection process implemented by PEF to identify a proposed site and alternative sites as potential geographic locations for the siting of a nuclear power generating facility, and to compare the sites to ascertain if any of the alternative sites were environmentally preferable (and thus, obviously superior) to the proposed site. The objectives of the selection procedure were to identify a geographic location for a nuclear power generating facility that: 1) meets PEF's business objectives for the COL project, 2) satisfies applicable NRC site suitability requirements, and 3) is compliant with NEPA requirements regarding the consideration of alternative sites (Reference 9.3-001).

PEF adopted the Electric Power Research Institute (EPRI) *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application*, dated March 2002, in its site selection process study (Reference 9.3-002).

In accordance with the EPRI Siting Guide, the PEF siting evaluation and selection process involved a four-step procedure in which the sequential

application of exclusionary, avoidance, and suitability criteria (including site reconnaissance, topographic data collection), and technical screening by application of scoring and associated weighting factors were applied to the suitability criteria in order to select a preferred site for the location of the proposed nuclear power generating facility. The exclusionary, avoidance, and suitability criteria address a full range of considerations important in nuclear power generating facility siting, including health and safety, environmental, socioeconomic, land use, and engineering and cost aspects. (Reference 9.3-002)

The EPRI Siting Guide provides the following information about the siting evaluation and selection process (Reference 9.3-002):

Step 1
The ROI is first screened using exclusionary criteria to eliminate those areas in which it is not feasible to site a nuclear power facility due to regulatory, institutional, facility design, and/or environmental constraints. Further screening is performed using avoidance criteria to eliminate feasible -- but less favorable -- areas, thus further reducing the area remaining under consideration. Should this process result in an area too small for identification of an adequate number of potential sites, the avoidance criteria can be relaxed and the process repeated.

Conversely, if the area remaining is too large and additional avoidance criteria can be defensibly applied, the criteria may be made more stringent, and the process repeated. The avoidance screening process is repeated until the candidate areas identified are adequate (but not unreasonably large) to present multiple siting options or until no more restrictive avoidance criteria can be justifiably applied.

Step 2
Candidate areas identified in Step 1 are further screened using refined exclusionary and avoidance criteria to identify optimum areas for a facility. As in Step 1, screening is conducted as an iterative process with the application of refined criteria until an appropriate number of potential sites can be identified. A key difference in the application of exclusionary and avoidance criteria in Step 2 is the introduction of data that is at a more refined scale (1:24,000 versus 1:250,000); therefore, information at this scale may not have been considered in Step 1. A variety of protected lands, population features, ecologically protected resources (e.g., wetlands), and resources set aside for cultural or historical reasons are at such a scale that (because of their limited areal extent) they would not be considered as part of Step 1. These could, for example, include resources that are identified at the state, county, or local institutional levels. However, circumventing these "smaller" sized exclusionary and avoidance features is equally as valid as avoiding the larger features considered in Step 1. Accordingly, the consideration of these more detailed features would be essential to the process of reducing candidate areas to potential sites.

From the application of these exclusionary and avoidance features, potential sites are identified as discrete parcels of land approximating the size of an actual facility site (e.g., 2-5 times the minimum land area required). While areal screening is used to identify areas within which potential sites can be identified, professional judgment should be incorporated in defining potential sites to ensure that they are feasible, optimized to the degree possible, and allow some flexibility in the site layout process.

Steps 1 and 2 of the siting process are based on the philosophy of driving away from (or avoiding) those features and conditions that would not be consistent with requirements of obtaining a site permit. The emphasis is on ensuring that those areal features that should not and can not be associated with a site are no longer being considered; the focus is on eliminating large tracts of land because they do not exhibit conditions consistent with a potential site. The remaining land areas are presumed acceptable in terms of continued consideration, because these parcels do not contain the "undesirable" features. Once potential sites are identified (at the completion of Step 2), a transition in the selection approach takes place. The emphasis becomes one of evaluating, as integrated entities, the acceptability of discrete parcels of land that could be suitable sites. The process then becomes one of comparing sites and identifying a site that possesses the most favorable set of conditions for siting a nuclear power facility.

Step 3

The objective of Step 3 is to identify and rank a relatively small number of candidate sites (from the list of potential sites) for more detailed study. This is principally performed using a series of suitability criteria based on published data and reconnaissance-level information. Application of these criteria is accompanied by the introduction of "quantified" judgments (or weights) regarding the relative importance of these suitability criteria to the siting process. As discussed in [EPRI Siting Guide] Section 2.4, incorporation of these judgments (weights) enables the applicant to incorporate preferences into the process. In addition, sensitivity analysis (to the process of applying criterion weights) is performed to help decision-makers understand the impact of these preferences on the siting process, provide the basis for making critical comparisons among sites, and enhance the confidence in the Step 3 results.

As a quality check, reconnaissance-level information can be examined at this step for a variety of reasons, including to ensure that no exclusionary or avoidance criteria appear which were not identified during application of the previous steps. For example, state, county, or local political institutions may be in the process of considering designation of additional protected features that did not appear at either the 1:250,000 or 1:24,000 scale of application. This quality check is part of considering the parcel as an integrated unit that must, in the final analysis, demonstrate compliance with all applicable laws and regulations.

> The more detailed data used during Step 3 allows the applicant to identify a suite of sites (the highest ranked sites) that, based on the data, are acceptable candidates.

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" provides the information for the fourth step as follows (Reference 9.3-001):

> The candidate site list is further screened using refined exclusionary and avoidance criteria to identify optimum areas for a facility. Protected lands, population features, ecologically protected resources (e.g., wetlands), and resources set aside for cultural or historical reasons, result in reducing the potential site list to a fewer number of "alternative sites".
>
> From the application of these exclusionary and avoidance features, alternative sites are identified as discrete parcels of land approximately the size of an actual nuclear site, thus eliminating large tracts of land that do not exhibit conditions suitable to a nuclear facility site. The process then becomes one of comparing the small number of alternative sites, and identifying a site that possesses the most favorable set of conditions for siting a nuclear power facility. The evaluation technique to this point ensures that the remaining alternative sites have no fatal flaws which could result in extended licensing delays and increased costs.
>
> Thus, the remaining alternative sites are evaluated against suitability criteria, resulting in a transition from the elimination approach to a technical evaluation approach of the suitable sites. The objective of evaluation against suitability criteria is to score and rank the small number of alternative sites for determination of the preferred site.

Suitability criteria used in evaluation include health and safety, environmental, socioeconomic, and engineering and cost-related. In addition, detailed onsite investigations can also be conducted to help score and rank the alternative sites.

During the evaluation process, certain key assumptions and criteria were used as "bounding conditions" to aid in the evaluation process. The key assumptions are provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" as follows (Reference 9.3-001):

- The new nuclear baseload generation must reach commercial in-service status by mid-2015.
- The new nuclear plant siting location must be suitable to envelope the range of specific design parameters contemplated for deployment of a standard plant design as certified by the NRC.
- The location must be compatible with Progress Energy's System Operation and Transmission Delivery capabilities.

- The recommended site's expected licensing path and regulatory outlook must reduce Progress Energy's schedule and financial risk for establishing new nuclear baseload generation.

- The cost of the new nuclear generation as impacted by the location must be reasonable and fair, and methods to ensure greater certainty of the cost/schedule during the licensing, design engineering, and construction phases of the project must be included.

- Evaluation criteria and methodology established as part of the EPRI Early Site Permit Demonstration Program will be employed in the nuclear plant site selection process. Specifically, the EPRI Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application dated March 2002 will be utilized.

- The evaluation and selection process will include "greenfield" (e.g., locations with no current generation facilities), existing nuclear generation plant locations, and other sites previously characterized by PEF.

- Compliance with current NRC regulations and NRC guidance (as of November 2005), including 10 CFR Part 50 – "Domestic Licensing of Production and Utilization Facilities," 10 CFR Part 52- "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants," and SECY-05-0139, "Semi-annual Update of the Status of New Reactors Licensing Activities and Future Planning for New Reactors," dated August 4, 2005.

- Compliance with NEPA – National Environmental Policy Act of 1969 requirements.

Sites were evaluated based on the assumption that a twin-unit, Westinghouse Electric Company, LLC's (Westinghouse) AP1000 Reactor (AP1000) design facility will be built and operated (Reference 9.3-001). This assumption provided a realistic, consistent basis for evaluation of site conditions against site requirements for a nuclear power generating facility design.

By invoking these key assumptions and criteria, the relative scores for a particular attribute of the various siting locations, such as cooling water supply, were determined.

9.3.2.1 Progress Energy Florida Site Selection Process

This subsection provides an overview of the PEF site selection process that was used to select a proposed site as the geographic location for the PEF COLA. The following subsections provide a description of the basis, assumptions, and processes applied in the siting process.

9.3.2.1.1 Region of Interest Screening Process

The first step in the PEF siting process is to define the ROI. The ROI is the PEF service territory (Figure 8.1-1). The ROI was derived from PEF's fundamental business decisions on the economic viability of a nuclear power generating facility, the market for the facility's output, and the general geographic area where the facility should be deployed to serve the market (Reference 9.3-001). The PEF service territory covers approximately 51,800 km^2 (20,000 $mi.^2$) and includes the densely populated areas around Orlando, Clearwater, and St. Petersburg (Reference 9.3-003).

For the purpose of the siting study alone, PEF expanded the ROI by one additional county around the periphery of its service territory in Florida, in order to identify viable sites within reasonable distance of the service territory and to allow additional flexibility in consideration of siting tradeoffs. Counties added to the ROI in Florida include all or parts of Bay, Calhoun, Jackson, Suwannee, Columbia, Union, Bradford, Alachua, Clay, Putnam, Flagler, Volusia, Seminole, Brevard, Indian River, Okeechobee, St. Lucie, Glades, Highlands, DeSoto, Hardee, Manatee, Pasco, Polk, and Hillsborough (Reference 9.3-001).

Next, the ROI was screened to eliminate those areas that are either unsuitable or are significantly less suitable than other potential siting areas. Exclusionary and avoidance criteria identified in the EPRI Siting Guide were reviewed to identify those criteria and related physical features that provide insights into site suitability on an areal basis within the ROI.

Table 9.3-1 presents the process for this ROI screening. This process includes the following information: mapped data, screening criteria used to define site suitability, suitability impact, data sources, and additional comments and rationale on the ROI screening process.

Areas not excluded during the ROI screening process were reviewed to verify that they provided adequate land area for a number of potential sites, diversity among potential sites, and the ability to meet PEF's business objectives (Reference 9.3-001).

9.3.2.1.2 Identification of Candidate Areas within the Region of Interest

The results of the ROI screening process yielded nine candidate areas that formed the basis for the eventual identification of potential site locations. The identified ROI candidate areas are described below.

The candidate areas included land along potential cooling water sources. Areas that included high population density, dedicated land use areas, or known locations of threatened or endangered species habitat (other than that for the Gulf sturgeon [*Acipenser oxyrinchus desotoi*]) were excluded from the land segments considered. The nine candidate areas, as provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites," are (Reference 9.3-001):

- Western Panhandle along the Gulf Coast/St. Joseph Bay (Bay and Gulf Counties)
- Apalachicola and Chipola River basin areas (Calhoun, Gulf and Liberty Counties)
- Ochlockonee River basin along borders of Liberty, Franklin, Leon and Wakulla Counties
- Gulf Coast along Taylor and Dixie, Levy, Citrus and Hernando Counties
- Tampa Bay area/Manatee River south of Tampa/St. Petersburg area (Hillsborough and Manatee Counties)
- Suwannee River Basin (Dixie, Levy, Gilchrist, and Lafayette Counties)
- Kissimmee River near Lake Okeechobee (Highlands, Okeechobee and Glades Counties)
- St. Johns River Basin (Seminole, Volusia and Putnam Counties)
- Atlantic Coastal areas (numerous locations between Flagler County to the north, and Indian River County to the south)

Nearly all of the rivers feeding the Gulf of Mexico, and the Gulf itself, provide habitat for the Gulf sturgeon. Both the Suwannee and Apalachicola rivers are designated as sturgeon habitat. Siting a nuclear power generating facility would not have a significant impact on the Gulf sturgeon because the site would potentially impact only a small fraction of the habitat, the site would not require dams or other restrictions on the free range of sturgeon, and mitigative measures could be implemented to minimize any impacts. (Reference 9.3-001)

Because significant impacts are not expected, areas designated as sturgeon habitat were included in the candidate areas. (Reference 9.3-001)

9.3.2.1.3 Identification of Potential Sites within the Candidate Area

The next step in the site selection process is the identification of potential sites within the candidate areas for the placement of the proposed nuclear power generating facility. Based on the composite ROI screening results, identification of potential sites was conducted in a two-phased process.

The first phase involved identifying candidate areas resulting from the ROI screening process to evaluate siting tradeoffs within the ROI. Considerations applied in selecting these areas are provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites," as follows (Reference 9.3-001):

- At least one siting area for each major water source
- Proximity to transmission/load centers
- Avoidance of high population areas
- Consideration of ecologically sensitive and special designation areas, both along the coast and river corridors (e.g. Outstanding Florida Waters, critical habitat of Federally protected gulf sturgeon)
- Proximity to transportation (e.g., rail lines, barge terminals).

- Diversity of siting areas within the large Florida ROI (coastal and inland waterways)
- Areas that are particularly compatible with the Progress business objectives

Aerial photographs and other available geographic information were used to identify potential sites from the candidate areas that met the above-listed characteristics. Potential sites that ranged from 809 ha (2000 ac.) to 2424 ha (6000 ac.) were considered in the site evaluation process. Major siting tradeoffs in the ROI were considered, as previously noted; therefore, this phase of the process was focused on the evaluation of cost and environmental considerations. (Reference 9.3-001)

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites," provides the following information (Reference 9.3-001):

> Additional factors taken into account in this process, as feasible, included:
>
> - Flexibility to optimize site layout and design for cost minimization
> - Flexibility to optimize site layout and design for avoidance or mitigation of environmental impacts
> - Minimization of the number of land parcels contained within the site
> - Optimization of site engineering factors, e.g., topography, foundation conditions, grading requirements
>
> The output of this task was a list of potential sites to be evaluated with respect to the EPRI site suitability criteria, along with general boundaries of each site marked on aerial photos and/or maps of suitable scale.
>
> Geographic [candidate] areas identified in the ROI screening were examined to identify sites that would be feasible for a new nuclear power plant, taking into account the considerations identified in Section 4.1 [in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites"]. The following process was used:
>
> 1. 1:100,000-scale topographic maps ([U.S. Geological Survey] USGS) were examined to identify possible areas for potential sites within the previously screened siting areas; information on identified areas was supplemented using [American Automobile Association] AAA Florida state map, 1998, and Florida County highway maps showing roads, towns, wetlands, dedicated lands, etc.
> 2. Low resolution aerial photographs of the areas were scanned using Google Earth® (http://earth.google.com/). Potential sites of approximately 6000 acres were identified by visually applying the criteria described below.
> 3. The latitude and longitude of the approximate center point of the potential site was noted.

4. Higher resolution USGS aerial photographs were inspected to confirm the location of nearby communities and the amount of development in the vicinity of the potential site as well as topography. (http://www.terraserver-usa.com). If a potential conflict was determined from information found on the USGS aerial photograph, the potential site was relocated, using the same resources and process.

The following criteria were applied, as feasible, in locating potential sites:

- Distance to existing transmission load centers in the Orlando and Tampa-St. Petersburg areas was minimized to the extent possible. (Load conditions on the existing grid are such that a new plant would likely be connected directly to load centers rather than being tied into the existing system.)
- Distance from towns, villages, and developed areas was maximized. Developed areas were identified from aerial photographs, county and topographic maps.
- Distance from industrial areas identifiable from the aerial photographs and topographic maps (e.g. airports, industrial complexes) was maximized.
- Whenever possible, land near existing water supply sources (rivers, lakes and coastal areas) was identified.
- The optimal topography was assumed to be a relatively flat area and above the 100-year floodplain for construction of the plant, adjacent to streams with surrounding topography showing some relief. Topographic maps and aerial photographs were qualitatively examined to find areas as close to this ideal as possible.
- Vehicle transportation access to the potential sites was qualitatively evaluated. Land areas around major highways were avoided; those within a reasonable distance of state highways were considered.

The evaluation of candidate areas resulted in the identification of 20 potential sites for the location of the proposed nuclear power generating facility. The 20 potential sites are located within the following counties: Calhoun, Liberty (2 sites), Gilchrist, Putnam (3 sites), Volusia, Seminole, Highlands, Manatee, Hillsborough, Citrus, Levy (3 sites), Dixie, Lafayette, Taylor, and Gulf. (Reference 9.3-001)

9.3.2.1.4 Evaluation of Potential Sites and Selection of the Candidate Sites

A technical evaluation of the 20 potential sites was completed, and eight candidate sites were identified as a result. The technical evaluation was based on EPRI criteria and on input within PEF for local knowledge of five key parameters, including transmission, environmental, community support, economic development, and legislative considerations.

Specific criteria used to evaluate the potential sites are listed in Table 9.3-2, along with the methodology applied to developing site ratings for each criterion.

Criteria presented in Table 9.3-2 are derived from the larger set of more detailed criteria listed in the EPRI Siting Guide. The EPRI criteria types (exclusionary, avoidance, and suitability) are defined based on the severity of constraints imposed by underlying requirements.

The EPRI Siting Guide provides the following information about these criteria (Reference 9.3-002):

> Exclusionary criteria are used to eliminate areas based on considerations of go/no-go situations and are generally based on regulatory and/or plant design (e.g., [Plant Parameter Envelope] PPE) requirements.
>
> Avoidance criteria have the same site screening effect as exclusionary criteria but are more flexible in their application. They are utilized to identify broad areas with more favorable than unfavorable conditions, for example distance from population centers. Because the distinction between favorable and unfavorable areas is not well defined in regulation, applications of avoidance criteria help ensure that the siting approach is effective.
>
> Finally, suitability criteria represent requirements that affect the relative environmental suitability or cost of developing the site, but do not represent unacceptable environmental stress, severe licensing problems, or excessive additional cost.

These criteria provided insights into the overall site suitability tradeoffs inherent in the available sites within the PEF ROI and were designed to take advantage of data available at this stage of the site selection process.

The potential site evaluation process was comprised of the following elements: develop criterion ratings for each site, develop weight factors reflecting the relative importance of each criterion, and develop composite suitability ratings. This evaluation process reduced the 20 potential sites down to eight candidate sites. The potential sites that were eliminated displayed the characteristics that indicated unsuitability for a nuclear power generating facility: excessive distance from PEF load centers, requirement for cooling water sources from Florida Protected Waters, and proximity to heavily populated areas and sensitive estuaries. (Reference 9.3-001)

The following elements of the overall process for potential site evaluation are provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" (Reference 9.3-001):

> Criterion Ratings – Each site was assigned a rating of 1 to 5 (1 = least suitable, 5 = most suitable) for each of the potential site evaluation criteria, using the rationale listed in [Table 9.3-2]. Information sources for these evaluations included publicly available data, information available from Progress files, personnel, and large scale satellite photographs.

Weight Factors – Weight factors reflecting the relative importance of these criteria were synthesized from those developed for previous nuclear power plant siting studies. The weight factors were originally derived using methodology consistent with the modified Delphi process specified in the Siting Guide. The process used in the weight factor development is described in Appendix B [in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites"]; weight factor results (1 = least important, 10 = most important) are listed in [Table 9.3-3].

Composite Suitability Ratings – Ratings reflecting the overall suitability of each site were developed by multiplying criterion ratings by the criterion weight factors and summing over all criteria for each site.

The results of the potential sites technical evaluation screening process yielded a list of eight top-ranked sites: Taylor, Crystal River, Levy 2, Levy 3, Gilchrist, Dixie, Lafayette, and Hillsborough (Table 9.3-4). The next four highest-rated sites (Putnam 1, Putnam 2, Putnam 3, and Manatee) were rated similarly and were very close to the eighth site (Hillsborough). Finally, Levy 1 and Highlands followed closely behind Manatee. Given the small difference in site suitability ratings between the top eight sites and the next four to six sites, additional considerations were evaluated to ensure that important site suitability tradeoffs could be evaluated in more detail. (Reference 9.3-001)

These additional considerations included the potential for additional water sources and the ability to consider different transmission/system reliability tradeoffs. Greater diversity in the decision process was achieved by considering sites that could use additional water sources, such as the Putnam sites on the St. Johns River and the Highlands site on the Kissimmee River. These sites provide a wider range of alternatives, considering that three of the top eight sites are in the Suwannee River Basin. The site selection process also considered the potential advantages resulting from the different transmission/system reliability tradeoffs. The varying locations of the sites allow the consideration of different directions of approach to PEF load centers and connection routes that are remote from existing transmission corridors. (Reference 9.3-001)

The sites were further characterized based on their potential for issues involving new nuclear power generating facility development. Potential issues include public acceptance, economic development, and environmental, transmission, and legislative issues in Florida. The likelihood of these issues, as shown in Table 9.3-5, were assigned color ratings. This characterization was developed by polling PEF personnel familiar with the issues from current and ongoing PEF operations, and was based on the group's knowledge, experience, and professional judgment. (Reference 9.3-001)

This evaluation and screening process grouped the 20 potential sites in order of suitability, based on the composite suitability ratings and the overall level of concern identified for each site. This grouping produced the following results (Reference 9.3-001):

- Group 1 — Minimal Concerns: Crystal River, Highlands, Levy 2, Levy 3, and Taylor.
- Group 2 — Intermediate Concerns: Putnam 1, Putnam 2, and Putnam 3.
- Group 3 — One potential significant concern and favorable transmission: Dixie, Lafayette, Levy 1, and Gilchrist.
- Group 4 — One or more potential significant concerns and no favorable transmission: Calhoun, Gulf, Hillsborough, Liberty 1, Liberty 2, Manatee, Seminole, and Volusia.

Minor modifications to the list of sites were made based on the following reasons: Gilchrist was removed from the list due to the need for a supplemental reservoir and related water supply constraints; Hillsborough was removed from the list due to uncertainty about water supply, as well as potential transmission connection constraints; Putnam 3 and Highlands were added to the candidate site list based on their locations allowing for alternative water sources (St. Johns River and Kissimmee River, respectively), as well as proximity to PEF load centers, which provide the opportunity to connect from different directions. Putnam 3 was chosen out of the three potential sites in Putnam County based on rail and transmission access advantages and real estate considerations. (Reference 9.3-001)

Based on the potential sites evaluaton and ratings identified above, the following eight candidate sites were selected for more detailed evaluation: Taylor, Crystal River, Levy 2, Levy 3, Dixie, Putnam 3, Lafayette, and Highlands (Reference 9.3-001).

9.3.2.1.5 Technical Evaluation of Candidate Sites and Selection of Alternative Sites

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" provides the following information (Reference 9.3-001):

> The continued evaluation of the eight candidate sites utilized an additional set of criteria that included 40 parameters to refine suitability with an increased level of detail associated with water management, population profiles, reconnaissance level information, etc. to culminate in a small number of alternative sites considered suitable for a nuclear plant. This phase included literature research and specific weighted scoring for each candidate site against the criteria. A few examples of the heaviest weighted parameters were geology/seismology, transmission access, accident effect related, and land use.

The objective of this component of the site selection process was to further evaluate the eight candidate sites and select a smaller set of alternative sites for detailed evaluation and ultimate selection of the preferred site for the PEF COLA.

General siting criteria used to evaluate the eight candidate sites were derived from those presented in the EPRI Siting Guide and discussed in detail in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" (Reference 9.3-001). The siting criteria were tailored to reflect issues applicable to, and data available for, the PEF candidate sites. A list of the criteria is shown in Table 9.3-6. The overall process for applying the general site criteria is provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" as follows (Reference 9.3-001):

> Criterion Ratings – Each site was assigned a rating of 1 to 5 (1 = least suitable, 5 = most suitable) for each of the potential site evaluation criteria, using the rationale provided in Appendix D [in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites"]. Information sources for these evaluations included publicly available data, information available from Progress files and personnel, USGS topographic maps, information derived from site flyovers, and from additional analyses conducted by Progress consultants and contractors.
>
> Weight Factors – Weight factors reflecting the relative importance of these criteria were synthesized from those developed for previous nuclear power plant siting studies. The weight factors were originally derived using methodology consistent with the modified Delphi process specified in the Siting Guide and summarized in Appendix B [in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites"]. Weight factors used (1 = least important, 5 = most important) are listed in [Table 9.3-7].
>
> Composite Suitability Ratings – Ratings reflecting the overall suitability of each site were developed by multiplying criterion ratings by the criterion weight factors and summing over all criteria for each site.

Table 9.3-7 provides the results of the candidate site technical evaluation.

Based on these results and on-site inspections conducted via helicopter over-flights, the following five sites were identified as alternative sites that warranted further and more detailed evaluation and consideration: Crystal River, Dixie, Levy 2, Putnam 3, and Highlands (Note: for purposes of further discussion, the five alternative sites will be identified as Crystal River, Dixie, Levy, Putnam, and Highlands). The five alternative sites represent a cross-section of siting tradeoffs available within the ROI, including a variety of water sources, locations, and transmission connection strategies. (Reference 9.3-001)

The basis for deferral of the three candidate sites not included as alternative sites (Taylor, Levy 3, and Lafayette) include the following reasons: both the Taylor and Levy 3 site locations would require extended pipelines in the lengthy estuarine areas between the sites and the Gulf of Mexico, potentially resulting in significant permitting and regulatory concerns. Both sites are also located along the coast and are vulnerable to storm surge flooding. The location of the Lafayette site

includes much recreational and residential development, which would result in the need for zoning and land use changes. Additionally, the Lafayette site has slower water flows in comparison to the Dixie site. (Reference 9.3-001)

9.3.2.1.6 Technical Evaluation of Alternative Sites

Based on the previously described evaluations, all of the alternative sites appear to be feasible locations for a new nuclear power generating facility. To support selection of a proposed site from this set of alternative sites, additional and more detailed studies of the alternative sites were conducted. The objective of the more detailed studies for the five alternative sites was to provide additional insights into site conditions and to provide further confidence on specific issues that were viewed important to the COLA site decision. Examples of additional information that was gathered include site research, "on the ground" surveillance by a senior environmental consultant and a senior geologist, and core borings, which were collected to determine foundation design suitability. (Reference 9.3-001)

Additionally, the five alternative sites were subjected to further technical evaluation using the 40 general siting criteria. The overall process for applying the general site criteria (including the criterion rating and weight factors scale, and the composite suitability rating) was analogous to that process described in ER Subsection 9.3.2.1.5. The results of the alternative site technical evaluation is provided in Table 9.3-8. The results of the detailed alternative site studies are summarized in Table 9.3-9.

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" provides the following information about the additional alternative site studies (Reference 9.3-001):

> Transmission Evaluations – Transmission analysis (*Transmission Impact Study in Support of Site Selection for a Florida Nuclear Power Plant*, Navigant Consulting, Inc., June 30, 2006) of the alternative sites involved the following:
>
> - Establishing tentative interconnection points for each site on the existing Progress grid,
> - Defining the new transmission lines required to carry power from a new two-unit nuclear plant to the connection points,
> - Conducting load flow studies to identify contingencies that could occur with the new plant connected to the grid,
> - Identifying system upgrades necessary to handle the additional new plant capacity on the grid, and
> - Developing cost estimates for the new transmission lines and upgrades.
>
> Results of these studies (summarized in Table 9.3-9) indicated that transmission connection cost would be in the range of

$560 to 725 million (M) at the northwestern sites (Crystal River, Dixie, Levy) and would be greater than $1 billion at Putnam ($1,013 M) and Highlands ($1,370 M). Much of the additional cost at the latter two sites results from the need to upgrade the transmission grid outside the Progress service territory to address contingencies that could occur when power from a new two-unit nuclear plant is injected into the system.

Geotechnical Studies – Overall, the geotechnical studies conducted to further evaluate the alternative sites involved a review of existing geotechnical information (e.g., available near-site boring and geological information) and on-site borings at Dixie, Highlands, Levy, and Putnam. Geophysical studies were also conducted at Levy. Scope and results of these studies are reported in *Technical Memorandum: Geological and Geotechnical Evaluations and Recommendations for Siting of a Nuclear Power Plant in Florida*, CH2MHill, Inc., September 26, 2006.

Geotechnical characteristics at Crystal River were assumed to be acceptable for new nuclear units, because the site is located near the area investigated for the existing unit, and subsurface conditions are expected to be similar to those underlying the existing plant.

Based on the preliminary subsurface on-site investigations, the most suitable site appears to be Levy. The Highlands and Putnam County Sites are considered least suitable for a nuclear power plant, because of the thick soil deposits underneath these sites and the depth to bedrock being greater than 100 feet [ft.], which make it very difficult and/or expensive to found the facilities on rock. The Dixie site was found to be less favorable than Levy because of numerous sinkholes and depressions observed during field reconnaissance, and many voids and cavities encountered during rock coring.

Environmental – On-site reconnaissance of the alternative sites (Dixie, Highlands, Levy, Putnam) was conducted to determine whether there were any ecological resources or conditions that would present significant impacts or that would indicate significant differences in the ecological suitability between the alternative sites. Going beyond the aerial reconnaissance conducted in support of the evaluation of candidate sites (Section 6.0 [in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites"]), these surveys were conducted via vehicle drive-over and examination on foot.

All of the sites examined have been previously disturbed via farming or mining activity and/or are in the process of being logged. All sites appeared to contain some wetland areas (less than 5% of total site area), although very little standing water was actually observed during the site visits. The wetland areas were mostly characterized by depressed areas which tend to be wet (usually due to surface aquifer inflow) except during drought conditions and typically exhibit vegetation that is characteristic of wetlands. Except for Highlands, which is largely farmland (sod and dairy

farming), all of the greenfield sites exhibit land cover typical of open forested pineland. There is considerable existing farming activity on and near the Highlands site (i.e., dairy and cattle), very typical of the farming in Highlands County (farming accounts for 88% of the total acreage in Highlands County, with approximately 70% of the land on farms used as cropland and pasture (40%)); this local land use is considered to be less suitable for a nuclear plant than that of the other sites.

Crystal River is characterized by industrial development with both nuclear and fossil power plants and associated support facilities present; although, areas that would be newly disturbed in adding to new units at Crystal River are ecologically similar to the greenfield sites.

All sites are located near special ecologically protected areas (1-5 miles) and all lie in the range of threatened or endangered species which could occur onsite (e.g., eastern indigo snake), although none were observed during the site visits.

Overall, from an ecological perspective, Crystal River is judged to be slightly superior to the other sites as a result of existing land use and the Highlands site less suitable because of the local intensive dairy and beef farming. The other three sites are considered to be similar, and there is no compelling basis for differentiating among them from an ecological perspective.

Reliability – Adding two nuclear units (nominal total power output of 2200 MW) to the existing units at Crystal River would result in the concentration of a large fraction of Progress' total generation capacity at one site subject to disruption by a single weather event (e.g., hurricane, tornado, storm surge flooding). Vulnerability of the site to such events extends to the transmission lines, because connections for the new units would be co-located with existing transmission lines. Because the loss of total generation at Crystal River would create a major electrical disaster for the Progress service territory, a qualitative reliability analysis of the alternative sites was conducted to determine their relative suitability – as compared to Crystal River – in mitigating this concern.

Two initiating weather events were considered in this analysis: storm surge flooding and hurricane or tornado wind damage. The potential for flooding was considered greatest at near-coastal and lower elevation sites, with sites farther inland and with higher elevations ranked higher. For outages initiated by a single weather event, the greater the distance from Crystal River, the less likely a single-event outage would be. Any separation from Crystal River would provide a significant decrease in risk that all units could be taken off line by a single event, but additional distance provides additional risk mitigation.

Both Highlands and Putnam are located relatively far from the coast and are therefore expected to provide significant redundancy relative to the

storm surge risk if the two new units are located at Crystal River. Of the two sites, Highlands is considered more favorable due to its higher elevation and because of the potential for tidal run-up from the Atlantic Ocean and the St. Johns River at Putnam. Both Dixie and Levy are located farther from the coast than Crystal River; site elevation at Levy is greater than that at Dixie, and therefore would be expected to provide additional protection from storm surge flooding.

Both Dixie and Levy, because of their physical separation from Crystal River, have reduced risk of disturbance from other weather events; Dixie rates slightly higher from this perspective because of its increased distance from the existing plant site. Both Putnam and Highlands are located far from Crystal River; siting the new units at either of these locations would minimize risk of outages from a single initiating weather event.

Land Acquisition – Because of the aggressive schedule for plant development mandated by the Progress business objectives for the new units, there is no potential for accommodating significant delays (e.g., condemnation process under eminent domain) in obtaining access to land for a new site. Accordingly, a land availability analysis was conducted through a third-party real estate agent to identify parcels of adequate size at each of the sites and to make initial contact with landowners to arrange for site access for the on-site geotechnical investigation and to assess availability of the property for sale.

Results of this analysis indicate that land acquisition appears to be feasible at Crystal River, Levy, Highlands, and Putnam; however, it appears that land acquisition at the Dixie site would not be feasible in the required time frame (Reference 9.3-001).

The technical evaluation concluded that each of the five sites are technically suitable for a new nuclear power generating facility. Crystal River and Levy were the highest-ranked sites due primarily to geological conditions and water sources. Crystal River scored only slightly higher than Levy due to its location adjacent to an existing nuclear power generating facility (the CREC) with the associated advantages of existing site characterization suitable for a nuclear power generating facility and the infrastructure offered by the operating nuclear power generating facility. Dixie was found to be less favorable than Levy because of numerous sinkholes and depressions observed during field reconnaissance and many voids and cavities encountered during rock coring. Highlands and Putnam demonstrated the least desirable conditions associated with deep soft sand. Highlands was further less suitable due to local intensive dairy farming. Putnam has potential for tidal run-up from the Atlantic Ocean on the St. Johns River, and Dixie is susceptible to hurricane surge flooding. Levy, being located farther from the coast than Crystal River and of greater elevation, provides additional protection from hurricane surge and probable maximum flooding. A major disadvantage for Crystal River is the resulting concentration of generation capacity subject to a single weather event with associated tornados

and storm surge flooding. Additionally, the CREC is currently challenged due to thermal discharge limitations into the Gulf of Mexico requiring the use of helper cooling towers. Therefore, Levy demonstrated significant reliability advantages over Crystal River, with respect to storm surge flooding and the potential for single weather event outages and thermal discharge impacts. (Reference 9.3-001)

9.3.2.1.7 Selection of Preferred Site

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" provides the following information (Reference 9.3-001):

> At the conclusion of the above Technical Evaluation process, the technically acceptable and ranked sites then undergo a final evaluation and verification to ensure compliance and compatibility with Progress Energy transmission and generation business strategy. This analysis allows the decision of site selection to consider tradeoffs in business requirements and identification of basis for differentiation among sites, thereby ensuring the optimal site is chosen.

The strategic considerations evaluation evaluated the alternative sites against the following criteria: system reliability, site permitting, extreme weather vulnerability, system strategic fit, existing site advantages, local and state government constraints, public support, local community challenges, NRC considerations, land utilization, additional cost considerations, and site expandability. (Reference 9.3-001)

The overall process for applying the general site criteria (including the criterion rating and weight factors scale, and the composite suitability rating) was analogous to that process described in ER Subsection 9.3.2.1.5. The results of the alternative site strategic evaluation are provided in Table 9.3-10.

The strategic considerations evaluation indicated that Levy ranked the highest. Levy scored better than Crystal River based on the location being a reasonable distance off the coast line and a higher elevation, allowing additional protection from wind and flood damage. Adding new nuclear generating capacity to the CREC will result in a significant concentration of PEF generating assets in one geographical location. This increases the likelihood of a significant generation loss from a single event and a resulting large scale impact on the PEF system. Dixie, although approximately 32.2 km (20 mi.) inland from the Gulf coast, is within the Department of Community Affairs Division of Emergency Management Geographic Information System (GIS) Section surge zone for a Category 5 hurricane. The remote locations at Highlands and Putnam offered no opportunity for shared PEF facilities or resources. (Reference 9.3-001)

The transmission system analysis evaluated each alternative site against transmission system direct connection costs and system upgrade costs. The transmission system deliverability analysis concluded that the Levy site ranked the highest (along with Crystal River) with the transmission system requirements.

Levy and Crystal River scored the best due to lower estimated direct connect and upgrade costs. Levy offers a significant advantage by not co-locating transmission lines in the same corridor with the CREC and thereby avoiding loss from a single event and a resulting large scale impact on the PEF system. Dixie was slightly higher in estimated cost than Levy. Highlands and Putnam resulted in significantly higher costs. (Reference 9.3-001)

Table 9.3-10 displays the results of the technical evaluation, strategic considerations, and transmission study composite ratings against the evaluation criteria.

The results of the evaluations are provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" as follows (Reference 9.3-001):

- All five alternative sites may be viable locations for a nuclear power plant,
- There are significant differences in their suitability with regard to some siting issues, and
- Additional study would be required to confirm site suitability at several of the sites.

Specifically, additional study would be required to confirm whether geotechnical conditions at Dixie, Highlands, and Putnam are suitable, as well as to evaluate the issue of extensive dairy and cattle farming at Highlands. The level of effort and schedule required to complete the necessary confirmation studies are not compatible with schedule requirements for the Progress COL, especially since final resolution could result in additional licensing requirements (e.g., modified design certification to address deep foundations).

Accordingly, Crystal River and Levy were identified as the primary alternative locations for the Progress COL. Given this result, selection of a preferred site for the Progress COL was based on:

1. Satisfying Progress's overall business objectives for the COL.

2. Enhancing the ability of future nuclear units that would be built and operated at the site to provide Progress customers with reliable, cost-effective electric service.

Based on these considerations, Levy was selected as the proposed site for the Progress COL. Levy is characterized by:

- Transmission costs as low as any of the sites under consideration,
- Significant reliability advantages over Crystal River, both with respect to storm surge flooding and the potential for single weather event outages,

- Geotechnical conditions that allow design of plant foundations that will support deployment of a certified design without a requirement for deep foundations,
- Ecological conditions similar to those at other alternative sites, and
- Adequate water supply (from the Gulf of Mexico through the Florida Barge Canal), without impacting riverine surface water resources.

Although many of these characteristics also apply to Crystal River, the severe potential impact of single-event weather-related outages if all units were placed at that site drives the decision to select the Levy site. The significant additional reliability inherent in developing a new nuclear plant at Levy – versus Crystal River – is the primary reason for selecting Levy over the existing plant site for the Progress Florida COL.

9.3.3 SUMMARY RESULTS OF THE ALTERNATIVE SITES ENVIRONMENTAL IMPACT EVALUATION

In order to determine if there is an environmentally preferable (and thus, obviously superior) site for the location of the new nuclear power generating facility, an evaluation that compared the alternative sites to the proposed site was conducted. As noted in ER Subsection 9.3.2.1.7, the Levy site is the proposed site. (Note: from this point on, the Levy site will be referred to as the LNP site) The alternative sites that are compared with the LNP site include: Crystal River, Dixie, Highlands, and Putnam.

The evaluation consisted of assessing and analyzing the environmental impacts of constructing and operating a nuclear power generating facility at the proposed site and alternative sites using the NRC's three-level standard of significance: SMALL, MODERATE, or LARGE. This standard of significance is defined in ER Subsection 9.2.2. PEF assumed the construction and operation practices described in ER Chapters 4 and 5, including the construction and operation of transmission corridors, would generally be applied to each site, thereby allowing for a consistent description of the impacts on each site.

According to NUREG-0099, Regulatory Guide 4.2, Revision 2, "the applicant is not expected to conduct detailed environmental studies at alternative sites; only preliminary reconnaissance-type investigations need be conducted." Therefore, existing information and PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" (Reference 9.3-001) was used to conduct the evaluation.

The results of the evaluation concluded that none of the alternatives sites are environmentally preferable (and thus, obviously superior) to the LNP site (the proposed site). Therefore, the LNP site is the candidate site submitted to the NRC by the applicant as the proposed location for a nuclear power generating facility.

A summary of the proposed site and alternative sites environmental impact evaluation is presented in the following subsections.

9.3.3.1 Crystal River Site

The Crystal River site is located in Citrus County, Florida, approximately 4.8 km (3 mi.) west of Red Level, approximately 12.9 km (8 mi.) northwest of Crystal River, and is adjacent to the CREC (Reference 9.3-001).

9.3.3.1.1 Land Use

The CREC is an existing nuclear power generating facility owned by Florida Power Corporation doing business as PEF; therefore, land needed for a new facility would not have to be purchased. This site has generally level terrain that gradually slopes west toward the Gulf of Mexico. Due to the developed nature of the site and level terrain, extensive site grading is not anticipated, and any costs associated with site grading are expected to be low. (Reference 9.3-001)

Land use surrounding the site is generally industrial, and the site is zoned for uses compatible with the development of a new unit. It should be noted that there are a number of publicly owned properties in the vicinity of the site, including the Withlacoochee State Forest, Crystal River and Chassahowitchka National Wildlife Refuges (NWR), Fort Cooper State Park, Homosassa Springs State Park, and Withlacoochee State Trail. (Reference 9.3-001)

Hazardous land use in the area includes two airports, freight rail, the CREC and assumed power transmission lines, and a power plant. No pipelines or military installations are located near the site. (Reference 9.3-001)

The elevation of the site is approximately 2.7 meters (m) (9 ft.) above sea level, which is located within the 100-year floodplain (1.2 m [4 ft.] below flood elevation, Zone A12). The site is underlain by Ocala Limestone and Avon Park Limestone. Therefore, this site is considered to be rock. Possible geologic hazards associated with this site include the potential for solution cavities within the limestone. Additionally, the site is located adjacent to the Gulf of Mexico and is therefore subject to seismic and other induced water waves and floods. The peak ground acceleration (PGA) expected is 3.87 percent of gravity (%g) with a 2-percent probability of exceedance (PE) in 50 years. No Class A or Class B features occur within 322.0 km (200 mi.) of the Crystal River site. No surface faulting or deformation is known to occur near the site. (Reference 9.3-001)

Land use impacts from construction and operation of a nuclear power generating facility are anticipated to be SMALL.

9.3.3.1.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils, are expected to be SMALL. Potential impacts can be minimized with the use of drift eliminators on the cooling towers.

Based on the new reactor design and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting a nuclear power generating facility at this location would have a SMALL impact on air quality.

9.3.3.1.3 Water

The water metric evaluated for each of the alternative sites is the ability of a primary water source to provide adequate cooling water for a two-unit nuclear power generating facility with cooling towers without significant permitting issues or operational restrictions. The closed-cycle cooling system cooling water supply requirements for the proposed two-unit nuclear power generating facility is approximately 2.65 cubic meters per second (m^3/s) (93.58 cubic feet per second [ft^3/sec]) or 42,000 gallons per minute (gpm). (Reference 9.3-001)

The Crystal River site is located near the Gulf of Mexico (less than 4.8 km [3 mi.] east and 2.4 km [1.5 mi.] northeast of an inlet channel near the CREC), adequate cooling water is available, and a reservoir would not have to be constructed (Reference 9.3-001).

Water usage in all source waters is governed by individual water management districts in Florida. Approval for proposed water usage by the cognizant water management district will be required. It will be necessary to meet with the appropriate agencies to obtain preliminary confirmation of available water and to define requirements for obtaining final approval of any proposed water use. (Reference 9.3-001)

It is anticipated that the proposed nuclear power generating facility discharge would be mixed with the existing facility's discharge, thereby reducing potential thermal impacts to aquatic and terrestrial species and their habitat by construction of a new discharge pipeline. Given the presence of an existing nuclear power generating facility in the immediate vicinity and the availability of a large heat sink (Gulf of Mexico), the siting of a second nuclear power generating facility at this location is not considered problematic. (Reference 9.3-001)

Overall water use impacts would be SMALL.

9.3.3.1.4 Terrestrial Ecology

The relative suitability of the Crystal River site with respect to potential impacts to terrestrial ecology (rare, threatened, and endangered terrestrial species, and critical habitat) and wetlands was evaluated. There are approximately 33.2 ha (82 ac.) of high quality wetlands within the Crystal River site area (Reference 9.3-001). State and federally listed protected terrestrial species that have the potential to occur in Citrus County, and therefore, within the vicinity of the Crystal River site, are shown in Table 9.3-11. (Reference 9.3-004)

Based on the amount of wetlands and threatened and endangered terrestrial species on the site, anticipated impacts would be SMALL.

9.3.3.1.5 Aquatic Ecology

The relative suitability of the Crystal River site with respect to potential impacts to aquatic ecology (rare, threatened, and endangered aquatic species, and critical habitat) was evaluated. State and federally listed protected aquatic species that have the potential to occur in Citrus County, and therefore, within the vicinity of the Crystal River site, are shown in Table 9.3-11. (Reference 9.3-004)

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" provides the following information (Reference 9.3-001):

> Citrus County is one of four counties called the Nature Coast, the most accessible part of the Gulf Coast in Central Florida. The floodplain forests and feeder lakes of the Withlacoochee River define the interior of the region, while vast estuaries along the coast fringe its western border. According to the Citrus County profile, Citrus County is home to the largest herd of wintering manatees in the nation – 380 as of January 10, 2006, and record numbers were recorded in 2005. A permanent population resides in rehab at the Homosassa Springs State Wildlife Park to the south of the site. Thirty springs protected by the Crystal River National Wildlife Refuge (NWR) in Crystal River serve as critical wintering grounds for nearly 20 percent of the nation's manatee population.
>
> Crystal River and Kings Bay, just south of the Crystal River site, form a unique hydrologic system. The tidally influenced Kings Bay is the headwater of Crystal River which forms at the northwest corner of the bay. Six miles west of the Kings Bay, the river ends at the Gulf of Mexico. Crystal River and Kings Bay are classified as Class III waters (Chapter 62-302 of the F.A.C.). Mounting public concern about the environmental sensitivity of the Crystal River/Kings Bay system prompted the Florida Department of Environmental Protection to make Crystal River an Outstanding Florida Water (OFW). The intent of this designation is not to change the designated uses, [but] to prevent further degradation of ambient water quality using certain regulatory restrictions. Changes in water chemistry, particularly water clarity, and nuisance aquatic vegetation are the major management issues for the Crystal River/Kings Bay system with the primary concern being a reduction in water clarity.
>
> The eight candidate sites were evaluated with respect to relative potential for entrainment and impingement impacts for the closed-cycle cooling water system. Proposed facilities at each site will include cooling towers that will reduce the amount of cooling water withdrawal required for plant operation. In addition, proper design of the water intake structure would minimize the potential adverse impacts. In NUREG 1437, NRC concludes that, with cooling towers and appropriate intake design, potential adverse impacts due to entrainment or impingement of aquatic organisms are minor and do not significantly disrupt existing populations. Assuming a two-unit closed-cycle plant at the site, and 100 percent of the local plankton passing through the plant, it appears that there would be no

discernible effect on the plankton population in existing rivers and reservoirs at each site. This is due to the very small volume of water used by the plant relative to the total volume in the river or reservoir at the site. Because of the low flow velocities of a closed cycle plant at the site, impingement of adult fish would be expected to be minimal. Use of a deep water intake would have a minimal effect on entrainment of larval fish.

It is anticipated that impacts to aquatic ecology would be SMALL.

9.3.3.1.6 Socioeconomics

Citrus County has a 2006 population estimate of 138,143, which is a 17-percent increase from the 2000 population of 118,085. As of 2004, the annual median household income was $33,576, and the mean value of owner-occupied housing units was $84,400. Approximately 11.2 percent of the county's population lives below the poverty level. There were 9825 firms doing business in the county in 2002. (Reference 9.3-005)

The impact on area employment from construction and operation of the proposed nuclear power generating facility would be SMALL because Citrus County is in proximity to one population center within 32.3 km (20 mi.) (Dunnellon) and one densely populated area within 64.6 km (40 mi.) (Ocala) (Reference 9.3-001).

It is expected that the impact on housing and community services would be SMALL based on the following information provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" (Reference 9.3-001): Each alternative site "appears to have sufficient population centers within commuting distance and/or has experienced tremendous growth since 1990 such that its public services sector would be able to absorb the population in-migration associated with plant construction and operation with minimal impact."

A GIS search of metadata from the Florida Geographic Data Library (FGDL) was conducted to determine the number of airports, hospitals, parks, schools, law enforcement agencies and fire departments/emergency medical service centers within a 50-mile radius of the Citrus County site. The 50-mile radius search encompassed all or portions of the following counties: Alachua, Citrus, Dixie, Gilchrist, Hernando, Lake, Levy, Marion, Pasco, and Sumter. The findings of the 50-mile radius search are as follows:

- Approximately 88 airports comprised of heliports, airports, and seaplane bases are located within the 50-mile radius of the Citrus County site, with five airports, one heliport, and one sea plane base located within Citrus County (Reference 9.3-032).
- Approximately 19 hospitals comprised of Acute Care, Rehabilitation, Psychiatric, Specialty, and Federal are located within a 50-mile radius of the Citrus County site, with two Acute Care hospitals residing within Citrus County (Reference 9.3-033).

- Approximately 363 public/private schools comprised of pre-kindergarten, kindergarten, elementary, middle, junior and senior high school, community colleges, colleges, universities, special needs, and adult education are located within a 50-mile radius of the Citrus County site, with 35 schools located within Citrus County (Reference 9.3-034).
- Approximately 50 law enforcement agencies comprised of police departments, sheriffs departments, and state highway patrol are located within a 50-mile radius of the Citrus County site, with five law enforcement agencies located within Citrus County (Reference 9.3-035).
- Approximately 154 fire departments and emergency medical stations comprised of fire departments, volunteer fire departments, fire rescue stations, and emergency medical service stations are located within the 50-mile radius of Citrus County site, with 25 fire departments and emergency medical stations located within Citrus County (Reference 9.3-036 and Reference 9.3-037).
- Approximately 248 parks comprised of trails, preserves, woods, forests, conservation areas, and a nature center are located within a 50-mile radius of the Citrus County site, with 20 parks located within Citrus County (Reference 9.3-038).

The effect of the proposed facility on the population and demographics of Citrus County would be SMALL.

9.3.3.1.7 Transportation

The Crystal River site location is discussed in ER Subsection 9.3.3.1. The main highway serving the site is U.S. Highway 19 (US-19) located approximately 4.8 km (3 mi.) from the site. Access to the site is provided by local roads servicing the CREC; therefore, new road construction is expected to be minimal. (Reference 9.3-001)

The site is located approximately 1.8 km (1.1 mi.) from an existing rail line (co-located with CREC). This line connects to Seaboard Coast Railroad approximately 12.6 km (7.8 mi.) east of the site near Citronelle. The site also has the potential for barge access since the site is located approximately 4.8 km (3 mi.) east of the Gulf of Mexico and approximately 2.4 km (1.5 mi.) northeast of an inlet channel near the CREC. (Reference 9.3-001)

In the event of an emergency evacuation, possibilities exist for evacuations in three directions. Evacuation is limited to the west by the close proximity of the Gulf of Mexico. Locating a new nuclear power generating facility adjacent to the existing CREC brings the added advantage of having an existing Emergency Plan that is already adopted and could be modified to accommodate the new site. (Reference 9.3-001)

It is anticipated that there would be impacts to transportation on local roads during construction and operation activities. There are several ways to mitigate

the potential transportation impacts during construction such as developing a construction traffic management plan before construction to address potential impacts on local roadways. Coordinating with local planning authorities for the upgrading of local roads, intersections, and signals to handle increased traffic loads would be considered. Schedules during workforce shift changes and for the delivery of larger pieces of equipment or structures could be coordinated to limit impacts on local roads. Use of shared (carpooling) and multi-person transportation (buses) during construction and operation of the facility could be encouraged. By implementing the appropriate measures, it is expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impacts during operation of the facility.

9.3.3.1.8 Historic, Cultural, and Archeological Resources

Cultural resources in Citrus County listed on the National Register of Historic Places (NRHP) include: the Citrus County Courthouse, Old Building, and the Fort Cooper site in Inverness, the Yulee Sugar Mill Historic Site in Homosassa, Mullet Key Site, and the Crystal River State Archaeological Site/Indian Mounds (Reference 9.3-001). Investigation would be required before siting a new nuclear power generating facility at this location. Consultation with the State Historic Preservation Officer (SHPO) would occur if any historic, cultural, or archeological resources were identified. Appropriate mitigation measures would be put in place before construction and operation. Therefore, impacts would be SMALL.

9.3.3.1.9 Environmental Justice

Table 9.3-12 presents demographic information for several counties surrounding the Crystal River site: Levy, Marion, Hernando, and Sumter counties.

It is anticipated that environmental justice impacts would be SMALL based on the following information provided in PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" (Reference 9.3-001):

> Given that no significant impacts on any human populations are expected to occur at any of the sites under consideration, there cannot be significant disproportionate impacts to minority or low income-populations; and based on actual employment experience, positive economic benefits have been shown to be available to all members of the population, without regard to income or ethnicity.
>
> . . . If no significant health and safety impacts are identified from reactor construction and operation, then there would be no environmental justice concerns, regardless of the percentage of minority or low-income populations found within the surrounding communities.

9.3.3.1.10 Transmission Corridors

It is anticipated that transmission system infrastructure will be needed for the proposed nuclear power generating facility. The Crystal River site is located in

the vicinity of existing load centers, and due to co-location with the CREC, construction of power transmission infrastructure within existing corridors may be possible. However, co-location with the CREC is a reliability concern due to potential impacts caused by single climatic event. (Reference 9.3-001)

It is anticipated that transmission connection costs would be in the range of $560 to $725 million (Reference 9.3-001). Transmission corridors and towers would be situated (if possible) in existing ROWs to avoid critical or sensitive habitats and species as much as possible. Specific monitoring requirements for new transmission lines, corridors, and associated switchyards will be designed to meet conditions of applicable federal, state, and local permits, to minimize adverse environmental impacts, and to ensure that organisms are protected against impacts during transmission line construction.

Transmission corridor impacts would be MODERATE on ecological resources due to the commitment of land and construction impacts associated with the installation of new infrastructure. Utilization of existing transmission corridor ROWs (if available) could present opportunities to minimize adverse impacts.

9.3.3.2 Dixie Site

The Dixie site is located in Dixie County, Florida.

9.3.3.2.1 Land Use

Existing land use surrounding the vicinity of the Dixie site is generally comprised of low-impact development including agriculture, commercial forestry, and low-density residential development. Agricultural land uses are generally not consistent with the development of a nuclear power generating facility; therefore, land use and zoning changes would be required at this site. It should be noted that much of the region's economy is dependent on ecotourism, as Dixie County is home to a NWR and numerous state parks and trails. (Reference 9.3-001)

Construction of the Dixie site would require that the land be purchased and improved. The site is relatively flat with only minor relief (approximately 0.6 m [2 ft.]), and therefore, costs associated with site improvements (such as grading and filling) are expected to be low. However, it should be noted that the site is located in an area considered to be low lying and flood prone, and the construction of flood protection structures may be required. (Reference 9.3-001)

Hazardous land use in the area includes airports. No freight rail, pipelines, or military installations are located near the site. (Reference 9.3-001)

The geology of the site consists of unconsolidated sediments (sand, silt, and clay) followed by Ocala Limestone and then Avon Park Limestone. In general, the site is primarily rock; however, the limestone rock is of variable quality and is subject to solution activity and the formation of surface and subsurface sinkholes (karst areas). Maps of the site vicinity exhibit surface depressions indicative of sinkhole formation. The PGA is 4.20%g with a 2-percent PE in 50 years. No

Class A or Class B features occur within 322.0 km (200 mi.) of the Dixie site. No surface faulting or deformation is known to occur near the site. (Reference 9.3-001)

Land use impacts from construction and operation of a nuclear power generating facility would be SMALL.

9.3.3.2.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils, would be SMALL. Potential impacts can be minimized with the use of drift eliminators on the cooling towers.

Based on the new reactor design and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting a nuclear power generating facility at this location would have a SMALL impact on air quality.

9.3.3.2.3 Water

The water metric evaluated for the Dixie site and general water usage approval are discussed in ER Subsection 9.3.3.1.3.

The primary water supply for the Dixie site is the Suwannee River. The Suwannee River has been identified by the Federal Government and the states of Florida and Georgia as "an ecosystem in need of protection", and the FDEP has classified the waterway as an OFW. It should also be noted that the Suwannee River is considered one of the largest and most ecologically unique blackwater river systems in the southeastern United States. (Reference 9.3-001)

The Suwannee River Water Management District (SRWMD) recently completed minimum flow levels (mfl) for the Suwannee River in areas potentially relevant to the Dixie site. Based on the data, there appears to be sufficient water potentially available to accommodate two nuclear units without causing an mfl violation. This data does not consider existing water consumption or available capacity; however, it does indicate that on a gross scale, the proposed nuclear power generating facility could potentially be accommodated. The SRWMD would determine the actual post-mfl yield available for consumption; however, it is likely that the site would require construction of a reservoir (size unknown at this time), because of potential water use issues. The reservoir would likely affect site development and pumping distances. (Reference 9.3-001)

Based on this information, overall water impacts would be MODERATE to LARGE.

9.3.3.2.4 Terrestrial Ecology

The relative suitability of the Dixie site with respect to potential impacts to terrestrial ecology (rare, threatened, and endangered terrestrial species, and

critical habitat) and wetlands was evaluated. There are approximately 4.5 ha (11 ac.) of high quality wetlands within the Dixie site area (Reference 9.3-001). State and federally listed protected terrestrial species that have the potential to occur in Dixie County, and therefore, within the vicinity of the Dixie site, are shown in Table 9.3-13. (Reference 9.3-004)

Anticipated terrestrial ecology impacts would be MODERATE to LARGE based primarily on the need to construct a reservoir.

9.3.3.2.5 Aquatic Ecology

The relative suitability of the Dixie site with respect to potential impacts to aquatic ecology (rare, threatened, and endangered aquatic species, and critical habitat) was evaluated. State and federally listed protected aquatic species that have the potential to occur in Dixie County, and therefore, within the vicinity of the Dixie site, are shown in Table 9.3-13. (Reference 9.3-004)

The relative potential for entrainment and impingement impacts is discussed in ER Subsection 9.3.3.1.5.

It is anticipated that impacts to aquatic ecology would be SMALL.

9.3.3.2.6 Socioeconomics

Dixie County has a 2006 population estimate of 14,964, which is an 8.2-percent increase from the 2000 population of 13,827. As of 2004, the annual median household income was $26,999, and the mean value of owner-occupied housing units was $61,700. Approximately 18 percent of the county's population lives below the poverty level. There were 840 firms doing business in the county in 2002. (Reference 9.3-006)

The impact on area employment from construction and operation of the proposed nuclear power generating facility would be SMALL because Dixie County is in reasonable proximity to population centers and a densely populated area (Reference 9.3-001).

It is expected that the impact on housing and community services in Dixie County would be SMALL based on the information provided in ER Subsection 9.3.3.1.6.

A GIS search of metadata from the FGDL was conducted to determine the number of airports, hospitals, parks, schools, law enforcement agencies and fire departments/emergency medical service centers within a 50-mile radius of the Dixie County site. The 50-mile radius search encompassed all or portions of the following counties: Alachua, Bradford, Citrus, Columbia, Dixie, Gilchrist, LaFayette, Levy, Marion, Suwannee, Taylor, and Union. The findings of the 50-mile radius search are as follows:

- Approximately 78 airports comprised of heliports, airports, and seaplane bases are located within the 50-mile radius of the Dixie County site, with

two airports, one heliport, and one sea plane base located within Dixie County (Reference 9.3-032).

- Approximately 13 hospitals comprised of Acute Care, Rehabilitation, Psychiatric, Specialty, and Federal are located within a 50-mile radius of the Dixie County site, with no hospitals located within Dixie County (Reference 9.3-033).
- Approximately 182 public/private schools comprised of pre-kindergarten, kindergarten, elementary, middle, junior and senior high school, community colleges, colleges, universities, special needs, and adult education are located within a 50-mile radius of the Dixie County site, with five schools located within Dixie County (Reference 9.3-034).
- Approximately 27 law enforcement agencies comprised of police departments, sheriffs departments, and state highway patrol are located within a 50-mile radius of the Dixie County site, with two law enforcement agencies located within Dixie County (Reference 9.3-035).
- Approximately 93 fire departments and emergency medical stations comprised of fire departments, volunteer fire departments, fire rescue stations, and emergency medical service stations are located within the 50-mile radius of Dixie County site, with 10 emergency medical stations located within Dixie County (Reference 9.3-036 and Reference 9.3-037).
- Approximately 248 parks comprised of trails, preserves, woods, forests, conservation areas, and nature center are located within the 50-mile radius of the Dixie County site, with 20 parks located within Dixie County (Reference 9.3-038).

Therefore, the effect of the proposed nuclear power generating facility on the population and demographics of Dixie County would be SMALL.

9.3.3.2.7 Transportation

The Dixie site is located near suitable roads which provide main access to the area. However, construction of local access roads would be required. Both railroad and barge access could be made available, but may not be practical because of the need to construct supporting infrastructure. Emergency evacuation of the area is possible in three directions, being limited to the west by the Gulf of Mexico. (Reference 9.3-001)

It is anticipated that there would be impacts to transportation on local roads during construction and operation activities. Mitigation measures are discussed in ER Subsection 9.3.3.1.7. By implementing the appropriate measures, it is expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impacts during operation of the facility.

9.3.3.2.8 Historic, Cultural, and Archeological Resources

Potentially significant cultural resources are located within Dixie County (Reference 9.3-001). Therefore, investigation would be required before siting a new reactor at this location. Consultation with the SHPO would occur if any significant historic, cultural, or archeological resources are identified. Appropriate mitigation measures would be put in place before construction and operation. Therefore, impacts would be SMALL.

9.3.3.2.9 Environmental Justice

Table 9.3-14 presents demographic information for several counties surrounding the Dixie site: Taylor, Suwannee, Lafayette, Gilchrist, Columbia, Levy, and Alachua counties.

It is anticipated that environmental justice impacts would be SMALL based on the information provided in ER Subsection 9.3.3.1.9.

9.3.3.2.10 Transmission Corridors

It is anticipated that power transmission system infrastructure would be needed for the proposed nuclear power generating facility. Transmission connection costs would be in the range of $560 to $725 million (Reference 9.3-001). Transmission corridors and towers would be situated (if possible) in existing ROWs to avoid critical or sensitive habitats and species as much as possible. Specific monitoring requirements for new transmission lines and corridors, and associated switchyards will be designed to meet conditions of applicable federal, state, and local permits, to minimize adverse environmental impacts, and to ensure that organisms are protected against impacts during transmission line construction.

Transmission corridor impacts would be MODERATE on ecological resources due to the commitment of land and construction impacts associated with the installation of new infrastructure. Utilization of existing transmission corridor ROWs (if available) could present opportunities to minimize adverse impacts.

9.3.3.3 Highlands Site

The Highlands site is located in Highlands County, Florida.

9.3.3.3.1 Land Use

Land use in the vicinity of the Highlands site is mostly agricultural. Both land use change and zoning change would be required for the construction of a nuclear power generating facility at this site. The area contains publicly owned land including state and county parks, and a number of lakes. (Reference 9.3-001)

Land needed for a new nuclear power generating facility would have to be purchased. The site is relatively flat, with only minor relief (approximately 0.3 m

[1 ft.]), and therefore, costs associated with site improvements (such as grading and filling) are expected to be low. The site has the potential for flooding and the construction of flood protection structure may be necessary. (Reference 9.3-001)

Hazardous land use in the area includes airports, railroads, and a military installation. No pipelines are located within 16.1 km (10 mi.) of the site. (Reference 9.3-001)

The geology of the Highlands site consists of approximately 15.2 m (50 ft.) of undifferentiated sediments consisting primarily of sands and silty clays. Under this layer is approximately 137.2 m (450 ft.) of Hawthorn Group sediments consisting predominately of sands, clays, limestone, and dolostone. The Hawthorn sediments are underlain by the Suwannee and Ocala Limestones. The PGA is 3.58%g with a 2-percent PE in 50 years. No Class A or Class B features occur within 322 km (200 mi.) of the site. No surface faulting or deformation is known to occur at the site. The site is located in an area of potential solutioning and sinkhole formation. (Reference 9.3-001)

Land use impacts from construction and operation of a nuclear power generating facility would be SMALL.

9.3.3.3.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils, would be SMALL. Potential impacts can be minimized with the use of drift eliminators on the cooling towers.

Based on the new reactor design and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting a nuclear power generating facility at this location would have a SMALL impact on air quality.

9.3.3.3.3 Water

The water metric evaluated for the Highlands site and general water usage approval is discussed in ER Subsection 9.3.3.1.3.

The primary water source for the Highlands site is the Kissimmee River. It is likely that the construction of a reservoir would be required to meet the water requirements for the proposed nuclear power generating facility. (Reference 9.3-001)

There are several water-related issues that make use of the Highlands site problematic. The channelized Kissimmee River is the nearest primary water source for this site. This stretch of the river will be affected by the ongoing Kissimmee River restoration project. The restoration project will convert the channelized portion of the river back to the original Kissimmee River bed. (Reference 9.3-001)

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" provides the following information about the Kissimmee River restoration project (Reference 9.3-001):

> The South Florida Water Management District (SFWMD or District) published a Kissimmee Basin Water Supply Plan in April of 2000 (KBWSP) . . . Based upon these documents, related documents describing the Kissimmee River Restoration Plan, and various maps and supporting information available from the District and the [U.S.] Army Corps of Engineers [USACE], the following matters are relevant to the Highland County site and the potential use of the Kissimmee River for water supply and discharge.
>
> 1. *The Lower Kissimmee River Is Regulated By the SFWMD and [USACE].* While not necessarily an obstacle to drawing water from the lower Kissimmee, any such water use would have to be coordinated with the [USACE] and District and be consistent with each agency's efforts in implementing the Comprehensive Everglades Restoration Plan (CERP) as well as the Kissimmee River Restoration Plan. Additionally, the District is a party to an intergovernmental agreement with the Seminole Tribe to assure water entitlements to the Brighton Reservation south of the Highlands County site in Glades County.
>
> 2. *Water Supply Is Highly Regulated In The Vicinity of the Proposed Site.* The District's 2000 Water Supply Plan identifies a large area northwest of Lake Okeechobee as a "Water Resource Caution Area" and "Restricted Allocation Area" . . . Additionally, under Rule 40E-23.021(2), F.A.C., the District defines "Critical Water Supply Problem Areas" as those which have experienced water supply problems or are expected to have water supply problems in the next 20 years. The definition incorporates the area northwest of Lake Okeechobee, and encompassing the general vicinity of the proposed Highlands County site, as part of the Critical Water Supply Problem Area.
>
> While the site does fall in an area where water supply is an issue, the District seems to take the position that power plants—which fall into the District's water use category of "Thermoelectric Self-Supplied" in the plan—are not problematic from a water supply perspective.
>
> 3. *Minimum Flows And Levels Are Pending.* A minimum flow is that flow at which further withdrawals would cause significant harm to the water resources or ecology of the area. [Mfls] for the Kissimmee River have not been adopted to date but are anticipated for 2008, and the 2005 draft KBWSP update notes that a pending "Long Term Management Plan" for the lakes in the Kissimmee chain must be completed to determine the volume and timing of water availability in the Kissimmee River.

> In summary, while there is nothing absolutely precluding the Lower Kissimmee River as a source of water, and point of discharge, the regulatory intricacies and potential costs need to be weighed. At this point, it is still unknown what effect, if any, the Kissimmee Restoration River Project might have on water availability and whether the project would limit water supply or provide an opportunity for collaboration with the District and [USACE].

Based on the information provided, overall water impacts would be MODERATE to LARGE based primarily on the uncertainty of available water.

9.3.3.3.4 Terrestrial Ecology

The relative suitability of the Highlands site with respect to potential impacts to terrestrial ecology (rare, threatened, and endangered terrestrial species, and critical habitat) and wetlands was evaluated. There are approximately 13.8 ha (34 ac.) of high quality wetlands within the Highlands site area. State and federally listed protected terrestrial species that have the potential to occur in Highlands County, and therefore, within the vicinity of the Highlands site, are shown in Table 9.3-15. (Reference 9.3-004)

Based on the number of threatened and endangered terrestrial species in the area and the need to construct a reservoir, anticipated terrestrial ecology impacts would be MODERATE to LARGE.

9.3.3.3.5 Aquatic Ecology

The relative suitability of the Highlands site with respect to potential impacts to aquatic ecology (rare, threatened, and endangered aquatic species, and critical habitat) was evaluated. There are no federally listed protected aquatic species in the site vicinity. Protected aquatic species listed by the State of Florida that have the potential to occur in Highlands County, and therefore, within the vicinity of the Highlands site, are shown in Table 9.3-15. (Reference 9.3-004)

The relative potential for entrainment and impingement impacts is discussed in ER Subsection 9.3.3.1.5.

Anticipated aquatic ecology impacts would be SMALL.

9.3.3.3.6 Socioeconomics

Highlands County has a 2006 population estimate of 97,987, which is a 12.2-percent increase from the 2000 population of 87,366. As of 2004, the annual median household income was $30,343, and the mean value of owner-occupied housing units was $72,800. Approximately 13.1 percent of the county's population lives below the poverty level. There were 6020 firms doing business in the county in 2002. (Reference 9.3-007)

The impact on area employment from construction and operation of the proposed nuclear power generating facility would be SMALL because Highlands County is located near population centers and densely populated areas (Reference 9.3-001).

A GIS search of metadata from the FGDL was conducted to determine the number of airports, hospitals, parks, schools, law enforcement agencies and fire departments/emergency medical service centers within a 50-mile radius of the Highlands County site. The 50-mile radius search encompassed all or portions of the following counties: Brevard, Charlotte, Collier, DeSoto, Glades, Hardee, Hendry, Highlands, Indian River, Lee, Martin, Okeechobee, Osceola, Palm Beach, Polk, and St. Lucie. The findings of the 50-mile radius search are as follows:

- Approximately 101 airports comprised of heliports, airports, and seaplane bases are located within the 50-mile radius of the Highlands County site, with nine airports, five heliports, and one sea plane base located within Highlands County (Reference 9.3-032).
- Approximately 15 hospitals comprised of Acute Care, Rehabilitation, Psychiatric, Specialty, and Federal are located within a 50-mile radius of the Highland County site, with 3 Acute Care hospitals residing within Highland County (Reference 9.3-033).
- Approximately 260 public/private schools comprised of pre-kindergarten, kindergarten, elementary, middle, junior and senior high school, community colleges, colleges, universities, special needs, and adult education are located within a 50-mile radius of the Highlands County site, with 37 schools located within Highlands County (Reference 9.3-034).
- Approximately 30 law enforcement agencies comprised of police departments, sheriffs departments, and state highway patrol are located within a 50-mile radius of the Highlands County site, with five law enforcement agencies located within Highlands County (Reference 9.3-035).
- Approximately 88 fire departments and emergency medical stations comprised of fire departments, volunteer fire departments, fire rescue stations, and emergency medical service stations are located within the 50-mile radius of Highlands County site, with 24 fire departments and emergency medical stations located within Highlands County (Reference 9.3-036 and Reference 9.3-037).
- Approximately 248 parks comprised of trails, preserves, woods, forests, conservation areas, and nature center are located within a 50-mile radius of the Highlands County site, with 20 parks located within Highlands County (Reference 9.3-038).

It is expected that the impact on housing and community services would be SMALL based on the information provided in ER Subsection 9.3.3.1.6. Therefore,

the effect of the proposed facility on the population and demographics of Highlands County would be SMALL.

9.3.3.3.7 Transportation

There are sufficient roads in the vicinity of the Highlands site that provide main access to the area. However, construction of local access roads would be required. Both railroad and barge access could be made available, but may not be practical because of the need to construct supporting infrastructure. Emergency evacuation of the area is possible in all directions, but is limited to the southeast due to Lake Okeechobee. (Reference 9.3-001)

It is anticipated that there would be impacts to transportation on local roads during construction and operation activities. Mitigation measures are discussed in ER Subsection 9.3.3.1.7. By implementing the appropriate measures, it is expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impacts during operation of the facility.

9.3.3.3.8 Historic, Cultural, and Archeological Resources

An initial database search for potentially significant cultural resources in Highlands County did not identify any NRHP-listed sites in the vicinity of the Highlands site (Reference 9.3-001). However, a cultural and archeological resources investigation would be required before siting a new reactor at this location. Consultation with the SHPO would occur if any significant historic, cultural, or archeological resources are identified. Appropriate mitigation measures would be put in place before construction and operation. Therefore, impacts would be SMALL.

9.3.3.3.9 Environmental Justice

Table 9.3-16 presents demographic information for several counties surrounding the Highlands site: Highlands, Hardee, De Soto, Glades, Okeechobee, Martin, Polk, Osceola, and St. Lucie counties.

It is anticipated that environmental justice impacts would be SMALL based on the information provided in ER Subsection 9.3.3.1.9.

9.3.3.3.10 Transmission Corridors

It is anticipated that power transmission system infrastructure would be needed for the proposed nuclear power generating facility. Transmission connection costs would be in the range of $1370 million (Reference 9.3-001). Transmission corridors and towers would be situated (if possible) in existing ROWs to avoid critical or sensitive habitats and species as much as possible. Specific monitoring requirements for new transmission lines and corridors, and associated switchyards will be designed to meet conditions of applicable federal, state, and local permits, to minimize adverse environmental impacts, and to ensure that organisms are protected against impacts during transmission line construction.

Transmission corridor impacts would be LARGE on ecological resources due to the commitment of land and construction impacts associated with the installation of new infrastructure. Utilization of existing transmission corridor ROWs (if available) could present opportunities to minimize adverse impacts.

9.3.3.4 Putnam Site

The Putnam site is located in Putnam County, Florida.

9.3.3.4.1 Land Use

Land use surrounding the Putnam site is mostly agricultural. As previously noted, agricultural land uses are generally not compatible with a nuclear power generating facility; therefore, both land use and zoning changes would be required. It should be noted that there are large publicly owned properties in the vicinity of the site including a national forest and a state park. The St. Johns River is also located in the county and is one of only 14 rivers designated as an American Heritage River. (Reference 9.3-001)

Land needed for a new nuclear power generating facility would have to be purchased. The Putnam site consists of relatively flat upland area with greater relief (approximately 6.1 m [20 ft.]); therefore, costs associated with site grading are expected to be relatively low. The Putnam site is located at a sufficient elevation such that construction of flood protection structures is not likely to be necessary. (Reference 9.3-001)

Hazardous land use near the Putnam site includes airports, railroads, power generating facilities, and a military installation. There are no pipelines within 16.1 km (10 mi.) of the site. (Reference 9.3-001)

The geology of the Putnam site consists of undifferentiated sediments in excess of 6.1 m (20 ft.) in thickness consisting primarily of sands and silty clays, which are underlain by Hawthorn Group sediments consisting predominately of sands, clays, limestone, and dolostone. The Hawthorn sediments are underlain by Ocala Limestones. The PGA is 5.29%g with a 2-percent PE in 50 years. No Class A or Class B features occur within 322 km (200 mi.) of the Putnam site. [b] No surface faulting or deformation is known to occur at the site. The site is located in an area of potential limestone solution and sinkhole formation (karst development). (Reference 9.3-001)

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b. Class A features have good geologic evidence of tectonic origin and are potentially seismogenic. Class B features have geologic evidence that supports the existence of a seismogenic fault or suggests Quaternary deformation, but the currently available geologic evidence for Quaternary tectonic activity is less compelling than for a Class A feature.

Land use impacts from construction and operation of a nuclear power generating facility would be SMALL.

9.3.3.4.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils would be SMALL. Potential impacts can be minimized with the use of drift eliminators on the cooling towers.

Based on the new reactor design and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting the unit at this location would have a SMALL impact on air quality.

9.3.3.4.3 Water

The water metric evaluated for the Putnam site and general water usage approval is discussed in ER Subsection 9.3.3.1.3.

The primary water supply for the Putnam site is the St. Johns River. Based on a preliminary review of the low flow of record event for the St. Johns River in the proximity of the site, reservoir construction may be needed at the site. Construction of a reservoir would impact existing hydrologic conditions, require large land use changes, and interfere with future restoration plans on the St.Johns River. (Reference 9.3-001) Therefore, the impact would be LARGE.

One water-related issue associated with the Putnam site is a restoration project. The St. Johns River Alliance, in coordination with the water management district and the FDEP, is developing a 4.6 billion dollar restoration plan for the entire river. Some of this money will go to the purchasing of thousands of acres of land along the river for conservation purposes. (Reference 9.3-001)

PEF's "New Nuclear Baseload Generation Addition, Evaluation of Florida Sites" provides the following information (Reference 9.3-001):

> Also of note for [the Putnam site] is the importance of commercial fishing in Putnam County. According to the Putnam County Chamber of commerce, Putnam County is the bass capital of the world. The St. Johns River abounds with largemouth bass [*Micropterus salmoides*], speckled perch [*Pomoxis nigromaculatus*], striped bass [*Morone saxatilis*], catfish [*Ameiurus* spp.], and bream [*Lepomis* spp.]. Also blue crabs [*Callinectes sapidus]* and shrimp [*Penaeidae spp.*] are caught in the river in season. Some 40 or more fish camps and resorts are found along the banks of the river.

It is anticipated that water impacts would be MODERATE to LARGE based on the low flow of record event for the St. Johns River and the need for a reservoir.

9.3.3.4.4 Terrestrial Ecology

The relative suitability of the Putnam site with respect to potential impacts to terrestrial ecology (rare, threatened, and endangered terrestrial species, and critical habitat) and wetlands was evaluated. There are approximately 110.5 ha (273 ac.) of high quality wetlands within the Putnam site area (Reference 9.3-001). State and federally listed protected terrestrial species that have the potential to occur in Putnam County, and therefore, within the vicinity of the Putnam site, are shown in Table 9.3-17 (Reference 9.3-004).

Based on the amount of wetlands on site and the need to construct a reservoir, anticipated terrestrial ecology impacts would be MODERATE to LARGE.

9.3.3.4.5 Aquatic Ecology

The relative suitability of the Putnam site with respect to potential impacts to aquatic ecology (rare, threatened, and endangered aquatic species, and critical habitat) was evaluated. State and federally listed protected aquatic species that have the potential to occur in Putnam County, and therefore, within the vicinity of the Putnam site, are shown in Table 9.3-17. (Reference 9.3-004)

The relative potential for entrainment and impingement impacts is discussed in ER Subsection 9.3.3.1.5.

It is anticipated that aquatic ecology impacts would be SMALL based on the information described above.

9.3.3.4.6 Socioeconomics

Putnam County has a 2006 population estimate of 74,083, which is a 5.2-percent increase from the 2000 population of 70,423. As of 2004, the annual median household income was $30,098, and the mean value of owner-occupied housing units was $68,500. Approximately 17.3 percent of the county's population lives below the poverty level. There were 4372 firms doing business in the county in 2002. (Reference 9.3-008)

The impact on area employment from construction and operation of the proposed nuclear power generating facility would be SMALL because Putnam County is in reasonable proximity to population centers and a densely populated area (Reference 9.3-001).

A GIS search of metadata from the FGDL was conducted to determine the number of airports, hospitals, parks, schools, law enforcement agencies and fire departments/emergency medical service centers within a 50-mile radius of the Putnam County site. The 50-mile radius search encompassed all or portions of the following counties: Alachua, Baker Bradford, Clay, Duval, Flagler, Lake, Marion, Nassau, Putnam, St. Johns, Union, and Volusia. The findings of the 50-mile radius search are as follows:

- Approximately 84 airports comprised of heliports, airports, and seaplane bases are located within the 50-mile radius of the Putnam County site, with 11 airports and two heliports located within Putnam County (Reference 9.3-032).
- Approximately 35 hospitals comprised of Acute Care, Rehabilitation, Psychiatric, Specialty, and Federal are located within a 50-mile radius of the Putnam County site, with one Acute Care hospital residing within Putnam County (Reference 9.3-033).
- Approximately 801 public/private schools comprised of pre-kindergarten, kindergarten, elementary, middle, junior and senior high school, community colleges, colleges, universities, special needs, and adult education are located within a 50-mile radius of the Putnam County site, with 42 schools located within Putnam County (Reference 9.3-034).
- Approximately 41 law enforcement agencies comprised of police departments, sheriffs departments, and state highway patrol are located within a 50-mile radius of the Putnam County site, with five law enforcement agencies located within Putnam County (Reference 9.3-035).
- Approximately 218 fire departments and emergency medical stations comprised of fire departments, volunteer fire departments, fire rescue stations, and emergency medical service stations, are located within the 50-mile radius of Putnam County site, with 27 fire departments and emergency medical stations located within Putnam County (Reference 9.3-036 and Reference 9.3-037).
- Approximately 248 parks comprised of trails, preserves, woods, forests, conservation areas, and nature center are located within a 50-mile radius of the Putnam County site, with 20 parks located within Putnam County (Reference 9.3-038).

It is expected that the impact on housing and community services would be SMALL based on the information provided in ER Subsection 9.3.3.1.6. Therefore, the effect of the proposed facility on the population and demographics of Putnam County would be SMALL.

9.3.3.4.7 Transportation

There appear to be sufficient roads in the vicinity of the site, which provide main access to the area. However, construction of local access roads would be required. Both railroad and barge access to the site may be practical. Emergency evacuation of the area is possible in all directions, but area evacuation is limited to the east due to the Atlantic Ocean. (Reference 9.3-001)

It is anticipated that there would be impacts to transportation on local roads during construction and operation activities. Mitigation measures are discussed in ER Subsection 9.3.3.1.7. By implementing the appropriate measures, it is

expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impacts during operation of the facility.

9.3.3.4.8 Historic, Cultural, and Archeological Resources

NRHP-listed sites are located in Putnam County (Reference 9.3-001). Therefore, investigation would be required before siting a new reactor at this location. Consultation with the SHPO would occur if any significant historic, cultural, or archeological resources are identified. Appropriate mitigation measures would be put in place before construction and operation. Therefore, impacts would be SMALL.

9.3.3.4.9 Environmental Justice

Table 9.3-18 presents demographic information for several counties surrounding the Putnam site: Putnam, Clay, Alachua, Marion, Volusia, Flagler, and St. Johns (St. Augustine) counties.

It is anticipated that environmental justice impacts would be SMALL based on the information provided in ER Subsection 9.3.3.1.9.

9.3.3.4.10 Transmission Corridors

It is anticipated that power transmission system infrastructure would be needed for the proposed nuclear power generating facility. Transmission connection costs would be in the range of $1013 million (Reference 9.3-001). Transmission corridors and towers would be situated (if possible) in existing ROWs to avoid critical or sensitive habitats and species as much as possible. Specific monitoring requirements for new transmission lines and corridors, and associated switchyards will be designed to meet conditions of applicable federal, state, and local permits, to minimize adverse environmental impacts, and to ensure that organisms are protected against impacts during transmission line construction.

Transmission corridor impacts would be LARGE due to the commitment of land and construction impacts associated with the installation of new infrastructure on ecological resources. Utilization of existing transmission corridor ROWs (if available) could present opportunities to minimize adverse impacts.

9.3.3.5 LNP Site

The LNP site is located in Levy County, approximately 6.4 km (4 mi.) north of County Road 40 (CR-40), approximately 6.4 km (4 mi.) east of US-19 at Inglis, and approximately 14.5 km (9 mi.) west of US-41 at Dunnellon (Reference 9.3-001).

9.3.3.5.1 Land Use

Potential land use impacts associated with the construction and operation of the LNP are discussed in ER Sections 4.1 and 5.1, respectively.

Overall land use impacts are anticipated to be SMALL.

9.3.3.5.2 Air Quality

Potential air quality impacts associated with the construction and operation of the LNP are discussed in ER Subsections 4.4.1.2 and 5.8.1.2, respectively.

Air quality impacts are anticipated to be SMALL.

9.3.3.5.3 Water

LNP water use and associated impacts from construction and operation activities are discussed in ER Subsections 4.2.2 and 5.2.2, respectively.

Water use impacts are anticipated to be SMALL.

9.3.3.5.4 Terrestrial Ecology

Terrestrial ecology impacts at the LNP site from the construction and operation of the LNP are discussed in ER Subsections 4.3.1, 5.3.3.2, and 5.6.1.

Terrestrial ecology impacts are anticipated to be SMALL to MODERATE due to the loss of habitat associated with the construction of the LNP.

9.3.3.5.5 Aquatic Ecology

Aquatic ecology impacts at the LNP site from the construction and operation of the LNP are discussed in ER Subsections 4.3.2, 5.3.1.2, 5.3.2.2, and 5.6.2.

Aquatic ecology impacts are anticipated to be SMALL.

9.3.3.5.6 Socioeconomics

Socioeconomic impacts associated with the construction and operation of the LNP are discussed in ER Sections 4.4 and 5.8, respectively.

As described in ER Chapter 2, airports, hospitals, parks, schools, law enforcement agencies, and fire departments/emergency medical service centers have been identified within a 50-mile radius of the Levy County site. The 50-mile radius search encompassed all or portions of the following counties: Alachua, Citrus, Dixie, Gilchrist, Hernando, Lake, Levy, Marion, Pasco, Putnam, and Sumter. The findings of the 50-mile radius search are as follows:

- Fifty-seven public and private airports are located within the 50-mile radius of the Levy County site.
- Sixteen hospitals are located within a 50-mile radius of the Levy County site.

- One hundred sixty-one primary and secondary schools are located within a 50-mile radius of the Levy County site.
- Seventy-nine police and sheriffs departments are located within a 50-mile radius of the Levy County site.
- One hundred fifty-four fire departments are located within the 50-mile radius of Levy County site, with 14 in Levy County.
- Twenty-nine state parks and numerous other parks and recreational areas are located within a 50-mile radius of the Levy County site.

Overall socioeconomic impacts are anticipated to be SMALL.

9.3.3.5.7 Transportation

The impacts on transportation from the construction and operation of the LNP are discussed in ER Subsections 4.4.2.10 and 5.8.2.8, respectively.

Transportation impacts are anticipated to be SMALL to MODERATE during construction of the power generating facility and SMALL during operation of the power generating facility.

9.3.3.5.8 Historic, Cultural, and Archeological Resources

A discussion of potential impacts to historic, cultural, and archeological resources from the construction and operation of the LNP is provided in ER Subsections 4.1.3.4 and 5.1.3, respectively.

Overall historic, cultural, and archeological resources impacts are anticipated to be SMALL.

9.3.3.5.9 Environmental Justice

Environmental justice impacts from the construction and operation of the LNP are discussed in ER Subsections 4.4.3 and 5.8.3, respectively.

Environmental justice impacts are anticipated to be SMALL.

9.3.3.5.10 Transmission Corridors

Transmission system environmental impacts from the construction and operation of the LNP are discussed in ER Subsection 4.1.2 and ER Section 5.6, respectively.

Overall transmission system impacts are anticipated to be SMALL.

9.3.4 SUMMARY AND CONCLUSIONS

As discussed in detail in ER Subsections 9.3.2.1.6 and 9.3.2.1.7, the LNP site was selected as the proposed site for the PEF COLA based on the following site characteristics:

- Lower transmission system direct connect and upgrade costs than the Dixie, Highlands, and Putnam sites.
- Significant strategic reliability advantages over Crystal River, both with respect to storm surge flooding and the potential for single weather event outages.
- Geotechnical conditions that allow design of facility foundations that will support deployment of a certified design without a requirement for deep foundations.
- Ecological conditions similar to those at other alternative sites.
- Adequate water supply (from the Gulf of Mexico through the Florida Barge Canal), without impacting riverine surface water resources.

Although many of these characteristics also apply to Crystal River, the severe potential impact of single-event weather-related outages if all units were placed at the Crystal River site drives the decision to select the LNP site over the Crystal River site. The significant additional reliability inherent in developing a nuclear power generating facility at the LNP site, rather than at Crystal River, is the primary reason for selecting the LNP site as the preferred (or proposed) site for preparation of the PEF COLA in Florida.

Finally, as summarized in Table 9.3-19, no alternative sites are environmentally preferable and, therefore, cannot be considered obviously superior to the LNP site.

9.3.5 REFERENCES

9.3-001 Progress Energy Florida, Inc., “New Nuclear Baseload Generation Addition, Evaluation of Florida Sites,” (Proprietary) October 2007.

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9.3-006 U.S. Census Bureau, "State & County QuickFacts: Dixie County, Florida," Website, www.quickfacts.census.gov/qfd/states/12/12029.html, accessed January 4, 2008.

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9.3-015 U.S. Census Bureau, "State & County QuickFacts: Lafayette County, Florida," Website, www.quickfacts.census.gov/qfd/states/12/12067.html, accessed January 31, 2008.

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9.3-019 U.S. Census Bureau, "State & County QuickFacts: St. Lucie County, Florida," Website, www.quickfacts.census.gov/qfd/states/12/12111.html, accessed January 31, 2008.

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Table 9.3-1 (Sheet 1 of 2)
Process Used for Screening the Region of Interest

Data Category	Mapped Data	Screening Criteria	Suitability Impact	Data Source(s)	Comments/Rationale
Geology/ Seismic	None (see Comments)	Areas within 25 mi. of capable faults Areas within 5 mi. of surface faults	Excluded Excluded	USGS Records Crystal River FSARs	No surface faults appear on the Florida. State Geologic Map and no capable structures are identified in the USGS database for Florida. There are no Class A or B features in Florida. Accordingly, no mapping criteria for geologic/seismic issues were applied in regional screening.
Population	Population Density	Counties where population density is greater than 300 persons/mi.^{2}	Excluded	2000 Census	Counties with greater than 300 persons/mi.^{2} likely have multiple imbedded areas with greater than 500 persons/mi.^{2}. Siting within these areas would place the plant within an unacceptable distance of high population density areas.
Water Availability	Water sources (large rivers, coastal areas)	River reaches for which the average flow is greater than 10 times the plant makeup water requirement.	Excluded areas greater than 5 mi. from water bodies that meet the mapping criteria	USGS Records	Rivers for which more than 10% of the average flow will be required for makeup water may present permitting or operational water supply problems. Pumping makeup water more than 5 mi. imposes significant construction and operational costs and can result in operational risks.
Dedicated Land Use	Federal and State parks, monuments, wildlife areas, wilderness areas, wild and scenic rivers	5-mi. buffer around each mapped feature.	Excluded	Federal and State Land Use Maps	A 5-mi. buffer is expected to provide mitigation for potential visual impacts of a plant located near dedicated land uses.
Regional Ecological Features	Known mapped wetlands, estuaries, designated Threatened and Endangered species habitat	Map areal extent of identified features	Excluded		Development of a plant at the location of significant known areas of ecological importance could result in unacceptable environmental impacts and/or challenge as to whether obviously superior alternatives are available. Permitting may be significantly more difficult in marsh or estuarine areas of ecological sensitivity.

Table 9.3-1 (Sheet 2 of 2)
Process Used for Screening the Region of Interest

Data Category	Mapped Data	Screening Criteria	Suitability Impact	Data Source(s)	Comments/Rationale
Transmission	None (see Comments)	N/A	N/A	N/A	Load conditions on the existing transmission grid are such that a new plant would be connected directly to load centers rather than being tied into the existing system. Accordingly, transmission was not evaluated directly in regional screening, but was taken into account in later stages of the site selection process as a site-specific cost issue in terms of distance to the load centers in the Orlando and Tampa-St. Petersburg areas.

Notes:

FSAR = Final Safety Analysis Report
mi. = mile
mi.^{2} = square mile
N/A = not applicable
USGS = U.S. Geological Survey

Source: Reference 9.3-001

Table 9.3-2 (Sheet 1 of 3)
Screening Criteria Used for the Evaluation of Potential Sites

Criterion Number	Criterion	Measure of Suitability	
		Metric	Rating Rationale
P1	Water Supply	Low flow for period of record.	5 = no practical restriction 4 = greater than approximately 10 times the requirement 3 = 2 to 10 times the requirement 2 = 2 times the requirement 1 = requirement near or below low flow
P2	Flooding	Difference between mean site elevation and mean water elevation from USGS topographic maps, USGS gaging station measurements.	5 = greater than 20 ft. 4 = less than 20 ft. 3 = less than 10 ft. 2 = less than 6 ft. (or near swamp lands) 1 = less than 3 ft. (or in swamp lands)
P3	Population	Composite ratings were based on an average of following two features: (1) Distance to nearest population center (high density based on screening map); and (2) population density of host county. In addition, a rating point was deducted or added, respectively, if the site is in a particularly densely populated area or not.	5 = no population centers within 20 mi. 4 = population centers within 20 mi. 3 = population centers within 15 mi. 2 = population centers within 10 mi. 1= population centers within 5 mi. County Population Density Ratings: 5 = less than 50 persons per square mi. 4 = less than 100 persons per square mi. 3 = less than 250 persons per square mi. 2 = less than 500 persons per square mi. 1 = greater than 500 persons per square mi. Point added if no densely populated area is found within 40 mi. of the site; point deducted if a densely populated area is found within 15 mi. of the site or if a large grouping of densely populated areas are located within 15 to 40 mi. of the site.

Table 9.3-2 (Sheet 2 of 3)
Screening Criteria Used for the Evaluation of Potential Sites

Criterion Number	Criterion	Measure of Suitability	
		Metric	Rating Rationale
P4	Hazardous Land Uses	Number of airports, pipelines, and other known hazardous industrial facilities (including Air Force Bases and Kennedy Space Center/Cape Canaveral), as determined from publicly available data.	5 = No hazardous land uses within 10 mi. 4 = No major or multiple hazardous land uses within 5 mi.; minor hazardous land uses between 5 and 10 mi. (for example, small airport or pipeline). 3 = No hazardous land uses within 5 mi.; major or multiple (minor) hazardous land uses between 5 and 10 mi. 2 = Minor hazardous facilities within 5 mi. 1 = Major hazardous facilities within 5 mi.
P5	Ecology	Number of Federal Rare, Threatened, and Endangered Species in the county (aquatic and terrestrial)	5 = 0 species 4 = 1 to 5 species 3 = 6 to 10 species 2 = 11 to 15 species 1 = 16 or more species
P6	Wetlands	Number of ac. or percentage of wetlands within site area (acreages based on nominal 6000 ac.).	5 = less than 60 ac. (1%) 4 = less than 300 ac. (5%) 3 = less than 600 ac. (10%) 2 = less than 1200 ac. (15%) 1 = greater than 1200 ac.
P7	Railroad Access	Estimated cost of constructing rail spur to the site, based on distance in miles to the nearest in-service rail line.	Ratings computed by scaling costs from lowest (rating = 5) to highest (rating = 1). Costs were estimated by applying an assumed unit cost of $2 million per mile to the distance measured to the nearest in-service rail line.

Table 9.3-2 (Sheet 3 of 3)
Screening Criteria Used for the Evaluation of Potential Sites

Criterion Number	Criterion	Measure of Suitability	
		Metric	Rating Rationale
P8	Transmission Access	Load conditions on the existing grid are such that a new plant would be connected directly to load centers rather than being tied into the existing system. Transmission access is evaluated in terms of distance to the load centers in the Orlando and Tampa – St. Petersburg areas. Measurements taken from each potential site to each area, as well as a point midway between the two. Shortest distance of the three was used in ratings determination.	Ratings computed by scaling costs from lowest (rating = 5) to highest (rating = 1). Costs were estimated by applying an assumed unit cost of $4 million per mi. ($2 million per mile multiplied by 2 to reflect double-circuit connections) to the measured distance.
P9	Land Acquisition	Estimated cost of acquiring land (nominally 2000 ac.) at the site, based on the following assumed cost per ac: – very remote areas = $1500 per ac. – farm areas = $1500 to $3000 per acre (based on 2002 average cost of farmland per ac. by county, U.S. Census of Agriculture) – land near population centers = $3000 to $6000 per ac.	Ratings computed by scaling costs from lowest (rating = 5) to highest (rating = 1)

Notes:

Ratings for Criteria P7, P8, and P9 were developed by normalizing ratings for individual cost criteria across the total cost differentials across all sites, so that differences in ratings are proportional to relative differences in cost across all three criteria. Criteria types are identified in ER Subsection 9.3.2.1.4.

ac. = acre
ft. = foot
mi. = mile
USGS = U.S. Geological Survey

Source: Reference 9.3-001

Table 9.3-3
Criterion Weight Factors Used for the Evaluation of Potential Sites

Criterion Number	Criterion	Weight Factor
P1	Cooling Water Supply	9.8
P2	Flooding	4.4
P3	Population	8.6
P4	Hazardous Land Uses	5.9
P5	Ecology	5.6
P6	Wetlands	5.6
P7	Railroad Access	6.7
P8	Transmission Access	7.4
P9	Land Acquisition	6.3

Source: Reference 9.3-001

Table 9.3-4 (Sheet 1 of 2)
Technical Evaluation Screening for Potential Sites

Potential Site Name	Criterion									Composite Site Rating
	P1	P2	P3	P4	P5	P6	P7	P8	P9	
	Cooling Water Supply	Flooding	Population	Hazardous Land Uses	Ecology	Wetlands	Railroad Access	Transmission Access	Land Acquisition	
	Weight Factor									
	9.8	4.4	8.6	5.9	5.6	5.6	6.7	7.4	6.3	
	Site Ratings									
Taylor	5	4	5	3	2	5	4.4	2.9	5	248.8
Levy 2	5	4	4	2	2	4	4.9	3.9	5	239.2
Levy 3	5	2	5	2	2	4	4.7	3.5	5	234.7
Lafayette	3	5	5	2	3	4	4.8	3.1	5	232.2
Crystal River	5	3	4	1	2	4	4.9	3.9	5	229.1
Gilchrist	3	5	4	2	4	3	4.9	3.1	5	224
Dixie	3	4	4	2	2	5	4.7	3.1	5	218.8
Hillsborough	5	4	1	2	2	5	5	3.7	5	218.4
Putnam 2	3	3	4	2	3	3	4.9	3.9	5	215.9
Putnam 1	3	2	3	3	3	4	5	4	5	215.1
Putnam 3	3	2	3	3	3	4	5	3.9	5	214.5
Manatee	2	5	2	3	2	5	4.9	4.6	5	214
Levy 1	3	4	3	2	2	4	4.9	3.3	5	206.6
Highlands	2	4	3	2	1	5	4.9	3.6	5	199.1

Table 9.3-4 (Sheet 2 of 2)
Technical Evaluation Screening for Potential Sites

Potential Site Name	Criterion									Composite Site Rating
	P1	P2	P3	P4	P5	P6	P7	P8	P9	
	Cooling Water Supply	Flooding	Population	Hazardous Land Uses	Ecology	Wetlands	Railroad Access	Transmission Access	Land Acquisition	
	Weight Factor									
	9.8	4.4	8.6	5.9	5.6	5.6	6.7	7.4	6.3	
	Site Ratings									
Seminole	2	4	1	2	3	4	4.9	4.7	5	195.6
Volusia	2	3	2	3	1	4	4.8	4.6	5	193.4
Liberty 1	4	5	4	2	1	1	4.9	1.3	5	192.3
Gulf	5	1	5	2	1	1	5	1	5	191.6
Liberty 2	1	5	4	4	1	3	4.9	1.6	5	188.3
Calhoun	2	1	4	2	2	2	4.8	1.1	5	164.8

Source: Reference 9.3-001

Table 9.3-5 (Sheet 1 of 2)
Summary of Screening Evaluation for Potential Sites

Potential Sites	Composite Technical Screening Order	Final Ranking		Water Source	PEF Preliminary Input				
		Technical Screening Top 8	PEF Down-Select Decision		Transmission	Community Support	Economic Development	Environment	Legislative
Taylor	1	**Taylor**	**Taylor**	Gulf of Mexico	Green	Green	Yellow	Yellow	
Levy 2	2	**Levy 2**	**Levy 2**	Florida Barge Canal	Green	Green	Green	Yellow	
Levy 3	3	**Levy 3**	**Levy 3**	Gulf of Mexico	Green	Green	Yellow	Yellow	
Lafayette	4	**Lafayette**	**Lafayette**	Suwannee River	Green	Yellow	Red	Yellow	
Crystal River	5	**Crystal River**	**Crystal River**	Gulf of Mexico	Yellow	Green	Yellow	Green	Green
Gilchrist	6	**Gilchrist**	(Not Selected)	Suwannee/ Santa Fe	Green	Yellow	Red	Yellow	
Dixie	7	**Dixie**	**Dixie**	Suwannee River	Green	Yellow	Red	Yellow	Yellow
Hillsborough	8	**Hillsborough**	(Not Selected)	Tampa Bay	Yellow	Red	Red	Yellow	
Putnam 2	9	(Not in Top 8)	(Not Selected)	St. Johns River	Yellow	Yellow	Yellow	Green	
Putnam 1	10	(Not in Top 8)	(Not Selected)	St. Johns River	Yellow	Yellow	Yellow	Green	
Putnam 3	11	(Not in Top 8)	**Putnam 3**	St. Johns River	Yellow	Yellow	Yellow	Green	
Manatee	12	(Not in Top 8)	(Not Selected)	Manatee River	Yellow		Red	Yellow	

Table 9.3-5 (Sheet 2 of 2)
Summary of Screening Evaluation for Potential Sites

Potential Sites	Composite Technical Screening Order	Final Ranking		Water Source	PEF Preliminary Input				
		Technical Screening Top 8	PEF Down-Select Decision		Transmission	Community Support	Economic Development	Environment	Legislative
Levy 1	13	(Not in Top 8)	(Not Selected)	Suwannee River	Green	Yellow	Red	Yellow	
Highlands	14	(Not in Top 8)	**Highlands**	Kissimmee River	Green	Green	Green	Yellow	
Seminole	15	(Not in Top 8)	(Not Selected)	St. Johns River	Green	Red	Red	Yellow	
Volusia	16	(Not in Top 8)	(Not Selected)	St. Johns River	Green	Red	Yellow	Yellow	
Liberty 1	17	(Not in Top 8)	(Not Selected)	Apalachicola River	Red	Yellow	Green	Yellow	Yellow
Gulf	18	(Not in Top 8)	(Not Selected)	Gulf of Mexico	Red	Yellow	Red	Yellow	Yellow
Liberty 2	19	(Not in Top 8)	(Not Selected)	Ochlockonee River	Red	Green	Yellow	Yellow	
Calhoun	20	(Not in Top 8)	(Not Selected)	Chipola River	Red	Yellow	Yellow	Yellow	Yellow

Notes:

Green = no significant concerns
Yellow = some potential concerns
Red = some significant concerns
No color = neutral ranking

Source: Reference 9.3-001

Table 9.3-6 (Sheet 1 of 2)
Screening Criteria Used for the Evaluation of Candidate Sites

Siting Criteria	Siting Criteria
Health and Safety Criteria: Accident Cause-Related Criteria	**Environmental Criteria: Operational-Related Effects on Aquatic Ecology**
Geology and Seismology	Thermal Discharge Effects
Cooling System Requirements: Cooling Water Supply	Entrainment/Impingement effects
Cooling Water System: Ambient Temperature Requirements	Dredging/Disposal Effects
Flooding	**Environmental Criteria: Operational-Related Effects on Terrestrial Ecology**
Nearby Hazardous Land Uses	Drift Effects on Surrounding Areas
Health and Safety Criteria: Accident Effects-Related	**Socioeconomic Criteria**
Extreme Weather Conditions	Socioeconomic – Construction Related Effects
Population	Socioeconomics – Operation
Emergency Planning	Environmental Justice
Atmospheric Dispersion	Land Use
Health and Safety Criteria: Operational Effects-Related	**Engineering and Cost Related Criteria: Health and Safety Related Criteria**
Surface Water- Radionuclide Pathway	Water Supply
Groundwater Radionuclide Pathway	Pumping Distance
Air Radionuclide Pathway	Flooding
Air-Food ingestion pathway	Civil Works
Surface Water – food radionuclide pathway	Brownfield Site Remediation (if applicable)
Transportation Safety	Water Supply

Table 9.3-6 (Sheet 2 of 2)
Screening Criteria Used for the Evaluation of Candidate Sites

Siting Criteria	Siting Criteria
Environmental Criteria: Construction-Related Effects on Aquatic Ecology	**Engineering and Cost: Transportation- or Transmission-Related Criteria**
Disruption of Important Species/Habitats	Railroad Access
Bottom Sediment Disruption Effects	Highway Access
Environmental Criteria: Construction-Related Effects on Terrestrial Ecology	Barge Access
Disruption of Important Species/Habitats and Wetlands	Transmission Cost and Market Price Differentials
Dewatering Effects on Adjacent Wetlands	**Engineering and Cost-Related Criteria: Related to Socioeconomic & Land Use**
Environmental Criteria: Operational-Related Effects on Aquatic Ecology	Topography
Thermal Discharge Effects	Land Rights
	Labor Rates

Source: Reference 9.3-001

Table 9.3-7 (Sheet 1 of 3)
General Technical Evaluation for Candidate Sites

			Crystal River		Dixie		Highlands		Lafayette		Levy 2		Levy 3		Putnam 3		Taylor	
	Criteria	Weight Factor	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
1.1.1	Geology / Seismology	3.77	5	18.85	5	18.85	5	18.85	5	18.85	5	18.85	5	18.85	5	18.85	5	18.85
1.1.2	Cooling System Requirements	3.27	4	13.08	3	9.81	2	6.54	3	9.81	3	9.81	4	13.08	3	9.81	4	13.08
1.1.3	Flooding	2.4	2	4.8	3	7.2	1	2.4	2	4.8	5	12	3	7.2	5	12	3	7.2
1.1.4	Nearby Hazardous Land Uses	3.35	1	3.35	3	10.05	3	10.05	3	10.05	2	6.7	3	10.05	2	6.7	3	10.05
1.1.5	Extreme Weather Conditions	2.36	2	4.72	3	7.08	3	7.08	3	7.08	3	7.08	1	2.36	3	7.08	2	4.72
1.2	Accident Effect Related	4.09	4	16.36	4	16.36	4	16.36	4	16.36	3	12.27	4	16.36	4	16.36	4	16.36
1.3.1	Surface Water – Radionuclide Pathway	2.5	5	12.5	4	10	4	10	4	10	5	12.5	5	12.5	4	10	5	12.5
1.3.2	Groundwater Radionuclide Pathway	2.55	2	5.10	2	5.10	3	7.65	2	5.10	2	5.10	2	5.10	2	5.10	1	2.55
1.3.3	Air Radionuclide Pathway	2.5	5	12.5	4	10	4	10	4	10	4	10	5	12.5	4	10	5	12.5
1.3.4	Air-Food Ingestion Pathway	2.5	4	10	4	10	1	2.5	3	7.5	3	7.5	3	7.5	3	7.5	5	12.5
1.3.5	Surface Water-Food Radionuclide Pathway	2.41	5	12.05	4	9.64	3	7.23	4	9.64	5	12.05	5	12.05	4	9.64	5	12.05
1.3.6	Transportation Safety	2.14	3	6.42	3	6.42	3	6.42	3	6.42	3	6.42	3	6.42	3	6.42	3	6.42
2.1.1	Disruption of Important Species/Habitats	2.64	2	5.28	2	5.28	5	13.2	3	7.92	2	5.28	1	2.64	3	7.92	1	2.64

Table 9.3-7 (Sheet 2 of 3)
General Technical Evaluation for Candidate Sites

			Crystal River		Dixie		Highlands		Lafayette		Levy 2		Levy 3		Putnam 3		Taylor	
EPRI Guide Section	Criteria	Weight Factor	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
2.1.2	Bottom Sediment Disruption Effects	2.14	3	6.42	2	4.28	2	4.28	2	4.28	2	4.28	3	6.42	2	4.28	3	6.42
2.2.1	Disruption of Important Species/Habitats and Wetlands	3.18	3	9.54	4	12.72	3	9.54	3	9.54	3	9.54	2	6.36	3	9.54	3	9.54
2.2.2	Dewatering Effects on Adjacent Wetlands	2.77	3	8.31	4	11.08	4	11.08	3	8.31	4	11.08	2	5.54	3	8.31	4	11.08
2.3.1	Thermal Discharge Effects	3.64	3	10.92	2	7.28	3	10.92	3	10.92	3	10.92	3	10.92	3	10.92	3	10.92
2.3.2	Entrainment/Impingement Effects	3.23	3	9.69	3	9.69	4	12.92	3	9.69	3	9.69	3	9.69	3	9.69	3	9.69
2.3.3	Dredging/Disposal Effects	2.36	3	7.08	2	4.72	2	4.72	2	4.72	2	4.72	3	7.08	2	4.72	3	7.08
2.4.1	Drift Effects on Surrounding Areas	2.36	2	4.72	3	7.08	3	7.08	3	7.08	2	4.72	2	4.72	3	7.08	2	4.72
3.1.1	Socioeconomics – Construction – Related Effects	2	4	8.0	3	6.0	5	10.0	3	6.0	4	8.0	4	8.0	5	10.0	3	6.0
3.3.1	Environmental Justice	1.95	5	9.75	5	9.75	5	9.75	5	9.75	5	9.75	5	9.75	5	9.75	5	9.75
3.4.1	Land Use	3.8	2	7.6	2	7.6	3	11.4	2	7.6	2	7.6	2	7.6	4	15.2	2	7.6
4.1.1	Water Supply	3.7	5	18.5	3	11.1	2	7.4	3	11.1	4	14.8	5	18.5	4	14.8	5	18.5
4.1.2	Pumping Distance	3.05	5	15.25	4	12.2	3	9.15	5	15.25	3	9.15	1	3.05	3	9.15	1	3.05
4.1.3	Flooding	2.9	2	5.8	3	8.7	2	5.8	2	5.8	5	14.5	3	8.7	5	14.5	3	8.7

Table 9.3-7 (Sheet 3 of 3)
General Technical Evaluation for Candidate Sites

			Crystal River		Dixie		Highlands		Lafayette		Levy 2		Levy 3		Putnam 3		Taylor	
EPRI Guide Section	Criteria	Weight Factor	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
4.1.5	Civil Works	3.4	3	10.2	3	10.2	3	10.2	4	13.6	3	10.2	3	10.2	3	10.2	3	10.2
4.2.1	Railroad Access	2.6	5	13.0	3	7.8	4	10.4	3	7.8	4	10.4	3	7.8	5	13.0	3	7.8
4.2.2	Highway Access	2.8	5	14.0	5	14.0	5	14.0	5	14.0	5	14.0	5	14.0	5	14.0	5	14.0
4.2.3	Barge Access	2.85	5	14.25	2	5.7	2	5.7	2	5.7	2	5.7	3	8.55	4	11.4	3	8.55
4.2.4	Transmission Access	4.8	3	14.4	4	19.2	4	19.2	4	19.2	5	24	4	19.2	4	19.2	4	19.2
4.3.1	Topography	2.55	5	12.75	5	12.75	5	12.75	4	10.2	5	12.75	5	12.75	3	7.65	4	10.2
4.3.2	Land Rights	2.75	5	13.75	4	11	3	8.25	1	2.75	2	5.5	1	2.75	3	8.25	4	11
4.3.3	Labor Rates	3.3	5	16.5	4	13.2	3	9.9	3	9.9	5	16.5	5	16.5	2	6.6	3	9.9
	Composite Site Rating		**355**		**332**		**323**		**317**		**343**		**325**		**346**		**335**	

Notes:

Site ratings for each criterion are assigned in the range: 1 = least suitable to 5 = most suitable

Source: Reference 9.3-001

Table 9.3-8 (Sheet 1 of 3)
General Technical Evaluation for Alternative Sites

PEF General Site Criteria Ratings

EPRI Guide Section	Criteria	Weight Factor	Crystal River		Dixie		Highlands		Levy		Putnam 3	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
A.1.1	Geology / Seismology	**3.77**	5	18.85	5	18.85	5	18.85	5	18.85	5	18.85
A.1.2	Cooling System Requirements	**3.27**	4	13.08	3	9.81	2	6.54	3	9.81	3	9.81
A.1.3	Flooding	**2.4**	2	4.8	3	7.2	1	2.4	5	12	5	12
A.1.4	Nearby Hazardous Land Uses	**3.35**	1	3.35	3	10.05	3	10.05	2	6.7	2	6.7
A.1.5	Extreme Weather Conditions	**2.36**	2	4.72	3	7.08	3	7.08	3	7.08	3	7.08
A.2	Accident Effect Related	**4.09**	4	16.36	4	16.36	4	16.36	3	12.27	4	16.36
A.3.1	Surface Water Radionuclide Pathway	**2.5**	5	12.5	4	10	4	10	5	12.5	4	10
A.3.2	Groundwater Radionuclide Pathway	**2.55**	2	5.10	2	5.10	3	7.65	2	5.10	2	5.10
A.3.3	Air Radionuclide Pathway	**2.5**	5	12.5	4	10	4	10	4	10	4	10
A.3.4	Air-Food Ingestion Pathway	**2.5**	4	10	4	10	1	2.5	3	7.5	3	7.5
A.3.5	Surface Water-Food Radionuclide Pathway	**2.41**	5	12.05	4	9.64	3	7.23	5	12.05	4	9.64
A.3.6	Transportation Safety	**2.14**	3	6.42	3	6.42	3	6.42	3	6.42	3	6.42
B.1.1	Disruption of Important Species / Habitats	**2.64**	2	5.28	2	5.28	5	13.2	3	7.92	3	7.92

Table 9.3-8 (Sheet 2 of 3)
General Technical Evaluation for Alternative Sites

PEF General Site Criteria Ratings

EPRI Guide Section	Criteria	Weight Factor	Crystal River		Dixie		Highlands		Levy		Putnam 3	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
B.1.2	Bottom Sediment Disruption Effects	**2.14**	3	6.42	2	4.28	2	4.28	2	4.28	2	4.28
B.2.1	Disruption of Important Species/Habitats and Wetlands	**3.18**	3	9.54	4	12.72	3	9.54	3	9.54	3	9.54
B.2.2	Dewatering Effects on Adjacent Wetlands	**2.77**	3	8.31	4	11.08	4	11.08	4	11.08	3	8.31
B.3.1	Thermal Discharge Effects	**3.64**	3	10.92	3	10.92	3	10.92	3	10.92	3	10.92
B.3.2	Entrainment/ Impingement Effects	**3.23**	3	9.69	3	9.69	4	12.92	3	9.69	3	9.69
B.3.3	Dredging/Disposal Effects	**2.36**	3	7.08	2	4.72	2	4.72	2	4.72	2	4.72
B.4.1	Drift Effects on Surrounding Areas	**2.36**	2	4.72	3	7.08	3	7.08	3	7.08	3	7.08
C.1.1	Socioeconomics Construction Related Effects	**2**	4	8.0	3	6.0	5	10.0	4	8.0	5	10.0
C.3.1	Environmental Justice	**1.95**	5	9.75	5	9.75	5	9.75	5	9.75	5	9.75
C.4.1	Land Use	**3.8**	2	7.6	2	7.6	3	11.4	2	7.6	4	15.2
D.1.1	Water Supply	**3.7**	5	18.5	4	14.8	2	7.4	4	14.8	4	14.8
D.1.2	Pumping Distance	**3.05**	5	15.25	4	12.2	3	9.15	3	9.15	3	9.15
D.1.3	Flooding	**2.9**	2	5.8	3	8.7	2	5.8	5	14.5	5	14.5
D.1.5	Civil Works	**3.4**	3	10.2	3	10.2	3	10.2	3	10.2	3	10.2

Table 9.3-8 (Sheet 3 of 3)
General Technical Evaluation for Alternative Sites

PEF General Site Criteria Ratings

EPRI Guide Section	Criteria	Weight Factor	Crystal River		Dixie		Highlands		Levy		Putnam 3	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
D.2.1	Railroad Access	**2.6**	5	13.0	3	7.8	4	10.4	4	10.4	5	13.0
C.3.1	Environmental Justice	**1.95**	5	9.75	5	9.75	5	9.75	5	9.75	5	9.75
C.4.1	Land Use	**3.8**	2	7.6	2	7.6	3	11.4	2	7.6	4	15.2
D.1.1	Water Supply	**3.7**	5	18.5	4	14.8	2	7.4	4	14.8	4	14.8
D.1.2	Pumping Distance	**3.05**	5	15.25	4	12.2	3	9.15	3	9.15	3	9.15
D.1.3	Flooding	**2.9**	2	5.8	3	8.7	2	5.8	5	14.5	5	14.5
D.1.5	Civil Works	**3.4**	3	10.2	3	10.2	3	10.2	3	10.2	3	10.2
D.2.1	Railroad Access	**2.6**	5	13.0	3	7.8	4	10.4	4	10.4	5	13.0
D.2.2	Highway Access	**2.8**	5	14.0	5	14.0	5	14.0	5	14.0	5	14.0
D.2.3	Barge Access	**2.85**	5	14.25	2	5.7	2	5.7	2	5.7	4	11.4
D.2.4	Transmission Access	**4.8**	3	14.4	4	19.2	4	19.2	5	24	3	14.4
D.3.1	Topography	**2.55**	5	12.75	5	12.75	5	12.75	5	12.75	3	7.65
D.3.2	Land Rights	**2.75**	5	13.75	4	11	3	8.25	2	5.5	3	8.25
D.3.3	Labor Rates	**3.3**	5	16.5	4	13.2	3	9.9	5	16.5	2	6.6
Composite Site Rating				355		339		323		348		341
Normalized Score			100%		95.9%		91.0%		98.0%		96.1%	

Notes:
Site ratings for each criterion are assigned in the range: 1 = least suitable to 5 = most suitable

Source: Reference 9.3-001

Table 9.3-9 (Sheet 1 of 4)
Summary of the Alternative Site Studies

	Site Suitability Issue				
	Transmission	**Geotechnical**	**Environmental**	**Reliability**	**Land Acquisition**
Basis for Evaluation → / **Site** ↓	Detailed transmission impact study (Navigant 2006)	On-site geotechnical investigations, including borings and geophysical studies [Relative suitability scale of 1 to 5, with 5 representing most suitable and 1 the least suitable.]	On-site reconnaissance survey of greenfield sites, visual evaluation of plant communities; Crystal River characterization based on other existing data	Qualitative analysis of risk factors for reliable power production and supply (such as vulnerability to single-event failures)	Real estate analysis supplemented by preliminary third-party negotiations with landowners
Crystal River	Upgrade costs conservatively estimated to be similar to those for Levy 2: $563 million [(a)]	Geotechnical characteristics assumed to be acceptable; similar to those underlying existing plant.	Site is characterized by industrial development with both nuclear and fossil power plants and associated support facilities.	Site is subject to coastal storm surge flooding and concentration of additional units at the site would subject the entire service territory to a single weather event failure. Co-location of new units at the site does not allow for any physical separation of transmission lines from new units from existing corridors and would subject them to single weather event failures over several miles of co-located lines.	The Crystal River site is on land that is already owned by PEF and is already zoned for uses compatible with the development of new nuclear units.

Table 9.3-9 (Sheet 2 of 4)
Summary of the Alternative Site Studies

	Site Suitability Issue				
	Transmission	**Geotechnical**	**Environmental**	**Reliability**	**Land Acquisition**
Dixie	Estimated total direct connect plus upgrade costs: $726 million [(a)]	Recommended Suitability Index = 2. This site exhibits numerous sinkholes and depressions. The rock quality at this site is mostly very poor to poor with many voids and cavities.	Site is characterized primarily by open forested pineland with some evidence of timbering. Some wetlands indicator species apparent on relatively small fraction of site area.	Site would not be subject to storm surge flooding and would significantly reduce the possibility that new units would be affected by a single weather event. Location allows additional separation of transmission lines over that provided by Levy.	Acquisition of sufficient land for a nuclear power plant in the time frame necessary to meet the COLA schedule appears not to be feasible.
Highlands	Estimated total direct connect plus upgrade costs: $1370 million. Includes significant ($592 million) upgrades due to contingencies in FPL service area required. [(b)]	Recommended Suitability Index = 1. This site is assigned the lowest suitability index because of the thickness and variable consistency of soil deposits underneath it.	Mostly agricultural cleared land; significant sod farming on site and significant cattle and dairy farming near the site.	Site would not be subject to storm surge flooding and would almost eliminate the possibility that new units would be affected by a single weather event with Crystal River. Location provides for a different directional approach to load centers for transmission lines as compared to Crystal River, Dixie and Levy.	Acquisition of land appears to be feasible. However, coordination of water supply strategy with ongoing water resources plans of regional water management districts would likely preclude development of new units on the schedule required.

Table 9.3-9 (Sheet 3 of 4)
Summary of the Alternative Site Studies

	Site Suitability Issue				
	Transmission	**Geotechnical**	**Environmental**	**Reliability**	**Land Acquisition**
Putnam	Estimated total direct connect plus upgrade costs: $1013 million. Includes significant ($590M) upgrades due to contingencies in FPL service area required. [(b)]	Recommended Suitability Index = 1. This site is assigned the lowest suitability index because of the thickness and variable consistency of soil deposits underneath it.	The majority of the site area has been disturbed from previous mining activities and much of the land reclaimed. Currently characterized by mostly open canopied forest. Some wetland areas noted on relatively small fraction of site area.	Site would be less subject to storm surge flooding and would significantly reduce the possibility that new units would be affected by a single weather event with Crystal River. Location provides for a different directional approach to load centers for transmission lines as compared to Crystal River, Dixie and Levy 2.	Acquisition of land appears to be feasible.

Table 9.3-9 (Sheet 4 of 4)
Summary of the Alternative Site Studies

	Site Suitability Issue				
	Transmission	**Geotechnical**	**Environmental**	**Reliability**	**Land Acquisition**
Levy	Estimated total direct connect plus upgrade costs: $653 million.	Levy 1 (Rayonier property): Recommended Suitability Index = 3. This site has a small variation in the top of limestone bedrock elevation, although rock quality is not good (very poor to fair rock). Levy 2 (Lybass property): Recommended Suitability Index = 3. This site seems to have slightly better rock quality than Levy 1. However, the top of limestone bedrock elevation is erratic across this site, with a boring advanced to a depth of 100 feet without encountering bedrock.	Site is characterized primarily by forested pineland but has been heavily timbered with associated disturbance to site ecology. Some wetlands indicator species apparent on relatively small fraction of site area.	Site would not be subject to storm surge flooding and would reduce the possibility that new units would be affected by a single weather event with Crystal River. Location allows some separation of transmission lines as compared to Crystal River.	Land to be used for new units is owned by PEF. The land is currently a Greenfield site that will need to be re-zoned for development of the nuclear facility.

Notes:

a) Connection to Crystal River East substation with 800 MW assumed to be installed at the proposed Taylor Energy Complex.

b) Upgrades in service areas other than the PEF service area are subject to additional schedule uncertainty because of the need to negotiate upgrade strategies with other transmission operator(s).

Source: Reference 9.3-001

Table 9.3-10
Composite Rating Comparison of Alternative Sites

Siting Evaluation Criteria		Alternative Site Compliance									
		Crystal River		Dixie		Highlands		Levy 2		Putnam	
	Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Site Comparison with PEF Strategic Considerations											
Composite Score for Evaluation of Business Strategy	20	89.1%	17.8	80.5%	16.1	79.8%	16	100%	20	77.5%	15.5
Normalized Scores			**17.8**		**16.1**		**36.4**		**20**		**15.5**
Site Comparison of Technical Evaluation											
Composite Score for Technical Evaluation of Suitability Criteria	40	100%	40	95.9%	38.4	91.0%	36.4	98.0%	39.2	96.1%	38.4
Normalized Scores			**40**		**38.4**		**16**		**39.2**		**38.4**
Site Comparison of Transmission System Impacts											
Composite Score for Evaluation of Transmission System Impact	40	100%	40	95%	38	30%	12	100%	40	40%	16
Normalized Scores			**40**		**38**		**12**		**40**		**16**

Source: Reference 9.3-001

Table 9.3-11 (Sheet 1 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Citrus County

Scientific Name	Common Name	State Status	Federal Status
	Amphibians		
Rana capito	Gopher Frog	Species of Special Concern	--
	Reptiles		
Alligator mississippiensis	American Alligator	Species of Special Concern	Threatened Similarity of appearance)
Chelonia mydas	Green Sea Turtle	Endangered	Endangered
Dermochelys coriacea	Leatherback Sea Turtle	Endangered	Endangered
Caretta caretta	Loggerhead Sea Turtle	Threatened	Threatened
Lepidochelys kempii	Kemp's Ridley Sea Turtle	Endangered	Endangered
Eretmochelys imbricata	Hawksbill	Endangered	Endangered
Gopherus polyphemus	Gopher Tortoise	Threatened	--
Pituophis melanoleucus mugitus	Florida Pine Snake	Species of Special Concern	--
Pseudemys concinna suwanniensis	Suwannee Cooter	Species of Special Concern	--
Drymarchon couperi	Eastern Indigo Snake	Threatened	Threatened
Stilosoma extenuatum	Short-tailed Snake	Threatened	--
	Birds		
Ammodramus maritimus peninsulae	Scott's Seaside Sparrow	Species of Special Concern	--
Aphelocoma coerulescens	Florida Scrub-jay	Threatened	Threatened
Aramus guarauna	Limpkin	Species of Special Concern	--
Athene cunicularia floridana	Florida Burrowing Owl	Species of Special Concern	--
Charadrius melodus	Piping Plover	Threatened	Threatened
Cistothorus palustris marianae	Marian's Marsh Wren	Species of Special Concern	--
Egretta caerulea	Little Blue Heron	Species of Special Concern	--
Egretta thula	Snowy Egret	Species of Special Concern	--
Egretta tricolor	Tricolored Heron	Species of Special Concern	--
Eudocimus albus	White Ibis	Species of Special Concern	--
Falco peregrinus	Peregrine Falcon	Endangered	--

Table 9.3-11 (Sheet 2 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Citrus County

Scientific Name	Common Name	State Status	Federal Status
Falco sparverius paulus	Southeastern American Kestrel	Threatened	--
Grus canadensis pratensis	Florida Sandhill Crane	Threatened	--
Haematopus palliatus	American Oystercatcher	Species of Special Concern	--
Haliaeetus leucocephalus	Bald Eagle	Threatened	--
Mycteria americana	Wood Stork	Endangered	Endangered
Pandion haliaetus	Osprey	Species of Special Concern	--
Pelecanus occidentalis	Brown Pelican	Species of Special Concern	--
Picoides borealis	Red-cockaded Woodpecker	Species of Special Concern	Endangered
Platalea ajaja	Roseate Spoonbill	Species of Special Concern	--
Rynchops niger	Black Skimmer	Species of Special Concern	--
Sterna antillarum	Least Tern	Threatened	--
Mammals			
Trichechus manatus latirostris	West Indian (Florida) Manatee	Endangered	Endangered
Podomys floridanus	Florida Mouse	Species of Special Concern	--
Puma concolor coryi	Florida Panther	Endangered	Endangered
Sorex longirostris eionis	Homosassa Shrew	Species of Special Concern	--
Sciurus niger shermani	Sherman's Fox Squirrel	Species of Special Concern	--
Ursus americanus floridanus	Florida Black Bear	Threatened	--
Plants			
Adiantum tenerum	Brittle Maidenhair Fern	Endangered	--
Agrimonia incisa	Incised Groove-bur	Endangered	--
Asplenium pumilum	Dwarf Spleenwort	Endangered	--
Asplenium verecundum	Modest Spleenwort	Endangered	--
Blechnum occidentale	Sinkhole Fern	Endangered	--
Centrosema arenicola	Sand Butterfly Pea	Endangered	--
Cheilanthes microphylla	Southern Lip Fern	Endangered	--

Table 9.3-11 (Sheet 3 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Citrus County

Scientific Name	Common Name	State Status	Federal Status
Glandularia maritima	Coastal Vervain	Endangered	--
Glandularia tampensis	Tampa Vervain	Endangered	--
Matelea floridana	Florida Spiny-pod	Endangered	--
Monotropsis reynoldsiae	Pygmy Pipes	Endangered	--
Pecluma ptilodon	Swamp Plume Polypody	Endangered	--
Peperomia humilis	Terrestrial Peperomia	Endangered	--
Pteroglossaspis ecristata	Giant Orchid	Threatened	--
Spiranthes polyantha	Green Ladies'-tresses	Endangered	--
Stylisma abdita	Scrub Stylisma	Endangered	--
Thelypteris reptans	Creeping Maiden Fern	Endangered	--
Triphora craigheadii	Craighead's Nodding-caps	Endangered	--

Source: Reference 9.3-004

Table 9.3-12
Crystal River Site Minority and Low Income Population

County	Population (2006 estimate)	White (not Hispanic)	Black[(a)]	Hispanic[(b)]	Asian[(a)]	American Indian [(a)]	Low Income (as of 2004)
Citrus	138,143	125,710 (91.0%)	3868 (2.8%)	5111 (3.7%)	1658 (1.2%)	553 (0.4%)	15,472 (11.2%)
Levy	39,076	32,199 (82.4%)	4142 (10.6%)	2032 (5.2%)	195 (0.5%)	156 (0.4%)	5861 (15.0%)
Marion	316,183	245,990 (77.8%)	36,677 (11.6%)	26,876 (8.5%)	3794 (1.2%)	1581 (0.5%)	38,574 (12.2%)
Hernando	165,409	141,094 (85.3%)	8105 (4.9%)	13,398 (8.1%)	1489 (0.9%)	496 (0.3%)	17,533 (10.6%)
Sumter	68,768	53,639 (78.0%)	8458 (12.3%)	5501 (8.0%)	481 (0.7%)	343 (0.5%)	8596 (12.5%)
Total	**727,579**	**598,632 (82.3%)**	**61,250 (8.4%)**	**52,918 (7.3%)**	**7617 (1.0%)**	**3129 (0.4%)**	**86,036 (11.8%)**

Notes:

Percentages equal percent of total population for corresponding county.

a) Includes persons reporting only one race.

b) Hispanics may be of any race, so also are included in applicable race categories.

Sources: References 9.3-005, 9.3-009, 9.3-010, 9.3-011, and 9.3-012

Table 9.3-13 (Sheet 1 of 2)
State and Federal Threatened and Endangered Species Potentially Occurring in Dixie County

Scientific Name	Common Name	State Status	Federal Status
		Fish	
Acipenser oxyrinchus desotoi	Gulf Sturgeon	Species of Special Concern	Threatened
Micropterus notius	Suwannee Bass	Species of Special Concern	--
		Amphibians	
Rana capito	Gopher Frog	Species of Special Concern	--
		Reptiles	
Alligator mississippiensis	American Alligator	Species of Special Concern	Threatened (Similarity of appearance)
Caretta caretta	Loggerhead Sea Turtle	Threatened	Threatened
Chelonia mydas	Green Sea Turtle	Endangered	Endangered
Dermochelys coriacea	Leatherback Sea Turtle	Endangered	Endangered
Gopherus polyphemus	Gopher Tortoise	Threatened	--
Lepidochelys kempii	Kemp's Ridley Sea Turtle	Endangered	Endangered
Macrochelys temminckii	Alligator Snapping Turtle	Species of Special Concern	--
Drymarchon couperi	Eastern Indigo Snake	Threatened	Threatened
Pituophis melanoleucus mugitus	Florida Pine Snake	Species of Special Concern	--
Pseudemys concinna suwanniensis	Suwannee Cooter	Species of Special Concern	--
		Birds	
Ammodramus maritimus peninsulae	Scott's Seaside Sparrow	Species of Special Concern	--
Aramus guarauna	Limpkin	Species of Special Concern	--
Charadrius melodus	Piping Plover	Threatened	Threatened
Cistothorus palustris marianae	Marian's Marsh Wren	Species of Special Concern	--
Egretta caerulea	Little Blue Heron	Species of Special Concern	--
Egretta thula	Snowy Egret	Species of Special Concern	--

Table 9.3-13 (Sheet 2 of 2)
State and Federal Threatened and Endangered Species Potentially Occurring in Dixie County

Scientific Name	Common Name	State Status	Federal Status
Egretta tricolor	Tricolored Heron	Species of Special Concern	--
Eudocimus albus	White Ibis	Species of Special Concern	--
Falco peregrinus	Peregrine Falcon	Endangered	--
Falco sparverius paulus	Southeastern American Kestrel	Threatened	--
Haematopus palliatus	American Oystercatcher	Species of Special Concern	--
Haliaeetus leucocephalus	Bald Eagle	Threatened	--
Mycteria americana	Wood Stork	Endangered	Endangered
Pandion haliaetus	Osprey	Species of Special Concern	--
Pelecanus occidentalis	Brown Pelican	Species of Special Concern	--
Rynchops niger	Black Skimmer	Species of Special Concern	--
Sterna antillarum	Least Tern	Threatened	--
Mammals			
Podomys floridanus	Florida Mouse	Species of Special Concern	--
Ursus americanus floridanus	Florida Black Bear	Threatened	--
Trichechus manatus latirostris	West Indian (Florida) Manatee	Endangered	Endangered
Plants			
Agrimonia incisa	Incised Groove-bur	Endangered	--
Leitneria floridana	Corkwood	Threatened	--
Phyllanthus leibmannianus ssp. platylepis	Pinewood Dainties	Endangered	--
Sideroxylon lycioides	Buckthorn	Endangered	--

Source: Reference 9.3-004

Table 9.3-14
Dixie Site Minority and Low Income Population

County	Population (2006 estimate)	White (not Hispanic)	Black[a]	Hispanic[b]	Asian[a]	American Indian[a]	Low Income (as of 2004)
Dixie	14,964	12,974 (86.7%)	1437 (9.6%)	359 (2.4%)	45 (0.3%)	60 (0.4%)	2694 (18.0%)
Levy	39,076	32,199 (82.4%)	4142 (10.6%)	2032 (5.2%)	195 (0.5%)	156 (0.4%)	5861 (15.0%)
Taylor	19,842	15,179 (76.5%)	3790 (19.1%)	377 (1.9%)	99 (0.5%)	198 (1.0%)	3155 (15.9%)
Suwannee	39,494	31,398 (79.5%)	4463 (11.3%)	2923 (7.4%)	237 (0.6%)	148 (0.4%)	6043 (15.3%)
Lafayette	8045	5696 (70.8%)	1352 (16.8%)	933 (11.6%)	161 (0.2%)	563 (0.7%)	1496 (18.6%)
Gilchrist	16,865	14,926 (88.5%)	1079 (6.4%)	607 (3.6%)	51 (0.3%)	67 (0.4%)	2192 (13.0%)
Columbia	67,007	51,193 (76.4%)	11,726 (17.5%)	2613 (3.9%)	536 (0.8%)	335 (0.5%)	9448 (14.1%)
Alachua	227,120	152,398 (67.1%)	46,105 (20.3%)	15,217 (6.7%)	10,220 (4.5%)	681 (0.3%)	31,932 (14.5%)
Total	**393,337**	**283,764 (72.1%)**	**69,952 (17.8%)**	**23,029 (5.8%)**	**11,349 (2.9%)**	**2052 (0.5%)**	**56,960 (14.5%)**

Notes:

Percentages equal percent of total population for corresponding county.

a) Includes persons reporting only one race.

b) Hispanics may be of any race, so also are included in applicable race categories.

Sources: References 9.3-006, 9.3-009, 9.3-013, 9.3-014, 9.3-015, 9.3-016, 9.3-017, and 9.3-018

Table 9.3-15 (Sheet 1 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Highlands County

Scientific Name	Common Name	State Status	Federal Status
		Amphibians	
Rana capito	Gopher Frog	Species of Special Concern	--
		Reptiles	
Alligator mississippiensis	American Alligator	Species of Special Concern	Threatened (Similarity of appearance)
Drymarchon couperi	Eastern Indigo Snake	Threatened	Threatened
Eumeces egregius lividus	Blue-tailed Mole Skink	Threatened	Threatened
Gopherus polyphemus	Gopher Tortoise	Threatened	--
Neoseps reynoldsi	Sand Skink	Threatened	Threatened
Pituophis melanoleucus mugitus	Florida Pine Snake	Species of Special Concern	--
Stilosoma extenuatum	Short-tailed Snake	Threatened	--
		Birds	
Ammodramus savannarum floridanus	Florida Grasshopper Sparrow	Endangered	Endangered
Aphelocoma coerulescens	Florida Scrub-jay	Threatened	Threatened
Aramus guarauna	Limpkin	Species of Special Concern	--
Athene cunicularia floridana	Florida Burrowing Owl	Species of Special Concern	--
Caracara cheriway	Crested Caracara	Threatened	Threatened
Egretta caerulea	Little Blue Heron	Species of Special Concern	--
Egretta thula	Snowy Egret	Species of Special Concern	--
Egretta tricolor	Tricolored Heron	Species of Special Concern	--
Eudocimus albus	White Ibis	Species of Special Concern	--
Falco peregrinus	Peregrine Falcon	Endangered	--
Falco sparverius paulus	Southeastern American Kestrel	Threatened	--
Grus canadensis pratensis	Florida Sandhill Crane	Threatened	--
Haliaeetus leucocephalus	Bald Eagle	Threatened	--

Table 9.3-15 (Sheet 2 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Highlands County

Scientific Name	Common Name	State Status	Federal Status
Mycteria americana	Wood Stork	Endangered	Endangered
Pandion haliaetus	Osprey	Species of Special Concern	--
Picoides borealis	Red-cockaded Woodpecker	Species of Special Concern	Endangered
Sterna antillarum	Least Tern	Threatened	--
Mammals			
Podomys floridanus	Florida Mouse	Species of Special Concern	--
Puma concolor coryi	Florida Panther	Endangered	Endangered
Sciurus niger shermani	Sherman's Fox Squirrel	Species of Special Concern	--
Ursus americanus floridanus	Florida Black Bear	Threatened	--
Plants			
Bonamia grandiflora	Florida Bonamia	Endangered	Threatened
Calamintha ashei	Ashe's Savory	Threatened	--
Calopogon multiflorus	Many-flowered Grass-pink	Endangered	--
Centrosema arenicola	Sand Butterfly Pea	Endangered	--
Chionanthus pygmaeus	Pygmy Fringe Tree	Endangered	Endangered
Cladonia perforata	Perforate Reindeer Lichen	Endangered	Endangered
Clitoria fragrans	Scrub Pigeon-wing	Endangered	Threatened
Conradina brevifolia	Short-leaved Rosemary	Endangered	Endangered
Crotalaria avonensis	Avon Park Rabbit-bells	Endangered	Endangered
Dicerandra christmanii	Garrett's Scrub Balm	Endangered	Endangered
Dicerandra frutescens	Scrub Mint	Endangered	Endangered
Drosera intermedia	Spoon-leaved Sundew	Threatened	--
Eltroplectris calcarata	Spurred Neottia	Endangered	--
Eriogonum longifolium var. gnaphalifolium	Scrub Buckwheat	Endangered	Threatened
Eryngium cuneifolium	Wedge-leaved Button-snakeroot	Endangered	Endangered
Hartwrightia floridana	Hartwrightia	Threatened	--
Hypericum cumulicola	Highlands Scrub Hypericum	Endangered	Endangered
Hypericum edisonianum	Edison's Ascyrum	Endangered	--

Table 9.3-15 (Sheet 3 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Highlands County

Scientific Name	Common Name	State Status	Federal Status
Justicia crassifolia	Thick-leaved Water-willow	Endangered	--
Lechea cernua	Nodding Pinweed	Endangered	--
Lechea divaricata	Pine Pinweed	Endangered	--
Liatris ohlingerae	Florida Blazing Star	Endangered	Endangered
Najas filifolia	Narrowleaf Naiad	Threatened	--
Nolina brittoniana	Britton's Beargrass	Endangered	Endangered
Panicum abscissum	Cutthroat Grass	Endangered	--
Paronychia chartacea ssp. chartacea	Paper-like Nailwort	Endangered	Threatened
Platanthera integra	Yellow Fringeless Orchid	Endangered	--
Polygala lewtonii	Lewton's Polygala	Endangered	Endangered
Polygonella basiramia	Florida Jointweed	Endangered	Endangered
Polygonella myriophylla	Small's Jointweed	Endangered	Endangered
Prunus geniculata	Scrub Palm	Endangered	Endangered
Pteroglossaspis ecristata	Giant Orchid	Threatened	--
Schizachyrium niveum	Scrub Bluestem	Endangered	--
Stylisma abdita	Scrub Stylisma	Endangered	--
Warea carteri	Carter's Warea	Endangered	Endangered
Zephyranthes simpsonii	Rain Lily	Threatened	--
Ziziphus celata	Scrub Ziziphus	Endangered	Endangered

Source: Reference 9.3-004

Table 9.3-16
Highlands Site Minority and Low Income Population

County	Population (2006 estimate)	White (not Hispanic)	Black[a]	Hispanic[b]	Asian[a]	American Indian[a]	Low Income (as of 2004)
Highlands	97,987	71,922 (73.4%)	9407 (9.6%)	14,992 (15.3%)	1274 (1.3%)	490 (0.5%)	12,836 (13.1%)
St. Lucie	252,724	169,072 (66.9%)	42,710 (16.9%)	35,634 (14.1%)	4044 (1.6%)	758 (0.3%)	28,558 (11.3%)
Okeechobee	40,406	27,355 (67.7%)	3232 (8.0%)	8930 (22.1%)	444 (1.1%)	404 (1.0%)	5536 (13.7%)
Martin	139,393	115,696 (83.0%)	7806 (5.6%)	13,103 (9.4%)	1255 (0.9%)	1394 (1.0%)	11,291 (8.1%)
Glades	11,230	7434 (66.2%)	1202 (10.7%)	1954 (17.4%)	45 (0.4%)	573 (5.1%)	1359 (12.1%)
Hardee	28,621	14,024 (49.0%)	2605 (9.1%)	11,677 (40.8%)	172 (0.6%)	401 (1.4%)	5581 (19.5%)
DeSoto	35,315	19,247 (54.4%)	4132 (11.7%)	11,654 (33.0%)	212 (0.6%)	954 (2.7%)	5898 (16.7%)
Polk	561,606	387,508 (69.0%)	79,748 (14.2%)	81,433 (14.5%)	7862 (1.4%)	2808 (0.5%)	74,132 (13.2%)
Osceola	244,045	115,189 (47.2%)	26,601 (10.9%)	97,374 (39.9%)	7321 (3.0%)	1464 (0.6%)	29,773 (12.2%)
Total	**1,411,327**	**927,447 (65.7%)**	**177,443 (12.6%)**	**276,751 (19.6%)**	**22,629 (1.6%)**	**9246 (0.7%)**	**174,964 (12.4%)**

Notes:

Percentages equal percent of total population for corresponding county.

a) Includes persons reporting only one race.

b) Hispanics may be of any race, so also are included in applicable race categories.

Sources: References 9.3-007, 9.3-019, 9.3-020, 9.3-021, 9.3-022, 9.3-023, 9.3-024, 9.3-025, and 9.3-026

Table 9.3-17 (Sheet 1 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Putnam County

Scientific Name	Common Name	State Status	Federal Status
		Fish	
Acipenser brevirostrum	Shortnose Sturgeon	Endangered	Endangered
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	Species of Special Concern	--
Etheostoma olmstedi	Tessellated Darter	Species of Special Concern	--
Pteronotropis welaka	Bluenose Shiner	Species of Special Concern	--
		Amphibians	
Rana capito	Gopher Frog	Species of Special Concern	--
		Reptiles	
Alligator mississippiensis	American Alligator	Species of Special Concern	Threatened (Similarity of appearance)
Gopherus polyphemus	Gopher Tortoise	Threatened	--
Drymarchon couperi	Eastern Indigo Snake	Threatened	Threatened
Neoseps reynoldsi	Sand Skink	Threatened	Threatened
Pituophis melanoleucus mugitus	Florida Pine Snake	Species of Special Concern	--
Stilosoma extenuatum	Short-tailed Snake	Threatened	--
		Birds	
Aphelocoma coerulescens	Florida Scrub-jay	Threatened	Threatened
Aramus guarauna	Limpkin	Species of Special Concern	--
Egretta caerulea	Little Blue Heron	Species of Special Concern	--
Egretta thula	Snowy Egret	Species of Special Concern	--
Egretta tricolor	Tricolored Heron	Species of Special Concern	--
Eudocimus albus	White Ibis	Species of Special Concern	--
Falco peregrinus	Peregrine Falcon	Endangered	--
Falco sparverius paulus	Southeastern American Kestrel	Threatened	--
Grus canadensis pratensis	Florida Sandhill Crane	Threatened	--
Haliaeetus leucocephalus	Bald Eagle	Threatened	--

Table 9.3-17 (Sheet 2 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Putnam County

Scientific Name	Common Name	State Status	Federal Status
Mycteria americana	Wood Stork	Endangered	Endangered
Pandion haliaetus	Osprey	Species of Special Concern	--
Picoides borealis	Red-cockaded Woodpecker	Species of Special Concern	Endangered
Mammals			
Podomys floridanus	Florida Mouse	Species of Special Concern	--
Sciurus niger shermani	Sherman's Fox Squirrel	Species of Special Concern	--
Trichechus manatus latirostris	West Indian (Florida) Manatee	Endangered	Endangered
Ursus americanus floridanus	Florida Black Bear	Threatened	--
Decapods			
Procambarus pictus	Black Creek Crayfish	Species of Special Concern	--
Plants			
Andropogon arctatus	Pine-woods Bluestem	Threatened	--
Arnoglossum diversifolium	Variable-leaved Indian-plantain	Threatened	--
Balduina atropurpurea	Purple Honeycomb-head	Endangered	--
Calydorea coelestina	Bartram's Ixia	Endangered	--
Carex chapmanii	Chapman's Sedge	Endangered	--
Conradina etonia	Etonia Rosemary	Endangered	Endangered
Ctenium floridanum	Florida toothache-grass	Endangered	--
Drosera intermedia	Spoon-leaved Sundew	Threatened	--
Hartwrightia floridana	Hartwrightia	Threatened	--
Helianthus carnosus	Lake-side Sunflower	Endangered	--
Litsea aestivalis	Pondspice	Endangered	--
Matelea floridana	Florida Spiny-pod	Endangered	--
Parnassia grandifolia	Large-leaved Grass-of-parnassus	Endangered	--
Pteroglossaspis ecristata	Giant Orchid	Threatened	--

Table 9.3-17 (Sheet 3 of 3)
State and Federal Threatened and Endangered Species Potentially Occurring in Putnam County

Scientific Name	Common Name	State Status	Federal Status
Pycnanthemum floridanum	Florida Mountain-mint	Threatened	--
Salix floridana	Florida Willow	Endangered	--
Schwalbea americana	Chaffseed	Endangered	Endangered
Sideroxylon lycioides	Buckthorn	Endangered	--
Stylisma abdita	Scrub Stylisma	Endangered	--

Source: Reference 9.3-004

Table 9.3-18
Putnam Site Minority and Low Income Population

County	Population (2006 estimate)	White (not Hispanic)	Black[a]	Hispanic[b]	Asian[a]	American Indian[a]	Low Income (as of 2004)
Putnam	74,083	54,599 (73.7%)	12,520 (16.9%)	5778 (7.8%)	444 (0.6%)	370 (0.5%)	12,816 (17.3%)
Alachua	227,120	152,398 (67.1%)	46,105 (20.3%)	15,217 (6.7%)	10,220 (4.5%)	681 (0.3%)	31,932 (14.5%)
Marion	316,183	245,990 (77.8%)	36,677 (11.6%)	26,876 (8.5%)	3794 (1.2%)	1581 (0.5%)	38,574 (12.2%)
Clay	178,899	143,656 (80.3%)	16,459 (9.2%)	11,092 (6.2%)	4830 (2.7%)	894 (0.5%)	12,702 (7.1%)
Volusia	496,575	386,832 (77.9%)	50,154 (10.1%)	48,664 (9.8%)	6952 (1.4%)	1986 (0.4%)	55,616 (11.2%)
Flagler	83,084	66,467 (80.0%)	8059 (9.7%)	6065 (7.3%)	1496 (1.8%)	166 (0.2%)	6481 (7.8%)
St. Johns	169,224	147,733 (87.3%)	9984 (5.9%)	6600 (3.9%)	3215 (1.9%)	338 (0.2%)	12,692 (7.5%)
Bradford	28,384	20,891 (73.6%)	6103 (21.5%)	823 (2.9%)	227 (0.8%)	114 (0.4%)	4201 (14.8%)
Total	**1,573,552**	**1,218,566 (77.4%)**	**186,061 (11.8%)**	**121,115 (7.7%)**	**31,178 (2.0%)**	**6130 (0.4%)**	**175,014 (11.1%)**

Notes:

Percentages equal percent of total population for corresponding county.

a) Includes persons reporting only one race.

b) Hispanics may be of any race, so also are included in applicable race categories.

Sources: References 9.3-008, 9.3-010, 9.3-018, 9.3-027, 9.3-028, 9.3-029, 9.3-030, and 9.3-031

Table 9.3-19
Summary Comparison of Alternative Sites

Location	LNP Site	Crystal River Site	Dixie Site	Highlands Site	Putnam Site
Land Use	SMALL	SMALL	SMALL	SMALL	SMALL
Air Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Water	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Terrestrial Ecology	SMALL to MODERATE	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Aquatic Ecology	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL	SMALL	SMALL	SMALL
Historic, Cultural, and Archeological Resources	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL	SMALL
Transmission Corridors	SMALL	MODERATE	MODERATE	LARGE	LARGE
Transportation	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Is this Site a Candidate Site?	Yes	Yes	Yes	Yes	Yes
Is this Candidate Site a Good Alternative Site to the Proposed Site?	Yes	Yes	Yes	Yes	Yes
Is the Site Environmentally Preferable?	Preferred alternative	No	No	No	No
Is the Site Obviously Superior?	Preferred alternative	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated

9.4 ALTERNATIVE PLANT AND TRANSMISSION SYSTEMS

In accordance with the requirements specified in NUREG-1555, ESRP 9.4, this section describes the evaluation of the alternative plant and transmission systems for heat dissipation, circulating water, and power transmission for the LNP. PEF proposes to build and operate two pressurized water reactors (PWR), Units 1 and 2. These units are based on the AP1000 standard design, a certified nuclear power generating facility design under 10 CFR 52, Subpart B.

As discussed in ER Chapters 4 and 5, some clearing and other development will be required for the construction and operation of the LNP. Potential SMALL adverse impacts were noted for the installation of the selected heat dissipation system, cooling water intake structure (CWIS), and associated pipelines for the makeup water at the Cross Florida Barge Canal (CFBC). Additionally, SMALL impacts are anticipated from the placement of the transmission lines because existing corridors and existing PEF-owned or other ROWs are expected to be utilized. ER Subsection 9.4.1 discusses alternative heat dissipation systems, ER Subsection 9.4.2 discusses alternative circulating water systems (CWS), and ER Subsection 9.4.3 reviews transmission systems.

9.4.1 HEAT DISSIPATION SYSTEMS

The purpose of a heat dissipation system is to dissipate waste heat to the environment. The condenser creates the low pressure required to draw steam through and increase the efficiency of the turbines. The lower the pressure of the exhaust steam leaving the low-pressure turbine, the more efficiency that is gained. The limiting factor is the temperature of the cooling water.

Generally, heat dissipation systems are dependent on the availability of water resources at a particular site. The potential sources of cooling water for the LNP include freshwater (groundwater, surface waters, and reuse water) and saltwater.

Heat dissipation systems differ in how the energy transfer takes place, and therefore, have different environmental impacts. There are generally two types of heat dissipation systems: once-through cooling and closed-cycle cooling. Once-through cooling systems involve the use of a large quantity of cooling water, withdrawn from and returned to a large water source after its circulation through the main condenser. Closed-cycle cooling systems involve substantially less water usage because the water performing the cooling is continually re-circulated through the main condenser, and only makeup water for normal system losses is required. Normal system losses include evaporation, blowdown, and drift. Evaporation occurs as part of the cooling process in wet systems. The purpose of blowdown is to control solids in the water that accumulate due to evaporation and to help protect surfaces from scaling or corrosion problems. Drift is water that escapes from the heat dissipation system in the form of unevaporated droplets during operation. In closed-cycle systems, two pumping stations are usually required: a makeup water system and a cooling water system. Closed-cycle systems include cooling towers and cooling ponds or spray ponds. As a result of the evaporation process, the concentration of compounds in

the water will increase. To maintain acceptable water chemistry, water must be discharged at a small rate (blowdown) and losses compensated by a makeup water source.

For the LNP, the preferred method for dissipating the waste heat is a closed-cycle cooling system that consists of a series of mechanical draft cooling towers, which will draw seawater via a new CWIS from the CFBC to serve as cooling water makeup. The AP1000, which will be used for the LNP, is designed to effectively remove or enable removal of heat from the reactor during all modes of operation, including shutdown and accident conditions.

Heat dissipation systems are categorized as wet or dry, and the use of either system depends on site characteristics (Reference 9.4-001). Both wet and dry cooling systems use water as the heat exchange medium. A wet cooling tower cools water circulated through the tower. Heat from the water is dissipated by direct contact with air circulating through the tower. The heat transfer takes place primarily by evaporation of some of the water into the air stream (latent heat transfer). Generally, a relatively minor amount of sensible heat transfer (heating of the air and cooling of the water) also occurs. During very cold weather, the amount of sensible heat transfer can be fairly substantial. On the other hand, during a warm, dry summer day, the amount of sensible heat transfer might be nil or even negative (when negative, the air discharged from the tower is cooler than the ambient dry bulb temperature). This does not adversely affect the cold-water performance of mechanical draft cooling towers, but it does affect the evaporation rate. The wet cooling tower is used widely in the industry and is considered a mature technology.

Because wet cooling towers provide direct contact between the cooling water and the air passing through the tower, some of the water could be entrained in the air stream and be carried out of the tower as drift droplets. The magnitude of drift loss is influenced by the number and size of the droplets produced within the cooling tower. The droplets, in turn, are influenced by the fill design, the air and water patterns, and other interrelated factors. Tower maintenance and operation levels can influence the formation of drift droplets. For example, excessive water flow, excessive air flow, and water bypassing the tower drift eliminators can promote and increase drift emission.

The USEPA's *AP 42* provides the following information (Reference 9.4-001):

> To reduce the drift from cooling towers, drift eliminators are usually incorporated into the tower design to remove as many droplets as practical from the air stream before exiting the tower. The drift eliminators rely on inertial separation of the droplets, caused by direction changes, while passing through the eliminators. Types of configurations for drift eliminators include herringbone (blade-type), wave form, and cellular (or honeycomb) designs. The cellular units are generally the most efficient. Drift eliminators include various materials, such as ceramics, fiber reinforced cement, fiberglass, metal, plastic, and wood installed or formed into closely spaced slats, sheets, honeycomb assemblies, or tiles. The

materials might include other features, such as corrugations and water removal channels, to enhance the drift removal further.

According to guidance provided in NUREG-1555, ESRP 9.4.1, this subsection discusses alternatives to the proposed heat dissipation system described in detail in ER Section 3.4. Each AP1000 unit heat dissipation system will consist of rectangular fiberglass mechanical draft cooling towers.

9.4.1.1 Screening of Alternative Heat Dissipation Systems

As discussed in ER Subsection 9.4.1, the variety of heat dissipation system alternatives that can be evaluated are generally included in the broad categories of once-through and closed-cycle systems. An initial evaluation of once-through cooling and closed-cycle cooling alternative designs was performed to eliminate systems that are unsuitable for use at the LNP site. In addition to rejecting the once-through cooling alternative, the following types of closed-cycle cooling heat dissipation system alternatives were considered but rejected early in the process:

- Cooling ponds and spray ponds.
- Dry cooling towers.
- Hybrid wet/dry cooling towers.
- Natural draft cooling towers.

These alternatives, which were eliminated from further consideration because they were determined not to be environmentally preferred alternatives, are discussed in ER Subsections 9.4.1.1.1, 9.4.1.1.2, 9.4.1.1.3, 9.4.1.1.4, and 9.4.1.1.5. A summary of the environmental impacts of the heat dissipation system alternatives is provided in Table 9.4-1. Table 9.4-2 provides economic comparisons of the cooling tower options for a single hot weather year.

Only mechanical draft cooling towers are considered a suitable heat dissipation system for the LNP site and are evaluated in detail. This system is discussed in ER Sections 3.4 and 5.3, and is evaluated further in ER Subsection 9.4.1.2. In accordance with NUREG-1555, the heat dissipation alternatives were evaluated for land use, water use, and other environmental (legislative or regulatory) requirements (Table 9.4-1).

9.4.1.1.1 Once-Through Cooling

In once-through cooling systems, water is withdrawn from a body of water, passes through the heat exchanger, and is discharged back to an adjacent body of water or the same source but in a different location. The waste heat is dissipated to the atmosphere, mainly by evaporation from the water body and, to a much smaller extent, by conduction, convection, and thermal radiation loss. (Reference 9.4-002) The discharged water temperature is higher than the intake

water due to the warmth gained when passing through the heat exchanger. Based on the LNP configuration and size, the once-through cooling alternative would not support the cooling requirements for the LNP.

The environmental impacts associated with the once-through cooling heat dissipation system are described as follows: land use impacts would be SMALL due to the on-site requirements of land and terrain considerations; water use impacts would be LARGE due to the volume of makeup water and for the potential impacts to aquatic biota from the intake system; atmospheric impacts would be SMALL to MODERATE due to waste heat fogging associated with the discharge canal; thermal and physical effects would be LARGE due to the size of the intake and discharge structures as well as the quantity of offshore piping; and legislative restrictions are complex due to the potential compliance issues regarding Section 316(b) of the CWA and compliance with National Pollutant Discharge Elimination System (NPDES) thermal discharge requirements surrounding discharge back into the CREC discharge canal.

This alternative is subject to the requirements of the 316(b) Phase I rules governing new power generating facilities. Once-through cooling would pose risks of thermal effects and have the potential to damage aquatic organisms. USEPA regulations (40 CFR 125) governing CWIS under Section 316(b) of the CWA make the use of once-through cooling systems difficult for steam power generating facilities. As a result, the use of a once-through cooling water system would require approval from the USEPA Regional Director.

The overall environmental impacts associated with the use of a once-through cooling system would be LARGE due to the reasons discussed above. Therefore, the use of a once-through cooling system is not a viable cooling system option and was eliminated from further consideration. A summary of the environmental impacts of the once-through cooling heat dissipation system alternative is provided in Table 9.4-1.

9.4.1.1.2 Cooling Ponds and Spray Ponds

A cooling pond is generally a man-made shallow body of water having a large surface area for removing heat from heated water (Reference 9.4-003). Cooling ponds are often used where land is relatively inexpensive, cooling water is scarce or expensive, or where there are strict thermal loading restrictions in place. Water cooling occurs partly by radiation but is principally dependent on evaporation (the relative humidity of the air) and on the surface area of the water body. Water cooling is often very slow compared to other closed-cycle systems.

Spray ponds are similar to cooling ponds in that they use a shallow surface water body to cool heated water, but the spray pond requires less space. The heated water from the condenser is cooled by spraying it into the air so that it falls in a thin mist in the cooling pond below. The water surface area exposed to the air is increased with spray nozzles, which promote evaporative cooling in the ponds and reduces the pond-size requirements and potential land impacts. However, higher operating and maintenance costs for the spray modules offset this

advantage. Although water in the cooling pond would be reused, thereby potentially reducing the overall water-withdrawal requirement, both of these alternatives would still require the creation of new bodies of surface water at the LNP site. In addition, there is an unlimited supply of sea water available for cooling purposes. For these reasons, the cooling pond and spray pond alternatives were considered environmentally unsuitable for the LNP site.

The environmental impacts associated with the cooling ponds and spray ponds heat dissipation system are described as follows: land use impacts would range from MODERATE to LARGE due to the on-site requirements of land and SMALL for terrain considerations; water use impacts would be MODERATE due to the volume of makeup water needed; atmospheric impacts would be SMALL to MODERATE due to waste heat fogging associated with the cooling and spray ponds; and thermal and physical effects would be SMALL since there is no discharge associated with the cooling and spray ponds, no tangible aesthetic or recreational impacts, and no effects on fisheries or navigation. Noise impacts would be SMALL since the cooling system would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. The overall environmental impacts associated with the use of cooling ponds and spray ponds heat dissipation system would be SMALL to LARGE due to the reasons discussed above. Therefore, the use of cooling and spray ponds heat dissipation system is not a viable cooling system option and was eliminated from further consideration. A summary of the environmental impacts of the cooling ponds and spray ponds heat dissipation system alternative is provided in Table 9.4-1.

9.4.1.1.3 Dry Cooling Tower Systems

Dry cooling is an alternative cooling method in which heat is dissipated directly to the atmosphere using a tower without the evaporative loss of water (Reference 9.4-004). This tower transfers the heat to the air by conduction and convection rather than by evaporation. The condenser coolant is enclosed within a piping network with no direct air to water interface. Heat transfer is then based on the dry bulb temperature of the air and the thermal transport properties of the piping material. Both natural and mechanical draft can be used to move the air. While water loss is less for dry cooling towers than wet cooling towers, some makeup water is typically required.

The environmental impacts associated with the dry cooling tower heat dissipation system are described as follows: land use impacts would be SMALL due to the on-site requirements of land and terrain considerations; water use impacts would be SMALL since no makeup water is needed and thus no significant impacts to aquatic biota; atmospheric impacts would be SMALL since there is no visible plume associated with a dry cooling tower system; thermal and physical effects would be SMALL since there is minor-to-no discharge associated with the dry cooling tower heat dissipation system, no tangible aesthetic or recreational impacts, and no effects on fisheries or navigation; and legislative restrictions impacts would be SMALL to MODERATE since there are potential compliance issues with the requirements for emissions under the federal Clean Air Act that

may influence overall operational costs. Noise impacts would be SMALL since the dry cooling tower heat dissipation system would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. The overall environmental impacts associated with the use of a dry cooling tower heat dissipation system would be SMALL to MODERATE due to the reasons discussed above. However, as discussed below, the use of a dry cooling tower heat dissipation system is not a viable cooling system option and was eliminated from further consideration. A summary of the environmental impacts of the dry cooling tower heat dissipation system alternative is provided in Table 9.4-1.

There are two types of dry cooling systems for nuclear power generating facility applications: direct dry cooling and indirect dry cooling. Direct dry cooling systems utilize air to directly condense steam, while indirect dry cooling systems utilize a closed-cycle water cooling system to condense steam, and the heated water is then air cooled. Indirect dry cooling generally applies to retrofit situations at existing power generating facilities because a water-cooled condenser would already be in place for a once-through or closed-cycle cooling system (Reference 9.4-004).

Because there is no evaporative or drift losses in this type of system, many of the problems of conventional cooling systems are eliminated. For example, there are no problems with blowdown disposal, water availability, chemical treatment, fogging, or icing when dry cooling towers are utilized. Although the elimination of such problems is beneficial, the dry towers have associated technical obstacles such as high turbine backpressure and possible freezing in cooling coils during periods of light load and startup.

This is an inherently less efficient process and requires an extensive heat transfer surface area of metal fin tubing within the tower, which could be either mechanical or natural draft. In this system, the temperature of the water leaving the tower could only approach the dry bulb temperature of air, which would be invariably higher than the wet bulb temperature approached by the wet towers.

Additionally, the thermal performance of the dry cooling tower is only dependent on the dry bulb temperature of the entering air; therefore, the cold water temperature attainable could be 11.1 degrees Celsius (°C) to 16.7°C (20 degrees Fahrenheit [°F] to 30°F) higher than would be expected from a normal evaporative-type cooling tower. This warmer circulating water temperature would result in maximum turbine backpressures that are higher than AP1000 standard turbine trip set point of 7.4 inches of mercury absolute (in. HgA).

PEF concluded that this alternative is not suitable for the reasons discussed in the USEPA preamble to the final rule addressing CWIS for new facilities. In summary, dry cooling systems carry not only high capital costs, but operating and maintenance costs that are sufficient to pose a barrier to entry to the marketplace for some nuclear power generating facilities. In addition, dry cooling has a detrimental effect on electricity production by reducing the efficiency of steam turbines. Dry cooling towers require the nuclear power generating facility to use more energy than would be required with wet cooling towers to produce

the same amount of electricity. This energy penalty is most significant in warmer southern regions during summer months when the demand for electricity is at its peak. The energy penalty would result in an increase in environmental impacts, because replacement of the generating capacity would be needed to offset the loss in efficiency from dry cooling. The USEPA concluded that dry cooling is appropriate in areas with limited supplies of water available for cooling or where the source of cooling water is associated with extremely sensitive biological resources (for example, endangered species and specially protected areas). In addition, dry cooling towers have the potential to increase plant heat rate by 1 to 4 percent and result in the need for this amount of replacement power from the CO_2 emitting technologies. In addition, where there is an essentially unlimited supply of sea water available to support cooling in wet towers, dry tower technologies are not economical and considered not environmentally suitable. Based on these conditions, dry cooling does not warrant further consideration at the LNP site.

9.4.1.1.4 Hybrid Wet/Dry Cooling Tower System

Hybrid wet/dry cooling tower systems incorporate both a wet section and a dry section and are used primarily in areas where plume abatement is necessary for aesthetic reasons or to minimize fogging and icing produced by the tower plume. Wet/dry cooling towers use approximately one-third to one-half less water than wet cooling towers (Reference 9.4-004). In a wet/dry cooling tower, efficient wet cooling water temperatures are achieved with a reduced visible plume similar to dry cooling systems. Fans are located in both the wet section and the dry section of the tower. In the dry section, the fans are located above the wet level in front of the heat exchangers. The hyperbolic shell achieves a natural draft effect that helps reduce power consumption.

Somewhat more land is required for the dry/wet cooling tower due to the additional equipment (fans and cooling coils) required in the tower assembly. The same disadvantages previously described for dry cooling towers would apply to the dry cooling portion of the dry/wet cooling tower. The dry cooling process is not as efficient as the wet cooling process because it requires the movement of a large amount of air through the heat exchanger to achieve the necessary cooling. This results in less net electrical power for distribution. Consequently, an increase would occur in environmental impacts because replacement generating capacity would be needed to offset the loss in efficiency from dry cooling. Therefore, this alternative is not considered to be environmentally preferable to the proposed rectangular mechanical draft cooling towers.

The environmental impacts associated with the hybrid wet/dry cooling tower heat dissipation system are described as follows: land use impacts would be SMALL due to the on-site requirements of land and terrain considerations; water use impacts would be SMALL since there is a potential minor impact to aquatic biota; atmospheric impacts would be SMALL since there is a visible plume that presents a minor potential for fogging and salt disposition; thermal and physical effects would be SMALL since the discharge would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations,

discharge is not likely to produce tangible aesthetic impacts, and no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected; noise impacts would be SMALL since the hybrid wet/dry cooling tower heat dissipation system would emit broadband noise that is largely the same as background levels and would be considered unobtrusive; and legislative restrictions impacts would be SMALL to MODERATE because of the potential compliance issues regarding Section 316(b) of the CWA and compliance with NPDES thermal discharge requirements surrounding discharge back into the CREC discharge canal. The overall environmental impacts associated with the use of a hybrid wet/dry cooling tower heat dissipation system would be SMALL to MODERATE. However, as described earlier in this subsection, the use of a hybrid wet/dry cooling tower heat dissipation system is not a viable cooling system option and was eliminated from further consideration. A summary of the environmental impacts of the hybrid wet/dry cooling tower heat dissipation system alternative is provided in Table 9.4-1.

9.4.1.1.5 Natural Draft Hyperbolic Cooling Tower

Natural draft cooling towers function on the basic principle that hot air rises. As the air inside the tower is heated, it rises through the tower. This process draws more air in, creating a natural air flow to provide cooling of the water.

A natural draft hyperbolic cooling tower is one that relies on the latent heat of water evaporation to exchange heat between the water transfer process and the air passing through the tower. In a natural draft cooling tower, warmer water is brought into direct contact with the cooler air. When air enters the cooling tower, its moisture content is generally less than saturation. When the air exits, it emerges at a higher temperature and with moisture content at or near saturation. Even at saturation, cooling can take place because a temperature increase results in an increase in heat capacity, which allows better absorption of sensible heat. A natural draft cooling tower induces the air flow by generating warm moist air that is less dense than the ambient air, which results in a convection flowing up the tower. This air convection cools the water on contact. Because of the tremendous size of these towers (typically 152.4 m [500 ft.] high and 121.9 m [400 ft.] in diameter at the base), they are generally used for flow rates above 12,620 liters per second (l/s) (200,000 gpm), which are the flow rates generally used in utility power stations in the United States (Reference 9.4-005). They are generally loaded at approximately 1.4 to 2.5 liters per second per square meter ($l/s/m^2$) (2 to 4 gallons per minute per square foot [gpm/ft^2]). Natural draft cooling towers are, however, infrequently used for installation in the United States (Reference 9.4-004). Natural draft cooling towers were eliminated as an option for the LNP because of the local zoning height limitations, which limit the maximum height of each tower to 91.4 m (300 ft.).

The environmental impacts associated with the natural draft hyperbolic cooling tower heat dissipation system are described as follows: land use impacts would be SMALL due to the on-site requirements of land and terrain considerations; Water use impacts would be SMALL to MODERATE since there is a potential for impacts to aquatic biota; atmospheric impacts would be SMALL since there is a

visible plume that presents a potential for fogging and salt disposition; thermal and physical effects would be SMALL since the discharge would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations, discharge is not likely to produce tangible aesthetic impacts, and no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected; noise impacts would be SMALL since the natural draft hyperbolic cooling tower heat dissipation system would emit broadband noise that is largely the same as background levels and would be considered unobtrusive; and legislative restrictions impacts would be SMALL to MODERATE because of the potential compliance issues regarding Section 316(b) of the CWA and compliance with NPDES thermal discharge requirements surrounding discharge back into the CREC discharge canal. The overall environmental impacts associated with the use of a natural draft hyperbolic cooling tower heat dissipation system would be SMALL to MODERATE due to the reasons discussed above. However, as discussed earlier in this subsection, the use of a natural draft hyperbolic cooling tower heat dissipation system is not a viable cooling system option and was eliminated from further consideration. A summary of the environmental impacts of the natural draft hyperbolic cooling tower heat dissipation system alternative is provided in Table 9.4-1.

9.4.1.2 Analysis of Preferred Heat Dissipation Alternative — Mechanical Draft Cooling Tower

A mechanical draft cooling tower induces or forces air through the tower by one or more fans built into the tower. Induced-draft cooling towers use fans to create a draft that pulls air through the cooling tower fill. Forced-draft cooling towers blow air in at the bottom of the tower and the air exits at low velocities out the top of the tower.

Mechanical draft cooling towers may also employ a crossflow (XF) or counterflow (CF) design. Mechanical draft towers consist of shared fans that are clustered in the center of the tower (XF towers) or uniformly spaced on the fan deck (CF towers). An XF tower is designed so that the air and water are mixed at a 90-degree angle. The CF cooling tower design allows vertically falling water to mix with vertically rising, cooling air at an angle of 180 degrees. Generally, XF and CF cooling towers have similar drift loss. (Reference 9.4-005) Water to be cooled is pumped to a hot water distribution system above the fill and then falls over the fill into the cold water basin. Air is drawn through the falling water by a fan, which results in the transfer of heat from the water to the air, and the evaporation of some of the water. The fill serves to increase the air-water contact surface and contact time, thereby promoting heat transfer. A mechanical draft cooling tower employs large fans to either force or induce a draft that increases the contact time between the water and the air maximizing the heat transfer. A forced-draft tower has the fan mounted at the base, forcing air in at the bottom and discharging air at low velocity through the top. An induced draft tower uses fans to create a draft that pulls air through the cooling tower fill. A typical mechanical draft cooling tower has a loading capacity of 1.4 to 4.1 $l/s/m^2$ (2 to 6 gpm/ft^2) (Reference 9.4-005). Additionally, a rectangular mechanical draft

cooling tower consists of a continuous row of rectangular cells in a side-by-side arrangement sharing a common cold water basin.

Many mechanical draft cooling towers are wood-framed structures based on cost considerations. Wood towers are generally constructed of treated redwood or treated Douglas fir. Redwood is a better material, but has become increasingly expensive in recent decades and is now seldom used for new construction. In addition, such wood has to be treated for outdoor use with chromated copper arsenate (CCA) or similar compounds. Concerns over leaching chromium, copper, and arsenic compounds into the environment have resulted in decreased usage of treated lumber and has spurred research into alternative wood preservation methods. Wooden structures are not considered to be a preferable option. Wood towers offer the shortest life expectancy, leach the preservative chemicals (CCA or acid copper chromate [ACC]) with which they are treated into the blowdown and tower basin sediment, and require a hydrogen ion concentration (pH) balance below 8.5, but they are relatively inexpensive to build and repair.

Other materials commonly used for mechanical draft towers are ceramic, fiberglass, steel, or concrete. Although ceramic cooling towers offer aesthetic advantages over other cooling towers constructed of other materials, they are typically more expensive. Due to their resistance to severe weather, fiberglass cooling towers are considered to be useful in harsher environmental conditions. Additionally, these cooling towers also provide good corrosion resistance, which remains advantageous in applications when the tower is exposed to chemicals, such as for water treatment. Fiberglass is considered to be stronger than Douglas fir and redwood, and because it is available in long lengths, it allows a cooling tower to be designed and built with a minimum number of airflow obstructions. Concrete towers will last the longest, but are the most expensive to build. A summary of the environmental impacts of the round mechanical draft cooling tower heat dissipation system alternative is provided in Table 9.4-1.

The proposed heat dissipation system for the LNP includes one mechanical draft tower for each AP1000 unit using makeup water from the CFBC. As discussed in ER Subsection 3.1.4.2, the heat dissipation system will typically have a height of up to 22.3 m (75 ft.), and each of the two trains (two trains for each unit) will have an approximate length of 304.8 m (1000 ft.), which would slightly alter the visual aesthetics of the LNP site. As noted in ER Subsection 5.8.1.3, the majority of the site will be preserved in its present forested condition, creating a natural buffer around the industrial area. The physical structures of the LNP will not be visible from public areas at ground level, and only the cooling tower plumes will potentially be visible (during limited meteorological conditions) from a limited number of off-site locations. The plumes from the cooling towers are not expected to be visible from the closest recreational areas in the area, primarily because of the large distances from these areas to the cooling towers, as well the amount of view-obstructing vegetation between these areas and the cooling towers. Visual impacts on nearby residents are expected to be SMALL.

In addition, as discussed in ER Subsection 5.3.3.1.1, under most meteorological conditions, the waste heat discharge will condense upon leaving the tower, and the length of the visible plume will depend on the temperature and humidity of the atmosphere. Colder and more humid weather is conducive to longer plumes. On very humid days, when the longest plumes are expected, there may be a naturally occurring overcast. On such occasions, it may be more difficult to distinguish the cooling tower plume from the overcast cloud layer. Most of the time, the visible plume will extend only a short distance from the tower and then disappear by evaporation.

As discussed in ER Subsection 5.3.3.1.2, there may be icing impacts on the immediate vicinity of the cooling tower, but none are expected at any off-site locations. The impact of cooling tower plumes on terrestrial ecosystems is expected to be SMALL, and no mitigation will be warranted.

As discussed in ER Subsection 5.3.3.1.4, no significant increase in local precipitation is expected to occur as a result of cooling tower operation at the LNP site. Any additional precipitation will be small in comparison with the average rainfall in the region, which has been shown to range from 114 cm (45 in.) to 160 cm (63 in.) (Table 2.7-2).

The operation of the LNP cooling towers is not expected to result in a significant increase in precipitation, and no mitigation will be warranted.

Several important terrestrial species exist within the vicinity of the proposed cooling towers (see ER Subsections 2.4.1 and 4.3.1). As discussed in ER Subsection 5.3.3.2, operation of the heat dissipation system proposed for the LNP site has only a very small potential to have any discernible impact on local terrestrial plants and animals. The operation of the LNP cooling towers will result in relatively small amounts of salt and particle drift from the tower, and very limited occurrences of visible vapor plumes at off-site locations. No occurrences of fogging or icing are expected at any off-site locations. The potential for local precipitation modification is considered to be almost nonexistent. While there will be an increase in noise in the immediate vicinity of the cooling towers and the CWIS, these noise impacts are expected to be minimal and limited primarily to on-site locations. ER Subsection 5.3.4.2 and the GEIS provide further discussion of impacts. The operation of the LNP cooling towers is not expected to have a significant or adverse impact on any terrestrial species from the presence of vapor plumes, the small amount of cooling tower drift and solids deposition, or plume fogging or icing.

The evaporation rate for the proposed cooling towers at the LNP is estimated to be 1.82 m^3/s (64.30 ft^3/sec) or 28,860 gpm during normal operations. As discussed in ER Subsection 5.3.3.2.1, cooling tower drift normally contains small amounts of solids that can ultimately deposit at ground level. ER Subsection 5.3.3.1.3 points out that a very small fraction of the water circulating through the LNP cooling towers will be carried into the cooling tower plumes as small water droplets (as cooling tower “drift”). Because modern cooling towers have almost no drift losses, this is not considered to be a critical design parameter. Site wind

velocities, direction, and orientation to the site have been considered in designing the mechanical draft cooling towers to minimize any recirculation of air and vapor exiting the towers and to provide adequate cooling capacity should any recirculation occur.

Water droplets emitted from the cooling towers will contain the same concentration of dissolved and suspended solids as the water within the cooling tower basin that is circulated through the towers. The dissolved and suspended solid concentrations in the cooling tower basins will be controlled through use of the makeup and blowdown water lines from the CFBC. Further discussion regarding impacts from the amount of dissolved solids generated during operation is presented in ER Subsection 5.3.3.1.3. It is expected that, because of the relatively large distances from the cooling towers to the LNP site boundaries, the impacts from deposition solids from the cooling towers at off-site locations will be SMALL, and additional mitigation should not be required.

ER Subsections 4.1.1 and 4.1.2 provide a detailed discussion of anticipated land use changes as a result of the physical presence of the major LNP on-site and off-site components, respectively. Impacts on vegetation attributable to salt drift emissions from the proposed cooling tower plumes at the LNP site are expected to be SMALL, and increases in soil salinity are anticipated to be minimal. No mitigation will be warranted.

Construction of the LNP is not expected to adversely affect the regional population of any protected plant or animal species. Native habitats on the LNP property have been significantly altered through silvicultural operations, and mobile-listed species are likely to preferentially use less disturbed habitats on adjacent conservation lands. Impacts on important species are expected to be SMALL. The operation of the LNP cooling towers is not expected to have a significant or adverse impact on any terrestrial species from the presence of vapor plumes, the small amount of cooling tower drift and solids deposition, or plume fogging or icing. The impacts are, therefore, expected to be SMALL and no mitigation will be warranted.

As discussed in ER Subsection 4.2.1.1, construction of the LNP, including cooling towers, will result in hydrologic alterations of the watersheds at the LNP, including filling wetlands and excavation. The alterations related to LNP site preparation and construction may temporarily increase the volume of stormwater runoff to the CFBC, Withlacoochee River, and Inglis Lock Bypass Channel, and may also temporarily alter the quality of runoff. Any long-term impacts of the temporary increase in runoff from the construction are expected to be SMALL, and mitigation will not be warranted.

Construction activities will cause only temporary effects on streams. All construction will be performed in accordance with CWA Sections 401 and 404 regulations and Florida's regulations concerning CWA Section 401 water quality certifications.

Hydrologic alterations resulting from CWIS construction will only affect the immediate area surrounding the location in the CFBC. Circulation patterns are expected to be minimally and temporarily affected during construction. ER Section 5.2 describes any long-term hydrologic alterations resulting from LNP operation. The potential hydrologic alterations resulting from the operation of the LNP and the adequacy of the water supply proposed for plant water needs are directly related to freshwater streams, lakes and impoundments, the CFBC, groundwater, and the Gulf of Mexico.

The hydrologic features near the LNP site are diverse and include wetland areas, a river, a manmade canal and lake, and the Gulf of Mexico. On-site alterations from the development of the site will include SMALL to MODERATE impacts to wetlands and changes in stormwater runoff. Operation of the LNP, including the withdrawal of cooling water from the CFBC and discharge to the CREC discharge canal, is not expected to alter surface water hydrology in the CFBC or the Gulf of Mexico. Groundwater withdrawals for freshwater needs could affect groundwater hydrology. Water quality impacts from LNP operation are discussed in ER Subsection 5.2.2.

Discharges related to construction activities will be nonpoint source. All federal, state, regional, tribal, and local regulations relating to nonpoint sources will be observed. Impacts on water quality are expected to be SMALL. The withdrawal and discharge resulting from the operation of the LNP and the adequacy of the water supply proposed for plant water needs could affect surface and groundwater use. Discharges of effluent from the LNP will be to the Gulf of Mexico through a discharge pipeline routed to the CREC discharge canal. For this reason, impacts on surface freshwater hydrology and water quality are expected to be SMALL. Impacts on water quality in freshwater streams are expected to be SMALL. The LNP will not withdraw from or discharge to freshwater surface streams. Runoff from the site will be managed according to FDEP stormwater regulations. Impacts on water availability and quality from lakes and impoundments are expected to be SMALL. The LNP will not withdraw from or discharge to lakes or impoundments. Runoff from the site does not drain to lakes or impoundments in the vicinity of the site.

As described in ER Subsection 2.4.2.3.6, the aquatic ecosystems of the CFBC, CREC discharge canal, and the Gulf of Mexico are well adapted to a range of temperature and salinity conditions. Withdrawing water from the CFBC will not change temperature and salinity conditions beyond the natural range that presently occurs. The impacts of withdrawals from the CFBC and discharge to the CREC discharge canal on flow patterns, temperature, and water quality are described in more detail in ER Subsections 5.3.1 and 5.3.2. Although changes to the hydrology and water quality of the CFBC and the CREC discharge canal could occur, only minor effects on the Gulf of Mexico are expected.

As discussed in ER Subsection 5.2.2.3, the withdrawal of groundwater from the Floridan aquifer could affect the potentiometric head in the aquifer over an area around the wellfield. The overall impacts on groundwater supply and quality are expected to be SMALL.

Environmental impacts of the two mechanical draft cooling towers system alternatives are expected to be SMALL to MODERATE, and details are provided in Table 9.4-1.

9.4.1.3 Summary of Alternative Heat Dissipation Evaluation

PEF's evaluation of heat dissipation alternatives assumed that if the predicted differences in net economic benefit were small, then other considerations might be given higher consideration. Other considerations include aesthetics, corporate preferences related to operations and maintenance issues, initial cost, risk associated with tower technology or vendor capability, and associated site work for arrangement and fitting of cooling water piping to the tower.

In addition to the above evaluation, a review of the cooling of tower blowdown in hot months was performed. Sizing the main towers to maintain tower blowdown to temperatures below expected environmental constraints was not practical. Therefore, blowdown cooling options were reviewed, and a recommended option was selected. As noted in ER Subsection 9.4.1.1.5, local zoning height limitations eliminated the natural draft cooling towers as an alternative; therefore only mechanical draft cooling towers were considered for use at the LNP. A summary of the environmental impacts of the three mechanical draft cooling tower options (two rectangular fiberglass units, three round fiberglass units, and three round concrete units) is provided in Table 9.4-1.

Each of the cooling tower options were evaluated at three different circulating water flow rates using two different weather profiles (the representative "hot" year and the "average" year): 31.55 m^3/s (1114.01 ft^3/sec) or 500,000 gpm, 37.85 m^3/s (1336.81 ft^3/sec) or 600,000 gpm, and 39.75 m^3/s (1403.65 ft^3/sec) or 630,000 gpm. In addition, two energy rates were applied to the net production differences between the base case and each option. For this evaluation, "net power" referred to gross production less the circulating water pump and tower fan power consumed for each option. Auxiliary power serving the power block was common to all options and, therefore, was not considered for the evaluation. For the base case, two rectangular fiberglass mechanical draft cooling towers with a 37.85 m^3/s (1336.81 ft^3/sec) or 600,000 gpm circulating water flow rate were used.

It was determined that the environmental impacts of the three cooling tower alternatives evaluated were SMALL to MODERATE. Therefore, in considering the comparison of the various cooling tower options, three main costs and benefits were considered:

- Production — The detailed present net value for production benefits for a single average year and a single hot year of nuclear power generating facility operation for each cooling tower option was calculated.

- Initial Cost — Initial "overnight" cooling tower cost was based on vendor input and expected cost differences associated with procurement, support

systems, and general contractor items to integrate the towers into the site.

- Maintenance — Inspection and maintenance (replacement parts) cost differences were considered over the anticipated 60-year life of the nuclear power generating facility.

Because the evaluation was performed at different circulating water flows, temperatures, and condenser heatloads, a separate evaluation was performed to determine the condenser backpressure at these operating conditions. The methodology used in the evaluation allowed for condenser backpressure to be determined for a given steam loading, condenser surface area, circulating water temperature and flow rate, condenser cleanliness, tube material, and other nuclear power generating facility-specific parameters. The condensing temperatures are then computed based on this input. The condenser backpressure is then the saturation pressure at the condensing temperature.

The evaluation used weather data for central Florida (Tampa) from 1961 to 1990 to develop a hottest year and an average year based on hourly wet bulb temperatures. The average year weather data were developed from the 30 years of the meteorological data by averaging the hourly wet bulb temperatures and relative humidities to generate a single year of average weather.

In addition to the differences in the initial cost of construction for each of the cooling tower options, some differences exist in the expected operation and maintenance costs that were included in the overall economic evaluation. These include the following:

- Inspection and replacement of the cooling tower fill.
- Inspection and replacement of the distribution piping/nozzle.
- Inspection and maintenance of mechanical components.
- Replacement of mechanical components.

Cooling towers, whether of natural or mechanical draft design, use blowdown to maintain tower water chemistry within design limits. Blowdown will be regulated by environmental permit. As discussed in ER Subsection 3.3.1, the LNP site will withdraw water from the CFBC to supply cooling water for the proposed reactors. Although a maximum blowdown temperature was not identified, the evaluation assumed that the blowdown would be limited to a maximum temperature of 32.8°C (91°F); however, the actual temperature limit will be determined and established as a part of the final NPDES permitting process. After usage, the portion of the cooling tower water supply not lost to evaporation will be discharged to the Gulf of Mexico through the use of a blowdown pipeline routed to the CREC discharge canal. Studies on the impacts on the Gulf of Mexico from existing CREC discharges have been performed since the 1980s. The existing

NPDES permit for those discharges has been designed based on the findings of these studies to minimize impacts.

Potential impacts on water quality from discharge of additional cooling water to the CREC discharge canal, and ultimately to the Gulf of Mexico, will be mitigated through compliance with an NPDES permit. This permit will specify limits on numerous water quality characteristics including temperature and constituent concentrations.

Design of the LNP will include cooling systems, which will allow the discharge characteristics to meet NPDES permit requirements as determined by FDEP. Monitoring to support the NPDES compliance is discussed further in ER Chapter 6.

With expected extreme wet bulb temperatures in the range of 26.7°C to 29.4°C (80°F to 85°F), and expected approach temperatures for aged towers to be in the range of 5.6°C to 8.3°C (10°F to 15°F), it is not prudent to expect that blowdown temperatures will remain below 32.8°C (91°F) for critical production times in the hottest weather. A forced downpower to address periodically high blowdown temperatures might not be economical. As a result, the following options were considered to address high blowdown temperatures:

- Blowdown Tower — A dedicated small cooling tower for blowdown could be included in the design. However, in addition to operating and maintenance expenses, such a tower would have the same difficulty in achieving the close approach temperature needed to meet the environmental limit (as would the main tower).

- Isolate Blowdown and Makeup with Fresh Water — For the limited times when blowdown is expected to exceed the environmental limit, blowdown could simply be isolated. In order to maintain tower chemistry, makeup could not be continued with sea water. Rather, freshwater makeup with a dedicated pump would be required. This system would require instrumentation and valves to control the system, freshwater makeup storage, and a freshwater makeup transfer pump station. The pump station would require a capacity of approximately 15,000 gpm per unit. It is assumed that blowdown isolation would typically be on the order of 12 hours per event. At 30,000 gpm for two units, this would require freshwater storage of 400 acre-feet to address six consecutive days of blowdown isolation (12 hours per day). This option is considered to be less promising and cost effective than the option below, and is not developed further.

- Cooling Blowdown Using Makeup — Blowdown is cooled by makeup using a plate-and-frame heat exchanger. Large units, such as these, are equipped with titanium or stainless steel plates for saltwater duty. These units are capable of very close approach temperatures (approaches in the range of 1.9°C to 2.8°C [3.5°F to 5.0°F] are economically achievable). A single unit is capable of flow in excess of 0.95 m^3/s (33.42 ft^3/sec) or

15,000 gpm, and would likely accomplish the total blowdown cooling duty for two units.

Circulating water pump and motor efficiency is assumed to be 85 percent and 95 percent, respectively, for all cases. The assumed efficiency values are typical for this type of application. Pump efficiencies are not expected to vary significantly for the different tower options.

Since blowdown and makeup are operated simultaneously, the design will essentially always have a cooling medium. Further, the design is passive without requirements for power-actuated valves or devices. Blowdown is either gravity fed or pump driven, depending on the nuclear power generating facility layout. The plate-and-frame heat exchanger would not impact this aspect of the blowdown system design.

Since heating of the makeup adds to the tower heat load and costs some plant, a bypass is included in the design such that cooling would only be affected when required by permit. It is likely that this flow balancing through and around the heat exchanger could likely be performed as a seasonal activity (without the need for automated valves and associated instrumentation). This would assist in heat rate improvement without the associated capital, operating, and maintenance costs of automated equipment

Since the heat exchanger is passive and has high anticipated reliability, it is expected that it will only occasionally require cleaning, and therefore there is no required redundancy for this equipment. The unit can simply be bypassed during the short time frame associated with disassembly for cleaning.

In summary, a makeup / blowdown system designed to cool blowdown (as necessary) using makeup in a plate-and-frame heat exchanger is considered to be a cost-effective alternative to reliably maintain blowdown and mixing zone temperatures within environmental limits. This approach would eliminate constraints on main tower performance and avoid unit downpowers for this issue. Since a cost-effective option to address the environmental permitting issue associated with blowdown heat load is available, and common to all options, the need for and cost of this supplemental cooling option is not studied further here.

Note: To prevent any undesirable impact of the hot makeup water on the service water system (makeup system is planned to be common for service water and circulating water) the plate-and-frame heat exchanger should be installed only on the circulating water leg of the makeup system.

The cooling tower performance evaluation demonstrated that the design with two natural draft cooling towers, one per AP1000 unit, resulted in the largest yearly gross generation revenue for all cases considered. However, this is also the

cooling tower alternative with the highest initial cost. The simplified economic evaluation shown in Table 9.4-2 includes the initial tower cost and maintenance cost differences along with the power generation revenue differences for the expected 60-year life of the nuclear power generating facility for the cases with an assumed 37.85 m^3/s (1336.81 ft^3/sec) or 600,000 gpm of circulating water flow.

Table 9.4-2 (single hot year weather) indicates that the power generation benefits partially offset the high initial cost of the fiberglass mechanical draft towers. For the high (2005 year) energy rate, the round fiberglass mechanical draft tower has the lowest overall cost (net present value). The rectangular mechanical draft tower was next in cost (difference of $6,415,000) and the round concrete mechanical draft tower cost the most (difference of $17,944,000). Costs are for one AP1000 unit.

An economic analysis for the average weather year was not performed because the fan power (production differences) associated with the three options evaluated are the same as for the hot weather year.

Although the evaluation indicated a slight economic benefit in net present value for the circular cooling tower over the rectangular towers, rectangular towers were considered to be the preferred cooling tower option for the following reasons:

- Less complicated construction sequencing and wide availability of qualified vendors.
- Easy maintenance and removal of single cells from operation for repairs.
- Greater flexibility to add additional cells.

9.4.2 CIRCULATING WATER SYSTEMS

In accordance with NUREG-1555, ESRP 9.4.2, this subsection presents a discussion of alternatives to the following components of the CWS for the LNP: intake systems, discharge systems, water supply, and water treatment processes. Makeup water to the CWS will be provided by the raw water system (RWS) via the CWIS in the CFBC. In addition, water chemistry will be controlled by the turbine island chemical feed system (CFS).

NUREG-1555, ESRP 9.4.2, provides the following information:

> The scope of the review directed by this plan should be limited to alternative circulating water systems considered feasible for construction and operation at the proposed plant site and that (1) are not prohibited by Federal, State, regional, local, and affected Native American tribal agreements, (2) are consistent with the Federal Water Pollution Control Act (FWPCA), commonly referred to as the CWA (CWA), and (3) can be judged as practical from a technical standpoint with respect to the

proposed dates of plant construction and operation. This review should also include the investigation of alternatives proposed by other reviewers to mitigate impacts associated with construction and operation of the proposed circulating water system.

The CWS is an integral part of the heat dissipation system. It provides the interface between (1) the normal heat sink, main steam turbine condenser (heat exchanger), where waste heat is discharged from the steam cycle and is removed by the circulating water, and (2) the heat dissipation system where the heat energy is then dissipated or transferred to the environment.

As noted in ER Subsection 9.4.1, two cooling water systems are available for removing this waste heat: once-through and closed-cycle systems. In once-through cooling systems, water is withdrawn from a cooling source, passed through the condenser, and then returned to the source (receiving body of water). In the closed-cycle cooling system, heat picked up from the condenser by the circulating water is dissipated through auxiliary cooling facilities, after which the cooled water is recirculated to the condenser.

As discussed in ER Section 3.3, the LNP requires water for both plant cooling and operational uses. The LNP will use two independent cooling water systems:

- Seawater as makeup water that cools the turbine generator will be supplied from the CWIS on the CFBC for the cooling water system.

- Freshwater from well water pumps located in the freshwater aquifer (Floridan) at the LNP for the SWS.

Freshwater from the RWS will also be used for the other water services required for operation, including the potable water system (PWS), the demineralized water treatment system (DTS), and the fire protection system (FPS). Potable water is required for human consumption, sanitary, and other domestic purposes. The RWS supply will be from well water pumps located in the freshwater aquifer at the LNP site.

Water from the CWS will be pumped from the cooling tower basin through the main steam turbine condensers and turbine plant auxiliary heat exchangers, where heat transferred to the cooling water in the condenser will be dissipated to the atmosphere by evaporation, cooling the water before its return to the condenser. The water from the cooling system lost to the atmosphere through evaporation must be replaced. This evaporation would increase the level of solids in the circulating water. To control solids, a portion of the recirculated water must be removed (generating blowdown) and replaced with clean water. In addition to the blowdown and evaporative losses, a small percentage of water in the form of drift droplets will be lost from the cooling tower.

Makeup water for the CWS will be supplied from the CWIS (see ER Subsection 9.4.1) located on the CFBC. This makeup water will be used to replace water lost by evaporation, drift, and blowdown from the cooling tower.

Cooling tower blowdown from a series of mechanical draft cooling towers, including waste heat, will be transported via two pipelines (one for each unit) from the LNP. It will run south to the CFBC, turn and follow the berm along the northern edge of the canal, cross the CFBC, and proceed along a southerly route, and discharge into the CREC discharge canal (see ER Subsection 9.4.2.1.3). The LNP blowdown rate of 81.34 mgd equates to 4.9 percent of the combined CREC/LNP discharge canal flow rates (see ER Subsection 5.3.2.1). ER Section 3.3 provides a discussion of the anticipated LNP water use and discharge for the two new AP1000 units.

9.4.2.1 Intake and Discharge Systems

A preliminary environmental review of potential cooling tower makeup water sources (intake) and blowdown (discharge) alternatives for the LNP was conducted. ER Subsection 9.4.2.1.2 presents the results of the environmental review for identifying and evaluating alternative locations for the CWIS and associated pipeline corridor. ER Subsection 9.4.2.1.3 presents the results of the environmental review for identifying and evaluating alternative locations for the blowdown discharge location and associated pipeline corridor. Conceptual designs of the LNP CWIS are presented in Figures 2-1 and 2-2 and Attachment 2 of Appendix 10.2.2 (316[b] Demonstration) of the Site Certication Application (SCA).

For both once-through and closed-cycle cooling systems, the CWIS and discharge structure can be of various configurations to accommodate the source body of water and to minimize impacts to the aquatic ecosystem. CWIS are generally located along the shoreline of the body of water and are equipped with fish protection devices. Discharge structures are generally of the jet or diffuser outfall type and are designed to promote rapid mixing of the effluent stream with the receiving body of water. Biocides and other chemicals used for corrosion control and for other water treatment purposes can be mixed with the condenser cooling water and discharged from the system. Only biocides or chemical additives that are approved by the USEPA and the FDEP as safe for humans and the environment will satisfy requirements established in the LNP NPDES permit.

CWIS are typically regulated under Section 316(b) of the federal CWA and under Chapter 62-620.100-910, F.A.C., which sets the procedure used to apply for, develop, and issue wastewater discharge permits.

According to the Florida NPDES permit requirements, a mixing zone can be established in the area of a discharge to provide reasonable opportunity for the mixture of the discharge with the receiving waters. The limits of such mixing zones will be defined by the FDEP on a case-by-case basis after consideration of the magnitude and character of the discharge and the size and character of the receiving waters. Thermal wastewater discharges in Florida are subject to effluent limitations under Chapter 62-302.520, F.A.C. This rule limits thermal discharges in open waters to 9.4°C (17°F) above the natural water temperature and includes further restrictions based on geographic regions of the state.

Exceptions to these limits are allowed under the temperature variance provisions of the CWA, Section 316(a). Under this provision, permittees must demonstrate that the variance for the thermal component of the discharge ensures the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in the receiving water.

A CWIS and a discharge structure will be required for operation of the LNP. No long-term physical changes in land use are anticipated from construction of the CWIS, the pumphouse, and the makeup water pipeline corridor. Construction activities will cause only temporary effects to shallow pools, streams, and wetlands. The proposed CWIS and discharge structure will be designed to meet all applicable operation, maintenance, and navigation criteria and requirements.

Long-term changes in land use from operation of the LNP will be associated primarily with the roads, cooling/heat dissipation systems, makeup water pipeline, CWIS, pumphouse, blowdown pipeline, and transmission corridor routes. The long-term impacts on land use are expected to be SMALL to MODERATE.

Short-term changes in land use from operation of the LNP will be associated primarily with impacts resulting from the increase in the stormwater due to development of the LNP. Short-term changes in land use would be minor and would include roads, LNP buildings and structures, and ecological issues.

As discussed in ER Subsection 4.2.1.5, approximately 39 percent of the land area of the LNP site is classified as wetlands. Clearing vegetation around the proposed LNP site and within the associated corridors will affect wetlands on the site. Wetlands will be drained and filled, and elevations at the site will be raised. These alterations affect the ecological and hydrologic value of the wetland. Construction of access roads may result in temporary and/or permanent wetland impacts. Wetlands at the proposed LNP site may be impacted by increased erosion and sedimentation due to construction activities. The actual LNP footprint will only be a small percentage of the total site. Permanent and affected wetlands will be mitigated through Florida's Regional Off-Site Mitigation Area Plan. Construction of stormwater drainage ditches may provide an opportunity to create additional wetlands to meet Florida wetland mitigation requirements. Close coordination with the appropriate resource agencies will be required before a definitive mitigation strategy is developed. Stormwater drainage channels and the riparian zone along the channels could be planted with native vegetation such as cattails, sedges, and hydrophilic grasses. Any wetlands created could provide supplemental habitat for area wildlife

These wetlands will be delineated according to USACE guidelines and the State of Florida's Wetlands Delineation Manual, and mitigation measures will be implemented prior to construction. Mitigation for unavoidable impacts to wetlands is required through both the federal Section 404/10 and the state environmental resource permitting processes and will require careful planning and close coordination with the FDEP for regulations concerning CWA Section 401 water quality certifications. Functions of these wetlands will be mitigated through the

permitting process. Overall impacts to wetlands as a result of the LNP construction are expected to be SMALL.

Measures such as accepted best management practices (BMP) will be taken during construction to minimize effects to ground and surface waters. Specific erosion control measures will be implemented to minimize effects to the CFBC and CREC discharge canal water quality. In addition, LNP site preparation and construction activities will comply not only with BMP, but also with federal, state, and local regulations to prevent adverse aquatic ecological effects along the perimeter of the CFBC, Lake Rosseau, and the CREC discharge canal.

During LNP site preparation, construction activities such as clearing and grading activities will have localized noise and air quality effects. Construction noise will occur during construction activities and while installing equipment (such as turbines, generators, pumps, transformers, and switchyard equipment). As a result, background noise levels on or near the site will increase in the short term, but will primarily be limited to daytime hours. The level of perceptible noise at any given location will depend on the intensity of the construction activities; meteorological conditions including temperature, humidity, and wind speed; the distance from the site; and the amount of noise absorbing vegetation between the source of the noise and the observer

An assessment of the impacts on ambient noise levels of the LNP site was performed in support of the LNP's SCA is described in ER Subsections 2.5.2.7.1, 4.4.1.1, and 5.8.1.1. This assessment was based on a conservative noise modeling analysis to predict noise levels during operation. Noise during construction is not expected to significantly affect off-site areas, including the locations of nearest residences and recreational areas that are in the general proximity of the LNP site. Therefore, noise impacts on the surrounding area during construction are expected to be SMALL. Noise-related impacts on people, buildings, roads, and recreation areas from operation of the LNP and appurtenant facilities, including impacts from increased worker and other vehicular traffic in the area, are expected to be SMALL, and no mitigation measures will be warranted.

Additionally, the construction of the LNP site has the potential to have an impact on ambient air quality in the immediate vicinity of the LNP site, and to a lesser extent, in the vicinity of the heavy haul road, transmission corridors, pipeline corridor, and CWIS near the CFBC. Controls will be implemented to mitigate potential air emissions from construction sources. Slight but negligible increases in emissions of PM and combustion by-products might occur during LNP site preparation and construction activities. Construction-related dust and air emissions from equipment are expected to be SMALL and will be controlled by implementing mitigation measures. Because of the very low level of emissions from the LNP, its operation is not expected to cause or contribute to a violation of any state or federal ambient air quality standard for any pollutant at any location. Air quality impacts on people, buildings, roads, and recreation areas from operation of the LNP and appurtenant facilities, including impacts from increased

worker and other vehicular traffic in the area, are expected to be SMALL, and no mitigation measures will be warranted.

9.4.2.1.1 Intake, Discharge, and Pipeline Route Alternative Evaluation

Several potential source water alternatives were identified based on a preliminary consideration of engineering, regulatory, and environmental factors. Key environmental considerations in determining the viability of source water alternatives were: the ability to route a pipeline to the source location, water quantity and the reliability of future supply, water quality, and environmental impacts. A preliminary inventory and assessment of freshwater makeup source water, saltwater makeup source water, blowdown, and associated pipeline routing alternatives is provided below in ER Subsections 9.4.2.1.1.1, 9.4.2.1.1.2, 9.4.2.1.1.3, and 9.4.2.1.1.4, respectively. Table 9.4-3 presents a preliminary evaluation of makeup water sources considered in the assessment, including both freshwater and saltwater. Table 9.4-4 presents a preliminary evaluation of the blowdown site alternatives considered. The preliminary evaluation of the pipeline routes considered in the assessment is presented in Table 9.4-5.

9.4.2.1.1.1 Intake Makeup Water — Freshwater Sources

The freshwater sources reviewed included groundwater, surface freshwater, and reuse water from municipal or commercial sources. The assessment determined that freshwater sources are considered limited in the LNP site area. The use of freshwater or groundwater would be more restrictive because of the expected regulatory restrictions and political resistance. Using reuse water or saltwater is expected to be less limiting. In addition, potential land use changes and riverine protection and restoration programs could affect the availability of freshwater in the future.

- Groundwater: There are three groundwater aquifers in the LNP site area. The surficial aquifer generally extends to a depth of 6.1 to 12.2 m (20 to 40 ft.). The limited capacity of the surficial aquifer would not supply sufficient makeup water to the LNP, and therefore, was not considered as a viable alternative.

  The second aquifer, the Upper Floridan aquifer, is unconfined or semi-confined and offers more promise. It extends from approximately 15.2 to 182.9 m (50 to 600 ft.) and probably contains freshwater in the upper 61.0 to 91.4 m (200 to 300 ft.), and the water is expected to be more brackish with depth.

  The top portion of the third aquifer, the Lower Floridan aquifer, extends from approximately 243.8 m (800 ft.) to approximately 548.6 m (1800 ft.). No information was found about the transmissivity and subsequent well capacity of the Lower Floridan aquifer. It is expected that, because there is more brackish water in the Lower Floridan, more wells would be required than for the Upper Floridan aquifer to compensate for fewer concentration cycles within the cooling system.

- Fresh Surface Water: As discussed in ER Section 2.3, the Withlacoochee River and Lake Rousseau are the fresh surface waters within the LNP site vicinity. The Withlacoochee River is designated as an OFW and is, therefore, afforded a high degree of regulatory protection. The Withlacoochee River Basin Board has made the restoration of Lake Rousseau and the Lower Withlacoochee River a priority in their Fiscal Year 2006 Basin Priorities Statement. Additionally, both surface waters contribute to the Green Swamp, a major groundwater recharge area.

- Reuse Water: Reuse water generally refers to domestic or industrial treated wastewater that is considered for alternative uses to offset the demand of potable water. Because there is a relatively low population and little industry in the region, the review identified no sources of reuse water in the LNP site vicinity sufficient to support LNP requirements. Reuse of municipal wastewater, if it were available, is consistent with state policy and would be strongly supported by the regulatory agencies; however, challenges may occur when considering the concentration and disposal aspects of a reuse water source. Nutrient concentrations could be a significant issue, depending on the location of the blowdown discharge.

In summary, at present, groundwater and freshwater sources of cooling tower makeup water are not considered feasible. Reuse water is a preferred option from an environmental and regulatory perspective. However, there is no reuse water realistically available to the LNP site. Provisions for future use of this source if and when it might become available could reduce the requirement from the source ultimately selected, though this reduction would likely be minor.

9.4.2.1.1.2 Intake Makeup Water — Saltwater Sources

Saltwater source locations considered include the CFBC, the Withlacoochee Bay off the mouth of the CFBC, waters offshore of the Withlacoochee Bay, and the CREC intake canal and discharge canal. Sites were selected to avoid or minimize the potential for impacts to the Big Bend Aquatic Preserve and sensitive coastal wetlands. The saltwater locations reviewed include the following:

- CFBC near Inglis Lock: A makeup water pipeline from the LNP site would draw water from the CWIS located on the CFBC just below the Inglis Lock, near the upstream end of the CFBC.

- Nearshore of Withlacoochee Bay: A makeup water pipeline would extend into Withlacoochee Bay, within 1.6 km (1 mi.) of the shoreline. The specific location and design would be selected to meet environmental and engineering criteria. The dredged portions of the CFBC extend into Withlacoochee Bay and beyond.

- Offshore of Withlacoochee Bay: A makeup water pipeline would connect to the CWIS located in coastal waters at a distance 4.8 to 8 km (3 to

5 mi.) from the Withlacoochee Bay shore. The specific location would be selected to meet environmental and engineering criteria. The dredged portions of the CFBC extend into the Withlacoochee Bay and beyond.

- CREC Intake Canal: Makeup water would be drawn from the CREC intake canal.
- CREC Discharge Canal: Makeup water would be drawn from the CREC discharge canal.

The success of a makeup source water alternative was considered dependent upon the following factors:

- Quantity/Quality — refers to availability of water in sufficient quantity and of sufficient quality.
- Engineering — refers to perceived degree of difficulty for implementation and construction.
- Natural resources — refers to perceived potential effect of a given alternative on the environment.
- Regulatory constraints — refers to perceived degree of difficulty to obtain permits and approvals.
- Cost — refers to the evaluation of potential cost based upon engineering judgement of capital, operations, and maintenance costs.

Weightings were developed for each factor. The weightings assigned attempted to recognize the fact that there may be significant influences between factors, such as natural resources affects and regulatory permitting. For each alternative considered, the weight of each factor was multiplied by the rank assigned to that factor, and the results summed to yield an overall score for the alternative.

It is also recognized that in some cases, a single factor may preclude an alternative from consideration and that, in such cases, scoring is not appropriate. Based on available information, none of the freshwater sources considered provided the demonstrated availability and long-term reliability required for the LNP.

All of the saltwater sources considered would have an adequate amount of makeup water for the LNP. Coastal waters in the area are shallow, and concerns over potential silt burdens resulted in lower ratings for nearshore locations, and to a lesser extent, offshore locations relative to the other sites where channels and jetties could potentially reduce the concentration of suspended sediments.

The engineering rating for the saltwater options considered the relative difficulty of establishing a CWIS at the candidate locations. Nearshore and offshore ratings

reflect the interconnection of the structure to intake piping, while the ratings for the CREC alternatives reflect the difficulties associated with siting new facilities, given the existing, congested infrastructure at CREC.

Natural resource ratings for the saltwater alternatives are based on limited information but reflect the increased potential for impacts to the nearshore environment. Impacts of makeup withdrawal from the CREC discharge canal would be less than those from the CREC intake canal because discharge waters would have already been impacted by passage through the cooling system. A CWIS, located 12.1 km (7.5 mi.) inland on the CFBC, would change the water quality characteristics and the biota of the upper portions, but would not be located in a natural sensitive estuarine environment.

Table 9.4-3 presents a preliminary evaluation of makeup water sources considered, including both freshwater and saltwater.

The preferred makeup water source is discussed in ER Subsection 9.4.2.1.2.

9.4.2.1.1.3 Discharge Cooling Tower Blowdown Site Alternatives

Key considerations for identifying preliminary blowdown discharge location alternatives included the potential for thermal effects, engineering constraints, regulatory constraints, and impacts to natural resources (ecology and water quality). Candidate sites were selected to avoid, or minimize, potential impacts to the Big Bend Aquatic Preserve and sensitive coastal wetlands. These factors were evaluated for the discharge location alternatives identified, and a preliminary assessment was conducted based on current available data.

The discharge location alternatives considered include the following:

- Deepwell Injection: Blowdown would be injected into deep aquifers via well(s) located on the LNP site.
- Nearshore of Withlacoochee Bay: A pipeline would connect with a blowdown discharge structure located in nearshore waters, within 1.6 km (1 mi.) of the coast. The specific location would be selected to meet environmental and engineering criteria.
- Offshore of Withlacoochee Bay: A cooling tower blowdown pipeline would connect to a discharge structure located in offshore waters approximately 4.8 to 8.0 km (3 to 5 mi.) from the coast. The specific location would be selected to meet environmental and engineering criteria.
- CREC Discharge Canal: A cooling tower blowdown pipeline would run to the CREC and discharge into the CREC discharge canal.

The same factors and weighting assignment methodology that were used for evaluating the makeup water sources were used to measure success of a cooling tower blowdown site alternative (see ER Subsection 9.4.2.1.1.2).

Deepwell injection was not considered to be a technically feasible option at the LNP site. The deep aquifers in this area may not have the capacity to receive the volume of projected discharge for many of the same reasons previously discussed for water supply.

Nearshore locations (within 1.6 km [1 mi.] of the coast) and offshore (4.8 to 8 km [3 to 5 mi.] from the coast) for blowdown were also considered. Because of potential mixing zone limitations in shallower waters and the increased potential for impacts to sensitive habitats, nearshore locations were rated lower than offshore locations.

There is the potential that NPDES permit compliance would be an issue with the blowdown to the CREC discharge canal. The CREC discharge canal receives discharge from the five CREC generating units, and additional loading of this system could limit operational flexibility. CREC has implemented helper cooling towers to meet thermal limits without cutting back on power generation.

Table 9.4-4 presents a preliminary evaluation of the blowdown discharge site alternatives that were considered. ER Subsection 9.4.2.1.3 discusses the preferred blowdown discharge location.

9.4.2.1.1.4 Pipeline Routing Alternatives

Several potential corridor routes are under consideration for makeup and blowdown pipelines. Routes were selected to maximize the use of existing corridors and ROWs associated with the CREC. All potential corridors will connect the LNP to a makeup water intake location or blowdown discharge location. In some cases, these corridors represent alternative routes to the same location. For instance, the location nearshore of Withlacoochee Bay and offshore makeup alternatives and blowdown alternatives could use either the Pumpkin Island route or the CFBC route.

The potential corridor routes include the following:

- Pumpkin Island Route: This route runs from the LNP site and parallels U.S. 19 and County Route 40, with a Gulf terminus near Pumpkin Island. The corridor traverses or is adjacent to lands under ownership by numerous parties and includes several crossings of wetlands and tidal creeks. The upland portion of this route extends approximately 17.7 km (11 mi.) from the southern portion of the LNP site. The aquatic portion of this route ([1.6 to 8.0 km [1 to 5 mi.]) would be selected to minimize impacts to sensitive nearshore and coastal habitat.

- CFBC Berm Route: This route runs along the northern berm of the CFBC, with a Gulf terminus at the western end of the CFBC. The corridor

traverses lands owned by the State of Florida, though at least one segment is owned by a private entity. The upland portion of this route extends approximately 16.1 km (10 mi.) from the southern portion of the LNP site. There are few wetlands or sensitive habitats along the CFBC berm. The aquatic portion of this route (assumed to be 4.8 to 8.0 km [3 to 5 mi.] or more) would be selected to minimize impacts to sensitive nearshore and coastal habitat.

- CREC Route: This alternative route would run from the LNP site to the CREC intake canal or discharge canal. While there are several potential routes between these points, the one evaluated uses existing electrical transmission corridors along U.S. 19 and is considered representative. This route would be primarily located on uplands but would require crossing the Withlacoochee River and the CFBC. The estimated length of this route from the southern portion of the LNP site is 24.1 km (15 mi.).

- CFBC Submerged Route: This route enters the CFBC west of the Inglis Lock. The pipeline would be submerged and entrenched along the north side of the CFBC, outside of the main channel. The corridor would extend offshore, offset to the north from the CFBC channel. This corridor traverses lands primarily under State ownership. The inshore portion of this route would extend approximately 11.3 to 12.1 km (7 to 7.5 mi.) within the CFBC and would traverse previously disturbed aquatic habitats. The nearshore aquatic portion of this route (assumed to be 4.8 to 8 km [3 to 5 mi.] or more) would be selected to minimize impacts to sensitive coastal habitats.

The same factors and weighting assignment methodology that were used for evaluating the makeup water sources and the blowdown site alternatives were used to measure success of a pipeline routing alternatives (see ER Subsection 9.4.2.1.1.2). Table 9.4-5 presents a preliminary evaluation of the pipeline routes considered.

All routes except the Pumpkin Island route scored similarly. The CREC route and both CFBC routes appear viable. The CREC route rating reflects the assumptions of an overland route largely within existing corridors.

9.4.2.1.2 Preferred Makeup System

The makeup water for the circulating water cooling tower at the LNP will be supplied from a CWIS located south of the LNP on the CFBC. A pipeline will run from the CWIS to the LNP site. The CWIS will likely consist of the intake structure, vertical bar screens, traveling screens, pumps, and pumphouse. The CWIS will be located approximately 11.1 km (6.9 mi.) from the Gulf of Mexico on the berm that forms the north side of the canal and is within 0.8 km (0.5 mi.) east of the Inglis Lock on Lake Rousseau. The blowdown water will be discharged through a pipeline into the CREC discharge canal. The general arrangement and section view of the proposed CWIS are shown on Figures 3.3-3 and 3.3-4, respectively.

As discussed in ER Subsections 4.3.2.2 and 4.3.2.3, dredging will be required in the CFBC. and the CREC discharge canal. The overall short- and long-term effects of construction at the proposed location of the LNP CWIS are expected to be SMALL due to the small footprint and the existence of other water-related infrastructure in the area.

As previously noted, Section 316(b) of the CWA requires the USEPA to ensure that the location, design, construction, and capacity of CWIS reflect the best technology available (BTA) for minimizing adverse environmental impacts. The objective of any CWIS design is to have adequate flow sweeping past the screens to achieve entrainment and impingement-reduction goals established under the 316(b) requirements. In addition to the impingement and entrainment losses associated with the CWIS are the cumulative effects of multiple intakes and re-siting or modification of the CWIS contributing to environmental impacts at the ecosystem level. These impacts include disturbances to threatened and endangered species, to keystone species, to the thermal stratification of bodies of water, and to the overall structure of the aquatic system food web.

9.4.2.1.3 Preferred Discharge System

The cooling tower blowdown from a series of mechanical draft cooling towers, including waste heat, will be transported from the LNP via two pipelines (one for each unit). It will run south to the CFBC and along the northern edge of the canal. It will then cross the CFBC north of CREC and follow a southerly route and discharge into the CREC discharge canal (see Figure 2.3-13). As discussed in ER Subsection 2.4.2.5, the CREC contains five power generating units, four coal-powered and one nuclear-powered. Units 1, 2, and 3 (coal, coal, and nuclear, respectively) use once-through condenser cooling and discharge cooling water under NPDES Permit No. FL0000159. Units 4 and 5 (coal) use closed-cycle cooling using natural draft cooling towers.

The common discharge canal for all units is located just north of CREC Units 1, 2, and 3. The canal extends west-northwest for almost 2.6 km (1.6 mi.) to the point of discharge at the shoreline where the CREC discharge canal opens into a bay. The dredged channel continues for another 1.9 km (1.2 mi.) and is bordered to the south by a spoil bank. Water depth in the CREC discharge canal is approximately 3 m (9.8 ft.). Discharges from the CREC units enter the discharge canal near the eastern end. Each discharge uses four circulating water lines that enter an open, concrete discharge chamber. The pipes turn downward, discharging flow into a basin. The discharge exits the chamber over a short weir and mixes immediately with water in the canal.

The final LNP discharge will consist of cooling tower blowdown from both the CWS cooling towers and site wastewater streams, including the domestic water treatment and circulation water treatment systems. As noted in ER Subsection 9.4.2.1, only biocides or chemical additives that are approved by USEPA and FDEP as safe for humans and the environment will satisfy requirements established in the NPDES permit.

The potential physical impacts of adding the LNP blowdown on the existing CREC discharge canal are expected to be SMALL due to the significant dilution factor of adding the LNP blowdown to the much larger flows of the CREC discharge. In addition, the blowdown effluent will be in compliance with the temperature and other parameter requirements of an issued NPDES permit. Additional information on the thermal component of the blowdown discharge can be found in the environmental descriptions provided in ER Sections 2.3, 3.3, and 3.4, and ER Subsection 2.4.2. Discharge will be permitted by the FDEP and will comply with applicable state water quality regulations. Impacts to aquatic biota from chemicals added to the cooling water are expected to be SMALL and will not warrant mitigation.

Historical 316(b) studies from the existing CREC discharge canal were reviewed to assess the impacts of the existing thermal discharge on the environment. The effects of the discharge of heated water on benthic infauna, macrophytes, salt marsh, oyster reefs, and fisheries were assessed. Thermal effects on the benthos varied between organisms, but were limited to an area within approximately 3.5 km (2.2 mi.) of the point of discharge (see ER Subsection 2.4.2.5). The results consistently indicated adverse effects due to the thermal discharge in Basin 1, Basin 3, and the southern section of Basin 2 (see Figure 2.4-33). Central areas of Basin 2 and the offshore edge of Basin 3 were found to be transitional with organisms showing limited, if any, adverse thermal effects. Fisheries data collected using trawls, seines, creek trawls, and drop nets did not indicate a pattern of adverse effects for any Selected Important Organism. Generally, fish species seemed to be more abundant outside the warmest portion of the discharge but did occur regularly in outer portions of the thermal plume. Detailed discussion of the characterization of aquatic ecology of the CREC discharge is provided in ER Subsection 2.4.2.5.

The thermal plume simulations representing worst case, full load operation were completed to determine the plume extent over different tidal cycles (see Figures 2.4-34, 2.4-35, 2.4-36, 2.4-37, 2.4-38, 2.4-39, 2.4-40, and 2.4-41). Modeling agreed well with the results of the biological and water quality monitoring. Basin 1, nearest the point of discharge, is exposed to the highest delta T's (5°C to 8°C [9°F to 14.4°F]). On ebb or low slack tides, however, the largest volume of the discharge is confined to the dredged channel adjacent to the discharge spoil and exits into Basin 3. The plume at that point tends to travel toward the southwest, but rapidly becomes well mixed in the relatively shallow water. On flood or high tides, the plume effect in Basin 3 is lacking as the discharge spreads over Basin 1 and extends further north in southern Basin 2. Little variation is seen in the summer or winter cases. Detailed discussion of the characterization of aquatic ecology of the CREC discharge is provided in ER Subsection 2.4.2.5.

Because PEF will employ a closed-cycle cooling tower heat dissipation system rather than a once-through system, the issue of heat shock should not be a factor in the CREC discharge canal. Additionally, all discharges in the open-water mixing zone of the Gulf of Mexico are required to meet the state NPDES permit

requirements. Because most of the water column is unaffected by the blowdown, even under extreme (worst case) conditions, the thermal plume is not expected to create a barrier to movement of key indicator organisms. Detailed discussion of the aquatic ecology in the CREC intake and discharge canal, including key indicator organisms, is provided in ER Subsection 2.4.2. Impacts to aquatic communities are expected to be SMALL and will not warrant mitigation.

9.4.2.2 Water Treatment

The LNP will require water treatment measures for the influent and effluent water streams for the heat dissipation system and the CWS. Evaporation of water from the cooling towers leads to an increase in chemical and solids concentrations in the circulating water, which in turn increases the scaling tendencies of the water. The RWS supplies water to the SWS cooling tower to make up for water consumed as a result of evaporation, drift, and blowdown. The SWS cooling tower will be operated so that the concentration of solids in the circulating water would be approximately four times the concentration in the makeup water (that is, four cycles of concentration). This concentration ratio will be sustained through the addition of makeup water and blowdown of the circulating water from the cooling towers. A description of the proposed intake water treatment system (cooling water) is provided in LNP ER Subsection 3.3.2 and discussed below. PEF has provided information on alternative water treatment systems in response to an NRC request for additional information.

A description of the fuel assembly, fuel rod, and fuel pellet description is provided in ER Section 3.2. The anticipated plant water use for the LNP is discussed in ER Section 3.3. The LNP requires water for both plant cooling and operational uses. The LNP will use two independent cooling water systems. Seawater that cools the turbine generator will be used for the CWS, and freshwater will be used for the SWS. The waters in the CFBC downstream of Inglis Lock vary in salinity, seasonally and with tidal influences; however, when the intake is operational, it is anticipated that the makeup water to the cooling towers will be seawater drawn from shallow, nearshore Gulf waters. Freshwater from the RWS will also be used for the other water services required for operation. The other water services supplied from the RWS will consist of potable water, demineralized water treatment, and the FPS. Potable water is required for human consumption, sanitary, and other domestic purposes. The RWS supply will be from well water pumps located in the freshwater aquifer at the site. Makeup water for the CWS will be supplied from the CWIS located on the CFBC.

Reactor water chemistry limits will be established to provide an environment favorable to these materials. Design limits will be placed on conductivity and chloride concentrations. Operationally, the conductivity will be limited because it can be measured continuously and reliably. In addition, conductivity measurements will provide an indication of abnormal conditions and the presence of unusual materials in the coolant. Chloride limits will be specified to prevent stress corrosion cracking of stainless steel.

The circulating water treatment system provides treated water for the CWS, PWS, DTS, and FPS, and consists of three phases: makeup treatment, internal circulating water treatment, and blowdown treatment. Makeup treatment will consist of a biocide (for example, Towerbrom 960) injected into influent water during spring, summer, and fall months to minimize marine growth and to control fouling on surfaces of the heat exchangers. Treatment will improve the quality makeup water and will allow increased cycles of concentration in the cooling tower. An environmental permit to operate this treatment system will be obtained from the state. For prevention of *Legionella*, treatment for internal circulating water components (piping between the new CWIS and condensers) will include existing power-industry control techniques that consist of hyperchlorination (chlorine shock) in combination with intermittent chlorination at lower levels, biocide (for example, bromine), and scale-sludge inhibitor. Blowdown treatment will depend on water chemistry, but is anticipated to include application of an acid, biocide, and scale inhibitor to control pH, biogrowth, and scaling, respectively.

The service water chemical injection system, DTS, and PWS operate the same in all nuclear power generating facility operational modes (that is, no difference exists in how the systems operate during full power operations, facility shutdown/refueling, and facility startup).

The Westinghouse Electric Company, LLC, AP1000 Design Control Document for the certified design as amended (DCD) provides the following information:

> Filtered water is supplied from a site-specific water source for the potable water distribution system.
>
> The onsite water supply system will maintain an appropriate pressure throughout the distribution system.
>
> Potable water is supplied to areas that have the potential to be contaminated radioactively. Where this potential for contamination exists, the potable water system is protected by a reduced pressure zone type backflow prevention device.
>
> No interconnections exist between the potable water system and any system using water for purposes other than domestic water service including any potentially radioactive system. The common supply from the onsite raw water system is designed to use an air gap to prevent contamination of the potable water system from other systems supplied by the raw water system.
>
> The demineralized water transfer and storage system receives water from the demineralized water treatment system and provides a reservoir of demineralized water to supply the condensate storage tank and for distribution throughout the plant. Demineralized water is processed in the demineralized water transfer and storage system to remove dissolved oxygen. In addition to supplying water for makeup of systems that require

pure water, the demineralized water is used to sluice spent radioactive resins from the ion exchange vessels in the chemical and volume control system (as described in [DCD] Subsection 9.3.6), the spent fuel pool cooling system (as described in [DCD] Subsection 9.1.3), and the liquid radwaste system (as described in [DCD] Section 11.2) to the solid radwaste system.

The site-specific water source for the LNP will be an aquifer.

As discussed in ER Subsection 3.3.1.4, the PWS will treat the raw water so that it meets the Florida potable (drinking) water program and USEPA bacteriological and chemical standards for drinking water quality under the National Primary Drinking Water Regulation and National Secondary Drinking Water Regulation as well as in compliance with 29 CFR 1910, Occupational Safety and Health Standards, Part 141. The system will be designed to function during normal operation and outages (that is, shutdown).

Discharges to outfalls from processing of demineralized and potable water will typically include coagulation, filtration, disinfection, and ion exchange. Wastes from treatment could include filter backwash and demineralized regeneration wastes.

Liquid wastes generated by the LNP during all modes of operation will be managed by the liquid waste storage and processing systems. The liquid waste storage system collects and segregates incoming waste streams, provides initial chemical treatment of those wastes, and delivers them to one of the processing systems. The liquid waste processing system separates wastewaters from radioactive and chemical contaminants. The treated water is returned to the liquid waste storage system for monitoring and eventual release. Chemicals used to treat wastewater for both systems include sulphuric acid for reducing pH, sodium hydroxide for raising pH, and an antifoaming agent for promoting settling of precipitates.

During construction and operation of the LNP, sanitary system wastes will be treated by a wastewater treatment facility and will be discharged in accordance with agreements with the FDEP. This treatment system removes and processes raw sewage so that discharged effluent conforms to applicable local and state health and safety codes, and environmental regulations. Sodium hypochlorite (chlorination) is used to disinfect the effluent by destroying bacteria and viruses, and sodium thiosulfate (de-chlorination) reduces chlorine concentration to a specified level before final discharge. Soda ash (sodium bicarbonate) is used for pH control. Alum and polymer are used to precipitate and settle phosphorus and suspended solids in the alum clarifier; polymer also is used to aid flocculation.

The frequency of treatment for each of the normal modes of operation, as well as the quantities and points of addition of the chemical additives, is described in ER Chapter 3. All methods of chemical use are monitored. No substitutions are proposed for the current treatment amounts or methods. The environmental

impact on the use of this water treatment is expected to be SMALL. No alternative treatment is identified that is environmentally equivalent or superior.

9.4.3 TRANSMISSION SYSTEMS

As specified in the guidelines in NUREG-1555, ESRP 9.4.3, the preparation of the summary discussion identifies the feasible and legislatively compliant alternative transmission systems. Four major 500-kV transmission lines will leave the station switchyard and two of these lines will connect to the proposed Citrus Substation, one will connect to the proposed Central Florida South Substation, and one will connect to the CREC 500-kV switchyard. Additional system upgrades will be constructed to accommodate demand in the central and south Florida areas primarily served by the LNP. Detailed descriptions of the transmission line system are described in ER Subsection 2.2.2 and ER Section 3.7, and associated environmental impacts are described in ER Chapters 4 and 5. Corridors are defined as transmission line routes of variable widths, which are sufficient to contain the eventual ROWs (NUREG-1555, Section 3.71[a]). Several new transmission line corridors will be required to integrate the LNP to the Florida electrical grid system, as described in ER Subsection 2.2.2 and ER Section 3.7.

The actual ROW width and alignment within the corridors will depend on adjacent land uses, property boundaries, ownership patterns, structure types, and height and span lengths. Acreages of land use and vegetative communities for the transmission line corridors are provided in ER Subsection 2.2.2. Descriptions of and figures showing typical structure types, height, and span lengths of the proposed transmission line structures are provided in ER Section 3.7.

PEF is an integrated IOU serving a 51,800-km^2 (20,000-mi.^{2}) area in central and north Florida, including metropolitan St. Petersburg, Clearwater, and the greater Orlando area. The PEF electrical grid consists of nuclear and fossil fuel power generating facilities and an extensive 500-kV/230-kV bulk power transmission system serving 1.5 million customers and a population of more than 5 million people. PEF maintains multiple direct interconnections with neighboring utilities. These interconnections with neighboring utilities serve to increase the reliability of the PEF electrical grid. PEF participates as a member of the FRCC and the SERC.

PEF will bear the ultimate responsibility for defining the nature and extent of system improvements, as well as the design and routing of connecting transmission lines. For transmission system approval and to obtain licenses for the new transmission lines, PEF is required to submit filings to the FDEP, the Florida Department of Community Affairs, and the FPSC. PEF, as the Regional Transmission Organization (RTO), both regulated by FERC and the FRCC, a subregion within the NERC, will bear the ultimate responsibility for the following:

- Defining the nature and extent of system improvements.
- Designing and routing connecting transmission.

- Addressing the impacts of such improvements.

Therefore, the construction described in this subsection is based on the existing infrastructure, PEF system design preferences, and best transmission practices. The guiding assumptions for transmission route design include the following:

- The new construction will follow in parallel with some of the transmission corridors serving the CREC.

- The new transmission lines will reach the nearest substation to provide connection to the greater area grid.

The proposed transmission line corridors will be primarily within or adjacent to PEF's existing high voltage transmission lines. The proposed corridors will be approximately 304.8 to 1609.3 m (1000 to 5280 ft.) wide to allow for maximum flexibility when determining the ROW. A total of approximately 146.5 km (91 mi.) of transmission lines to the first substations will need to be constructed in order to incorporate the power generated by the LNP into the electrical grid system.

The effects of constructing and maintaining new transmission lines are evaluated further in ER Chapters 4 and 5, respectively. No mitigation will be required. The measures and controls to limit adverse transmission system impacts that were developed because of this environmental review are described in ER Sections 4.6 and 5.10. No alternative construction methods are indicated to mitigate effects from vegetation, erosion control, access roads, towers, conductors, equipment, or timing.

9.4.3.1 Corridor Selection

Comprehensive siting studies were conducted to identify preferred and alternate corridors for the transmission lines required to support the LNP. The study consisted of a sequential screening and evaluation process which was conducted in four phases:

- Phase 1: Establishment and definition of project study areas.

- Phase 2: Regional screening and mapping.

- Phase 3: Selection of candidate corridors.

- Phase 4: Section of primary corridors.

A summary description of each phase and the methodology for ranking corridors is presented in the following subsections. The methodology for ranking corridors, which used measurable evaluation criteria that reflected the suitability of corridors in terms of minimizing impacts to environmental and land use resources

and evaluating project design, engineering, safety, and cost considerations, is also presented.

9.4.3.2 Establishment and Definition of the Project Study Area

Based on the location of identified endpoints for each of the proposed transmission lines, study area boundaries were established that would allow for multiple candidate corridors to be developed for the proposed transmission line corridors that will connect the LNP to the electrical grid system.

9.4.3.2.1 North Study Area

The North Study Area was defined to include several proposed transmission line corridors, including from the LNP to proposed Citrus Substation (LPC), from the LNP to CREC 500-kV switchyard (LCR), from the proposed 230-kV CREC to the proposed Citrus Substation, and corridors for the transmission needed to support the construction and administration of LNP. The overall study area is approximately 32 km (20 mi.) (east-west) by 17 km (10.5 mi.) (north-south) and includes approximately 523 km^2 (202 $mi.^2$) of land. It includes property in Citrus, Levy, and Marion counties.

9.4.3.2.2 Central Study Area

The Central Study Area was defined to address the proposed 500-kV transmission line from the LNP to proposed Central Florida South Substation (LCFS) in Sumter County, Florida. This study area is approximately 89 km (55 mi.) (east-west) by 40 km (25 mi.) (north-south) and includes approximately 3193 km^2 (1233 $mi.^2$) in Levy, Citrus, Marion, and Sumter counties.

9.4.3.2.3 West and South Study Area

Additional study areas were defined to include the additional (and supplemental) transmission lines required beyond the first substations to connect the LNP to the electrical grid. The West Study Area is approximately 34 km (21 mi.) (east-west) by 63 km (39 mi.) (north-south) and includes approximately 2053 km^2 (793 $mi.^2$) in Levy, Citrus, and Hernando counties. The South Study Area is approximately 32 km (19.6 mi.) (east-west) by 64 km (39.5 mi.) (north-south) and includes approximately 2331 km^2 (900 $mi.^2$). It includes land in Hernando, Pasco, Hillsborough and Pinellas counties.

9.4.3.2.4 Regional Screening and Mapping

Based on environmental and land use features, the regional screening exhibits for the study areas were developed to preliminarily identify potentially unfavorable and restricted areas within each study area, as well as to identify existing linear facilities that could be considered as co-location opportunities in subsequent analysis phases.

Using collected geographic information and the regional screening criteria developed by the corridor selection team, environmental and land use features were identified and input into the GIS database. The features included on the regional screening map are identified in Table 9.4-6. Aerial photography, the regional screening exhibits, and other data collected by the corridor selection team was used in the candidate corridor identification process.

9.4.3.2.5 Selection and Evaluation of Corridor Segments

Based on the corridor selection team's experience in Florida, experience in previous transmission line studies, and input from community outreach activities, criteria for identifying corridor segments were developed based on the following considerations:

- Maximize co-location with existing PEF transmission lines (greater than or equal to 115 kV).
- Maximize co-location with other linear features, including arterial and collector roads, major canals, and railroads.
- Minimize locating corridor segments adjacent to existing residential development where no transmission line already exists.
- Minimize the severance of land under common ownership.
- Wherever practicable, follow previously disturbed alignments (roads, trails, canals, ditches, and so forth) through flood management areas, wetlands, and upland forested areas.
- Minimize river and canal crossings where no crossing (road, railroad, transmission, or other utility crossing) already exists.
- Minimize locating corridor segments abutting schools or community facilities.
- Encourage location close to existing industrial and extractive land uses.
- Minimize location within traditional business districts with concentrations of older or historic buildings.
- Maintain distance from registered public and private airports consistent with Federal Aviation Authority and other applicable state and county regulations.

Candidate corridor segments were identified by applying these criteria to the data collected during the regional screening stage of this project and mapping the data using aerial photography. The corridor selection team then reviewed and accepted the data. Candidate corridors were developed by linking the candidate

corridor segments together to extend between the two proposed transmission line endpoints, then the corridors were entered into a table, given a corridor identification number, and carried forward for further evaluation. Some of the corridor segments were included in more than one candidate corridor. The GIS database was used to determine quantitative measurements and other engineering considerations that formed the basis of the cost evaluation for the candidate corridors. The candidate corridors were subjected to a quantitative and qualitative evaluation to determine the transmission line corridors most suitable for construction, operation, and maintenance in a safe, reliable manner considering the environmental, land use/real estate, design, engineering, safety, and cost criteria described herein.

9.4.3.2.6 Candidate Corridor Review

Available engineering information for candidate corridor review included system maps for the existing PEF transmission lines and other facilities within the study area, and PEF's general substation arrangement drawings for existing, planned, and proposed LNP switchyard and substations. The identification and evaluation of ecological, physiographical, infrastructure, land use, and cultural resource data was also conducted based on data collected from various federal, state, and local agencies, as well as private sources including the following data sources:

- USGS 7.5-Minute Series Topographic Quadrangle Maps.
- Florida Fish and Wildlife Conservation Commission Species Data.
- Florida Natural Areas Inventory (FNAI) data for the study areas.
- Southwest Florida Water Management District (SWFWMD) Land Use Land Cover Data.
- St. Johns River Water Management District (SJRWMD) Land Use Land Cover Data.
- County information regarding existing and proposed schools, community facilities, parks, and roadway improvements.
- County GIS databases consisting of property ownership maps, records, and aerial photography.
- Comprehensive Plans, Future Land Use Maps, and Land Development Codes for the towns and counties.
- Florida Turnpike Authority facility maps.

Systematic land use field reconnaissance was conducted during the summer and fall of 2007 for each corridor segment. Field reconnaissance was conducted on publicly accessible roads and by helicopter. In the field, the team's land use

observations were recorded on the aerial photographs. When new aerial photography became available to the corridor selection team in January 2008, those aerials were compared to the previously marked-up aerials.

The ecological review of the preliminary candidate corridors utilized existing SWFWMD and SJRWMD land use/land cover data and FNAI element occurrence data for the study areas. Protected species (flora and fauna), Bald Eagle nests, upland forests, forested wetland areas, and herbaceous wetland areas were mapped and entered into the GIS database. Listed species that were not directly observed or identified in the FNAI database, but considered likely to occur based upon available habitat within the corridors, were described and their protective status identified.

9.4.3.3 Quantitative Evaluation

Quantitative evaluation was used to eliminate less desirable candidate corridor segments and narrow down the list of potential candidate corridors to a reasonable number of discrete options for further detailed evaluation. The corridor selection team developed measurable evaluation criteria that reflected the suitability of candidate corridors in terms of environmental and land use resources, project design, engineering, safety, and cost considerations. Each criterion was developed as a measure of “friction” for locating a transmission line in, or in close proximity, to a particular location. The use of GIS spatial analysis allowed the corridor selection team to compile, integrate, analyze, and compare all of the land feature data within a study area to meet the technical objectives of the project and to establish relative numerical weights among the data layers for the analysis.

The initial evaluation of candidate corridors consisted of a quantitative measurement of a series of environmental, land use, engineering/safety, and cost criteria. All criteria used in this quantitative evaluation were measurable in terms of actual numbers of units, length or area, and U.S. dollars. The quantitative criteria presented in Table 9.4-7 were validated by and are consistent with the criteria identified in the community outreach Utility Search Conference activities.

Criteria weights were developed by a panel of experts that was comprised of environmental scientists, land use planners, real estate specialists, project managers, and transmission engineers experienced in corridor selection and the multidisciplinary aspects of transmission line facilities. The quantitative criteria weights used in the quantitative evaluation were based on the average quantitative criteria scores generated by each disciplinary group of the panel members after discussion and independent weighting by the panel members. Weights were assigned to each criterion to reflect their relative importance to the overall ranking. The candidate corridors were then ranked based on the weighted composite scores (the lowest weighted composite score quantitatively representing the top candidate corridor).

The quantitative criteria included the following attributes, which were validated by and are consistent with the criteria identified in the community outreach Utility Search Conference activities:

- A count of residences, airports, heliports, parcels, existing and proposed public schools, existing private schools, community facilities, conservation lands, parks, archaeological resource site locations, commercial and services land uses, industrial and extractive land uses, protected species (flora and fauna) locations, and eagle nest locations in close proximity to the corridor segment.

- Area in close proximity to the corridor segment that intersects the area of future residential land use designations as identified on adopted local government future land use maps.

- Length of transmission centerline identified as being co-located with existing PEF transmission lines (greater than or equal to 115 kV).

- Length of other existing linear facilities (existing and committed roads, existing railroads) identified in close proximity to the corridor segment.

- Area in close proximity to the corridor segment that intersects upland forested areas, forested wetland areas, and/or herbaceous wetland areas.

- Area of a 100-year flood plain in close proximity to the corridor segment.

- A U.S. dollar amount of estimated costs to construct the proposed transmission lines in close proximity to the corridor segment.

Definitions of each of these quantitative criteria were prepared and reviewed with the corridor selection team. All criteria were measurable in terms of actual number of units, length or area, and U.S. dollars. The GIS database was used to determine segment length, number of road crossings, and other design and engineering considerations that formed the basis of the cost evaluation for the candidate corridors.

GIS raw data for each of the candidate corridors was compiled in the GIS database and variable candidate corridor segments widths (specific geographical distances) were utilized for the initial quantitative evaluation. Wherever a candidate corridor segment was located adjacent to an existing PEF transmission line (greater than or equal to 115 kV), the corridor width was designed to provide adequate space on both sides of the existing ROW to allow for the alternative of constructing the proposed transmission line on either side of

the existing ROW. These candidate corridor widths vary depending on the width of the existing transmission line ROW, but range from 116 m (380 ft.) to 0.8 km (0.5 mi.). When considering candidate corridors in areas without an existing PEF transmission line (greater than or equal to 115 kV), the candidate corridor widths were set at 0.8 km (0.5 mi.) to evaluate multiple alternative locations for the proposed transmission line. The quantitative evaluation resulted in the identification of a group of high ranking candidate corridors that were ranked based on the weighted composite scores. These high ranking candidate corridors (that is, the lowest weighted composite scores) were further evaluated in the qualitative evaluation process.

9.4.3.4 Qualitative Evaluation

After completing the quantitative evaluation, a comprehensive evaluation was conducted on the high quantitatively ranked candidate corridors by the PEF corridor selection team to determine the candidate corridors most suitable for certification based on the environmental and land use considerations, suitability for construction, operation and maintenance, safety, public acceptance, cost, and electric system needs consistent with applicable regulations and PEF's policies. The collected information was also used to assess the effort required and likelihood of meeting environmental standards so that environmental permits could be obtained for the selected primary corridor.

This evaluation included information collected during each phase of the analysis supplemented by information received from public outreach activities, and site visits and meetings with PEF field personnel experienced in construction, operation, and maintenance of transmission lines, state and local agencies, and the corridor selection team. Input from the Utility Search Conferences was utilized in the corridor selection team's initial evaluation of potential transmission line opportunity areas within the study areas. The result of the quantitative and qualitative evaluations was the selection of the LPC, LCR, and LCFS corridors to connect the LNP to the first substations.

9.4.3.5 Candidate Corridor Evaluation

Multiple candidate corridors were evaluated for the proposed 500-kV transmission lines. After eliminating candidate corridors with circuitous routes, the GIS raw data from the quantitative analysis for the each remaining candidate corridors was evaluated. GIS raw data for each candidate segment were analyzed within the corridor widths described in ER Subsection 9.4.3.3, as well as with a consistent 0.40-km (0.25-mi.) width for each criterion for the proposed LPC, LCR, and LCFS corridors. The data sets were analyzed with and without cost as an evaluation criterion. The overall weighted composite scores for the highest ranking candidate corridors and their overall ranking is presented in Tables 9.4-8, 9.4-9, and 9.4-10 for each respective corridor alternative. Opportunity areas containing these alternatives were reviewed at the Utility Search Conference for this geographic region. In general, the preferences of the Utility Search Conference committees were consistent with the ranking presented in the tables.

9.4.3.5.1 LPC Corridor

Total weighted scores for the candidate corridors ranged from 16.4 to 23.6. Quantitative analysis results indicated that the candidate corridors that ran directly south from the LNP to the proposed Citrus Substation, utilizing the Levy/Citrus common corridor (which is discussed further in ER Subsection 9.4.3.5.4), received the highest ranking scores (that is, the lowest weighted composite scores). The only major physical differences between the top candidate corridors are the locations where the two corridors cross the CFBC and the final approaches to the proposed Citrus Substation. The 1.6-km (1-mi.) wide primary corridor between the LNP and the proposed Citrus Substation (LPC primary corridor) encompasses the high ranking options, which are shown on Table 9.4-8.

The proposed Citrus Substation is planned to be located on approximately 28 ha (70 ac.) in Citrus County near the intersection of the PEF 500-kV/230-kV transmission line ROW and US-19. The specific location of this substation is unknown at this time. This general location is reasonably central to the population served and has adequate undeveloped land area for a substation. The proposed Citrus Substation will be designed to accommodate 500-kV and 230-kV transmission lines.

No alternative corridors are proposed for the LPC corridor.

9.4.3.5.2 LCR Corridor

The total weighted scores for the LCR candidate corridors ranged from 18.4 to 52.8 (see Table 9.4-9). Approximately half of the 100 highest ranking candidate corridors follow the proposed LCR corridor in whole or in part. Additionally, the width of the proposed LCR corridor encompasses many of the highest ranking options. Considered in isolation, many of these candidate corridors may have presented a viable alternative, but were eliminated from further consideration because of the cumulative impact, such as proximity to wetlands and residences, they presented considering the high ranking LPC and LCFS candidate corridors.

No substations are proposed as a part of the LCR corridor project. No alternative corridors are proposed for the LCR corridor.

9.4.3.5.3 LCFS Corridor

Through the quantitative analysis, approximately 80 percent of the highest ranking corridors are similar, regardless of which corridor widths were used and whether cost was used as a criterion. The range of scores for the candidate corridors ranged from 14.2 to 64.2. LCFS Candidate Corridor 20 ranked second overall, utilizing the 0.8-km (0.5-mi.) corridor width and no cost considerations. It ranked third using 0.8-km (0.5-mi.) corridor width and considering cost as a factor. The proposed width of the LCFS corridor encompasses Candidate

Corridor 20, as well as many of the other highest ranking options, all of which are shown on Table 9.4-10.

Considered in isolation, LCFS Candidate Corridors 2, 6, 7, 8, 10, 13, 15, 17, 18, 22, and 24 may present viable alternatives, but consideration of the cumulative impact of these alternatives combined with the high ranking LPC (two lines) and LCR candidate corridors discussed above would be needed. LCFS Candidate Corridors 2, 6, 7, 8, 10, 13, 15, 17, 18, 22, and 24, were eliminated from further consideration because of the cumulative impact they presented. It should also be noted that the easterly alignment of the group of candidate corridors out of the LNP ranked lower than the candidate corridors with a north-south orientation, the highest ranking alignment.

The proposed Central Florida South Substation is planned to be located on approximately 24.3 ha (60 ac.) near the boundary between Sumter and Lake counties. The specific location of this proposed substation is unknown at this time. This general location is reasonably central to the population to be served and has adequate undeveloped land area for a substation. The proposed Central Florida South Substation will be designed to accommodate 500-kV and 230-kV transmission lines.

9.4.3.5.4 Levy/Citrus Common Corridor

The northerly segments of many high ranking candidate corridors for all four proposed 500-kV transmission lines originating at the LNP (the two LPC, one LCR, and one LCFS transmission lines) will follow an alignment that runs directly south from the LNP, across the CFBC, across the Withlacoochee River, to an area near CR-488 (West Dunnellon Road). After CR-488 (West Dunnellon Road), these high ranking candidate corridors will diverge. Those heading to the proposed Central Florida South Substation will head south and then east. Those heading to the proposed Citrus Substation and the CREC 500-kV switchyard will head south and then west.

Other high ranking candidate corridors for each of the four proposed 500-kV transmission lines originating at the LNP follow different alignments. Each of the alignments have varying levels of potential to affect resources considered in corridor selection. After lengthy discussion and review of the data, the corridor selection team concluded that co-locating the first 8.5 km (5.3 mi.) of two LPC, one LCR, and one LCFS transmission lines in one common alignment, referred to herein as the Levy/Citrus common corridor, would be most appropriate. Factors that were considered include the following:

- Locating the four 500-kV transmission lines in a single common corridor reduces the required total ROW width. The typical ROW width is 67 m (220 ft.) for a single new 500-kV transmission line constructed with H-frames and 60 m (200 ft.) when constructed with monopoles, with the structure located in the center of the easement. For that part of the Levy/Citrus common corridor located north of CR-40, a 305-m (1000-ft.) transmission line ROW is proposed. This ROW will provide adequate

space for the two new 500 kV LPC, the single 500-kV LCR, the single 500-kV LCFS transmission lines, as well as a single 69-kV transmission line related to the construction and operation of the LNP. South of CR-40, the ROW within the proposed Levy/Citrus common corridor is anticipated to be reduced to 216 m (710 ft.) in width.

- A single transmission line corridor crossing the CFBC, Inglis Island, and the Withlacoochee River is preferable to multiple crossings.

- Instead of having four transmission line ROWs, there would be only one transmission line ROW for the Levy/Citrus common corridor.

The decision to co-locate the first 8.5 km (5.3 mi.) of two LPC, one LCR, and one LCFS transmission lines in one common alignment was also corroborated by the input from the participants in the Utility Search Conference conducted in this area who recommended against exiting the LNP in an easterly alignment through the City of Dunnellon.

As discussed above, four new 500-kV transmission lines will connect LNP to the proposed Citrus Substation, the proposed Central Florida South Substation, and the CREC 500-kV switchyard. Two of the four 500-kV transmission lines will connect to the proposed Citrus Substation.

9.4.3.5.5 Certification of Corridors

PEF is seeking certification of the corridors pursuant to the Florida Electrical Power Plant Siting Act (PPSA), Chapter 403, F.S. and Chapter 62-17, F.A.C. The certification will provide for the centralized and coordinated permitting of the LNP, as well as the associated facilities, including the associated transmission lines included in this application. For linear facilities associated with an electrical power generating facility, such as the proposed transmission lines, the PPSA provides for the certification of “corridors,” which is the area within which the associated linear facility ROW must be located. Certification under the PPSA is the sole license of the State of Florida and provides non-federal agency approval of the location of the LNP, associated facilities, and transmission corridors. Certification under the PPSA also authorizes construction and maintenance of the transmission lines. The actual ROW width and alignment within the corridors will depend upon adjacent land uses, property boundaries, ownership patterns, structure types, height, and span lengths, as discussed in ER Subsection 2.2.2.

9.4.4 PUBLIC OUTREACH

9.4.4.1 Utility Search Conferences

PEF hired STAR Group, LLPC (STAR Group), to design and facilitate a local community public involvement process in connection with this corridor selection process. The process is part of a statewide outreach effort by PEF to inform the public and obtain input on the need and location for proposed transmission infrastructure to support the growth in Florida. Working with PEF, STAR Group

identified and convened a leadership team made up of local leaders to direct the planning for three regional Utility Search Conferences; each was a 2-day conference to discuss transmission. The leadership team determined the Focus Statement for each conference, key stakeholder groups, and the criteria for participant selection. In addition, members of the leadership team participated in the Background Report Committee, overseeing the development of a Background Report on the Community Partnership for Energy Planning. UtiliPoint International (UtiliPoint), an independent engineering firm, was hired to prepare the Background Report. UtiliPoint prepared the Background Report by compiling and analyzing information supplied to it by PEF and reviewed by members of the Background Report Committee. The report was mailed to conference participants approximately 10 days before the Conference.

Three regional Utility Search Conferences were held. The first was held at the Mission Inn in Howey-in-the-Hills, Florida, on September 25 and 26, 2007, for residents of Marion, Lake, and Sumter counties. The second was held on October 17 and 18, 2007, for residents of Polk, Hillsborough, and Pasco counties. The third was held on November 28 and 29, 2007, for residents of Citrus, Hernando, and Levy counties. Conference attendees represented government officials, local businesses, large commercial power users, environmental and alternative energy advocates, community organizations, emergency services, and utilities. Several observers attended, but did not participate in, the conferences. The feedback obtained from these committees was used to confirm the corridor selection team's corridor preferences.

9.4.4.2 Community Working Groups

Subsequent to the Utility Search Conferences, PEF established three regional community working groups that consist of approximately 20 participants each. These community working groups consist of diverse groups of community stakeholders that represent various communities, interest groups, and concerns. These groups will continue to work with PEF refining recommendations regarding this project.

9.4.4.3 Community Outreach

PEF held 13 open houses within the various affected communities to present the overall project, review the opportunity areas for the proposed candidate corridors, the project methodology, and to receive input from local community members.

9.4.5 REFERENCES

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9.4-003 U.S. Geologic Survey, "Chapter 11: Water Use," National Handbook of Recommended Methods for Water Data Acquisition, Available at website, www.pubs.usgs.gov/chapter11/, accessed February 4, 2008.

9.4-004 U.S. Environmental Protection Agency, "Chapter 4: Dry Cooling," Cooling Water Intake Structures—CWA 316(b), Phase I—New Facilities, Technical Development Document for the Final Regulations, Technical Report Number EPA 821-R-01-036, November 2001, Website, www.epa.gov/waterscience/316b/phase1/technical/ch4.pdf, accessed February 5, 2008.

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Table 9.4-1 (Sheet 1 of 5)
Summary of Environmental Impacts of the Heat Dissipation System Alternatives

Factors Affecting System Selection	Once-Through Cooling System	Cooling and Spray Ponds	Dry Cooling Tower System	Hybrid Wet/Dry Cooling Tower System	Natural Draft Hyperbolic Cooling Tower System	Two Rectangular Fiberglass Mechanical Draft Cooling Towers	Three Round Fiberglass Mechanical Draft Cooling Towers	Three Round Concrete Mechanical Draft Cooling Towers
Land Use: On-Site Land Requirements	N/A Rejected from range of alternatives before land use evaluated. Impacts would be SMALL.	Impacts would be MODERATE to LARGE.	Impacts would be SMALL.	Impacts would be SMALL.	Impacts would be SMALL.	Impacts would be SMALL.	Impacts would be SMALL to MODERATE.	Impacts would be SMALL to MODERATE.
Land Use: Terrain Considerations	N/A Rejected from range of alternatives before land use evaluated. Impacts would be SMALL.	N/A Rejected from range of alternatives before land use evaluated. Impacts would be SMALL.	Terrain features of the LNP site are suitable for a dry tower cooling system. Impacts would be SMALL.	Terrain features of the LNP site are suitable for a hybrid wet/dry cooling tower system. Impacts would be SMALL.	Terrain features of the LNP site are suitable for a natural draft hyperbolic cooling tower system. Impacts would be SMALL.	Terrain features of the LNP are suitable. Impacts would be SMALL.	Terrain features of the LNP are suitable. Impacts would be SMALL.	Terrain features of the LNP are suitable. Impacts would be SMALL.
Water Use	Significant volume of makeup water needed. Potential for significant impacts to aquatic biota. Impacts would be LARGE.	Potential for small volume of makeup water needed. No significant impacts to aquatic biota. Impacts would be MODERATE.	No makeup water needed for use of a dry tower cooling system. No significant impacts to aquatic biota. Impacts would be SMALL.	Potential for SMALL impacts to aquatic biota. Impacts would be SMALL.	Potential for SMALL to MODERATE impacts to aquatic biota. Impacts would be SMALL to MODERATE.	Potential for SMALL impacts to aquatic biota. Impacts would be SMALL.	Potential for SMALL to MODERATE impacts to aquatic biota. Impacts would be SMALL to MODERATE.	Potential for SMALL to MODERATE impacts to aquatic biota. Impacts would be SMALL to MODERATE.

Table 9.4-1 (Sheet 2 of 5)
Summary of Environmental Impacts of the Heat Dissipation System Alternatives

Factors Affecting System Selection	Once-Through Cooling System	Cooling and Spray Ponds	Dry Cooling Tower System	Hybrid Wet/Dry Cooling Tower System	Natural Draft Hyperbolic Cooling Tower System	Two Rectangular Fiberglass Mechanical Draft Cooling Towers	Three Round Fiberglass Mechanical Draft Cooling Towers	Three Round Concrete Mechanical Draft Cooling Towers
Atmospheric Effects	Some waste heat fogging associated with discharge canal. Impacts would be SMALL to MODERATE.	Some waste heat fogging associated with cooling and spray ponds. Impacts would be SMALL to MODERATE.	No visible plume associated with a dry tower cooling system. Impacts would be SMALL.	Visible plume. Presents minor potential for fogging and salt deposition. Impacts would be SMALL.	Visible plume. Presents greater potential for fogging and salt deposition. Impacts would be SMALL.	Visible plume. Presents minor potential for fogging and salt deposition. Impacts would be SMALL.	Visible plume. Presents minor potential for fogging and salt deposition. Impacts would be SMALL.	Visible plume. Presents minor potential for fogging and salt deposition. Impacts would be SMALL.
Thermal and Physical Effects	Enormous size of the intake and discharge structures and offshore pipes are needed. Thermal discharges associated with the once-through cooling system would need to meet applicable water quality standards and comply with applicable thermal discharge regulations. Thermal discharge study needed to identify environmental impacts on CREC discharge canal. Impacts would be LARGE.	Minor to no discharges associated with a cooling/spray pond cooling system would need to meet applicable water quality standards and comply with applicable thermal discharge regulations. The discharge is not likely to produce tangible aesthetic or recreational impacts. No effect on fisheries or navigation is expected. Impacts would be SMALL.	Minor to no discharges associated with a dry tower cooling system would need to meet applicable water quality standards and comply with applicable thermal discharge regulations. The discharge is not likely to produce tangible aesthetic or recreational impacts. No effect on fisheries or navigation is expected. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.

Table 9.4-1 (Sheet 3 of 5)
Summary of Environmental Impacts of the Heat Dissipation System Alternatives

Factors Affecting System Selection	Once-Through Cooling System	Cooling and Spray Ponds	Dry Cooling Tower System	Hybrid Wet/Dry Cooling Tower System	Natural Draft Hyperbolic Cooling Tower System	Two Rectangular Fiberglass Mechanical Draft Cooling Towers	Three Round Fiberglass Mechanical Draft Cooling Towers	Three Round Concrete Mechanical Draft Cooling Towers
Noise Levels	N/A Rejected from range of alternatives before noise evaluated.	Would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely the same as background levels and would be considered unobtrusive. Impacts would be SMALL.
Aesthetic and Recreational Benefits	N/A Rejected from range of alternatives before aesthetic and recreational benefits were evaluated.	N/A Rejected from range of alternatives before aesthetic and recreational benefits were evaluated.	No visible plume with the use of a dry tower air-cooled system. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Gulf of Mexico is expected. Impacts would be SMALL.

Table 9.4-1 (Sheet 4 of 5)
Summary of Environmental Impacts of the Heat Dissipation System Alternatives

Factors Affecting System Selection	Once-Through Cooling System	Cooling and Spray Ponds	Dry Cooling Tower System	Hybrid Wet/Dry Cooling Tower System	Natural Draft Hyperbolic Cooling Tower System	Two Rectangular Fiberglass Mechanical Draft Cooling Towers	Three Round Fiberglass Mechanical Draft Cooling Towers	Three Round Concrete Mechanical Draft Cooling Towers
Legislative Restrictions	Potential compliance issues with Section 316(b) of the CWA. In addition, potential significant NPDES thermal discharge issues surrounding discharges back into CREC discharge canal. Impacts would be LARGE.	N/A Rejected from range of alternatives before legislative restrictions were evaluated.	Potential compliance issues with the requirements for emissions under the federal Clean Air Act. These regulatory restrictions would not negatively affect implementation of this heat dissipation system, but they may influence overall operational cost. Impacts would be SMALL to MODERATE.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into CREC discharge canal and the Gulf of Mexico. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL to MODERATE.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into CREC discharge canal and the Gulf of Mexico. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL to MODERATE.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into CREC discharge canal. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into CREC discharge canal. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into the CREC discharge canal. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL.

Table 9.4-1 (Sheet 5 of 5)
Summary of Environmental Impacts of the Heat Dissipation System Alternatives

Factors Affecting System Selection	Once-Through Cooling System	Cooling and Spray Ponds	Dry Cooling Tower System	Hybrid Wet/Dry Cooling Tower System	Natural Draft Hyperbolic Cooling Tower System	Two Rectangular Fiberglass Mechanical Draft Cooling Towers	Three Round Fiberglass Mechanical Draft Cooling Towers	Three Round Concrete Mechanical Draft Cooling Towers
Environmental Impacts	LARGE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Is this a suitable alternative heat dissipation system?	No (see discussion in ER Subsection 9.4.1.1.1)	No (see discussion in ER Subsection 9.4.1.1.2)	No (see discussion in ER Subsection 9.4.1.1.3)	No (see discussion in ER Subsection 9.4.1.1.4)	No (see discussion in ER Subsection 9.4.1.1.5)	Yes (see discussion in ER Subsection 9.4.1.2)	No (see discussion in ER Subsection 9.4.1.2)	No (see discussion in ER Subsection 9.4.1.2)

Notes:

CREC = Crystal River Energy Complex
CWA = Clean Water Act
ER = Environmental Report
LNP = proposed Levy Nuclear Plant Units 1 and 2
N/A = not applicable
NPDES = National Pollutant Discharge Elimination System

Table 9.4-2
Life Cycle Cost Benefit for Tower Options (Hot Weather Year)

Type of Cooling Tower	Rectilinear Mechanical Draft — Fiberglass	Round Mechanical Draft — Fiberglass	Round Mechanical Draft — Fiberglass	Round Mechanical Draft — Concrete	Round Mechanical Draft — Concrete
Circulating Water Flow Rate (gpm)	600,000	600,000	600,000	600,000	600,000
Energy Rate	**High**	**Average**	**High**	**Average**	**High**
Cooling Tower Initial Cost [(a)]	$58,610	$60,969	$60,969	$72,219	$72,219
Contractor+Engineer +Manager+Owner+ Construction Cost	$34,873	$36,277	$36,277	$42,971	$42,971
Construction Cost [(a)]	$93,483	$97,246	$97,246	$115,190	$115,190
Total Present Value of Cooling Tower Cost Including Maintenance Differences	$96,858	$100,007	$100,007	$117,951	$117,951
Total Present Value of Cooling Tower Cost Including Production Difference Benefits	$96,858	$93, 672	$90,443	$111,616	$108,387

Notes:

All dollar amounts are in thousands of dollars.

High energy rate for hot weather year refers to maximum rate during any given time period during the year. Average energy rate for a hot weather year refers to the median rate during any given time period during the year.

a) The presented cost excludes common items such as circulating water pumps, makeup and blowdown systems, and tower fill replacement.

gpm = gallons per minute

Table 9.4-3
Preliminary Assessment of Makeup Water Source Alternatives

Key Factors	Quantity/ Quality	Engineering	Natural Resources	Regulatory	Cost	Overall Score
Weight	**5**	**3**	**3**	**4**	**3**	
Freshwater Sources						
Upper Floridan	2	4	2	1	N/A	N/A
Lower Floridan	3	4	3	2	N/A	N/A
Surface Water	2	5	2	2	N/A	N/A
Reuse Water	1	N/A	5	5	N/A	N/A
Saltwater Sources						
CFBC near Inglis Lock	5	5	4	4	5	83
Nearshore of Withlacoochee Bay	3	4	2	2	3	50
Offshore of Withlacoochee Bay	4	3	3	3	2	56
CREC Intake Canal	5	2	3	4	3	65
CREC Discharge Canal	5	4	5	4	3	77

Notes:

The ranking scale (cost factors) is relative, ranges from 1 to 5 (like non-cost factors) and is based upon engineering judgment of capital, operations, and maintenance costs; the weighting scale is relative and ranges from 1 to 5; the overall score is derived by multiplying rank values by weights for each factor and summing for each alternative.

Evaluations are subjective and are based on best professional judgment; assessments are based on current information and design concepts; constraints are based on limited technical and regulatory information.

Based on available information, none of the freshwater sources considered provides the demonstrated availability and long-term reliability required for this project. Accordingly, these options were considered not applicable (N/A).

Ranking Scale (non-cost factors):
1 = Very serious constraint to development.
2 = Serious constraint to development.
3 = Moderate constraint to development
4 = Limited constraints to development.
5 = Favorable characteristics for development.

CFBC = Cross Florida Barge Canal
CREC = Crystal River Energy Complex
N/A = not applicable

Table 9.4-4
Preliminary Assessment of Blowdown Site Discharge Alternatives

Key Factors	Technical Feasibility	Engineering	Natural Resources	Regulatory	Cost	Overall Score
Weight	**5**	**3**	**3**	**4**	**3**	
Deepwell Injection	1	2	4	3	5	50
Nearshore of Withlacoochee Bay	2	3	2	2	3	42
Offshore of Withlacoochee Bay	5	3	3	4	3	68
CREC Discharge Canal	5	3	3	2	4	63

Notes:

The ranking scale (cost factors) is relative, ranges from 1 to 5 (like non-cost factors) and is based upon engineering judgment of capital, operations, and maintenance costs; the weighting scale is relative and ranges from 1 to 5; the overall score is derived by multiplying rank values by weights for each factor and summing for each alternative.

Evaluations are subjective and are based on best professional judgment; assessments are based on current information and design concepts; constraints are based on limited technical and regulatory information.

Ranking Scale (non-cost factors):
1 = Very serious constraint to development.
2 = Serious constraint to development.
3 = Moderate constraint to development
4 = Limited constraints to development.
5 = Favorable characteristics for development.

CREC = Crystal River Energy Complex

Table 9.4-5
Preliminary Assessment of Makeup and Blowdown Route Alternatives

Key Factors	Engineering	Natural Resources	Regulatory	Cost	Overall Score
Weight	**4**	**3**	**4**	**3**	
Pumpkin Island Route	2	2	2	3	31
CFBC Berm Route	3	4	3	3	45
CREC Route	3	5	2	3	44
CFBC Submerged Route	3	3	3	4	45

Notes:

The ranking scale (cost factors) is relative, ranges from 1 to 5 (like non-cost factors) and is based upon engineering judgment of capital, operations, and maintenance costs; the weighting scale is relative and ranges from 1 to 5; the overall score is derived by multiplying rank values by weights for each factor and summing for each alternative.

Evaluations are subjective and are based on best professional judgment; assessments are based on current information and design concepts; constraints are based on limited technical and regulatory information.

Ranking Scale (non-cost factors):
1 = Very serious constraint to development.
2 = Serious constraint to development.
3 = Moderate constraint to development
4 = Limited constraints to development.
5 = Favorable characteristics for development.

CFBC = Cross Florida Barge Canal
CREC = Crystal River Energy Complex

Table 9.4-6
Features Included on a Regional Transmission Corridor Screening Map

Feature	Description
Residences	Identification of existing residential areas within the study area based on the FLUCCS 110-139 class definition areas and Land Use/Land Cover maps
Major Developments	Identification of approved Developments of Regional Impact within the study area
Existing PEF Transmission Lines	Identification of existing PEF transmission lines (≥115 kV) within the study area
Other Existing Linear Facilities	Identification of other existing linear facilities (existing and committed major public roads and existing railroads) within the study area
Conservation Lands and Parks	Identification of conservation lands and parks (using federal, state, and local government data sources and available online data) in the study area.
Wetlands	Identification of wetlands within the study area using the FLUCCS Land Use/Land Cover 600-654 class definition areas.
National Register of Historic Places	Identification of NRHP sites within the study area
Threatened and Endangered Species	Identification of the location of threatened and endangered species within the study area based on the FNAI database.
Airports	Identification of any licensed public or private airports and helipads registered with Federal Aviation Authority and/or Florida Department of Transportation within the study area
Agriculture and Rangelands	Identification of agriculture and rangelands within the study area using FLUCCS Land Use/Land Cover 200-330 class definitions

Notes:

FLUCCS = Florida Land Use Cover and Forms Classification System
FNAI = Florida Natural Areas Inventory
NRHP = National Register of Historic Places

Table 9.4-7
Transmission Corridor Qualitative Evaluation Criteria

Feature	Description
Residences	A count of residences within to the corridor segment
Residential Parcels	A count of parcels within the corridor segment
Schools	A count of existing and proposed public and existing private schools within or in close proximity to the corridor segment
Community Facilities	A count of community facilities within or in close proximity to the corridor segment
Existing PEF Transmission Lines	Length of the corridor segment within or in close proximity to an existing PEF transmission line (≥ 115 kV).
Other Existing Linear Facilities	Length of the corridor segment within or in close proximity to existing and committed major public roads and existing railroads
Conservation Lands and Parks	Area of conservation lands and parks within or in close proximity to the corridor segment
Upland Forests	Area of upland forested areas within corridor segment
Herbaceous Wetlands	Area of herbaceous wetland areas within corridor segment
Forested Wetland	Area of forested wetland areas within corridor segment
Flood Plain	Area of a 100-year flood plain within the corridor segment
National Register of Historical Places	A count of archaeological and historical resource site locations within or in close proximity to the corridor segment;
Threatened and Endangered Species	A count of protected species (flora and fauna) locations within or in close proximity to the corridor segment (not including Bald Eagle nests)
Bald Eagle Nests	A count of Bald Eagle nest locations within or in close proximity to the corridor segment
Airports	A count of airports and heliports within or in close proximity to the corridor segment
Cost	The U.S. dollar amount estimated to construct the proposed transmission line within the corridor segment

Table 9.4-8
LNP to Proposed Citrus Substation Highest Ranking Candidate Transmission Corridors

Ranking	Candidate Corridor	Corridor Segments	Total Score
1	91	S71+S73+S23+S22+S75+S53+S21+S57+S77	16.4
2	92	S71+S73+S23+S22+S75+S53+S21+S76+S5	17.2
3	90	S71+S73+S23+S22+S75+S53+S21+S56+S6+S5	19.1
4	83	S71+S73+S23+S22+S74+S54+S53+S21+S57+S77	19.2
5	88	S71+S73+S23+S22+S75+S53+S118+S12+S20+S77	19.7
6	67	S71+S73+S23+S2+S9+S54+S53+S21+S57+S77	19.9
7	84	S71+S73+S23+S22+S74+S54+S53+S21+S76+S5	20.0
8	79	S71+S73+S23+S22+S74+S16+S14+S6+S5	20.3
9	72	S71+S73+S23+S2+S9+S74+S75+S53+S21+S57+S77	20.3
10	68	S71+S73+S23+S2+S9+S54+S53+S21+S76+S5	20.7
11	63	S71+S73+S23+S2+S9+S16+S14+S6+S5	20.9
12	73	S71+S73+S23+S2+S9+S74+S75+S53+S21+S76+S5	21.1
13	77	S71+S73+S23+S22+S74+S16+S14+S56+S57+S77	21.2
14	61	S71+S73+S23+S2+S9+S16+S14+S56+S57+S77	21.9
15	82	S71+S73+S23+S22+S74+S54+S53+S21+S56+S6+S5	21.9
16	78	S71+S73+S23+S22+S74+S16+S14+S56+S76+S5	22.0
17	26	S19+S18+S17+S15+S24+S117+S14+S6+S5	22.2
18	80	S71+S73+S23+S2+S9+S54+S53+S21+S56+S6+S5	22.5
19	66	S71+S73+S23+S2+S9+S54+S53+S21+S56+S6+S5	22.5
20	62	S71+S73+S23+S2+S9+S16+S14+S56+S76+S5	22.7
21	71	S71+S73+S23+S2+S9+S74+S75+S53+S21+S56+S6+S5	23.0
22	64	S71+S73+S23+S2+S9+S54+S53+S118+S12+S20+S77	23.1
23	24	S19+S18+S17+S15+S24+S117+S14+S56+S57+S77	23.1
24	3	S19+S18+S17+S13+S24+S117+S14+S6+S5	23.5
25	69	S71+S73+S23+S2+S9+S74+S75+S53+S118+S12+S20+S77	23.6

Table 9.4-9 (Sheet 1 of 2)
LNP to CREC 500-kV Switchyard Highest Ranking Candidate Transmission Corridors

Ranking	Candidate Corridor	Corridor Segments	Total Score
1	1438	S19+S18+S17+S360+S15+S368+S24+S374+S343+S117+ S349+S14+381+353+327+354	18.4
2	1166	S19+S18+S17+S360+S15+S368+S24+S374+S343+S344+ S346+S348+S349+S350+S353+S327+S354	19.6
3	3427	S19+S18+S17+S360+S15+S368+S24+S375+S378+S376+ S346+S348+S349+S350+S353+S327+S354	19.8
4	1527	S19+S18+S17+S360+S15+S368+S24+S374+S343+S117+ S349+S14+S381+S351+S355+356+359	20.2
5	1717	S19+S18+S17+S360+S15+S368+S24+S374+S343+S117+ S349+S14+S381+S351+S355+357+359	20.2
6	403	S19+S18+S17+S360+S15+S368+S24+S374+S343+S344+ S346+S348+S349+S350+S351+S352+S354	20.4
7	2968	S19+S18+S17+S360+S15+S368+S24+S375+S378+S376+ S346+S348+S349+S350+S351+S352+S354	20.6
8	1464	S71+S73+S23+S22+S75+S53+S21+S57+S77+S383+S55+ S327+S354	20.9
9	1208	S71+S73+S23+S2+S9+S16+S349+S14+S56+381+353+ 327+354	21.1
10	228	S19+S18+S17+S360+S15+S368+S24+S374+S343+S117+ S349+S350+S353+S327+S354	21.1
11	1285	S19+S18+S17+S360+S15+S368+S24+S374+S343+S117+ S349+S14+S6+S5+S383+S55+S327+S354	21.2
12	1183	S71+S73+S23+S22+S74+S16+S349+S14+S56+381+353+ 327+354	21.2
13	891	S71+S73+S23+S2+S9+S74+S75+S53+S21+S56+381+353 +327+354	21.3
14	307	S19+S18+S17+S360+S15+S368+S342+S379+S374+S343+ S344+S346+S348+S349+S350+S353+S327+S354	21.4
15	690	S71+S73+S23+S2+S9+S54+S53+S21+S56+381+353+327+ 354	21.5
16	1263	S71+S73+S23+S22+S75+S53+S118+S12+S20+S77+ S383+S55+S327+S354	21.6
17	2721	S19+S18+S17+S360+S15+S368+S342+S369+S377+S378+ S376+S346+S348+S349+S350+S353+S327+S354	21.6
18	1861	S71+S73+S23+S22+S74+S54+S53+S21+S56+381+353+ 327+354	21.6

Table 9.4-9 (Sheet 2 of 2)
LNP to CREC 500-kV Switchyard Highest Ranking Candidate Transmission Corridors

Ranking	Candidate Corridor	Corridor Segments	Total Score
19	409	S19+S18+S17+S360+S15+S368+S342+S379+S375+S378+ S376+S346+S348+S349+S350+S353+S327+S354	21.6
20	100	S19+S18+S17+S360+S15+S371+S373+S379+S374+S343+ S344+S346+S348+S349+S350+S353+S327+S354	21.7
21	1845	S71+S73+S23+S2+S9+S16+S349+S14+S381+S351+ S355+357+359	21.7
22	306	S71+S73+S23+S2+S9+S16+S349+S14+S381+S351+ S355+356+359	21.7
23	2476	S71+S73+S23+S22+S74+S16+S349+S14+S381+S351+ S355+356+359	21.8
24	873	S71+S73+S23+S22+S74+S16+S349+S14+S381+S351+ S355+357+359	21.8
25	334	S19+S18+S17+S360+S15+S371+S373+S369+S377+S378+ S376+S346+S348+S349+S350+S353+S327+S354	21.9

Table 9.4-10 (Sheet 1 of 2)
LNP to Proposed Central Florida South Substation Highest Ranking Candidate Transmission Corridors

Ranking	Candidate Corridor	Corridor Segments	Total Score
1	20	S71+S73+S23+S22+S75+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S141+S47+ S142	14.2
2	671	S71+S73+S23+S22+S75+S53+S118+S12+S112+S81+ S44+S97+S150+S45+S113+S46+S102+S141+S47+S142	15.0
3	2393	S71+S73+S23+S2+S9+S54+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S141+S47+ S142	15.3
4	811	S71+S73+S23+S22+S74+S54+S53+S21+S57+S20+ S112+S81+S44+S97+S150+S45+S113+S46+S102+ S141+S47+S142	15.3
5	1602	S71+S73+S23+S2+S9+S74+S75+S53+S21+S57+S20+ S112+S81+S44+S97+S150+S45+S113+S46+S102+ S141+S47+S142	15.6
6	3044	S71+S73+S23+S2+S9+S54+S53+S118+S12+S112+S81+ S44+S97+S150+S45+S113+S46+S102+S141+S47+S142	16.1
7	1462	S71+S73+S23+S22+S74+S54+S53+S118+S12+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S141+S47+ S142	16.1
8	2253	S71+S73+S23+S2+S9+S74+S75+S53+S118+S12+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S141+S47+ S142	16.4
9	531	S71+S73+S23+S22+S75+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S69+S127+ S47+S142	16.8
10	17	S71+S73+S23+S22+S75+S53+S118+S132+S111+S81+ S44+S97+S150+S45+S113+S46+S102+S141+S47+S142	16.9
11	21	S71+S73+S23+S22+S75+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S141+ S126+S142	17.3
12	27	S71+S73+S23+S22+S75+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S151+S98+S49+S113+S46+S102+ S141+S47+S142	17.5
13	668	S71+S73+S23+S22+S75+S53+S118+S12+S112+S81+ S44+S97+S150+S45+S113+S46+S102+S69+S127+S47+ S142	17.7
14	2904	S71+S73+S23+S22+S74+S54+S53+S118+S132+S111+ S81+S44+S97+S150+S45+S113+S46+S102+S141+S47+ S142	17.9

Table 9.4-10 (Sheet 2 of 2)
LNP to Proposed Central Florida South Substation Highest Ranking Candidate Transmission Corridors

Ranking	Candidate Corridor	Corridor Segments	Total Score
15	1322	S71+S73+S23+S22+S74+S54+S53+S21+S57+S20+ S112+S81+S44+S97+S150+S45+S113+S46+S102+S69+ S127+S47+S142	17.9
16	2390	S71+S73+S23+S2+S9+S54+S53+S118+S132+S111+ S81+S44+S97+S150+S45+S113+S46+S102+S141+S47+ S142	18.0
17	808	S71+S73+S23+S2+S9+S54+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S69+S127+ S47+S142	18.0
18	672	S71+S73+S23+S22+S75+S53+S118+S12+S112+S81+ S44+S97+S150+S45+S113+S46+S102+S141+S126+ S142	18.1
29	6	S71+S73+S23+S22+S75+S53+S21+S57+S20+S112+ S81+S44+S97+S66+S152+S98+S49+S113+S46+S102+ S141+S47+S142	18.1
20	2113	S71+S73+S23+S22+S74+S54+S53+S21+S57+S20+ S112+S81+S44+S97+S150+S45+S113+S46+S102+ S141+S126+S142	18.2
21	2394	S71+S73+S23+S2+S9+S54+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S45+S113+S46+S102+S141+ S126+S142	18.3
22	812	S71+S73+S23+S2+S9+S74+S75+S53+S21+S57+S20+ S112+S81+S44+S97+S150+S45+S113+S46+S102+S69+ S127+S47+S142	18.3
23	1599	S71+S73+S23+S2+S9+S74+S75+S53+S118+S132+ S111+S81+S44+S97+S150+S45+S113+S46+S102+ S141+S47+S142	18.3
24	678	S71+S73+S23+S22+S75+S53+S118+S12+S112+S81+ S44+S97+S150+S151+S98+S49+S113+S46+S102+ S141+S47+S142	18.3
25	2400	S71+S73+S23+S2+S9+S54+S53+S21+S57+S20+S112+ S81+S44+S97+S150+S151+S98+S49+S113+S46+S102+ S141+S47+S142	18.6