CHAPTER 5
ENVIRONMENTAL IMPACTS OF STATION OPERATION

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

°	degree
°C	degree Celsius
°F	degree Fahrenheit
ac.	acre
AEA	Atomic Energy Act of 1954
ALARA	As Low As Reasonably Achievable
AP1000	Westinghouse Electric Company, LLC, AP1000 Reactor
bgs	below ground surface
BLS	Bureau of Labor Statistics
BMP	best management practice
BOD_5	5-day biochemical oxygen demand
BTA	best technology available
Btu	British thermal unit
Btu/hr	British thermal unit per hour
BWR	boiling water reactor
C-14	radiocarbon
CA^{+2}	calcium
CAA	Clean Air Act
CDC	Center for Disease Control
CEQ	Council on Environmental Quality
CFBC	Cross Florida Barge Canal

ACRONYMS AND ABBREVIATIONS (CONTINUED)

CFG	Marjorie Harris Carr Cross Florida Greenway
CFR	Code of Federal Regulations
Ci	Curie
Cl^-	chlorine
cm	centimeter
CO	carbon monoxide
COL	Combined License
COLA	Combined License Application
CPI	consumer price index
CREC	Crystal River Energy Complex
CWA	Clean Water Act
CWIS	cooling water intake structure
D&D	decontamination and dismantlement
D/Q	relative deposition
dBA	decibel (A-weighted scale)
DCD	Westinghouse Electric Company, LLC, AP1000 Design Control Document for the certified design as amended
DOE	U.S. Department of Energy
DSN	discharge serial number
DWRM2	District Wide Regulation Model, Version 2
E&SCP	Erosion and Sedimentation Control Plan
EAB	exclusion area boundary
EHSS	Environmental Health and Safety Services
EHV	extra high voltage

ACRONYMS AND ABBREVIATIONS (CONTINUED)

EMF	electromagnetic field
ER	Environmental Report
ESO	Environmental Support Organization
ESP	Early Site Permit
ESRP	Environmental Standard Review Plan
F	fluorine
F.A.C.	Florida Administrative Code
F.S.	Florida Statute
FDACS	Florida Department of Agriculture and Consumer Services
FDCA	Florida Department of Community Affairs
FDEP	Florida Department of Environmental Protection
Fe	iron
FEIS	Final Environmental Impact Statement
FIPS	Federal Information Processing Standards
FLUCCS	Florida Land Use and Cover Classification System
FLUM	future land use map
FMSF	Florida Master Site File
FNAI	Florida Natural Areas Inventory
ft.	foot
ft/sec	foot per second
$ft.^3$	cubic foot
ft^3/sec	cubic foot per second
FWCC	Florida Fish and Wildlife Conservation Commission

ACRONYMS AND ABBREVIATIONS (CONTINUED)

GAE	granulomatious amoebic encephalitis
GBq	gigabecquerel
GEIS	Generic Environmental Impact Statement
GI-LLI	gastrointestinal tract-lower large intestine wall
gpd	gallon per day
gpm	gallon per minute
ha	hectare
HCl	hydrogen chloride
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HLW	high-level waste
hr/yr	hour per year
I-129	Iodine-129
I-131	Iodine-131
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ID	identification
in.	inch
kg	kilogram
kg/ha/mo	kilogram per hectare per month
kg/yr	kilogram per year
km	kilometer
km^2	square kilometer
Kr-85	Krypton-85

ACRONYMS AND ABBREVIATIONS (CONTINUED)

kV	kilovolt
L/yr	liter per year
lb/ac/mo	pound per acre per month
lb/hr	pound per hour
LCFS	LNP to proposed Central Florida South Substation
LCR	LNP to CREC 500-kV switchyard
LLW	low-level waste
LNP	proposed Levy Nuclear Plant Units 1 and 2
LNP 1	proposed Levy Nuclear Plant Unit 1
LNP 2	proposed Levy Nuclear Plant Unit 2
LPC	LNP to proposed Citrus Substation
lpm	liter per minute
LWR	light water reactor
m	meter
m/s	meter per second
m^3/s	cubic meter per second
m^3/yr	cubic meter per year
mg/kg	milligram per kilogram
mgd	million gallons per day
mi.	mile
mld	million liters per day

ACRONYMS AND ABBREVIATIONS (CONTINUED)

µm	micrometer
mrad	milli-radiation absorbed dose
mrad/day	milli-radiation absorbed dose per day
mrem	milliRoentgen equivalent man
mrem/yr	milliRoentgen equivalent man per year
MSDS	material safety data sheet
msl	mean sea level
MT	metric ton
MW	megawatt
MW-yr	megawatt year
MWd/MTU	megawatt day per metric ton of uranium
MWe	megawatt electric
MWt	megawatt thermal
N/A	not applicable
Na^{+}	sodium
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NAVD88	North American Vertical Datum of 1988
NH_3	ammonia
NO_3^-	nitrate
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PAM	primary amoebic meningoencephalitis
PCB	polychlorinated biphenyl
PEF	Florida Power Corporation doing business as Progress Energy Florida, Inc.
person-rem	person-roentgen equivalent man
person-rem/yr	person-roentgen equivalent man per year
pH	hydrogen ion concentration
PM	particulate matter
PM_{10}	particulate matter of 10 micrometers and smaller
PM_{25}	particulate matter of 25 micrometers and smaller
ppm	part per million
PPSA	Power Plant Siting Act
PPWMP	Pollution Prevention and Waste Minimization Program
PSD	Prevention of Significant Deterioration
PUD	planned unit development
PWR	pressurized water reactor
Ra-226	Radium-226
rad/day	radiation absorbed dose per day
RAT	reserve auxiliary transformer
RCA	radiologically controlled area
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man

ACRONYMS AND ABBREVIATIONS (CONTINUED)

RI	radio interference
RIMS	Regional Input-Output Modeling System
Rn-222	Radon-222
RO	reverse osmosis
ROW	right-of-way
RR	reference reactor
RRY	reference reactor year
Ru-106	Ruthenium-106
SCA	Site Certification Application
SHPO	State Historic Preservation Officer
SO_4^{-2}	sulfate
SO_2	sulphur dioxide
SO_x	sulphur oxide
SSC	structures, systems, and components
su	standard unit
Sv/yr	Sievert per year
SWFWMD	Southwest Florida Water Management District
SWP3	Stormwater Pollution Prevention Plan
Tc-99	Technetium-99
TEDE	total effective dose equivalent
Th-230	Thorium-230
tpy	ton per year

ACRONYMS AND ABBREVIATIONS (CONTINUED)

TRU	transuranic
TSD	treatment, storage, disposal
TSS	total suspended solids
TVI	television interference
U-235	uranium-235
U-238	uranium-238
U_3O_8	uranium oxide
UF_6	uranium hexafluoride
UFC	uranium fuel cycle
UHS	ultimate heat sink
UO_2	uranium dioxide
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compound
Westinghouse	Westinghouse Electric Company, LLC
X/Q	atmospheric dilution factor

5.0 ENVIRONMENTAL IMPACTS OF STATION OPERATION

This chapter of the Environmental Report (ER) presents the environmental impacts of operation and is organized by the following sections:

- ER Section 5.1 — Land Use Impacts
- ER Section 5.2 — Water-Related Impacts
- ER Section 5.3 — Cooling System Impacts
- ER Section 5.4 — Radiological Impacts of Normal Operation
- ER Section 5.5 — Environmental Impacts of Waste
- ER Section 5.6 — Transmission System Impacts
- ER Section 5.7 — Uranium Fuel Cycle Impacts and Transportation Impacts
- ER Section 5.8 — Socioeconomic Impacts
- ER Section 5.9 — Decommissioning
- ER Section 5.10 — Measures and Controls to Limit Adverse Impacts during Operation
- ER Section 5.11— Cumulative Impacts Related to Station Operation

As discussed in ER Chapter 3, construction of the proposed Levy Nuclear Plant Units 1 and 2 (LNP) will result in a large industrial facility similar in general appearance to most nuclear power generating facilities. ER Subsection 3.1.1 discusses in detail the location of the two reactors and ancillary power production support facilities (comprising approximately 121 hectares [ha] (300 acres [ac.]) near the center of the site.

Commercial operation is scheduled to commence in 2016 or 2017 for the proposed Levy Nuclear Plant Unit 1 (LNP 1) and in 2017 or 2018 for proposed Levy Nuclear Plant Unit 2 (LNP 2). As discussed in detail in ER Section 5.8, the LNP will require approximately 773 workers for operations. The ER conservatively assumes that Florida Power Corporation doing business as Progress Energy Florida, Inc. (PEF) will apply for license renewal for LNP 1 and LNP 2, which would extend their 40-year operation by an additional 20 years or until 2076 and 2077, respectively. Additionally, refueling outages will last approximately 25 to 30 days and require approximately 800 additional workers every 18 months.

Where relevant in discussions below, a single significance level of the potential effect (SMALL, MODERATE, or LARGE) is assigned to each analysis. This is consistent with the criteria that the NRC established in 10 Code of Federal Regulations (CFR) 51, Appendix B to Subpart A, Table B-1, Footnote 3, as follows:

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

5.1 LAND USE IMPACTS

This section describes the land use impacts of operation and is divided into three subsections that address the site and vicinity, transmission corridors and off-site areas, and historic properties, respectively. It evaluates the effects of plant operation in sufficient detail to determine the significance of potential land use impacts in the vicinity of the site. ER Subsections 4.1.1 and 4.1.2 provide a detailed discussion of land use changes during construction as a result of the physical presence of the major LNP on-site and off-site components, respectively. Many operational land use impacts, particularly on-site, are only an extension in time of the construction impact and, therefore, are not evaluated in this section. For example, the creation of the three stormwater ponds (A, B, and C [C1 and C2]) during construction and the corresponding change in land use from mixed forest lands and forested wetlands to lakes is discussed in detail in ER Subsection 4.1.1 and is not revisited in this section because the ponds will continue to be used during operation. This applies to all of the on-site components, while operational impacts from transmission corridors and off-site areas are discussed in ER Subsection 5.1.2.

As discussed further in ER Section 5.8, it is conservatively assumed that 100 percent of the 773 LNP operations workers will migrate into the region with their families resulting in an approximate population influx of 1925 people (773 new operations workers multiplied by 2.49) to the region and an additional 800 temporary workers will be needed for about 25 to 30 days every 18 months for refueling outages. For the purposes of this evaluation, it is assumed that the operations and outage workforces will primarily reside within the three counties closest to the LNP, as follows: Levy (28 percent), Citrus (30 percent), and Marion (35 percent). The remaining 7 percent will be distributed across the remaining five counties in the 80-kilometer (km) (50-mile [mi.]) region. The rationale for this assumed distribution is that the LNP site is located at the apex of these three surrounding counties, and there is sufficient availability of housing units to accommodate the operations workforce and their families. Nonetheless, because Levy County is relatively rural (see ER Section 2.1 and ER Subsection 2.2.1) and is lagging behind Marion and Citrus counties in terms of infrastructure and public services, this analysis of scenarios further assumes that the workers choosing to locate in Levy County will require new housing.

A summary of unavoidable adverse environmental impacts on land use that are predicted to occur as a result of plant operation is provided in ER Subsection 10.1.2. A summary of irreversible and irretrievable commitments of land use resources that are predicted to occur as a result of plant operations is provided in ER Section 10.2. Land use information at the LNP site and vicinity related to short-term uses and long-term productivity of the environment is provided in ER Section 10.3. A list of potential adverse environmental impacts from operation and potential measures and controls to limit these impacts is provided in ER Section 5.10.

5.1.1 THE SITE AND VICINITY

The land use impacts of the LNP station operation build on the site and vicinity information are presented in the following subsections:

- ER Subsection 3.4.1 describes the heat dissipation system, including type, location, size, and schedule of operation.
- ER Subsections 5.3.3.1 and 5.3.3.2 describe the LNP mechanical draft cooling towers, the length and duration of elevated plumes and salt drift/deposition predictions.
- ER Subsection 2.2.1.1 describes the appropriate U.S. Geological Survey (USGS)-based land use categories, tabulation of major uses, and absence of prime farmland.
- ER Subsection 5.4.4 provides information on the sensitivity of resident species (biota other than members of the public) to salts expected from effluents from the LNP cooling towers.
- ER Subsection 2.2.1.3 describes the highways, railroads, and utility right-of-ways (ROWs) and potential road crossings.

As a general rule, NUREG-1555 recognizes that land use changes evaluated in ER Subsection 4.1.1 are sufficient to cover most land use impacts on the site and vicinity because of the physical presence of the plant. Such land use changes on the site will not be altered during subsequent plant operation; therefore, the above referenced analyses of these changes should suffice for plant operation. For example, because plant construction pre-empts the exploitation of mineral resources, the analysis of this impact in ER Subsection 4.1.1.3 is adequate because the operational impact is only an extension in time of the construction impact. Other LNP land use components discussed primarily in ER Chapter 4 include the on-site land use changes such as the two units, three stormwater ponds, heavy haul road, construction access roads, and switchyard, and off-site indirect land use changes (see ER Subsection 4.1.1.1.2.1).

This subsection is limited to those direct restrictions, or limitations, placed on land use in the site vicinity as a result of the plant operation. It evaluates the potential impacts of plant operation on crops, vegetation, and transportation systems, and assesses the potential for cooling system impacts of sufficient magnitude such as fogging, icing, and drift damage that could result in land use changes.

5.1.1.1 Impacts on Crops, Vegetation, or Transportation Systems

This subsection addresses the potential impacts of LNP operation on crops, vegetation, and transportation systems to demonstrate that there will not be impacts that would be significant enough to result in a change in land use patterns in the site vicinity. As discussed in detail in ER Subsections 5.3.3.1 and 5.3.3.2 and summarized below, there is minimal potential for the makeup water and heat discharge systems to result in potential land use changes, and land use impacts from operation of the LNP cooling towers are expected to be SMALL for the presence of vapor plumes, the small amount of cooling tower drift and solids deposition, and plume fogging or icing.

5.1.1.1.1 Crop or Other Vegetation Impacts

The potential for adverse off-site impacts on land use attributable to the operation of the LNP cooling towers is expected to be minimal. Because the cooling towers will use saltwater from the Cross Florida Barge Canal (CFBC) for cooling, the potential exists for salt deposition to the surface. A small amount of the salt-containing particles in the cooling water will become entrained into the cooling tower exhaust as cooling tower “drift.” A detailed assessment of cooling tower drift and deposition from the proposed LNP 1 and LNP 2 mechanical draft cooling towers was performed (refer to ER Subsections 5.3.3.1.3 and 5.3.3.2.1), and the results indicated that the amount of deposition would be relatively minor and insufficient to cause adverse impacts on vegetation at any off-site location. The potential for impacts attributable to fogging and icing from cooling tower plumes was evaluated as described in ER Subsection 5.3.3.1.2. The results of that analysis indicated that there should be no occurrences of ground level fogging or icing at any off-site location.

The operation of the LNP cooling towers is expected to have only a SMALL impact on crops or vegetation at off-site locations in the vicinity of the site.

ER Sections 5.2 and 5.3 discuss cooling system impacts on the water supply, water quality, and aquatic and terrestrial ecosystems as a result of water withdrawal from the CFBC and reintroduction at the existing Crystal River Energy Complex (CREC) discharge canal before entering the Gulf of Mexico.

5.1.1.1.2 Transportation and "Special Case" Land Use Impacts

The increase in the number of workers required for the operation of the LNP will have minor long-term impacts on transportation facilities on-site and in the vicinity, as described in ER Subsection 2.2.1.3 and discussed in detail in ER Subsections 5.8.1.1 and 5.8.2.8. The peak operations workforce of 773 workers would result in a maximum of 1925 new residents in the vicinity, well below the peak construction workforce, if 100 percent of the operations workforce moved into the region. The Lincks and Associates, Inc., transportation study described in detail in ER Subsection 4.4.2.10 estimated a travel capacity of 40,800 trips in each direction along U.S. Highway 19. The study concludes that US-19 will operate at an acceptable level of service during the operation, and impacts on traffic, as a result of increased volume, are anticipated to be SMALL.

On-site plant roads will require very little maintenance because the roads will be paved. When maintenance or improvements are required, appropriate measures will be taken to minimize any disturbances. Maintenance-related access road traffic is expected to be limited and short in duration. Therefore, maintenance-related traffic is not expected to result in changes to nearby land use. Operational impacts from these new plant roads are expected to be SMALL.

As discussed in ER Subsection 4.1.1.1.2.1 and defined in NUREG-1555, there will be "special case" land use impacts (for example, operational impacts on floodplains) at the LNP site. As illustrated in Figure 4.1-4 and discussed further in ER Subsections 2.3.1.2.1.4 and 2.4.1.1.1.4, much of the site and much of the vicinity is located in the 100-year floodplain. The existing groundwater elevation near the main reactors and the cooling towers is 12.8 meters (m) (42 feet [ft.]) North American Vertical Datum of 1988 (NAVD88), while the overall property elevation varies from 12.5 m to 14.9 m (41 ft. to 49 ft.) NAVD88. After grading, the land around the reactors and cooling towers will be raised to elevation 15.2 m (50 ft.) NAVD88, while the switchyard and construction laydown areas in the periphery around the main plant building will be raised to 14.3 m (47 ft.) NAVD88. Because the ground elevation at the main reactors and the cooling towers will be raised 2.4 m (8 ft.) above the existing grade, these structures will be above the 100-year floodplain. As a result of the on-site grading and facility design plans noted above, the operational impacts on the 100-year floodplain are expected to be SMALL.

5.1.1.2 Long-Term Land Use Restrictions

Long-term changes in land use from operation of the LNP are summarized in Table 4.1-4 for on-site features. As summarized in ER Subsection 4.1.1.1.1 and shown in Table 4.1-4, a total of 50.8 ha (125.5 ac.) of mixed forest lands and 15.2 ha (37.6 ac.) of other agricultural land would be changed on-site at the LNP. Table 2.2-2 illustrates that these lands are not unique to the site or vicinity with mixed forest lands and other agricultural lands representing 28.6 percent and 3.9 percent of the vicinity, respectively. Because of the limited amount (under 75 ha [185 ac.]), less than 2 percent of such land or up to 500 ha (1236 ac.) in the vicinity, and the fact that these lands are not unique to the vicinity, the restrictions on the use of land (that is, farmlands or forests) are expected to be SMALL.

As described in detail in ER Subsections 2.2.1.1 and 2.2.1.5, long-term land use at the site will change from lands currently used as rural open lands, tree plantations, and cypress and zoned as Forestry/Rural Residential to Public Use to allow a nuclear power generating facility (References 5.1-001 and 5.1-002). During the operation of the LNP, one exclusion area boundary (EAB), which represents the combination of each individual unit's EAB, will be maintained for the two new reactors, as shown on Figures 2.1-1 and 2.1-2. Public use of the land within these boundaries will be restricted and the boundaries will be patrolled by PEF. As discussed in detail in ER Subsection 4.1.1.1.1, land use restrictions for the site are pending Florida Department of Community Affairs (FDCA) final approval of the Public Use zoning and future land use changes. The Levy County Board of County Commission adopted ordinances related to the Amendment on March 18, 2008, with effective dates pending either an FDCA final order or the Administration Commission finding the amendment adopted by the Levy County Board of County Commission to be in compliance with Section 163.3184 of the Florida Statutes (F.S.), after which the LNP site will be designated as Public Use. Public use provides for public buildings and grounds including public utilities, which are defined as gas, water, and electric, water power, well houses, electric substations, power generating facilities, sewerage, telephone facilities, utility poles and street lighting, and other similar equipment necessary for the furnishing of adequate services.

5.1.2 TRANSMISSION CORRIDORS AND OFF-SITE AREAS

This subsection assesses the direct impacts on land use resulting from operation and maintenance of the transmission corridors, access corridors, and off-site areas; it builds on the information found in ER Subsection 2.2.2.

5.1.2.1 Transmission Corridors

The LNP's new transmission system will be made up of four 500-kilovolt (kV) transmission lines that will leave the LNP switchyard and connect to the proposed Citrus Substation, the proposed Central Florida South Substation, and the CREC 500-kV switchyard. Additional system upgrades will be constructed by PEF to accommodate demand in the central and south Florida areas primarily served by the LNP. Detailed descriptions of the transmission line system are described in ER Subsection 2.2.2 and Section 3.7 with associated environmental impacts described in ER Subsection 4.1.2 and ER Section 5.6. Typical structure types, height, and span lengths of the proposed transmission line structures are provided in ER Section 3.7.

The actual ROW width and alignment within the corridors will depend on adjacent land uses, property boundaries, ownership patterns, structure types, and height and span lengths. Acreages of land uses and vegetative communities for the transmission line corridors are provided in ER Subsection 2.2.2.

PEF is seeking certification of the corridors pursuant to the Florida Electrical Power Plant Siting Act (PPSA), Chapter 403, F.S., and Chapter 62-17, Florida Administrative Code (F.A.C.). The certification provides for the centralized and coordinated permitting of the LNP, as well as the associated facilities, including the associated transmission lines included in this application. For linear facilities associated with an electrical power plant, such as the proposed transmission lines, the PPSA provides for the certification of "corridors," which is the area within which the associated linear facility ROW must be located. Certification under the PPSA is the sole license of the State of Florida, and nonfederal agency approval of the location of the LNP, associated facilities, and transmission corridors, and authorizes construction and maintenance of the transmission lines.

Maintenance activities for the transmission lines will consist of preventive and corrective measures. Although transmission lines normally require minimal maintenance, PEF will conduct annual inspections to ensure the safe and reliable operation using ground or aerial means.

In general, maintenance of the ROWs will consist of mowing, pruning, and removing trees (including danger trees), as well as herbicide treatments. Clearing will be determined by existing conditions, environmental constraints, and line design requirements. Vegetation in upland areas will be cleared to ground level. Vegetation in wetland areas will be cleared using restrictive clearing techniques. Restrictive wetland clearing will be done by hand, usually with chain saws, or with low-ground pressure shear or rotary machines to reduce soil compaction and damage to vegetation. These methods may be used alone or in combination, as may be necessary for specific sites. Pruning along the ROW edge will be performed to remove any overhanging branches in the easement area. Herbicides used on the transmission line ROW will include only those registered by the U.S. Environmental Protection Agency (USEPA) and which have state approval. Herbicide application rates and concentrations will be in accordance with label directions and will be carried out by a licensed applicator, meeting all federal, state, and local regulations.

Danger trees are any dead, diseased, damaged, or leaning trees standing outside the easement area that could interfere with or endanger the transmission lines and related facilities. Danger trees also will be removed in accordance with the guidelines above, except in wetlands, where the wetland tree removal guidelines described below will be followed.

The exact manner in which maintenance will be performed will depend on the location, type of terrain, and surrounding environment. Each area of the ROW will be addressed based on site-specific vegetation and habitat. Endangered or threatened species, if present, are considered and accommodated in the maintenance program.

Maintenance of the transmission line will be performed using various types of equipment. This equipment may consist of helicopters, bucket trucks, cranes, semi-trucks and support vehicles. Typical line maintenance operations may include insulator replacements, conductor repairs, shield wire repairs, grounding, and other activities associated with structures, conductors, and foundations. In general, PEF crews or authorized contractors will mobilize in-line trucks capable of supporting various operations. Once on-site, the crew will establish a safe working area and perform the required repair. When repairs require affecting environmentally sensitive areas, authorities will be notified of the proposed operation. When maintenance is required in environmentally sensitive areas where access and fill pads do not exist, temporary matting may be used to minimize damage to the areas during repairs.

Wherever the transmissions line will be constructed either adjacent to, or in proximity of existing ROW and/or existing planted pine, impacts on plant and animal populations as a result of maintenance and post-construction activities will be minimized. In those areas where the existing ROW will need to be widened to accommodate the transmission lines, maintenance practices for the new transmission lines will be similar to the initial clearing activities and are not expected to result in adverse impacts on plant and animal populations.

Neither the establishment of the transmission line ROW nor the construction of access roads is anticipated to increase the exposure of previously undisturbed areas to the public. The only vehicular traffic permitted will be that necessary for PEF routine maintenance activities. In areas where the transmission lines will be located either adjacent to, or in proximity of, existing transmission line ROW, the degree of public access is anticipated to remain unchanged. Locked gates will be provided at all points where a transmission line access road intersects previously fenced property. Other access restrictions will be coordinated with the underlying fee owners.

PEF currently maintains a ROW utilization program that will consider requests for multiple uses. Multiple uses within a transmission line ROW typically can include agricultural operations (for example, grazing, orange groves, and row crops), controlled landscaping, and other activities that do not interfere with PEF’s use of the ROW for the safe and reliable operation and maintenance of the transmission lines. In areas where the new transmission lines will be located within, adjacent to, or in proximity of an existing transmission line ROW, multiple uses consistent with those currently allowed will generally be acceptable.

Because maintenance will follow established industry procedures and conform to any applicable regulations, impacts associated with routine ROW maintenance are anticipated to be SMALL.

5.1.2.2 Off-Site Areas

Table 4.1-5 summarizes the off-site land use changes anticipated by construction of the LNP by general component. Figure 4.1-2 shows that a total of 441.1 ha (1090 ac.), or 1.5 percent of the LNP vicinity area, will be affected during construction. The majority of these lands will be returned to their preconstruction use during operation, with the exception of the heavy haul road, rail line, anticipated barge slip, and access road south from the site, and the makeup water pumphouse at the intake location. Construction and erosion control measures and stormwater controls, as discussed in ER Subsection 4.2.1, apply to this subsection, and will be followed during clearing, preparation, and construction activities. If necessary, best management practices (BMPs) used during construction will be maintained to minimize erosion and sedimentation in off-site areas. Maintenance activities for these off-site areas will consist of preventive and corrective measures, if required. Measures may include mowing, pruning, removing trees, and herbicide treatments. Because the lands tabulated for these components in Table 4.1-4 are not unique to the vicinity, impacts from operation on land use in the LNP vicinity are expected to be SMALL.

5.1.3 HISTORIC PROPERTIES

There are no known archaeological or historic sites on the LNP site and associated facilities described in ER Subsection 2.5.3, though field surveys of the transmission lines and rail corridors are pending route finalization. It is unlikely that unidentified resources would be found on the LNP site during facility operation. In the event that a project or work activity during facility operation inadvertently uncovered an archaeological site or other historical artifacts, activities in the site area will be halted, and the appropriate PEF Environmental Support Organization (ESO) for the LNP project will be contacted. For the LNP project the ESO is the Environmental Health and Safety Services (EHSS). A cultural resource assessment will be performed and PEF, through EHSS, will consult with the Florida State Historic Preservation Officer (SHPO), as necessary, to determine appropriate steps to be taken prior to resuming site activities. PEF will coordinate directly with the Florida SHPO to determine appropriate mitigation or other measures, as needed, in accordance with federal and state regulations and PEF policy.

The technical report describing the results of the 2007 and 2008 architectural and archaeological surveys will be submitted to the Florida SHPO for concurrence. It is anticipated that no historic properties will be affected by the operation of the LNP site and associated facilities or the impacts are expected to be SMALL (see ER Subsection 2.5.3.1).

5.1.4 REFERENCES

5.1-001 Levy County, “Levy County Comprehensive Plan Future Land Use Element (Data and Analysis),” adopted June 1999.

5.1-002 Progress Energy Florida and Engelhardt, Hammer & Associates, “Application for Large-scale Future Land Use Map and Text Amendments,” March 1, 2007.

5.2 WATER-RELATED IMPACTS

The LNP site will be located in Levy County, Florida, near the Gulf of Mexico. Hydrologic alterations may result from construction of the site and operation of the reactor units. The LNP will require a supply of freshwater for general plant operation, a supply of freshwater or saltwater for cooling, and a location for discharge of cooling water, which is not evaporated in the cooling process.

This section describes the analysis and assessment of the changes to surface water and groundwater that could occur during plant operation. ER Subsection 5.2.1 describes the plant water supply and anticipated alterations to hydrologic features and their potential effects on other users that may result from operation of the LNP. ER Subsection 5.2.2 describes the anticipated impacts on water use in the vicinity of the LNP as a result of plant water use.

Hydrologic alterations and impacts on water use were evaluated with regards to domestic, commercial, municipal, agricultural, industrial, mining, recreation, navigation, and hydroelectric power. Stormwater permits, water use permits, and effluent discharge permits will be developed during the facility permitting process to ensure that operational activities affecting surface water and groundwater quality groundwater withdrawals will comply with federal, state, regional, local, and affected Native American tribal agency water quality standards for effluents and receiving water bodies. Several agencies have been contacted regarding this Combined License Application (COLA) and have been consulted about hydrologic impacts. Contact information for these agencies is summarized in ER Section 1.2.

The topics discussed in this section include the following:

- Analysis of plant water needs and availability of water supply.
- Identification and description of hydrologic alterations resulting from proposed operational activities.
- The effects, description, and analysis of the hydrologic alterations on the water supply for other water users.
- Analysis of practices to minimize water use impacts.
- Conclusions of adequacy of the water supply.

5.2.1 HYDROLOGIC ALTERATIONS AND PLANT WATER SUPPLY

A number of environmental effects of operation were identified in ER Section 5.0. Of these, the withdrawal of water for general plant operation and for cooling water may cause hydrological alterations. The discharge of blowdown water may also cause hydrological alterations. Impacts related to the construction phase of project are described in ER Chapter 4.

The proposed project is to install and operate two new Westinghouse Electric Company, LLC (Westinghouse), AP1000 Reactors (AP1000) at the LNP site (Figure 5.2-1). As described in ER Subsection 3.3.1, service water cooling tower makeup water (to replace evaporation and drift), potable water supply, raw water supply, raw water to demineralizer, fire protection, service water strainer backwash, and media filter backwash would be taken from groundwater wells on the site. The proposed reactors would also require a large water supply for cooling processes. As described in ER Subsection 3.3.1, this water will be withdrawn from the CFBC and will be used for cooling tower evaporation, cooling tower blowdown, and pump strainer backwash. The portion of the cooling tower water supply not lost to evaporation will be discharged to the Gulf of Mexico through the use of a blowdown pipeline routed to the Crystal River discharge canal located at the CREC. Specific plant requirements for maximum plant water use, minimum water availability, average plant operation by month, and during shutdown and hydrologic variations affecting water use are described in ER Subsection 3.3.1.

The potential hydrologic alterations resulting from the operation of the LNP and the adequacy of the water supply proposed for plant water needs are directly related to freshwater streams, lakes and impoundments, the CFBC, groundwater, and the Gulf of Mexico.

A summary of the hydrological and chemical characteristics of the hydrological features is provided in ER Section 2.3. The following subsections describe the general conditions and potential impacts on each.

5.2.1.1 Freshwater Streams

The majority of the LNP site lies within the Waccasassa River Basin with a small portion of the site lying in the Withlacoochee River Basin (Figure 2.3-6). Surface water, including freshwater streams, will only receive stormwater runoff from the site. During operation, stormwater runoff from the LNP site will be collected and controlled by a stormwater drainage system to minimize erosion and sediment transport and impacts on the floodplain. ER Subsection 4.2.1 describes the hydrological alterations to the floodplain during construction of the site. A series of stormwater drainage ditches will be constructed within the plant site to drain the stormwater to three stormwater detention ponds located around the LNP site. Stormwater retention/infiltration ponds are designed to drain within 5 days. Any excess rainfall will be pumped to the cooling tower blowdown basin and, if necessary, discharged with blowdown.

Although the ponds are designed to retain a 25-year, 24-hour rainfall event, larger storm events (100-year rainfall) will be drained out of the ponds through broad-crested weir emergency spillways provided in each of the ponds. A minimum freeboard of 0.6 m (2 ft.) will be provided for each pond above the spillway elevation. Water will be discharged from the spillways through long spreader swales to pass runoff to the surrounding wetland as sheet flow to prevent erosion.

Stormwater runoff will be transported away from the roadways near the LNP site by constructing swales along the roads. These swales will be constructed on the sides of the roadway to provide essential drainage and water quality treatment. Overflow from these swales will be managed to discharge to surrounding lands as sheet flow to reduce the potential for erosion.

Site grading and drainage during facility operation will be designed to mitigate erosion and comply with a comprehensive erosion and sedimentation control plan (E&SCP) and a Stormwater Pollution Prevention Plan (SWP3). These controls will minimize the impacts on other water users, increases in erosion, sedimentation, or turbidity.

The general direction of overland flow is predominately to the west toward the Gulf of Mexico. In southern portions of the LNP site, the direction of overland flow is more to the southwest toward the Lower Withlacoochee River (Reference 5.2-001).

Drainage from the LNP site will occur in three different subbasins of the Waccasassa and Withlacoochee River Basins (Figure 5.2-2). There are no named streams at the LNP site (Figure 5.2-3). The upper part of the site lies in the Spring Run subbasin of the Waccasassa Basin. Runoff from this area is through overland pathways until it reaches Spring Run Creek off-site. Flow from Spring Run Creek travels directly to the Gulf of Mexico. Flow from the middle of the site, including the locations of the two proposed reactor units (LNP 1 and LNP 2); drains into the Direct Runoff to Gulf subbasin that flows directly to the Gulf of Mexico. Although LNP 1 and LNP 2 are located in this subbasin, blowdown discharge from the two units will be routed from the subbasin to the CREC discharge canal through a blowdown pipeline. The third subbasin, named Withlacoochee, drains a small area located at the southern end of site. Runoff from this subbasin flows directly to the Withlacoochee River off-site. Applicable state stormwater control requirements will be implemented to minimize the impact from stormwater. Operation of the blowdown pipeline and discharge structure is expected to have a SMALL impact on water supply and surface waters.

The Withlacoochee River is the nearest freshwater river to the LNP site (Figure 5.2-1). The normal flow path of the Withlacoochee River is through Lake Rousseau, into the Inglis Lock Bypass Channel, and then through the lower Withlacoochee River (Figure 5.2-4). During extreme flood events, flow from the lake enters the CFBC through the Inglis Dam and associated spillway (Reference 5.2-002).

5.2.1.2 Lakes and Impoundments

There are no lakes or impoundments currently on the LNP site. The three stormwater ponds will be impoundments on the LNP site but will not be hydrologically connected to any other surface water. The infiltration ponds are designed to drain within 5 days. Lake Rousseau is hydrologically distant from the LNP site. Although Lake Rousseau is located directly upstream of the proposed CFBC intake, but the lake is hydrologically disconnected because of the presence of the Inglis Lock. This lock is currently inoperable and has not been in use since 1999 because of disrepair of the upper gate (Reference 5.2-003). The primary flow pathway from the lake is through the Inglis Lock Bypass Channel and into the lower Withlacoochee River (Figure 5.2-4). During high inflow conditions to the lake, when the operating capacity of the Inglis Bypass Spillway is exceeded, the Inglis Dam is used to control the elevation of Lake Rousseau. The maximum allowable headwater elevation at the dam is 8.53 m (28 ft.) mean sea level (msl) (Reference 5.2-003). The Inglis Dam and associated spillway is the main flood control structure for the Withlacoochee River Basin, by releasing excess water to the Gulf of Mexico through the CFBC.

Because the withdrawal of makeup cooling water will be from the CFBC, which is downstream and hydrologically disconnected from Lake Rousseau, impacts on the lake from operation of the proposed units are anticipated to be SMALL. No future water users of Lake Rousseau are expected to be affected.

5.2.1.3 Cross Florida Barge Canal

The CFBC was part of a federal project to create a northern inland water route between the Gulf of Mexico and Northeast Florida. The canal was designed to have a depth of 3.7 m (12 ft.), a minimum bottom width of 45.7 m (150 ft.), and a total of five locks (25.6 m [84 ft.] wide and 182.9 m [600 ft.] long). Total length of the project was to be approximately 172.2 km (107 mi.) (Reference 5.2-004). Construction of the CFBC was halted in the 1970s and deauthorized in 1990 (Reference 5.2-003). It is now a protected green belt corridor known as Marjorie Harris Carr Cross Florida Greenway (CFG).

An 11.9 km (7.4 mi.) section of the CFBC between Lake Rousseau and the Gulf of Mexico was completed during the initial construction phase. This section of canal bisects the Withlacoochee River, severing the hydraulic connection between Lake Rousseau and the river (Figure 5.2-4). To maintain flow to the lower Withlacoochee River, the Inglis Lock Bypass Channel and associated Inglis Bypass Spillway were built adjacent to and just downstream of the Inglis Lock.

Potential sources for a cooling water supply were evaluated and the best option for the proposed LNP units is the CFBC. Considerations included water availability, water quality, engineering constraints, natural resources, regulatory requirements, and cost to identify the best source for water supply.

The LNP makeup water pumphouse would be constructed approximately 11.1 km (6.9 mi.) from the Gulf of Mexico on the berm that forms the north side of the CFBC and within 0.8 km (0.5 mi.) of the Inglis Lock (Figure 5.2-5). The LNP makeup water pumphouse would withdraw cooling water from the canal and would consist of an intake structure, vertical bar screens, traveling screens, pumps, and pumphouse.

When the intake is operational, it is anticipated that withdrawal of the makeup water will change the characteristics of water in the canal and could result in slow-flowing up-canal unidirectional flows from the Gulf of Mexico. The CFBC will become an intake canal, with higher-salinity water from the estuarine portions of the nearshore Gulf continuously moving upstream (eastward) toward the intake structure. As described in ER Subsection 2.4.2.3.6, the aquatic ecosystems of the CFBC and the Gulf of Mexico are well-adapted to a range of temperature and salinity conditions. Withdrawing water from the CFBC will not change conditions beyond the natural range that presently occurs in the CFBC. The more constant range of higher-salinity waters during LNP full pumping conditions is anticipated to improve water quality conditions for many aquatic organisms and result in an improved biota in the upper CFBC. The impacts of withdrawals from the CFBC and discharge to the CREC discharge canal on flow patterns, temperature, and water quality are described in more detail in ER Subsections 5.3.1 and 5.3.2.

The flow into the CFBC will be from the Gulf of Mexico, a substantial body of water that is not subject to extreme changes in volume. For this reason, it is expected that cooling water withdrawal will not have a major effect on the hydrology of the CFBC. Use of these waters will provide an essentially unlimited source of cooling water even during drought conditions without affecting other water users' needs in the Waccasassa and Withlacoochee River Basins. Changes to water levels in the CFBC as a result of the proposed withdrawal were evaluated using the Hydrologic Engineering Centers River Analysis System (HEC-RAS) model and were determined to be negligible.

Construction-related impacts on surface-oriented water use in the CFBC are described in ER Subsection 4.2.2. Stormwater controls will mitigate any erosion and sediment related impacts on the CFBC. For this reason, sedimentation in the CFBC should not occur. As determined by the HEC-RAS modeling, water levels are not expected to be affected. This will allow the same level of navigation and recreation as is currently seen on the CFBC. Makeup water intake screens will mitigate any safety or navigation hazards associated with the intake.

Impacts on uses of the CFBC, including water supply, aquatic ecosystems, recreation, and navigation are expected to be SMALL.

5.2.1.4 Groundwater

In west-central Florida, the groundwater flow system is a combination of a surficial aquifer made up of unconsolidated sediments of Quaternary age, and an underlying carbonate rock aquifer of Miocene to Paleocene age rocks known as the Floridan aquifer system. Deposits comprising the Floridan aquifer system actually extend into Georgia, Alabama, and South Carolina receiving recharge from a broad area. In Florida, the Floridan aquifer system consists of an Upper and Lower Floridan aquifer and ranges in thickness from about 152 m (500 ft.) to over 549 m (1800 ft.). The Upper Floridan aquifer is the main source of potable water and spring flow in west-central Florida (Reference 5.2-005). A summary of the hydrological and chemical characteristics of the groundwater is provided in ER Section 2.3.

An analysis of groundwater supply performed as part of the preliminary site investigation indicated that aquifers in the region will not readily support the cooling water supply needs of the proposed reactors. However, groundwater supply will be sufficient to provide the water supply for general plant uses. It is proposed that groundwater be used for service water cooling tower makeup water, potable water supply, raw water supply, raw water to demineralizer, fire protection, service water strainer backwash, and media filter backwash. Groundwater for operations will be withdrawn from on-site supply wells (see Figure 4.2-1). Permit approval is anticipated for four 16-inch (in.) diameter supply wells constructed to a maximum depth of 500 ft. with a minimum cased interval of 150 ft. Planned pump capacity per well is 1000 gallons per minute (gpm), with an anticipated average annual withdrawal rate of 395,000 gallons per day (gpd) and a peak monthly withdrawal rate of 1,462,500 gpd.

Use of groundwater supply could alter the groundwater characteristics in the area. These impacts were evaluated using the Southwest Florida Water Management District's (SWFWMD's) District Wide Regulation Model, Version 2 (DWRM2), and discussed further in ER Subsection 5.2.2.3. The overall impact on groundwater supply and characteristics on site and in the vicinity of the plant is anticipated to be SMALL.

5.2.1.5 Wetlands

As discussed in ER Subsection 2.4.1, wetlands occur throughout the LNP site (Figure 5.2-3). These wetlands could be affected during construction activities. ER Section 4.2 describes the potential impacts on these wetlands and the actions, which will be taken to minimize these impacts. To the extent practical, wetland areas will be avoided and impacts minimized.

During plant operations, wetlands will not be directly affected by runoff or infiltration from the stormwater retention ponds, as runoff will be controlled to meet Florida Department of Environmental Protection (FDEP) requirements.

Stormwater runoff from the LNP site will be collected and controlled by a stormwater drainage system. After site grading, a series of stormwater drainage ditches will be constructed within the plant site to drain the stormwater to three stormwater detention ponds located around the LNP site. Site drainage will be maintained through a series of pipes, open ditches, culverts, and storm sewers.

These stormwater drainage ditches will direct surface water into three stormwater retention/infiltration ponds, designed to drain within 5 days. Any excess rainfall will be pumped to the cooling tower blowdown basin and, if necessary, discharged with blowdown.

Although the ponds are designed to retain a 25-year, 24-hour rainfall event, larger storm events (100-year rainfall) will be drained out of the ponds through broad-crested weir emergency spillways provided in each of the ponds. A minimum freeboard of 0.6 m (2 ft.) will be provided for each pond above the spillway elevation. Water will be discharged from the spillways through long spreader swales to pass runoff to the surrounding wetland as sheet flow to prevent erosion.

Stormwater runoff will be transported away from the roadways near the LNP site by constructing swales along the roads. These swales will be constructed on the sides of the roadway to provide essential drainage and water quality treatment. Overflow from these swales will be managed to discharge to surrounding lands as sheet flow to reduce the potential for erosion.

Wetlands could be affected by groundwater use. Pumping groundwater for potable usage could cause groundwater levels to decrease and potentially eliminate wetlands. Water usage impacts on wetlands as a result of groundwater use are discussed in ER Subsection 5.2.2.3.

Site grading and drainage during facility operation will be designed to mitigate erosion and comply with a comprehensive E&SCP and a SWP3. As a result, the overall impacts on wetlands in the vicinity of the plant are expected to be SMALL.

5.2.1.6 Gulf of Mexico

Four potential blowdown discharge alternatives, including discharge offshore of the CFBC in the Gulf of Mexico or routing the discharge to the CREC, were evaluated by technical feasibility, engineering constraints, natural resources, regulatory requirements, and cost. Routing blowdown discharge to the CREC and using the existing discharge canal had one of the highest ratings in the evaluation. Offshore locations were also highly rated because of sufficient mixing zone volume, and the reduced potential for impacts on sensitive habitats. Coastal waters in the area are shallow and concerns over potential silt burdens resulted in lower ratings for nearshore, and to a lesser extent, offshore locations.

Because the Gulf of Mexico is a substantial body of water that is not subject to extreme changes in volume, cooling water withdrawal from the CFBC and discharge to the CREC discharge canal are expected to have a SMALL effect on the hydrology of the Gulf of Mexico.

5.2.1.7 Conclusion

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

5.2.2 WATER USE IMPACTS

This section discusses the analysis and assessments of the predicted impacts of operational water use. The topics discussed are as follows:

- Analysis of hydrologic alterations that could have impacts on water use, including water availability.
- Analysis of water quality changes that could affect water use.
- Analysis and evaluation of impacts resulting from these alterations and changes.
- Analysis and evaluation of proposed practices to minimize or avoid these impacts.
- Evaluation of compliance with federal, state, regional, local, and affected Native American tribal regulations applicable to water use and water quality.

The proposed project is to install and operate two new AP1000 reactors at the LNP site (Figure 5.2-1). As described in ER Subsection 3.3.1, service water cooling tower makeup water, potable water supply, raw water supply, raw water to demineralizer, fire protection, service water strainer backwash, and media filter backwash would be taken from on-site groundwater wells. The proposed reactors would also require a large water supply for cooling processes. As described in ER Subsection 3.3.1, this water will be withdrawn from the CFBC and will be used for cooling tower evaporation, cooling tower blowdown, and pump strainer backwash. The portion of the cooling tower water supply not lost to evaporation will be discharged to the Gulf of Mexico through the use of a blowdown pipeline routed to the Crystal River discharge canal located at the CREC. Specific plant requirements for maximum plant water use, minimum water availability, average plant operation by month and during shutdown, and hydrologic variations affecting water use are described in ER Subsection 3.3.1.

The withdrawal and discharge resulting from the operation of the LNP and the adequacy of the water supply proposed for plant water needs could affect surface and groundwater use. A summary of the hydrological and chemical characteristics of the hydrological features is provided in ER Section 2.3. The following subsections describe the general conditions and potential impacts on each.

5.2.2.1 Freshwater Water Bodies

Evaluations of water supply for general LNP plant operation and cooling water have concluded that freshwater water bodies are not a viable alternative for cooling water supply or general plant use. Surface water, including freshwater streams, will only receive stormwater runoff from the site. Applicable state stormwater control requirements will be implemented to minimize the impact from stormwater. Discharges of effluent from the plant will be to the Gulf of Mexico through a discharge pipeline routed to the CREC discharge canal. For this reason, impacts on surface freshwater hydrology and water quality are anticipated to be SMALL.

Three counties, Levy, Citrus, and Marion, lie within 16 km (10 mi.) of the LNP. There are no surface water withdrawals for public water supply and domestic water supply within these counties as shown in Table 5.2-1 (Reference 5.2-006). The primary source of drinking water in the region is groundwater. Nondrinking water surface water withdrawals within 16 km (10 mi.) of the LNP site include the following (Reference 5.2-006):

- Irrigation — 13.89 million liters per day (mld) (3.67 million gallons per day [mgd]) of freshwater.
- Livestock — 0.45 mld (0.12 mgd) of freshwater.
- Mining — 8.52 mld (2.25 mgd) of freshwater.
- Thermoelectric power — 1491.1 mld (393.9 mgd) of saline water.

In addition to Levy, Citrus, and Marion counties, a small portion of Sumter County is located within an 80-km (25-mi.) radius of the LNP site (Figure 5.2-6). There are no surface water withdrawals for public, domestic, or industrial water supply in this county (Table 5.2-1). Surface water withdrawals in this county include the following (Reference 5.2-006):

- Irrigation — 2.42 mld (0.64 mgd) of freshwater.
- Livestock — 0.26 mld (0.07 mgd) or freshwater.
- Mining — 64.28 mld (16.98 mgd) of freshwater.

Additional counties within an 80-km (50-mi.) radius of the LNP site include Alachua, Dixie, Gilchrist, Hernando, Lake, Pasco, and Putnam (Figure 5.2-6). Pasco and Putnam counties make minimal surface water withdrawals for domestic water supply (Table 5.2-1). Surface water withdrawals in these counties include the following (Reference 5.2-006):

- Public Supply — 0.04 mld (0.01 mgd) of freshwater.
- Industrial Water Use — 115.64 mld (30.55 mgd) of freshwater.
- Irrigation — 61.25 mld (16.18 mgd) of freshwater.
- Livestock — 0.91 mld (0.24 mgd) or freshwater.
- Mining — 7.76 mld (2.05 mgd) of freshwater.
- Thermoelectric Power — 52.6 mld (13.9 mgd) of freshwater and 1706.2 mld (1956.5 mgd) of saline water.

5.2.2.1.1 Freshwater Streams

Impacts on water availability from local freshwater streams are anticipated to be SMALL. The plant will not withdraw or discharge to freshwater streams.

Impacts on water quality in freshwater streams are anticipated to be SMALL. The plant will not withdraw from or discharge to freshwater surface streams. Runoff from the site will be managed according to FDEP stormwater regulations.

5.2.2.1.2 Lakes and Impoundments

Impacts on water availability from lakes and impoundments are anticipated to be SMALL. The plant will not withdraw from or discharge to lakes or impoundments. Runoff from the site will drain to the constructed stormwater ponds on the site, which will not drain to lakes or impoundments in the vicinity of the site.

Impacts on water quality in lakes and impoundments are anticipated to be SMALL. The plant will not withdraw from or discharge to lakes or impoundments. Runoff from the site does not drain to lakes or impoundments in the vicinity of the site.

5.2.2.2 Gulf of Mexico, Cross Florida Barge Canal, and Crystal River Energy Complex Discharge Canal

As discussed in ER Subsection 3.3.1, the LNP site will withdraw water from the CFBC to supply cooling water for the proposed reactors. Because the Gulf of Mexico is a substantial body of water that is not subject to extreme changes in volume, cooling water availability will not be an issue. Changes to water levels in the CFBC were evaluated using the HEC-RAS model. It was determined that the proposed withdrawal would not change the surface water level and would change flow velocities less than 0.01 feet per second (ft/sec). For this reason, the impacts on recreation and navigation are anticipated to be SMALL.

Preliminary designs assume the makeup cooling water will be saltwater and, therefore, will not be affected by the varying salinity levels in the CFBC. The withdrawal of cooling water from the CFBC near the Inglis Lock could change water quality characteristics of the CFBC. Current water quality data in the CFBC are presented in ER Section 2.3. Review of this data shows a gradual decrease in salinity of about ten parts per thousand from the nearshore estuarine waters to a location near the proposed cooling water intake structure (CWIS). When the intake is operational, it is anticipated that withdrawal of the cooling water could result in very slow up-canal unidirectional flows from the Gulf of Mexico. The CFBC will become an intake canal, with estuarine waters very slowly, but continuously, moving upstream toward the plant intake structure. The plant design is based on the assumption that the cooling water supply is of a salinity equivalent to the nearshore estuarine waters. It is recognized that some periodic freshwater contributions to the upper portions of the CFBC will occur from wet period releases from the Lake Rousseau Dam and from leakage from Inglis Lock and contributions from local springs. These freshwater contributions are the subject of current additional study, and the results will be presented in a supplement to the ER.

After usage, the portion of the cooling tower water supply not lost to evaporation will be discharged to the Gulf of Mexico through the use of a blowdown pipeline routed to the CREC discharge canal. Studies on the impacts on the Gulf of Mexico from existing CREC discharges have been performed since the 1980s. The existing National Pollutant Discharge Elimination System (NPDES) permit for those discharges has been designed based on the findings of these studies to minimize impacts.

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

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

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

Although changes to the hydrology and water quality of the CFBC and the CREC discharge canal could occur, the impacts on the Gulf of Mexico are expected to be SMALL.

5.2.2.3 Groundwater Use

Groundwater will be used for general plant operation, excluding primary makeup water cooling uses. Groundwater is the primary source for freshwater in the vicinity of the LNP. A review of other groundwater users was performed to determine whether groundwater use in the vicinity of the site is extensive and would be affected by the proposed withdrawal.

Cities and towns within 16 km (10 mi.) of the LNP site include the City of Dunnellon (Marion County), and the Towns of Inglis (Levy County) and Yankeetown (Levy County) (Figure 5.2-6). The public water source for these municipalities is groundwater (Reference 5.2-006).

Counties within 16-km (10-mi.) radius of LNP site have a combined population of 411,760 that mainly uses groundwater from the Floridan aquifer system (Table 5.2-1). Groundwater use in counties within 16 km (10 mi.) of the site is about 167 mld (44.12 mgd) from public sources and 104.5 mld (27.57 mgd) that is self-supplied. Counties within an 80-km (50-mi.) radius of the LNP site have a combined population of 1,468,130 that uses groundwater for water supply. The estimated public and self-supplied groundwater usage for counties within an 80-km (50-mi.) radius is 1126.9 mld (297.68 mgd) (Table 5.2-1).

The surficial aquifer in the area generally extends to a depth of 6.1 to 12.2 m (20 to 40 ft.) below ground surface (bgs) (Reference 5.2-005). Because of its limited capacity, this aquifer cannot supply sufficient makeup water to the LNP for cooling water demands. However, groundwater supply from the Floridan aquifer would be sufficient to provide the water supply for general plant uses. Proposed groundwater will be used for service water cooling tower makeup water, potable water supply, raw water supply, raw water to demineralizer, fire protection, service water strainer backwash, and media filter backwash, and will be obtained from a Floridan aquifer wellfield located on-site.

Withdrawal of groundwater from the Floridan aquifer could affect the potentiometric head in the aquifer over an area around the wellfield. Such a withdrawal could affect spring discharges, other well users, and cause upconing of brackish water into previously fresher portions of the Floridan aquifer. It could result in localized effects on water levels in surface water bodies and wetlands, possibly producing SMALL ecological impacts.

To assess the impacts of the proposed groundwater withdrawal, the DWRM2 groundwater model was obtained from the SWFWMD and used to simulate LNP's proposed average-day (1.58 mgd) and maximum-day (5.8 mgd) Floridan aquifer withdrawals. The DWRM2 model is a regional model that encompasses virtually all of the SWFWMD region and is used as the framework for developing a site-specific model by use of the telescopic mesh refinement approach. After development, the model was modified and re-calibrated to match observed LNP site parameters, based on slug test, aquifer test, and water level data. Simulations indicated that potential drawdown impact to adjacent groundwater users of the upper Floridan aquifer is on the order of 1 ft. or less, and drawdown is not expected to cause any adverse impacts to the users' ability to withdraw groundwater. Therefore, if appropriate mitigation measures are in place, the overall impacts from groundwater use on water supply and quality are expected to be SMALL.

5.2.3 REFERENCES

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5.2-004 U.S. Army Corps of Engineers, "Project Portfolio: Cross-Florida Barge Canal," Website, www.saj.usace.army.mil/digitalproject/dpn/sajn_006.htm, accessed August 23, 2007.

5.2-005 Ryder, Paul D., "Hydrology of the Floridan Aquifer System in West-Central Florida," USGS Professional Paper 1403-F, 1985.

5.2-006 U.S. Geological Survey, "Estimated Use of Water in the United States County-Level Data for 2000," Website, water.usgs.gov/watuse/data/2000/index,html, accessed August 9, 2007.

Table 5.2-1 (Sheet 1 of 6)
USGS County Water Use Data — Florida 2000

		All Counties within 10 Miles of LNP Site			Additional Counties within 25 Miles of LNP Site	Additional Counties within 50 Miles of LNP Site						
	Units	**Citrus**	**Levy**	**Marion**	**Sumter**	**Alachua**	**Dixie**	**Gilchrist**	**Hernando**	**Lake**	**Pasco**	**Putnam**
Federal Information Processing Standards (FIPS)		12017	12075	12083	12119	12001	12029	12041	12053	12069	12101	12107
State		FL	FL	FL	FL	FL	FL	FL	FL	FL	FL	FL
State FIPS Code		12	12	12	12	12	12	12	12	12	12	12
County FIPS Code		17	75	83	119	1	29	41	53	69	101	107
Year		2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Population of County	Thousands	118.09	34.75	258.92	53.35	217.96	13.83	14.44	130.8	210.8	344.77	70.42
		Public Supply			**Public Supply**	**Public Supply**						
Total Population Served	Thousands	66.23	11.07	136.84	28.24	179.12	4.62	1.85	116.03	171.14	275.8	23.31
Groundwater Withdrawals, Fresh Coded	mgd	13.97	2.16	27.99	4.44	28.26	0.67	0.27	20.26	39.92	102.67	3.2
Surface Water Withdrawals, Fresh Coded	mgd	0	0	0	0	0	0	0	0.01	0	0	0
Total Withdrawals, Fresh	mgd	13.97	2.16	27.99	4.44	28.26	0.67	0.27	20.27	39.92	102.67	3.2
		Domestic Water Use			**Domestic Water Use**	**Domestic Water Use**						
Self-Supplied Population	Thousands	51.86	23.38	122.08	25.11	38.84	9.21	12.59	14.77	39.39	68.97	47.11
Groundwater Withdrawals, Fresh Coded	mgd	7.2	3.95	16.42	4.7	4.12	0.98	1.33	1.41	4.27	4.5	4.99
Surface Water Withdrawals, Fresh Coded	mgd	0	0	0	0	0	0	0	0	0	0	0
Total Withdrawals, Fresh	mgd	7.2	3.95	16.42	4.57	4.12	0.98	1.33	1.41	4.27	4.5	4.99

Table 5.2-1 (Sheet 2 of 6)
USGS County Water Use Data — Florida 2000

		All Counties within 10 Miles of LNP Site			Additional Counties within 25 Miles of LNP Site	Additional Counties within 50 Miles of LNP Site						
	Units	Citrus	Levy	Marion	Sumter	Alachua	Dixie	Gilchrist	Hernando	Lake	Pasco	Putnam
		Industrial Water Use			Industrial Water Use	Industrial Water Use						
Groundwater Withdrawals, Fresh Coded	mgd	0.14	0.01	1.1	0.26	0.45	0.02	0	6.01	3.69	3.72	16.79
Total Withdrawals, Groundwater	mgd	0.14	0.01	1.1	0.26	0.45	0.02	0	6.01	3.69	3.72	16.79
Surface water Withdrawals, Fresh Coded	mgd	0	0	0	0	0	0	0	0	0	0.27	30.28
Total Withdrawals, Surface water	mgd	0	0	0	0	0	0	0	0	0	0.27	30.28
Total Withdrawals, Fresh	mgd	0.14	0.01	1.1	0.26	0.45	0.02	0	6.01	3.69	3.99	47.07
Total Withdrawals	mgd	0.14	0.01	1.1	0.26	0.45	0.02	0	6.01	3.69	3.99	47.07

Table 5.2-1 (Sheet 3 of 6)
USGS County Water Use Data — Florida 2000

	Units	All Counties within 10 Miles of LNP Site			Additional Counties within 25 Miles of LNP Site	Additional Counties within 50 Miles of LNP Site						
		Citrus	Levy	Marion	Sumter	Alachua	Dixie	Gilchrist	Hernando	Lake	Pasco	Putnam
		Irrigation			Irrigation	Irrigation						
Irrigation, Acres Irrigated, Sprinkler	Thousands	2.95	14.37	13.26	3.68	15.28	0.38	6.74	3.12	9.95	9.53	3.15
Irrigation, Acres Irrigated, Micro Irrigation	Thousands	0.25	0.07	1.39	0.2	0.38	0	0	1.12	17.38	9.55	0.4
Irrigation, Acres Irrigated, Surface (Flood)	Thousands	0	0.2	0	0	0	0	0	0	0.51	0.77	5.5
Irrigation, Acres Irrigated, Total	Thousands	3.2	14.64	14.65	3.88	15.66	0.38	6.74	4.24	27.84	19.85	9.05
Irrigation, Groundwater Withdrawals, Fresh	mgd	6.31	21.16	20.74	15.29	21.48	1.55	11.99	7.41	36.21	26.76	12.33
Irrigation, Surface Water Withdrawals, Fresh	mgd	0.97	0.61	2.09	0.64	0.54	0.03	0.21	0.91	9.17	1.42	3.9
Irrigation, Total Withdrawals, Fresh	mgd	7.28	21.77	22.83	15.93	22.02	1.58	12.2	8.32	45.38	28.18	16.23
		Livestock Water Use			Livestock Water Use	Livestock Water Use						
Groundwater Withdrawals, Fresh Coded	mgd	0.2	1.11	0.45	2.14	0.59	0.04	1.98	0.68	0	0.89	0
Surface Water Withdrawals, Fresh Coded	mgd	0.04	0.06	0.02	0.07	0.03	0	0.11	0	0	0.1	0
Total Withdrawals, Fresh	mgd	0.24	1.17	0.47	2.21	0.62	0.04	2.09	0.68	0	0.8	0
		Mining			Mining	Mining						
Groundwater Withdrawals, Fresh Coded	mgd	0.62	0	0	0	0	0	0	13.69	5.65	0.11	2.26
Surface Water Withdrawals, Fresh Coded	mgd	0.29	1.96	0	16.98	0	0	0	0.07	0.6	0.54	0.84
Total Withdrawals, Fresh	mgd	0.91	1.96	0	16.98	0	0	0	13.76	6.25	0.65	3.1

Table 5.2-1 (Sheet 4 of 6)
USGS County Water Use Data — Florida 2000

		All Counties within 10 Miles of LNP Site			Additional Counties within 25 Miles of LNP Site	Additional Counties within 50 Miles of LNP Site						
	Units	**Citrus**	**Levy**	**Marion**	**Sumter**	**Alachua**	**Dixie**	**Gilchrist**	**Hernando**	**Lake**	**Pasco**	**Putnam**
		Thermoelectric Power Water Use			**Thermoelectric Power Water Use**	**Thermoelectric Power Water Use**						
		Irrigation			**Irrigation**	**Irrigation**						
Groundwater Withdrawals, Fresh Coded	mgd	1.55	0	0	0	2.63	0	0	0	0	0.14	0.69
Surface Water Withdrawals, Fresh Coded	mgd	0	0	0	0	0	0	0	0	0	0	13.9
Surface Water Withdrawals, Saline	mgd	393.9	0	0	0	0	0	0	0	0	1956.5	0
Total Withdrawals, Surface Water	mgd	393.9	0	0	0	0	0	0	0	0	1956.5	13.9
Total Withdrawals, Fresh	mgd	1.55	0	0	0	2.63	0	0	0	0	0.14	0.69
Total Withdrawals	mgd	395.45	0	0	0	2.63	0	0	0	0	1956.64	14.59

Table 5.2-1 (Sheet 5 of 6)
USGS County Water Use Data — Florida 2000

		All Counties within 10 Miles of LNP Site			Additional Counties within 25 Miles of LNP Site	Additional Counties within 50 Miles of LNP Site						
	Units	**Citrus**	**Levy**	**Marion**	**Sumter**	**Alachua**	**Dixie**	**Gilchrist**	**Hernando**	**Lake**	**Pasco**	**Putnam**
		Thermoelectric Power Once-Through			**Thermoelectric Power Once-Through**	**Thermoelectric Power Once-Through**						
Surface Water Withdrawals, Fresh Coded	mgd	0	0	0	0	0	0	0	0	0	0	0
Surface Water Withdrawals, Saline	mgd	291.62	0	0	0	0	0	0	0	0	1956.5	0
Total Withdrawals, Surface Water	mgd	291.62	0	0	0	0	0	0	0	0	1956.5	0
		Thermoelectric Power Closed-Loop			**Thermoelectric Power Closed-Loop**	**Thermoelectric Power Closed-Loop**						
Groundwater Withdrawals, Fresh Coded	mgd	1.55	0	0	0	2.63	0	0	0	0	0.14	0.69
Surface Water Withdrawals, Fresh Coded	mgd	0	0	0	0	0	0	0	0	0	0	13.9
Surface Water Withdrawals, Saline	mgd	102.28	0	0	0	0	0	0	0	0	0	0
Total Withdrawals, Fresh	mgd	1.55	0	0	0	2.63	0	0	0	0	0	13.9
Total Withdrawals	mgd	103.83	0	0	0	2.63	0	0	0	0	0.14	14.59

Table 5.2-1 (Sheet 6 of 6)
USGS County Water Use Data — Florida 2000

		All Counties within 10 Miles of LNP Site			Additional Counties within 25 Miles of LNP Site	Additional Counties within 50 Miles of LNP Site						
	Units	Citrus	Levy	Marion	Sumter	Alachua	Dixie	Gilchrist	Hernando	Lake	Pasco	Putnam
			Totals		Totals				Totals			
Total Groundwater Withdrawals, Fresh Coded	mgd	29.99	28.39	66.7	26.7	57.53	3.26	15.57	49.46	89.94	138.79	48.26
Total Withdrawals, Groundwater	mgd	29.99	28.39	66.7	26.7	57.53	3.26	15.57	49.46	89.94	138.97	40.26
Total Surface Water Withdrawals, Fresh Coded	mgd	1.3	2.63	2.11	17.69	0.57	0.03	0.32	0.99	9.77	2.24	48.92
Total Surface Water Withdrawals, Saline	mgd	393.9	0	0	0	0	0	0	0	0	1956.5	0
Total Withdrawals, Surface Water	mgd	395.2	2.63	2.11	17.69	0.57	0.03	0.32	0.99	9.77	1958.74	48.92
Total Withdrawals, Fresh	mgd	31.29	31.02	68.81	44.39	58.1	3.29	15.89	50.45	99.51	141.03	89.18
Total Withdrawals	mgd	425.19	31.02	68.81	44.39	58.1	3.29	15.89	50.45	99.51	2097.53	89.18

Notes:

mgd = million gallons per day

Source: Reference 5.2-006

5.3 COOLING SYSTEM IMPACTS

5.3.1 INTAKE SYSTEM

The information presented in this section addresses that defined in NUREG-1555, Environmental Standard Review Plan (ESRP) 5.3.1.1, Hydrodynamic Descriptions and Physical Impacts, and ESRP 5.3.1.2, Aquatic Ecosystems, pertaining to the operational impacts of the cooling water intake system. This information is consistent with 10 CFR 51.70.

The regulatory setting for the evaluation of the cooling water intake systems for new facilities is governed by Section 316 of the Clean Water Act (CWA), The 316(b) Phase I Rule (Federal Register / Vol. 66, No. 243 / Tuesday, December 18, 2001 / Rules and Regulations recirculating cooling system; (40 CFR 125.84[b][1]) establishes requirements for new facilities that use water withdrawn from rivers, streams, lakes, reservoirs, estuaries, oceans, or other waters of the United States for cooling purposes. The final rule establishes national technology-based performance requirements applicable to the location, design, construction, and capacity of cooling water intake structures at new facilities. The national requirements establish the best technology available (BTA), based on a two-track approach, for minimizing adverse environmental impact associated with the use of these structures. This final rule applies to new Greenfield power plant sites, such as the LNP, and standalone facilities that use cooling water intake structures to withdraw water from waters of the United States, and that have or require an NPDES permit issued under Section 402 of the CWA. New facilities subject to this regulation include those that have a design intake flow of greater than 2 mgd and that use at least 25 percent of water withdrawn for cooling purposes. The Phase I Rule establishes a two-track approach for regulating cooling water intake structures at new facilities. Track I establishes uniform requirements based on facility cooling water intake capacity. Track II provides dischargers with the opportunity to establish that alternative requirements will achieve comparable performance. The regulated entity has the opportunity to choose which track it will follow. PEF has chosen to follow Track I for the LNP cooling water system. Under Track I, new facilities with a design intake flow equal to or greater than 10 mgd, must meet the following requirements: (1) cooling water intake flow must be at a level commensurate with that achievable with a closed-cycle, recirculating system, and (2) through-screen intake velocity must be less than or equal to 0.15 meters per second (m/s) (0.5 feet per second [ft/sec]) (40 CFR 125.84[2]).

5.3.1.1 Hydrodynamic Descriptions and Physical Impacts

The operation of a cooling water intake results in the creation of velocity flow fields in front of, and adjacent to, the CWIS that hold the potential to cause bottom scouring, induced localized turbidity, and silt buildup. The potential for these impacts to occur depends on the velocities induced by the water withdrawal pumps, the size of the induced flow field, the nature of the substrates adjacent to the raw water pumphouse, the sediment load characteristics of the water body, and the location and design features of the intake structure. This subsection describes the proposed cooling water system design and discusses potential impacts from the cooling water system's design and operation.

As discussed in ER Subsection 2.3.2.1, the CWIS will be located approximately 11.1 km (6.9 mi.) from the Gulf of Mexico on the berm that forms the north side of the CFBC, and is within 0.8 km (0.5 mi.) of Inglis Lock. The CWIS consists of the intake structure, vertical bar screens, traveling screens, pumps, and pumphouse. The proposed reactors will require an estimated 5.61 cubic meters per second (m^3/s) (198.1 cubic feet per second [ft^3/sec]) or 122.1 mgd) of water for cooling processes. This water will be withdrawn from the CFBC and used for cooling tower evaporation, cooling tower blowdown, and pump strainer backwash. The velocity of up-canal water movement associated with the intake flow is about 0.02 m/s (0.07 ft/sec); therefore, no significant change is expected. The CWIS during full operation is pulling approximately 5.38 m^3/s (190 ft^3/sec), or approximately 33 percent of the mean tidal flow in the CFBC. This rate of withdrawal when compared with the size of the CFBC and the open nearshore Gulf waters will not appreciably affect the water levels in the canal over typical tidal cycles {7 mi. x 5280 feet per mile x (5.27 - 2.44) ft. mean tidal range x 0.5(256 + 180) ft. width / (11 hrs cycle x 3600 seconds per hour) = 574.5 ft^3/sec per tide change}. Because of the low velocity of upstream movement of water withdrawn from the CFBC by the CWIS, no adverse impacts on canal sediments or side wall erosion rates are anticipated.

As described in ER Subsection 3.4.2.1.1, the CWIS has been designed with 0.95-centimeters (cm) (3/8-inch [in.]) screen openings and a through-screen velocity at the traveling screens of less than 0.15 m/s (0.5 ft/sec). Because the 0.95-cm (3/8-in.) screens take up approximately 50 percent of the total screen area, the approach velocity at the face of the traveling screens will be approximately 0.08 m/s (0.25 ft/sec), and the velocity at the bar screens will be significantly less. The CWIS design will be in compliance with the requirements of the CWA Section 316 Phase I Rule. Once the CWIS begins operations, these low intake velocities will be a consistent background hydrological force in the CFBC during reactor operation, overlaid with wind-driven and tidal-driven water velocities. Any adverse effects of water velocities from the CWIS on the sediments and side wall substrates of the canal will occur during major storm events and will not result from the operation of the CWIS. Therefore, the effects of the intake on water body velocities will be minimal, and potential physical impacts on the bottom sediments and benthic organism habitats are expected to be SMALL.

NUREG-1555 suggests that calculations or modeling of the flow fields caused by the new raw water pumphouse should be undertaken, where appropriate, to describe impacts on the physical habitats and aquatic biota. Evaluations of the impacts on physical habitats, aquatic biota of water withdrawal, impingement, and entrainment in this section do not include development of calculations or modeling predictions of the induced potential flow fields. This is because development of flow field velocity profiles is not required to evaluate impacts because the facility will be designed to meet the stringent intake design through-screen velocity requirements of less than 0.15 m/s (0.5 ft/sec) required by the CWA Section 316 Phase I regulations for new raw water pumphouse. Because modeling would not produce different results than this criterion, the through-screen velocity of 0.15 m/s (0.5 ft/sec) was used to evaluate the impacts at the LNP site.

Additional information on the hydrodynamics of the LNP cooling water system can be found in ER Subsections 2.3.1, 2.3.2, 2.3.3, 5.4.1, and 5.4.2, and ER Sections 3.3 and 3.4.

5.3.1.2 Aquatic Ecosystems

As noted in ER Subsection 5.3.1, Section 316 of the CWA establishes the regulatory setting for the evaluation of CWIS. The impacts of the operation of the LNP CWIS on aquatic ecosystems are limited to the following areas of potential concern:

- Increase in salinity in the upper reaches of the CFBC.
- Impingement impacts.
- Entrainment impacts.

5.3.1.2.1 Increase in Salinity in Upper Reaches of the CFBC

As noted in ER Subsection 5.2.1.3, when the CWIS is operational, it is anticipated that withdrawal of the makeup water will, over time, consistently change the characteristics of water in the upper portions of the CFBC and may, during dry conditions and low wind velocity periods, result in slow unidirectional, upchannel flows of higher salinity Gulf waters (approximately 0.02 m/s [0.07 ft/sec] up-canal velocities) toward the CWIS. Lower salinity water will still be present in the upper portions of the CFBC as a result of dilution by freshwater springs discharging in the canal, as observed during the aquatic field studies, and discharges of freshwater over the Lake Rousseau Dam during periods of wet weather.

Therefore, although the upper portions of the canal will be consistently more saline than present-day conditions and during most conditions are expected to closely approximate the average salinity conditions of the lower canal and nearshore Gulf waters, there still may be periods during high freshwater flows in the old Withlacoochee River channel when freshwater could dominate the upper portions of the canal. Freshwater releases from the old Withlacoochee channel will enter the CFBC and be pushed up-canal by flood tides and wind. These less saline conditions will persist in the upper CFBC for as yet unpredicted periods of time. Additional hydrological predictive studies of the old Withlacoochee channel are planned in 2008, and the results will be presented as a supplement to the ER.

As shown in ER Section 2.4, the aquatic benthic infauna near the proposed location of the CWIS are depauperate and exhibit the lowest abundance and diversity of any location in the CFBC. This is likely a result of the variable salinities that occur near the lock and proposed CWIS location. These variable salinities have resulted in an isolated and very limited freshwater aquatic fauna in areas near the lock. The projected consistently higher salinity during CWIS operation will result in an improved aquatic biota in the upper reaches of the canal for much of the yearly weather cycle. This improved aquatic biota will more closely resemble the biota now present in the lower reaches of the CFBC and the near-shore Gulf waters, and allow for the development of a more abundant and diverse aquatic fauna than the very limited existing aquatic community.

Adverse impacts are projected to only affect the existing small population of low-salinity-tolerant benthic and motile aquatic organisms now inhabiting those upper portions of the canal near the lock and proposed CWIS. These adverse impacts are projected to be SMALL because of the low population sizes, limited geographical extent, and low diversity of these low-salinity-tolerant benthic populations. The positive improvements projected to occur with the operation of the CWIS are anticipated to be MODERATE. These positive impacts are projected to include higher populations and higher diversity of benthic aquatic populations, fish, and motile crustaceans; and over time, the developed aquatic communities are projected to more closely resemble those now existing in the lower portions of the canal. Although water quality conditions in the upper portions of the canal are expected to improve and to be more consistent, occasional lower salinities are still expected to occur during high precipitation periods in the Withlacoochee River watershed when water is released over the dam and downstream freshwater flows enter the canal. Also, the CWIS will not alter the fundamentally dead-end nature of the canal, and sediments near the proposed CWIS may remain organically enriched. The aquatic benthic population may remain more limited than those in lower canal locations.

5.3.1.2.2 Impingement Impacts

The impingement and entrainment 316(b) data from the CREC studies from the 1980s were examined to determine if the data would be helpful in evaluating potential future impacts from the proposed LNP CWIS. It was determined that the CREC data were not representative given the greater through-screen velocities at the CREC intakes, the age of the information and the hydrological differences between the proposed LNP CFBC location and the CREC intake forebay.

As noted in ER Subsection 5.3.1, a key component of the Phase I requirements is the design of the intake traveling screens to include through-screen velocities of 0.15 m/s (0.5 ft/sec) or less. The LNP design intake through-screen velocities of less than 0.15 m/s (0.5 ft/sec) and the low approach velocities described in ER Subsection 5.3.1.1 of approximately 0.08 m/s (0.25 ft/sec), at the bar screens ensure that most healthy fish, crabs, and shrimp approaching the CWIS will be able to swim away from the screens. Any manatees approaching the screens will be able to avoid impingement because these animals will be restrained from entering the CWIS forebay by trash rack (that is, bar screens); also, the very low

0.08 m/s (0.25 ft/sec) approach velocities at the bar screens will allow the animals to easily swim away from the screens.

No fish return system is planned at present. The screens will be cleaned by a high pressure spray. Removed debris and organisms will be deposited in a collection basket and the contents will be periodically taken to a local approved landfill. Some crab species are attracted to traveling screens because their food supplies attach and develop populations on the screens' surfaces. Some crabs will retain their position following the high-pressure screen wash and may require periodic manual removal.

Neither protected fish species, the smalltooth sawfish nor the Gulf sturgeon, would be adversely affected by impingement. The smalltooth sawfish is viviparous, and the live birthed young are born 1.5 ft. to 2 ft. long and fully capable of avoiding impingement where the approach velocities are in the very low 0.25 ft/sec range. The Gulf sturgeon does not spawn in the area of the CFBC, and the young are not anticipated to be present near the LNP CWIS.

The CWA Section 316(b) component of the NPDES permit to be issued to the LNP for the operation of the CWIS will likely require some monitoring of impingement rates during early periods of operation to ensure that impingement rates are low, as predicted by the design. The impacts of the CWIS are predicted to be SMALL.

Although the low design approach and through-screen velocity values are expected to result in low impingement rates, should impingement rates be higher than anticipated, adjustments to the installed technology could be made to further reduce impingement impacts.

5.3.1.2.3 Entrainment Impacts

Entrainment refers to those organisms, which, because of the nature of their small size and limited mobility, enter the intake flows of power plants and pass through the designed cooling system. The primary methods for cooling power plant condensers are once-through cooling and closed-cycle cooling. The potential entrainment impacts from the operation of the proposed LNP have been reduced by approximately 90 percent from the potential flows of a once-through cooling system by the decision to utilize Track 1 of the CWA Section 316 Phase I Rule and to use a closed-cycle cooling water system for the LNP. The design use of cooling towers at the LNP means that potential entrainment has been minimized to the extent practical by the use of the BTA cooling system.

The biological studies conducted on the CFBC and presented in ER Section 2.4 showed that the ichthyoplankton and meroplankton collected in the upper portions of the CFBC and in the vicinity of the CWIS were limited. No larval stages of any protected aquatic species were collected, and the number of identified taxa represented in the plankton collections were relatively low compared with the number of aquatic species present in the canal and nearshore Gulf waters. As noted in ER Section 2.4, the protected aquatic species are not expected to use the CFBC for spawning or as a nursery. The smalltooth sawfish is viviparous, and the live birthed young are born 1.5 ft. to 2 ft. long and are not subject to entrainment through a $^3/_8$-in. mesh traveling screen. The Gulf sturgeon does not spawn in the CFBC area of the Gulf and the larval and juvenile stages, and therefore, is not subject to entrainment at the LNP CWIS. However, only one portion of the late spawning season was sampled and, therefore, the characterization of the ichthyoplankton and meroplankton community is considered incomplete. Additional sampling efforts are planned for the projected peak ichthyoplankton and meroplankton periods during 2008, and the results from these additional sampling efforts will be presented in a supplement to the ER.

Impacts on the CFBC aquatic ecology from those organisms entrained into the CWIS are projected to be minimal based on the use of BTA cooling towers and the approximately 90 percent reduction from once-through cooling water potential usage, the projected low up-canal CWIS-induced water movement velocities (approximately 0.02 m/s [0.07 ft/sec]), the likely limited use of the CFBC for spawning and nursery activities, and the approximately 11-km (7-mi.) distance from the more productive spawning and nursery areas of the near-shore Gulf waters. However, a final conclusion on the magnitude of potential impacts will presented in the ER supplement, once additional ichthyoplankton/meroplankton collections are complete, and analysis of the additional data is completed.

5.3.2 DISCHARGE SYSTEM

This subsection describes the impact of the thermal heat discharge system for the LNP on the aquatic ecology and the physical impacts, such as scouring, silt buildup, and shoreline erosion induced by the discharge system flows during station operation.

ER Subsection 5.3.2.1 describes the physical impacts associated with thermal discharges to the existing CREC discharge canal. ER Subsection 5.3.2.2 describes the impacts of the thermal discharges on the aquatic ecosystems.

5.3.2.1 Thermal Description and Physical Impacts

As noted in ER Sections 2.3 and 3.4, the preferred alternative for the return of the cooling tower blowdown is to the existing CREC discharge canal (Figure 4.3-1). As discussed in ER Subsection 3.4.2.2.1, the design heat dissipation capacity for the mechanical draft cooling towers is 7628 x 10^6 British thermal units per hour (Btu/hr). At design conditions, water enters the tower at 47.7 degrees Celsius (°C) (117.8 degrees Fahrenheit [°F]) and discharges at 31.7°C (89.1°F). The blowdown rate at 1.5 concentrations is 56,520 gpm for two units, resulting in a required makeup flow of 84,780 gpm for the two units.

Calculation shows that the LNP blowdown will be approximately 4.9 percent of the combined total CREC discharge flow ([81.34 mgd blowdown flow / 1651.8 mgd CREC discharge flow] x 100 = 4.9 percent). The temperature of the LNP blowdown will be approximately 31.7°C (89.1°F) and is not anticipated to result in changes to the requirement for “helper” cooling tower use related to the existing CREC discharge canal during the warm summer months and any reductions to the CREC thermal discharge due to the addition of the LNP blowdown contribution will be slight and comply with applicable permits and regulations. The addition of the LNP blowdown to the existing CREC discharge canal will not significantly increase velocities within the CREC discharge canal; therefore, no significant physical changes, including shoreline erosion, bottom scouring, increased turbidity and siltation, are anticipated to occur at the end of the discharge canal and in those areas of Crystal Bay affected by the CREC discharge. The potential physical impacts of adding the LNP blowdown on the existing CREC discharge canal are expected to be SMALL due to the significant dilution factor (of approximately 20 times) of adding the LNP blowdown to the much larger flows of the CREC discharge. In addition, the blowdown effluent will be in compliance with the temperature (96.5°F as a 3-hour rolling average) and other parameter requirements of an issued NPDES permit. Additional information on the thermal component of the blowdown discharge can be found in the environmental descriptions provided in ER Sections 2.3, 2.7, 3.3, and 3.4, and Subsection 2.4.2.

5.3.2.2 Aquatic Ecosystems

Blowdown discharges from the LNP heat rejection system may potentially affect the receiving body of water through heat loading and chemical contaminants, most notably chlorine or other biocides. More detail on biocides can be found in ER Subsection 3.6.1. Heated effluents may potentially affect aquatic organisms directly by either heated effluents or cold shock. In addition, a number of indirect or sublethal stresses are associated with thermal discharges that have the potential to alter aquatic communities (for example, increased incidence of disease, predation, or parasitism, as well as changes in dissolved gas concentrations, as well as combined thermal and chemical effects). Additionally, as stated in ER Subsection 5.3.2.1, all effluent discharges are regulated by the CWA and standards established by the USEPA and the individual states. Conditions and limits for the heated discharge are specified in the current CREC NPDES permit, and a new permit to be issued for the combined LNP and CREC is anticipated to have similar conditions.

As noted in ER Subsection 5.3.2.1, the LNP blowdown will be approximately 4.9 percent of the combined total CREC discharge flow ([81.34 mgd blowdown flow / 1651.8 mgd CREC discharge flow] x 100 = 4.9 percent). The addition of the relatively smaller LNP blowdown discharge to the existing CREC discharge canal is not anticipated to have measurable impacts on the aquatic ecology of the estuarine habitats presently affected by the CREC thermal plume. The temperatures of the combined thermal discharge will be slightly reduced; although, the very small change may be difficult to measure and the combined discharge will still utilize the use of helper cooling towers to meet established NPDES permitted limits for temperature during the warm summer months. The original 1985 combined CWA Section 316(a) thermal effluent demonstration and 316(b) intake effects (Reference 5.3-001) demonstration showed adverse impacts on the aquatic ecology, including adverse impacts on area sea grasses and their associated community of aquatic organisms. The effects of the discharge of heated water on benthic infauna, macrophytes, salt marsh, oyster reefs, and fisheries were assessed for the LNP site and are discussed in ER Subsection 2.4.2.5.

The subsequent addition of the helper cooling towers to trim CREC discharge temperatures has resulted in recent visually apparent improvements in the abundance of sea grasses and likely the community of aquatic organisms normally inhabiting sea grass beds. A recent study of sea grass abundance and speciation has been conducted by a subcontractor to PEF, and the results of the study are discussed in ER Subsection 2.4.2.5.1. Additional surveys of aquatic life in the vicinity of the CREC discharge canal are planned for 2008 because the data used in the original 1985 316(a) and (b) demonstration document have not been updated. Based on available ecological information in the 1985 316(a) and 316(b) (Reference 5.3-001) and the relatively small size and lower temperature characteristics of the LNP blowdown plume, the impacts of the LNP addition are anticipated to be SMALL. No measurable adverse impacts on aquatic biota, including populations of important species present in the CREC discharge canal and the nearshore Gulf sea grass habitats are likely to result from the addition of the smaller thermal component of the LNP blowdown; however, additional aquatic field surveys are planned for the sea grass habitats within the influence of the CREC thermal plume and the sea grass study results and the impacts of the combined LNP/CREC discharge canal will be predicted in a supplement to this ER.

5.3.3 ATMOSPHERIC HEAT DISSIPATION SYSTEM

Mechanical draft cooling towers will be used to provide a heat sink during normal operation of LNP 1 and LNP 2. The AP1000 reactor does not rely on site service water as a safety grade ultimate heat sink (UHS) and meteorological design parameters for the cooling tower during normal operation have been established. This subsection contains a brief description of the potential impacts of the normal operation heat sink system for LNP 1 and LNP 2 on the environment in the area surrounding the LNP site.

5.3.3.1 Heat Dissipation to the Atmosphere

5.3.3.1.1 Length and Frequency of Elevated Plumes

The mechanical draft cooling towers that will be used to dissipate waste heat from LNP 1 and LNP 2 to the atmosphere are not expected to have a significant influence on the local environment. While there may be some near-field changes in temperature or humidity (that is, in the immediate vicinity of the towers), the cooling tower plumes should not significantly affect conditions at ground level at any off-site location.

Under full power, it is expected that the LNP cooling towers will evaporate up to 106,142.9 liters per minute (lpm) (28,040 gpm), depending on weather conditions. Under most meteorological conditions, the discharge will condense upon leaving the tower, and the length of the visible plume will depend on the temperature and humidity of the atmosphere. Colder and more humid weather is conducive to longer plumes. On very humid days, when the longest plumes are expected, there may be a naturally occurring overcast. On such occasions, it is more difficult to distinguish the cooling tower plume from the overcast cloud layer. Most of the time, the visible plume will extend only a short distance from the tower and then disappear by evaporation.

USEPA's CALPUFF dispersion model was used to evaluate cooling tower plume behavior and to estimate the frequency of occurrence and length of visible cooling tower plumes (Reference 5.3-002). The analysis of cooling tower plume behavior was performed under the assumption of full load operation, with maximum heat dissipation to the atmosphere. The maximum potential system heat rejection rate to the cooling towers is 7.63E09 Btu/hr per unit, which was assumed to be a bounding value for purposes of the analysis. The physical and operating characteristics of the cooling towers for each of the two banks of towers (that is, one bank of towers for each generating unit, LNP 1 and LNP 2) are as follows:

Number of cells	44
Orientation of cells	2x22
Length	362.8 m (1190 ft.)
Width	292.6 m (97 ft.)
Height	17.1 m (56 ft.)
Fan diameter	10.0 m (32.8 ft.) (per cell)
Circulating water flow rate	2,010,187 lpm (531,100 gpm)
Drift rate	0.0005 percent
Cycles of Concentration	1.5 (normal operation
Cycles of Concentration	2.0 (short-term excursions)
Heat rejection rate	7.63E09 Btu/hr

The analysis of cooling tower plume behavior was performed using 1 year of hourly surface meteorological data (2003) from the Gainesville, Florida, observing station. The results of the analysis indicate that visible plumes from the LNP cooling towers will remain very close to the cooling towers, primarily on-site and within approximately 100 m (328 ft.) of the cooling towers under most meteorological conditions. Visible vapor plumes greater than 1000 m (3280 ft.) in length (the approximate distance to the nearest property boundary) are predicted to occur less than approximately 2 percent of the time (less than 1 percent during daylight hours). The vertical rise of visible vapor plumes is predicted to be less than 200 m (656 ft.) above the cooling towers more than 98 percent of the time (99 percent during daylight hours). Based on this analysis, the expected frequency of occurrence of visible cooling tower plumes that will leave the property or that will be visible from off-site locations is expected to be very small. The nearest public road (US-19) is approximately 1400 m (0.9 mi.) to the west of the nearest cooling tower bank, and there are no predicted occurrences of fogging or icing at distances of more than 1000 m (3280 ft.) from the cooling towers. Additional detail on the results of the analysis of cooling tower plume behavior is provided in ER Subsection 5.8.1.3.

The nearest airport is the Crystal River Airport, which is a small municipal Airport located approximately 22.5 km (14 mi.) south of the LNP site. The operation of the cooling towers for LNP 1 and LNP 2 is neither expected to affect operations at this or any other airport, nor is the operation of the towers expected to result in an air traffic safety hazard at any location.

The design of the cooling towers minimizes tower visibility and improves plume dissipation. The additional water and heat released to the atmosphere by the cooling tower plumes is expected to have a SMALL impact on the local environment, and no mitigation is required.

5.3.3.1.2 Ground-Level Fogging and Icing

An analysis of cooling tower fogging and icing was also performed using USEPA's CALPUFF model as described in ER Subsection 5.3.3.1.1. The results indicated that there were no predicted occurrences of ground level fogging or icing beyond 1000 m (3280 ft.) of the cooling towers (that is, the approximate distance to the nearest property boundary). Since the nearest roadway (US-19) is located approximately 1400 m (0.9 mi.) (at its closest point) from the cooling towers, no instances of ground level fogging or icing are expected on any roadway as a result of the operation of the LNP cooling towers.

The impacts attributable to fogging and icing as a result of the operation of the LNP cooling towers are expected to be SMALL and no mitigation is required.

5.3.3.1.3 Solids Deposition

A very small fraction of the water circulating through the LNP 1 and LNP 2 cooling towers will be carried into the cooling tower plumes as small water droplets. These water droplets, referred to as "cooling tower drift" (typically defined as kilograms [kg] of water per second leaving the tower top divided by the kg of water per second circulating through the tower heat exchange section) would not exceed 0.0005 percent for the LNP cooling towers. Because modern cooling towers have almost no drift losses, this is not considered to be a critical design parameter. Site wind velocities and direction have been considered in designing the mechanical draft cooling towers and their orientation on the site to minimize any recirculation of air and vapor exiting the towers and to provide adequate cooling capacity should any recirculation occur.

Water droplets emitted from the cooling towers (as cooling tower "drift") will contain the same concentration of dissolved and suspended solids as the water within the cooling tower basin that is circulated through the towers. The dissolved and suspended solid concentrations in the cooling tower basins will be controlled through use of the makeup and blowdown water lines from the CFBC. Because the cooling water that will be pumped from the CFBC will be from the estuarine portions of the nearshore Gulf, the total dissolved solids of the makeup water is expected to be in the range of 25,000 parts per million (ppm) during normal operating conditions.

The estimated amount of dissolved solids that could potentially escape from the cooling towers in drift from the LNP cooling towers (for both LNP 1 and LNP 2 operating simultaneously) is estimated to be 115.7 pounds per hour (lb/hr) during normal operation and 154.26 (lb/hr) for short-term excursions (as total particulate). This amount of material could be released and dispersed over the area surrounding the LNP site once both units become fully operational. A description of the results of an analysis of cooling tower plume drift and deposition is provided in Subsection 5.3.3.2.1.

Given the relatively large distances from the cooling towers to the LNP site boundaries, it is expected that the deposition solids from the cooling towers at off-site locations will be SMALL and no mitigation is required.

5.3.3.1.4 Cloud Shadowing and Additional Precipitation

Although there will be visible plumes during some periods of operation of the proposed LNP site, adverse effects attributable to cloud shadowing or additional precipitation are not expected to be significant. Given the large distance to the LNP site boundary and the low profile of the mechanical draft cooling towers, the cooling tower plumes are not expected to be visible except on rare occasions from off-site locations. The impacts of cloud shadowing or additional precipitation are, therefore, expected to be SMALL and no mitigation is required.

5.3.3.1.5 Interaction with Existing Pollution Sources

No synergistic effects of cooling tower plumes mixing with plant radiological (see ER Section 5.4) or any other releases (see ER Subsection 5.5.1.3) are expected to occur. Any gaseous effluents released from the plant during operation would be at a different elevation or at a location well removed from the cooling towers. Any such releases would also be at or near ambient temperature, and no significant plume rise from those releases would occur. The potential for the mixing of the plumes is expected to be minimal and at different locations from where any water droplets in the cooling tower plume would still be present.

Interactions with other sources of air pollution are expected to be SMALL and no mitigation is required.

5.3.3.1.6 Ground-Level Humidity Increase

No discernible increase in atmospheric humidity at off-site locations is expected as a result of the operation of the LNP. No mitigation is required.

5.3.3.2 Terrestrial Ecosystems

The heat dissipation system proposed for the LNP site has only a very small potential to have any discernible impact on local terrestrial plants and animals. The operation of the LNP cooling towers will result in relatively small amounts of salt and particle drift from the tower and very limited occurrences of visible vapor plumes at off-site locations. No occurrences of fogging or icing are expected at any off-site locations. The potential for local precipitation modification is considered to be almost nonexistent. While there will be an increase in noise in the immediate vicinity of the cooling towers and the cooling water intake system, noise impacts are expected to be minimal, with mobile organisms avoiding high noise environments. Refer to ER Subsection 5.1.1.1 and the Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants prepared by the U.S. Nuclear Regulatory Commission (NRC) for further discussion on impacts.

The operation of the LNP cooling towers is not expected to have a significant or adverse impact on any terrestrial species from the presence of vapor plumes, the small amount of cooling tower drift and solids deposition, or plume fogging or icing. The impacts are expected to be SMALL, and no mitigation is required.

5.3.3.2.1 Salt Drift

Cooling tower drift, as discussed above, normally contains small amounts of solids that can ultimately deposit at ground level. A deposition analysis was performed to assess the rate of deposition to the surface in the area surrounding the plant site. The analysis was performed using USEPA's AERMOD dispersion model (Reference 5.3-003) and 5 years (2001 through 2005) of hourly meteorological data (Gainesville surface and Jacksonville upper air observations). The analysis resulted in a maximum predicted off-site deposition rate (during normal plant operation) of 6.81 kilogram per hectare per month (kg/ha/mo) (6.13 pounds per acre per month [lb/ac/mo]) of total solids at a location due west of the cooling towers at the nearest property boundary. Even assuming that all of the solids contained in the cooling tower drift are salts, this rate is below the threshold limit of 10 kg/ha/mo (9 lb/ac/mo) as provided in NUREG-1555, which is a threshold above which an adverse impact on vegetation could occur. The predicted off-site deposition impacts were also predicted to decrease significantly with increasing distance from the plant, with the maximum predicted deposition rate decreasing to approximately one-third of the maximum off-site value with an increasing distance of 1000 m (3280 ft.) from the site boundary. The maximum predicted on-site deposition (during normal plant operation) is 10.75 kg/ha/mo (9.68 lb/ac/mo).

It is noted that a comprehensive salt drift deposition study was conducted at the nearby CREC to evaluate the physical impacts of salt deposition from that facility's natural and mechanical draft cooling towers on vegetation surrounding the CREC. This long-term study was conducted from 1981 through 1995 as a condition of the facility's NPDES and Prevention of Significant Deterioration (PSD) permits. The results of the study demonstrated that there were no significant impacts to vegetation in the area surrounding the plant resulting from cooling tower operation and in 1995 FDEP was petitioned to approve termination of the study. In March of 1996, FDEP concluded that there were no significant impacts to vegetation due to salt drift from the plant and authorized facility to discontinue the study.

Impacts on vegetation attributable to salt drift emissions from the proposed cooling tower plumes at the LNP site are expected to be SMALL, and increases in soil salinity are anticipated to be minimal. No mitigation is required.

5.3.3.2.2 Vapor Plumes and Icing

As discussed in ER Subsection 5.3.3.1.1, there will be visible plumes resulting from the operation of the LNP cooling towers. As discussed in ER Subsection 5.3.3.1.2, there could also be icing impacts in the immediate vicinity of the cooling tower, but none are expected at any off-site locations.

The impact of cooling tower plumes on terrestrial ecosystems is expected to be SMALL, and no mitigation is required.

5.3.3.2.3 Precipitation Modifications

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

The operation of the LNP cooling towers is not expected to result in a significant increase in precipitation, its impacts are anticipated to be SMALL, and no mitigation is required.

5.3.4 IMPACTS ON MEMBERS OF THE PUBLIC

This subsection describes the potential human health impacts associated with the cooling system proposed for the new LNP units, specifically, potential impacts on human health from thermophilic microorganisms from the aerosolization of waterborne pathogens, and the potential impacts of noise generated by the cooling towers on humans residing outside the property boundary. Because the LNP closed-cycle cooling system will use mechanical draft cooling towers, most of the thermal discharge, and most of the thermophilic organisms, if any, will be released in the lower reaches of the local atmosphere and are not expected to move beyond the site boundary.

5.3.4.1 Thermophilic Microorganism Impacts

Microorganisms associated with cooling towers and thermal discharges can impair human health. These organisms are called thermophilic organisms, because their presence and numbers can be increased by the addition of heat to their habitats. Thermophilic organisms with the potential to affect human health include *Salmonella sp.*, *Shigella sp.*, *Legionella sp.*, *Naegleria sp.* (particularly *Naegleria fowleri*) and *Acanthamoeba sp.*

Salmonella and *Shigella* are enteric (digestive system) pathogens and must be ingested to produce symptoms. Other microorganisms normally present in surface water include the bacteria *Legionella sp.*, which is manifested as Legionnaires' disease, so named for the first documented cases at a Legionnaires' convention in Philadelphia some years ago and traced in improperly cleaned air conditioning systems, and the free-living amoebae of the genera *Naegleria* and *Acanthamoeba*. *Naegleria fowleri* causes primary amoebic meningoencephalitis (PAM) and *Acanthamoebic keratitis* and *Acanthamoebic uveitis* cause granulomatious amoebic encephalitis (GAE). GAE is a particular risk for persons who are immunodeficient, although infections have occurred in otherwise healthy individuals. The primary infection site is thought to be the lungs. The organisms that are in the brain are generally associated with blood vessels, suggesting vascular dissemination. Only 100 to 200 reports of PAM have occurred worldwide. Sources of infection for PAM generally include heated swimming pools, thermal springs, and a variety of naturally or artificially heated surface waters. During 1993 to 1994, only one case of PAM was reported by the Centers for Disease Control (CDC) (Reference 5.3-004).

A study of cooling waters from 11 nuclear power generating facilities and associated control source waters indicated that only two sites were positive for the pathogenic *Naegleria fowleri*. In addition to testing for pathogenic amoebae in cooling waters, the 11 nuclear power generating facilities in the 1981 study were also studied for the presence of *Legionella* sp. In general, the artificially heated waters showed only a slight increase (that is, less than tenfold) in concentrations of *Legionella* sp. relative to source water. In a few cases, source waters had higher levels than did heated waters. Infectious *Legionella* sp. was found in seven of 11 test waters and five of 11 source waters. An additional study of *Legionella* sp. presence in the environs of coal-fired electric power plants showed that *Legionella* was only infrequently found in locations that were not adjacent to cleaning operations. It was concluded that exposure to *Legionella* sp. from power plant operations was a potential problem for part of the workforce, but that it would not be a public health issue because concentrated aerosols of the bacteria would not traverse plant boundaries. Because the route of infection with *Naegleria* sp. is through inhalation, power plant workers directly working on cooling tower maintenance, and who are potentially exposed to aerosols that could harbor this pathogen, may require respiratory protection. The decision to require respiratory protection for workers addressing maintenance of the cooling towers will need to be a PEF decision, based on data and/or information acquired by qualified health professionals.

It is anticipated that the generated plumes from the low-rise banks of mechanical cooling towers will be restricted to within the power plant property boundaries and that the longest plumes will generally be restricted to the cooler months of the year. Coupled with planned biocide treatment of the cooling tower basin and the low probability of aerosol pathogen formation, the predicted impacts of cooling tower dispersed thermophilic pathogens on the public are expected to be SMALL.

5.3.4.2 Noise Impacts from Cooling Tower and CWIS Operation

When the LNP becomes fully operational, the potential for impacts from the cooling water system on ambient noise levels in the areas surrounding the plant and its supporting facilities will exist from the following primary sources of noise or noise-producing activities:

- Mechanical draft cooling towers and circulating water pumps
- CWIS makeup water pumphouse that will be located adjacent to the CFBC, approximately 5.75 km (3.5 mi.) south of the center of the main plant site near County Road 40 (CR-40).

An assessment of the impacts on ambient noise levels during the operation of the LNP was previously evaluated in support of PEF's Site Certification Application (SCA) to the State of Florida and described in a report entitled, "Noise Assessment of Proposed Levy Nuclear Plant," dated March 10, 2008. The noise sources evaluated as part of this assessment included the main plant components, including the cooling towers and the cooling system makeup water pumphouse located near the CFBC.

The noise assessment of the LNP was performed in support of the PEF's SCA to the State of Florida. The noise assessment, which included an ambient background noise survey (described in ER Subsection 2.5.2.7.1), was based on a noise modeling analysis to predict noise levels during operation. This analysis indicated that noise from the main plant equipment may be perceptible at the nearest off-site locations (that is, near the west property boundary of the project site); however, the areas where these perceptible noise levels would exist are not presently developed and there are no sensitive noise receptors (residences) in those areas. The nearest existing residences are located approximately 2.6 km (1.6 mi.) to the northwest and 2.8 km (1.7 mi.) to the west southwest of the center of the project site. There are no other potentially sensitive noise receptors at closer distances than these residences relative to the main plant site. At these locations noise impacts attributable to normal plant operation were predicted to be in the range of 25 to 28 decibels (A-weighted scale) (dBA) at the three nearest residences, which are located to the west of the project site. These noise levels would only be perceptible under limited ambient conditions, such as calm winds with very low background ambient noise levels. The increase in noise levels at the nearest residences would be less than 2 dBA during periods when ambient background noise levels are most quiet. The noise analysis also predicted that off-site noise levels would not threaten or exceed the noise limitations established by the Levy County Noise Ordinance (that is, 65 dBA for daytime hours, 55 dBA for nighttime hours in rural and residential areas).

A noise assessment (described in ER Subsection 2.5.2.7.1) was also performed in the vicinity of the cooling system makeup water pumphouse that will be located adjacent to the CFBC, which parallels the CFG. Maximum noise levels in the publicly accessible areas near the proposed location of the pumphouse (which is expected to be constructed of walls and roof with substantial noise transmission loss and acoustical grade louvers will be used for ventilation air) will be limited to acceptable levels. Noise levels in the vicinity of the pumphouse will be below the Levy County Noise Ordinance limitations for rural and residential areas.

The closest recreation areas to the LNP site (including the pipeline and heavy haul road corridor) are the CFG (parallel to the CFBC) and the Goethe State Forest, the most southerly portion of which borders the north boundary of the plant site (approximately 2.9 km [1.8 mi.] from the center of the plant site). Because of the large distances of these two areas from the main plant components at the LNP, noise impacts attributable to the operation of that equipment in these recreational areas are not expected to be significant. While noise levels in the immediate vicinity of the pumphouse might be noticeable, it will not exceed the Levy County Noise Ordinance limitations. The area where noise levels might be noticed is expected to be very localized and in close proximity to the pumphouse.

Noise-related impacts from operation of the cooling water system are expected to be SMALL, and no additional mitigation measures are warranted.

5.3.5 REFERENCES

5.3-001 Stone and Webster, “Final Report – Crystal River 316 Studies,” January 1985, prepared for Florida Power Corporation.

5.3-002 U.S. Environmental Protection Agency, “CALPUFF Modeling System, Version 6.112”. 2007. TRC Environmental Corp., 650 Suffolk Street, Lowell, MA 01854. Available at: www.trc.com/calpuff/calpuff1.htm

5.3-003 U.S. Environmental Protection Agency, “American Meteorological Society/U.S. Environmental Protection Agency Regulatory Model (AERMOD), Version 07026,” 2007, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, North Carolina, 27711. Available at: www.epa.gov/scram001/dispersion_prefrec.htm

5.3-004 Center for Disease Control and Prevention, “Surveillance for Waterborne-Disease Outbreaks – United States, 1993-1994,” Website, www.cdc.gov/mmwr/preview/mmwrhtml/00040818.htm, accessed August 29, 2007.

5.4 RADIOLOGICAL IMPACTS OF NORMAL OPERATION

This section describes the radiological impacts of normal plant operation on members of the public, plant workers, and biota. ER Subsection 5.4.1 describes the exposure pathways by which radiation and radioactive effluents could be transmitted from the LNP to organisms living near the plant. ER Subsection 5.4.2 estimates the maximum doses to the public from the operation of one new AP1000. ER Subsection 5.4.3 evaluates the effects of these doses by comparing them to regulatory limits for one unit and describes the radiation doses to plant workers from the new units. In addition, the impact of two new units is compared to the corresponding regulatory limit. ER Subsection 5.4.4 considers the effect to nonhuman biota.

5.4.1 EXPOSURE PATHWAYS

A radiological exposure pathway is the vehicle by which a receptor may become exposed to radiological releases from nuclear facilities. The major pathways of concern are those that could cause the highest calculated radiological dose. These pathways are determined from the type and amount of radioactivity released, the environmental transport mechanism, and how the station environs are used (for example, residence, gardens). The environmental transport mechanism includes the historical meteorological characteristics of the area that are defined by wind speed and wind direction. This information is used to evaluate how the radionuclides will be distributed within the surrounding area. The most important factor in evaluating the exposure pathway is the use of the environment by the residents in the area around the new units. Factors such as location of homes in the area, use of cattle for milk, and the growing of gardens for vegetable consumption are considerations when evaluating exposure pathways.

Routine radiological effluent releases from the LNP are a potential source of radiological exposure to man and biota. The potential exposure pathways include aquatic (liquid) and gaseous particulate effluents. The radioactive gaseous effluent exposure pathways include direct radiation, deposition on plants and soil, and inhalation by animals and humans. The radioactive liquid effluent exposure pathways include fish and invertebrate consumption and direct exposure from radionuclides that may be deposited in the Gulf of Mexico.

The description of the exposure pathways and the calculational methods used to estimate doses to the maximally exposed individual and to the population surrounding the LNP site are based on NRC Regulatory Guides 1.109 and 1.111. The source terms used in estimating exposure pathway doses are based on the values provided in ER Chapter 3.

5.4.1.1 Liquid Pathways

In accordance with plant procedures, small amounts of liquid radioactive effluents (below regulatory limits) will be mixed with the cooling water and discharged to the Gulf of Mexico. The most significant exposure pathways include the following:

- Internal exposure from ingestion of fish and invertebrates caught in the Gulf of Mexico.
- External exposure from the surface of contaminated water or from shoreline sediment.
- External exposure from immersion in contaminated water.

The LADTAP II computer program, as described in NUREG/CR-4013, and the liquid pathway parameters presented in Tables 5.4-1 and 5.4-2, were used to calculate the maximum exposed individual dose and the population doses from this pathway. This program implements the radiological exposure models described in Regulatory Guide 1.109 for radioactivity releases in liquid effluent.

A discussion pertaining to doses calculated for liquid pathway is presented in ER Subsection 5.4.2.1.

5.4.1.2 Gaseous Pathways

The methodology contained in the GASPAR II program (described in NUREG/CR-4653) was used to determine the doses for gaseous pathways. This program implements the radiological exposure models described in Regulatory Guide 1.109 for radioactivity releases in gaseous effluent. The code calculates the radiation exposure to people through the following potential pathways:

- External exposure to airborne radioactivity.
- External exposure to deposited activity on the ground.
- Inhalation of airborne radioactivity.
- Ingestion of contaminated agricultural products.

Tables 5.4-3, 5.4-4, and 5.4-5 present the gaseous pathway parameters used by the code to calculate doses for both the maximum exposed individual and for the population. A discussion pertaining to doses calculated for these gaseous pathways is presented in ER Subsection 5.4.2.2.

5.4.1.3 Direct Radiation from the LNP

Contained sources of radiation at the new units will be shielded. The AP1000 is expected to provide shielding that is at least as effective as existing light water reactors (LWRs). An evaluation of all operating plants by the NRC in NUREG-1437, Section 4.6.1.2 states that:

> . . . because the primary coolant of an [light-water reactor] LWR is contained in a heavily shielded area, dose rates in the vicinity of light water reactors are generally undetectable and are less than 1 [millirem per year]

mrem/year at the site boundary. Some plants [mostly (boiling water reactors) BWR] do not have completely shielded secondary systems and may contribute some measurable off-site dose.

The direct radiation from normal operation will result in small contributions at site boundaries. Therefore, direct dose contribution from the new units is anticipated to be SMALL, and would not warrant additional mitigation.

5.4.2 RADIATION DOSES TO MEMBERS OF THE PUBLIC

This subsection provides an evaluation of the calculated doses to the maximum exposed individual from liquid and gaseous effluents from one new unit using the methodologies and parameters specified in ER Subsection 5.4.1.

5.4.2.1 Liquid Pathways Doses

Dose rate estimates to the maximally exposed individual from liquid effluent releases were determined for the following:

- Eating fish and invertebrates caught in the Gulf of Mexico.
- Using the shoreline for activities, such as sunbathing or fishing.
- Swimming and boating on the Gulf of Mexico.

The estimates for whole body and critical organ doses from these interactions are presented in Table 5.4-6. These dose rates would only occur under conditions that maximize the resultant dose. It is unlikely that any individual would receive doses of the magnitude calculated.

5.4.2.2 Gaseous Pathways Doses

Dose rate estimates were calculated for hypothetical situations involving individuals of various ages exposed to gaseous radioactive effluents through the following pathways:

- Direct radiation from immersion in the gaseous effluent plume and from particulates deposited on the ground.
- Inhalation of gases and particulates.
- Ingestion of milk contaminated through the grass-goat-milk pathway.
- Ingestion of foods contaminated by gases and particulates.

Table 5.4-7 provides the estimated whole body and critical organ doses for the identified gaseous effluent pathways.

5.4.3 IMPACTS ON MEMBERS OF THE PUBLIC

In this subsection, the radiological effects on individuals and population groups from liquid and gaseous effluents are presented using the methodologies and parameters specified in ER Subsection 5.4.1. The maximum exposed individual dose calculated from the liquid effluents was compared to 10 CFR 50, Appendix I criteria as shown in Table 5.4-8. The maximum exposed individual dose calculated from the gaseous effluents was compared to 10 CFR 50, Appendix I criteria as shown in Table 5.4-9. The maximum exposed individual dose calculated from the liquid and gaseous effluents was compared to 40 CFR 190 criteria as shown in Table 5.4-10. As indicated in NUREG-1555, ESRP 5.4.3, demonstration of compliance with the limits of 40 CFR 190 is considered to be in compliance with the 0.1-roentgen equivalent man (rem) limit of 10 CFR 20.1301.

The population dose from gaseous effluents to individuals living within an 80-km (50-mi.) radius of LNP was also calculated. For these doses, the population data were projected to the year 2020. The population dose for the various pathways (immersion, inhalation, ingestion, and ground deposition) is provided in Table 5.4-11.

Population doses resulting from natural background radiation to individuals living within an 80-km (50-mi.) radius of LNP is presented in Table 5.4-12 for comparison. Comparing the values from Tables 5.4-11 and 5.4-12 demonstrates that the calculated person-roentgen equivalent man per year (person-rem/yr) exposure from the plant is much less than the estimated person-rem/yr exposure from natural radiation.

Impacts on members of the public from operation of the new units will be SMALL and will not warrant additional mitigation.

5.4.4 IMPACTS ON BIOTA OTHER THAN MEMBERS OF THE PUBLIC

Radiation exposure pathways to biota other than man or members of the public are examined to determine if the pathways could result in doses to biota greater than those predicted for man. This assessment uses surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are typically used for judging doses to biota since important attributes are well defined and accepted.

Important biota are state- or federally listed species that are endangered, threatened, commercial, recreationally valuable, or important to the local ecosystem. Table 5.4-13 identifies important biota from ER Section 2.4 and surrogate biota used in this evaluation. Surrogate biota includes algae (also taken as aquatic plants), invertebrates, fish, muskrat, raccoon, duck, and heron. Some of the important terrestrial biota derive their food from terrestrial pathways not readily associated with aquatic pathways used in the analyses of surrogate biota.

This assessment uses pathway models adopted from Regulatory Guide 1.109 to evaluate pathways including:

- Ingestion of aquatic foods including fish, invertebrates, and aquatic plants.
- Ingestion of water.
- External exposure from water immersion and shoreline sediment.
- External exposure to immersion in gaseous effluent plumes.
- Inhalation of gaseous effluents.
- Surface exposure from deposition of iodine and particulates from gaseous effluents.
- Ingestion of terrestrial vegetation and organisms.

As described and demonstrated in the following subsections, dose impacts to biota are SMALL.

5.4.4.1 Liquid Effluents

The concentrations of radioactive effluents are estimated in the CREC discharge canal since LNP effluents can be released via this path or directly to the Gulf of Mexico. The model used for estimating nuclide concentrations is similar to that used in the analysis for doses to man described in ER Subsection 5.4.2. Table 5.4-1 summarizes parameters used in the calculation of the LNP nuclide concentrations. Also, contributions from CREC Unit 3 liquid effluent releases are included in the biota dose assessment using the activities identified in CREC Unit 3's UFSAR, Table 11-6.

The radionuclide uptake for the aquatic plants, invertebrates and fish are calculated using element-dependent bioaccumulation factors. Doses to these primary organisms are then determined from the effective gamma and beta energies absorbed within the organisms.

Doses to important and surrogate biota assume the ingestion of the primary aquatic organisms with their associated radionuclide concentrations. The doses to important and surrogate biota are calculated using total body dose conversions factors for man with adjustments for food intake rate, body mass and effective radius (size) of the biota. These parameters are shown in Table 5.4-14.

Internal doses to primary aquatic organisms and surrogate biota are calculated by LADTAP II and are shown in Table 5.4-15. The internal doses to important biota are determined by adjusting the primary organism and surrogate doses as previously described. The resultant doses to important biota are also shown in Table 5.4-15.

The external doses from liquid effluents are calculated by LADTAP II for swimming and shoreline exposures. These doses are shown in Table 5.4-15 for primary organisms and surrogate biota. The external doses are directly proportional to the exposure times and can be scaled to obtain doses for the important biota. Residence times for the surrogate and important biota are shown in Table 5.4-14. External doses to important biota are shown in Table 5.4-15.

5.4.4.2 Gaseous Effluents

Gaseous effluents contribute to terrestrial total body doses. External doses occur due to deposition of radionuclides on the ground and immersion in a plume of noble gas. Inhalation doses can occur from non-noble radionuclides. Internal doses result from the consumption of food and water.

Doses to biota from gaseous effluents are determined using GASPAR II with the normal operating releases described in ER Subsection 5.4.3. Doses are calculated for biota in the vicinity of the site or within the site boundary. The biological site vicinity extends out to 10 miles. Doses in the vicinity of the site use dispersion and deposition coefficients averaged over the 0.8 km (0.5 mi.) to 16.09 km (10 mi.) distance. Doses within the site boundary are calculated using dispersion and deposition coefficients averaged out to 1.6 km (one mile). Sector averages are used since the evaluation is performed for the species population as a whole rather than to individual members of the population. Meteorological data from ER Section 2.7 for the worst sector are used in both cases.

This assessment uses the gamma and beta energy absorption rates in air calculated by GASPAR II to bound the external doses from ground deposition, immersion, and inhalation of the gaseous radionuclides. The doses are adjusted for terrestrials' residence times based on Table 5.4-14. The total dose from the three pathways is shown as the external dose from gaseous effluents in Table 5.4-15.

The external dose contribution from ground deposition is taken as twice the GASPAR II calculated dose for man in consideration of the closer proximity of terrestrials to ground than man.

GASPAR II's total body doses from gaseous plumes are based on a penetration depth of 5 cm (2 in.) corresponding to the approximate location of blood forming organs in man. This depth may be inappropriate for smaller terrestrials. The gamma energy absorption rate in air is used because it neglects the self-shielding provided by the terrestrial's body.

The beta energy absorption rate in air is reduced by one-half because of the limited penetration of beta radiation. GASPAR II shows that more than half of the gamma and beta air dose is deposited in the epidermal layer in man. Therefore, the beta dose can be reduced by one-half to provide an upper bound estimate of the beta contribution to the total body dose to terrestrials.

The inhaled noble gases do not deposit in the lungs and are only poorly absorbed in blood; hence, inhaled noble gases only irradiate the lungs and contribute very little to the total body dose. Inhalation of the non-noble radionuclides followed by uptake in the lung contributes to the total body dose. The contribution (mostly due to tritium) is only about 10 percent of the total body dose from immersion in the noble gas plume. The inhalation contribution is well bounded when using the gamma and beta energy absorption rates in air for the combined immersion and inhalation dose.

Some biota in Table 5.4-13 derive food from terrestrial plants, insects or small mammals. The ingested doses are estimated from the equilibrated concentrations of gaseous tritium and radiocarbon C-14 that accumulate in vegetation and in open pools of water. The approach is reasonable since GASPAR II calculations show that tritium and radiocarbon C-14 effluents account for 97 percent of the dose in humans from vegetation and meat from LNP gaseous effluents.

Concentrations of tritium and radiocarbon C-14 in air tend to set the ingested concentrations in terrestrial biota. If terrestrials feed on vegetation with given tritium and radiocarbon C-14 specific activities, the specific activities in the terrestrials in the steady state will be similar to the activities in the vegetation. The vegetation-specific activities, however, are in equilibrium with the specific activity concentrations in air. Similarly, terrestrials consuming insects or small mammals will have the same tritium and radiocarbon C-14 specific activities as those in the vegetation originally consumed. These conditions occur under steady state conditions and conservatively assume that the food (vegetation or insect or small mammal) is produced and consumed at the same location.

The specific activity concentrations in vegetation are calculated using guidance in Regulatory Guide 1.109. The ingested biota doses are calculated from the equilibrium-specific activities using the total body dose conversion factors for adult humans, adjusted for consumption rate and body mass in Table 5.4-14. The approach is similar to that used in LADTAP II to determine ingested doses to biota. Doses from ingestion of water and terrestrial vegetation and organisms as food are shown as internal doses from gaseous effluents in Table 5.4-15.

5.4.4.3 Biota Doses

Doses to surrogate and important biota from LNP's liquid and gaseous effluents are shown in Table 5.4-15. Table 5.4-16 shows the total doses to surrogate biota and the important biota identified in Table 5.4-13. Contributions from CREC Unit 3 are included in both tables since LNP and CREC Unit 3 liquid effluents can be released to a common discharge canal.

Table 5.4-16 shows that with the exception of the red-cockaded woodpecker and northern bobwhite, the doses meet the 25 milliRoentgen equivalent man per year (mrem/yr) whole body dose equivalent criterion in 40 CFR 190. The criteria for thyroid and next highest organ in 40 CFR 190 are not used in this assessment since all doses in the models are based on total body doses.

Use of exposure guidelines, such as 40 CFR 190, which apply to members of the public in unrestricted areas, are considered very conservative when evaluating calculated doses to biota. The International Council on Radiation Protection states that "…if man is adequately protected then other living things are also likely to be sufficiently protected," and uses human protection to infer environmental protection from the effects of ionizing radiation. This assumption is appropriate in cases where humans and other biota inhabit the same environment and have common routes of exposure.

Species in most ecosystems experience dramatically higher mortality rates from natural causes than humans. From an ecological viewpoint, population stability is considered more important to the survival of the species than the survival of individual organisms. Thus, higher dose limits could be permitted. In addition, no biota have been discovered that show significant changes in morbidity or mortality to radiation exposures predicted for nuclear power plants.

An international consensus has been developing with respect to permissible exposures to biota (Reference 5.4-001). The available evidence shows that appreciable effects in aquatic populations would not be expected at doses lower than 1 rad/day and that limiting the dose to the maximally exposed individual organisms to less than 1 rad/day would provide adequate protection of the population. In addition, chronic dose rates of 0.1 rad/day or less do not appear to cause observable changes in terrestrial animal populations. The lower threshold for terrestrials is assumed because some species of mammals and reptiles are considered more radiosensitive than aquatic organisms. The permissible dose rates are considered screening levels and higher species-specific dose rates could be acceptable with additional study or data.

The calculated total body doses for biota are compared in Table 5.4-16 to the dose criteria evaluated in the *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards*. The biota doses meet the dose guidelines by a large margin. In these cases, the annual dose to biota is much less than the daily allowable doses to aquatic and terrestrial organisms.

5.4.5 OCCUPATIONAL RADIATION EXPOSURES

This subsection provides a discussion of the anticipated occupational radiation exposure to LNP operating personnel. Estimates of these radiation doses are intended to provide a quantitative basis for the regulatory assessment of the potential risks and health effects on operating personnel.

Similar to current plant designs, occupational exposure from the operation of advanced reactor designs will continue to result from exposure to direct radiation from contained sources of radioactivity and from the small amounts of airborne sources typically resulting from equipment leakages. Past experience demonstrates that, for commercial nuclear power reactors, the dose to operating personnel from airborne activity is not a significant contributor to the total occupational dose. This experience is expected to continue to apply to the LNP.

As indicated in NUREG-1437, for the purpose of assessing radiological effects on`` workers, NRC has concluded that impacts are of small significance if doses and releases do not exceed permissible levels in the NRC's regulations. The standards for acceptable dose limits are given in 10 CFR Part 20. For AP1000 units at the LNP site, the radiation exposures to operating personnel will be maintained within the limits of 10 CFR 20 and will also satisfy the As Low As Reasonably Achievable (ALARA) guidance contained in Standard Review Plan, Chapter 12.1 and Regulatory Guide 8.8.

Administrative programs and procedures governing Radiation Protection and Health Physics in conjunction with the radiation protection design features will be developed with the intent to maintain occupational radiation exposures to ALARA levels.

The average annual collective occupational dose information for LWR plants operating in the United States between 1973 and 2005 are given in Table 5.4-17, based on data provided in NUREG-0713. The more recent dose data presented in this report are based on 35 BWR and 69 pressurized water reactors (PWR). The data show that, historically (since 1974), the average collective dose and average number of workers per BWR type plant have been higher than those for PWRs and that the values for both parameters, in general, continued to rise until 1983. Thereafter (data through 2005), the average collective dose per LWR dropped by about 85 percent. The overall decreasing trend in average reactor collective doses since 1983 is indicative of successful implementation of ALARA dose reduction measures at commercial power reactor facilities.

The variation in annual collective dose at operating reactors results from a number of factors such as required maintenance, reactor operations, and required in-plant surveillances. These factors have varied in the past, but are expected to improve with the AP1000 advanced design concepts.

The 3-year average collective doses per reactor is one of the metrics that the NRC uses in the Reactor Oversight Process to evaluate the effectiveness of a licensee's ALARA program. Tables 5.4-18 and 5.4-19 show the BWR and PWR commercial reactor sites in operation for at least 3 years as of December 31, 2005, and detail the occupational exposure statistics. As shown in Table 5.4-18, the BWR average annual collective total effective dose equivalent (TEDE) per reactor, average measurable TEDE per worker, and average collective TEDE per megawatt year (MW-yr) are 163 person-rem, 0.17 rem, and 0.19 person-rem per MW-yr, respectively. Similarly, as presented in Table 5.4-19, the PWR average annual collective TEDE per reactor, average measurable TEDE per worker, and average collective TEDE per MW-yr are 81 person-rem, 0.13 rem, and 0.09 person-rem per MW-yr, respectively.

Using this metric and the distribution of occupational exposures, a conservative estimate for the LNP is expected to be less than the recent PWR average collective TEDE dose per reactor of 81 person-rem. The average annual dose of less than 0.2 rem per nuclear plant worker at operating BWRs and PWRs is well within the limits of 10 CFR 20. The exposure impacts are considered to be SMALL and pose a risk that is comparable to the risks associated with other industrial occupations.

5.4.6 REFERENCES

5.4-001 Oak Ridge National Laboratory, Environmental Service Division, "Effects of Ionizing Radiation on Terrestrial Plants and Animals: A Workshop Report," ORNL/TM-13141, prepared for the U.S. Department of Energy, December 1995.

Table 5.4-1
Liquid Pathways Parameters

Description	Parameter
Saltwater Site	Selected
LNP Cooling Tower Blowdown Rate (mgd)	81.39
Crystal River Plant Discharge Canal Average Flow Rate (mgd)	1651.8
Source Term	Table 3.5-1
Reconcentration Model	No reconcentration
Shore Width Factor	1.0
50-mile Population	1,440,207
Dilution Factor for All Pathways	21[a]
Transit time – Aquatic Food and Recreational Uses (hour)	0
Sport Fish Annual Harvest (kg/yr)	210,246
Commercial Fish Annual Harvest (kg/yr)	734,960
Sport Invertebrate Annual Harvest (kg/yr)	142,438
Commercial Invertebrate Annual Harvest (kg/yr)	1,424,384
Shoreline Usage (person-hr/yr)	32,541,940
Swimming Exposure (person-hr/yr)	32,541,940
Boating Exposure (person-hr/yr)	32,071,440

Notes:

a) Dilution factor conservatively determined only taking credit for dilution of the LNP Cooling Tower Blowdown in the Crystal River plant discharge. No credit is taken for any additional dilution in the waters of the Gulf.

Dilution Factor = [1651.8 mgd + 81.39 mgd] / 81.39 mgd = 21

hr/yr = hours per year
kg/yr = kilograms per year
mgd = million gallons per day

Table 5.4-2
Liquid Pathways Consumption Factors for the Maximum Exposed Individual

Pathway	Adult	Teen	Child	Infant
Fish consumption[(a)]	21 kg/yr	16 kg/yr	6.9 kg/yr	N/A
Invertebrate consumption[(a)]	5 kg/yr	3.8 kg/yr	1.7 kg/yr	N/A
Shoreline usage[(a)]	12 hr/yr	67 hr/yr	14 hr/yr	N/A
Swimming exposure (assumed same as shoreline)	12 hr/yr	67 hr/yr	14 hr/yr	N/A
Boating (assumed)	100 hr/yr	67 hr/yr	14 hr/yr	N/A

Notes:

a) LADTAP default values.

hr/yr= hour per year
kg/yr = kilogram per year
N/A = not applicable

Table 5.4-3
Gaseous Pathways Parameters

Description	Value
Population Data	Tables 2.5-2 and 2.5-4
Milk Production	Table 5.4-5
Vegetable Production	Table 5.4-5
Meat Production	Table 5.4-5
Source Term	Table 3.5-3
Meteorological Data	
Annual Average (X/Q)	FSAR Section 2.3
Annual Average (D/Q)	FSAR Section 2.3
Annual Average Decayed (2.26 day) (X/Q)	FSAR Section 2.3
Annual Average Depleted and Decayed (8-day) D/Q	FSAR Section 2.3
Maximum Individual Data	
Fraction of the year leafy vegetables are grown	0.92
Fraction of the year milk cows are on pasture	N/A (No milk cows identified within 5 mi. of LNP)
Fraction of the year maximum individual's vegetable intake is from own garden	1.0
Fraction of the year goats are pasture	1.0
Fraction of the year beef cattle are on pasture	0.92
Fraction of the beef cattle feed intake from pasture while on pasture	1.0

Notes:

D/Q = relative deposition
N/A = not applicable
X/Q = atmospheric dilution factor

Table 5.4-4
Gaseous Pathways Consumption Factors for the Maximum Exposed Individual

Pathway	Adult	Teen	Child	Infant
Leafy Vegetables	64 kg/yr	42 kg/yr	26 kg/yr	N/A
Meat	110 kg/yr	65 kg/yr	41 kg/yr	N/A
Milk	310 L/yr	400 L/yr	330 L/yr	330 L/yr
Vegetable	520 kg/yr	630 kg/yr	520 kg/yr	N/A

Notes:

Data represent GASPAR default values.

kg/yr = kilogram per year
L/yr = liter per year
N/A = not applicable

Table 5.4-5 (Sheet 1 of 3)
Agricultural Statistics

From Degree	To Degree	Compass Direction	Radial Distance (miles)	Milk Production (liters)	Vegetable Production (kg)	Meat Production (kg)
78.75	101.25	E	0 - 1	0	0	0
78.75	101.25	E	1 - 2	0	0	0
78.75	101.25	E	2 - 3	0	0	0
78.75	101.25	E	3 - 4	0	0	0
78.75	101.25	E	4 - 5	0	433,253	36,818
78.75	101.25	E	5 - 10	1210	1,219,613	196,926
78.75	101.25	E	10 - 20	4582	4,759,022	780,419
78.75	101.25	E	20 - 30	7617	7,911,681	1,297,414
78.75	101.25	E	30 - 40	10,653	11,064,340	1,814,410
78.75	101.25	E	40 - 50	14,741	15,061,692	2,335,465
56.25	78.75	ENE	0 - 1	0	0	0
56.25	78.75	ENE	1 - 2	0	0	0
56.25	78.75	ENE	2 - 3	0	0	0
56.25	78.75	ENE	3 - 4	0	0	0
56.25	78.75	ENE	4 - 5	0	0	36,818
56.25	78.75	ENE	5 - 10	1140	1,380,349	204,628
56.25	78.75	ENE	10 - 20	4582	4,759,022	780,419
56.25	78.75	ENE	20 - 30	7617	7,911,681	1,297,414
56.25	78.75	ENE	30 - 40	10,653	11,064,340	1,814,410
56.25	78.75	ENE	40 - 50	13,688	14,217,000	2,331,406
101.25	123.75	ESE	0 - 1	0	0	0
101.25	123.75	ESE	1 - 2	0	0	0
101.25	123.75	ESE	2 - 3	0	0	0
101.25	123.75	ESE	3 - 4	0	0	28,806
101.25	123.75	ESE	4 - 5	0	0	35,065
101.25	123.75	ESE	5 - 10	5730	324,669	124,660
101.25	123.75	ESE	10 - 20	19,993	1,617,409	529,985
101.25	123.75	ESE	20 - 30	13,291	4,448,751	2,561,343
101.25	123.75	ESE	30 - 40	7959	5,741,741	5,310,936
101.25	123.75	ESE	40 - 50	24,900	21,643,531	4,210,140
348.75	11.25		0 - 1	0	0	0
348.75	11.25	N	1 - 2	0	0	0
348.75	11.25	N	2 - 3	0	244,688	0
348.75	11.25	N	3 - 4	0	338,971	28,806
348.75	11.25	N	4 - 5	0	433,253	36,818
348.75	11.25	N	5 - 10	983	3,580,503	304,271
348.75	11.25	N	10 - 20	3905	14,232,194	1,209,451
348.75	11.25	N	20 - 30	47,381	23,638,508	2,023,816
348.75	11.25	N	30 - 40	10,257,365	37,632,653	3,470,673
348.75	11.25	N	40 - 50	21,347,827	52,770,601	4,776,244
33.75	56.25	NE	0 - 1	0	0	0
33.75	56.25	NE	1 - 2	0	0	0
33.75	56.25	NE	2 - 3	0	0	0
33.75	56.25	NE	3 - 4	0	0	0
33.75	56.25	NE	4 - 5	0	433,253	0
33.75	56.25	NE	5 - 10	1085	2,141,241	239,088
33.75	56.25	NE	10 - 20	4252	9,376,042	989,520
33.75	56.25	NE	20 - 30	7570	8,581,101	1,327,732
33.75	56.25	NE	30 - 40	660,387	18,267,270	2,365,594
33.75	56.25	NE	40 - 50	1,652,407	31,831,266	3,525,587
11.25	33.75	NNE	0 - 1	0	0	0
11.25	33.75	NNE	1 - 2	0	0	0
11.25	33.75	NNE	2 - 3	0	0	0
11.25	33.75	NNE	3 - 4	0	0	0
11.25	33.75	NNE	4 - 5	0	433,253	0

Table 5.4-5 (Sheet 2 of 3)
Agricultural Statistics

From Degree	To Degree	Compass Direction	Radial Distance (miles)	Milk Production (liters)	Vegetable Production (kg)	Meat Production (kg)
11.25	33.75	NNE	5 - 10	985	3,547,914	302,795
11.25	33.75	NNE	10 - 20	3918	14,061,860	1,201,737
11.25	33.75	NNE	20 - 30	60,015	21,401,646	1,926,826
11.25	33.75	NNE	30 - 40	1,728,998	30,365,011	3,283,501
11.25	33.75	NNE	40 - 50	2,448,527	41,209,520	4,396,931
326.25	348.75	NNW	0 - 1	0	0	0
326.25	348.75	NNW	1 - 2	0	0	0
326.25	348.75	NNW	2 - 3	67	244,688	20,794
326.25	348.75	NNW	3 - 4	93	338,971	28,806
326.25	348.75	NNW	4 - 5	119	433,253	36,818
326.25	348.75	NNW	5 - 10	983	3,580,503	304,271
326.25	348.75	NNW	10 - 20	3905	14,232,194	1,209,451
326.25	348.75	NNW	20 - 30	6493	23,660,445	2,010,664
326.25	348.75	NNW	30 - 40	8,090,229	36,642,862	3,023,930
326.25	348.75	NNW	40 - 50	33,878,691	47,259,392	3,781,470
303.75	326.25	NW	0 - 1	0	0	0
303.75	326.25	NW	1 - 2	0	150,406	0
303.75	326.25	NW	2 - 3	0	244,688	20,794
303.75	326.25	NW	3 - 4	0	338,971	28,806
303.75	326.25	NW	4 - 5	0	433,253	36,818
303.75	326.25	NW	5 - 10	0	3,580,503	304,271
303.75	326.25	NW	10 - 20	3905	14,232,194	1,209,451
303.75	326.25	NW	20 - 30	6493	23,660,445	2,010,664
303.75	326.25	NW	30 - 40	11,764	13,379,001	1,413,496
303.75	326.25	NW	40 - 50	17,400	90,033	601,404
168.75	191.25	S	0 - 1	0	0	0
168.75	191.25	S	1 - 2	0	0	0
168.75	191.25	S	2 - 3	0	0	0
168.75	191.25	S	3 - 4	0	0	0
168.75	191.25	S	4 - 5	0	74,761	0
168.75	191.25	S	5 - 10	6837	38,550	103,969
168.75	191.25	S	10 - 20	24,613	138,786	374,310
168.75	191.25	S	20 - 30	1,165,283	790,676	761,169
168.75	191.25	S	30 - 40	3,558,278	2,092,383	1,379,435
168.75	191.25	S	40 - 50	4,527,997	12,984,779	3,313,093
123.75	146.25	SE	0 - 1	0	0	0
123.75	146.25	SE	1 - 2	0	0	0
123.75	146.25	SE	2 - 3	0	0	0
123.75	146.25	SE	3 - 4	0	322,661	0
123.75	146.25	SE	4 - 5	0	55,342	15,446
123.75	146.25	SE	5 - 10	6837	38,550	103,969
123.75	146.25	SE	10 - 20	27,175	153,231	413,268
123.75	146.25	SE	20 - 30	45,177	254,740	687,042
123.75	146.25	SE	30 - 40	368,345	3,520,984	3,849,831
123.75	146.25	SE	40 - 50	1,398,805	6,540,684	6,255,774
146.25	168.75	SSE	0 - 1	0	0	0
146.25	168.75	SSE	1 - 2	0	0	0
146.25	168.75	SSE	2 - 3	0	0	20,794
146.25	168.75	SSE	3 - 4	0	0	20,488
146.25	168.75	SSE	4 - 5	0	0	13,773
146.25	168.75	SSE	5 - 10	6837	38,550	103,969
146.25	168.75	SSE	10 - 20	27,175	153,231	413,268
146.25	168.75	SSE	20 - 30	696,386	598,278	823,903
146.25	168.75	SSE	30 - 40	4,907,218	2,911,669	1,978,859
146.25	168.75	SSE	40 - 50	6,477,526	10,715,080	3,553,342
191.25	213.75	SSW	0 - 1	0	0	0

Table 5.4-5 (Sheet 3 of 3)
Agricultural Statistics

From Degree	To Degree	Compass Direction	Radial Distance (miles)	Milk Production (liters)	Vegetable Production (kg)	Meat Production (kg)
191.25	213.75	SSW	1 - 2	0	0	0
191.25	213.75	SSW	2 - 3	0	0	20,794
191.25	213.75	SSW	3 - 4	0	289,570	26,012
191.25	213.75	SSW	4 - 5	0	7303	12,730
191.25	213.75	SSW	5 - 10	6834	38,536	103,932
191.25	213.75	SSW	10 - 20	7402	41,736	112,564
191.25	213.75	SSW	20 - 30	615	3470	9360
191.25	213.75	SSW [b]	30 - 40	0	0	0
191.25	213.75	SSW [b]	40 - 50	0	0	0
213.75	236.25	SW	0 - 1	0	0	0
213.75	236.25	SW	1 - 2	0	0	0
213.75	236.25	SW	2 - 3	0	244,688	0
213.75	236.25	SW	3 - 4	0	338,971	0
213.75	236.25	SW	4 - 5	0	189,196	0
213.75	236.25	SW	5 - 10	5835	32,899	88,730
213.75	236.25	SW	10 - 20	72	405	1091
213.75	236.25	SW [b]	20 - 30	0	0	0
213.75	236.25	SW [b]	30 - 40	0	0	0
213.75	236.25	SW [b]	40 - 50	0	0	0
258.75	281.25	W	0 - 1	0	0	0
258.75	281.25	W	1 - 2	0	0	0
258.75	281.25	W	2 - 3	0	0	0
258.75	281.25	W	3 - 4	0	0	0
258.75	281.25	W	4 - 5	0	0	0
258.75	281.25	W	5 - 10	823	2,997,698	254,744
258.75	281.25	W	10 - 20	201	731,207	62,138
258.75	281.25	W	20 - 30	85	309,125	26,269
258.75	281.25	W [b]	30 - 40	0	0	0
258.75	281.25	W [b]	40 - 50	0	0	0
281.25	303.75	WNW	0 - 1	0	0	0
281.25	303.75	WNW	1 - 2	0	0	0
281.25	303.75	WNW	2 - 3	0	0	0
281.25	303.75	WNW	3 - 4	0	0	0
281.25	303.75	WNW	4 - 5	0	0	0
281.25	303.75	WNW	5 - 10	983	3,580,503	304,271
281.25	303.75	WNW	10 - 20	2053	7,479,842	635,637
281.25	303.75	WNW	20 - 30	4652	16,951,694	1,440,554
281.25	303.75	WNW	30 - 40	3270	5,378,896	518,389
281.25	303.75	WNW	40 - 50	557	2,881	19,246
236.25	258.75	WSW	0 - 1	0	0	0
236.25	258.75	WSW	1 - 2	0	150,406	0
236.25	258.75	WSW	2 - 3	0	244,688	0
236.25	258.75	WSW	3 - 4	0	338,971	0
236.25	258.75	WSW	4 - 5	0	430,997	0
236.25	258.75	WSW	5 - 10	1494	1,969,817	181,453
236.25	258.75	WSW	10 - 20	1	4104	349
236.25	258.75	WSW [b]	20 - 30	0	0	0
236.25	258.75	WSW [b]	30 - 40	0	0	0
236.25	258.75	WSW [b]	40 - 50	0	0	0

Notes:

a) A land use survey was conducted of the areas within an 8-km (5-mi.) radius of the LNP site. Based on the results of this survey, the sectors that do not contain milk, vegetable, or meat production were identified and those areas were reported as zero production. Because the nearest feature was identified in the land use survey once a sector was identified as having milk, vegetable, or meat production the remaining sectors in the same direction were also assumed to have milk, vegetable, or meat production.

b) Sectors are situated over water bodies and there do not have current milk, vegetable, or meat production.

Table 5.4-6
Liquid Pathways – Maximum Exposed Individual Dose Summary Based on One AP1000 Unit

Location	Organ Receiving Maximum Dose	Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Gulf of Mexico	GI-LLI	0.071 (adult)	0.0052 (teen)

Notes:

GI-LLI = gastrointestinal tract – lower large intestine wall
mrem/yr = milliRoentgen equivalent man

Table 5.4-7 (Sheet 1 of 2)
Gaseous Pathways – Dose Summary Maximum Exposed Individuals
Based on One AP1000 Unit

Pathway		T.Body (mrem/yr)	GI-Tract (mrem/yr)	Bone (mrem/yr)	Liver (mrem/yr)	Kidney (mrem/yr)	Thyroid (mrem/yr)	Lung (mrem/yr)	Skin (mrem/yr)
Plume - EAB		1.05	1.05	1.05	1.05	1.05	1.05	1.15	6.68
Ground - EAB		1.22E-01	1.22E-01	1.22E-01	1.22E-01	1.22E-01	1.22E-01	1.22E-01	1.44E-01
Cow Milk	Adult	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Teen	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Child	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Infant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Goat Milk	Adult	1.73E-02	1.61E-02	5.26E-02	1.79E-02	1.70E-02	1.19E-01	1.61E-02	1.59E-02
	Teen	2.76E-02	2.63E-02	9.65E-02	2.96E-02	2.81E-02	1.90E-01	2.65E-02	2.61E-02
	Child	5.90E-02	5.77E-02	2.36E-01	6.35E-02	6.07E-02	3.82E-01	5.81E-02	5.75E-02
	Infant	1.15E-01	1.13E-01	4.58E-01	1.25E-01	1.19E-01	9.03E-01	1.14E-01	1.13E-01
Vegetable	Adult	5.53E-01	5.55E-01	2.18E+00	5.53E-01	5.49E-01	1.58E+00	5.41E-01	5.40E-01
	Teen	8.39E-01	8.41E-01	3.56E+00	8.45E-01	8.37E-01	2.18E+00	8.26E-01	8.24E-01
	Child	1.88E+00	1.87E+00	8.54E+00	1.89E+00	1.88E+00	4.43E+00	1.86E+00	1.86E+00
Inhalation	Adult	6.23E-02	6.30E-02	9.05E-03	6.36E-02	6.46E-02	5.45E-01	7.97E-02	6.06E-02
	Teen	6.30E-02	6.36E-02	1.10E-02	6.52E-02	6.66E-02	6.79E-01	8.99E-02	6.11E-02
	Child	5.58E-02	5.51E-02	1.33E-02	5.80E-02	5.91E-02	7.88E-01	7.79E-02	5.40E-02
	Infant	3.22E-02	3.14E-02	6.68E-03	3.45E-02	3.44E-02	7.05E-01	4.77E-02	3.10E-02
Meat	Adult	1.41E-02	1.50E-02	6.19E-02	1.41E-02	1.40E-02	2.02E-02	1.39E-02	1.39E-02
	Teen	1.14E-02	1.20E-02	5.22E-02	1.15E-02	1.14E-02	1.59E-02	1.14E-02	1.14E-02
	Child	2.08E-02	2.10E-02	9.81E-02	2.09E-02	2.08E-02	2.75E-02	2.07E-02	2.07E-02

Table 5.4-7 (Sheet 2 of 2)
Gaseous Pathways – Dose Summary Maximum Exposed Individuals
Based on One AP1000 Unit

Pathway		T.Body (mrem/yr)	GI-LLI (mrem/yr)	Bone (mrem/yr)	Liver (mrem/yr)	Kidney (mrem/yr)	Thyroid (mrem/yr)	Lung (mrem/yr)	Skin (mrem/yr)
Total without plume	Adult	7.69E-01	7.71E-01	2.43E+00	7.71E-01	7.67E-01	2.39E+00	7.73E-01	7.74E-01
	Teen	1.06E+00	1.06E+00	3.84E+00	1.07E+00	1.07E+00	3.19E+00	1.08E+00	1.07E+00
	Child	2.14E+00	2.13E+00	9.01E+00	2.15E+00	2.14E+00	5.75E+00	2.14E+00	2.14E+00
	Infant	2.69E-01	2.66E-01	5.87E-01	2.82E-01	2.75E-01	1.73E+00	2.84E-01	2.88E-01
Total with plume	Adult	1.82E+00	1.82E+00	3.48E+00	1.82E+00	1.82E+00	3.44E+00	1.92E+00	7.45E+00
	Teen	2.11E+00	2.11E+00	4.89E+00	2.12E+00	2.12E+00	4.24E+00	2.23E+00	7.75E+00
	Child	3.19E+00	3.18E+00	1.01E+01	3.20E+00	3.19E+00	6.80E+00	3.29E+00	8.82E+00
	Infant	1.32E+00	1.32E+00	1.64E+00	1.33E+00	1.33E+00	2.78E+00	1.43E+00	6.97E+00

Notes:

EAB = exclusion area boundary
GI-LLI = gastrointestinal tract lower large intestine
mrem/yr = milliRoentgen equivalent man per year

Table 5.4-8
Liquid Pathways – Maximum Individual Dose Compared to 10 CFR 50, Appendix I Criteria (One AP1000 Unit)

Type of Dose	Appendix I Criteria Dose Objective	Point of Dose Evaluation[(a)]	Calculated Doses (mrem/yr) [(b)]
Liquid Effluents			
Dose to whole body from all pathways	3 mrem/yr each unit	Gulf of Mexico	0.0052 Teen
Dose to any organ from all pathways	10 mrem/yr each unit	Gulf of Mexico	0.071 Adult GI-LLI

Notes:

a) Location of the highest dose off-site.

b) Calculated doses presented in Table 5.4-6.

GI-LLI = gastrointestinal tract lower large intestine
mrem/yr = milliRoentgen equivalent man per year

Table 5.4-9
Gaseous Pathways – Maximum Individual Dose Compared to 10 CFR 50, Appendix I Criteria (One AP1000 Unit)

Type of Dose	Design Objective	Point of Evaluation	Calculated Dose
Gaseous Effluents (Noble Gases Only)			
Gamma Air Dose	10 mrad	Exclusion area boundary	1.8 mrad
Beta Air Dose	20 mrad	Exclusion area boundary	9.9 mrad
Whole Body Dose	5 mrem	Exclusion area boundary	3.2 mrem
Skin Dose	15 mrem	Exclusion area boundary	6.7 mrem
Radioiodines and Particulates			
Dose to any organ from all pathways	15 mrem	Varies[(a)]	10.1 mrem (child - bone)

Notes:

a) Locations of highest pathway doses off-site.

mrad = milli-radiation absorbed dose
mrem = milliRoentgen equivalent man

Table 5.4-10
Maximum Exposed Individual Doses from the LNP Site Compared to 40 CFR 190 Criteria (mrem/yr)

Type of Dose	Design Objective (40 CFR 190)	CREC Total Liquid and Gaseous Dose[(a)]	LNP Calculated Liquid Dose (Two Units)	LNP Calculated Gaseous Dose (Two Units)	Total Site Dose
Whole Body Dose Equivalent	25	0.00008	0.021	5.8	5.82
Dose to Thyroid	75	0.002	0.025	13.6	13.63
Dose to another organ	25	0.002	0.14	20.2	20.34

Notes:

a) CREC operating data.

mrem/yr = milliRoentgen equivalent man per year

Table 5.4-11
Calculated Doses to the Population within 80 Km (50 Mi.) of the LNP Site from Gaseous and Liquid Pathways (Two AP1000 Units)

	Calculated Doses (Person-rem/yr-unit)	
Gaseous Pathway	**Whole Body**	**Critical Organ (skin)**
Plume	1.11	13.40
Ground	0.10	0.11
Inhalation	0.40	0.39
Vegetable Ingestion	2.41	2.39
Cow Milk Ingestion	0.23	0.22
Meat Ingestion	0.78	0.77
Total	5.02	17.30

	Calculated Doses (Person-rem/yr-unit)	
Liquid Pathway	**Whole Body**	**Critical Organ (GI-LLI)**
Sport Fish	0.027	0.083
Commercial Fish	0.001	0.004
Sport Invertebrate	0.042	1.700
Commercial Invertebrate	0.001	0.051
Shoreline	1.050	1.050
Swimming	0.005	0.005
Boating	0.003	0.003
Total	1.13	2.89

Notes:

GI-LLI = gastrointestinal tract lower large intestine
person-rem/yr = person-Roentgen equivalent man per year

Table 5.4-12
Natural Background – Estimated Whole Body Dose to the Population within 80 Km (50 Mi.) of the LNP Site

Source	Annual Individual Dose (mrem/yr)	Annual Population Dose[(a)] (person-rem/yr)
Estimated total background radiation dose	360[(b)]	5.2E+05

Notes:

a) Annual population dose based on projected residential population of 1,440,207 in year 2020 from Tables 2.5-2 and 2.5-4.

b) About 360 mrem/yr taken from NRC Fact Sheet, "Biological Effects of Radiation."

mrem/yr = milliRoentgen equivalent man per year
person-rem/yr = person-Roentgen equivalent man per year

Table 5.4-13 (Sheet 1 of 2)
Identified Important Species

Species	Remarks
American Alligator	Observed during site field survey. Lives in fresh and brackish marshes, ponds, lakes, rivers and swamps. Florida special species of concern.
Bald Eagle	Active nest observed south of LNP boundary. Prefers coastal areas or inland waterways. Most migrate north after the breeding season. No longer endangered but remains federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The bald eagle is assumed to reside in the terrestrial vicinity of the site during the breeding season.
Blue hard crab, oyster and stone crab	Commercially harvested invertebrates.
Eastern Indigo Snake	Often lives in gopher tortoise burrows. Snake is diurnal. Federal and state threatened species. The snake is assumed to reside in the terrestrial vicinity of the site.
Florida Black Bear	Known to live in Goethe State Forest and is expected to occasionally use the LNP site for forage or travel. Florida special species of concern. The bear is assumed to reside within the terrestrial vicinity of the site.
Gopher Tortoise	Borrows were observed on site. Prefers sandy, well drained upland areas. State threatened species.
Gulf Sturgeon	Critical habitat is 48 km (30 mi.) north of site at Suwannee River outlet. Spawns in upstream river and tributaries but feeds in estuaries and Gulf. The sturgeon is a state and federal species of special concern. No critical habitat near site.
Manatee	Critical habitat is Crystal River and its head waters. Federal and state-listed endangered species. Manatees reside within the vicinity of the site.
Northern Bobwhite	Recreationally hunted. Assumed to reside within LNP site boundaries due to limited forage range of this species.
Red-cockaded Woodpecker	Resides in the Goethe State Forest; it does not reside on the LNP site. Classified as a federally endangered species and state species of special concern.
Red drum, flounder, and spotted sea trout	More popular recreationally harvested fish.
Red grouper, black grouper, gag grouper, spotted sea trout and flounder	More important commercially harvested fish.
Sea Turtles	Five species of sea turtles (leatherback, loggerhead, hawksbill, green sea, and Kemp's Ridley) identified as endangered or threatened species in Florida waters. Green sea turtle is considered most limiting because of the importance of its feeding in waters near the LNP discharge.

Table 5.4-13 (Sheet 2 of 2)
Identified Important Species

Species	Remarks
Smalltooth Sawfish	Currently observed in the Everglades area near the tip of Florida; however, historically observed in the Gulf from Texas to Florida. Federally listed endangered species in Florida.
Suwannee Cooter	Observed within the vicinity of the site. Resides in river basins and large streams. The cooter is a species of special concern in Florida.
Whitetail deer	Recreationally hunted.
Wild Turkey	Recreationally hunted.
Wood Stork	No colonies observed on-site. Late winter breeding season in wetlands. Listed as federal and state endangered species. Assumed to reside within the terrestrial vicinity of the site for 6 months of the year.

Table 5.4-14 (Sheet 1 of 2)
Biota Parameters

Biota	Food Intake (gpd)	Body Mass (kg)	Shoreline Exposure (hr/yr)	Swimming Exposure (hr/yr)	Terrestrial Exposure (hr/yr)	Effective Body Radius (cm)	Food Organism
Surrogate Biota							
Fish	N/A	N/A	4380	8760	N/A	2	Primary organism
Invertebrate	N/A	N/A	8760	8760	N/A	2	Primary organism
Algae	N/A	N/A	N/A	8760	N/A	2	Primary organism
Muskrat	100	1	2992	2922	8760	6	Aquatic plants
Raccoon	200	12	2191	N/A	8760	14	Invertebrates
Heron	600	4.6	2922	2920	5842	11	Fish
Duck	100	1	4383	4383	8760	5	Aquatic plants
Important Aquatic Biota							
American Alligator	1500	160	4380	4380	4380	30	Fish
Gulf Sturgeon	1800	70	4380	8760	N/A	20	Invertebrates
Manatee	70000	700	4380	8760	N/A	30	Aquatic plants
Sea Turtles	6000	160	4380	8760	N/A	30	Various
Smalltooth Sawfish	6000	240	4380	4380	N/A	30	Fish, invertebrates
Suwannee Cooter	35	4.6	2192	4383	4383	5	Aquatic plants
Blue hard crab, oyster and stone crab	N/A	N/A	8760	8760	N/A	N/A	Primary organism
Red drum, flounder, and spotted sea trout	N/A	N/A	4380	8760	N/A	7	Primary organism
Red grouper, black grouper, gag grouper, spotted sea trout and flounder	N/A	N/A	4380	8760	N/A	14	Primary organism

Table 5.4-14 (Sheet 2 of 2) Biota Parameters

Biota	Food Intake (gpd)	Body Mass (kg)	Shoreline Exposure (hr/yr)	Swimming Exposure (hr/yr)	Terrestrial Exposure (hr/yr)	Effective Body Radius (cm)	Food Organism
Important Terrestrial Biota							
Bald Eagle	450	3.7	N/A	N/A	3700	10	Fish
Eastern Indigo Snake	60	3	1000	N/A	4380	5	Fish, reptiles, mammals
Florida Black Bear	8000	120	N/A	N/A	7300	N/A	Vegetation, insect
Gopher Tortoise	25	4.2	N/A	N/A	1100	N/A	Vegetation
Northern Bobwhite	180	0.2	N/A	N/A	8760	N/A	Vegetation
Red-cockaded Woodpecker	45	0.045	N/A	N/A	8760	N/A	Insects
Whitetail Deer	1800	57	N/A	N/A	8760	N/A	Vegetation
Wild Turkey	180	5.8	N/A	N/A	8760	N/A	Vegetation
Wood Stork	470	2.6	2922	2920	5842	10	Fish, invertebrates

Notes:

cm = centimeter
gpd = gallon per day
hr/yr = hour per year
kg = kilogram
N/A = not applicable

Table 5.4-15
Dose Contributions to Surrogate and Important Biota

	Doses from Liquid Effluents in Discharge Canal				Doses from Gaseous Effluents	
	LNP 1 and 2		CREC Unit 3		LNP 1 and 2	
	Internal Dose (mrad/yr)	External Dose (mrad/yr)	Internal Dose (mrad/yr)	External Dose (mrad/yr)	Internal Dose (mrad/yr)	External Dose (mrem/yr)
Surrogate Biota						
Saltwater Fish	1.1E-01	5.7E-01	6.8E-02	5.5E-01	0	0
Invertebrate	3.9E+00	1.1E+00	2.0E-01	1.1E+00	0	0
Algae	8.8E+00	3.0E-03	3.0E-01	1.6E-03	0	0
Muskrat	8.8E-01	3.8E-01	2.9E-01	3.7E-01	0	2.1E+00
Raccoon	1.4E-01	2.8E-01	4.3E-02	2.7E-01	0	2.1E+00
Heron	6.2E-01	3.8E-01	1.8E-01	3.7E-01	0	1.4E+00
Duck	8.3E-01	5.7E-01	2.5E-01	5.5E-01	0	2.1E+00
Important Aquatic Biota						
American Alligator	6.0E-02	5.7E-01	2.1E-02	5.5E-01	0	1.1E+00
Gulf Sturgeon	3.4E-01	5.7E-01	3.1E-01	5.5E-01	0	0
Manatee	1.3E+00	5.7E-01	6.1E-01	5.5E-01	0	0
Sea Turtles	4.8E-01	5.7E-01	2.3E-01	5.5E-01	0	0
Smalltooth Sawfish	4.2E-01	5.7E-01	4.0E-01	5.5E-01	0	0
Suwannee Cooter	0	0	0	0	2.6E-01	1.1E+00
Blue hard crab, oyster and stone crab	3.9E+00	1.1E+00	2.0E-01	1.1E+00	0	0
Red grouper, black grouper, gag grouper, spotted sea trout and flounder	1.9E-01	5.7E-01	1.5E-02	5.5E-01	0	0
Red drum, flounder, and spotted sea trout	2.7E-01	5.7E-01	2.4E-01	5.5E-01	0	0
Important Terrestrial Biota						
Bald Eagle	5.7E-01	0	1.6E-01	0	1.2E-01	9.0E-01
Eastern Indigo	8.1E-02	1.3E-01	2.0E-02	1.3E-01	6.7E-01	1.1E+00
Florida Black Bear	0	0	0	0	1.8E+00	1.8E+00
Gopher Tortoise	0	0	0	0	1.9E+00	2.4E+00
Northern Bobwhite	0	0	0	0	1.6E+02	1.9E+01
Red-cockaded Woodpecker	0	0	0	0	2.3E+01	2.1E+00
Whitetail Deer	0	0	0	0	1.5E+00	2.1E+00
Wild Turkey	0	0	0	0	1.1E+00	2.1E+00
Wood Stork	8.4E-01	3.8E-01	2.4E-01	3.7E-01	4.1E-01	1.4E+00

Table 5.4-16
Comparison of Surrogate and Important Biota Doses to ORNL 1995 Evaluated Daily Limits

Biota – Daily Limits	Total Dose, mrad/yr	Total Dose, mrad/day
Aquatic Biota - 1000 mrad/day		
Saltwater Fish	2	0.01
Saltwater Invertebrate	7	0.02
Algae	10	0.03
American Alligator	3	0.01
Gulf Sturgeon	2	0.01
Manatee	4	0.02
Sea turtles	2	0.01
Smalltooth Sawfish	2	0.01
Suwannee Cooter	2	0.01
Blue hard crab, oysters and stone crab	7	0.02
Red drum, flounder, and spotted sea trout	2	0.01
Red grouper, black grouper, gag grouper, spotted sea trout and flounder	2	0.01
Terrestrial Biota - 100 mrad/day		
Muskrat	5	0.02
Raccoon	3	0.01
Heron	3	0.01
Duck	5	0.02
Bald Eagle	2	0.01
Eastern Indigo Snake	3	0.01
Florida Black Bear	4	0.02
Gopher Tortoise	5	0.02
Northern Bobwhite	176	0.49
Red-cockaded Woodpecker	26	0.08
Whitetail Deer	4	0.02
Wild Turkey	4	0.02
Wood Stork	4	0.02

Notes:

Annual dose for biota are totals from Table 5.4-18.

Table 5.4-17 (Sheet 1 of 2)
Summary of Information Reported by Commercial Light Water Reactors (1973 – 2005)

Year	Number of Reactors Included[(a)]	Annual Collective Dose (person – rem)	No. of Workers With Measurable Dose[(b)]	Electricity Generated (MW/yr)	Average Measurable Dose Per Worker (rem)	Average Collective Dose Per Reactor (person – rem)	Average No. Personnel With Measurable Doses Per Reactor[(c)]
1973	24	13,962	14,780	7,164.1	0.95	582	616
1974	33	13,650	18,139	10,590.9	0.75	414	550
1975	44	20,901	28,234	17,768.9	0.74	475	642
1976	52	26,105	34,515	21,462.9	0.76	502	664
1977	57	32,521	42,393	26,448.3	0.77	571	744
1978	64	31,785	46,081	31,696.5	0.69	497	720
1979	67	39,908	64,253	29,926.0	0.62	596	959
1980	68	53,739	80,457	29,157.5	0.67	790	1,183
1981	70	54,163	82,224	31,452.9	0.66	774	1,175
1982	74	52,201	84,467	32,755.2	0.62	705	1,141
1983	75	56,484	85,751	32,925.6	0.66	753	1,143
1984	78	55,251	98,309	36,497.6	0.56	708	1,260
1985	82	43,048	92,968	41,754.7	0.46	525	1,134
1986	90	42,386	100,997	45,695.1	0.42	471	1,122
1987	96	40,406	104,403	52,116.3	0.39	421	1,088
1988	102	40,772	103,294	59,595.1	0.40	400	1,013
1989	107	35,931	108,278	62,223.0	0.33	336	1,012
1990	110	36,602	108,667	68,291.7	0.34	333	988
1991	111	28,519	98,782	73,448.4	0.29	257	890
1992	110	29,297	103,155	74,012.0	0.28	266	938
1993	106	25,597	93,749	70,704.9	0.27	241	884
1994	107	21,672	83,454	74,536.6	0.26	203	780
1995	107	21,233	85,671	78,875.2	0.25	198	801
1996	109	18,883	84,644	79,660.0	0.22	173	777
1997	109	17,149	84,711	71,851.4	0.20	157	777

Table 5.4-17 (Sheet 2 of 2) Summary of Information Reported by Commercial Light Water Reactors (1973 – 2005)

Year	Number of Reactors Included[(a)]	Annual Collective Dose (person – rem)	No. of Workers With Measurable Dose[(b)]	Electricity Generated (MW-yrs)	Average Measurable Dose Per Worker (rem)	Average Collective Dose Per Reactor (person – rem)	Average No. Personnel With Measurable Doses Per Reactor[(c)]
1998	105	13,187	71,485	77,069.9	0.18	126	681
1999	104	13,666	75,420	83,197.6	0.18	131	725
2000	104	12,652	74,108	86,006.8	0.17	122	713
2001	104	11,109	67,570	87,552.8	0.16	107	650
2002	104	12,126	73,242	88,829.7	0.17	117	704
2003	104	11,956	74,813	87,015.0	0.16	115	719
2004	104	10,368	69,849	89,823.5	0.15	100	672
2005	104	11,456	78,127	89,177.7	0.15	110	751

Notes:

a) Includes only those reactors that had been in commercial operation for at least 1 full year as of December 31 of each of the indicated years.

b) Figures are not adjusted for the multiple reporting of transient individuals.

c) Electricity generated reflects the gross electricity generated for the years 1973 through 1996. Beginning in 1997, it reflects the net.

Table 5.4-18
Three-Year Totals and Averages Listed in Ascending Order of Collective TEDE per BWR (2003 – 2005)

Site Name[a]	Reactor Years	Collective TEDE per Reactor (person-rem)	Collective TEDE per Site (person-rem)	Number of Workers with Measurable TEDE	Average TEDE per Worker (rem)	Total MW-Years	Average TEDE per MW-Year (rem)
LIMERICK 1,2	6	81	484	4023	0.12	6601.4	0.07
HATCH 1,2	6	93	556	3792	0.15	4809.7	0.12
DUANE ARNOLD	3	94	283	1928	0.15	1533.8	0.19
OYSTER CREEK	3	99	298	2078	0.14	1762.1	0.17
FITZPATRICK	3	100	300	1771	0.17	2330.9	0.13
SUSQUEHANNA 1,2	6	117	704	5976	0.12	6196.2	0.11
GRAND GULF	3	119	357	2859	0.13	3553.7	0.10
FERMI 2	3	125	375	3047	0.12	2885.7	0.13
CLINTON	3	125	376	2292	0.16	2890.4	0.13
MONTICELLO	3	126	379	2056	0.18	1605.4	0.24
BRUNSWICK 1,2	6	133	799	5878	0.14	5022.4	0.16
HOPE CREEK 1	3	149	446	4918	0.09	2390.1	0.19
COOPER STATION	3	153	458	2629	0.17	1884.8	0.24
PEACH BOTTOM 2,3	6	154	927	4864	0.19	6323.2	0.15
VERMONT YANKEE	3	155	464	2843	0.16	1412.6	0.33
PILGRIM	3	166	497	3076	0.16	1865.9	0.27
DRESDEN 2,3	6	166	996	6148	0.16	4512.2	0.22
RIVER BEND 1	3	170	509	3172	0.16	2607.4	0.20
LASALLE 1,2	6	193	1158	6716	0.17	6392.7	0.18
COLUMBIA GENERATING	3	199	596	4,052	0.15	2827.7	0.21
NINE MILE POINT 1,2	6	204	1225	4,229	0.29	4794.0	0.26
BROWNS FERRY 1,2,3	9	212	1912	9,593	0.20	6163.4	0.31
QUAD CITIES 1,2	6	318	1910	6,201	0.31	4529.4	0.42
PERRY	3	366	1097	4,110	0.27	3010.9	0.37
Totals and Averages	105		17,106	98,251	0.17	87,906.0	0.19
Averages per Reactor-Yr		163		936		837.2	

Notes:

a) Sites where not all reactors had completed 3 full years of commercial operation as of December 31, 2005, are not included.

Table 5.4-19 (Sheet 1 of 2) Three-Year Totals and Averages Listed in Ascending Order of Collective TEDE per PWR (2003 – 2005)

Site Name[(a)]	Reactor Years	Collective TEDE per Reactor (person-rem)	Collective TEDE per Site (person-rem)	Number of Workers with Measurable TEDE	Average TEDE per Worker (rem)	Total MW-Years	Average TEDE per MW-Year (rem)
SEABROOK	3	43	129	2306	0.06	3290.9	0.04
HARRIS	3	45	134	1697	0.08	2524.7	0.05
FARLEY 1,2	6	48	286	2739	0.10	4653.6	0.06
PRAIRIE ISLAND 1,2	6	48	289	2562	0.11	2899.0	0.10
SUMMER 1	3	51	153	1679	0.09	2625.7	0.06
GINNA	3	52	155	1185	0.13	1385.9	0.11
VOGTLE 1,2	6	53	316	2670	0.12	6408.5	0.05
POINT BEACH 1,2	6	54	323	2105	0.15	2612.0	0.12
KEWAUNEE	3	56	168	1101	0.15	1260.9	0.13
INDIAN POINT 3	3	58	174	2029	0.09	2777.0	0.06
ROBINSON 2	3	63	188	1852	0.10	2043.7	0.09
NORTH ANNA 1,2	6	63	376	2692	0.14	5006.2	0.08
BYRON 1,2	6	63	376	3272	0.12	6747.8	0.06
WOLF CREEK 1	3	66	199	1769	0.11	3171.2	0.06
PALO VERDE 1,2,3	9	68	610	5281	0.12	9393.4	0.07
CATAWBA 1,2	6	70	417	3551	0.12	6297.7	0.07
BRAIDWOOD 1,2	6	71	428	3484	0.12	6811.4	0.06
INDIAN POINT 2	3	73	219	1847	0.12	2815.5	0.08
MCGUIRE 1,2	6	74	441	3358	0.13	6225.8	0.07
COMANCHE PEAK 1,2	6	74	444	2868	0.16	6289.7	0.07
THREE MILE ISLAND 1	3	75	224	2290	0.10	2303.5	0.10
COOK 1,2	6	76	457	3275	0.14	5455.8	0.08
WATERFORD 3	3	78	234	1672	0.14	2968.0	0.08
TURKEY POINT 3,4	6	79	474	3667	0.13	3627.2	0.13
CRYSTAL RIVER 3	3	84	253	2031	0.13	2303.4	0.11
OCONEE 1,2,3	9	85	762	5991	0.13	6652.4	0.12

Table 5.4-19 (Sheet 2 of 2) Three-Year Totals and Averages Listed in Ascending Order of Collective TEDE per PWR (2003 – 2005)

Site Name[(a)]	Reactor Years	Collective TEDE per Reactor (person-rem)	Collective TEDE per Site (person-rem)	Number of Workers with Measurable TEDE	Average TEDE per Worker (rem)	Total MW-Years	Average TEDE per MW-Year (rem)
SOUTH TEXAS 1,2	6	85	511	3019	0.17	6491.9	0.08
BEAVER VALLEY 1,2	6	85	513	3871	0.13	4620.5	0.11
SALEM 1,2	6	86	513	5959	0.09	5893.8	0.09
DIABLO CANYON 1,2	6	86	514	3189	0.16	5729.4	0.09
SURRY 1,2	6	89	533	3533	0.15	4300.5	0.12
DAVIS-BESSE	3	93	278	1785	0.16	1474.9	0.19
CALVERT CLIFFS 1,2	6	96	577	3818	0.15	4890.2	0.12
SAN ONOFRE 2,3	6	97	582	3341	0.17	5892.8	0.10
SEQUOYAH 1,2	6	102	612	4770	0.13	6074.5	0.10
WATTS BAR 1	3	105	315	2856	0.11	3099.1	0.10
MILLSTONE 2,3	6	110	662	3407	0.19	5499.2	0.12
ARKANSAS 1,2	6	113	681	4535	0.15	4995.3	0.14
CALLAWAY 1	3	117	352	2976	0.12	2910.3	0.12
ST. LUCIE 1,2	6	118	707	4356	0.16	4425.1	0.16
FORT CALHOUN	3	169	507	2198	0.23	1195.5	0.42
PALISADES	3	195	584	1952	0.30	2066.3	0.28
Totals and Averages	207		16,673	124,538	0.13	178,110.2	0.09
Averages per Reactor-Yr		81		602		860.4	

Notes:

a) Sites where not all reactors had completed 3 full years of commercial operation as of December 31, 2005, are not included.

5.5 ENVIRONMENTAL IMPACTS OF WASTE

This section focuses on the identification of plant systems that have nonradioactive effluent discharges, and summarizes the effects of the systems that are identified. The section is divided into the following three major subsections:

- ER Subsection 5.5.1 — Nonradioactive Waste System Impacts
- ER Subsection 5.5.2 — Mixed Waste Impacts
- ER Subsection 5.5.3 — Pollution Prevention and Waste Minimization Program

Construction and operation of the LNP will result in the generation of several identifiable waste streams. The facility wastes are regulated during generation, storage, and disposal. Plant industrial, nonhazardous wastes are regulated by disposal at a permitted landfill by either the local municipality or state authority, or the wastes are recycled. Construction/demolition and industrial wastes generated at the LNP site may be disposed of at the permitted landfill that currently services the area or at a similarly permitted facility.

Used oil, hazardous, and mixed wastes are regulated under the Resource Conservation and Recovery Act (RCRA) for both managed storage and disposal. A facility generating these wastes is required to obtain a USEPA RCRA identification (ID) number that is site-specific. Wastes generated at the LNP that fall under RCRA regulations are either recycled or disposed of at RCRA-permitted treatment, storage, and disposal (TSD) facilities. No hazardous waste will be disposed of on-site.

Aqueous discharges are regulated through the NPDES program for both stormwater and wastewater. FDEP is authorized to oversee the NPDES program in Florida, and incorporates chemical monitoring requirements for wastewater and stormwater in NPDES discharge permits. Within the permit, point-source discharge outfalls are assigned a discharge serial number (DSN), constituents to be monitored or sampled, and associated limits. This permit is amended as new wastewater streams are identified. Because the discharge point for the LNP site will be the discharge canal at the CREC, PEF may choose to revise the Crystal River Plant NPDES permit to include discharges from the LNP site or apply for a new permit.

Air emissions are regulated through the Clean Air Act (CAA) by USEPA or an authorized state agency.

Descriptions of some typical nonradioactive and mixed waste streams generated and subject to the regulations noted above are discussed in the following subsections.

5.5.1 NONRADIOACTIVE WASTE SYSTEM IMPACTS

This subsection describes the potential environmental impacts of nonradioactive solid, liquid, and gaseous waste streams associated with the construction and operation of the LNP. Information provided within this subsection was obtained from currently operating plants. A description of possible chemical discharges and effluents is provided, based on Westinghouse Electric Company, LLC, AP1000 Design Control Document for the certified design as amended (DCD). A description of the nonradioactive waste systems is provided in ER Section 3.6. In addition, Table 3.3-3 presents the chemicals added to each system, the amount used per year (not by season), the frequency of use, and the concentration in the waste stream discharged from each unit to the discharge canal at the CREC. ER Section 2.3 includes a description of the past and present water quality conditions that could affect, or be affected by the construction or operation of the LNP. The subsections comprising ER Section 2.3 provide detailed information on the following:

- ER Subsections 2.3.1 and 2.3.2 — Information on site hydrology and water use, as well as associated impacts from discharges of nonradioactive wastes on the areas surrounding the LNP site.

- ER Subsections 2.3.3 and 2.4.2 — Discussion relating to water quality criteria and aquatic ecology and associated impacts from nonradioactive effluent discharges, respectively. Information regarding dilution factors associated with nonradioactive system discharges, waste concentrations at the point of discharge, predicted dilution in the receiving water body, and estimates of concentrations at various distances from the discharge point.

- ER Subsections 3.6.1 and 3.6.2 — Information on effluents that contain chemicals and biocides and sanitary waste system discharges, respectively.

- ER Chapter 4 — Information on the environmental impacts of construction (for example, land use impacts, water-related impacts, and ecological impacts).

5.5.1.1 Impacts of Discharges on Water

Nonradioactive liquid wastewater from nuclear power generating facilities may include cooling tower blowdown, auxiliary boiler blowdown, water treatment waste, floor and equipment drains, stormwater runoff, and laboratory waste. Many of these wastewater streams have their own NPDES-designated outfall number for monitoring purposes. The NPDES permit establishes criteria that are protective of water quality for the receiving water body. In this case, the criteria are established to protect the Gulf of Mexico.

ER Subsection 5.5.3 presents a discussion of the pollution prevention and waste minimization program that will be established at the LNP.

Discharges to outfalls will typically consist of cooling tower blowdown, sanitary waste, and low-volume wastes. These streams are monitored for multiple constituents, typically temperature, flow, hydrogen ion concentration (pH), fecal coliform, free available chlorine, total residual chlorine, total suspended solids (TSS), hydrazine, oil and grease, total nickel, total manganese, total chromium, total zinc, total copper, total nitrogen, total phosphorus, and total iron.

Typically, the approved NPDES permit for a facility will list the systems to be sampled, location of sampling stations (outfall DSN), constituents to be monitored or sampled, frequency of sampling, type of sample (for example, surface grab or depth composite), method of sample collection, and time period for required monitoring under the permit.

The dominant component of all discharges is the cooling tower blowdown with the contribution of other streams typically amounting to less than 10 percent of the flow. Cooling tower blowdown and other wastewater resulting from electric power generation will typically be monitored for flow, pH, total residual chlorine, free available chlorine, total chromium, total zinc, priority pollutants, temperature, and 7-day chronic toxicity, but monitoring requirements will be stipulated in the new NPDES permit for the LNP.

It is anticipated that the existing number of permitted DSNs will be reduced because the AP1000 design consolidates several facility liquid-waste streams from facility operations into a single discharge point that will discharge to the Gulf of Mexico through one NPDES permitted outfall. Chemicals that are added to cooling water for treatment are effective at low concentrations and are mostly consumed or broken down in application.

5.5.1.1.1 Liquid Effluents Containing Biocides or Chemicals

Descriptions of the anticipated nonradioactive, liquid-waste chemical and biocide discharge concentrations are provided in ER Subsection 3.6.1. Biocides are added in ppm concentrations and are normally consumed leaving very small concentrations by the time they are discharged. The NPDES permit that will be issued by FDEP for the LNP will impose monitoring and concentration limits for the main outfall (cooling tower blowdown) for free available chlorine, total residual chlorine, time of chlorine addition, total chromium, total zinc, and priority pollutants (typical for cooling tower blowdown, but actual constituents monitored for monitoring protocols and concentrations will be stipulated in the new or revised NPDES permit).

The environmental impacts from discharges of liquid effluents containing biocides or chemicals from the LNP to the Gulf of Mexico will be SMALL and mitigation will not be required.

5.5.1.1.2 Demineralized Water Treatment Wastes

The system to demineralize water prior to its use in various applications at the LNP will typically consist of a reverse osmosis (RO) system. During demineralization or regeneration, chemicals such as sulphuric acid and caustic soda are typically used to adjust the pH to between 6 and 9 standard units (su) for release to the wastewater stream outfall that discharges to the Gulf of Mexico.

Discharges to outfalls from processing of demineralized and potable water will typically include coagulation, filtration, disinfection, and ion exchange. Wastes from treatment may include filter backwash and demineralizer regeneration wastes. The spent RO system filters are disposed of in accordance with applicable industrial solid waste regulations.

Impacts from the discharge of this waste stream to the Gulf of Mexico will be SMALL and mitigation will not be required.

5.5.1.1.3 Waste Treatment Facility Sanitary Wastes

Discharges to outfalls from sanitary waste treatment facilities are typically monitored for flow, 5-day biochemical oxygen demand (BOD_5), TSS, fecal coliform, and total residual chlorine.

Impacts from the discharge of this waste stream on the Gulf of Mexico will be SMALL and mitigation will not be required.

5.5.1.1.4 Treated Wastewater (Low-Volume Wastes and Radwaste)

Discharges of treated wastewater or low-volume wastewater (including membrane backwash water) are usually monitored for flow, TSS, and oil and grease.

Impacts on the Gulf of Mexico from the discharge of this waste stream will be SMALL and mitigation will not be required.

5.5.1.1.5 Floor Drain Systems

Discharges from floor drains are components of wastewater that will also be discharged to a sump, where they are typically monitored for flow, pH, TSS, and oil and grease, and then to the main plant outfall. Monitoring requirements will be stipulated in the approved NPDES permit for the LNP.

Impacts on the Gulf of Mexico from the discharge of this waste stream will be SMALL and mitigation will not be required.

5.5.1.1.6 Surface Drainage and Roof Drains

During and after rainfall events, runoff from roof drains and impervious surfaces such as parking lots and sidewalks will flow over land to drainage ways leading to stormwater retention ponds. Collected stormwater will infiltrate into the subsurface. For large storm events, any excess stormwater will be pumped as necessary from the ponds to the cooling tower blowdown basin. The ponds will also receive main plant area runoff and fire and supply test water.

Blowdown will be discharged to the CREC discharge canal outfall structure (CREC NPDES monitored point). The outfall discharge is typically monitored for flow, pH, color, odor, clarity, floating solids, TSS, foam, oil and grease, and other obvious indications of stormwater pollution.

Impacts from these discharges are expected to be SMALL and mitigation will not be required.

5.5.1.2 Impacts of Discharges on Land

5.5.1.2.1 Nonradioactive Solid Waste

PEF has corporate programs in place to manage solid nonradioactive and nonhazardous waste. Corporate policies are contained in their policies document entitled, “Solid Waste” document number EVC-SUBS-00023. The document contains policies regarding waste minimization (pollution prevention, recycling, reuse, treatment, and disposal), prohibited materials, and solid waste disposal.

Solid nonradioactive and nonhazardous waste may include office waste, aluminum cans, laboratory waste, glass, metals, and paper, and will be collected from several on-site locations and deposited in dumpsters located throughout the site. These solid wastes are not burned or disposed of on-site. Solid nonradioactive and nonhazardous waste generated at the LNP site would be disposed of off-site at a permitted disposal landfill.

It is presently difficult to quantify the amount of these waste types that will be generated for the LNP. However, according to a study performed by the California Integrated Waste Management Board, employees typically generate approximately 4.8 kg (10.5 lb.) of cold waste per employee per day, or conversely, 5.9 kg (13 lb.) of waste per 92 square meters (1000 square feet) of working area per day, in a commercial environment such as the LNP.

Segregation and recycling of waste will be practiced to the greatest extent practical. It is expected that PEF will contract with an outside vendor who will perform weekly collections and disposal at area landfills. It is not expected that the amount of solid waste generated will significantly contribute to the total amount of household waste disposed of weekly by area residents. The waste is not expected to affect site terrestrial ecology, soil, or groundwater.

Water treatment and purification waste are containerized and disposed of at a permitted industrial waste landfill. Construction or demolition and industrial wastes generated at the LNP site would also be disposed of at a similarly permitted facility.

LNP demolition wastes, such as concrete and scrap steel, will be disposed of off-site in a properly permitted industrial waste landfill.

Impacts from the disposition of solid nonradioactive and nonhazardous waste will be SMALL and mitigation will not be required.

5.5.1.2.2 Hazardous Wastes

Solid hazardous waste is managed and disposed of in accordance with federal and state regulations under RCRA regulations and permits. The generation of hazardous waste at the LNP is expected to be small, and the facility will be considered a conditionally exempt small quantity generator or a small quantity generator under RCRA. Progress Energy has corporate programs in place to manage hazardous wastes. The applicable guidance and policies are contained in their corporate document entitled, “Hazardous Waste Management”, EVC-SUBS-00016.

RCRA wastes generated through LNP operations, and hazardous chemical wastes from laboratories and other sources at the site, will be collected and disposed of off-site at RCRA-permitted TSDs, using a site-specific assigned USEPA RCRA ID. Transportation of the hazardous waste will be performed by specifically licensed and permitted haulers in accordance with USEPA RCRA regulations. These wastes will not be released to the environment and are expected to have a SMALL impact on waste streams and will not present a potential impact on the environment.

5.5.1.2.3 Petroleum Waste

Petroleum wastes may include fuels, such as gasoline and diesel oil, and used oil and grease. These materials will be collected and stored on-site in accordance with federal, state, and local regulations. These materials will either be recycled or disposed of at RCRA-permitted TSD facilities and recyclers.

Impacts from this waste stream are expected to be SMALL, and mitigation would not be required.

5.5.1.3 Impacts of Discharges on Air

Nonradioactive gaseous effluents are generated by the operation of auxiliary generators and testing and operation of the diesel-driven fire pumps. Constituents of the gaseous effluents from these systems are typical of releases from the combustion of the fuel. Projected annual emissions and constituents or quantities are discussed in ER Subsection 3.6.3.1.4.

Minor emissions are expected to be generated from diesel storage tanks used to supply diesel fuel to this equipment. The emissions are expected to comply with applicable federal, state, and local regulations; emissions are also discussed in detail in ER Subsection 3.6.3.1.4.

Impacts from nonradioactive gaseous effluent emissions on the air are expected to be SMALL, and mitigation would not be required.

5.5.1.4 Sanitary Waste

Sanitary waste will be treated at the on-site wastewater treatment plant. Discharges will be through the blowdown line to the CREC discharge canal and will comply with the applicable NPDES permit. Impacts are anticipated to be SMALL, and mitigation would not be required.

5.5.2 MIXED WASTE IMPACTS

The management of mixed waste at nuclear power generating facilities is jointly regulated by the NRC under the Atomic Energy Act of 1954 (AEA), and USEPA or authorized states under RCRA. Nuclear power plants managing mixed waste must meet NRC requirements for general radiation protection (10 CFR 20), emission control requirements for low-level waste (LLW) specified in 10 CFR 61, and USEPA requirements for hazardous waste 40 CFR Parts 261, 264, and 265 before final transfer off-site for disposal.

Mixed waste generation is highly variable, but is projected to be approximately 5 cubic meters per year (m^3/yr) (177 cubic feet per year [ft^3/yr]), which is less than 3 percent of typical LLW volumes (Section 2.3.7.3 of NUREG-1437). Management of this waste is in accordance with NRC and USEPA regulations, and is subject to maintenance and containment criteria described in the RCRA regulations that require containers to be free of corrosion and stored in a bermed catchment area to contain leaks and spills.

Nuclear power generating facilities are not expected to generate significant volumes of mixed waste because of continued progress in reducing mixed waste generation. Mixed waste storage ensures that chemical and radiological exposures are minimized both by the ALARA process and chemical awareness training programs. Regular inspections are conducted and documented, and preventive maintenance measures are taken, when needed. An inventory of the mixed waste is maintained, and a material safety data sheet (MSDS) for the chemicals present is readily available to ensure proper protection is taken. The storage area is placarded with appropriate hazard warning signs, and access is restricted.

Mixed waste will not be generated at the LNP without knowing first where the waste can be properly treated and disposed of.

Mixed waste, if generated at the LNP site, will be containerized, segregated, and usually stored on-site in a remote, monitored structure to minimize the potential of chemical and radiological exposure to employees and the public. Only authorized individuals will be given access to the storage area to inspect for container integrity and leakage.

The LNP will be required to comply with an approved mixed waste minimization plan to ensure that mixed waste generation is minimized. LNP workers that handle mixed waste will be trained appropriately and knowledgeable of the chemical and radiological hazards associated with the waste being handled.

The controls that will be employed at the LNP if mixed waste is generated to control exposures to employees and releases to the environment from handling, storage, and transportation of mixed waste are presented in the following subsections.

5.5.2.1 Chemical Hazards Impacts

It is not possible, presently, to predict the exact types, generation rates, and quantities of mixed hazardous waste that may be generated prior to LNP site operations. As discussed previously, mixed waste generation is highly variable, but is projected to be approximately 5 m^3/yr (177 ft^3/yr). If PEF expects to generate, store, and offer to transport mixed waste, PEF must apply for and receive a USEPA ID in accordance with the requirements of 40 CFR 262.12 prior to performing these activities. If mixed wastes are generated, PEF will maintain a tracking mechanism that can be used to identify wastes, such as RCRA waste codes, source of the hazardous constituents, discussion of how and why the mixed waste was generated, and generation rates and volumes, such that waste minimization techniques can be employed to reduce or eliminate the unnecessary generation of mixed waste.

Generation and storage of mixed waste on-site has the potential to expose workers to hazards associated with the chemical component of the mixed waste matrix from leaks and spills. Mixed waste can, and usually does, exhibit one of the following hazardous characteristics: ignitability, corrosivity, reactivity, or toxicity, as well as exhibiting the characteristics of a radiological hazard (that is, contamination and radiation). Even though personnel may be properly trained, handling and storage accidents do occur where acids are inadvertently stored with bases and can become reactive during a spill. Another example might include the improper storage of oxidizers (nitric acid, nitrates, peroxides, and chlorates) and organics with inorganic reducing agents (metals). Workers and emergency response personnel can be potentially exposed during subsequent cleanup efforts both from the standpoint of the chemical hazard, and based on the radiological hazards that might be present.

If mixed waste is stored at the LNP site, USEPA mandates that waste storage containers must be inspected on a weekly basis; and certain aboveground portions of waste storage tanks must be inspected on a daily basis. The purpose of these inspections is to detect leakage from, or deterioration of, containers. The methods used for these inspections may include direct visual monitoring or the use of remote monitoring devices for detecting leakage or deterioration. The remote methods would reduce exposures resulting from direct visual inspections. Additionally, measures will be provided to promptly locate and segregate or remediate leaking containers.

As noted in this subsection, the volume of mixed waste produced at nuclear power generating facilities is typically a small fraction of the overall waste stream, accounting for less than 3 percent by volume of the annual LLW discharged. Because of the projected small volume of mixed waste, and because no significant emissions or releases of hazardous materials are expected as a result of control and containment programs requirements, the NRC concluded that the findings for both LLW and mixed-LLW impacts are SMALL and mitigation is not required.

5.5.2.1.1 Contingency Plans, Emergency Preparedness, and Prevention Procedures

LNP site management should develop and implement contingency plans, emergency preparedness, and prevention procedures that will be used in the event of a spill, including a mixed waste spill. Such contingency plans, emergency preparedness, and prevention procedures, when implemented properly, will virtually eliminate any adverse environmental effects or personnel exposures from spills. LNP personnel who are designated to handle mixed waste, or whose job function it is to provide emergency response for mixed waste spills, will receive appropriate training to perform their work properly and safely.

Mixed waste storage areas will contain emergency equipment sufficient to respond to the hazard posed by waste. Typical items in a mixed waste storage area include fire extinguishers, decontamination equipment, and an alarm system (if radio equipment is not available to all staff working in the storage area). Spill control equipment (for example, sorbent pads) will be available in the mixed waste storage areas, and where liquids are transferred from one vessel to another.

Because of the plans and procedures, impacts from chemical hazards are expected to be SMALL.

5.5.2.1.2 Off-Site Treatment and Disposal

If mixed waste is generated and shipped for treatment and disposal rather than stored on-site, LNP site management should identify potential disposal facilities based on the following selection criteria:

- The desired method of treatment or disposal (for example, incineration versus land disposal).
- The disposal facility’s permit (for example, determine whether polychlorinated biphenyls [PCBs], hazardous waste, or radioactive waste can be accepted).

- The disposal facility's turnaround time on approvals.
- The form of waste (for example, determine whether it is soil, debris, semisolid, or liquid).
- The mass or volume of waste.
- The cost of transportation and disposal.

LNP site management should also identify one disposal facility as the primary facility, and a second facility will be identified as an alternate in the event that laboratory testing or other observations prove the waste to be different than initially determined.

Impacts from the generation and storage of mixed waste will be SMALL and mitigation will not be required.

5.5.2.2 Radiological Hazards Impacts

If mixed waste is generated, it must either be stored on-site or shipped off-site for treatment and subsequent disposal. Off-site shipment, treatment, and disposal will depend on the toxicity levels and radiological characteristics of the mixed waste. Personnel performing packaging and shipping operations have the potential to be exposed to increased ambient radiation levels from the containers. Radiological exposures from mixed waste generation, treatment, storage, and off-site transportation activities will be in full compliance with the requirements stipulated in 10 CFR 20 for both radiological and nonradiological workers. Progress Energy's corporate Radiation Control and Protection Manual (NGGM-PM-0062) sets forth specific policies and standards for the corporate radiation control program. These policies and procedures ensure compliance with federal standards stipulated in 10 CFR 20.

Impacts on workers from the handling and storage of mixed waste will be SMALL and mitigation will not be required.

5.5.3 POLLUTION PREVENTION AND WASTE MINIMIZATION PROGRAM

Under RCRA, Congress declared it to be the national policy of the United States that, whenever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored, or disposed of as soon as possible to minimize the present and future threat to human health and the environment. To comply with this requirement, PEF is required to implement a pollution prevention and waste minimization program prior to generating any hazardous waste at the LNP site.

Pursuant to the regulations regarding hazardous waste management and the issuance of a license to operate the LNP, a hazardous waste minimization plan will be developed and implemented to address storage and management oversight requirements. Elements of the waste minimization plan include the following, at a minimum:

- Schedule for implementation.
- Projection of volume reductions to be achieved.
- Inventory identification and control.
- Work planning to reduce mixed waste generation.
- Hazardous waste reduction methods and processes.
- Key assumptions critical to successful implementation of waste management.

These requirements are part of the USEPA RCRA hazardous waste regulations codified in 40 CFR 260 to 265 implementing RCRA.

The hazardous waste minimization plan will be followed to ensure that activities are conducted in a manner intended to reduce the potential for generation. The storage area will be monitored for radiation level and inspected for container integrity. Occupational exposures from on-site storage have been shown to be reduced by the application of waste minimization technologies and procedures. Radiological exposures from hazardous waste generation, treatment, storage, and off-site transportation activities will be in full compliance with the requirements stipulated in 10 CFR 20 for both radiological and nonradiological workers. PEF's radiological safety program and procedures will ensure compliance.

Impacts from waste are expected to be SMALL.

5.5.3.1 Inventory Management

Inventory management or control techniques will be used to reduce the possibility of generating mixed waste resulting from excess or out-of-date chemicals and hazardous substances. Where necessary, techniques will be implemented to reduce inventory size of hazardous chemicals, size of containers, and amount of chemicals, while increasing inventory turnover.

A chemical management system, if required, will be established prior to initial operation, and acquisition of new chemical supplies will be documented in a controlled process that addresses, as appropriate, the following:

- Need for the chemical.

- Availability of nonhazardous or less hazardous substitutes or alternatives.

- Amount of chemical required and the on-site inventory of the chemical.

Excess chemicals will be managed in accordance with the site's chemical management procedures. Excess chemicals that are deemed usable will be handled through an excess chemical program. Material control operations will be revised or expanded to reduce raw material and finished product loss, waste material, and damage during handling, production, and storage.

5.5.3.2 Recycling and Reuse

Recycling of waste types will be considered. Opportunities for reclamation and reuse of waste materials will be explored. Decontamination of tools, equipment, and materials for reuse or recycle will be used to minimize the amount of waste for disposal. Impediments to recycling, whether regulatory or procedural, will be challenged to encourage generators to recycle.

5.5.3.3 Segregation

When radiological or hazardous waste is generated, proper handling, containerization, and separation techniques will be employed, as applicable. This will be done to minimize cross contamination resulting in the generation of unnecessary mixed waste.

5.5.3.4 Decay-In-Storage of Mixed Waste

Some portion of the generated mixed waste will, most probably, contain radionuclides with relatively short half-lives. The NRC generally allows facilities to store waste containing radionuclides with half-lives of less than 65 days until 10 half-lives have elapsed and the radiation emitted from the unshielded surface of the waste, as measured with an appropriate survey instrument, is indistinguishable from background levels. The waste can then be disposed of as a nonradioactive waste. For mixed waste, storage for decay is particularly advantageous because the waste can be managed solely as a hazardous waste after the radionuclides decay to background levels. Thus, the management and regulation of these mixed wastes are greatly simplified by the availability of storage for decay.

5.5.3.5 Work Planning

Planning will be completed to determine what materials and equipment are needed to perform the anticipated work. One objective of this planning is to prevent pollution, minimize the amount of mixed waste that may be generated, and use only what is absolutely necessary to accomplish the work. Planning will also be completed to prevent mixing of materials or waste types.

5.5.3.6 Pollution Prevention Tracking Systems

A tracking system will be developed, if required, to identify waste generation data and pollution prevention and waste minimization program (PPWMP) opportunities. This will provide essential feedback to successfully guide future efforts. The data collected by the system will be used for internal reporting. The tracking system will provide feedback on the progress of the PPWMP including the results of the implementation of pollution prevention technologies. In addition, it will facilitate reporting pollution prevention data and accomplishments to the NRC and FDEP.

The system will track waste from point of generation to point of final disposition (cradle to grave). The system will also permit the tracking of hazardous substances from the point of site entry to the final disposition to comply with environmental regulations and reporting requirements. The system will collect data on input material, material usage, type of waste, volume, hazardous constituents, generating system, generation date, waste management costs, and other relevant information.

5.5.3.7 Implement Pollution Prevention and Waste Minimization Awareness Programs

A successful PPWMP requires employee commitment. By educating employees in the principles and benefits of a PPWMP, solutions to current and potential environmental management problems can be found. The broad objective of the PPWMP is to educate employees in the environmental aspects of activities occurring at the LNP, in their community, and in their homes. A PPWMP should be developed and implemented, as required.

5.5.3.8 Implement Environmentally Sound Pollution Prevention Procurement Practices

Management at the LNP will implement procurement practices that comply with regulatory guidance, and other requirements for the purchase of products with recovered materials. This includes the elimination of the purchase of ozone-depleting substances and the minimization of the purchase of hazardous substances.

5.5.3.9 Ensure Consistent Policies, Orders, and Procedures

Policies and procedures will be developed, as applicable, to reflect a focus on integrating PPWMP objectives into the LNP activities. The respective environmental, health, and safety departments will review new procedures for the LNP activities. The procedures will determine whether the elimination or revision of procedures can contribute to the reduction of waste (hazardous, radiological, or mixed). This will include incorporating PPWMP into the appropriate on-site work procedures. Changes to procurement procedures to require affirmative procurement of FDEP designated recycled products, and reduction of procurement of ozone-depleting substances will also be completed.

5.6 TRANSMISSION SYSTEM IMPACTS

The LNP site is located in the service territory of PEF, the primary northwest and central Florida regional electrical transmission system owner/operator. The LNP will require a new transmission system to be constructed within the central Florida area.

The LNP will be connected to a new common dual-voltage 500-kV/230-kV switchyard. The 500-kV section of the switchyard is designed to connect the new 500-kV transmission lines to the main step-up transformer for each unit.

The LNP's new transmission system will be made up of four 500-kV transmission lines that will connect the LNP to the Florida electrical grid system. ER Subsection 2.2.2 describes the locations and land use of the proposed corridors. The four 500-kV transmission lines include the following: two 500-kV transmission lines from the LNP to proposed Citrus Substation (LPC), one 500-kV transmission line from the LNP to proposed Central Florida South Substation (LCFS), and one 500-kV transmission line from the LNP to CREC 500-kV switchyard (LCR). ER Section 3.7 provides a general discussion of the electric transmission system that is required in conjunction with construction and operation of the LNP. ER Subsection 4.1.2 provides information regarding the impacts anticipated from construction of that electric transmission system.

The 230-kV section of the switchyard will feed reserve auxiliary transformers (RAT) for the LNP. Two 500-kV/230-kV step-down transformers will be located within the switchyard boundary to feed 230-kV buses.

The proposed transmission line corridors will be primarily co-located with several of PEF's existing transmission lines where appropriate. In some sections, existing transmission line corridors will be widened. The proposed transmission line corridors could vary from approximately 304.8 to 804.7 m (1000 to 2640 ft.) wide. A total of approximately 146.5 km (91 mi.) of transmission lines will need to be constructed to the first substations to deliver the power generated by the LNP to the electrical grid system.

ROW maintenance activities in compliance with applicable federal, state, and local laws, regulations, and permit requirements are routinely performed by PEF. ROW maintenance activities within the ROWs will be the responsibility of PEF and will be in compliance with all local, state and federal requirements.

ER Subsections 5.6.1 and 5.6.2 discuss potential impacts of routine maintenance on terrestrial and aquatic ecosystems, respectively. ER Subsection 5.6.3 addresses impacts of the proposed transmission lines on the public.

5.6.1 TERRESTRIAL ECOSYSTEMS

The LPC, LCR, and LCFS corridors and the area within 0.40 km (0.25 mi.) of the corridors' edges were evaluated for the potential presence of important plant and wildlife species. Wildlife habitat in the area of the LPC, LCR, and LCFS corridors has been altered significantly from its natural state for planted pine, pastureland, utilities, and residential use. Both the Florida Natural Areas Inventory (FNAI) GIS database of documented occurrences of listed species (Reference 5.6-001) and Florida Fish and Wildlife Conservation Commission (FFWCC) bald eagle nest locator (Reference 5.6-002) were queried. ER Subsection 2.4.2 identifies the presence and potential for the occurrence of listed plant and important faunal species.

5.6.1.1 Natural Ecosystems and Rare, Threatened, and Endangered

Listed species refers to those plant and animal species that are designated by the U.S. Fish and Wildlife Service (USFWS), FFWCC, and the Florida Department of Agriculture and Consumer Services (FDACS) as threatened, endangered, or of special concern. Documented occurrences of listed species that lie within, adjacent to or near (generally equal to or less than 610 m [2000 ft.] from) the LPC, LCR, or LCFS corridors are discussed in ER Subsection 2.4.2. Additionally, locations of FNAI-documented occurrences and listed species were observed during the November 2007 field reconnaissance. Land use descriptions along the corridors are provided in ER Subsection 2.2.2.

No impacts on listed species are anticipated. The majority of listed species observed in the LPC, LCR, and LCFS corridors are mobile avian species that could relocate to similar habitats during construction activities. In the event that impacts on gopher tortoise or other less mobile species cannot be avoided, these impacts will be mitigated as required under existing FFWCC and USFWS regulations.

When the ROWs for the transmission lines are finalized, they will be surveyed for listed species and the applicants will consult with FFWCC on appropriate mitigation or avoidance methods in a post-certification process pursuant to conditions of the state’s certification of the LNP project under the Florida Electrical Power Plant Siting Act.

Where the transmission lines will be constructed either adjacent to, or in proximity of existing ROW and/or existing planted pine, impacts on plant and animal populations as a result of construction, maintenance, and post-construction activities will be minimized through BMPs. In those areas where an existing ROW will need to be widened to accommodate the 500-kV transmission lines, maintenance practices for the new transmission lines will be similar to the initial clearing activities, and impacts are anticipated to be SMALL and are not expected to result in adverse impacts on plant and animal populations.

5.6.2 AQUATIC IMPACTS

Surface water bodies and wetlands crossed by the LPC, LCR, and LCFS corridors were identified using 2004 SWFWMD land use/land cover data, recent aerial photographs, and observations recorded during site visits.

Given the measures taken by PEF to avoid affecting aquatic habitat, any impacts associated with routine maintenance and operation of the transmission corridors are expected to be SMALL.

5.6.2.1 Water Bodies

All of the named water bodies can be spanned, and most of the major unnamed ditches and canals can be avoided. Therefore, no structures will be located within major water bodies. Most of the ditches draining pastures and cropland are shallow and intermittent. It might be necessary to affect some of these manmade minor and shallow drainages.

BMPs will be used to minimize aquatic impacts. Major water bodies are crossed by the conceptual ROW at a perpendicular angle. PEF will coordinate construction and design standards according to SWFWMD practices and policies. PEF will design vertical clearances for waterways that have been determined to be navigable, in accordance with the USACE and U.S. Coast Guard requirements. Within the State of Florida, crossing major rivers may require a license or easement from the Board of Trustees of the Internal Improvement Trust Fund, FDEP, or SWFWMD, which can be issued post-certification pursuant to Section 403.509(5), F.S.

It is not anticipated that any transmission structures will need to be constructed in minor agricultural/ drainage canals. However, some access roads might need to be constructed across some of these canals and ditches. If so, PEF will provide appropriate drainage conveyances under the road to maintain flows.

Water quality along and adjacent to the construction site will be preserved by implementing appropriate BMPs to control the quantity and quality of runoff from the construction site.

The predominant conveyance in this and similarly situated regions is typically natural ponds and sloughs. These types of systems typically do not lend themselves to evaluation by gauging stations. As such, Natural Resources Conservation Service methods will be used to evaluate runoff characteristics for culvert crossings and access way designs.

5.6.2.1.1 LPC Corridor

Named water bodies that are crossed by the LPC corridor are the CFG, CFBC, and the Withlacoochee River. The other water bodies crossed by the LPC corridor are roadside ditches, drainage ditches in agricultural areas, and borrow ponds.

5.6.2.1.2 LCR Corridor

Named water bodies that are crossed by the LCR corridor are the CFG, CFBC, and the Withlacoochee River. The other water bodies crossed by the LCR corridor are roadside ditches, drainage ditches in agricultural areas, and borrow ponds.

5.6.2.1.3 LCFS Corridor

Named water bodies that are crossed by the LCFS corridor are the CFG, CFBC, and the Withlacoochee River (which the corridor crosses twice; once in the northernmost portion of the corridor near Lake Rousseau and once near the intersection of CR-39 and State Road 200 [SR-200]), and Lake Rousseau. The area of the Withlacoochee River near the second crossing is classified as Outstanding Florida Waters (Reference 5.6-003). Also, some unnamed tributaries are present in the LCFS corridor that drain stream and lake swamps that flow to John Lake. The other water bodies crossed by the LCFS corridor are roadside ditches, drainage ditches in agricultural areas, and borrow ponds.

5.6.2.2 Wetlands

All of the wetland types that occur in the area of the LPC, LCR, and LCFS corridors are listed in ER Subsection 2.2.2. Most of the herbaceous and shrub-dominated wetlands will not be affected because they will be spanned during construction activities. Permanent changes to the vegetation, wildlife, and aquatic systems within the corridors are anticipated to be minimal and localized. Vegetation in the transmission line ROW will be affected by maintenance activities such as trimming, mowing, or herbicide application. Forested wetlands will be cleared to facilitate construction and maintenance of the transmission line. This will result in the conversion of the wetland within the ROW from a forested system to an herbaceous wetland. Where practicable, herbaceous and open water wetland areas will be spanned to avoid impacts. A limited number of structures might result in unavoidable impacts on wetlands. In these cases, fill at each structure location may be required to facilitate construction and maintenance. Where practicable, access roads will be located to avoid or minimize wetland impacts. All wetland impacts will be addressed in accordance with the FDEP and USACE criteria and are expected to be SMALL.

5.6.3 IMPACTS ON MEMBERS OF THE PUBLIC

This subsection is included to analyze the impacts of the LNP transmission system on the public.

The LNP's new transmission system will be made up of four 500-kV transmission lines that will connect the LNP to the Florida electrical grid system. The highest voltage associated with the proposed transmission lines is 500 kV. Transmission lines will be clearly marked to prevent impacts on aircraft. Other potential impacts include electromagnetic field (EMF) effects, corona discharges, and visual impacts.

5.6.3.1 Electromagnetic Field Exposure

EMFs are produced by electrical devices, including transmission lines. Some epidemiological studies have suggested a link between power-frequency EMF and some types of cancer. There have been scientific research and there are ongoing studies on the potential health and other effects of EMFs. Studies, interpretations, and research to date are not conclusive about potential associations between electric or magnetic field and possible health impacts. Although there is no scientific consensus on the topic, the presence of EMF, especially from transmission lines, remains a public concern. PEF recognizes the public concern regarding the potential adverse health effects from EMFs that result from generation, transmission, distribution, and use of electricity. PEF has provided both financial and technical support for EMF research, and continues to monitor ongoing studies.

Because of the lack of evidence supporting a health risk from EMF, there are no federal health standards for EMF. However, FDEP has the authority to regulate EMF associated with transmission lines to protect public health and welfare, and has adopted EMF standards. The parameters that have a significant effect on EMF levels near the transmission line are operating voltage, current, conductor height, electrical phasing, and distance from the source. EMF reduction measures will be incorporated into the line and station designs to ensure compliance with FDEP's EMF standards and to minimize the EMF effects. PEF is committed to providing safe electric service for its customers and a safe working environment for its employees.

Impacts resulting from public exposure to EMF are expected to be SMALL.

5.6.3.2 Noise

When an electric transmission line is energized, an electric field is created in the air surrounding the conductors. If this field is sufficiently intense, it may cause the breakdown of the air in the immediate area surrounding the conductor (corona). Corona can result in audible noise. ER Subsection 3.7.3.1 provides information regarding the predicted audible noise levels from the proposed transmission lines. Design practices to minimize noise for the proposed transmission lines include the use of extra high voltage (EHV) conductors, corona-resistant line hardware, and grading rings at insulators.

Because of the low voltage of the transmission lines and precautionary design measures, impacts on the public from noise are expected to be SMALL.

5.6.3.3 Radio and Television Interference

Radio interference (RI) and television interference (TVI) can occur from corona, electrical sparking, and arcing between two pieces of loosely fitting hardware or burrs or edges on hardware. This noise occurs at discrete points and can be minimized with good design and maintenance practices. The effect of corona on radio and television reception depends on the radio/television signal strength, the distance from the transmission line, and the transmission line noise level. ER Subsection 3.7.3.2 provides information regarding the predicted RI and TVI from the proposed transmission lines. Design practices for the proposed transmission lines include the use of EHV conductors, corona-resistant line hardware, and grading rings at insulators to minimize noise.

Because of the low voltage of the transmission lines and precautionary design measures, impacts on the public from RI and TVI are expected to be SMALL.

5.6.3.4 Visual Impacts

Refer to ER Section 3.7 for further information on the locations of the transmission lines. The operation and maintenance of the proposed transmission lines adjacent to one another and to existing ROWs will minimize effects on visual aesthetics. Visual impacts on the public resulting from operation and maintenance of the proposed transmission lines are anticipated to be minimal.

Visual impacts on the public resulting from operational maintenance of the transmission lines are expected to be SMALL.

5.6.4 REFERENCES

5.6-001 Florida Natural Areas Inventory, database, www.fnai.org/gisdata.cfm, accessed May 1, 2008.

5.6-002 Florida Fish and Wildlife Conservation Commission, “Eagle Nest Locator,” Website, www.floridaconservation.org/eagle/eaglenests/Default.asp, accessed May 1, 2008.

5.6-003 Florida Department of Environmental Protection, “Outstanding Waters,” Website, www.dep.state.fl.us/water/wqssp/ofw.htm, accessed May 1, 2008.

5.7 URANIUM FUEL CYCLE IMPACTS AND TRANSPORTATION IMPACTS

The purpose of this section is to address the uranium fuel cycle (UFC) environmental and transportation impacts, as well as the LWR design that is presently being considered (that is, AP1000).

ER Subsection 5.7.1 contains a discussion regarding the environmental impacts from the UFC for the AP1000.

ER Subsection 5.7.2 required information regarding the impacts from the transportation of radioactive materials from the AP1000, which is already discussed in ER Section 3.8, and will not be addressed in this section. The remainder of this section evaluates the impacts and limitations of the UFC and LWR as defined in NUREG-1437.

5.7.1 ENVIRONMENTAL IMPACTS FROM THE URANIUM FUEL CYCLE

This section discusses the effects on the environment from the hazards associated with the UFC. The UFC is defined as the total of those options and processes associated with the provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

5.7.1.1 Regulatory Requirements

10 CFR 51.51[a] requires that:

> Every environmental report prepared for the construction permit stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S–3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power plant. Table S–3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

Specific categories of natural resource use included in 10 CFR 51 Table S-3 relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic (TRU) and high-level wastes (HLW) and LLWs, as well as radiation doses from transportation and occupational exposures. The contributions in Table S-3 for reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (no-recycle and uranium-only recycle); that is, the cycle that results in the greater impact is used.

The effects (those presented in 10 CFR 51 Table S-3 and reproduced as Table 5.7-1) are calculated for a Reference 1000-megawatt electric (MWe) LWR operating at an annual capacity factor of 80 percent for an effective electric output of 800 MWe.

In developing the Reference Reactor (RR) data, the NRC staff considered two fuel cycle options – no recycle and uranium-only recycle – which differed in the treatment of spent fuel removed from a reactor. “No recycle” treats all spent fuel as waste to be stored at a federal waste repository; “uranium-only recycle” involves reprocessing of spent fuel to recover unused uranium and return it to the system. Neither cycle involves the recovery of plutonium.

The RR values provided for reprocessing, waste management, and transportation are from the UFC option, which results in the larger environmental effect.

5.7.1.2 Uranium Fuel Cycle

The stages of the UFC include the following:

- Mining.
- Conversion.
- Enrichment of uranium.
- Fabrication of nuclear fuel.
- Use of this fuel.
- Disposal of the used (spent) fuel.

Natural uranium is mined in either open pits, underground mines, or by an in-place leaching process. The in-place leaching process involves injecting a solvent solution into the underground uranium ore to dissolve uranium, and then pumping the solution to the surface for further processing. The ore or leaching solution is moved to mills where it is processed to produce uranium oxide (U_3O_8). The U_3O_8 is then converted to uranium hexafluoride (UF_6) in preparation of the enrichment process.

The UF_6 is then transported to an enrichment facility. The process of enrichment increases the percentage of the more fissile isotope uranium-235 (U-235) and decreases the percentage of the isotope uranium-238 (U-238). Natural uranium is approximately 0.7 percent U-235.

All production methods of enrichment exploit the slight differences in atomic weights of the two isotopes. A feature common to all large-scale enrichment schemes is that they employ a number of identical stages, which produce successively higher concentrations of U-235. Each stage concentrates the product of the previous stage further before being sent to the next stage.

Similarly, the tailings from each stage are returned to the previous stage for further processing. This sequential enriching system is called a cascade.

At a fuel fabrication facility, the enriched uranium is then converted from UF_6 to uranium dioxide (UO_2). The UO_2 is formed into pellets, inserted into tubes, and loaded into fuel assemblies. The fuel assemblies are placed in the reactor to produce power. After most of the U-235 has fissioned, the concentration reaches a point at which the nuclear fission process becomes inefficient. The fuel assemblies are then withdrawn from the reactor. After on-site storage for sufficient time to allow for short-lived fission product decay and to reduce the heat generation rate, the fuel assemblies are transferred to a waste repository for interment. Storing the spent fuel elements in a repository constitutes the final step in the no-recycle option.

5.7.1.3 Proposed Plant and Reactor Characteristics

The LWR technology being considered in this ER is the AP1000 (Advanced Passive PWR). Two units will be constructed at the LNP. DCD for the AP1000 provides the following reactor characteristics:

- A single unit is rated at 3400 megawatts thermal (MWt), nominal 1000 MWe PWR.

- The AP1000 reactor fuel characteristics are as follows:

  Fuel pellets = UO_2 sintered

  Clad Material = ZIRLO™ — 10 CFR 50.46 allows the use of ZIRLO™. The ZIRLO™ cladding material combines neutron economy (low absorption cross section); high corrosion resistance to coolant, fuel, and fission products; and high strength and ductility at operating temperatures. ZIRLO™ is an advanced zirconium-based alloy that has the same or similar properties and advantages as Zircaloy-4 and was developed to support extended fuel burnup.

  U-235 enrichment = Region 1 (2.35), Region 2 (3.4), and Region 3 (4.45).

- The center-line temperature limit has been applied to reload cores with a lead rod average burnup of up to 60,000 megawatt days/metric ton of uranium (MWd/MTU).

In the subsections that follow, a comparative analysis has been performed and the environmental effects from the UFC for one AP1000 was evaluated against those presented in Table S-3 of 10 CFR 51.51. In order to compare them appropriately, only one AP1000 reactor was evaluated against the values calculated by the NRC for the RR.

Table S-3 of 10 CFR 51.51 provides estimates of the environmental effects from the UFC. The effects are calculated for a Reference 1000 MWe LWR operating at an annual capacity factor of 80 percent for an effective electric output of 800 MWe. Data are calculated and presented in tables for land use, water consumption, thermal effluents, radioactive releases, waste burial, and radiation doses.

As presented above, the DCD states that “the plant's net electrical power to the grid is at least 1000 MWe.” A value of 1115 is typically being used in the industry and provides a measure of conservatism for this comparative analysis. An assumed capacity factor of 93 percent is applied for conservatism. One AP1000 reactor operating at 1115 MWe, with an annual capacity factor of 93 percent, yields an effective electric output of 1037 MWe. A ratio of the generation values of 930 MWe and 800 MWe provides a scaling factor of 1.30 to convert the RR values to one AP1000 reactor specific value (Table 5.7-1). Applying the AP1000 scaling factor to the values presented in Table S-3, the environmental effects (including the effects from Radon-222 [Rn-222] and Technetium-99 [Tc-99]) of the UFC as a result of the operation of one AP1000 reactor can be basically assessed.

5.7.1.4 NUREG-1437

NUREG-1437, GEIS for License Renewal of Nuclear Plants, provides a detailed analysis of the environmental effects from the UFC. Although NUREG-1437 is specific to license renewal, the information is relevant because the LWR design considered herein uses the same type of fuel.

Recent changes in the UFC may have some bearing on environmental effects. Section 6.2 of NUREG-1437 discusses the sensitivity to recent changes in the UFC on the environmental effects in detail. For example, the reference plant values were calculated from industry averages for each type of facility or operation within the UFC. The values in 10 CFR 51 Table S-3 were calculated from industry averages for the performance of each type of facility or operation within the fuel cycle. Recognizing that this approach would result in a range of reasonable values for each estimate, the NRC staff followed the policy of choosing the assumptions or factors to be applied so the calculated values would not be underestimated. This approach was intended to ensure that the actual environmental impacts would be less than the quantities shown in Tables S-3 for all LWR nuclear power plants within the widest range of operating conditions. Many subtle fuel cycle parameters and interactions were recognized by the NRC staff as being less precise than the estimates and were not considered or were considered but had no effect on the 10 CFR 51 Table S-3 calculations. For example, to determine the quantity of fuel required for a year’s operation of a nuclear power plant in 10 CFR 51 Table S-3, the staff defined the model reactor as a 1000-MW(e) LWR operating at 80 percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a “reactor reference year” or “reference reactor year” (RRY) depending on the source document (either 10 CFR 51 Table S-3 or NUREG-1437), but it has the same meaning. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the now more likely 60-year (40-year initial license term and 20-year renewal license term) lifetime to obtain an average annual fuel requirement.

The quantity of fuel was determined in NUREG-1437 for both BWRs and PWRs; the higher annual requirement, 35 metric tons (MT) of uranium made into fuel for a BWR, was chosen in NUREG-1437 as the basis for the RRY. A number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. Since 10 CFR 51 Table S-3 was promulgated, these improvements have reduced the annual fuel requirement.

Another change considered is the elimination of the U.S. restrictions on importation of foreign uranium. The economic conditions of the uranium market currently favor utilization of foreign uranium at the expense of the domestic uranium industry. These market conditions have led to the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the U.S. from these activities. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and milling could drop levels below those given in 10 CFR 51 Table S-3.

5.7.1.5 Land Use

The total annual land requirement for the UFC supporting one operating AP1000 reactor is presented in Table 5.7-1. This includes values for both permanently and temporarily committed land. NUREG-1555 states that a “temporary” land commitment is a commitment for the life of the specific UFC plant (for example, a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use. “Permanent” commitments represent land that may not be released for use after plant shutdown or decommissioning. This is because decommissioning activities on the pertinent land cannot remove sufficient radioactive material to meet the limits in 10 CFR 20, Subpart E, for release of land for unrestricted use.

As stated in NUREG-1437, the LWR fuel cycle requires only 10 percent of the temporarily committed land and 9.5 percent of the permanently committed land that would be required by replacement with coal-fired capacity. If the quality and opportunity cost of the land were equivalent, then it would be reasonable to assume that land requirements for the UFC (at 20 to 30 percent of those for the coal fuel cycle) are relatively small.

The division of temporarily committed land into undisturbed and disturbed land is presented in Table 5.7-1. These values are compared to those that provide fuel for a coal-fired power plant using strip-mined coal whose power generation is equivalent to the AP1000 value. The impact on land use to support one or two AP1000 reactors from the UFC are expected to be SMALL.

5.7.1.6 Water Use

Power stations supply electrical energy to the enrichment stage of the UFC. The primary water requirement of the UFC is waste heat removal from these power stations. For the UFC supporting the proposed project, over 97 percent of the annual water requirement is used in this manner. Values for the various water uses required are presented in Table 5.7-1.

Water requirements for the UFC are compared to the annual requirements for an LWR. The amount of water withdrawn from surface and groundwater and discharged to air by activities within the fuel cycle represents only 2 percent of the annual discharges to air of an LWR with cooling towers. The fuel cycle discharges are spread among facilities involved in the various stages of the fuel cycle; thus, the water discharge to air from any one of these facilities will be less than the 2 percent calculation. The environmental impacts of water withdrawal, use, and discharge from LWRs with cooling towers is found to have only small, or in special, but unusual circumstances, moderate environmental impacts. Given that the water discharged to the air from other fuel cycle facilities for an RRY is only a small fraction of the discharge from an LWR, the environmental consequences will be even smaller.

The amount of water withdrawn from surface and groundwater and discharged to water bodies and to the ground represents only 4 percent of the annual discharges to water bodies and the ground of an LWR with once-through cooling. The fuel cycle discharges are spread among facilities involved in the various stages of the fuel cycle; thus, the water discharges from any one of these facilities will be less than the 4 percent. The environmental impacts of water withdrawal and discharge from LWRs with once-through cooling are found to have small environmental impacts. Given that the water discharged to water bodies and to the ground from other fuel cycle facilities for an RRY is only a small fraction of the discharge from an LWR, the environmental consequences will be even smaller.

The expected thermal effluent values for one AP1000 are presented in Table 5.7-1. It is concluded that the impact on water use for these combinations of thermal loadings and water consumption will be SMALL relative to the water use and thermal discharges of the proposed project (that is, two AP1000 units).

5.7.1.7 Fossil Fuel Effects

Electrical energy and process heat are required during various phases of the UFC process. The electrical energy is usually produced by combustion of fossil fuels at power plants. Electrical energy needs associated with the UFC represents about 5 percent of the annual electrical power production of the RR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the RR.

The fossil fuel (coal and natural gas) consumed to produce electrical energy and process heat during the various phases of the UFC results in a considerable net savings in the use of resources and chemical effluents over the use that would occur if the electrical output from the LWR were supplied by a coal-fired plant. The use of coal and natural gas in the UFC allows the production of electricity with nuclear fuel, which results in a substantial reduction in the requirements for coal and natural gas as fuels to produce electricity. The fossil fuel requirements are not only small per RRY, but there is a net savings in the use of fossil fuel compared to replacing the nuclear-generating capacity with coal-fired capacity.

Electrical energy needs for one operating AP1000 associated with the UFC are presented in Table 5.7-1. The fossil fuel effects from the consumption of electrical energy for UFC operations would be SMALL relative to the net power production of one or two AP1000 reactors.

5.7.1.8 Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents from UFC processes needed to support one AP1000 are presented in Table 5.7-1. The sitewide quantities of effluents would be approximately 2.32 times that of the reference 1000-MWe LWR model (considering the impacts from two AP1000 units). The principal effluents are sulphur oxides (SO_x), nitrogen oxides (NO_x), and particulates.

The gaseous effluents SO_x, NO_x, hydrocarbons, carbon monoxide (CO), and particulates listed in Table S-3 are the consequence of the coal-fired electrical energy used in the UFC. The volume of effluent is equivalent to that of a quite small (45 MWe) coal-fired plant; thus, the contribution to the degradation of air quality is small. The generation of electricity, with nuclear rather than coal-fired power, will result in a net improvement in air quality. For these reasons, the impact of these effluents is considered SMALL.

According to information presented in NUREG-1555, these emissions constitute a SMALL additional atmospheric loading in comparison with these emissions from the stationary fuel combustion and transportation sectors in the United States (that is, about 0.02 percent of the annual national releases for each of these species).

Liquid chemical effluents produced in UFC processes are related to fuel enrichment and fabrication, and may be released to receiving waters. These effluents are usually present in such small concentrations that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table 5.7-1 presents the amount of dilution water required for specific constituents. Additionally, any liquid discharges into the navigable waters of the United States from plants associated with UFC operations are subject to requirements and limitations set in an NPDES permit issued by an appropriate federal, state, regional, local, or affected Native American tribal regulatory agency. The impacts of these liquid chemical effluents from the UFC will be SMALL for the LNP (that is, two operating AP1000 units) and, therefore, mitigation will not be required.

Tailings solutions and solids are generated during the milling process. These materials are not released in quantities sufficient to have a significant effect on the environment. The impacts of these chemical effluents will be SMALL for the LNP (that is, two operating AP1000 units).

5.7.1.9 Radioactive Effluents

The estimates of radioactive effluent releases to the environment are presented in Table 5.7-1. These are from waste management activities and certain other phases of the UFC process. The 100-year involuntary environmental dose commitment to the United States population is calculated in several parts.

The portion of dose commitment from radioactive gaseous effluents during reactor operation per year of operation of the proposed project is presented in Table 5.7-2. This estimate excludes reactor releases and any dose commitment from Rn-222.

The portion of dose commitment from radioactive liquid effluents as a result of UFC operations other than reactor operation per year of operation of the proposed project is presented in Table 5.7-2. Thus, the total 100-year environmental dose commitment to the U.S. population from radioactive gaseous and liquid releases resulting from these portions of the UFC per year of operation of the proposed project is presented in Table 5.7-2.

Currently, the radiological effects associated with Rn-222 and Tc-99 releases are not addressed in the RR data presented in Table S-3. Principal Rn-222 releases occur during mining and milling operations and as emissions from mill tailings, whereas principal Tc-99 releases occur from gaseous diffusion enrichment facilities. Based on information contained in NUREG-1437, an assessment was performed to determine the effects from Rn-222 and Tc-99. In Section 6.2.2.1 of NUREG-1437, the NRC staff estimated the Rn-222 releases from the mining and milling operation and from mill tailings required to support each year of operations of the RR. Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tailings prior to stabilization.

The major risks from Rn-222 are bone and lung exposure; although, there is a small risk from whole-body exposure. The organ-specific dose-weighting factors from 10 CFR 20 were applied to the bone and lung doses to estimate the 100-year dose commitment from Rn-222 to the whole body presented in Table 6.2 of NUREG-1437. The estimated population dose commitment from mining, milling, and tailings before stabilization for each year of operation for one AP1000 at the LNP is presented in Table 5.7-3. From stabilized tailings piles, the estimated 100-year environmental dose commitment is presented in Table 5.7-3.

Additional insights regarding routine Rn-222 exposure and risk, and long-term releases from stabilized tailings piles, are discussed in NUREG-1437.

As shown in NUREG-1437, the NRC staff also considered the potential health effects associated with the release of Tc-99. Using that evaluation method, the releases of Tc-99 per year for one AP1000 are chemical reprocessing of recycled UF_6 before it enters the isotope enrichment cascade, and released into the groundwater from a federal repository. These values are presented in Table 5.7-3.

The major risks from Tc-99 are from gastrointestinal tract and kidney exposure; although, there is a small risk from whole body exposure. Using organ-specific risk estimators, these individual organ risks were converted to a whole body 100-year dose commitment per year for one operating AP1000. This value is presented in Table 5.7-3.

Although radiation may cause cancers at high doses and high dose rates, currently, there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates. However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response model is typically accepted and used to describe the relationship between radiation dose and risk such as cancer induction. A report by the National Research Council of the National Academies supports the linear, no-threshold dose response model. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. As noted in NUREG-1555, this theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the NRC staff estimated the risk to the public from radiation exposure. The sum of the estimated whole-body population doses from gaseous effluents, liquid effluents, Rn-222, and Tc-99 discussed above can be used to estimate the number of fatal cancers, nonfatal cancers, and severe hereditary effects that the United States population would incur annually. This risk is small compared to the number of fatal cancers, nonfatal cancers, and severe hereditary effects that would be estimated to occur in the U.S. population annually from exposure to natural sources of radiation using the same risk estimation method. ER Subsection 5.7.1.12 provides more information regarding public exposures from natural background radiation.

Typically, the radiation levels from Rn-222 released from tailings piles are indistinguishable from background radiation levels at a few kilometers from the tailings. The public dose limit specified by the USEPA regulation in 40 CFR 190, is 25 mrem/yr to the whole body from the entire UFC, but most NRC licensees have airborne effluents resulting in doses of less than 1 mrem/yr.

Based on the analyses presented above, the environmental impact of radioactive effluents from the UFC is SMALL, even when the effects to account for two operating AP1000 units are doubled.

5.7.1.10 Radioactive Wastes

The quantities of buried radioactive waste material (LLW, HLW, and TRU wastes) are specified in Table 5.7-1.

For LLW disposal at land burial facilities, the NRC notes in the RR data presented in Table S-3 that there will be no significant radioactive releases to the environment.

For HLW and TRU waste, the NRC notes in Table S-3 that these wastes are expected to be buried at a repository, and that no release to the environment is expected to be associated with such disposal. The gaseous and volatile radionuclides contained in the spent fuel would have been released and monitored before disposal.

The NRC is one of three federal agencies under the AEA with a role in the disposal of spent nuclear fuel and other HLW. Responsibility among the three agencies is described as follows:

- The U.S. Department of Energy (DOE) is responsible for developing permanent disposal capacity for spent fuel and other high-level radioactive waste.
- The USEPA is responsible for developing environmental standards to evaluate the safety of a geologic repository.
- The NRC is responsible for developing regulations to implement the USEPA safety standards and for licensing the repository.

The NRC regulations for geologic disposal of HLW in 10 CFR 60 limit the releases of radioactive material to the accessible environment. In addition to satisfying an overall performance objective to be established by USEPA, the basic requirements are that containment of HLW within the waste packages will be substantially complete for a period between 300 and 1000 years (to be determined by the NRC), and that the annual releases from the engineered barrier system thereafter should not exceed one part in 100,000 of the total inventory of each radionuclide calculated to be present 1000 years following permanent source of the repository. For HLW, 10 CFR 60.111 requires compliance with 10 CFR 20 and with USEPA general environmental standards in 40 CFR 191.

For HLW and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for off-site releases of radionuclides for the candidate repository at Yucca Mountain. If it is assumed that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, *Technical Bases* *for Yucca Mountain Standards*, and that in accordance with the NRC's Waste Confidence Decision, 10 CFR 51.23, a repository can, and likely will be, developed at some site that will comply with such limits; peak doses to virtually all individuals will be 100 mrem/yr or less.

Based on the discussion presented above, the environmental impact of radioactive waste disposal from the UFC is expected to be SMALL.

5.7.1.11 Occupational Dose

In the review and evaluation of the environmental effects of the UFC, the annual occupational dose attributable to all phases of the UFC for one operating AP1000 is presented in Table 5.7-2. Occupational doses would be maintained to meet the dose limits in 10 CFR 20, which is 5 rem/yr. On this basis, it is concluded that environmental impacts from this occupational dose are anticipated to be SMALL even if the doses were doubled for two units.

5.7.1.12 Transportation

The transportation dose to workers and the public is presented in Table 5.7-1 for one operating AP1000. For comparative purposes, it is estimated that the average annual dose from manmade and natural background radiation is approximately 360 mrem/yr as shown in Table 5.7-A-2 of NUREG-1555. The estimated population living within an 80-km (50-mi.) radius of the LNP in 2005 is approximately 1,123,616 as shown in Table 2.5-4. The estimated collective dose from manmade and natural background radiation to the population within 80 km (50 mi.) of the LNP is 404,501,760 person-mrem/yr. Doses from natural and manmade radioactive sources would significantly exceed any doses from transportation activities associated with radioactive wastes.

On this basis, the environmental impacts of transportation are anticipated to be SMALL.

5.7.1.13 Conclusion

Using an evaluation process as provided by NUREG-1437, considering the environmental effects of the UFC, the effects of Rn-222 and Tc-99, and the effects of the scaled data for the proposed AP1000 reactor, it is concluded that the environmental impacts of the UFC will be SMALL, and mitigation is not warranted. For conservatism, even if the 1.30 scaling factor is doubled and applied to the values in Tables 5.7-1, 5.7-2, and 5.7-3 to account for two AP1000 units at a site, the impacts would still be SMALL, and mitigation would not be required.

5.7.2 TRANSPORTATION OF RADIOACTIVE MATERIALS

The impacts from the transportation of radioactive materials are addressed in ER Section 3.8.

Table 5.7-1 (Sheet 1 of 6)
10 CFR 51.51 Table S-3 of Uranium Fuel Cycle Environmental Data
Normalized to Model LWR Annual Fuel Requirement (WASH-1248) or Reference Reactor Year (NUREG-0116)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MWe LWR	AP1000 Data (Reference Reactor Data Scaled to Proposed Plant [that is, RRY*Scaling Factor of 1.30])
NATURAL RESOURCE USE			
Land (hectares [acres]):			
Temporarily committed[(a)]	40.5 (100)		52.5 (130)
Undisturbed area	32 (79)		42 (102)
Disturbed area	9 (22)	Equivalent to a 110-MWe coal-fired power plant.	12(29)
Permanently committed	5 (13)		7 (17)
Overburden moved in MT	2.8 (3.1)	Equivalent to 95-MWe coal-fired power plant.	3.6 (4.0)
Water (millions of liters [millions of gallons]):			
Discharged to air	606 (160)	= 2 percent of model 1000 MWe LWR with cooling tower.	786 (207)
Discharged to water bodies	41,980 (11,090)		54,414 (14,375)
Discharged to ground	481 (127)		623 (165)
Total	**43,067 (11,377)**	<4 percent of model 1000 MWe LWR with once through cooling.	**55,823 (14,747)**
Fossil Fuel:			
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1000 MWe output.	419
Equivalent coal in thousands of tons	118 (130)	Equivalent to the consumption of a 45-MWe coal-fired power plant.	153 (169)
Natural gas in millions of m^3 ($ft.^3$)	3.8 (135)	<0.4 percent of model 1000 MWe energy output.	4.9 (175)

Table 5.7-1 (Sheet 2 of 6)
10 CFR 51.51 Table S-3 of Uranium Fuel Cycle Environmental Data
Normalized to Model LWR Annual Fuel Requirement (WASH-1248) or Reference Reactor Year (NUREG-0116)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MWe LWR	AP1000 Data (Reference Reactor Data Scaled to Proposed Plant [that is, RRY*Scaling Factor of 1.30])
EFFLUENTS — CHEMICAL (MT [tons])			
Gases (including entrainment)[(b)]			
SO_x	4400 (4850)		5703 (6287)
NO_x[(c)]	1190 (1312)	Equivalent to emissions from 45-MWe coal-fired plant for a year.	1543 (1701)
Hydrocarbons	14 (15)		18 (19)
CO	29.6 (32.6)		38.4 (2.3)
Particulates	1154 (1272)		1496 (1649)
Other gases:			
F	0.67 (0.74)	Principally from UF_6, production, enrichment, and reprocessing. Concentration within range of state standards-below level that has effects on human health.	0.87 (0.96)
HCl	0.014 (.015)		0.018 (0.019)
Liquids:			
SO_4^{-2}	9.9 (10.9)	From enrichment, fuel fabrication, and reprocessing steps.	12.8 (14.1)
NO_3^-	25.8 (28.4)	Components that constitute a potential for adverse environmental effect are present in dilute concentration levels below permissible standards. The constituents that require dilution and the flow of dilution water are as follows:	33.4 (36.8)
Fluoride	12.9 (14.2)		16.7 (18.4)
Ca^{+2}	5.4 (5.9)	NH_3 – 17 cubic meters per second (m^3/s) (600 ft^3/sec), NO_3 – 0.56 m^3/s (20 ft^3/sec), and Fluoride – 2 m^3/s (70 ft^3/sec).	7.0 (7.6)
Cl^-	8.5 (9.4)		11.0 (12.2)
Na^+	12.1 (13.3)		15.7 (17.2)

Table 5.7-1 (Sheet 3 of 6)
10 CFR 51.51 Table S-3 of Uranium Fuel Cycle Environmental Data Normalized to Model LWR Annual Fuel Requirement (WASH-1248) or Reference Reactor Year (NUREG-0116)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MWe LWR	AP1000 Data (Reference Reactor Data Scaled to Proposed Plant [that is, RRY*Scaling Factor of 1.30])
NH_3	10 (11)		13 (14)
Fe	0.4 (0.44)		0.5 (0.57)
Tailings Solutions (thousands of MT [tons])	240 (264.5)	From mills only — no significant effluents to environment.	311 (342.8)
Solids	91,000 (100,310)	Principally from mills — no significant effluents to environment.	117953 (130,021)
EFFLUENTS — RADIOLOGICAL – CURIES (GBq)			
Gases (including entrainment):			
Rn-222		Presently under reconsideration by the NRC.	
Ra-226	0.02 (0.74)		0.023 (0.96)
Th-230	0.02 (0.74)		0.023 (0.96)
Uranium	0.034 (1.26)		0.044 (1.63)
Tritium (thousands)	18.1 (669.7)		23.5 (868.1)
C-14	24 (888)		31 (1151)
Kr-85(thousands)	400 (14,800)		518 (19,184)
Ru-106	0.14 (5.18)	Principally from fuel reprocessing plants.	0.18 (6.71)
I-129	1.3 (48.1)		1.69 (62.4)
I-131	0.83 (30.7)		1.08 (39.8)
Tc-99		Presently under consideration by the NRC.	
Fission products and transuranics	0.203 (7.51)		0.263 (9.73)
Liquids:			
Uranium and daughters	2.1 (77.7)	Principally from milling — included tailings liquor and returned to ground — no effluents; therefore, no effect on the environment.	2.7 (100.7)
Ra-226	0.0034 (0.126)	From UF_6 production.	0.0044 (0.163)
Th-230	0.0015 (0.055)		0.0019 (0.071)

Table 5.7-1 (Sheet 4 of 6)
10 CFR 51.51 Table S-3 of Uranium Fuel Cycle Environmental Data Normalized to Model LWR Annual Fuel Requirement (WASH-1248) or Reference Reactor Year (NUREG-0116)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MWe LWR	AP1000 Data (Reference Reactor Data Scaled to Proposed Plant [that is, RRY*Scaling Factor of 1.30])
Th-234	0.01 (0.37)	From fuel fabrication plants — concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.	0.01 (0.48)
Fission and activation products	5.9E-06 (2.2E-04)		7.6E-06 (2.9E-04)
Solids (buried on-site):			
Other than high level (shallow)	11,300 (418,100)	The 9100 Ci comes from low-level reactor wastes and 1500 Ci comes from reactor decontamination and decommissioning buried at land burial facilities. The 600 Ci comes from mills included in tailing returned to ground. The approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.	14,647 (541,936)
TRU and HLW (deep)	1.1E+07 (4.07E+08)	Buried at federal repository.	1.4E+07 (5.28E+08)
Effluents — thermal (billions of Btu)	4063 (150,331)	<5 percent of model 1000 MWe LWR.	5,266 (194,857)
Transportation (person-rem/Sv):			
Exposure of workers and general public	2.5 (0.025)		3.2 (0.032)
Occupational exposure	22.6 (0.226)	From reprocessing and waste management.	29.3 (0.293)

Table 5.7-1 (Sheet 5 of 6)
10 CFR 51.51 Table S-3 of Uranium Fuel Cycle Environmental Data
Normalized to Model LWR Annual Fuel Requirement (WASH-1248) or Reference Reactor Year (NUREG-0116)

Notes:

In some cases, where no entry appears, it is clear from the background documents that the matter was addressed and that, in effect, the table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the table. Table S-3 does not include health effects from the effluents described in the table, or estimates of releases of Radon-222 from the UFC or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings. Data supporting this table are given in the ‘‘Environmental Survey of the Uranium Fuel Cycle,’’ WASH-1248, April 1974; the ‘‘Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle,’’ NUREG-0116 (Supp.1 to WASH-1248); the ‘‘Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle,’’ NUREG-0216 (Supp. 2 to WASH-1248); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium-only and no-recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in Columns A-E of Table S-3A of WASH-1248.

a) The contributions to temporarily committed land from reprocessing are not prorated over 30 years because the complete temporary impact accrues regardless of whether the plant services one reactor for 1 year or 57 reactors for 30 years.

b) Estimated effluents based on combustion of equivalent coal for power generation.

c) About 1.2 percent from natural gas use and process.

Btu = British thermal unit
C-14 = carbon-14
CA^{+2} = calcium
Ci = Curie
Cl^{-} = chloride
CO = carbon monoxide
F= fluorine
Fe = iron
$ft.^{3}$ = cubic foot
ft^{3}/sec = cubic foot per second
GBq = gigabecquerel
HCl = hydrogen chloride
I-129 = Iodine-129

Table 5.7-1 (Sheet 6 of 6)
10 CFR 51.51 Table S-3 of Uranium Fuel Cycle Environmental Data
Normalized to Model LWR Annual Fuel Requirement (WASH-1248) or Reference Reactor Year (NUREG-0116)

Notes: (continued)

I-131 = Iodine-131
Kr-85 = Krypton-85
LWR = light-water reactor
m^3 = cubic meter
m^3/s = cubic meter per second
MT = metric ton
MW = megawatt
MWe = megawatt electric
Na^+ = sodium
NH_3 = ammonia
NO_3^- = nitrate
NO_x = nitrogen oxide
Ra-226 = Radium-226
RRY = reference reactor year
Ru-106 = Ruthenium-106
SO_4^{-2} = sulfate
SO_x = sulphur oxide
Th-230 = Thorium-230
TRU = transuranic
UFC = uranium fuel cycle

Table 5.7-2
Whole Body 100-Year Committed Dose Estimate

100-Year Overall Involuntary Whole-Body Dose Commitment to the United States Population from the Uranium Fuel Cycle, Excluding Rn-222 or Tc-99	RR/RRY (person-rem [Sv])	Person-rem (Sv)/per AP1000 Operating Year (RRY*1.30 Scaling Factor)
From radioactive gaseous releases (this excludes reactor releases and the dose commitment from Rn-222 &Tc-99).	400 (4)	519 (5)
From radioactive liquid releases (all fuel-cycle operations excluding reactor operations).	200 (2)	259 (3)
Subtotal	**600 (6)**	**778 (8)**
Rn-222 Total from Table 5.7-3	140(1.4)	182 (1.8)
Tc-99 Total from Table 5.7-3	100 (1.0)	130 (1.3)
Total including contributions from Rn-222 and Tc-99	**840 (8.4)**	**1,090 (11.1)**

Table 5.7-3
Whole Body 100-Year Committed Dose Estimate from Rn-222 and Tc-99

	Release, Ci/RRY (GBq/RRY)	Release, Ci/AOY (RRY*1.30 Scaling Factor)	Release, GBq/AOY (RRY*1.30 Scaling Factor)	Whole-Body 100-Year Committed Dose (100-Yr person-rem/ RRY)
Rn-222 values				
Mining	4,060 (150,220) (78% of total)	5263	194,713	110 (~78% of total)
Milling	780 (28,860) (15% of total)	1,011	37,408	21 (~15% of total)
Tailings	350 (12,950) (7% of total)	454	23,267	9 (~7 % of total)
Stabilized Tailings	1 (37) (<1% of total)	1.3	48	0.027 (<1% of total)
Total-Rn-222	**5,191 (192,067)**	**6,729**	**248,955**	**140**
Tc-99 Values				
Chemical Processes	0.007 (0.259) (58% of total)	0.009	0.336	58 (58% of total)
Groundwater	0.005 (0.185) (42% of total)	0.006	0.240	42 (42% of total)
Tc-99 Totals	**0.012 (0.444)**	**0.015**	**0.576**	**100**

Notes:

AOY = AP1000 operating year
Ci = Curie
GBq = gigabecquerel
person-rem = person-Roentgen equivalent man
RRY = reference reactor year
Sv = Sievert

5.8 SOCIOECONOMIC IMPACTS

This section follows the content and organization of the NUREG-1555. NUREG-1555 is designed to meet the requirements of 10 CFR 51. This section was prepared in accordance with NUREG-1555 and is organized into the following subsections:

- ER Subsection 5.8.1 — Physical Impacts of Station Operation
- ER Subsection 5.8.2 — Social and Economic Impacts of Station Operation
- ER Subsection 5.8.3 — Environmental Justice Impacts

This section evaluates the socioeconomic impacts related to operation of the LNP and appurtenant facilities as described in ER Section 5.0. For this discussion, the LNP and appurtenant facilities will be collectively referred to as the LNP. It is assumed that these appurtenant facilities are those that support infrastructure and will not require daily operations personnel. It is further assumed that requirements for periodic maintenance of these facilities will be conducted by the proposed LNP maintenance personnel and no additional staff will be required. The socioeconomic impacts from operation of the LNP and appurtenant facilities are discussed in the following subsections.

5.8.1 PHYSICAL IMPACTS OF STATION OPERATION

The following subsections assess the potential physical impacts that could result from the operation of the LNP.

- ER Subsection 5.8.1.1 — Noise
- ER Subsection 5.8.1.2 — Air Quality
- ER Subsection 5.8.1.3 — Aesthetic Disturbances

Physical impacts are defined as noise, odors, exhausts, thermal emissions, and visual intrusion. Potential physical impacts have been assessed and alternative locations, designs, and procedures used where appropriate. Where applicable, these subsections identify people, structures, roads, and recreational areas that could be affected. These impacts are defined by regulations that specifically address acceptable levels of change to existing noise, air, and visual quality. Where impacts are identified that have the potential to be adverse, the LNP Combined License (COL) Applicant is committed to mitigating these physical impacts, and the project will meet the criteria and standards set forth in applicable local, regional, state, and federal regulations.

ER Section 4.4 discusses construction activities that may also have operational impacts. Direct physical impacts on the site, vicinity, and region resulting from these activities are further described in the following subsections.

5.8.1.1 Noise

When the LNP becomes fully operational, the potential for impacts on ambient noise levels in the areas surrounding the plant and its supporting facilities will exist from the following primary sources of noise or noise-producing activities:

- Main plant components, including the mechanical draft cooling towers, main transformers, steam turbines, circulating water pumps, and emergency power equipment.
- Off-site supporting equipment, including the cooling system makeup water pumphouse that will be located adjacent to the CFBC, approximately 5.75 km (3.5 mi.) south of the center of the main plant site near CR-40.
- Transportation-related noise attributable to an increase in the workforce and associated growth as a result of the operation of the plant.

An assessment of the impacts on ambient noise levels during the operation of the LNP was previously evaluated in support of PEF's SCA to the State of Florida and described in a report entitled, "Noise Assessment of Proposed Levy Nuclear Plant," dated March 10, 2008. The noise sources evaluated as part of this assessment included the main plant components and the cooling system makeup water pumphouse located near the CFBC. The emergency power equipment (diesel-powered emergency generators and diesel fire pumps) at the LNP will be located inside buildings equipped with noise reduction provisions to reduce ambient noise levels in the immediate vicinity of the equipment. Additionally, these units will be operated only very infrequently, primarily for testing and maintenance or during emergency conditions. As a result, these units are not expected to be significant sources of noise, particularly at off-site locations.

The noise assessment of the LNP was performed in support of the PEF's SCA to the State of Florida. The noise assessment, which included an ambient background noise survey (described in ER Subsection 2.5.2.7.1), was based on a conservative noise modeling analysis to predict noise levels during operation. This analysis indicated that noise from the main plant equipment may be perceptible at the nearest off-site locations (that is, near the west property boundary of the project site); however, the areas where these perceptible noise levels would exist are not presently developed, and there are no sensitive noise receptors (residences) in those areas. The nearest existing residences are located approximately 2.6 km (1.6 mi.) to the northwest and 2.8 km (1.7 mi.) to the west southwest of the center of the project site. There are no other potentially sensitive noise receptors at closer distances than these residences relative to the main plant site. At these locations noise impacts attributable to plant operation were predicted to be in the range of 25 to 28 dBA at the three nearest residences, which are located to the west of the project site. These noise levels would only be perceptible under limited ambient conditions, such as calm winds with very low background ambient noise levels. During the quietest periods of the day, the increase in noise levels (above the existing ambient background) at the nearest residences is predicted to be no greater than 1 dBA.

The presence of extensive vegetation in the site area should result in further reductions in noise levels that were not accounted for in the noise modeling. The noise analysis also predicted that off-site noise levels would not exceed the noise limitations established by the Levy County Noise Ordinance (that is, 65 dBA for daytime hours, 55 dBA for nighttime hours in rural and residential areas) at any location. The LNP site will be designed to ensure that all applicable Occupational Safety and Health Administration (OSHA) noise requirements are met.

A noise assessment was also performed in the vicinity of the cooling system makeup water pumphouse that will be located adjacent to the CFBC, which parallels the CFG. Maximum noise levels in the publicly accessible areas near the proposed location of the pumphouse (which will be constructed of concrete and sound-absorbing materials to maximize noise attenuation to the outside), are predicted to be well below the Levy County permissible noise levels for residential and recreational use areas and in the range of existing background levels. Final design of the pumphouse structure will incorporate these requirements to minimize ambient noise impacts in the immediate vicinity of the pumphouse. These noise levels are below the Levy County Noise Ordinance limitations for rural and residential areas.

During plant operation, the rail spur that will service the facility will be used on an extremely infrequent basis and, as such, noise impacts attributable to rail operation are not expected to represent a significant perceptible increase in noise levels when compared to existing rail traffic in the area.

Noise will also be generated by periodic testing of emergency sirens used to alert on- and off-site personnel for plant emergencies. Noise of this type will be episodic and infrequent, and comparable to civil defense siren testing or to sirens currently in place for the CREC.

The closest recreation areas to the proposed LNP site (including the pipeline and heavy haul road corridor) are the CFG (parallel to the CFBC) and the Goethe State Forest, the most southerly portion of which borders the north boundary of the plant site (approximately 2.9 km [1.8 miles] from the center of the plant site). Because of the large distances of these two areas from the main plant components at the LNP, noise impacts attributable to the operation of that equipment in these recreational areas are not expected to be significant. While noise levels in the immediate vicinity of the pumphouse may be noticeable, it will not exceed the Levy County Noise Ordinance limitations. The area where noise levels may be noticed is expected to be very localized and in close proximity to the pumphouse.

Noise-related impacts on people, buildings, roads, and recreation areas from operation of the LNP and appurtenant facilities, including impacts from increased worker and other vehicular traffic in the area are expected to be SMALL, and no mitigation measures are warranted.

5.8.1.2 Air Quality

As a nuclear-powered electrical generating plant, the LNP will have very few sources of air emissions. With the exception of some relatively small diesel-fueled emergency power generating equipment and fire pumps, the plant will not have any significant sources of emissions attributable to the combustion of fossil or other fuels. The air emissions associated with the infrequent operation of these diesel powered equipment (and their associated diesel fuel storage tanks) is described in ER Subsection 3.6.3. A summary of the emissions from this equipment is provided in ER Subsection 3.6.3.1.4. The primary source of air emissions at the LNP will be two banks of mechanical draft cooling towers (one for each reactor), which will emit water vapor and particulate matter (PM) to the atmosphere. Water vapor is not considered a pollutant, and its emissions are not regulated at the state or federal level in Florida. No odors should be associated with the cooling tower plumes. PM emissions from the cooling towers will consist of naturally occurring dissolved and suspended solids in the cooling tower circulating water that will be emitted with water droplets that become airborne as cooling tower "drift." The emissions of PM will exceed the State of Florida's "major source" threshold of 100 tons per year (tpy), and an application for a PSD Permit for air emissions has been prepared for construction and initial operation of the LNP. The PSD Permit Application was prepared and submitted in conjunction with PEF's SCA for the LNP. The PSD Permit Application indicates that air emissions of PM less than 10 micrometers (µm) in diameter (PM_{10}), sulphur dioxide (SO_2), NO_X, CO, and volatile organic compounds (VOCs) will not be emitted in significant quantities (as defined by Florida and USEPA) and, therefore, PSD review is not triggered for those pollutants.

Because of the very low level of emissions from the LNP, its operation is not expected to cause or contribute to a violation of any state or federal ambient air quality standard for any pollutant at any location. Although there will be PM emissions from the LNP's mechanical draft cooling towers, there are no ambient air quality standards for PM. Ambient air quality standards for particulate matter only exist for PM_{10} and $PM_{2.5}$ (PM less than 2.5 µm in diameter). Of the other emissions that will be emitted by the LNP, namely PM_{10}, SO_2, NO_X, CO, and VOC, none of these emissions will be emitted in "significant" quantities (as defined by state and federal air quality regulations), and their corresponding impacts on ambient air quality will, therefore, be insignificant. Levy County and the entire State of Florida is currently designated as being in attainment of the National Ambient Air Quality Standards (NAAQS) (as described in ER Subsection 2.7.2) and no change in this designation is expected.

There will be a small increase in regional and local air emissions as a result of increased vehicular traffic associated with plant operations and the workforce employed by the LNP. As described in the introduction to ER Section 5.8, the increase in employment as a result of plant operations will be approximately 773 personnel. However, the increase in traffic-related emissions from this increase in workforce is not expected to result in a significant change in the total number of vehicle miles traveled in the region, and the increase will not represent either a measurable or discernible change in air quality at any location.

Air quality impacts on people, buildings, roads, and recreation areas from operation of the LNP and appurtenant facilities, including impacts from increased worker and other vehicular traffic in the area are expected to be SMALL, and no mitigation measures are warranted.

5.8.1.3 Aesthetic Disturbances

A small portion of the LNP site will transition from an undeveloped mix of forested wetlands and actively managed silviculture lands to an area that is industrial in appearance at the center of the plant site. The majority of the site will be preserved in its present forested condition creating a natural buffer around the industrial area. As discussed in ER Subsection 3.1.4.3, the physical structures of the plant will not be visible from public areas at ground level, and only the cooling tower plumes will potentially be visible (during limited meteorological conditions) from a limited number of off-site locations. The plumes from the cooling towers are not expected to be visible from the closest recreational areas in the area, primarily because of the large distances from these areas to the cooling towers, as well the amount of view-obstructing vegetation between these areas and the cooling towers. The closest residence is approximately 2.6 km (1.6 mi.) from the LNP site and the closest town is Inglis, located 6.6 km (4.1 mi.) southwest of the LNP site; no significant visual impacts on nearby residents is expected.

The mechanical draft cooling towers that will be used at the LNP emit visible water vapor plumes, which are expected to be visible from a limited number of off-site locations only on rare occasions. Most of the time, the visible plumes will extend only a short distance from the cooling towers and then dissipate as a result of evaporation. The length of the visible plumes will depend on the temperature and humidity of the atmosphere. Generally, colder and more humid weather is more conducive to longer plumes. USEPA's CALPUFF dispersion model was used to evaluate the cooling tower plume behavior, and to estimate the frequency of occurrence and length of visible cooling tower plumes. The results of the CALPUFF analysis are summarized in Table 5.8-1. The results indicate that for all hours of the day, including daylight hours, visible plumes from the LNP cooling towers will remain primarily on-site and within 100 m (328 ft.) of the towers. Only a small percentage of visible plumes are predicted to extend beyond 100 m (328 ft.) from the cooling towers. Plumes greater than 1000 m (3280 ft.) (that is, the approximate distance to the nearest site boundary) are predicted to occur less than approximately 2 percent of the time (1 percent during daylight hours). The plume height during daylight hours is predicted to rise up to 200 m (656 ft.) above ground less than 1 percent of the time (0.5 percent during daylight hours). Based on the predictions of this analysis, the cooling tower plumes are expected to be visible outside the LNP property very infrequently throughout the year and only at select locations. In addition to the plume visibility assessment, the analysis also demonstrated that there were no predicted occurrences of ground level fogging or icing beyond 1000 m (3280 ft.) of the cooling towers. The nearest roadway (US-19) is located 1400 m (0.9 mi.) (at its nearest point) west of the cooling towers. Therefore, it is not expected that there will be any occurrences of ground level fog formation or icing on any public roadway due to the operation of the LNP cooling towers. There should also be no off-site occurrences of fogging or icing attributable to cooling tower operation at any location.

The presence of visible cooling tower plumes from the LNP is expected to have little or no significant impact on recreational facilities in the general vicinity of the LNP site. Recreational users of Goethe State Forest and the CFG – Inglis Island Trail, 2.6 km (1.6 mi.), and 5.4 km (3.4 mi.) from the LNP site respectively, are not expected to be able to see the cooling tower plumes, considering that plumes are predicted to extend beyond the nearest site boundary less than 1 percent of the time during daylight hours. Also, the area around the LNP site is heavily buffered with trees and other dense vegetation that will inherently limit visibility of the LNP site and the cooling tower plumes from most locations.

The cooling tower plumes and occasional ground level fogging events will rarely be visible in off-site areas will, therefore, have little to no impact on the surrounding recreational areas or residents. Also, the area surrounding the LNP site is heavily undeveloped forested timber and game lands, and the plumes will be buffered by existing trees and shrubby vegetation.

The operation of the LNP will have a SMALL impact on visual aesthetic impacts on people, nearby residences, roads, and recreation areas from operation of the LNP and appurtenant facilities, and no mitigation will be required.

5.8.2 SOCIAL AND ECONOMIC IMPACTS OF STATION OPERATION

The following subsections discuss social, political, and economic impacts in the vicinity and region. Impacts from both operation and operating workforce are addressed.

- ER Subsection 5.8.2.1 — Economic Characteristics
- ER Subsection 5.8.2.2 — Tax Impacts
- ER Subsection 5.8.2.3 — Social Structure
- ER Subsection 5.8.2.4 — Housing
- ER Subsection 5.8.2.5 — Educational System
- ER Subsection 5.8.2.6 — Recreation
- ER Subsection 5.8.2.7 — Public Facilities and Services

- ER Subsection 5.8.2.8 — Transportation Facilities
- ER Subsection 5.8.2.9 — Distinctive Communities

Social, political, and economic impacts associated with operating the LNP, appurtenant facilities, and meeting the requirements of the operations workforce include impacts on the economy (local labor force and employment, income, and private sector goods and services), tax revenues to local jurisdictions, local planning processes, social structure, housing, educational, recreational, public services and facilities, transportation facilities, and distinctive communities. This evaluation assesses impacts of operation and of demands placed by the workforce on the eight counties wholly or partially within the 80-km (50-mi.) region. These eight counties include Levy, Citrus, Marion, Alachua, Dixie, Gilchrist, Hernando, and Sumter. Depending on the type of analysis and extent of data available, impacts are evaluated for smaller regions that make up one or more of these counties within the region. The smaller study areas allow for conservative assumptions and more accurate conclusions by avoiding overestimated positive impacts and underestimated negative impacts.

Positive economic impacts include increases in jobs, earnings, and output, which are generally viewed as beneficial to the economic well-being of the community. These positive impacts are likely to be spread over the entire region because the workers are likely to commute to or relocate near the LNP from the major population centers within and outside this region.

Property tax revenues are also viewed as positive impacts because they are used to fund local services. Property tax revenues from the LNP will primarily accrue to Levy County and will not be spread out over the region because the LNP will be located in Levy County. A portion of the increase in tax revenue will provide a source of funds to pay for local public services and facilities.

To the extent that population shifts occur as a result of the construction and operation of the LNP, the existing housing, roads, schools, infrastructure, and public services may be negatively affected. Potential negative impacts are examined by using reasonable assumptions for allocating project-induced population shifts among the counties. Because of the small size of the operations workforce in relation to the population of the region, any impacts on these resources would not be apparent at the regional scale. However, closer examination of potential impacts from workers choosing to reside in the three counties closest to the LNP (Levy, Marion, and Citrus) is warranted. Levy County is of particular interest because it is relatively unpopulated and undeveloped.

The LNP will require approximately 773 workers for operations as presented in Table 5.8-2. Commercial operation is scheduled to commence in 2016 or 2017 for LNP 1 and in 2017 or 2018 for LNP 2. This analysis assumes that PEF may apply for license renewal for LNP 1 and LNP 2, which would extend their 40-year operation by an additional 20 years or until 2076 and 2077, respectively, resulting in a 60-year operational period. Decommissioning of the LNP is discussed in ER

Section 5.9. Refueling outages will last approximately 25 to 30 days and require approximately 800 additional workers every 18 months (Table 5.8-2). For the purpose of performing the socioeconomic analysis, it is assumed that the operations and outage workforces will primarily reside within the three counties closest to the LNP, as follows: Levy (28 percent), Citrus (30 percent), and Marion (35 percent). The remaining 7 percent will be distributed across the remaining five counties in the 80-km (50-mi.) region as presented on Table 5.8-2. The rationale for this assumed distribution is that the LNP site is located at the apex of these three surrounding counties, and there is sufficient availability of housing units to accommodate the operations workforce and their families. Nonetheless, because Levy County is relatively rural (see ER Section 2.1 and Subsection 2.2.1), and is lagging Marion and Citrus counties in terms of infrastructure and public services, this analysis of scenarios further assumes that the workers choosing to locate in Levy County will require new housing.

This analysis conservatively assumes that 100 percent of the LNP operations workforce will migrate into the region with their families. Based on the average family size of 2.49, there will be a population influx of 1925 people (773 new operations workers multiplied by 2.49) to the region (Reference 5.8-001). Levy County's 28 percent share equals 539 new in-migrants, Citrus County's 30 percent share equals 577 new in-migrants, and Marion County's 35 percent share equals 674 new in-migrants. The remaining 7 percent or 135 operation workers and their families would be dispersed among the other five counties in the region (Alachua, Dixie, Gilchrist, Hernando, and Sumter counties).

As previously noted, an additional 800 temporary workers will be needed for about 25 to 30 days every 18 months for refueling outages. Because of the close proximity of the CREC, it is assumed that PEF will rely upon many of the same workers who currently service the CREC refueling outages. This can be accomplished by staggering the planned outages.

5.8.2.1 Economic Characteristics

The assessment of economic impacts relies on the population, community characteristics, and other socioeconomic features described in ER Subsections 2.5.1 and 2.5.2. "Economic impact" refers to changes in the number of jobs, earnings, and output in the region as a result of the LNP operation. To estimate economic impacts of operations, the portion of the LNP workforce that will migrate into the region added to the number of workers employed needs to be estimated. As noted in ER Subsection 2.5.2.1, the size of the workforce in the region in 2005 was 439,252. Less than 2 percent of this workforce holds jobs in the transportation and utilities sector (Reference 5.8-002). The Employ Florida Banner Center for Energy and the Florida Agency for Workforce Innovation Labor Market Statistics Center are predicting a shortage in the energy sector workforce, primarily because of the age structure of the existing workforce, but also because of the plans for constructing new plants. The number of job openings in the energy sector in Florida is expanding, while many current workers are nearing retirement age. Efforts to mitigate this anticipated shortage, including educating and training a skilled workforce, are underway. Thus, it is likely that the LNP will rely upon attracting new workers with the necessary skills to operate the LNP. Occupations such as plant operators, line installers and repairers, maintenance and repair workers, electricians, plumbers, pipefitters, steamfitters, and engineering technicians are of interest. (References 5.8-003 and 5.8-004)

The following estimates of economic impacts use the maximum value (100 percent) of the migration assumption, and these estimates would be halved to correspond to the lowest value (50 percent) of the migration assumption. Any new jobs in operations would further generate new jobs and earnings in the region through the multiplier effect. That is, the spending by the new workforce would, in turn, generate income for additional workers who would respend some of that income. Consistent with ER Subsection 4.4.2, the Regional Industrial Multiplier System (RIMS) II was used to quantify the economic impacts associated with operating the plant and with employing the operations workforce. The most recent data are for 2005, and multipliers were retrieved from the Bureau of Economic Analysis for the eight counties (Levy, Citrus, Marion, Alachua, Dixie, Gilchrist, Sumter, and Hernando) that correspond to the utility industry in the 80-km (50-mi.) region. The input-output models include the entire eight-county aggregate, including the parts of these counties that extend beyond the region. This eight-county aggregate excludes the partial counties of Pasco, Lake, and Putnam because the portions of these counties that fall within the 80-km (50-mi.) region are small in relation to the entire region and the respective counties. The operation of the LNP will create new jobs, which would provide a SMALL beneficial economic impact to the region. In addition, PEF annual property tax payments from the operation of the LNP would provide a LARGE beneficial economic impact to Levy County; therefore, the operation of LNP would provide a SMALL to LARGE beneficial economic impact to the region.

5.8.2.1.1 Employment

Three types of economic impacts are assessed: jobs, earnings, and output. For every new job generated in the utility industry, a total of 2.34 jobs will be generated in the eight-county region based on the jobs multiplier (Reference 5.8-005). Assuming that all 773 workers represent new jobs for the region, the operation of two units at the LNP would lead to 1808 new jobs (773 multiplied by 2.34), which includes direct operations jobs, as well as indirect jobs to support operations, and jobs induced by the increased spending of the operations workforce. The distribution of these positive impacts within the region will depend on where the new operations workforce decides to live. Thus, the direct operations jobs, as well as the indirect and induced jobs, are likely to benefit the three counties closest to the LNP (Levy, Marion, and Citrus) more than the other five counties in the region. Most of the indirect and induced jobs will tend to be in the service industries. Most of these jobs are likely to occur in these same three counties and to be filled by current residents of these counties. This will help provide a consistent and long-term source of employment for the region. Because of the relatively small size of Levy County's economy compared with that of Marion and Citrus counties, the positive economic impacts will be felt more strongly in this county.

5.8.2.1.2 Earnings

Earnings depend on jobs and wages. The average wage for the 2006 energy workforce was $68,991 (Reference 5.8-003). Multiplying this sum by 773 workers equals $53,330,043 in direct earnings in the utility industry. Just as with the jobs multiplier, there is an earnings multiplier to capture the indirect and induced earnings generated, as the initial earnings are respent multiple times within the region. The earnings multiplier has a value of 1.47(Reference 5.8-005). Direct, indirect, and induced earnings equal $78,245,839 ($53,330,043 in earnings multiplied by 1.47). In 2005, the entire earnings for the transportation and utility sector within the region were over $372 million and $14.3 billion for all sectors (see Table 2.5-9) (Reference 5.8-006). Thus, the LNP would contribute over 10 percent to this sector's earnings, but less than 1 percent of total earnings within the region. However, assuming that a majority of the workforce will live in Levy, Marion, and Citrus counties, this area will receive a stronger positive benefit related to increased earnings.

Three types of economic impacts are assessed: jobs, earnings, and output. For every new job generated in the utility industry, a total of 2.34 jobs will be generated in the eight-county region based on the jobs multiplier (Reference 5.8-005). Assuming that all 773 workers represent new jobs for the region, the operation of two units at the LNP would lead to 1808 new jobs (773 multiplied by 2.34), which includes direct operations jobs, as well as indirect jobs to support operations, and jobs induced by the increased spending of the operations workforce. The distribution of these positive impacts within the region will depend on where the new operations workforce decides to live. Thus, the direct operations jobs, as well as the indirect and induced jobs, are likely to benefit the three counties closest to the LNP (Levy, Marion, and Citrus) more than the other five counties in the region. Most of the indirect and induced jobs will tend to be in the service industries. Most of these jobs are likely to occur in these same three counties and to be filled by current residents of these counties. This will help provide a consistent and long-term source of employment for the region. Because of the relatively small size of Levy County's economy compared to that of Marion and Citrus counties, the positive economic impacts will be felt more strongly in this county.

5.8.2.1.3 Output

The third and last measure of economic impacts is output. "Output" refers to "final demand" rather than sales. This measure captures the value of private sector goods and services produced in the region. This distinction is made to avoid double counting. Sales figures include sales of intermediary goods and services, whereas the final demand nets out these intermediary sales. The full value of output is captured in the final demand. The inverse of the final demand employment multiplier (0.27) for the region from the RIMS II output is used to estimate the contribution of LNP operations to final demand (Reference 5.8-005). The total direct, indirect, and induced jobs from operations (1808) are multiplied by the inverse of the final demand employment multiplier (0.27) to project the change in final demand in millions of 2005 dollars ($490 million). To convert this value to 2007 dollars, the consumer price index (CPI) for all urban consumers published by the Bureau of Labor Statistics is used. The 2005 value for the CPI is 195.3, the 2007 value for the CPI is 207.3, and thus, the inflator is 1.06 (Reference 5.8-007). Therefore, the value of final demand from operations expressed in 2007 dollars is about $520.6 million (1.06 multiplied by $490.3 million).

5.8.2.2 Tax Impacts

Similar to the tax impacts from construction discussed in ER Subsection 4.4.2.2, several sources of tax revenue and public expenditure are tied to the operation of the LNP. These include sales taxes, property taxes, and corporate income taxes. The State of Florida does not collect a personal income tax. PEF annual tax payments from the operation of the LNP would provide a LARGE beneficial economic impact to Levy County; therefore, mitigation is not warranted.

5.8.2.2.1 Sales Tax

As noted in ER Subsection 4.4.2.2, sales taxes will be paid on any services and items that are not tied directly to power production and pollution control. This leaves consumables, which will be taxed at 7 percent (6 percent Florida state sales tax plus 1 percent surcharge for Levy County). The sales taxes paid by new in-migrants to the region add to revenue. This source of revenue will primarily benefit Levy, Marion, and Citrus counties, where most of the operations workers are anticipated to reside and spend much of their disposable income. The 6 percent sales tax paid on purchases is collected by the State of Florida, but the state returns a portion (0.5 percent) to each of the counties (Reference 5.8-008). Also, Levy County collects a 1 percent county surcharge. Because it is estimated that 7 percent of the workforce, or 135 persons including family, would be distributed across the balance of the five-county region (97 percent in two-county vicinity area), resulting in a minimal change in taxes beyond the vicinity area.

5.8.2.2.2 Property Taxes

The LNP will increase the property value of the site and thus, increase property tax collections in Levy County. The property tax collections in Levy County are estimated based upon an assessed value equal to 100 percent of the cost of constructing the LNP, less the value for pollution control devices, which are approximately 25 percent of the total construction costs. As noted in ER Subsection 2.5.2.1.2, the millage rate in the part of Levy County where the LNP will be constructed is 15.58. This includes the county property tax, the tax for the school operating budget, and the school capital tax. Based upon the construction cost estimates from ER Section 4.4, with one unit in operation, total property tax collections will amount to approximately $63 million per year. When both units are operating, this value increases to approximately $104 million per year.

As noted in ER Subsection 2.5.2.1.2, Levy County collected over $18 million in taxes and over $38.8 million from all sources of revenue. The additional $104 million from the operation of the LNP will be a fiscal benefit to the county. New residents to the county will also contribute property taxes, thus increasing this figure.

On the other side of the ledger, providing services for the new residents will require increased public expenditures. As previously noted, Levy County is anticipated to have a population influx of approximately 539 people related to employment for LNP operations. The 2006 population for Levy County was 38,981 (Reference 5.8-008). Thus, the increase in population as a result of the migration of the operations workforce and their families to the county would be less than 2 percent of the total population. As new residents rent or buy existing homes or build new ones in the county, send their children to school, commute to work, and require police and fire protection, the county will need to expand the provision of such services. Nonetheless, the cost of providing such services is far outweighed by the increase in revenue from property taxes. It is likely that the county would have sufficient revenue to decrease the current property tax rate, and thus, offer tax relief to current county residents, while maintaining or increasing services.

Citrus and Marion counties would not have the benefit of the property taxes from the LNP, but the population changes caused by the operations workforce and their families would be even smaller in these counties. As previously noted, Citrus County is anticipated to have a population influx of approximately 577 people related to employment for LNP operations. The 2006 population for Citrus County was 136,749 (Reference 5.8-008). Therefore, the operations of the LNP would result in less than 1 percent increase in the county's total population. These new workers would not adversely affect the level of local public services, but rather, would pay for their share of services through their property taxes. This is also the case for Marion County, which is anticipated to have a population influx of approximately 674 people related to employment for LNP operations. In 2006, the Marion County population was 315,074 (Reference 5.8-008). The new residents would represent less than 1 percent of the county's total population.

5.8.2.2.3 Corporate Income Tax

As discussed in ER Subsection 4.4.2.2, PEF will pay corporate income taxes of approximately 5.5 percent of its net state income. However, these payments will be made at the corporate entity level and will be paid to the State of Florida, which extends beyond the 80-km (50-mi.) region. (Reference 5.8-009)

5.8.2.3 Social Structure

As noted in ER Subsection 2.5.2, siting the LNP in Levy County would make PEF the second largest employer in the county. This fact alone will make an imprint on the social structure of the county akin to its neighbor, Citrus County. However, unlike Citrus County, where over 80 percent of the CREC operations workforce resides, the LNP is located near the border of three counties so that the operations workforce is expected to be more dispersed and the impacts on social structure are expected to be SMALL.

Given the rural character of the vicinity of the LNP site, it is expected that some new housing will be constructed to accommodate the operations workforce and their families. Despite the relatively small influx of new operation workers and their families, the impact of the in-migrants is likely to be felt strongest in Levy County, which has the smallest supply of vacant housing. However, in relation to Levy County's total population, 539 new people represent a small change in population and is well within planned population growth for the county. Therefore, the operations workforce is expected to have a SMALL impact on local political or planning processes, as well as social structure.

5.8.2.4 Housing

The total population of the 80-km (50-mi.) region surrounding the LNP site was 884,089 in 2000. The majority of this population was concentrated in the cities Ocala, Gainesville, and Spring Hill (Reference 5.8-010). Based on the assumption discussed in ER Subsection 5.8.2, the LNP site will require a workforce of approximately 773 employees. It is assumed that 50 to 100 percent of the LNP workforce will migrate into the 80-km (50-mi.) region. It is also assumed that the workforce will primarily reside within the three vicinity counties closest to the LNP site as follows: Levy (28 percent), Citrus (30 percent), and Marion (35 percent). The remaining 7 percent are distributed across the remaining five counties in the 80-km (50-mi.) region.

Tables 2.5-16 and 5.8-2 summarize permanent and temporary housing availability in the LNP region, respectively, and illustrate that there is a robust supply of housing available to potential LNP employees. Table 2.5-16 notes an average vacancy rate of 16 percent for the permanent housing stock in the vicinity counties, which translates into 37,784 total units available. Because the operations workforce is estimated to be 773 persons, well below the available units, no housing shortages are anticipated as a result of operations. However, Levy, Citrus, and Marion counties are expected to experience the most housing impacts because they are the closest counties to the LNP site. Marion and Citrus counties offer three to five times more housing units than Levy County, and have the infrastructures and social services in place. Levy County is relatively rural and is lagging Marion and Citrus counties in terms of infrastructure and social services. Therefore, it is assumed that workers choosing to reside in Levy County will require new housing, which will be developed based on the county's Comprehensive Plan and located in the residential areas illustrated on an official future land use map; see Figure 4.1.2 for future land use plans for the LNP vicinity. The surrounding counties in the region have an abundance of housing for the remaining 7 percent or 135 operation workers and their families, and no housing impacts are expected for these areas. Impacts on the local housing markets in Citrus and Marion counties are anticipated to be SMALL. The housing market in Levy County is anticipated to be more affected than the other counties by in-migration related to employment for LNP operations; however, based on the number of expected in-migrants (539 including workers' families), the available housing (2703 units as of 2000), and Levy County's current growth plans, impacts on the Levy County housing market are also anticipated to be SMALL.

5.8.2.5 Education System

As discussed in ER Subsection 5.8.2, 1925 operations workers and their families will relocate to the region and primarily reside within Levy (28 percent), Citrus (30 percent), and Marion (35 percent) counties, and the remaining 7 percent will be distributed among the five remaining counties within the region. Representatives from Levy, Citrus, and Marion school systems were contacted to determine current and future capacities. Based on the residential distribution for operation workers as discussed above, Levy, Citrus, and Marion counties will experience 539, 577, and 674 new residents, respectively. Each of the remaining five counties are estimated to experience a total increase of 135 people.

For 2005, the following populations were reported for each of the counties discussed above: 304,926 (Marion), 240,764 (Alachua), 132,635 (Citrus), 37,985 (Levy), 15,377 (Dixie), 16,211 (Gilchrist), 150,784 (Hernando), and 74,052 (Sumter). Population projections for 2010 reported the following: 350,923 (Marion), 260,751 (Alachua), 147,437 (Citrus), 42,411 (Levy), 16,973 (Dixie), 18,583 (Gilchrist), 169,976 (Hernando), and 92,211 (Sumter) (Reference 5.8-011). Based on these data the following increases in population percentages are expected: 15.3 percent (Marion), 8.3 percent (Alachua), 11.2 percent (Citrus), 11.7 percent (Levy), 10.4 percent (Dixie), 14.6 percent (Gilchrist), 12.7 percent (Hernando), and 24.5 percent (Sumter). While it is unlikely that LNP operations workforce and their families were taken into consideration in the future population's projections, the additional growth that would result from LNP operations would be minimal. It is estimated that less than 0.5 percent increase in each county will occur from operation workers and their families relocating to the region, with the exception of Levy County, which could experience up to a 1.4 percent increase.

Approximately 161 primary and secondary schools are located within the 80-km (50-mi.) region. Based on previous years' growth, the Levy County School District is not expected to experience a signification increase in student enrollment over the next 5 years and, therefore, has no plans to add any new schools in the near future. Additional wings will be added to existing facilities, as needed, to accommodate student population growth. With the exception of three schools slightly over capacity, all of Citrus County's 17 schools are currently under capacity. The county is planning the construction of one additional elementary school to be open by September 2008.(Reference 5.8-012) Out of 45 primary and secondary schools in Marion County, 23 are currently over capacity. Over the past 5 years, Marion County has constructed five new schools and future plans include an additional four new schools.

Based on the capital outlay full time equivalent growth projections, Citrus County for the school years 2011 through 2112 will have five schools at capacity, and the remaining schools will be under capacity (Reference 5.8-012). Estimated growth rates project that Marion County schools will be over capacity during 2011 through 2012. For the remaining counties (Alachua, Dixie, Gilchrist, Hernando, and Sumter) any additional school impacts will be dispersed among these counties' school districts. If the number of school aged children increases slightly, the school systems discussed above should have sufficient capacity to serve them. Because operation workers and their families will be distributed among the eight counties, impacts on the educational system are anticipated to be SMALL.

5.8.2.6 Recreation

Recreation facilities within the region are described in ER Subsections 2.5.2.7 and 2.2.1.4. The closest recreational trails to the LNP site are as follows: the CFG-Inglis Island Trail 5.5 km (3.4 mi.) from the LNP site, the Goethe State Forest Trails 4.5 km (2.8 mi.) from the LNP site, and the Withlacoochee Bay Trail 7.6 km (4.7 mi.) from the LNP site (Figure 2.1-1). The CFG, located 5.2 km (3.2 0mi.) from the site, also offers multiple trails and is a popular recreation area as described in ER Subsection 2.5.2.7. However, these trails and recreation areas are located more than 1000 m (3280 ft.) from the site, and are expected to have little to no aesthetics impact from the cooling tower plumes, which is discussed in ER Subsection 5.8.1.3. The noise impacts are also expected to be insignificant except for areas of the CFG located near the pumphouse as described in ER Subsection 5.3.4.2.

Fishing opportunities and marinas are also described in ER Subsections 2.5.2.7 and 2.2.1.4. Bank fishing is available along the CFBC located 5.2 km (3.2 mi.) from the LNP site (Reference 5.8-013). The marinas for the vicinity and region are illustrated on Figure 2.2-5. Of the two marinas located in the vicinity, one is on Lake Rousseau. The lake, located approximately 4.8 km (3.0 mi.) from the LNP site, is also a popular fishing destination in the area (Reference 5.8-014). The CFBC and Lake Rousseau are located farther than 1000 m (3258 ft.) from the site and are also expected to experience few aesthetics and noise impacts. Only the areas around the pumphouse and blowdown pipeline corridor along the CFBC will experience slight noise impacts.

The land the LNP site will occupy has historically been used for hunting on limited basis. An agreement between a hunting club and the Rayonier Southeast Forest Resources allowed hunting on the property. Wild hog hunting occurred year round on the property, but deer season months were the most active hunting times. When the property was purchased for the LNP site, hunting was terminated (Reference 5.8-015). However, the Goethe State Forest, located approximately 2.6 km (1.6 mi.) from the site, is also a popular hunting area as described in ER Subsection 2.5.2.7 and is expected to have small noise and aesthetics operational impacts. Therefore, the overall impacts on hunting are expected to be relatively small because the land was not a popular hunting area before the LNP site was constructed, and the Goethe State Forest is still available to hunters.

Other parks and recreational features described in ER Subsections 2.5.2.7 and 2.2.1.4 are not within the vicinity of the LNP and are not expected to have direct operational impacts. As stated in ER Subsection 5.8.2, 1925 operational workers and their families will migrate to the region and be distributed amongst the eight counties within the region. Therefore, the increase in population could cause slight increases in recreational activities and park visits in the region, but this impact is expected to be SMALL. The estimated in-migrant population will have a positive impact on tourism activities in the region.

5.8.2.7 Public Facilities and Services

Public facilities and services within the region are discussed in ER Subsection 2.5.2.8. Public facilities should not be overcrowded because operation workers and their families will be distributed among the eight counties. Furthermore, the LNP site is near the larger Ocala and Gainesville metropolitan areas and, therefore, existing public facilities and services should be able to absorb the small increase in population. SMALL impacts on public facilities and services are anticipated.

5.8.2.7.1 Security Services

Security will be provided by PEF in accordance with Homeland Security and NRC regulations.

Levy County has six county and eight municipal fire stations. The Town of Inglis Fire Department is the closest fire station to the LNP site and is located 6.6 km (4.1 mi.) southwest from the LNP site. Marion County Fire and Rescue is made up of 27 stations. The City of Dunnellon Fire and Rescue is the closest fire station in Marion County and is located 15.6 km (9.7 mi.) from the LNP site. Citrus County is made up of one municipal and 23 fire stations.

Including the municipalities, Levy County has 88 full-time and 10 part-time sworn deputy officers. The Town of Inglis Police Station is the closest police station to the LNP site and is located 6.6 km (4.2 mi.) from LNP site. Citrus County has 236 full-time police officers, and Marion County has 559 full-time sworn officers (this includes the municipalities). Overall, approximately 154 fire stations or departments, 35 sheriff’s offices, and 44 police departments are located in the region.

The closest hospital to the LNP site is the Seven Rivers Regional Medical Center located in Citrus County and is 21.7 km (13.5 mi.) from the LNP site. In 2008, Seven Rivers Regional Medical Center plans to expand with an additional 16 beds. Other hospitals located in Levy, Marion, and Citrus counties include Nature Coast Regional Hospital (formally known as Williston Memorial Hospital), Shands Teaching Hospital and Clinic, Shands Alachua General Hospital, Citrus Memorial Medical Center, West Marion Community Hospital, Ocala Regional Medical Center, and Munroe Regional Hospital. A total of 16 hospitals are located within the region, and eight plan to expand in the near future. Additionally a hospital with 60 beds has been proposed to be built in the City of Chiefland, Levy County; however, no formal approval has been determined for construction (Reference 5.8-016).

In the event of a fire at LNP, the on-site Fire Brigade (composed of on-shift personnel trained in fighting fires) will respond initially to the fire and, if necessary, call upon the local fire departments for assistance. In the event of a large area fire at LNP, local fire departments will be called upon for assistance as will larger departments from outside the immediate area, as warranted. Also, PEF will implement a program to provide position-specific emergency response training for designated members of the emergency response organization.

In 2008, PEF consulted with emergency management services for Levy, Citrus, and Marion counties in regards to the proposed LNP site. The three county emergency management services organizations are able to support the emergency plan for the proposed expansion of LNP. Based on this information, existing public services and facilities will be capable of absorbing the increase in demand from security needs related to constructing the LNP site. Currently, hospitals within the region are under capacity and half plan to expand. Therefore, public services and facilities are sufficient to absorb any incremental growth associated with operation workers and their families and impacts are anticipated to be SMALL.

5.8.2.7.2 Water and Wastewater Services

As stated in ER Subsection 5.8.2, the LNP will require approximately 773 workers. The workers and their families will add 1925 residents to the population. Levy, Marion, and Citrus counties are anticipated to have a population influx of 539, 674, and 576 people, respectively, related to employment for LNP operations. The remaining LNP workers and their families will be dispersed among the other five counties in the region. In addition to the regular workforce, PEF estimates that an additional refueling outage workforce of approximately 800 temporary workers will be needed for about 25 to 30 days every 18 months. Because of the close proximity of the CREC, it is assumed that PEF will rely upon many of the same workers who currently service the CREC outages.

Using projected county population estimates for 2015 (Table 2.2-17) and assuming the average per capita demand for water is 150 gallons per person per day and wastewater is 100 gallons per capita per day, the demand for water and wastewater services by LNP operations workers and their families is estimated to increase by 0.01 percent in Alachua County, 0.35 percent in Citrus County, 0.10 percent in Dixie County, 0.09 percent in Gilchrist County, 0.02 percent in Hernando County, 0.0 percent in Lake County, 1.16 percent in Levy County, 0.17 percent in Marion County, 0.0 percent in Pasco County, 0.0 percent in Putnam County, and 0.02 percent in Sumter County (Reference 5.8-017). The estimated impact on county water and wastewater services is SMALL.

It is assumed that during operation of the LNP, sanitary system wastes will be treated by an on-site wastewater treatment plant and will be discharged in accordance with agreements with FDEP. As discussed in ER Subsection 3.6.2, the wastewater treatment plant will be designed using the extended aeration process for the operational stage of the LNP. The sanitary drainage system will collect sanitary waste from plant restrooms and locker room facilities in the turbine building, auxiliary building, and annex building, and will carry this waste to the wastewater treatment plant where it will be processed. The sanitary drainage system does not serve facilities in radiologically controlled areas (RCA).

ER Subsections 3.3.1.4 and 3.3.1.5 discuss the on-site potable water system and its operation at the LNP, respectively. The raw water system will be from supply wells installed into the freshwater aquifer that will be at the site, which will be used for potable water, demineralized water treatment, and the fire protection system. Potable water is required for human consumption, sanitary, and other domestic purposes.

The estimated impact on on-site water and wastewater services is SMALL.

5.8.2.8 Transportation Facilities

The major highway located near the LNP site is US-19/US-98, which is a four-lane roadway. The projected additional workforce for the LNP site will be 773 operations personnel.

A transportation study conducted in 2007 by Lincks and Associates, Inc., estimated the traffic associated with the trips by commuting operations workers based on a trip generation rate of 2.38 trip ends per operations worker (Reference 5.8-018). Based on this rate, it is estimated that at the operations stage, the project will attract 1840 daily trip ends associated with operations traffic. Based on the existing roadway network, residential development, lodging and commercial development, the distribution of the project traffic was estimated to be as follows:

- 30 percent to and from the north (through US-19) for 552 daily trips.
- 70 percent to and from the south (through US-19) for 1288 daily trips.

The transportation study estimates traffic without the LNP site from the north (through US-19) to the site access to be 10,584 daily trips in 2020. Project daily trips from the north are estimated to be 552 for a total of 11,136. Daily trips without the project from the project access to the south on US-19 in 2020 are estimated to be 10,584. Project daily trips from the south are estimated to be 1288 for a total of 11,872 daily trips. The travel capacity of US-19 is estimated to be 40,800 trips in each direction. The study concludes that US-19 will operate at an acceptable level of service during the operations phase of the project (Reference 5.8-018). The estimated impact from operations activities on US-19 is SMALL.

5.8.2.9 Distinctive Communities

While the population in the region is relatively diverse, it is fairly homogenous in the vicinity, and no special populations or distinctive communities exist. Because operational workers and their families are expected to relocate to the region, no unique communities are expected to develop as a result of LNP operations activities and impacts are anticipated to be SMALL.

5.8.3 ENVIRONMENTAL JUSTICE IMPACTS

This subsection uses NUREG-1555, Revision 0, to evaluate the potential for disproportionate impacts on low income and minority populations that could result from the operation of the LNP. Census data were analyzed to determine the potential effects of construction on low income and minority populations. Environmental justice involves evaluating whether there is a disproportionate impact on low income or minority populations as a result of the project. A disproportionate impact on these existing populations exists when they endure more than their "fair share" of industrial facilities (Reference 5.8-019). This subsection evaluates the potential for disproportionate impacts on low income and minority populations that could result from the operation of the new facilities.

Environmental justice issues also include the environmental health effects of air and noise pollution on low income and minority populations. Operation of the new facilities will meet the criteria and standards set forth in applicable local, regional, state, and federal regulations. Some low income populations augment their existing incomes with subsistence fishing or hunting. Subsistence fishing and/or hunting takes place in Levy and Citrus counties. Neither county, however, has specific information available that applies to the vicinity of the LNP site. Although the LNP site will not be available for subsistence fishing and hunting, surrounding areas will remain unaffected.

No impacts on minority or low income populations will occur from appurtenant facilities because the majority of the appurtenant facilities fall within the vicinity. Positive impacts from operation of the LNP are the potential for job opportunities to minority and/or low income populations. Therefore, no disproportionately high or adverse impacts on minority or low income populations are anticipated as a result of operations and impacts are anticipated to be SMALL.

5.8.3.1 Minority Populations

The evaluation process and baseline data used to identify minority populations living within the region that meet the requirements associated with the NRC guidance are defined in ER Subsection 2.5.4. Figure 2.5-14 identifies the minority populations in the region.

The spatial distribution of minority populations in the region occurs predominately in urban areas. No negative impacts are anticipated as a result of operation of the new facilities. Furthermore, no pathways were identified that could result in disproportionate environmental impacts on minority populations. Impacts on minority populations as a result of the operation of the LNP will be SMALL.

5.8.3.2 Low Income Populations

Census block data for household income were evaluated to identify low income populations. Baseline income characteristic data are defined in ER Subsection 2.5.4. Figure 2.5-15 shows the populations below the poverty level within each census block. The average for the low income populations in the State of Florida is 12.5 percent (Reference 5.8-020).

The spatial distribution of low income populations in the region occurs predominately in urban areas and based on the methodology discussed in ER Subsection 2.5.4.1, no low income populations are found within the vicinity of the LNP site. No pathways were identified that could result in disproportionate environmental impacts on low income populations. As the area surrounding the LNP site develops, small indirect impacts on communities could occur from the rising cost of living. This potential small impact could make it more difficult to find affordable housing in the area. As stated in ER Subsection 5.8.3, the potential for new jobs may become available to low income populations, which could alleviate the rising cost of living. Overall, impacts on low income populations as a result of the operation of the LNP will be SMALL.

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Table 5.8-1 (Sheet 1 of 2)
Predicted Visible Cooling Tower Vapor Plume Heights and Lengths for LNP 1 and LNP 2

		Winter		Spring		Summer		Fall		Annual[a]	
		hours	%	hours	%	hours	%	hours	%	hours	%
All Hours (Except Existing Fog/Calm)		1573	17.96%	1410	16.10%	1114	12.72%	1500	17.10%	5597	63.90%
Plume Height (m)											
>0	<200	1573	17.96%	1396	15.94%	1062	12.12%	1477	16.86%	5508	62.88%
>200	<400	0	0.00%	14	0.16%	25	0.29%	16	0.18%	55	0.63%
>400	<500	0	0.00%	0	0.00%	12	0.14%	6	0.07%	18	0.21%
>500		0	0.00%	0	0.00%	15	0.17%	1	0.01%	16	0.18%
Plume Length (m)[b]											
>0	<100	1573	17.96%	1326	15.14%	918	10.48%	1411	16.11%	5228	59.69%
>100	<300	0	0.00%	29	0.33%	67	0.76%	27	0.31%	123	1.40%
>300	<500	0	0.00%	6	0.07%	5	0.06%	5	0.06%	16	0.18%
>500	<1000	0	0.00%	12	0.14%	46	0.53%	12	0.23%	70	0.80%
>1000	<1500	0	0.00%	9	0.10%	20	0.23%	8	0.10%	37	0.42%
>1500	<5000	0	0.00%	16	0.18%	13	0.15%	9	0.14%	38	0.43%
>5000		0	0.00%	12	0.14%	45	0.51%	28	0.29%	85	0.97%

Table 5.8-1 (Sheet 2 of 2)
Predicted Visible Cooling Tower Vapor Plume Heights and Lengths for LNP 1 and LNP 2

		Winter		Spring		Summer		Fall		Annual[a]	
		hours	%	hours	%	hours	%	hours	%	hours	%
Daylight Hours(Except Existing Fog/Calm)		388	4.43%	301	3.44%	201	2.29%	353	4.03%	1243	14.19
Plume Height (m)											
>0	<200	388	4.43%	292	3.33%	182	2.08%	336	3.84%	1198	13.68%
>200	<400	0	0.00%	9	0.10%	9	0.10%	13	0.15%	31	0.35%
>400	<500	0	0.00%	0	0.00%	4	0.05%	4	0.05%	8	0.09%
>500		0	0.00%	0	0.00%	6	0.07%	0	0.00%	6	0.07%
Plume Length (m)[b]											
>0	<100	388	4.40%	267	3.05%	133	1.52%	301	3.44%	1089	12.43%
>100	<300	0	0.00%	4	0.05%	14	0.14%	10	0.11%	28	0.32%
>300	<500	0	0.00%	1	0.01%	1	0.01%	4	0.05%	6	0.07%
>500	<1000	0	0.00%	4	0.05%	11	0.13%	6	0.07%	21	0.24%
>1000	<1500	0	0.00%	3	0.03%	12	0.14%	5	0.06%	20	0.23%
>1500	<5000	0	0.00%	14	0.16%	3	0.03%	6	0.07%	23	0.26%
>5000		0	0.00%	8	0.09%	27	0.31%	21	0.24%	56	0.64%

Notes:

a) Period of Record is 2003 (Gainesville, FL).

b) Distance measured relative to a location midway between the two tower banks.

Table 5.8-2
Regional Housing and Residential Distribution for Operation Workers

County	Spatial Percent of Region	Permanent Housing	Owner Occupied Housing	Housing Units Theoretically Available to Rent or Purchase	2005 – 2006 Mobile Homes [(a)]	Public Lodging Units	Total Units Available to Workers	Percent of Total Regional Units	Workers During Operations (773 max)	Workers During Refueling (773 + 800 = 1573 max)
Levy	20%	16,570	11,591	4979	1303	936	7218	3%	28%	28%
Citrus	11%	73,609	51,176	22,433	5829	2269	30,531	12%	30%	30%
Marion	24%	152,858	101,381	51,477	15637	12851	79,965	31%	35%	35%
Alachua	12%	106,746	51,942	54,804	3545	31771	90,120	35%	2%	2%
Dixie	6%	7363	4498	2865	239	187	3291	1%	1%	1%
Gilchrist	4%	5906	4331	1575	741	130	2446	1%	1%	1%
Hernando	9%	77,423	56,709	20,714	5823	2968	29,505	12%	2%	2%
Sumter	8%	25,195	17,972	7223	2577	1859	11,659	5%	1%	1%
Total	-	465,670	299,600	166,070	35,694	52,971	254,735	-	100%	100%

Notes:

a) Data from Figure 2.5-6.

Sources: References 5.8-011, 5.8-012, 5.8-013, 5.8-014, 5.8-015, 5.8-016, 5.8-017, and 5.8-018

5.9 DECOMMISSIONING

In accordance with NUREG-1555, ESRP 5.9, this subsection provides an analysis and evaluation of decommissioning the LNP. A license to operate a nuclear power plant is issued for a term not to exceed 40 years from the date on which the NRC makes a finding that acceptance criteria are met under 10 CFR 52103(g). At the end of the specified period, the operator of a nuclear power plant must renew the license for another time period or must decommission the facility. The NRC defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property and termination of the license. Decommissioning must occur because NRC regulations do not permit an operating license holder to abandon a facility after ending operations. Specific regulatory requirements for decommissioning a nuclear power facility are discussed in ER Subsection 5.9.1.

5.9.1 REGULATORY REQUIREMENTS OF DECOMMISSIONING

There are regulatory actions that the NRC and a licensee must take to decommission a nuclear power facility. Specifically, Title 10 CFR 50.82 specifies the regulatory actions that the NRC and a licensee must take to decommission a nuclear power facility while NRC regulations at 10 CFR 20, Subpart E, identify the radiological criteria that must be met for license termination. One regulatory action that is required is that the NRC prohibits licensees from performing decommissioning activities that result in significant environmental impacts not previously reviewed. Therefore, NRC has indicated that licensees for existing reactors can rely on the findings of a GEIS to obtain an understanding of the type and magnitude of environmental impacts associated with decommissioning activities for the existing fleet of domestic nuclear power reactors.

Another requirement is the assurance that sufficient funds are available for decommissioning the nuclear facility. Pursuant to the requirements of 10 CFR 50.33(k)(1), an application for an operating license for a production or utilization facility must include information, in the form of a report, as described in 10 CFR 50.75 and summarized below, that indicates how reasonable assurance is to be provided that sufficient funds are available to decommission the facility.

- Paragraph 10 CFR 50.75 (b) requires each power reactor applicant for or holder of an operating license for a production or utilization facility of the type and power level specified in 10 CFR 50.75 (c) to submit a decommissioning report.

- The report must contain a certification that financial assurance for decommissioning is (for a license applicant) or has been (for a license holder) provided in an amount which may be more but not less than the amount stated in the table in paragraph 10 CFR 50.75 (c)(1).

- The report must state that the amount to be provided will be adjusted annually using a rate at least equal to that stated in paragraph 10 CFR 50.75 (c)(2).

- The report must include details that enable the NRC to determine that the amount of funding to be provided as financial assurance for decommissioning is derived using one or more of the methods described in paragraph 10 CFR 50.75(e)(1).

Paragraph 10 CFR 50.75(c) provides the table of minimum amounts (in January 1986 dollars) required to demonstrate reasonable assurance of funds for decommissioning by reactor type and power level. These amounts are based on activities related to the definition of "Decommission" in 10 CFR 50.2, and do not include the costs of removing and disposing of spent fuel or nonradioactive structures and materials beyond that necessary to terminate the license.

The amount stated in the applicant's or licensee's certification may be based on a cost estimate for decommissioning the facility. As part of the certification, a copy of the financial instrument obtained to satisfy the requirements of paragraph 10 CFR 50.75(e) must be submitted to the NRC. Cost estimates for decommissioning nuclear facilities were identified by the DOE. The DOE-funded a study that presents estimates of the costs to decommission the advanced reactor designs following a scheduled cessation of plant operations (Reference 5.9-001). These regulatory actions, radiological criteria requirements, and decommissioning activities apply to the existing fleet of power reactors and to advanced reactors such as the reactor(s) proposed for LNP. Per ER Table 3.2-1, the LNP is a PWR with a thermal power rating greater than or equal to 3400 MWt. The minimum amount required by 10 CFR 50.75(c) to demonstrate reasonable assurance of funds for decommissioning a facility of this type and power level is $105 million (in 1986 dollars). Additional information on the cost of decommissioning the LNP is provided in ER Subsection 5.9.4.

Further information relating to the decommissioning process (such as a description of the decommissioning process and schedule) is not required until after permanent cessation of operation and is not expected during the initial licensing or license-renewal phases.

The following subsections summarize the decommissioning GEIS, the DOE study on decommissioning costs, and the cost analysis of decommissioning the AP1000 at LNP.

5.9.2 NRC GENERIC ENVIRONMENTAL IMPACT STATEMENT REGARDING DECOMMISSIONING

The NRC’s GEIS on decommissioning of nuclear power facilities was written to provide an analysis of environmental impacts from decommissioning activities that can be treated generically so that decommissioning activities for commercial nuclear power reactors conducted at specific sites will be bounded, to the extent practicable, by this and appropriate previously issued environmental impact statements. Activities and impacts that NRC considered to be within the scope of the GEIS include the following:

- Activities performed to remove the facility from service once the licensee certifies that the facility has permanently ceased operations, including organizational changes and removal of fuel from the reactor.
- Activities performed in support of radiological decommissioning, including decontamination and dismantlement (D&D) of radioactive structures, systems, and components (SSC), and any activities required to support the D&D process such as isolating the spent fuel pool to reduce the scope of required safeguards and security systems so D&D can proceed on the balance of the facility without affecting the spent fuel.
- Activities performed in support of dismantlement of nonradiological SSCs, such as diesel generator buildings and cooling towers.
- Activities performed up to license termination and their resulting impacts as provided by the definition of decommissioning, including shipment and processing of radioactive waste.
- Impacts that are nonradiological, occurring after license termination from activities conducted during decommissioning.
- Activities related to release of the facility.
- Impacts on human health from radiological and nonradiological decommissioning activities.

Studies of social and environmental effects of decommissioning large commercial power generating units have not identified any significant impacts beyond those considered in the GEIS on decommissioning and the site-specific final environmental impact statement (FEIS) for the facility. The NRC's GEIS on decommissioning of nuclear facilities evaluates the environmental impact of the following three decommissioning methods:

- **DECON** – The equipment, structures, and portions of the facility and site that contain radioactive contaminants are removed or decontaminated to a level that permits termination of the license shortly after cessation of operations.
- **SAFSTOR** – The facility is placed in a safe stable condition and maintained in that state (safe storage) until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact, but the fuel is removed from the reactor vessel and radioactive liquids are drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thus reducing the quantity of contaminated and radioactive material that must be disposed of during the D&D of the facility at the end of the storage period.

- **ENTOMB** – This alternative involves encasing radioactive SSCs in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license.

NRC regulations do not require the applicant to inform the NRC of its plans for decommissioning the facility at either the construction permit or operating license stage; consequently, no definite plan for the decommissioning of the plant has been developed at this time. Decommissioning plans are required (by 10 CFR 50.82) after a licensee has determined to permanently cease operations.

General environmental impacts associated with decommissioning are summarized as follows. According to the NRC, decommissioning a nuclear power facility has a positive environmental impact. The major environmental impact, regardless of the specific decommissioning option selected, is the commitment of small amounts of land for waste burial in exchange for the potential reuse of the land where the facility is located. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those of power plant construction or operation because the level of activity and the releases to the environment are expected to be smaller during decommissioning than during construction and operation.

Decommissioning will generate radiological impacts associated with the transportation of radioactive material, which should be no different from those associated with transportation impacts during normal facility operation. Also, studies indicate that occupational radiation doses can be controlled to levels comparable to occupational doses experienced with operating reactors through the use of appropriate work procedures, shielding, and remotely controlled equipment. To date, experience at decommissioned facilities has shown that the occupational exposures during the decommissioning period are comparable to those associated with refueling and routine maintenance of the facility when operational.

5.9.3 DOE STUDY ON DECOMMISSIONING COSTS

The DOE commissioned a study that presents estimates of the costs to decommission the advanced reactor designs following a scheduled cessation of plant operations. Four reactor types were evaluated in the study: Toshiba and General Electric Advanced Boiling Water Reactor, General Electric Economic Simplified Boiling Water Reactor, AP1000, and the Atomic Energy of Canada, Limited's Advanced CANDU Reactor. The cost analysis described in the study is based on the prompt decommissioning alternative, or DECON as defined by the NRC. The DECON alternative is also the basis for the NRC funding regulations and the use of the DECON alternative for the advanced reactor designs facilitates the comparison with NRC's own estimates and financial provisions (Reference 5.9-001).

The cost estimates prepared for decommissioning the advanced reactor designs consider the unique features of a generic site, including the nuclear steam supply systems, power generation systems, support services, site buildings, and ancillary facilities The cost estimates are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, and low-level radioactive waste disposal practices. The primary cost contributors are either labor-related or associated with the management and disposition of the radioactive waste. (Reference 5.9-001)

The DOE study concluded that with consistent operating and management assumptions, the total decommissioning costs projected for the advanced reactor designs are comparable to those projected for operating reactors with appropriate reductions in costs because of reduced physical plant inventories (Reference 5.9-001).

5.9.4 DECOMMISSIONING COST ANALYSIS

As stated in NUREG-1555, ESRP 5.9, applicants are required to submit a report that contains a certification that financial assurance for radiological decommissioning will be provided. To provide this assurance, the regulation requires that two factors be considered: the amount of funds needed for decommissioning; and the method used to provide the financial assurance. At its discretion, a power reactor licensee may submit a certification based either on the formulas provided in 10 CFR 50.75(c)(1) and (2), or when a higher funding level is desired, on a facility-specific cost estimate that is equal to or greater than that calculated in the formula in 10 CFR 50.75(c)(1) and (2). COLA Part I contains PEF’s report on financial assurance for radiological decommissioning.

The amount of funding stated in the certification may be based on a cost estimate for decommissioning the facility. Minimum certification funding amounts required to demonstrate reasonable assurance of funds can be found in 10 CFR 50.75(c)(1)(i). These minimum funding amounts are based on reactor types (PWR versus BWR) and on the power level of the reactor. Adjustment factors are also provided in 10 CFR 50.75(c)(2) based on escalation factors for labor, energy, and waste burial costs. As described in ER Table 3.2-1, the proposed reactor for use at the LNP is the AP1000, a Westinghouse-designed pressurized water reactor with a core power rating of 3400 MWt.

As stated in the NRC’s Regulatory Guide 1.159, the certification amounts in 10 CFR 50.75(c)(1) act as threshold review levels. While not necessarily representing the actual cost of decommissioning for specific reactors, these certification amounts provide assurance that licensees are able to demonstrate adequate financial responsibility in that the bulk of the funds necessary for a safe decommissioning are being considered and planned for early in facility life, thus providing adequate assurance that the facility will not become a risk to public health and safety when it is decommissioned.

The minimum certification funding amount required to demonstrate reasonable assurance of funds was calculated by PEF using the formula delineated in

10 CFR 50.75(c)(1)(i) and the escalation indices provided in 10 CFR 50.75(c)(2). The funding calculations can be found in COLA Part I, which contains PEF's report on financial assurance for radiological decommissioning.

Per the COLA Part 1, PEF certifies that it possesses the financial wherewithal to perform decommissioning (for direct disposal with vender option) of the LNP. The estimated per unit decommissioning cost is $368,569,138 ($737,138,276 total for both units, in March 2007 dollars). The decommissioning funding amount will be covered by PEF through the external sinking fund method. PEF will collect decommissioning funding contributions through regulated, cost-of-service based rates. Funding of the decommissioning costs will be made up of one or more of the financial assurance instruments described in 10 CFR 50.75(e)(1).

5.9.5 SUMMARY AND CONCLUSIONS

The NRC has indicated that licensees for existing nuclear power reactors can rely on the findings of a GEIS to obtain an understanding of the type and magnitude of environmental impacts associated with decommissioning the existing fleet of domestic nuclear power reactors. The major environmental impact associated with decommissioning is the commitment of small amounts of land for waste burial in exchange for the potential reuse of the land where the facility is located. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those of power plant construction or operation because the level of activity and the releases to the environment are expected to be smaller. Decommissioning will generate radiological impacts associated with the transportation of radioactive material, but those should be no different from those associated with transportation impacts during normal facility operation. Overall, decommissioning a nuclear facility has a positive environmental impact.

The DOE compared activities required to decommission existing reactors to those activities required for decommissioning advanced reactors and presented cost estimates for the decommissioning of the advanced reactor designs. The DOE study concluded that with consistent operating and management assumptions, the total decommissioning costs projected for the advanced reactor designs are comparable to those projected for operating reactors with appropriate reductions in costs because of reduced physical plant inventories.

An applicant for a license to operate a nuclear power facility is required to provide a report containing a certification that financial assurance for radiological decommissioning will be provided. The cost estimate amount may be based on a cost estimate for decommissioning the facility that may be more, but not less, than that given in the table 10 CFR 50.75(c)(1). The purpose of this requirement is to ensure that a licensee will be financially able to radiologically decommission a facility when it ceases to produce power.

The minimum certification funding amounts required to demonstrate reasonable assurance of funds were calculated using the formula delineated in 10 CFR 50.75(c)(1)(i) and the escalation indices provided in 10 CFR 50.75(c)(2).

Per the COLA Part 1, PEF certifies that financial assurance for decommissioning LNP will be provided in an amount of $368,569,138 for each LNP Unit ($737,138,276 for both units, in March 2007 dollars) for the direct disposal with vendor option. The decommissioning funding amount will be covered by PEF through the external sinking fund method. PEF will collect decommissioning funding contributions through regulated, cost-of-service based rates.

5.9.6 REFERENCES

5.9-001 U.S. Department of Energy, "Study of Construction Technologies and Schedules, O&M Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactor Designs," prepared by Dominion Energy, Inc., Bechtel Power Corporation, TLG, Inc., and MPR Associates for United States Department of Energy Cooperative Agreement DE-FC07-031D14492, Contract DE-AT01-020NE23476, May 27, 2004.

5.10 MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION

In accordance with NUREG-1555, ESRP 5.10, this section summarizes potential adverse environmental impacts from the operation of the LNP, along with associated measures and controls to limit those adverse impacts.

5.10.1 ADVERSE ENVIRONMENTAL IMPACTS

PEF is committed to limiting, minimizing, and reducing adverse environmental impacts during operation activities wherever and whenever feasible and practical. The operation of the LNP will result in certain adverse environmental impacts.

The "Potential Impact Significance" columns in Table 5.10-1 list the elements identified in NUREG-1555, ESRP 5.10, that relate to operation activities. The following list identifies elements with potential adverse environmental impacts that could be encountered during operation of the proposed facilities:

- Noise.
- Erosion and Sediment.
- Air Quality.
- Traffic.
- Effluents and Wastes.
- Surface Water.
- Groundwater.
- Land Use.
- Water Use.
- Terrestrial Ecosystem.
- Aquatic Ecosystem.
- Socioeconomic.
- Radiation Exposure to Workers.
- Other (Site-Specific).

Table 5.10-1 lists and describes facility operational impacts that require mitigation along with corresponding measures and controls that may be committed to limit potential adverse environmental impacts. The listed measures and controls have been designed to achieve a practical level of mitigation that can be achieved through implementation. Further, the listed measures and controls are reasonable, specific, and unambiguous; and involve methods and techniques that are appropriate, achievable, and can be verified through subsequent field reviews and inspections. Finally, the environmental, economic, and social costs of implementing the measures and controls have been thoughtfully balanced against the expected benefits.

Some of the listed operational impacts do not require mitigation and are identified accordingly within the table. Some of the listed operational impacts for which mitigation is not practical have been identified in the table and are further discussed in ER Section 10.1.

In addition, Table 5.10-1 identifies the obligations of the licensee including, as appropriate, requirements for reporting and keeping records of environmental data, and any conditions and monitoring requirements for the protection of the nonaquatic environment that should be considered for inclusion in the environmental protection plan associated with the proposed project. The LNP environmental protection plan is located in Part 10, Appendix A of the COLA.

Table 5.10-1 uses the NRC's three-level standard of significance for each element (SMALL, MODERATE, or LARGE). These significance levels were determined by evaluating the potential effects after any controls or mitigation measures had been implemented. The following significance levels used in the evaluation were developed using the Council on Environmental Quality guidelines set forth in the footnotes to Table B-1 of Title 10 of the CFR Part 51, Subpart A, Appendix B:

- **SMALL** — Environmental effects are not detectable or are so minor 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 GEIS for License Renewal of Nuclear Plants, NUREG-1437, Volumes 1 and 2.

5.10.2 MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION OF THE PROPOSED FACILITY

The following measures and controls could limit potential adverse environmental impacts related to operation activities for the LNP:

- Compliance with local, regional, state (Florida), tribal, and federal laws, ordinances, and regulations intended to prevent or minimize adverse environmental effects (for example, solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, spill response and cleanup, and hazardous waste management).

- Compliance with applicable permits and licenses required for operation of the LNP.

- Compliance with PEF processes or procedures applicable to the operation of environmental compliance activities for the LNP site (for example, solid waste management, hazardous waste management, and spill prevention and response).

- Identification of environmental resources and potential effects during the development of this ER.

Operation activities at the LNP site will conform to the goals and criteria set forth in the regulatory guidelines and requirements. PEF will adhere to applicable local, regional, state, tribal, and federal requirements during operation activities. Because the technology might be different by the time a new facility is constructed, the listed commitments of potential mitigation measures and controls within Table 5.10-1 are subject to change. The mitigation techniques presented herein represent BMPs or standard industrial practices at the time of the LNP COLA submittal.

Table 5.10-1 (Sheet 1 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

	Potential Impact Significance[(a), (b)]															
Section Reference	**Noise**	**Erosion and Sediment**	**Air Quality**	**Traffic**	**Effluents and Wastes**	**Surface Water**	**Groundwater**	**Land Use[(c)]**	**Water Use[(d)]**	**Terrestrial Ecosystem**	**Aquatic Ecosystem**	**Socioeconomic**	**Rad Exp to Wkrs**	**Other (Site-Specific)**	**Impact Description or Activity**	**Measures and Controls to Limit Adverse Impacts**
ER Section 5.1	Land Use Impacts															
ER Subsection 5.1.1.1 Impacts on Crops, Vegetation, or Transportation Systems				S				S						S	1. Impacts on on-site and in-vicinity transportation infrastructure from an increased workforce. 2. Impacts from salt drift from cooling and heat dissipation system on vegetation. 3. Operational impacts on the 100-year floodplain.	1. Modifications and upgrades, if required, to existing roads and highways. Appropriate measures to minimize disturbances during maintenance. 2. Operation of cooling towers within design parameters. 3. Construction and grading to meet facility design plans.
ER Subsection 5.1.1.2 Long-Term Land Use Restrictions								S							Impacts of changes to Levy County's current zoning and future land use designation for the LNP site.	Development of revised FLUM and text amendment for Levy County comprehensive land use plan for submittal to FDCA and Levy County Board of County Commissioners.
ER Subsection 5.1.2.1 Transmission Corridors								S							Routine vegetation inspection and clearing activities in the ROW and access road construction for temporary maintenance needs.	Maintenance will follow established industry procedures and conform to any applicable regulations to minimize any soil or water impacts.

Table 5.10-1 (Sheet 2 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.1.2.2 Off-Site Areas								S							Routine vegetation inspection and clearing activities in the ROW and access road construction for temporary maintenance needs.	If necessary, BMPs used during construction will be maintained to minimize erosion and sedimentation in off-site areas. Maintenance activities for these off-site areas will consist of preventive and corrective measures, if required. Measures may include mowing, pruning, removing trees, and herbicide treatments.
ER Subsection 5.1.3 Historic Properties														S	Impacts on historic properties and archaeological sites.	In the event of an inadvertent cultural resource discovery during operation, PEF procedures will be followed and the Florida SHPO will be notified.
ER Section 5.2	Water-Related Impacts															
ER Subsection 5.2.1.1 Freshwater Streams						S			S						Hydrological impacts associated with stormwater management and blowdown discharge.	Maintenance of erosion control and stabilization measures; compliance with applicable discharge regulations and permits.
ER Subsection 5.2.1.2 Lakes and Impoundments						S			S						Surface water impacts associated with water quality and water use.	No impacts to lakes or impoundments are anticipated. No mitigation measures are required.

Table 5.10-1 (Sheet 3 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.2.1.3 Cross Florida Barge Canal						S			S		S			S	1. Impacts on uses of the CFBC, including water supply, aquatic ecosystems, recreation, and navigation. 2. Impacts associated with water quality and water use.	1. Water withdrawals from the CFBC are not expected to change water levels or supply. No impacts on recreational use or navigation are anticipated. No mitigation measures are anticipated. 2. Canal flow patterns and water quality changes are expected to be minor. No mitigation measures are anticipated.
ER Subsection 5.2.1.4 Groundwater							S		S						Hydrologic impacts associated with groundwater supply and quality.	Groundwater use impacts will be evaluated using the DWRM2; Compliance with applicable laws and regulations. Monitoring for groundwater quality impacts.
ER Subsection 5.2.1.5 Wetlands		S				S									Stormwater impacts on wetlands.	Maintenance of existing stormwater systems and erosion control measures; compliance with applicable plans and permits.
ER Subsection 5.2.1.6 Gulf of Mexico						S			S						Hydrologic impacts associated with water quality, quantity, and use.	No mitigation measures are anticipated.

Table 5.10-1 (Sheet 4 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[c]	Water Use[d]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
	Potential Impact Significance[(a), (b)]															
ER Subsection 5.2.2 Water Use Impacts																
ER Subsection 5.2.2.1 Freshwater Water Bodies						S			S						Hydrologic impacts associated with water availability and quality.	Compliance with applicable state and federal laws and permits.
ER Subsection 5.2.2.2 Gulf of Mexico, CFBC, CREC Discharge Canal						S			S		S			S	1. Impacts on uses on the Gulf of Mexico, CFBC, and CREC discharge canal, including water supply, recreation, and navigation. 2. Impacts associated with water quality and aquatic ecosystems.	1. Water withdrawals are not expected to change water levels or supply. No impacts on recreational use or navigation are anticipated. No mitigation measures are anticipated. 2. Compliance with applicable state and federal laws and permits.
ER Subsection 5.2.2.3 Groundwater Use							S		S		S				Impacts associated with water availability and quality.	Compliance with applicable state permits.
ER Section 5.3 Cooling System Impacts																
ER Subsection 5.3.1.1 Hydrodynamic Descriptions and Physical Impacts		S				S					S				Impact of new low intake velocity flow fields in the vicinity of the CWIS pumphouse on bottom sediments and benthic organism habitats.	Design of intake structure and screens to comply with federal laws on intake velocities.

Table 5.10-1 (Sheet 5 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.3.1.2 Aquatic Ecosystems						S					S				1. Impacts from increases in salinity on aquatic habitat in the upper-reaches of the CFBC. 2. Impingement and entrainment on aquatic organisms. 3. Possible impacts on spawning.	1. Monitoring of salinity changes. Salinity increases could increase biologic diversity in the upper reaches of the CFBC. 2. Design of intake structure and screens to comply with federal laws on intake velocity of less than 0.50 ft/sec. 3. Operation within permit requirements and the approximately 11.3-km (7-mi.) distance from the more productive spawning and nursery areas of the nearshore Gulf waters likely limit the use of the CFBC for spawning and nursery activities. No mitigation measures are anticipated.
ER Subsection 5.3.2.1 Thermal Description and Physical Impacts		S			S	S									Impacts from thermal discharge and additional blowdown water into the CREC discharge canal.	Compliance with applicable state permit requirements; no significant increases in flow velocity in the canal; no significant physical changes anticipated at the end of the discharge canal in Crystal Bay; LNP blowdown will not result in significant changes in existing water temperature in the CREC discharge canal.

Table 5.10-1 (Sheet 6 of 17) Summary of Measures and Controls to Limit Adverse Impacts During Operation

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[c]	Water Use[d]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
	Potential Impact Significance[(a), (b)]															
ER Subsection 5.3.2.2 Aquatic Ecosystems						S					S				1. Impacts from thermal discharge. 2. Impacts from chemicals in the blowdown discharge. 3. Impacts from additional blowdown water into the CREC discharge canal.	1. Compliance with applicable permit requirements. LNP blowdown will not result in significant changes in existing water temperature in the CREC discharge canal. 2. Compliance with applicable permit requirements. LNP blowdown volume will not significantly affect chemical composition or water quality in the CREC discharge canal. 3. No significant increases in flow velocity in the canal; no significant physical changes anticipated at the end of the discharge canal in Crystal Bay.
ER Subsection 5.3.3.1 Heat Dissipation to the Atmosphere			S											S	1. Impacts attributable to cooling tower height and plume height, length, and frequency. 2. Impacts attributable to ground-level fogging and icing. 3. Impacts attributable to solids deposition. 4. Impacts attributable to cloud shadowing and additional precipitation. 5. Impacts attributable to interaction with existing pollution sources. 6. Impacts attributable to ground-level humidity increase.	1. Design of the mechanical draft cooling tower minimizes tower visibility and improves plume dissipation. 2. No mitigation measures are anticipated. 3. No mitigation measures are anticipated. 4. No mitigation measures are anticipated. 5. No mitigation measures are anticipated. 6. No mitigation measures are anticipated.

Table 5.10-1 (Sheet 7 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.3.3.2 Terrestrial Ecosystems	S		S							S					1. Impacts attributable to noise from cooling tower operation. 2. Impacts attributable to ground-level fogging and icing. 3. Impacts attributable to solids deposition. 4. Impacts attributable to cloud shadowing and additional precipitation. 5. Impacts attributable to ground-level humidity increase.	1. No mitigation measures are anticipated; mobile organisms may relocate to quieter environments. 2. No mitigation measures are anticipated. 3. No mitigation measures are anticipated. 4. No mitigation measures are anticipated. 5. No mitigation measures are anticipated.
ER Subsection 5.3.4.1 Thermophilic Microorganism Impacts			S											S	Impacts of microorganisms in cooling tower emissions and thermal discharges on the public.	Planned biocide treatment of the cooling tower basin; low probability of aerosol pathogen formation; power plant workers directly working on cooling tower maintenance, and who are potentially exposed to aerosols that could harbor pathogens, may require respiratory protection.
ER Subsection 5.3.4.2 Noise Impacts from Cooling Tower and CWIS Operation	S														Noise impacts from the operation of the cooling tower and CWIS.	CWIS pumphouse design to attenuate operation noise; distance to site boundary to minimize impacts on public.

Table 5.10-1 (Sheet 8 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

	Potential Impact Significance[(a), (b)]															
Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Section 5.4	Radiological Impacts of Normal Operation															
ER Subsection 5.4.1.3 Direct Radiation from the LNP													S		Direct radiation impacts to the public from normal plant operations.	Minimize direct radiation impact through plant design.
ER Subsection 5.4.3 Impacts on Members of the Public														S	Impacts on members of the public from operation of the new units.	Minimize direct radiation impact through plant design.
ER Subsection 5.4.4 Impacts on Biota Other than Members of the Public										S	S				Impacts of radiation exposure on biota other than members of the public.	Minimize direct radiation impact through plant design.
ER Subsection 5.4.5 Occupational Radiation Exposures													S		Impacts of occupational radiation exposure on LNP operating personnel.	Minimize direct radiation impact through plant design and compliance with applicable regulations and standards.

Table 5.10-1 (Sheet 9 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Section 5.5	Environmental Impacts of Waste															
ER Subsection 5.5.1.1 Impacts of Discharges on Water						S									1. Impacts from liquid effluents containing biocides or chemicals. 2. Impacts from demineralized water treatment wastes. 3. Impacts from waste treatment facility sanitary wastes. 4. Impacts from treated wastewater (low volume wastes and radwaste). 5. Impacts from floor drain systems. 6. Impacts from surface drainage and roof drains.	1. Compliance with state and federal permits; plant design will reduce number of waste streams; rapidly degrading system treatment chemicals will be used; waste discharge point will be monitored. 2. Compliance with state and federal permits; waste stream pH will be adjusted before discharge; waste discharge point will be monitored. 3. Compliance with state and federal permits; waste discharge point will be monitored. 4. Compliance with state and federal permits; waste discharge point will be monitored. 5. Compliance with state and federal permits; waste discharge point will be monitored. 6. Compliance with state and federal permits; collection in stormwater ponds; waste discharge point will be monitored.

Table 5.10-1 (Sheet 10 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[c]	Water Use[d]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.5.1.2 Impacts of Discharges on Land					S										1. Impacts from nonradioactive solid waste. 2. Impacts from hazardous wastes. 3. Impacts from petroleum waste.	1. Solid nonradioactive and nonhazardous waste will be disposed of at an off-site, permitted disposal landfill. Compliance with federal and state regulations and permits. 2. Compliance with federal and state regulations and permits. 3. Collected, stored, and recycled or disposed of in accordance with federal, state, and local regulations.
ER Subsection 5.5.1.3 Impacts of Discharges on Air			S		S										Impacts from discharge of nonradioactive gaseous effluents.	Compliance with federal, state, and local regulations and permits.
ER Subsection 5.5.1.4 Sanitary Waste					S										Impacts from discharge of sanitary waste to surface waters.	Compliance with federal and state regulations and permits.
ER Subsection 5.5.2.1 Chemical Hazards Impacts					S										1. Impacts from mixed waste handling and storage practices. 2. Impacts to personnel.	1. Compliance with federal and state regulations and permits; laboratory testing of waste. 2. Laboratory testing of wastes, contingency plans, emergency preparedness, and prevention procedures; off-site treatment and disposal.

Table 5.10-1 (Sheet 11 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.5.2.2 Radiological Hazards Impacts					S								S		Impacts on workers from the handling and storage of mixed waste.	Compliance with federal and state regulations and permits.
ER Subsection 5.5.3 Pollution Prevention and Waste Minimization Program					S										Development of a hazardous waste minimization plan.	Mitigation measures specific to a pollution prevention and waste minimization program (described further in ER Subsection 5.5.3.)
ER Section 5.6	Transmission System Impacts															
ER Subsection 5.6.1.1 Natural Ecosystems and Rare, Threatened and Endangered Species										S					Impacts on terrestrial ecosystems from maintenance of existing transmission corridors.	Follow BMPs; coordination with regulatory agencies; compliance with applicable federal, state, and local permit and regulatory requirements; and use of approved maintenance procedures and herbicides.
ER Subsection 5.6.2 Aquatic Impacts											S				Impacts from maintenance of transmission corridors on aquatic ecology.	BMPs; coordination with appropriate regulatory agencies; compliance with permit requirements; and use of approved herbicides.

Table 5.10-1 (Sheet 12 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.6.2.2 Wetlands										S	S				Impacts from maintenance of transmission corridors on terrestrial and aquatic ecosystems.	Minimize permanent changes to vegetation; and use of approved herbicides.
ER Subsection 5.6.3.1 Electromagnetic Field Exposure														S	Impacts associated with electromagnetic fields from transmission lines.	No mitigation measures are anticipated.
ER Subsection 5.6.3.2 Noise	S														Noise impacts associated with transmission lines.	Implement standard designs to minimize noise.
ER Subsection 5.6.3.3 Radio and Television Interference														S	Impacts from transmission lines on radio and television reception.	Implement standard design and maintenance practices to minimize interference.
ER Subsection 5.6.3.4 Visual Impacts														S	Visual impacts associated with transmission lines.	Use adjacent corridors and ROWs to minimize visual impact.

Table 5.10-1 (Sheet 13 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Section 5.7 Uranium Fuel Cycle Impacts and Transportation Impacts																
ER Subsection 5.7.1.5 Land Use								S							Land use impacts associated with the UFC.	Evaluation of impacts as specified in NUREG-1437.
ER Subsection 5.7.1.6 Water Use									S						Water use impacts associated with the UFC.	Evaluation of impacts and limitations as specified in NUREG-1437.
ER Subsection 5.7.1.7 Fossil Fuel Effects														S	Impacts associated with fossil fuel combustion to support the UFC.	Evaluation of impacts and limitations as specified in NUREG-1437.
ER Subsection 5.7.1.8 Chemical Effluents			S		S										Impacts associated with chemical effluents to support the UFC.	Evaluation of impacts and limitations as specified in NUREG-1437.
ER Subsection 5.7.1.9 Radioactive Effluents					S										Impacts associated with the radioactive effluents associated with the UFC.	Evaluation of impacts and limitations as specified in NUREG-1437.

Table 5.10-1 (Sheet 14 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Section Reference	Potential Impact Significance[(a), (b)] Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.7.1.10 Radioactive Wastes					S										1. Impacts of radioactive wastes associated with the UFC. 2. Impacts associated with occupational dose associated with the UFC. 3. Transportation impacts associated with UFC.	1. Compliance with regulatory requirements and limitations. 2. Compliance with applicable regulatory limits. 3. Compliance with applicable regulatory limits.
ER Section 5.8 Socioeconomics																
ER Subsection 5.8.1.1 Noise	S														Noise impacts associated with station operation.	Use of standard noise control devices and abatement techniques.
ER Subsection 5.8.1.2 Air Quality			S												Air quality impacts associated with station operation.	Compliance with applicable regulatory requirements and permits.
ER Subsection 5.8.1.3 Aesthetic Disturbances														S	Aesthetic impacts associated with station operation.	Specific measures and controls are not required.
ER Subsection 5.8.2.1 Economic Characteristics												S - L			Beneficial economic impacts associated with station operation. Operations will result in approximately 1800 direct and indirect jobs with the associated increases in sales, property tax, and output revenues. The current $18 million Levy County annual property tax base will gain an additional $63 million and another $41 million when LNP 1 and LNP 2 become operational, respectively.	Specific measures and controls are not required.

Table 5.10-1 (Sheet 15 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.8.2.2 Tax Impacts												L			Beneficial tax impacts associated with station operation. The current $18 million Levy County annual property tax base will gain an additional $63 million and another $41 million when LNP 1 and LNP 2 become operational, respectively.	Specific measures and controls are not required.
ER Subsection 5.8.2.3 Social Structure												S			Impacts of station operation on social structure.	Specific measures and controls are not required.
ER Subsection 5.8.2.4 Housing												S			Impacts of station operation on housing.	Specific measures and controls are not required.
ER Subsection 5.8.2.5 Education System												S			Impacts of station operation on educational system.	Specific measures and controls are not required.
ER Subsection 5.8.2.6 Recreation												S			Impacts of station operation on recreation resources.	Specific measures and controls are not required.

Table 5.10-1 (Sheet 16 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

Potential Impact Significance[(a), (b)]

Section Reference	Noise	Erosion and Sediment	Air Quality	Traffic	Effluents and Wastes	Surface Water	Groundwater	Land Use[(c)]	Water Use[(d)]	Terrestrial Ecosystem	Aquatic Ecosystem	Socioeconomic	Rad Exp to Wkrs	Other (Site-Specific)	Impact Description or Activity	Measures and Controls to Limit Adverse Impacts
ER Subsection 5.8.2.7 Public Services and Facilities												S			1. Impacts of station operation on public services and facilities. 2. Impacts of station operation on security services. 3. Impacts of station operation on water and wastewater services.	1. Community services exist in sufficient capacity to support operation. 2. Community services are sufficient to absorbed anticipated growth associated with operation workers and their families; coordination of emergency services in surrounding counties. 3. Community services are sufficient to absorbed anticipated growth associated with operational workers and their families and outage personnel.
ER Subsection 5.8.2.8 Transportation Facilities				S											Impacts of station operation on regional transportation.	Transportation study to be conducted.
ER Subsection 5.8.2.9 Distinctive Communities												S			Impacts of station operation on distinctive communities.	Specific measure or controls are not required.
ER Subsection 5.8.3 Environmental Justice Impacts												S			Impacts associated with environmental justice issues due to LNP operation.	Specific mitigation measures and controls are not needed.
ER Subsection 5.8.3.1 Minority Populations												S			Impacts of station operation on racial, ethnic, and special groups.	Specific mitigation measures and controls are not needed.

Table 5.10-1 (Sheet 17 of 17)
Summary of Measures and Controls to Limit Adverse Impacts During Operation

	Potential Impact Significance[(a), (b)]															
Section Reference	**Noise**	**Erosion and Sediment**	**Air Quality**	**Traffic**	**Effluents and Wastes**	**Surface Water**	**Groundwater**	**Land Use[(c)]**	**Water Use[(d)]**	**Terrestrial Ecosystem**	**Aquatic Ecosystem**	**Socioeconomic**	**Rad Exp to Wkrs**	**Other (Site-Specific)**	**Impact Description or Activity**	**Measures and Controls to Limit Adverse Impacts**
ER Subsection 5.8.3.2 Low Income Populations												S			Impacts of station operation on income characteristics.	Specific mitigation measures and controls are not needed.

Notes:

a) The assigned potential impact significance levels of SMALL, MODERATE, or LARGE are based on the assumption that mitigation measures and controls would be implemented.

b) A blank in the elements column denotes “no impact” on that specific element because of the assessed activities.

c) Land Use Protection/Restoration.

d) Water Use Protection/Restoration.

BTA = best technology available
DWRM2 = District Wide Regulation Model, Version 2
FDCA = Florida Department of Community Affairs
FLUM = future land use map
ROW = right-of-way
SHPO = State Historic Preservation Officer
UFC = uranium fuel cycle

5.11 CUMULATIVE IMPACTS RELATED TO STATION OPERATION

In accordance with NUREG-1555 (Draft Revision 0), ESRP 5.11, this section summarizes potential cumulative environmental impacts associated with the operation of the LNP.

5.11.1 CUMULATIVE ENVIRONMENTAL IMPACTS

This subsection has identified the cumulative impacts associated with the operation of the LNP. As identified in NUREG-1555 (Draft Revision 0), ESRP 5.11, cumulative impact is defined as:

> The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

As identified in NUREG-1555 (Draft Revision 0), ESRP 5.11, the anticipated magnitude of the potential cumulative impacts was surmised from the following information:

- Identification of past, present, and future federal, nonfederal, and private actions that could have meaningful cumulative impacts with the proposed action (review of the aggregate effects of past actions is needed to the extent that the review provides information regarding the proposed action);
- Identification of cumulative impacts of relevant actions within the geographic area (natural ecological or sociocultural boundaries); and
- Identification and tabulation of the cumulative impacts associated with operation of the plant. Cumulative impacts should be relevant and reasonably foreseeable significant adverse impacts.

5.11.1.1 Identification of Past Actions that May Have Contributed Meaningful Cumulative Impacts with the Proposed Action

The identification of past federal, nonfederal, and private actions that might have contributed meaningful cumulative impacts with the LNP project include the following:

- CREC.
- CFBC.
- Damming of Withlacoochee River to create Lake Rousseau.
- Withlacoochee River Bypass Channel.

- Federal, state, and county transportation (roads, rail, airports) and infrastructure (water/sewer treatment facilities, pipelines) in the region.
- Goethe State Forest.

The resulting cumulative impacts of these past actions are reflected in the current environmental conditions as described in ER Chapter 2.

5.11.1.2 Identification of Present and Future Actions that Could Have Meaningful Cumulative Impacts with the Proposed Action

To identify present and future federal, nonfederal, and private actions that could have meaningful cumulative impacts with the LNP project, the geographic area in which to consider cumulative impacts must be identified along with an understanding of current and future land use plans in the region. For the purpose of this evaluation, cumulative impacts were evaluated within the LNP region as defined in NUREG-1555 as an area within a 80-km (50-mi.) radius of the proposed site. While the NUREG-1555 definition excludes the site and vicinity, these areas were included in this discussion. The area was then used to evaluate the potential cumulative impacts associated with the LNP and the region (identified as the counties within 50 mi.). These counties include: Levy, Citrus, Marion, Alachua, Dixie, Gilchrist, Hernando, Lake, Pasco, Putnam, and Sumter counties. The region evaluated for cumulative impacts is shown on Figure 5.11-1.

ER Subsection 2.2.3.1 provides a description of the region, and ER Table 2.2-2 provides a tabulation of areas within the region, organized by land use category. As discussed in ER Subsection 2.2.2.6, the State of Florida is made up of state, regional, and local planning authorities. Each of the counties and municipalities located within the region has developed strategic regional comprehensive and future land use plans that promote a collaborative process for each region to coordinate planning between local governments, regional entities, and state and federal agencies. A list and description of the land use plans developed for each county within the LNP region can be found in ER Subsections 2.2.3.1, 2.2.1.5, and 2.2.2.6, respectively. In addition, the three counties that could be primarily affected by construction at the LNP site — Levy, Marion, and Citrus — are discussed in ER Chapter 4. Future land use components that are indicative of future development trends, such as developments of regional impact and planned unit developments, are also discussed (see Figure 4.1-3). Present and future federal, nonfederal, and private actions that could have meaningful cumulative impacts with the LNP project are identified within these land use plans. One proposed project not identified in the Levy County land use plan is the Tarmac King Road Limestone Mine, as described in ER Subsections 2.2.1.2 and 4.1.1.3.

5.11.1.3 Identification of Cumulative Impacts Associated with the Proposed Action

USEPA provides the following guidance in identifying and determining cumulative impacts: Cumulative impacts can affect a broad array of resources and ecosystem components. In addition to considering the biological resources that are the staple of NEPA analysis, examples of other resources that should be considered include socioeconomic resources, human health, recreation, quality of life issues, and cultural and historical resources (Reference 5.11-001).

Elements evaluated for cumulative impacts associated with the LNP project are listed in Table 5.11-1. Florida Statute (F.S.) 163.3177 outlines the required and optional elements of Florida's comprehensive planning process; it requires that each local government develop a comprehensive plan. The table presents the elements contained in the comprehensive plans that were evaluated for cumulative impact purposes. The following list describes each of these elements:

- Future Land Use: Characterizes the proposed future general distribution, location, and extent of the uses of land for residential, commercial, industry, agriculture, recreation, conservation, education, and other categories of the public and private uses of land.

- Housing: Consists of standards, plans, and principles to anticipate the provision of housing for all current and anticipated future residents, as well as the provision of adequate sites for future housing, including affordable workforce housing.

- Transportation: Describes the types, locations, and extent of existing and proposed major thoroughfares and transportation routes.

- Infrastructure: Addresses general sanitary sewer, solid waste, drainage, potable water, and natural groundwater aquifer recharge components that should be correlated to principles and guidelines for future land use.

- Coastal Management: For applicable local governments, describes policies that guide the local government's decisions and program implementation with respect to the maintenance, restoration, and enhancement of the overall quality of the coastal zone environment.

- Conservation: Describes the conservation, use, and protection of natural resources in the area.

- Recreation and Open Space: Addresses a comprehensive system of public and private sites for recreation.

Based on the information contained in the land use plans for the counties located in the LNP region, it is anticipated that there would be SMALL cumulative impacts on the region.

5.11.2 REFERENCES

5.11-001 U.S. Environmental Protection Agency, Office of Federal Activities (2252A), *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, EPA 315-R-99-002, May 1999.

Table 5.11-1
Elements Included in County Comprehensive Plans Evaluated for Cumulative Impacts

Counties in the LNP Region	Future Land Use[a]	Housing	Transportation	Infrastructure	Coastal Management	Conservation	Recreation and Open Space
Levy	X	X	X	X	X	X	X
Citrus	X	X	X	X	X	X	X
Marion	X	X	X	X	N/A	X	X
Alachua	X	X	X	X	N/A	X	X
Dixie	X	X	X	X	X	X	X
Gilchrist	X	X	X	X	N/A	X	X
Hernando	X	X	X	X	X	X	X
Lake	X	X	X	X	N/A	X	X
Pasco	X	X	X	X	X	X	X
Putnam	X	X	X	X	N/A	X	X
Sumter	X	X	X	X	N/A	X	X

Notes:

a) These comprehensive planning elements are further described in ER Subsection 5.11.1.3.

X = Addressed in the Comprehensive Plan.

N/A = not applicable