8.0 Environmental Impacts of Alternatives to Operating License Renewal

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

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

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

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

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

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (10 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative

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

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

FPL will be required to comply with NRC decommissioning requirements whether or not the OLs are renewed. If the St. Lucie Units 1 and 2 OLs are renewed, decommissioning activities will not be avoided but may be postponed for up to an additional 20-year period. If the OLs are not renewed, FPL would conduct decommissioning activities according to the requirements in 10 CFR 50.82.

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

The environmental impacts associated with the no-action alternative are summarized in Table 8-1. Implementation of the no-action alternative would also have certain positive impacts in that adverse environmental impacts associated with current operation of St. Lucie Units 1 and 2; for example, solid waste impacts and adverse impacts on aquatic life would be eliminated.

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

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

Impact Category	Impact	Comment
Land Use	SMALL	Onsite impacts expected to be temporary. No offsite impacts expected.
Ecology	SMALL	Impacts to ecology are expected to be temporary and largely mitigatable using best management practices.
Water Use and Quality	SMALL	Water use will decrease. Water quality unlikely to be adversely affected.
Air Quality	SMALL	Greatest impact is likely to be from fugitive dust; impact can be mitigated by good management practices.
Waste	SMALL	Low-level radioactive (LLW) waste will be disposed of in licensed facilities. A permanent disposal facility for high-level waste (HLW) is not currently available.
Human Health	SMALL	Radiological doses to workers and members of the public are expected to be within regulatory limits and comparable to, or lower than, doses from operating plants. Occupational injuries are possible, but injury rates at nuclear power plants are below the U.S. average industrial rate.
Socioeconomics	SMALL	Decrease in employment in St. Lucie and surrounding counties and tax revenues in St. Lucie County.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Impacts primarily confined to land used during plant operations. No impact to undisturbed land expected. Land occupied by Units 1 and 2 would likely be retained by FPL for other corporate purposes.
Environmental Justice	SMALL	Some loss of employment opportunities and social programs is expected.

8.1.1 Land Use

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

8.1.2 Ecology

At the St. Lucie site, impacts on aquatic ecology could result from removal of in-water pipes and structures or the filling of the intake and discharge canals. Impacts to aquatic ecology would

likely be short-term and could be mitigated. The aquatic environment is expected to recover naturally. Impacts on terrestrial ecology could occur as a result of land disturbance for additional laydown yards, stockpiles, and support facilities. Land disturbance is expected to be minimal and result in relatively short-term impacts that can be mitigated using best management practices. The land is expected to recover naturally. Overall, the ecological impacts associated with the no-action alternative are considered SMALL.

8.1.3 Water Use and Quality

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

8.1.4 Air Quality

Decommissioning activities that can adversely affect air quality include dismantlement of systems and equipment, demolition of buildings and structures, and the operation of internal combustion engines. The most likely adverse impact would be the generation of fugitive dust. Best management practices, such as seeding and wetting, could be used to minimize the generation of fugitive dust. Overall, air quality impacts associated with the no-action alternative are considered SMALL.

8.1.5 Waste

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

A permanent repository for high-level waste (HLW) is not currently available. The NRC has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in its spent fuel pool or at either onsite or offsite independent spent fuel storage installations [10 CFR 51.23(a)]. Overall, waste impacts associated with the no-action alternative are considered SMALL.

8.1.6 Human Health

Radiological doses to occupational workers during decommissioning activities are estimated to average approximately 5 percent of the dose limits in 10 CFR Part 20, and to be similar to, or lower than, the doses experienced by workers in operating nuclear power plants. Collective doses to members of the public and to the maximally exposed individual as a result of decommissioning activities are estimated to be well below the limits in 10 CFR Part 20, and to be similar to, or lower than, the doses received from operating nuclear power plants. Occupational injuries to workers engaged in decommissioning activities are possible. However, historical injury and fatality rates at nuclear power plants have been lower than the average U.S. industrial rates. Overall, the human health impacts associated with the no-action alternative activities are considered SMALL.

8.1.7 Socioeconomics

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

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

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

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

to be SMALL. Appendix J of Supplement 1 to NUREG-0586 (NRC 2002) shows that the overall socioeconomic impact of plant closure plus decommissioning could be greater than SMALL.

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

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

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

8.1.8 Aesthetics

Decommissioning would result in the eventual dismantlement of buildings and structures at the site resulting in a positive aesthetic impact. Noise would be generated during decommissioning operations that may be detectable offsite; however, the impact is unlikely to be of large significance. Overall, the aesthetic impacts associated with the no-action alternatives are considered SMALL.

8.1.9 Historic and Archaeological Resources

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

8.1.10 Environmental Justice

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

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by St. Lucie assuming that the OLs for Units 1 and 2 are not renewed. The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts. The following generation alternatives are considered in detail:

- coal-fired generation at an alternate site (Section 8.2.1)
- natural-gas-fired generation at an alternate site (Section 8.2.2)
- nuclear generation at an alternate site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated by St. Lucie Units 1 and 2 is discussed in Section 8.2.4. Other power generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for St. Lucie Units 1 and 2 are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

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

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

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

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

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

(a) In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

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

Each year the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. In its *Annual Energy Outlook 2002*, EIA projects that combined-cycle or combustion turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electric-generating capacity through the year 2020 (DOE/EIA 2001a). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet base-load[(a)] requirements. Coal-fired plants are projected by EIA to account for approximately 9 percent of new capacity during this period. Coal-fired plants are generally used to meet base-load requirements. Renewable energy sources, primarily wind, geothermal, and municipal solid waste units, are projected by EIA to account for the remaining 3 percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2005 and 2020, followed by coal-fired plants and then wind generation (DOE/EIA 2001a).

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

EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States through the year 2020 because natural-gas- and coal-fired plants are projected to be more economical (DOE/EIA 2001a). In spite of this projection, a new nuclear plant alternative for replacing power generated by St. Lucie Units 1 and 2 is considered in the SEIS for reasons stated in Section 8.2.3. NRC established a New Reactor Licensing Project Office in 2001 to prepare for and manage future reactor and site licensing applications (NRC 2001).

(a) A base-load plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for base-load generation; i.e., these units generally run near full load.

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

8.2.1 Coal-Fired Generation

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

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

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the FPL ER (FPL 2001). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

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

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

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

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

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

8.2.1.1 Closed-Cycle Cooling System

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

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

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

(a) Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (Btu) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of fuel burned for electric generation by the resulting net kWh generation. The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

Table 8-2. (cont'd)

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

- **Land Use**

The coal-fired generation alternative would necessitate converting approximately 467 ha (1155 ac) to industrial use for the power block; infrastructure and support facilities; coal storage and handling; and landfill disposal of ash and scrubber sludge (FPL 2001). Spent selective catalytic reduction (SCR) catalyst (used for control of nitrogen oxide [NO_x] emissions) would be disposed of offsite. Disposal of ash and sludge over a 40-year plant life would require approximately 280 ha (680 ac) of the 467 ha (FPL 2001). Additional land could be needed for an electric power transmission line, a rail spur, and/or pipelines to supply cooling-water intake and discharge. The FPL ER (FPL 2001) assumes that these activities could impact up to 380 ha (940 ac). Land-use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. In the GEIS, the staff estimated that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing of the waste to support a 1000 MW(e) coal plant during its operational life (NRC 1996). A replacement coal-fired plant for St. Lucie Units 1 and 2 would be 1600 MW(e) and would affect proportionately more land. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for St. Lucie Units 1 and 2. In the GEIS, the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant (NRC 1996).

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

- **Ecology**

The coal-fired generation alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface-water body could have adverse aquatic resource impacts. If needed, construction and maintenance of an electric power transmission line and a rail spur would have ecological impacts. There would be some impact on terrestrial ecology from cooling tower drift. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE and would be greater than renewal of the St. Lucie Units 1 and 2 OLs.

- **Water Use and Quality**

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

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

- **Air Quality**

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

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

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified for criteria pollutants[(a)] under the Clean Air Act. All of the FPL preferred and potential power plant sites (FPL 2002) are in areas that are designated as attainment or unclassified for criteria pollutants.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a state, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure that there is no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308[d][1]). If a new coal-fired power station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Mandatory Class I Federal areas in Florida are Everglades National Park, Chassahowitzka National Wildlife Refuge, and St. Marks National Wildlife Refuge (40 CFR 81.407).

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

Impacts for specific pollutants are as follows:

- Sulfur oxides. A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative since a nuclear power plant releases almost no SO_2 during normal operations.

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

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

  FPL estimates that by using low-NO_x burners with overfire air and selective catalytic reduction, the total annual NO_x emissions for a new coal-fired power plant would be approximately 1840 MT (2030 tons) (FPL 2001). Regardless of the control technology, this level of NO_x emissions would be greater than the OL renewal alternative since a nuclear power plant releases almost no NO_x during normal operations.

- Particulates. FPL estimates that the total annual stack emissions of particulates would include approximately 196 MT (216 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 micrometer [μm] up to approximately 45 μm). The 196 MT (216 tons) would include approximately 45 MT (50 tons) of PM_{10} (particulate matter having an aerodynamic diameter less than or equal to 10 μm). Fabric filters or electrostatic precipitators would be used for control (FPL 2001). In

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

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

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

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

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

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

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

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent SCR catalyst, and scrubber sludge. Four 400-MW(e) coal-fired plants would annually generate approximately 390,000 MT (430,000 tons) of ash and 532,000 MT (586,000 tons) of scrubber sludge (FPL 2001). Approximately 10 percent of the ash would be bottom ash that could be used beneficially (e.g., road base, fill, asphalt, and road surfacing) (FPL 2001). The remaining 90 percent of the ash would be fly ash. The fly ash and scrubber sludge would be disposed of in a landfill. Spent SCR catalyst would be regenerated or disposed of offsite. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality but, with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses.

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

Construction-related debris would be generated during construction activities.

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

- **Human Health**

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risks from coal and lime/limestone transportation, worker and public risks from disposal of coal combustion wastes, and public risks from inhalation of stack emissions.

Emission impacts can be widespread and health risks difficult to quantify. The coal alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

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

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

- **Socioeconomics**

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

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

jurisdiction. The staff stated in the GEIS that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction work force would need to move to the area to work (NRC 1996). Socioeconomic impacts at a rural site could be LARGE. Transportation-related impacts associated with commuting construction workers at an alternate site are site-dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL.

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

Overall, socioeconomic impacts are characterized as MODERATE to LARGE.

- **Aesthetics**

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

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

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

- **Historic and Archaeological Resources**

A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

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

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

8.2.1.2 Once-Through Cooling System

The environmental impacts of constructing a coal-fired generation system at an alternate Florida site using once-through cooling are similar to the impacts for a coal-fired plant using a closed-cycle system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation at an Alternate Florida Site with Once-Through Cooling

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

8.2.2 Natural-Gas-Fired Generation

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

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

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

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

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

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

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

Unless otherwise indicated, the assumptions and numerical values used throughout this section are from the FPL ER (FPL 2001). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the natural-gas-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a natural-gas-fired plant).

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

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	30 ha (75 ac) for power block, switchyard, cooling towers, and infrastructure support facilities. Additional impact of up to 425 ha (1050 ac) for electric power transmission line, natural gas pipeline, and cooling-water intake/discharge pipelines.
Ecology	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and possible electric power transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface water body. Discharge of cooling tower blowdown will have impacts.
Air Quality	MODERATE	Sulfur oxides • 150 MT/yr (165 tons/yr) Nitrogen oxides • 607 MT/yr (669 tons/yr) Carbon monoxide • 1402 MT/yr (1545 tons/yr) PM_{10} particulates • 89 MT/yr (98 tons/yr) Some hazardous air pollutants
Waste	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.
Human Health	SMALL	Impacts considered to be minor.
Socioeconomics	MODERATE	During construction impacts would be MODERATE. Up to 700 additional workers during the peak of the 3-year construction period. St. Lucie County would experience loss of the tax base and employment associated with St. Lucie Units 1 and 2 with potentially SMALL impacts. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	MODERATE to LARGE	MODERATE impact from plant, stacks, and cooling towers and associated plumes. Additional impact that could be LARGE if a new electric power transmission line is needed.
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts at alternate site vary depending on population distribution and makeup at site. St. Lucie County would lose tax revenue and jobs, however the impacts on minority and low-income populations would likely be SMALL.

8.2.2.1 Closed-Cycle Cooling System

The overall impacts of the natural-gas-generating system are discussed in the following sections and summarized in Table 8-4. The extent of impacts at an alternate site will depend on the location of the particular site selected.

- **Land Use**

The natural-gas-fired alternative would necessitate converting approximately 30 ha (75 ac) to industrial use for the power block, cooling towers, and infrastructure and support facilities (FPL 2001). Additional land would likely be impacted for construction of an electric power transmission line, natural gas pipeline, and water intake/discharge pipelines to serve the plant. The FPL ER assumes that these activities could impact up to 425 ha (1050 ac) (FPL 2001). For any new natural-gas-fired power plant, additional land would be required for natural gas wells and collection stations. In the GEIS, the staff estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Proportionately more land would be needed for a natural-gas-fired plant replacing the 1678 MW(e) from St. Lucie. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for St. Lucie. NRC staff stated in the GEIS (NRC 1996) that approximately 400 ha (1000 ac) would be affected for mining and processing the uranium during the operating life of a 1000-MW(e) nuclear power plant. Overall, land-use impacts for a natural-gas-fired plant would be MODERATE to LARGE.

- **Ecology**

There would be ecological land-related impacts associated with siting of the gas-fired plant. If needed, there would also be temporary ecological impacts associated with bringing a new underground gas pipeline and/or electric power transmission line to the site. Ecological impacts would depend on the nature of the land converted for the plant and the possible need for a new transmission line and/or gas pipeline. Ecological impacts to the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Cooling makeup water intake and discharge could have aquatic resource impacts. There would be some impact on terrestrial ecology from cooling tower drift. Overall, the ecological impacts are considered MODERATE to LARGE.

- **Water Use and Quality**

The impact on the surface water would depend on the discharge volume and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State of Florida. There would be a consumptive use of water due to

evaporation from the cooling towers. A natural-gas-fired plant sited at an alternate site may use groundwater. Groundwater withdrawal impacts are considered SMALL.

Water-quality impacts from sedimentation during construction of a natural-gas-fired plant were characterized in the GEIS as SMALL (NRC 1996). NRC staff also noted in the GEIS that operational water-quality impacts would be similar to, or less than, those from other generating technologies.

Overall, water use and quality impacts at an alternate Florida site are considered SMALL to MODERATE.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative.

A new gas-fired generating plant would likely need a PSD permit and an operating permit under the Clean Air Act. A new combined-cycle natural gas power plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x.

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as attainment or unclassified under the Clean Air Act. All of the FPL preferred and potential power plant sites (FPL 2002) are in areas that are designated as attainment or unclassified for criteria pollutants.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a state, the State must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure that there is no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308[d][1]). If a new natural-gas-fired power station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Mandatory Class I Federal areas in Florida are Everglades National Park, Chassahowitzka National Wildlife Refuge, and St. Marks National Wildlife Refuge (40 CFR 81.407).

FPL estimates that a natural-gas-fired plant equipped with appropriate pollution control technology would have the following emissions (FPL 2001):

- sulfur oxides – 150 MT/yr (165 tons/yr)
- nitrogen oxides – 607 MT/yr (669 tons/yr)
- carbon monoxide – 1402 MT/yr (1545 tons/yr)
- PM_{10} particulates – 89 MT/yr (98 tons/yr).

A natural-gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). Natural-gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal- and oil-fired plants, EPA did not determine that regulation of emissions of hazardous air pollutants from natural-gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

Impacts of emissions from a gas-fired plant would be clearly noticeable, but would not be sufficient to destabilize air resources as a whole. The overall air-quality impact for a new natural-gas-generating plant sited at an alternate Florida site is considered MODERATE.

- **Waste**

The only significant waste generated at a natural gas-fired plant would be spent SCR catalyst, which is used for control of NO_x emissions. The spent catalyst, estimated to be approximately 31 m^3/yr (1100 ft^3/yr), would be regenerated or disposed of offsite. The 31 m^3/yr estimate was scaled by the staff from a comparable number in the ER for McGuire Nuclear Station Units 1 and 2 prepared by Duke Energy corporation (Duke 2001). In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in few combustion by-products because of the clean nature of the fuel. Other than spent SCR catalyst, waste generation at an operating gas-fired plant would be largely limited to typical office wastes. Construction-related debris would be generated during construction activities. Overall, the waste impacts are characterized as SMALL for a newly constructed natural-gas-fired plant.

- **Human Health**

In the GEIS, the staff identified cancer and emphysema as potential health risks from natural-gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. For a plant sited in Florida, NO_x emissions would be regulated by FDEP. Human health effects are not expected to be detectable or are expected to be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of a newly constructed natural gas-fired plant are considered SMALL.

- **Socioeconomics**

Construction of a natural-gas-fired plant would take approximately 3 years. Peak employment could be up to 700 workers (FPL 2001). The staff assumed that construction would take place while St. Lucie continues operation and would be completed by the time St. Lucie permanently ceases operations. During construction, the communities immediately surrounding the plant site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from more distant communities. After construction, the communities would be impacted by the loss of jobs. The current St. Lucie work force (929 workers) would decline through a decommissioning period to a minimal maintenance size. The new natural-gas-fired plant would provide a new tax base at an alternate Florida site and provide approximately 125 permanent jobs (FPL 2001). Siting at an alternate Florida site would result in the loss of the nuclear plant tax base in St. Lucie County and associated employment. These losses would have SMALL socioeconomic impacts, given the moderate (10 percent) proportion of the tax base in St. Lucie County attributable to St. Lucie (see Section 8.1.7).

In the GEIS, the staff concluded that socioeconomic impacts from constructing a natural-gas-fired plant would not be very noticeable and that the small operational work force would have the lowest socioeconomic impacts of any nonrenewable technology (NRC 1996).

Compared to the coal-fired and nuclear alternatives, the smaller size of the construction work force, the shorter construction time frame, and the smaller size of the operations work force would mitigate socioeconomic impacts.

Transportation impacts associated with construction personnel commuting to the plant site would depend on the population density and transportation infrastructure in the vicinity of the site. The impacts can be classified as MODERATE. Impacts associated with operating personnel commuting to the plant site would be SMALL. Overall, socioeconomic impacts from construction of a natural-gas-fired plant would be MODERATE.

Alternatives

- **Aesthetics**

The turbine buildings, exhaust stacks (approximately 61 m [200 ft] tall), cooling towers, and the plume from the cooling towers would be visible from offsite during daylight hours. The gas pipeline compressors also would be visible. Noise and light from the plant would be detectable offsite. If a new electric power transmission line is needed, the aesthetic impact could be as much as LARGE. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with a replacement natural-gas-fired plant at an alternate Florida site are categorized as MODERATE to LARGE, with site-specific factors determining the final categorization.

- **Historic and Archaeological Resources**

A cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

- **Environmental Justice**

Environmental impacts on minority and low-income populations associated with a replacement natural-gas-fired plant built at an alternate Florida site would depend upon the site chosen and the nearby population distribution. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of St. Lucie would result in the loss of approximately 929 operating jobs. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, St. Lucie is located in a relatively urban area with many employment possibilities. St. Lucie County would also experience a loss of property tax revenue, which could affect its ability to provide services and programs. However, these losses would likely have SMALL environmental justice impacts, given the moderate proportion of the tax base in St. Lucie County attributable to St. Lucie (see Section 8.1.3). Overall, impacts are expected to be SMALL.

8.2.2.2 Once-Through Cooling System

The environmental impacts of constructing a natural-gas-fired generation system at an alternate Florida location using a once-through cooling system are similar to the impacts for a natural gas-fired plant using closed-cycle cooling with cooling towers. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-5 summarizes the incremental differences.

Table 8-5. Summary of Environmental Impacts of Natural-Gas-Fired Generation with Once-Through Cooling at an Alternate Florida Site

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

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). All of these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to the NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent volatility in prices of natural gas and electricity have made new nuclear power

plant construction more attractive from a cost standpoint. Additionally, Entergy Nuclear, a subsidiary of Entergy Corporation, announced that it will prepare an application for an early site permit for a new advanced nuclear power plant under the procedures in 10 CFR Part 52, Subpart A (Entergy Corporation 2002). For the preceding reasons, construction of a new nuclear power plant at an alternate Florida site using both closed- and open-cycle cooling is considered in this section. The staff assumed that the new nuclear plant would have a 40-year lifetime.

The NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of St. Lucie, which has a capacity of 1678 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using closed-cycle cooling with cooling towers is presented in Section 8.2.3.1 and using once-through cooling in Section 8.2.3.2.

8.2.3.1 Closed-Cycle Cooling System

The overall impacts of the nuclear generating system are discussed in the following sections. The impacts are summarized in Table 8-6. The extent of impacts will depend on the location of the particular site selected.

- **Land Use**

Land-use requirements at an alternate Florida site would be approximately 200 to 400 ha (500 to 1000 ac) (NRC 1996). Additional land could be needed for an electric power transmission line, a rail spur to bring construction materials to the plant site, and/or pipelines to supply cooling-water intake and discharge. For an alternative coal-fired plant, the FPL ER (FPL 2001) estimates that these activities could impact up to 380 ha (940 ac). A similar land impact is likely for a nuclear plant. Depending particularly on transmission line routing, siting a new nuclear plant at an alternate Florida site could result in MODERATE to LARGE land-use impacts.

There would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel for St. Lucie.

- **Ecology**

A new nuclear plant would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Intake and discharge of cooling water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of an electric power transmission line would have ecological impacts. There would be some impact on terrestrial ecology from cooling tower drift. Overall, the ecological impacts at an alternate Florida site would be MODERATE to LARGE.

- **Water Use and Quality**

Cooling water would likely be withdrawn from a surface-water body. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by FDEP through a NPDES permit. Use of groundwater for a nuclear plant at an alternate site is a possibility. Groundwater withdrawal could require a permit. There would be a consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation would likely occur during construction (NRC 1996). Overall, impacts are considered SMALL to MODERATE.

- **Air Quality**

Construction of a new nuclear plant would result in fugitive emissions during the construction process. Exhaust emissions would come from vehicles and motorized equipment during the construction process and after operation commences. An operating nuclear plant would have minor air emissions associated with diesel generators. These emissions would be regulated by FDEP. Overall, emissions and associated impacts are considered SMALL.

- **Waste**

The waste impacts associated with operation of a nuclear power plant are set forth in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. In addition to the impacts shown in Table B-1, construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts are considered SMALL.

Table 8-6. Summary of Environmental Impacts of New Nuclear Generation Using Closed-Cycle Cooling at an Alternate Florida Site

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Requires approximately 200 to 400 ha (500 to 1000 ac) for the plant. Up to 380 ha (940 ac) for a new electric power transmission line, rail spur, and cooling-water intake/discharge pipelines.
Ecology	MODERATE to LARGE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and electric power transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface-water body. Discharges would be regulated by FDEP.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amounts of emissions from diesel generators, vehicles, and possibly other sources during operation.
Waste	SMALL	Waste impacts for an operating nuclear power plant are set forth in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Debris would be generated and removed during construction.
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set forth in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
Socioeconomics	MODERATE to LARGE	During construction, impacts would be MODERATE to LARGE. Up to 2500 workers during the peak of the 5-year construction period. Operating work force assumed to be similar to St. Lucie. Impacts at a rural location could be LARGE. St. Lucie County would experience loss of tax base and employment with SMALL impacts. Transportation impacts associated with commuting construction workers could be MODERATE to LARGE. Transportation impacts during operation would be SMALL to MODERATE.
Aesthetics	MODERATE to LARGE	Containment buildings, cooling towers, and the plumes from cooling towers would be visible from offsite. No exhaust stacks would be needed. Daytime visual impact could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated. Potential LARGE impact if a new electric power transmission line is needed.

Table 8-6. (cont'd)

Impact Category	Impact	Comment
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts will vary depending on population distribution and makeup at the site. St. Lucie County would lose tax revenue and jobs, however, impacts on minority and low-income populations would likely be SMALL.

- **Human Health**

Human health impacts for an operating nuclear power plant are set forth in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Overall, human health impacts are considered SMALL.

- **Socioeconomics**

The construction period and the peak work force associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantified data, the staff assumed a construction period of 5 years and a peak work force of 2500. The staff assumed that construction would take place while the existing St. Lucie units continue operation and would be completed by the time St. Lucie permanently ceases operations. During construction, the communities surrounding the plant site would experience demands on housing, transportation, and public services that could have MODERATE to LARGE impacts. These impacts would be tempered by construction workers commuting to the site from more distant communities. In the GEIS, the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction work force would need to move to the area to work (NRC 1996). Socioeconomic impacts at a rural site could be LARGE. After construction, the communities would be impacted by the loss of the construction jobs. The replacement nuclear units are assumed to have an operating work force comparable to the 929 workers currently working at St. Lucie. Transportation impacts related to commuting of plant operating personnel are considered SMALL to MODERATE. The communities around St. Lucie would experience the impact of St. Lucie operational job loss and St. Lucie County would experience the loss of tax base. However, the socioeconomic impacts would likely be SMALL (see Section 8.1.7).

- **Aesthetics**

The containment buildings for a replacement nuclear power plant, other associated buildings, the cooling towers, and the plume from the cooling towers would be visible during daylight

hours. Natural draft towers could be up to 160 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact. Visual impacts of buildings and structures could be mitigated by landscaping and selecting a color that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. There would also be a significant aesthetic impact if a new electric power transmission line were needed. No exhaust stacks would be needed.

Noise from operation of a replacement nuclear power plant would potentially be audible offsite in calm wind conditions or when the wind is blowing in the direction of the listener. Mitigation measures, such as reduced or no use of outside loudspeakers, could be employed to reduce noise level and keep the impact SMALL to MODERATE.

Overall, the aesthetic impacts can be categorized as MODERATE; however, the impact could be LARGE if a new electric power transmission line is needed to connect the plant to the power grid.

- **Historic and Archaeological Resources**

A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

Environmental impacts on minority and low-income populations associated with a replacement nuclear plant built at an alternate Florida site would depend upon the site chosen and the nearby population distribution. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of St. Lucie would result in the loss of approximately 929 operating jobs. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, St. Lucie is located in a relatively urban area with many employment possibilities. St. Lucie County would experience a loss of property tax revenue that could affect its ability to provide services and programs. However, these losses would likely have SMALL environmental justice impacts, given the moderate (10 percent) proportion of the tax base in

St. Lucie County attributable to the St. Lucie plant (see Section 8.1.7). Overall, impacts are expected to be SMALL.

8.2.3.2 Once-Through Cooling System

The environmental impacts of constructing a nuclear power plant at an alternate Florida site using once-through cooling are similar to the impacts for a nuclear power plant using closed-cycle cooling with cooling towers. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

Table 8-7. Summary of Environmental Impacts of New Nuclear Generation Using Once-Through Cooling at an Alternate Florida Site

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

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the St. Lucie Units 1 and 2 OLs. FPL currently purchases power from other generators. Overall, Florida is a net importer of electricity.

FPL includes future power purchases in its *Ten Year Power Plant Site Plan* (FPL 2002). The Plan indicates how FPL will meet customers' energy needs through existing generation, customer demand-side options, short-term purchase power transactions, and new generating resources constructed by FPL. The 2002 Plan shows power purchases of 2403 MW for the

summer of 2002, dropping to 1757 MW for the summers of 2005 and 2006, and then decreasing further to 382 MW in the summers of 2010 and 2011 (FPL 2002). FPL purchases additional capacity in the short-term power market as necessary.

Imported power from Canada or Mexico is unlikely to be available for replacement of St. Lucie capacity. In Canada, 62 percent of the country's electricity capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2002). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (DOE/EIA 2002). Canada's nuclear generation capacity is projected to increase by 2020, but its share of electric power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (DOE/EIA 2002). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 47.9 billion kWh in year 2000 to 66.1 billion kWh in year 2005 and then gradually decrease to 47.4 billion kWh in year 2020 (DOE/EIA 2001a). On balance, it appears unlikely that electricity imported from Canada or Mexico would be able to replace the St. Lucie capacity.

If power to replace St. Lucie capacity were to be purchased from sources within the United States or a foreign country, the generating technology likely would be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the impacts associated with the purchased electrical power alternative to renewal of the St. Lucie OLs. Under the purchased power alternative, the environmental impacts of imported power would still occur, but would be located elsewhere within the region, nation, or another country.

If implemented, the purchase power alternative could necessitate adding as much as 500 km (300 mi) of electric power transmission lines to import power to central Florida (FPL 2001). Assuming a 110-m (350-ft) right-of-way, the lines could impact up to 5140 ha (12,700 ac) and have MODERATE to LARGE land-use and aesthetic impacts.

8.2.5 Other Alternatives

Other generation technologies are discussed in the following sections.

8.2.5.1 Oil-Fired Generation

The EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States through the year 2020 because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). Oil-fired operation is more expensive than coal, natural gas, or nuclear generation alternatives. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than other generation alternatives. The high cost of oil has prompted a steady decline in its use for electricity generation. In Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 49 ha (120 ac) (NRC 1996). Operation of oil-fired plants would have environmental impacts

(including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

8.2.5.2 Wind Power

Most of Florida is in a wind power Class 1 region (average wind speeds at 9-m (30-ft) elevation of 0 to 4.4 m/s (9.8 mph). Class 1 has the lowest potential for wind energy generation (DOE 2002a). Wind turbines are economical in wind power Classes 4 through 7 (average wind speeds of 5.6 to 9.4 m/s [12.5 to 21.1 mph] [DOE 2002a]). Wind turbines typically operate at a 25 to 35 percent capacity factor compared to 80 to 95 percent for a base-load plant (NWPPC 2000). As of December 31, 2000, there were no grid-connected wind power plants in Florida (NREL 2001). Ten offshore wind power projects are currently operating in Europe, but none have been developed in the United States. The European plants together provide approximately 170 MW, which is far less than the electrical output of St. Lucie (British Wind Energy Association 2002). For the preceding reasons, the staff concludes that locating a wind-energy facility on or near the St. Lucie site or offshore as a replacement for St. Lucie generating capacity would not be economically feasible given the current state of wind energy generation technology.

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies, photovoltaic and thermal, cannot currently compete with conventional fossil-fueled technologies in grid-connected applications due to higher capital costs per kilowatt of capacity. The average capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for solar thermal systems is about 25 percent to 40 percent (NRC 1996). Energy storage requirements limit the use of solar-energy systems as base-load electricity supply.

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high: 14,000 ha (55 mi^2) per 1000 MW(e) for photovoltaic (NRC 1996) and approximately 5700 ha (22 mi^2) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric system would fit at the St. Lucie site, and both would have large environmental impacts at an alternate site.

The St. Lucie site receives approximately 4 to 5 kWh of direct normal solar radiation per square meter per day compared to 7 to 8 kWh of solar radiation per square meter per day in areas of the western United States such as California, which are most promising for solar technologies (DOE/EIA 2000). Because of the natural resource impacts (land and ecological), the area's relatively low rate of solar radiation, and high cost, solar power is not deemed a feasible base-load alternative to renewal of the St. Lucie OLs. Some onsite-generated solar power, e.g., from

rooftop photovoltaic applications, may substitute for electric power from the grid. Implementation of solar generation on a scale large enough to replace St. Lucie would likely result in LARGE environmental impacts.

8.2.5.4 Hydropower

Florida has an estimated 43 MW of undeveloped hydroelectric resource (INEEL 1998). This amount is significantly less than needed to replace the 1678 MW(e) capacity of St. Lucie. As stated in Section 8.3.4 of the GEIS, hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about land requirements, destruction of natural habitat, and alteration of natural river courses. EIA states that potential sites for hydroelectric dams have already been largely established in the United States, and environmental concerns are expected to prevent the development of any new sites in the future (DOE/EIA 2002). In the GEIS, the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e) (NRC 1996). Replacement of St. Lucie generating capacity would require flooding more than this amount of land. Due to the relatively low amount of undeveloped hydropower resource in Florida and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace St. Lucie, the staff concludes that local hydropower is not a feasible alternative to renewal of the St. Lucie OLs. Any attempts to site hydroelectric facilities large enough to replace St. Lucie would result in LARGE environmental impacts.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for base-load power where available. However, geothermal technology is not widely used as base-load generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. There is no feasible eastern location for geothermal capacity to serve as an alternative to St. Lucie. The staff concludes that geothermal energy is not a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.6 Wood Waste

A wood-burning facility can provide base-load power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent energy conversion efficiency (NRC 1996). The energy conversion efficiency of a conventional fossil-fired plant is on the order of 35 percent. The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction

impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a base-load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and relatively low energy conversion efficiency, the staff has determined that wood waste is not a feasible alternative to renewing the St. Lucie OLs.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001b). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. The initial capital costs for municipal solid waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is due to the need for specialized waste-separation and -handling equipment for municipal solid waste (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills with lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001b).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters and/or scrubbers (DOE/EIA 2001b).

Currently, there are approximately 102 waste-to-energy plants operating in the United States. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2001). The staff concludes that generating

electricity from municipal solid waste would not be a feasible alternative to replace the 1678-MW(e) base-load capacity of St. Lucie and, consequently, would not be a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including crops, crops converted to a liquid fuel such as ethanol, and crops (including wood waste) that have been converted to a gas. In the GEIS, the staff stated that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a base-load plant such as St. Lucie (NRC 1996). For these reasons, such fuels do not offer a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.9 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. These are commercially available today at a cost of approximately $4500 per kW of installed capacity (DOE 2002b). Higher-temperature second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations. DOE has a performance target that by 2003, two second-generation fuel cell technologies using molten carbonate and solid oxide technology, respectively, will be commercially available in sizes up to approximately 3 MW at a cost of $1000 to $1500 per kW of installed capacity (DOE 2002b). For comparison, the installed capacity cost for a natural-gas-fired combined-cycle plant is approximately $456 per kW (DOE/EIA 2001a). As market acceptance and manufacturing capacity increase, natural-gas-fueled fuel cell plants in the 50- to 100-MW range are projected to become available. At the present time, however, fuel cells are not economically or technologically competitive with other alternatives for base-load electricity generation. Fuel cells are, consequently, not a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.10 Delayed Retirement

FPL has no current plans to retire any existing generating units. For this reason, delayed retirement of FPL generating units would not be a feasible alternative to renewal of the St. Lucie OLs.

8.2.5.11 Utility-Sponsored Conservation

FPL has developed residential, commercial, and industrial programs to reduce both peak demands and daily energy consumption. These programs are commonly referred to as demand-side management (DSM). FPL's DSM programs through 2001 have resulted in a cumulative summer peak reduction of approximately 2790 MW at the meter (FPL 2002). FPL's additional incremental summer peak reduction goals attributable to DSM programs are 269 MW at the meter for 2002 increasing to 765 MW by 2009 (FPL 2002). These goals have been approved by the Florida Public Service Commission (FPL 2001).

FPL's current DSM program includes the following components (FPL 2002):

- Residential Conservation Service – This is an energy audit program designed to assist residential customers in understanding how to make their homes more energy-efficient through the installation of conservation measures and practices.

- Residential Building Envelope – This program encourages the installation of energy-efficient ceiling insulation in residential dwellings that use whole-house electric air conditioning.

- Duct System Testing and Repair – This program encourages demand and energy conservation through the identification of air leaks in whole-house air conditioning duct systems and the repair of those leaks by qualified contractors.

- Residential Air Conditioning – This program is designed to encourage customers to purchase higher-efficiency central cooling and heating equipment.

- Residential Load Management (On Call) – This program offers load control of major appliances and household equipment to residential customers in exchange for monthly electric bill credits.

- New Construction (BuildSmart) – This program encourages the design and construction of energy-efficient homes that cost-effectively reduce FPL's coincident peak demand and energy consumption.

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- Business Energy Evaluation – This program encourages energy efficiency in both new and existing commercial and industrial facilities by identifying DSM opportunities and providing recommendations to the customer.

- Commercial/Industrial Heating, Ventilating, and Air Conditioning – This program encourages the use of high-efficiency heating, ventilating, and air conditioning systems in commercial and industrial facilities.

- Commercial/Industrial Efficient Lighting – This program encourages the installation of energy-efficient lighting measures in commercial and industrial facilities.

- Business Custom Incentive – This program encourages commercial and industrial customers to implement unique energy conservation measures or projects not covered by other FPL programs.

- Commercial/Industrial Load Control – This program reduces peak demand by controlling customer loads of 200 kW or greater during periods of extreme demand or capacity shortages in exchange for monthly electric bill credits.

- Commercial/Industrial Building Envelope – This program encourages the installation of energy-efficient building envelope measures such as window treatments and roof/ceiling insulation.

- Business on Call – This program offers load control of central air conditioning units to small, non-demand-billed and medium, demand-billed commercial and industrial customers in exchange for monthly electric bill credits.

FPL's DSM program also includes a variety of research and development activities (FPL 2002).

Historic and projected reduction in generation needs as a result of DSM programs have been credited in the FPL *Ten Year Power Plant Site Plan 2002-2011* (FPL 2002) to meet part of FPL's projected customer demand. Because these DSM savings are part of the long-range plan for meeting projected demand, they are not available offsets for St. Lucie. Therefore, the conservation option is not considered a reasonable replacement for the OL renewal alternative.

8.2.6 Combination of Alternatives

Even though individual alternatives might not be sufficient on their own to replace St. Lucie capacity due to the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective.

As discussed in Section 8.2, St. Lucie has a combined average net capacity of 1678 MW(e). For the natural-gas combined-cycle alternative, FPL assumed three 596-MW units in its ER

(FPL 2001) as potential replacements for the two St. Lucie nuclear units. The staff also assumed three 596-MW units as potential replacements for the two St. Lucie units in Section 8.2.2.

There are many possible combinations of alternatives. Table 8-8 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of 1192 MW(e) of combined-cycle natural-gas-fired generation (two 596-MW units) at an alternate Florida site using closed-cycle cooling, 298 MW(e) purchased from other generators, and 298 MW(e) gained from additional DSM measures. The impacts associated with the combined-cycle natural-gas-fired units are based on the gas-fired generation impact assumptions discussed in Section 8.2.2, adjusted for the reduced generating capacity. While the DSM measures would have few environmental impacts, operation of the new natural-gas-fired plant would result in increased emissions (compared to the OL renewal alternative) and other environmental impacts. The environmental impacts associated with power purchased from other generators would still occur, but would be located elsewhere within the region, nation, or another country as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-8. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the St. Lucie OLs.

Table 8-8. Summary of Environmental Impacts for an Assumed Combination of Generating and Acquisition Alternatives

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	20 ha (50 ac) for power block, offices, roads, and parking areas. Additional impact for construction of an underground natural gas pipeline, electric power transmission line, and cooling-water intake/discharge pipelines.
Ecology	MODERATE to LARGE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface-water body. Discharge of cooling tower blowdown will have impacts.
Air Quality	MODERATE	Sulfur oxides: 100 MT/yr (110 tons/yr) Nitrogen oxides: 406 MT/yr (448 tons/yr) Carbon monoxide: 939 MT/yr (1035 tons/yr) PM_{10} particulates: 59 MT/yr (65 tons/yr)

		Some hazardous air pollutants.
Waste	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.
Human Health	SMALL	Impacts considered to be minor.
Socioeconomics	MODERATE	Construction impacts depend on location, but could be significant if location is in a rural area. St. Lucie County would experience loss of tax base and employment with potentially SMALL impacts. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	MODERATE to LARGE	MODERATE impact from plant, stacks, and cooling towers and associated plumes. Additional impact that could be LARGE if a new electric power transmission line is needed.
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts vary depending on population distribution and makeup at site. St. Lucie County would lose tax revenue and jobs; however, the impacts on minority and low-income populations would likely be SMALL.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the St. Lucie OLs, are SMALL for all impact categories (except collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned). Alternative actions, i.e., no-action alternative (discussed in Section 8.1), new generation alternatives (from coal, natural gas, and nuclear discussed in Sections 8.2.1 through 8.2.3, respectively), purchased electrical power (discussed in Section 8.2.4), alternative technologies (discussed in Section 8.2.5), and the combination of alternatives (discussed in Section 8.2.6) were considered.

The no-action alternative would result in decommissioning St. Lucie Units 1 and 2 and would have SMALL environmental impacts for all impact categories. The no-action alternative is a conceptual alternative resulting in a net reduction in power production, but with no environmental impacts assumed for replacement power. In actual practice, the power lost by not renewing the St. Lucie Unit 1 and 2 OLs would likely be replaced by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than St. Lucie, or (4) some combination of these options. This replacement power would produce additional environmental impacts as discussed in Section 8.2.

For each of the new generation alternatives (coal, natural gas, and nuclear), the environmental impacts would not be less than the impacts of license renewal. For example, the land-

disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of St. Lucie. The impacts of purchased electrical power would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time, and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the OLs for St. Lucie.

8.4 References

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

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

10 CFR 50. Code of Federal Regulations, Title 40, Protection of Environment Part 50, "National Primary and Secondary Ambient Air Quality Standards."

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

10 CFR 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR 50. Code of Federal Regulations, Title 40, Protection of Environment, Part 50, "National Primary and Secondary Ambient Air Quality Standards.

40 CFR 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

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

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