Applicant's Environmental Report – Operating License Renewal Stage Crystal River Unit 3 Progress Energy

Unit 3
Docket No. 50-302
License No. DPR-72

Final
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ACRONYMS AND ABBREVIATIONS

AADT	Annual Average Daily Traffic
AEC	U.S. Atomic Energy Commission
AQCR	Air Quality Control Region
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CCUD	Citrus County Utilities Division
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGCC	coal gasification combined cycle
CR-3	Crystal River Unit 3
CREC	Crystal River Energy Complex
CWA	Clean Water Act
DECON	decontamination and dismantlement
DSM	demand-side management
°F	degrees Fahrenheit
FDEP	Florida Department of Environmental Protection
FES	Final Environmental Statement
FGUA	Florida Government Utilities Authority
FNAI	Florida Natural Areas Inventory
FPC	Florida Power Corporation
FPSC	Florida Public Service Commission
FSAR	Final Safety Analysis Report
FWC	Florida Fish and Wildlife Conservation Commission
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants
gpd	Gallons per day
gpm	gallons per minute
IPA	Integrated Plant Assessment
kV	kilovolt
LOCA	loss-of-coolant accident
LOS	level of service
MGD	million gallons per day
MSA	Metropolitan Statistical Area
msl	mean sea level
MSW	municipal solid waste
MW	megawatt
MWe	megawatts-electrical
MWt	megawatts-thermal

NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESC®	National Electrical Safety Code®
NMFS	National Marine Fisheries Service
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
ROW	right-of-way
SAFSTOR	safe storage of the stabilized and defueled facility
SAMA	Severe Accident Mitigation Alternatives
SHPO	State Historic Preservation Officer
SMITTR	surveillance, monitoring, inspections, testing, trending, and recordkeeping
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SWFWMD	Southwest Florida Water Management District
TtNUS	Tetra Tech NUS
USCB	U.S. Census Bureau
USDOI	U.S. Department of Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRWSA	Withlacoochee Regional Water Supply Authority
WTE	waste-to-energy

1.0 INTRODUCTION

1.1 PURPOSE OF AND NEED FOR ACTION

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. Progress Energy operates Crystal River Unit 3 (CR-3) pursuant to NRC Operating License DPR-72. The license will expire December 3, 2016. Progress Energy has prepared this environmental report in conjunction with its application to NRC to renew the CR-3 operating license, as provided by the following NRC regulations:

> Title 10, Energy, Code of Federal Regulations (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application-Environmental Information (10 CFR 54.23) and
>
> Title 10, Energy, CFR, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, Section 51.53, Postconstruction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)].

NRC has defined the purpose and need for the proposed action, the renewal of the operating license for nuclear power plants such as CR-3, as follows:

> "...The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decision makers." (NRC 1996a)

The renewed operating licenses would allow an additional 20 years of plant operation beyond the current CR-3 licensed operating period of 40 years.

1.2 ENVIRONMENTAL REPORT SCOPE AND METHODOLOGY

NRC regulations for domestic licensing of nuclear power plants require environmental review of applications to renew operating licenses. The NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document entitled *Applicant's Environmental Report - Operating License Renewal Stage*. In determining what information to include in the CR-3 Environmental Report, Progress Energy has relied on NRC regulations and the following supporting documents that provide additional insight into the regulatory requirements:

- NRC supplemental information in the *Federal Register* (NRC 1996a, 1996b, 1996c, and 1999a)
- *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996d and 1999b)
- Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses (NRC 1996e)
- Public Comments on the Proposed 10 CFR Part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response (NRC 1996f)

Progress Energy has prepared Table 1-1 to verify conformance with regulatory requirements. Table 1-1 indicates where the environmental report responds to each requirement of 10 CFR 51.53(c). In addition, each responsive section is prefaced by a boxed quote of the regulatory language and applicable supporting document language.

1.3 CRYSTAL RIVER UNIT 3 LICENSEE AND OWNERSHIP

The CR-3 facility operating license lists 10 licensees: Florida Power Corporation, City of Alachua, City of Bushnell, City of Gainesville, City of Kissimmee, City of Leesburg, City of New Smyrna Beach Utilities Commission and City of New Smyrna Beach, City of Ocala, Orlando Utilities Commission and City of Orlando, and Seminole Electric Cooperative. Florida Power Corporation, now doing business as Progress Energy Florida, will submit the CR-3 license renewal application to the NRC. Progress Energy Florida, which serves approximately 1.7 million customers in Florida, is a wholly owned subsidiary of Progress Energy, a diversified energy services company headquartered in Raleigh, North Carolina (Progress Energy 2007).

CR-3 has ten licensees and ten owners, but Progress Energy Florida owns 91.8 percent of the plant (NEI 2007). Progress Energy also has exclusive control of operation and maintenance of the plant. Seminole Electric Cooperative has the second largest ownership percentage, 1.7 percent. The remaining 6.5 percent ownership is divided among the eight municipalities and utility commissions listed above.

TABLE 1-1
ENVIRONMENTAL REPORT RESPONSES TO LICENSE RENEWAL ENVIRONMENTAL REGULATORY REQUIREMENTS

Regulatory Requirement	Responsive Environmental Report Section(s)	
10 CFR 51.53(c)(1)		Entire Document
10 CFR 51.53(c)(2), Sentences 1 and 2	3.0	Proposed Action
10 CFR 51.53(c)(2), Sentence 3	7.2.2	Environmental Impacts of Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(1)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(2)	6.3	Unavoidable Adverse Impacts
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(3)	7.0	Alternatives to the Proposed Action
	8.0	Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(4)	6.5	Short-Term Use Versus Long-Term Productivity of the Environment
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(5)	6.4	Irreversible and Irretrievable Resource Commitments
10 CFR 51.53(c)(2) and 10 CFR 51.45(c)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
	6.2	Mitigation
	7.2.2	Environmental Impacts of Alternatives
	8.0	Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(d)	9.0	Status of Compliance
10 CFR 51.53(c)(2) and 10 CFR 51.45(e)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
	6.3	Unavoidable Adverse Impacts
10 CFR 51.53(c)(3)(ii)(A)	4.1	Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a Small River with Low Flow)
	4.6	Groundwater Use Conflicts (Plants Using Cooling Towers or Cooling Ponds and Withdrawing Makeup Water from a Small River)
10 CFR 51.53(c)(3)(ii)(B)	4.2	Entrainment of Fish and Shellfish in Early Life Stages
	4.3	Impingement of Fish and Shellfish
	4.4	Heat Shock
10 CFR 51.53(c)(3)(ii)(C)	4.5	Groundwater Use Conflicts (Plants Using >100 gpm of Groundwater)
	4.7	Groundwater Use Conflicts (Plants Using Ranney Wells)
10 CFR 51.53(c)(3)(ii)(D)	4.8	Degradation of Groundwater Quality
10 CFR 51.53(c)(3)(ii)(E)	4.9	Impacts of Refurbishment on Terrestrial Resources
	4.10	Threatened or Endangered Species
10 CFR 51.53(c)(3)(ii)(F)	4.11	Air Quality During Refurbishment (Non-Attainment Areas)

TABLE 1-1
ENVIRONMENTAL REPORT RESPONSES TO LICENSE RENEWAL ENVIRONMENTAL REGULATORY REQUIREMENTS (Continued)

Regulatory Requirement	Responsive Environmental Report Section(s)	
10 CFR 51.53(c)(3)(ii)(G)	4.12	Microbiological Organisms
10 CFR 51.53(c)(3)(ii)(H)	4.13	Electric Shock from Transmission-Line-Induced Currents
10 CFR 51.53(c)(3)(ii)(I)	4.14	Housing Impacts
	4.15	Public Utilities: Public Water Supply Availability
	4.16	Education Impacts from Refurbishment
	4.17	Offsite Land Use
10 CFR 51.53(c)(3)(ii)(J)	4.18	Transportation
10 CFR 51.53(c)(3)(ii)(K)	4.19	Historic and Archaeological Resources
10 CFR 51.53(c)(3)(ii)(L)	4.20	Severe Accident Mitigation Alternatives
10 CFR 51.53(c)(3)(iii)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(3)(iv)	6.2	Mitigation
	5.0	Assessment of New and Significant Information
10 CFR 51, Appendix B, Table B-1, Footnote 6	2.6.2	Minority and Low-Income Populations

1.4 REFERENCES

NEI (Nuclear Energy Institute). 2007. U.S. Nuclear Plant Operators, Owners, and Holding Companies. Nuclear Energy Institute, Washington, DC.

NRC (U.S. Nuclear Regulatory Commission). 1996a. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." Federal Register. Vol. 61, No. 109. June 5.

NRC (U.S. Nuclear Regulatory Commission). 1996b. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses; Correction." Federal Register. Vol. 61, No. 147. July 30.

NRC (U.S. Nuclear Regulatory Commission). 1996c. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." Federal Register. Vol. 61, No. 244. December 18.

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

NRC (U.S. Nuclear Regulatory Commission). 1996e. Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses. NUREG-1440. Washington, DC. May.

NRC (U.S. Nuclear Regulatory Commission). 1996f. Public Comments on the Proposed 10 CFR Part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response. Volumes 1 and 2. NUREG-1529. Washington, DC. May.

NRC (U.S. Nuclear Regulatory Commission). 1999a. "Changes to Requirements for Environmental Review for Renewal of Nuclear Power Plant Operating Licenses; Final Rule." Federal Register. Vol. 64, No. 171. September 3.

NRC (U.S. Nuclear Regulatory Commission). 1999b. Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS). Section 6.3, "Transportation" and Table 9-1, "Summary of findings on NEPA issues for license renewal of nuclear power plants." NUREG-1437. Volume 1, Addendum 1. Washington, DC. August.

Progress Energy. 2007. Progress Energy Data Book. Prepared by Progress Energy, Inc., Raleigh, North Carolina. Available online at http://www.progress-energy.com/investors/overview/databook/databook_fulldocument.pdf.

2.0 SITE AND ENVIRONMENTAL INTERFACES

2.1 LOCATION AND FEATURES

Crystal River Unit 3 (CR-3) is located in northwestern Citrus County, Florida, on Crystal Bay, an embayment of the Gulf of Mexico. The Plant lies approximately 35 miles southwest of the city of Ocala, Florida, and 60 miles north of the city of Clearwater, Florida. Figures 2-1 and 2-2 are the 50-mile and 6-mile vicinity maps, respectively.

CR-3 is part of the larger Crystal River Energy Complex (CREC), which includes the single nuclear unit and four fossil-fueled units, Crystal River Units 1, 2, 4, and 5. The Crystal River Energy Complex is the largest power-producing facility in Florida (EIA 2006) and the eighth largest power producing facility in the U.S., with a total generating capacity of 3,163 megawatts-electrical (EIA 2007; EIA 2008; NRC 2008). CR-3, a pressurized water reactor that began operating in 1977, is rated at 850 MWe (NRC 2008). Crystal River Units 1 and 2, built in the 1960s, produce 379 and 491 MWe, respectively, while Crystal River Units 4 and 5, larger units built in the early 1980s, produce 721 and 722 MWe, respectively (EIA 2007).

CR-3 and the four fossil units lie in the developed core area of the 4,738 acre site, which is shown in the photograph that follows. Aside from generating and support facilities, this developed area also contains office buildings, warehouses, oil tanks, coal storage areas, and ash storage basins (see Figure 3-1). Units 1 and 2 are sometimes referred to as “Crystal River South,” while Units 4 and 5 are sometimes referred to as “Crystal River North.”

Crystal River Unit 3's Reactor Building, Turbine Building, and Auxiliary Building are in the southern part of the developed area (foreground of photograph), but in the approximate center of the larger 4,738 acre site. The nuclear exclusion zone is defined by a circle centered on the Reactor Building (Figure 2-3) with a radius of 4,400 feet (Florida Power 2005, Section 1.2.1). The stacks of the four coal-fired units and the Unit 4 and 5 cooling towers dominate the local viewscape (see photograph), with CR-3-associated structures much less obtrusive visually.

The area immediately surrounding the plant is a mix of upland (pine) forest, agricultural lands, swamps, and salt marshes. The large tract of land immediately north of the plant is owned by an agri-business concern with mining interests. Parts of this property are forested, parts are used for cattle ranching and cultivation of citrus trees, and other parts of this property are devoted to limestone/dolomite mining. The area southwest of the plant is salt marsh, while the area south and southeast of the plant is mostly forested wetlands.

The nearest incorporated community to CR-3 is the town of Crystal River, located approximately 6 miles southeast of the CR-3 site, with a population estimated at 3,485 in 2000 and 3,656 in 2006 (USCB 2000a; City of Crystal River 2006). The area within a 6-mile radius includes the unincorporated communities of Yankeetown and Inglis (Figure 2-2). Aside from these and other small towns that have grown up around crossroads, the area is rural in character, with large, privately-owned tracts of forest land and agricultural land and state- and federally-owned forest land and wetlands dominating the landscape.

The Big Bend area of the western Florida coast, which includes eight coastal counties, has been dubbed "the Nature Coast" by promoters of tourism who tout its spring-fed rivers, abundant wildlife, and fishing, scuba-diving, bird-watching, and manatee-watching opportunities. The CREC lies roughly in the center of the Big Bend area, and is ringed by state parks, state forests, greenways, and state and federal wildlife refuges.

Crystal River Preserve State Park adjoins the southern/southeastern boundary of the CREC, and Crystal River Archaeological State Park (affiliated with Crystal River Preserve State Park) lies approximately 2.5 miles southeast of the CREC boundary. Homosassa Springs Wildlife State Park lies approximately 10.5 miles southeast of the CREC boundary, while Chassahowitzka National Wildlife Refuge is approximately 10.5 miles south of the CREC boundary.

A portion of the Marjorie Harris Carr Cross Florida Greenway lies immediately north of the site, occupying much of the land formerly known as the Cross Florida Barge Canal. The Cross Florida Barge Canal was a massive public works project conceived during the Great Depression to connect the Atlantic and Gulf Coasts of Florida and create desperately needed jobs. The project stalled, then proceeded in fits and starts through the 1960s before being halted in 1971 by a lawsuit filed by environmentalists. In 1990, President George Bush signed a law de-authorizing the Cross Florida Barge Canal Project and promoting the use of the lands for recreation and conservation. In 1991, the State of Florida agreed to the terms of the Federal de-authorization, leading to the creation of the Cross Florida Greenway State Recreation and Conservation area. In 1998, it was renamed the Marjorie Harris Carr Cross Florida Greenway, honoring the individual who led the fight against the Cross Florida Barge Canal project. Further to the northwest, approximately 22 miles from the CREC, lies Cedar Keys National Wildlife Refuge.

Section 3.1 describes key features of CR-3, including reactor and containment systems, cooling water system, and transmission system.

2.2 AQUATIC RESOURCES

The two most comprehensive sources of information on the aquatic resources of the CR-3 area are the *Final Environmental Statement related to the proposed Crystal River Unit 3* (FES*)* (AEC 1973) and the *Crystal River Units 1, 2, and 3* (Section) *316 Demonstration* (SWEC 1985). Although two and three decades old, respectively, these documents contain useful information on the oceanography (bathymetry, currents, tides, water quality) and marine/estuarine communities of the Crystal Bay area. Progress Energy has supplemented this historical information with information from state and federal resource agency websites.

The Physical Setting

The Crystal River site is on Crystal Bay, a shallow embayment of the Gulf of Mexico. As far out as Fisherman's Pass, approximately three miles west of the site, the depth of the Bay is less than 10 feet (SWEC 1985, page 3-1). Shallow inshore areas are characterized by oyster bars (or oyster "reefs") oriented parallel to shore that are visible at low tide and covered by water at high tide. These oyster bars, composed mostly of broken shell, create numerous small basins with north-south orientation in the area of the intake and discharge canals.

The Crystal River site is midway between the Withlacoochee and Crystal Rivers, and approximately two miles from each (see Figure 2-2). The Withlacoochee River, with a watershed of more than 2,000 square miles, has an annual average flow of 1,034 cubic feet per second, measured at a Withlacoochee River Bypass Channel gaging station 1.4 miles upstream of the mouth of the river (USGS 2008). Crystal River, with a much smaller watershed, has an annual average flow of 829 cubic feet per second at Bagley Cove, which is 3.6 miles upstream of the mouth of the river (USGS 2008).

Salinity in the area of the plant ranges from 22 to 29 parts per thousand (ppt), depending on freshwater inflows to Crystal Bay from rivers and creeks in the area (AEC 1973, page 2-19). Eight to ten miles offshore, in the Gulf of Mexico, the salinity is more typical of open ocean waters, approximately 35 ppt. Water temperatures in the area are lowest in December-January and highest in late summer (July-September). Temperatures as high as 92°F were measured in the general area of the plant (Cedar Keys) prior to CR-3 operation, but more typically average in the mid-to-high 80s in late summer (AEC 1973, Appendix D). Water temperatures in mid-winter can approach 40°F in shallow areas, but are generally in the 50s (AEC 1973, Appendix D).

Biological Communities

Shoreline Marshlands

A well-developed, 0.5 to 1.0 mile-wide band of marshland extends up and down the coast in the Crystal River area, separating the uplands to the east from the Gulf of Mexico. This transition zone is evident in the false infra-red aerial photograph of the site and environs that was used to create Figure 3-1. These marshlands are drained by numerous small creeks. The marshlands in the vicinity of the site are typical of those found up and down this part of the Gulf Coast, with *Juncus* and *Spartina* the dominant marshland plants. These marshlands and associated creeks provide habitat for a variety of invertebrate organisms, including oysters and crabs, and are nursery areas for finfish including mullet, spot, black drum, red drum, and croaker (AEC 1973, page 2-23). They also support alligators, wading birds, waterfowl, and small mammals, including river otters and raccoons.

Seagrasses

Five species of seagrass were found in shallow water adjacent to the site prior to plant startup (AEC 1973). Three species were most abundant: shoal grass (*Halodule wrightii*), widgeon grass (*Ruppia maritima*), and turtle grass (*Thallassia testudinum*). Manatee grass (*Syringodium filiforme*) and star-grass *Halophila englemanni* were also present. Seagrass beds often contained dense assemblages of rooted green algae, primarily *Caulerpa* spp. Limestone outcroppings were colonized by rockweeds, such as *Sargassum*.

The same five seagrass species were observed by biologists conducting studies in the Crystal Bay area in support of the Crystal River Section 316 Demonstration in 1983-1984 (SWEC 1985). These operational surveys confirmed what studies in the 1970s had suggested --- that the heated effluent from the plant influenced seagrass abundance and distribution in the immediate area of the discharge (SWEC 1985, page 6-48). In 1983-1984, shoalgrass was the only seagrass species observed at Station D, northwest of the plant’s discharge canal and the station most obviously affected by the plant’s heated discharge (SWEC 1985). Shoal grass often colonizes areas where other, more-sensitive seagrasses cannot grow (FOCC 2003). It may be locally dominant in disturbed areas and areas subject to salinity and temperature extremes.

More seagrass species were observed at Stations E and F, which were further offshore but still affected by the plant’s thermal discharge. The greatest number of species was observed at stations (A, B, C) south of the intake canal and outside of the influence of the plant’s heated discharge. Stations (G, H, and I) several miles north, in the area of Luttrell Island and the terminus of the (never-completed) Cross Florida Barge Canal, also had a lower number of seagrass species over this period.

Biomass of the three dominant seagrasses (*Thalassia*, *Halodule*, and *Syringodium*) was also lower in the discharge area than at stations (A, B, C) south of the intake canal outside of the plant’s thermal influence (SWEC 1985). Studies conducted in the late 1970s showed the same general trends with respect to biomass, but looked at combined biomass of all seagrass species rather than individual species.

Benthic Invertebrates

Preoperational surveys of marine benthos at the Crystal River site identified 286 species, including Carolinian (Atlantic Coast) and West Indian species. Most of these were widely distributed forms capable of withstanding a wide variation of environmental conditions (fluctuating temperature and salinity). Thirty mollusks were characterized as "common" or "abundant," including 22 marine gastropods (snails) and 8 marine pelecypods (bivalves). The following mollusks were described as "abundant" in the vicinity of the Crystal River plant: *Bittium varium* (variable bittium), *Anachis semiplicata* (semiplicate doveshell), *Mitrella lunata* (lunar doveshell), *Nassarius vibex* (common eastern nassa), *Brachidontes exustus* (scorched mussel), *Musculus lateralis* (lateral musculus), and *Crassostrea virginica* (Eastern oyster). Other important groups were Polychaetes (six families), Isopods (four species), and Decapods (eight species, including pink shrimp, *Farfantepenaeus duorarum*).

Fisheries

The FES (AEC 1973) for CR-3 lists 64 finfish species and 6 shellfish species commonly found in the Crystal River area that are either commercially/recreationally important or important as "food chain species" (serving as a food source for other, more-important species). The four finfish species collected most often in pre-operational (1969-1970) surveys were silver perch, spot, pigfish, and pinfish. American oyster, blue crab, stone crab, and pink shrimp were the most important shellfish. The FES contains useful information on spawning periods and food habits of important species, including species sought by recreational anglers (e.g., spot, Atlantic croaker, spotted seatrout), forage species (e.g., striped mullet) and species sought by commercial fishermen (e.g., blue crab and pink shrimp).

Extensive studies of adult and juvenile fish were carried out in support of the Crystal River 316 Demonstration (SWEC 1985) and are perhaps the best source of information on the area's fisheries. Fish were collected monthly over the June 1983-May 1984 period using a variety of sampling gear intended to capture fish occupying a range of marine (offshore and inshore) and estuarine (creeks) habitats.

Trawls captured 98 species of fish and 108 species of invertebrates in the general vicinity of the plant (SWEC 1985). Catch varied by season, with highest numbers in the spring and summer (April through August) and lowest numbers in January and February. Although there was considerable variability in the data, some trends were apparent. Lowest densities of fish and invertebrates were observed along the central transect (stations T4, T5, and T6), the transect most affected by the plant's heated discharge. Transects to the north (stations T1, T2, and T3) and south (stations T7, T8, and T9) had similar densities of fish, and were both higher than the central transect. Highest numbers of fish were collected at northern transects in 1983 and southern transects in 1984.

With regard to important species, spot were present year-round and were captured in highest numbers at northern transects (T1, T2, and T3). Pigfish were collected primarily in spring and summer, but were found in greater concentrations at southern transects. Pinfish were collected mostly in spring and summer, but were collected in substantial numbers at both northern and southern transects.

Seine collections in 1983-1984 produced 49 species of fish and 15 invertebrate species (SWEC 1985). Fish captured in significant numbers were usually juveniles of schooling species, such as spot and bay anchovy. Highest densities were generally observed in June and July and lowest densities were normally observed in fall, winter, and spring. Large numbers of spot, clupeids, and anchovies were sometimes captured during these "slow" periods, however, as schools of these small fish moved into nearshore shallows where they were more vulnerable to capture by seiners.

Creek trawls collected 43 species of fish and 27 species of invertebrates. The largest numbers of fish were collected from January through May with the peak in March (SWEC 1985). Juveniles dominated all creek samples. Fish biomass was also highest in the spring, with a secondary peak in November. Invertebrate numbers were highest from November through March. Fish and invertebrate densities were highest at Station TC2, a creek north of the discharge canal. They were lowest at Stations TC1, a creek north of the discharge canal, and TC4, a creek south of the intake canal.

Commercial and Recreational Fishing in the CR-3 Area

The FES (AEC 1973) observed that the shallow waters and numerous oyster bars in the area of the Crystal River site make commercial fishing infeasible. It noted that the marshy shoreline and lack of facilities in the area (marinas and landings) limited sport fishing opportunities to some degree but fishing from small boats in the area appeared to be increasing in popularity (AEC 1973, page 2-53). The FES listed redfish (red drum), spotted seatrout, sheepshead, black drum, jack crevalle, and croaker as species sought by anglers in the plant's intake and discharge canals. The CWA Section 316 Demonstration for Crystal River Units 1, 2, and 3 was concerned exclusively with assessing potential impacts of the plant's cooling water intake structures and thermal discharge. The authors of the report did not survey recreational anglers or fishing guides in the area, focusing instead on data that was verifiable and amenable to statistical analysis.

Essential Fish Habitat in the CR-3 Area

Many marine fish and estuarine fishes that are federally managed by the Gulf of Mexico Fisheries Management Council (GMFMC) and the National Marine Fisheries Service (NMFS) rely on coastal bays and tidal rivers during part of their lives. Crystal Bay has been designated essential fish habitat (EFH), which is defined as those waters and substrate necessary to fish or shellfish for spawning, breeding, feeding, or growth to maturity (GMFMC 1998). Discussion of EFH is in §600.10 of the regulations implementing the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; P.L. 104-297). The GMFMC and NMFS are responsible for designating EFH for each life stage of federally managed marine fish species.

The generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the GMFMC (1998) proscribe EFH for federally managed species, including red drum, reef fish, coastal migratory pelagic species, shrimp, and stone crab. Habitats in Crystal Bay near the Crystal River site include estuarine water column, estuarine mud and sand bottoms (unvegetated estuarine benthic habitats), estuarine shell substrate (oyster reefs and shell substrate), estuarine emergent wetlands, and seagrasses. EFH consists of areas of higher species density, based on the NOAA Atlas and functional relationships analysis (GMFMC 2005, page 14). Crystal Bay is considered EFH for all life stages (egg, larvae, post-larvae, juvenile, and adult) of these species, as described below:

- Red Drum FMP: all estuaries; Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms (GMFMC 2004, page xvi and GMFMC 2005, Figure 2).
- Reef Fish and Coastal Migratory Pelagics FMPs: all estuaries out to depths of 100 fathoms (GMFMC 2004, page xvi and GMFMC 2005 Figures 3 and 4).
- Shrimp FMP: all estuaries; Pensacola Bay, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida, to Naples, Florida, between depths of 10 and 25 fathoms (GMFMC 2004, page xvi and GMFMC 2005 Figure 5).
- Stone Crab FMP: all estuaries; the US/Mexico border to Sanibel, Florida, from estuarine waters out to depths of 10 fathoms; (GMFMC 2004, page xvii and GMFMC 2005, Figure 6).

General categories of EFH in Crystal Bay include estuarine water column, estuarine mud and sand bottoms (unvegetated estuarine benthic habitats), estuarine shell substrate (oyster reefs and shell substrate), estuarine emergent wetlands, and seagrasses. Detailed information on EFH is provided in Final Amendment 3 of the Fishery Management Plans for the Gulf of Mexico (GMFMC 2005).

In addition to providing EFH for the federally managed species listed above, Crystal Bay provides nursery and rearing habitat for other important estuarine species, as well as for non-harvested forage species that support the harvested species.

Because the comprehensive EFH in the Gulf of Mexico encompasses large expanses of habitat, the GMFMC identified Habitat Areas of Particular Concern (HAPC), areas that provide important ecological function, are rare, or are thought to be sensitive to human induced degradation (GMFMC 2005, page 9). HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to HAPC are more carefully scrutinized during the consultation process and are subject to more stringent EFH conservation recommendations (NMFS 2006, page 3). The nearest HAPC to the Crystal River site is the Hard Bottom habitat offshore and to the south of the site (GMFMC 2005, Figure 9).

2.3 GROUNDWATER RESOURCES

Crystal River Unit 3 (CR-3) is part of Progress Energy's Crystal River Energy Complex. The complex is located in west-central Florida on the Gulf Coast between the Withlacoochee River to the north and the Crystal River to the south (Florida Power 2005, Section 2.4). CR-3 is located in the central portion of the CREC property in a former marsh area reclaimed for the plant site. The CREC is located within the Terraced Coastal Lowlands of the Coastal Plain of West Florida. The entire area is one of very low relief (originally 2 to 5 feet above mean sea level).

Tertiary bedrock is located approximately 20 feet beneath the current ground surface which is characterized by surface fill (AEC 1973). The surface fill at the site varies in thickness from three to five feet. Beneath the fill, the natural soil cover consists of recent deposits of thinly laminated organic sandy silts and clays, interspersed with a Pleistocene marine deposit known as the Pamlico Terrace formation. These deposits vary in thickness to approximately four feet. Underlying these deposits is a limey residual soil derived from the Inglis Member of the Moody's Branch formation which is Tertiary in age. The Inglis member varies in thickness from approximately 70 to 90 feet and consists of a biogenic limestone and dolomite. The underlying formation, the Avon Park limestone formation is the oldest (Tertiary) and deepest formation encountered during the initial site exploration. The Inglis member and the Avon Park formation are separated by the Jackson-Claiborne Unconformity. This erosional feature is overlain by a depositional sequence that acts as a confining unit throughout the Floridan aquifer. The Inglis member and the Avon Park formation comprise a part of the Floridan aquifer which supplies most of the groundwater in the state.

In Citrus County, the Floridan aquifer is under water table conditions along the Gulf Coast due to the presence of shallow bedrock. Flow within the Floridan at the site is primarily through solution cavities and along fractures (Florida Power 2005, Section 2.5). The hydraulic gradient in the vicinity of the site slopes 2 feet per mile to the southwest (seaward); groundwater eventually discharges into the Gulf of Mexico (Florida Power 2005, Section 2.4).

The fresh/saltwater interface is approximately 3 miles east of the site, 10 miles from the coast. At this distance from the coast, the depth to the interface is approximately 300 feet. Directly along the coast, the interface is near surface. Chloride concentration in site wells is greater than 250 parts per million (Florida Power 2005, Section 2.5).

Recharge to the groundwater table occurs as a result of 55 inches of annual rainfall, most of which occurs during the summer. (Florida Power 2005, Section 2.5). In the FES (AEC 1973), the AEC estimated that recharge to the water table aquifer was approximately 10,500 million gallons per day. At the plant site, the groundwater table is approximately 10 feet below grade and is influenced by tidal variations (Florida Power 2005, Section 2.5). Numerous springs, lakes, and ponds exist in this section of Florida. The primary uses of these waterbodies are fresh water sport fishing and water supply for livestock. Water for all public supplies in the vicinity of Crystal River, and most of the water used by municipalities and industries in the area are obtained from wells drilled into the Floridan aquifer. There are no groundwater wells other than those of the CREC within several miles of the site (Florida Power 2005, Section 2.4.1).

The CREC maintains seven active production groundwater wells located linearly eastward away from the complex (Johnson 2006). The closest of the production wells is approximately 3 miles east of the complex. These wells provide raw water to two water treatment plants, North and South. At the North water treatment plant, well water is softened, filtered, and chlorinated to produce potable water. At the South water treatment plant, well water is filtered by a microfiltration process and chlorinated to produce potable water. Some portion of the potable water produced at both plants is demineralized for use in boilers and steam generators. The North water treatment plant serves water from the 4 eastern-most wells (PW-1, PW-2, PW-3, and PW-4). Wells PW-1, PW-2, PW-3, and PW-4 are each permitted to remove approximately 459,375 gallons per day (gpd). These wells are installed in the Floridan aquifer to depths 200 feet with a combined pumping limit of one million gallons per day (MGD). CR-3 and Crystal River Units 1 and 2 receive water from the South water treatment plant. This facility is served by the three western-most wells (SPW-3, SPW-4, and SPW-5). Wells SPW-3, SPW-4, and SPW-5 are permitted to withdraw an average of 380,000 gallons per day (gpd), 285,000 gpd, and 285,000 gpd, respectively. Well PW-1A/B provides brackish water for ash processes. Well PW-1A/B operation is contained in the permit with SPW-3, SPW-4 and SPW-5. The combined permit allows for a maximum combined pumping of one MGD. The wells are installed in the Floridan aquifer at depths ranging from 72 to 125 feet. The North and South plant water systems are interconnected and have the ability to interchange both potable water and demineralized water, but not well water prior to treating (Johnson 2006).

There are also 3 additional inactive wells (PW-5, PW-6, and PW-7) currently permitted for emergency use only. The wells are located further to the east than the primary production wells and are intended to be used in the future to support pollution control projects for the fossil plants. When the status of these wells is changed and the wells completed and put into production, the average daily use limits will change to 262,500 gpd. The three inactive wells (completed to depths of 200 feet) have been completed to ground surface but lack well houses and pumps.

For the period from 2001 through 2005, CR-3 used groundwater supplied to the South water treatment plant from wells SPW-3, SPW-4, and SPW-5 at a total rate of 227 gallons per minute (gpm). This value represented 49 percent of the South water treatment plant’s production (461 gpm). The total groundwater production rate used to supply both the North and the South water treatment plants was 1,067 gpm during this same period (Johnson 2006).

2.4 CRITICAL AND IMPORTANT TERRESTRIAL HABITATS

The CREC is located in west-central Florida about midway between the mouths of the Withlacoochee and Crystal rivers and adjacent to the Gulf of Mexico. Terrain in the northwestern portion of Citrus County, in which the CREC is located, rises gradually from mangrove swamp and coastal marshes along the coast to gently rolling hills about 16 miles inland. The area encompassing the CREC is about 2 to 5 feet above mean sea level (AEC 1973). As discussed in Section 2.8, land use near the CREC is a mixture of residential and commercial developments, industry, agriculture (primarily improved pasture and silviculture), and undeveloped land. The southeastern portion of the CR-3 site adjoins the northern portion of the Crystal River Preserve State Park.

The CREC covers approximately 4,738 acres (AEC 1973). Approximately 1,062 acres support the generating facility and associated buildings, maintenance facilities, parking lots, roads, railroads, and transmission corridors associated with the single nuclear unit (Unit 3) and the four fossil-fueled units (Units 1, 2, 4, and 5). The remainder of the site (approximately 3,676 acres) consists of four natural habitat types: salt marsh, hardwood hammock forest, pineland, and freshwater swamp (AEC 1973).

The salt marshes at the CREC are typical of coastal marshes in this part of Florida and are dominated by smooth cordgrass (*Spartina alternifolia*) and black rush (*Juncus roemerianus*). Salt marshes are used by many wildlife species, especially wading birds such as egrets and herons. The flat topography and tidal conditions have resulted in salt marshes typically about ¾ mile wide in the vicinity of the CREC. The salt marshes contain numerous tidal channels (AEC 1973). The intake and outlet canals at the CREC traverse salt marshes (Figure 2-3). Although included here as “terrestrial” habitats, these areas can be thought of as semi-aquatic marine habitats.

Hardwood hammock forests lie immediately inland of the salt marshes in undisturbed areas at the CREC. Most of the CREC facilities occupy terrain that was originally this habitat type (AEC 1973). Hammocks are slightly elevated and drier than the surrounding areas and often have an island-like appearance. Hardwood hammocks are quite variable in plant species makeup, but those at CREC are characterized by magnolia (*Magnolia grandiflora*), laurel oak (*Quercus laurifolia*), and blue-beech, which is also known as American hornbeam (*Carpinus caroliniana*). Hardwood hammocks are used by many different birds, mammals, reptiles, and amphibians (AEC 1973). Numerous hardwood hammocks are scattered throughout the undeveloped portion of the CREC to the south and southeast of the developed area.

Pinelands, also known as pine flatwoods, are found inland of the hardwood hammocks at the CREC. Pinelands at the CREC are dominated by slash pine (*Pinus elliottii*) and loblolly pine (*P. taeda*). Several deciduous tree species also occur in the pinelands, especially where this habitat merges with lower areas (swamps). Sawtooth palmetto (*Serenoa repens*) often forms a dense understory in the pinelands. Fewer wildlife species are found within the pinelands than in the hardwood hammocks, but the pinelands are used by many different birds, mammals, reptiles, and amphibians (AEC 1973).

Wet depressions at the CREC, especially within the pinelands, support habitats characterized as freshwater swamp. These areas are not continuously flooded, and the extent of surface water present depends on recent rainfall and in some areas, the occasional influence of saltwater. Pond cypress (*Taxodium ascenduns*), swamp tupelo, (*Nyssa biflora*) and swamp ash (*Fraxinus pauciflora*) characterize these swamps (AEC 1973).

In 2003, Progress Energy granted permission for the Florida Fish and Wildlife Conservation Commission (FWC) to post signs for the protection of shorebird and sea bird nesting sites at the CREC. The posted areas are on sandbars and spoil islands owned or managed by Progress Energy, and especially in spoil islands along the barge canal leading to the intake canal. Posting of those sites was primarily for the protection of nesting least terns, black skimmers, and American oystercatchers.

Section 3.1.3 describes the routes of the transmission lines that were built to connect CR-3 to the transmission system. The transmission corridors are maintained to keep vegetation heights low enough to prevent interference with the transmission lines in accordance with established procedures described in Section 3.1.3. The principal land use types traversed by the transmission corridors are agriculture and forest. Immediately north of the Citrus-Marion County line, the Central Florida transmission corridor crosses an area identified by the Florida Natural Areas Inventory (FNAI; the non-profit entity that collects and disseminates information on rare species and significant biological communities in Florida) as oak scrub habitat (FNAI 2008a). Scrub habitat is considered by the FNAI to be imperiled in Florida.

The Lake Tarpon transmission corridor crosses the Withlacoochee State Forest in southern Citrus County (see Figure 3-2). The Withlacoochee State Forest is divided into seven tracts of land in four counties, and is managed by the Florida Department of Agriculture and Consumer Services, Division of Forestry (FDACS 2006). Approximately four miles of the Lake Tarpon transmission corridor cross the Citrus tract, and an additional two miles of the transmission corridor are adjacent to the Citrus tract. The Central Florida transmission corridor crosses a two-mile-long segment of the Two Mile Prairie tract of the Withlacoochee State Forest.

Approximately three miles of the Lake Tarpon transmission corridor skirt the edge of the Chassahowitzka Wildlife Management Area, managed by FWC, in northern Hernando County.

Approximately eight miles of the Lake Tarpon transmission corridor cross the Starkey Wilderness Preserve in southwestern Pasco County. The Starkey Wilderness Preserve is comprised of three tracts, two of which (the Serenova Tract and the J.B. Starkey Wilderness Park) are crossed by the transmission corridor. The Serenova Tract is managed by the Southwest Florida Water Management District and the J.B. Starkey Wilderness Park is managed by Pasco County (SWFWMD 2006). The Starkey Wilderness Preserve is one of the largest undeveloped tracts in Pasco County, and consists of pine flatwoods, cypress domes, freshwater marshes, stream and lake swamps, sandhill and scrub communities. Approximately 6,000 acres of the 18,000 acre preserve are wetlands (SWFWMD 2006).

The Lake Tarpon transmission corridor crosses the eastern portion of the Brooker Creek Preserve for approximately 4.5 miles in northeastern Pinellas County. The Brooker Creek Preserve is a wilderness area surrounded on all sides by urban development, and is managed by the Pinellas County Department of Environmental Management. The preserve is comprised mostly of pinelands and freshwater swamps (FBCP 2006).

The northernmost portion of the Central Florida transmission corridor skirts the edges of the Halpata Tastanaki Preserve, managed by the Southwest Florida Water Management District, and the Ross Prairie State Forest, managed by the Florida Department of Agriculture and Consumer Services, Division of Forestry.

The Central Florida and Lake Tarpon transmission lines are contained with a common corridor for the first 5.3 miles east of CR-3. A 1.5 mile portion of the southern edge of the common corridor is adjacent to the northern boundary of the Crystal River Preserve State Park, managed by the Florida Department of Environmental Protection, Division of Recreation and Parks.

With the exception of the above-mentioned areas, the CR-3-associated transmission lines do not cross any other state or federal wildlife refuges, wildlife management areas, parks, or preserves.

Crystal River and its headwaters, known as King’s Bay, have been designated as Critical Habitat for the Florida Manatee (50 CFR 17.95). The Crystal River Critical Habitat is adjacent to the southern boundary of the CREC. No other areas designated by the U.S. Fish and Wildlife Service as “Critical Habitat” for endangered species occurs at CR-3 or adjacent to CR-3-associated transmission lines.

2.5 THREATENED OR ENDANGERED SPECIES

Table 2-1 indicates protected animal and plant species that are known to occur in counties within which CR-3 and associated transmission lines are located. These consist of species that are state-or federally-listed as endangered or threatened, species proposed for federal listing, and candidates for federal listing. The Central Florida transmission line crosses portions of Citrus, Marion, and Sumter counties, and the Lake Tarpon transmission line crosses portions of Citrus, Hernando, Pasco, and Pinellas counties (see Figure 3-2). Special-status species shown in Table 2-1 as occurring in these counties were taken from county records maintained by the U.S. Fish and Wildlife Service (USFWS 2007a) and FNAI (2008b). Specific recorded locations of federally-listed and state-listed species in the vicinity of the transmission corridors were provided by FNAI (2008a, c).

As shown in Table 2-1, numerous special-status animal and plant species have been recorded in one or more of the six counties crossed by the transmission lines. Species in Table 2-1 that are federally-listed as endangered or threatened and those that are proposed for federal listing or candidates for federal listing are discussed below. The wood stork, alligator, manatee, and four sea turtle species (Kemp's Ridley, green, loggerhead, and hawksbill) are the only federally-listed species known to occur in the vicinity of CR-3. Progress Energy has written the USFWS, NMFS, and the FWC requesting information on listed species and sensitive habitats in the area of CR-3 or along CR-3-associated transmission lines (see Appendix C).

2.5.1 FISH

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is a large (to 8 feet in length) anadromous fish that inhabits Gulf Coast rivers from Louisiana to Florida (USGS 2006). A sub-species of the Atlantic sturgeon, the Gulf sturgeon was listed by the USFWS and NMFS as threatened in 1991 (USGS 2006). Adult and sub-adult sturgeon ascend Gulf Coast rivers in early spring to spawn, when water temperatures range from 61-75°F, remain in these rivers for 8 or 9 months, and then move back to the Gulf in September or October, when water temperatures return to the 70s (GSRT 1995, pp. 14-15). Sturgeon, which normally feed on small benthic invertebrates, do not feed during spawning runs. Gulf sturgeon reach sexual maturity between the ages of 8 and 12 years, and can live as long as 25 years (USGS 2006).

The status of the Gulf sturgeon, including several Florida populations, was reviewed in The Gulf Sturgeon Recovery/Management Plan (GSRT 1995). The Plan noted that the Suwannee River (approximately 35 miles northwest of CR-3) supported the most significant population in Florida, and estimated this population at from 2,250 to 3,300 individuals. Large numbers of Gulf sturgeon were caught by commercial fishermen in Tampa Bay in the late 1880s, but this population was virtually eliminated by overfishing (GSRT 1995, p. 12). Although individual sturgeon were occasionally caught in the Tampa Bay area by commercial fishermen in the 1980s and 1990s (GSRT 1995) or in more recent years found dead on area beaches (Minai 2002), this population is no longer considered self-sustaining. These fish were probably strays from the Suwannee River area.

Critical Habitat for the Gulf sturgeon was designated in 2003 (Federal Register Volume 68, No. 53, March 19, 2003, pp. 13370-13495), and includes riverine and estuarine/coastal areas of Alabama and Florida. The riverine Critical Habitat closest to CR-3 is the East Pass of the Suwannee River, which is approximately 33 miles northwest of the Crystal River site (68 FR 53, Map 7.2). The nearest estuarine/coastal Critical Habitat is Suwannee Sound, the southern boundary of which is approximately 30 miles from the site (68 FR 53, page 13495).

Progress Energy is not aware of any Gulf sturgeon occurrences at CR-3.

2.5.2 AMPHIBIANS

Flatwoods Salamander

The flatwoods salamander (*Amystoma cingulatum*) is listed as threatened by USFWS and has been designated a Species of Special Concern by the FWC. It is locally distributed in the Florida panhandle and northern Florida, formerly south to Marion County. This small to medium-sized salamander is an inhabitant of pine flatwood communities with wiregrass groundcover and scattered wetlands. Population declines are due to habitat loss and increased mortality due to presence of more roads (FNAI 2001). With the exception of the northern (Marion County) portion of the Central Florida transmission corridor, the CR-3 site and associated transmission corridors are south of the geographic range of this species.

2.5.3 MAMMALS

West Indian (Florida) Manatee

Adult Florida manatees (*Trichechus manatus latirostris*) average about 10 feet in length and 2,200 pounds in weight. The manatee is an aquatic mammal that feeds primarily on seagrass and other aquatic vegetation. The Florida manatee population is divided into four sub-populations, with those in northwest Florida (including Crystal River) making up approximately 12 percent of the total population (USFWS 2001). The northwest population is thought to be increasing. The manatee is federally- and state-listed as endangered and is protected not only by the Endangered Species Act, but also by the Marine Mammal Protection Act and the Florida Manatee Sanctuary Act. In addition, Citrus County has a federally- and state-approved manatee protection plan as guidance for coastal development (CCCD 2006).

Crystal River is the northernmost natural, warm-water refuge used by manatees on the west coast of Florida (USFWS 2001). Manatees require water temperatures greater than 68°F, therefore they tend to inhabit springs and power plant discharge areas during the winter months. Manatee sightings in the Crystal River discharge canal are typically during fall and winter. A major threat to manatees is collisions with watercraft (USFWS

2001). Restricted recreational boat access to the Crystal River intake and discharge canal for safety concerns enhances this area for manatee survival by reducing the chance of boat/manatee collisions (CCCD 2006). Another threat to manatees is the loss of reliable warm water refugia during the winter months (USFWS 2001).

Since manatees are sometimes found in the discharge canal at the CREC, Progress Energy has established a Manatee Protection Plan that has been approved by the Florida Department of Environmental Protection (FDEP 2002). The plan establishes various precautions to minimize hazards to manatees at intake and outfall areas, such as having observers on board vessels associated with in-water work, operating vessels at “no wake/idle” speeds while in the warm water refuge area, and avoiding major in-water work in the discharge canal from November 15 through March 31 unless approved by FWC’s Bureau of Protected Species Management. Progress Energy cooperates with USFWS, FWC, Florida Marine Research Institute, and the U.S. Geological Survey in providing access to the CREC for manatee research and monitoring by these agencies.

Florida panther

The Florida panther (*Puma concolor coryi*) is one of the rarest mammals in the world (USFWS 1999) and thus is federally- and state-listed listed as endangered. Adults weigh 70 to 150 pounds and require extensive blocks of forests and wetlands as habitat. While its historical range included the states of Alabama, Arkansas, Florida, Georgia, Mississippi, and South Carolina, the only known reproducing panther population is currently found in the Big Cypress Swamp and Everglades region of southern Florida. The core of the breeding population is located in Collier, Hendry and Miami-Dade counties, but radio-collared panthers have also been reported in Broward, DeSoto, Glades, Highlands, Lee, Monroe, Osceola, Palm Beach and Polk counties in south and central Florida (USFWS 1999). The CR-3 associated transmission lines are not located in any of these counties. However, the FNAI (2008b) database includes recorded occurrences of the Florida panther in Marion and Citrus counties, which are crossed by CR-3 associated transmission lines.

2.5.4 BIRDS

Florida Scrub-jay

The Florida scrub-jay (*Aphelocoma coerulescens*) is listed as threatened by USFWS and FWC. Florida scrub-jays typically inhabit fire-dominated, oak-scrub habitat and require bare sand patches to forage and to cache acorns. Their diet consists largely of insects and acorns. They are cooperative breeders, with large extended families using fledgling scrub-jays as “helpers” to raise the next brood. The Florida scrub-jay’s current breeding range is from Citrus and Marion counties southward (FNAI 2001, USFWS 2006). Habitat for this species does not occur at the CREC.

The Central Florida and Lake Tarpon transmission corridors traverse areas of scrub habitat that might harbor Florida scrub jays. As mentioned in Section 2.4, the Central

Florida transmission corridor crosses oak-scrub habitat in Marion County slightly north-of the Citrus-Marion County line. Two Florida scrub-jays were observed in this vicinity in 1981 (see Map 4 of 7, FNAI 2008a). The FNAI (2008) database does not contain any Florida scrub-jay occurrence records at this location post-1981, and does not contain any occurrence records of Florida scrub-jays along the Lake Tarpon or Central Florida transmission corridors at other locations. Florida scrub-jays were recorded by the USFWS (Pranty et al. undated) at several locations in or near the two CR-3 associated transmission corridors during 1992-1996. Progress Energy has written the USFWS and FWC requesting information on listed species and sensitive habitats along CR-3 associated transmission lines.

Piping Plover

The piping plover (*Charadrius melodus*) is listed as threatened by USFWS and FWC. Most piping plovers breed in the Great Plains region. Piping plovers are uncommon winter residents of Florida's Gulf Coast. Winter habitat in Florida is open, sandy beaches and tidal mudflats (FNAI 2001). Piping plovers would not occur on the transmission corridors due to the absence of appropriate winter habitat. There are no sandy beaches at the CR-3 site, but tidal mudflats do occur along the western edge of the site. Piping plovers have not been observed on the CREC.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is listed by the state of Florida as threatened. The USFWS removed the bald eagle from the federal list of threatened and endangered species effective August 8, 2007 (72 Federal Register 130, pp 37346-37372). At the federal level, the bald eagle is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (72 Federal Register 130, pp 37346-37372). Bald eagles nest throughout the United States and occur in a wide variety of habitats, but proximity of their nests to water (as foraging habitat) is important (Stalmaster 1987). Preferred nesting habitat includes a high amount of water-to-land edge where their aquatic prey is concentrated. Thus, bald eagles are generally restricted to coastal areas, lakes, and rivers. They prey on fish and other aquatic prey near the surface but will eat dead fish or other carrion, as well as birds, mammals, and occasionally reptiles. Some bald eagles in the southern United States migrate northward in mid-summer (after the nesting season) and return in early autumn, but some bald eagles in Florida are non-migratory (Stalmaster 1987).

Florida has the largest breeding population of bald eagles of any state other than Alaska (FNAI 2001). Bald eagles breed throughout most of peninsular Florida and the Keys. One bald eagle nest (nest ID CI013) has been documented on the CREC and another nest (nest ID CI004) has been confirmed slightly north of the CREC (FWC 2008). The on-site nest is in the southeast corner of the CREC, approximately 1.9 miles from Unit 3. The off-site nest is approximately 1.2 miles northwest of Unit 3. Both nests were active during all years from 2003-2007 (period of monitoring provided on FWC [2008] website). Bald eagles are occasionally observed flying and foraging along Crystal Bay and perching in trees at the CREC.

The FWC maintains a state-wide eagle nest database with locations (accurate to 0.1 mile) of bald eagle nests (FWC 2008). The FWC database indicates 202 active bald eagle nests (over the 2003-2007 period) in the counties containing CR-3 and its associated transmission lines and Levy County (slightly north of CR-3 and adjacent to Citrus County). The closest nest was within 0.1 mile of the Lake Tarpon transmission line in Pinellas County (nest ID PI030) and the next closest was within 0.6 mile of the Central Florida transmission line in Sumter County (nest ID SU030) (FWC 2008).

Wood Stork

The wood stork (*Mycteria americana*) is listed as endangered by USFWS and FWC. Wood stork habitats include cypress/gum ponds, river swamps, marshes (freshwater and saltwater), and bays. The wood stork is highly gregarious in its nesting and feeding behavior. They are tactile feeders (vision seldom used to locate or catch prey) and usually forage in shallow water (6 to 20 inches). Small fish are the primary food items, but storks also consume crustaceans, salamanders, tadpoles, and insects. The distance between nesting colonies and feeding areas can range up to 60 miles or more, although the average distance is typically 12 to 15 km (7 to 9 miles) (Ogden 1996; USFWS 1997). FWC considers the “core foraging area” of wood storks to be that area within 30 km (18.6 miles) of the colony (Cox et al. 1994).

There are no known stork rookeries on the CREC. It is unlikely that any rookeries exist on the site, since the gregarious behavior of this species would result in numerous sightings. Wood storks are occasionally seen foraging in the percolation ponds at the CREC and they probably forage, at least occasionally, in nearby salt marshes and in suitable wetlands in or near the transmission corridors.

Red-cockaded Woodpecker

The red-cockaded woodpecker (*Picoides borealis*) is listed as endangered by USFWS and has been designated a species of special concern by the state of Florida. The red-cockaded woodpecker is a cooperative breeder that lives in social units known as clans (Hooper et al. 1980). The species is unique among North American woodpeckers because it excavates cavities in living pines. Cavity excavation usually requires from one to several years. Active clusters of cavities occur in open, mature pine stands with sparse midstory vegetation. When the hardwood midstory grows above 15 feet, cavity abandonment usually occurs. Cavities are rarely found in trees as young as 30 to 40 years old, and most cavity trees are at least 80 years old. Ideal foraging habitat consists of pine stands with trees > 9 inches diameter at breast height (dbh). They also forage in pine stands of 4 to 9 inches dbh, and sometimes in pines scattered through hardwood stands. Food consists primarily of arthropods (Hooper et al. 1980).

The red-cockaded woodpecker has been recorded in Citrus, Hernando, Marion, Pasco, Pinellas, and Sumter counties (FNAI 2008b, USFWS 2007a). Preferred habitat for this species does not occur at the CREC. The probability of this species being found at the CREC or along the CR-3-associated transmission corridors is very low, due to the absence of suitable habitat.

Everglade Snail Kite

The Everglade snail kite (*Rostrhamus sociabilis plumbeus*) is listed as endangered by USFWS and FWC. It is a medium-sized raptor that formerly inhabited all of peninsular Florida, but now resides primarily in aquatic habitats in southern Florida. Preferred habitat for the snail kite is large open-water freshwater marshes and shallow lakes with a low density of emergent vegetation. It feeds exclusively on apple snails (*Pomacea paludosa*) caught at the water's surface (FNAI 2001). Critical Habitat for the snail kite is limited to Broward, Dade, Glades and Palm Beach counties in extreme southeastern Florida (Federal Register Vol. 42, No. 155, page 40685, August 11, 1977). The USFWS (2007a) database includes occurrences in Citrus, Marion, and Sumter Counties (which are crossed by CR-3 transmission lines), and the FNAI (2008b) database includes an occurrence in Marion County, but as mentioned above, most occurrences are in southern Florida. Preferred habitat for snail kites is not found at the CREC, and Progress Energy is not aware of sightings along CR-3-associated transmission lines. In addition, an FNAI database search showed no recorded occurrences of this species near the transmission lines (FNAI 2008a, c).

2.5.5 REPTILES

Sea Turtles

Sea turtles are sometimes seen in the Crystal River plant's intake canal and are occasionally found on the Unit 3 intake bar racks. From 1994 to 1997, eight sea turtles were stranded on the Unit 3 intake bar racks. However, monitoring for sea turtles prior to 1997 was non-systematic, and data on species, size, and age was not always obtained.

In the Spring of 1998, an unusually high number of Kemp's ridley sea turtles (approximately 50) were stranded on the bar racks. As a result, a Biological Opinion was issued by the National Marine Fisheries Service in 1999; the Biological Opinion determined that the cooling water intake system was not likely to jeopardize the existence of the five sea turtle species that might be found in the area. A second Biological Opinion, issued by the National Marine Fisheries Service in 2002, stated that continued operation of CR-3 would not jeopardize any of the listed sea turtle species populations, and included an Incidental Take Statement allowing the live take of 75 sea turtles annually and three annual lethal takes that are causally related to plant operations (NMFS 2002). There is no limit on non-causally related dead turtles, although there is a reporting requirement if the non-causal take reaches eight individuals (NMFS 2002).

In 1998, a continuous monitoring and rescue program was initiated by Florida Power Corporation to reduce potential sea turtle strandings and mortalities at CR-3. Progress Energy implemented Sea Turtle Rescue and Handling Guidance, which provides instructions for sea turtle observation, rescue, handling, notifications, and reporting requirements (Progress Energy undated). As per the guidelines, the bar racks are continuously inspected during times of high turtle concentrations in the intake canal.

Monitoring of the bar racks is reduced to once every two hours during periods of low concentration.

Five species of sea turtles have been recorded in nearshore waters of Citrus County (Table 2-1) and are discussed below. Four of these sea turtle species have been observed at or near the CREC: Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*), and hawksbill (*Eretmochelys imbricata*).

The Kemp's ridley is federally- and state-listed as endangered. It is the most seriously endangered of the sea turtles, with nesting primarily limited to two provinces in Mexico. It does not nest in Florida. This species is associated with a wide range of coastal benthic habitats, typically with sand or mud bottoms supporting crustaceans and/or other invertebrates. They primarily feed on portunid crabs (*Callinectes* spp.), but other crabs, mollusks and invertebrates are consumed as well. Nearshore waters of the northern Gulf of Mexico provide important developmental habitat for juvenile and subadult Kemp's ridley sea turtles (USFWS 2006). The most frequently captured and rescued sea turtles in the CR-3 cooling water intake areas are subadult Kemp's ridleys, which reflects their abundance within the nearshore waters of northern Gulf Coast.

The green sea turtle is federally- and state-listed as endangered. Most green turtle nesting in Florida occurs during June through September. They require open gradually sloping beaches and minimum disturbance for nesting. Critical Habitats have been defined for this species, but do not include areas in Florida. Green sea turtles are herbivores, preferring to feed on marine grasses and algae in shallow bays and lagoons (USFWS 2006).

The loggerhead sea turtle is federally- and state-listed as threatened. In the United States, loggerheads nest from Texas to Virginia with approximately 80 percent of the nesting occurring in southern Florida coastal counties. They nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. No Critical Habitat has been defined for this species. The nearshore waters of the Gulf of Mexico are thought to provide important developmental areas for juvenile loggerheads (USFWS 2006).

The hawksbill sea turtle is federally- and state-listed as endangered. In contrast to other sea turtles, hawksbills tend to nest in low densities on scattered small beaches. Nesting may occur on almost any undisturbed deep-sand beach, typically from April through November. Critical Habitats have been defined for this species, but do not include areas in Florida. Hawksbills prefer coral reefs and thus are uncommon in western Gulf waters (USFWS 2006).

The leatherback sea turtle is federally- and state-listed as endangered. The largest and most pelagic of the sea turtles, its decline was a result of a crash of the breeding population in western Mexico due to harvest for meat and eggs. Small numbers nest in along the east coast of Florida, but none on the western Florida coast. Critical Habitats have been defined for this species, but do not include areas in Florida. They feed primarily on jellyfish and thus may come into shallow waters if there is an abundance of jellyfish nearshore (USFWS 2006). Although leatherbacks have been observed in Citrus County waters, none have been observed at the CREC.

American Alligator

The American alligator (*Alligator mississippiensis*) is common throughout Florida. The alligator is federally listed as “threatened due to similarity in appearance” to the endangered American crocodile (*Crocodylus acutus*), and has been designated a species of special concern by the state of Florida. Alligator habitat consists of swamps, marshes, ponds, lakes, and slow-moving streams and rivers. Alligators are opportunistic feeders and eat fish, turtles, birds, snakes, frogs, insects, and small mammals (Mount 1975). Alligators are occasionally seen in swampy areas at CREC and undoubtedly occur in wetlands, ponds, and streams along the transmission corridors.

Eastern Indigo Snake

The Eastern indigo snake (*Drymarchon corais couperi*) is listed as threatened by USFWS and FWC. It typically inhabits dry areas that are bordered by water. Prey includes fish, frogs, toads, lizards, snakes, small turtles, birds, and small mammals. Indigo snakes are diurnal and wide ranging, typically using areas of 125-250 acres or more (Moler 1992). Eastern indigo snakes were documented during 1970 to 1982 in the Withlacoochee State Forest in the general vicinity of the Lake Tarpon transmission corridor (FNAI 2008c). Progress Energy is not aware of recorded occurrences of indigo snakes at CREC but the species could occur at CR-3 or along the CR-3-associated transmission corridors.

Sand Skink

The sand skink (*Neoseps reynoldsi*) is a short (4-5 inch adult length), nearly legless lizard that is federally- and state-listed as threatened. It requires loose sand with large patches of sparse groundcover; its habitats include sand pine scrub, oak scrub, scrubby flatwoods, and turkey oak ridges. Sand skinks occur along the Central Ridge of Florida, and are found in low numbers on Mount Dora Ridge in Marion and Lake counties (FNAI 2001). The Central Florida transmission line traverses a small portion of Marion County west of the Central Ridge. Because CR-3 and associated transmission lines are outside the known geographic range of this species, its occurrence on either is unlikely.

Gopher Tortoise

The gopher tortoise (*Gopherus polyphemus*) is not federally listed in Florida, but it is listed as threatened by FWC, which has produced guidelines for the protection of the gopher tortoise. Gopher tortoises inhabit sandy, well drained areas where adequate vegetation for foraging exists. Principal foods include grasses, legumes, sedges, and fruit. Gopher tortoises excavate burrows that are also used by numerous other species (FNAI 2001). Gopher tortoises do not occur at the CREC but are found at several locations on the two associated transmission line corridors. During transmission corridor maintenance, Progress Energy policy is to avoid using heavy equipment such as tractors within 25 feet of gopher tortoise burrows; instead hand cutting is used to avoid damaging the burrows.

2.5.6 PLANTS

Florida Bonamia

Florida bonamia (*Bonamia grandiflora*) is federally-listed as threatened and state-listed as endangered. Primary threats include agricultural and residential development. This plant is a perennial vine with prostrate stems about three feet long. It is found in open sandy areas of sand pine (*Pinus clausa*) scrub vegetation, primarily in the Ocala National Forest in Marion County (USFWS 2006), which is 14 miles northeast of the Central Florida transmission corridor. Habitat for Florida bonamia does not exist at CREC, and Progress Energy is not aware of any recorded occurrences of Florida bonamia along CR-3-associated transmission lines. As noted earlier in this section, Progress Energy has written the USFWS and the FWC requesting information on listed species and sensitive habitats along CR-3-associated transmission lines.

Brooksville Bellflower

This plant is federally- and state-listed as endangered. Brooksville bellflower (*Campanula robinsiae*) is an annual herb found only on the Brooksville Ridge in north-central Hernando County. The Lake Tarpon transmission line crosses Hernando County. There are only two known populations of this species, which occurs in wet prairies and edges of ponds near pasture. Threats include loss of wetlands or alteration of hydrology such as increased runoff due to development (USFWS 2006).

Florida Golden Aster

The Florida golden aster (*Chrysopsis floridana floridana*) is federally- and state-listed as endangered. It is a perennial herb that occurs in substrates of excessively-drained sand in relatively open scrub vegetation. Historically, it also grew on beach dunes. It is currently known from four Florida counties (Hardee, Hillsborough, Manatee and Pinellas) (USFWS 2006), one of which (Pinellas) is crossed by the Lake Tarpon transmission line. The primary threat to this species is loss of habitat due to residential and industrial development (USFWS 2006).

Longspurred Mint

Longspurred mint (*Dicerandra cornutissima*) is federally- and state-listed as endangered. It is a short-lived perennial growing to approximately 18-inches tall, and is found only in open areas of sand pine scrub or oak scrub and in ecotones between these and turkey oak communities. The 15 known populations for this species are in Marion and Sumter counties (USFWS 2006), which are crossed by the Central Florida transmission line. The FNAI (2008a) database indicates the occurrence of this species (recorded in 1988) in the vicinity of the Central Florida transmission line approximately 0.5 mile south of the Marion-Sumter County line.

Scrub Buckwheat

Scrub buckwheat (*Eriogonum longifolium gnaphalifolium*) is federally-listed as threatened and state-listed as endangered. It is a perennial herb with a three foot flowering stem. It occurs in habitats intermediate between scrub and sandhills (high pines) and in turkey oak barrens. It is threatened by habitat loss to agriculture and residential development (USFWS 2006). It is known from seven counties in Florida (FNAI 2008b), two of which (Marion and Sumter) are crossed by the Central Florida transmission line.

Cooley's Water Willow

Cooley's water willow (*Justicia cooleyi*) is federally- and state-listed as endangered. It is a perennial herb and is found only in central Florida, typically in upland hardwood forests. The primary threat to this species is loss of habitat due to agriculture and development (USFWS 2006b). It has been recorded in Hernando County, which is crossed by the Lake Tarpon transmission line, and Sumter County, which is crossed by the Central Florida transmission line (FNAI 2008b).

Britton's Beargrass

Britton's beargrass (*Nolina brittoniana*) is federally- and state-listed as endangered. It is a clump-forming perennial with leaves 3 to 6 feet long and a flowering stem 6 feet high. This species occurs on xeric soils in scrub and high pines, and occasionally in hammocks and sandhills (USFWS 2006b). It has been recorded in Marion County, which is crossed by the Central Florida transmission line, and in Hernando and Pasco counties, which are crossed by the Lake Tarpon transmission line.

Lewton's Milkwort

Lewton's milkwort (*Polygala lewtonii*), also know as Lewton's polygala, is federally- and state-listed as endangered. It is a small perennial herb endemic to the Central Florida Ridge in Marion County. Habitats include sandy openings in oak scub, sandhills, and transition zones between high pine and turkey oaks (FNAI 2001). The Central Florida transmission line traverses a portion of Marion County west of the Central Ridge. Because CR-3-associated transmission lines are outside the geographic range of this species, its occurrence along the transmission corridors is unlikely.

2.6 DEMOGRAPHY

2.6.1 REGIONAL DEMOGRAPHY

The Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) presents a population characterization method that is based on two factors: “sparseness” and “proximity” (NRC 1996). “Sparseness” measures population density and city size within 20 miles of a site and categorizes the demographic information as follows:

Demographic Categories Based on Sparseness

		Category
Most sparse	1.	Less than 40 persons per square mile and no community with 25,000 or more persons within 20 miles
	2.	40 to 60 persons per square mile and no community with 25,000 or more persons within 20 miles
	3.	60 to 120 persons per square mile or less than 60 persons per square mile with at least one community with 25,000 or more persons within 20 miles
Least sparse	4.	Greater than or equal to 120 persons per square mile within 20 miles

Source: NRC 1996.

“Proximity” measures population density and city size within 50 miles and categorizes the demographic information as follows:

Demographic Categories Based on Proximity

		Category
Not in close proximity	1.	No city with 100,000 or more persons and less than 50 persons per square mile within 50 miles
	2.	No city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles
	3.	One or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 miles
In close proximity	4.	Greater than or equal to 190 persons per square mile within 50 miles

Source: NRC 1996.

The GEIS then uses the following matrix to rank the population category as low, medium, or high.

GEIS Sparseness and Proximity Matrix

Proximity

Sparseness		1	2	3	4
	1	1.1	1.2	1.3	1.4
	2	2.1	2.2	2.3	2.4
	3	3.1	3.2	3.3	3.4
	4	4.1	4.2	4.3	4.4

Low Population Area — Medium Population Area — High Population Area

Source: NRC 1996, pg. C-159.

Progress Energy used 2000 census data from the U.S. Census Bureau (TtNUS 2006) with geographic information system software (ArcGIS®) to determine most demographic characteristics in the CR-3 vicinity. The calculations (TtNUS 2006) determined that 89,491 people live within 20 miles of CR-3, producing a population density of 125 persons per square mile. Applying the GEIS sparseness criteria, the 20-mile population falls into the least sparse category, Category 4 (greater than or equal to 120 persons per square mile within 20 miles).

To calculate the proximity measure, Progress Energy determined that 825,847 people live within 50 miles of CR-3, which equates to a population density of 170 persons per square mile (TtNUS 2006). Applying the GEIS proximity measures, CR-3 is classified as Category 2 (no city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles). Therefore, according to the GEIS sparseness and proximity matrix, CR-3 with a sparseness rank of 4 and a proximity rank of 2 (a score of 4.2) is located in a medium population area.

The nearest major metropolitan area is Tampa, Florida (70 miles south), with a 2000 population of 303,447 (USCB 2000a). The population distribution within a 50-mile radius of CR-3 is generally considered rural, with the exception of those areas closer to the Tampa-St. Petersburg-Clearwater MSA. The municipality nearest the CR-3 is the City of Crystal River (8 miles southeast) with a 2000 population of 3,485 (USCB 2000a).

All or parts of 10 counties, Crystal River, Inverness (the County seat), and sections of two Metropolitan Statistical Areas (MSAs) and two Micropolitan Statistical Areas are located within 50 miles of the CR-3 (Figure 2-1). The MSAs are (1) Tampa-St. Petersburg-Clearwater, Florida, and (2) Ocala, FL, and the Micropolitan Statistical Areas are (1) Homosassa Springs, Florida, and (2) The Villages, Florida (USCB 2003).

From 1990 to 2000, the population of the Tampa-St. Petersburg-Clearwater, Florida MSA increased from 2,067,959 to 2,395,997, an increase of 15.9 percent. The population of the Ocala, Florida MSA increased from 194,833 to 258,916, an increase of 32.9 percent. The population of the Homosassa Springs, Florida Micropolitan Statistical Area increased from 93,515 to 118,085, an increase of 26.3 percent. And, the population of the Villages Micropolitan Statistical Area increased from 31,577 to 53,345, an increase of 68.9 percent (USCB 2003).

Because approximately 83 percent of employees at CR-3 reside in Citrus County, it is the county with the greatest potential to be socioeconomically affected by license renewal at CR-3 (see Section 3.4). Table 2-2 shows population estimates and decennial growth rates for Citrus County. Values for the State of Florida are provided for comparison. The table is based on data from the Florida Legislature's Office of Economic and Demographic Research.

From 1980 to 1990, both the State of Florida and Citrus County had positive population growth rates; however, Citrus County outpaced the state of Florida by nearly 40 percent. From 1990 to 2000, Citrus County's population growth (26.3 percent) was slightly higher than that of the State of Florida (23.5 percent).

Each year, Citrus County is host to a seasonal population that, in the 1990s, was estimated to be between 9,000 and 11,000. In 2000, the estimate was approximately 14,500. The County projects that the seasonal population will grow to 15,000 to 18,000 over the next 25 years (Citrus County 2006).

2.6.2 MINORITY AND LOW-INCOME POPULATIONS

NRC performed environmental justice analyses for previous license renewal applications and concluded that a 50-mile radius could reasonably be expected to contain potential environmental impact sites and that the state was appropriate as the geographic area for comparative analysis. Progress Energy has adopted this approach for identifying the CR-3 minority and low-income populations that could be affected by CR-3 operations.

Progress Energy used ArcGIS® geographic information system software to determine the minority characteristics by block group. Progress Energy included all block groups if any part of their area lay within 50 miles of CR-3. The 50-mile radius includes 483 block groups (Table 2-3).

2.6.2.1 Minority Populations

The NRC Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues defines a "minority" population as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black Races, and Hispanic Ethnicity (NRC 2004). Additionally, NRC's guidance requires that (1) all other single minorities are to be treated as one population and analyzed, (2) multi-racial populations are to be analyzed, and (3) the aggregate of all minority populations are to be treated as one population and analyzed. The guidance indicates that a minority population exists if either of the following two conditions exists:

1. The minority population in the census block group or environmental impact site exceeds 50 percent.

2. The minority population percentage of the environmental impact area is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area chosen for comparative analysis.

For each of the 483 block groups within the 50-mile radius, Progress Energy calculated the percent of the block group's population represented by each minority. If any block group minority percentage exceeded 50 percent, then the block group was identified as containing a minority population. Progress Energy selected the entire state of Florida as the geographic area for comparative analysis, and calculated the percentages of each minority category in the state. If any block group percentage exceeded the corresponding state percentage by more than 20 percent, then a minority population was determined to exist (TtNUS 2006).

Census data for Florida (TtNUS 2006) characterizes 0.3 percent of the population as American Indian or Alaskan Native; 1.7 percent Asian; 0.1 percent Native Hawaiian or other Pacific Islander; 14.6 percent Black races; 3.0 percent all other single minorities; 2.4 percent multi-racial; 22.0 percent aggregate of minority races; and 16.8 percent Hispanic ethnicity.

Table 2-3 presents the numbers of block groups in each county in the 50-mile radius that exceed the threshold for minority populations. Figures 2-4 through 2-7 locate the minority block groups within the 50-mile radius.

Thirty-two census block groups within the 50-mile radius have Black races minority populations that exceed the state average by 20 percent or more. Of those 32 block groups, 20 have Black races minority populations of 50 percent or more.

One census block group within the 50-mile radius has All Other Single Minority populations that exceed the state average by 20 percent or more. It is located in Pasco County.

Thirty-one census block groups within the 50-mile radius have Aggregate Minority populations that exceed the state average by 20 percent or more. Of those 31 block groups, 22 have Aggregate Minority populations of 50 percent or more.

Three census block groups within the 50-mile radius have Hispanic Ethnicity populations that exceed the state average by 20 percent or more. Of those three block groups, two have Hispanic Ethnicity populations of 50 percent or more. They are also located in Pasco County.

2.6.2.2 Low-Income Populations

NRC guidance defines low-income population based on statistical poverty thresholds (NRC 2004) if either of the following two conditions are met:

1. The low-income population in the census block group or the environmental impact site exceeds 50 percent.

2. The percentage of households below the poverty level in an environmental impact area is significantly greater (typically at least 20 percentage points) than the low-income population percentage in the geographic area chosen for comparative analysis.

Progress Energy divided USCB low-income households in each census block group by the total households for that block group to obtain the percentage of low-income households per block group. Using the state of Florida as the geographical area chosen for comparative analysis, Progress Energy determined that 11.7 percent of Florida as low-income households (TtNUS 2006). Table 2-3 identifies the low-income block groups in the region of interest, based on NRC's two criteria. Figure 2-8 locates the low-income block groups.

Sixteen census block groups within the 50-mile radius have low-income households that exceed the state average by 20 percent or more. Of those 16 block groups, three have 50 percent or more low-income households.

2.7 TAXES

The owners of CR-3 pay annual property taxes to only one local government or municipality, Citrus County, so the focus of this analysis will be on Citrus County.

From 2005 through 2007, Citrus County collected between $157.8 and $194.1 million annually in property tax revenues (see Table 2-4). Each year, Citrus County collects these taxes, and disburses them to, among others, the Board of County Commissioners, the Citrus County School District, the Southwest Florida Water Management District, the Citrus County Hospital Board, the Homosassa Special Water District, mosquito control, and the county's municipalities to fund their respective operating budgets (Waldemar 2006). For the years 2005 through 2007, CR-3's property taxes have represented 4.7 to 5.4 percent of Citrus County's total property tax revenues (see Table 2-4).

CR-3's annual property taxes are expected to remain relatively constant through the license renewal period. With respect to utility deregulation, the State of Florida has taken no action (Section 7.2.1.2). Therefore, the potential effects of deregulation would be unknown at this time. Should deregulation ever be enacted in Florida, this could affect utilities' tax payments to counties. However, any changes to CR-3 property tax rates due to deregulation would be independent of license renewal.

2.8 LAND USE

This section focuses on Citrus County because the majority (approximately 83 percent) of the permanent CR-3 workforce lives in this county (see Section 3.4) and because CR-3 pays property taxes in Citrus County.

Existing Land Use

From 1990 to 2000, Citrus County's population grew 26.3 percent, while the population of the State of Florida grew 23.5 percent (Section 2.6). Over the same period, 1990 to 2000, the number of housing units in Citrus County increased by 24.8 percent, while the total number of units in the State increased by 19.7 percent (USCB 1990; USCB 2000b).

Citrus County is located in west-central Florida along the Gulf Coast. It is bounded by the Withlacoochee River to the north and east, Hernando County to the south, and the Gulf of Mexico to the west. It is also bordered by Levy, Marion, Sumter, and Hernando Counties (Figure 2-1).

Citrus County encompasses approximately about 773 square miles (494,720 acres), including both land and inland waters. There are approximately 373,760 acres of land and 66,233 acres of inland water. The remaining surface water areas are estuaries and coastal river systems (Citrus County 2006).

There are two incorporated cities located within the County, Inverness and Crystal River. Inverness, the county seat, is located on the east side of the County and occupies approximately 4,578 acres. The City of Crystal River is located on the west side of the County and occupies approximately 3,636 acres (Citrus County 2006).

Although Citrus County has been experiencing rapid population growth, much of the County is still rural in nature and a large percentage of the land is undeveloped (Citrus County 2006). This is rapidly changing however, as is evidenced by a decrease in vacant and agricultural land and an increase in residential land. County planners attribute the majority of population growth to an influx of retirees and a growing tourism industry. These two segments of the economy have led to the expansion of the construction, wholesale and retail trade, and service sectors (Citrus County 2006).

The Citrus County Comprehensive Plan characterizes the overall land use pattern in the County as "suburban sprawl" (Citrus County 2006). Residential and commercial developments, as well as other land uses, are sporadically located throughout the County (Citrus County 2006). Citrus County uses its comprehensive land use plan and land development regulations (Citrus County Land Development Code) to guide development. For example, the County employs housing density limits to encourage growth in areas where public facilities, such as water and sewer systems, exist or are scheduled to be built in the future and to promote the preservation of the communities' natural resources. The County has no formal growth control measures, however.

Table 2-5 details existing land use in Citrus County. Each land use category and the status of that category in Citrus County is described below.

Residential

Land committed to residential use has been steadily increasing and is the largest single use of developed land in the County. There are 68,727 acres of residentially committed land, or 18.0 percent of the unincorporated land area. The greatest concentrations of residential land are located adjacent to the incorporated Cities of Inverness and Crystal River, and the unincorporated areas of Homosassa Springs and Beverly Hills. As of 2004, the County had an excess of 70,000 vacant residential lots (Citrus County 2006).

The majority of the multi-family dwelling units in Citrus County are low density duplexes, condos, or single-story apartments. There are few high density multi-family units. In 2004, there were 796 acres in multi-family units. Most growth in this category has been due to an increase in mobile home parks. Mobile home sites are dispersed throughout the County and cover approximately 10,000 acres in established housing developments, mobile home parks, or rural areas (Citrus County 2006).

Commercial

Commercial uses have been increasing in tandem with residential growth and are generally located along major highways, arterials, and major collectors near concentrations of residential development. Neighborhood commercial uses such as convenience stores are dispersed throughout the residential areas. The major concentrations of commercial uses are located along US-19, SR-44, US-41, and on CR-491 adjacent to Beverly Hills (Citrus County 2006).

There are more than 30 commercial centers (those with six or more stores) in the County. Most commercial centers are located near the urbanized areas of Crystal River, Inverness, Homosassa, Beverly Hills, and Hernando. Newer commercial sites include the WalMart Superstore on SR-44 west of Inverness, Lowe's just west of WalMart, and several smaller projects along US-19 (Citrus County 2006).

In addition to the traditional commercial land uses, Citrus County also considers recreational vehicle (RV) parks and campgrounds commercial uses because of their general characteristics and intensity of use. They are dispersed throughout the County and are most often located near a water bodies. There are about 100 acres of land designated as RV parks. While traditionally tourist oriented, RV parks in Citrus County are also being used as seasonal residences (Citrus County 2006).

Agricultural

Agricultural land uses are limited due to the presence of widespread platted land and a preponderance of urban uses. Agricultural land makes up approximately 20 percent of the unincorporated land in the County. A majority of the agricultural land in Citrus County can be classified as improved pasture or silviculture, and most of the farms are owned by individual or family organizations. There has been little change in agricultural acreage over the past decade (Citrus County 2006).

Despite its name, Citrus County produces very small quantities of citrus fruit. The Great Freeze of 1894-1895 damaged many of Florida's citrus groves, particularly in north Florida, and led growers to shift production further south (Florida Department of Citrus Undated). Most citrus fruit is produced in counties (e.g., Polk, Highlands, DeSoto, St. Lucie, Hendry) well south and southeast of Citrus County (GCGA 2006).

Industrial

Industrial development comprises approximately 464 acres or 0.12 percent of the land area of unincorporated Citrus County (see Table 2-5). The major industries operating in Citrus County are sheet metal, concrete, and boat manufacturing. There are also many firms that serve the construction sector by producing cabinets, millwork, furniture, awnings, windows, etc. Currently, there are 10 industrial parks distributed throughout the County. Most of the industrial parks are located along major arterials, such as US-19/US-98/SR-55, US-41, or SR-44 (Citrus County 2006).

Transportation, Communications, and Utilities (TCU)

Transportation land uses include airports, railroad lines, and major shipping channels. Communication land uses include telephone, radio, and television facilities, including transmission towers. Public utilities include major utility transmission rights-of-way (230 KV or greater), water supply plants, sewage treatment plants, and electrical power facilities (Citrus County 2006).

There are 5,416 acres designated as TCU in Citrus County. This land use category comprises 1.42 percent of the County land area. The majority of this allocation is attributed to the CR-3, the major transmission lines, the Crystal River Airport, and the Inverness Airport (Citrus County 2006).

Public/Semi-Public, Institutional (PSPI)

Major uses in this land use category include educational, religious, and governmental uses. PSPI uses account for 1,588 acres or 0.42 percent of the County's land areas (Citrus County 2006).

The school system represents the majority of the PSPI acreage. Other major uses in this category include: Roger Weaver Educational Complex, Citrus County Government Complex, Marine Science Station, National Guard Armory, Citrus County Fairgrounds, and Central Florida Community College (Citrus County 2006).

Recreation

Recreation accounts for 5,052 acres or about 1.32 percent of the County’s unincorporated land area (see Table 2-5). Citrus County operates and maintains, either solely or by interlocal agreement, four district parks, seven community parks, and twenty-seven shoreline and water use access sites. These developed parks are usually located in urbanized areas where the population is sufficient to support them. Private commercial facilities, such as golf courses, comprise a large percentage of recreational land. Most of the golf courses are part of large housing developments such as: Citrus Springs, Pine Ridge, Black Diamond Ranch, Beverly Hills, Brentwood, Citrus Hills, and Sugarmill Woods (Citrus County 2006).

From 1996 to 2004, recreation land increased by 17.9 acres and is largely attributed to an increase in RV parks (Citrus County 2006).

Extractive

The Extractive land use category includes those activities predominantly associated with active mining. Citrus County also has a large number of abandoned mines that have been reclassified as vacant-undeveloped, unless reclaimed for another use (Citrus County 2006).

Historically, mining has played a large role in Citrus County's development. Hard rock phosphate, limestone, dolomite, and sand are the principal materials mined. Due to data collection issues, the County does not have a current inventory of mining acreage. However, County planners are currently attempting to develop one (Citrus County 2006).

Limestone mines are generally located in the central and southeast parts of the County, with the largest concentrations adjacent to the Withlacoochee State Forest. Dolomite mining is generally confined to the Red Level area, which is located within several miles of the CR-3 (Citrus County 2006).

Phosphate deposits are located in eastern Citrus County and the mines are generally found north of Inverness and along the US-41 corridor from South Dunnellon to Floral City. Sand and gravel pits are smaller operations found in the central part of the County (Citrus County 2006).

Conservation

Conservation land in Citrus County can be defined as areas designated for such purposes as protecting and managing natural resources, including private, Federal, State, and County reserves. Also included are designated historic and archaeological sites (Citrus County 2006).

Conservation lands have grown significantly from 67,186 acres of land and inland water in 1988 (the date of the 1980s comprehensive plan) to 124,498 in 2004. This increase is attributed to the major land purchases by the state and the Southwest Florida Water Management District (SWFWMD) for conservation and flood control purposes. Most of the conservation areas, with the exception of the Withlacoochee State Forest, are located in the coastal and eastern areas of the County; however, some recent conservation efforts are targeting upland habitats (Citrus County 2006).

The major reserves include: the Chassahowitzka National Wildlife Refuge, Crystal River Preserve State Park, Crystal River National Wildlife Refuge, Withlacoochee State Forest (Citrus and Homosassa Tracts), Flying Eagle Ranch, Pott's Preserve, Chassahowitzka Riverine Swamp Sanctuary, Two-Mile Prairie (Jordan Ranch) (proposed), the McGregor-Smith Boy Scout Reservation, Annuteliga Hammock, and the Marjorie Harris Carr Cross Florida Greenway (Citrus County 2006).

Vacant-Committed

Although Citrus County is becoming more urbanized, the County is still rural in nature and contains a large amount of undeveloped land. Vacant land accounts for 51,162 acres or 13.41 percent of the County land area. Vacant land use is comprised of two categories: vacant-committed and vacant-undeveloped (Citrus County 2006).

The vacant-committed land use category can be described as large areas of land that have been subdivided, but on which little or no development has occurred. The purpose of this category is to classify land committed for residential development; however, a small percentage of vacant-committed land may eventually develop as commercial, recreational, conservation, or another land use (Citrus County 2006).

The central third of the County contains the largest amount of vacant-committed land. A majority of the platted lands are in large planned developments such as Citrus Springs, Pine Ridge, Black Diamond Ranch, Beverly Hills, Citrus Hills, and Sugarmill Woods. While many of these planned developments are thriving residential areas, they are not close to build-out at this time and still contain large tracts of vacant-committed lands (Citrus County 2006).

Vacant-Undeveloped

This land use category consists of undeveloped land that has not been subdivided. There are 47,790 acres of vacant land which represents 12.53 percent of the County land area (refer to Table 2-5). Most of the land in this category can be described as wooded, abandoned fields, or wetlands. Since 1988, there has been a 52.8 percent reduction in vacant acreage. Large tracts of vacant land are located along the coast, in the central third of the County, and along the Withlacoochee River in the eastern portion of the County (Citrus County 2006).

Future Land Use

Below are the basic future land use strategies from the latest update of the Citrus County Development Plan (Citrus County 2006):

- Designate different land uses and densities in the most appropriate locations while recognizing existing communities and protecting the character of the area.

- Establish commercial nodes of appropriate sizes and locations to promote well-planned, orderly commercial development within the County and discourage strip and isolated commercial development and the premature conversion of land.
- Designate “Planned Service Areas” where development will be encouraged through the establishment of higher densities.
- Establish “Corridor Planning Zones” to promote planned, orderly development along the County arterials and CR-486 and CR-491.
- Promote timely development which is concurrent with the provision of infrastructure including roads, water, and sewer.
- Designate lower density development outside the urban service areas where the supporting infrastructure is not available or proposed.
- Limit development to low density and intensity uses within the coastal, lakes, and river areas of the County.
- Limit the development of new mobile home parks, hospitals, congregate living facilities, correctional facilities, and similar uses or facilities serving special needs populations within the “Coastal High Hazard Area.”
- Protect natural and historic resources in the County by designating low intensity and compatible uses adjacent to conservation areas.
- Establish commercial nodes at appropriate locations to limit strip commercial development, reduce sprawl, take advantage of economies of scale, reduce travel times and distances, increase commercial viability, and protect the County's rural character between nodes.
- Allow the co-location of residences and businesses on commercial parcels in order to enable property owners to work and live on the same property thereby reducing costs, improving financial stability, improving security, and improving the design and maintenance of commercial property.
- Require the permanent preservation of open space in all new residential subdivisions and mixed use developments.
- Utilize the County Land Development Code which will set standards for development throughout the County.

2.9 SOCIAL SERVICES AND PUBLIC FACILITIES

2.9.1 PUBLIC WATER SYSTEMS

Because CR-3 is located in Citrus County and most CR-3 employees reside in the County, the discussion of public water supply systems will be limited to Citrus County. CR-3 obtains potable water from three groundwater wells on the plant site, and is not connected to a public water system.

Historically, the majority of Citrus County residents received potable water from private wells, drawing groundwater from either the shallow surficial aquifer or the underlying Floridan aquifer. As the population increased, several communities developed water service utilities. The Withlacoochee Regional Water Supply Authority (WRWSA) was created in 1977 to develop storage and supply facilities for municipal purposes. Citrus County is a member of the WRWSA (Citrus County 2006).

In the 1980s, Citrus County established the Citrus County Utilities Division (CCUD). Prompted, in part, by increasing saltwater intrusion into coastal groundwater supplies, the County enacted various ordinances to promote the establishment of centralized county water services. The CCUD began a coordinated effort to develop a public water supply system by acquiring and developing private water systems and constructing distribution lines. The CCUD operates two major interconnected water treatment and distribution facilities as well as a number of small isolated systems. The largest of these facilities are the Charles A. Black-No. 1 Water Plant (CAB-1), located in Hampton Hills, and the Charles A. Black-No. 2 (CAB-2) in the Meadowcrest area (Citrus County 2006).

In 1998, the Citrus County Board of County Commissioners commissioned the development of a Water Supply Master Plan for Citrus County Utilities, which was published in 2000 and approved by the Citrus County Board of County Commissioners in January, 2001. The study documented population trends, service areas, sources of supply, water demands, and existing facilities. It modeled the existing system and simulated future system requirements to develop and evaluate expansion alternatives. The study focused on unincorporated areas presently served by the County, unincorporated areas within the County’s service area but not currently served, and communities served by interconnection to the central water system. The document serves as a tool for the guidance of system expansions and upgrades (Citrus County 2006).

In 2005, the County contracted with a company to update the County's Master Plans for potable water, wastewater and reuse water, identify capital project requirements in support of the Master Plans, develop a “County Utilities 20-year Business Plan,” and develop rate structure recommendations in support of the Plans. Currently, this update has not been completed (Citrus County 2006).

Citrus County is presently served by ten large community facilities, including the two operated by the CCUD (CAB-1 and CAB-2). Six facilities are owned, operated, and maintained by private and semi-public utilities. These include: Citrus Springs and

Sugarmill Woods (owned by the Florida Government Utilities Authority (FGUA); Floral City Water Association; Homosassa Special Water District; Ozello Water Association; and Rolling Oaks Utilities. The two remaining facilities are owned and operated by the Cities of Crystal River and Inverness (Citrus County 2006). Table 2-6 details usage and capacity information for these systems.

Overall, water supply capacity is not a problem in Citrus County, although reaching currently unserved areas remains a concern. Also, there are some water quality issues in selected areas of the county, but they have been and continue to be mitigated by the use of counteractive measures. The two main issues are saltwater intrusion and water supply contamination.

The quantity of groundwater available for public supply in the coastal area ranges from poor to fair due to saltwater intrusion. Very few individual wells in this portion of the County meet federal drinking water standards. Therefore, the County has responded with two measures: (1) they have developed new well fields further inland in productive aquifer areas and are transporting the water back to the users along the coast, and (2) they have connected water users to other water suppliers from other parts of the County.

With respect to contamination, water supplies in certain areas west of the US-41 corridor have high mineral content, particularly iron and manganese. To mitigate this issue, additional treatment of the raw water in these locations is sometimes required. Water supply in the remainder of the County is plentiful and generally of good quality (Citrus County 2006).

Citrus County potable water goals include: meeting current and future demand, the protection of aquifers and aquifer recharge areas, and the mitigation of saltwater intrusion (Citrus County 2006).

2.9.2 TRANSPORTATION

Citrus County covers approximately 584 square miles (USCB 2006). Citrus County is situated on the Gulf Coast of Florida, between Levy County to the north, Marion and Sumter Counties to the east, and Hernando County to the south.

Public airports serving the county are the Crystal River and Inverness Airports, which are general aviation airports. The Tampa International Airport is the nearest airport with scheduled commercial airline service (Enterprise Florida Undated).

There is one railroad serving Citrus County, the Seaboard Coast Railroad, owned by CSX Transportation (Enterprise Florida Undated). A spur from this line runs just south of West Power Line Street, the CR-3 main access road, and terminates on CR-3 property.

One Federal interstate, (Interstate (I-) 75), two Federal highways (United States (US-) 19 and US-98), five state highways (State Road (SR-) 41, SR-55, SR-44, SR-200, and the Suncoast Parkway) (Enterprise Florida Undated), and nine major county roads (County Road (CR-) 495, CR-491, CR-581, CR-39, CR 480, CR-486, CR-488, CR-494, and CR-490) traverse Citrus County. (Citrus County 2006; Enterprise Florida Undated) See Figures 2-1 and 2-2 for locations.

US-19/US-98/SR-55 is the major north-south route in the western portion of the County, traveling through Crystal River and Homosassa Springs, connecting Levy County to the north with Hernando County to the south. Except for six-lanes within the City of Crystal River and the two-lane segment bridging the Cross Florida Barge Canal, it is a four-lane divided arterial (Citrus County 2006). US-98 diverts from US-19/SR-55 in Chassahowitzka in the southern part of the County.

Road access to CR-3 is via US-19/US-98/SR-55. The plant access road, West Power Line Street, intersects with US-19/US-98/SR-55 (Figure 2-2). North of this intersection, US-19/US-98/SR-55 intersects with CR-488. Employees traveling from the north, northwest, northeast, east, and west of CR-3 would use these roads to reach the CR-3 site. South of the access road intersection, US-19/US-98/SR-55 intersects with CR-495, SR-44, CR-494, CR-490, and CR-480. Employees traveling from the south, southeast, southwest, east, and west would use a combination of these roads to reach CR-3. CR-3 employees report that there are no congestion issues during shift changes or normal refueling outages.

Citrus County traffic volumes are expected to increase over the next several decades. To meet current and projected capacity requirements, the County plans to widen many roads, including several analyzed in this document. Additionally, the Florida Department of Transportation is currently conducting a Project Development and Environment (PD&E) study in support of a new four-lane (toll) turnpike called Suncoast Parkway 2. Also known as the Citrus County portion of the Suncoast Parkway, the new turnpike would extend from US 98 to US 19, alleviating congestion along US-19/US-

98/SR-55 and around Crystal River and other towns along the west coast of Citrus County (FDOT 2006).

In determining the significance levels of transportation impacts for license renewal, NRC uses the Transportation Research Board's level of service (LOS) definitions (NRC 1996). In its Citrus County Comprehensive Plan, Draft Evaluation and Appraisal Report Based Amendments, Traffic Circulation Element (Citrus County 2006), the County has calculated LOS ratings for most roads in Citrus County. Table 2-7 lists roadways in the vicinity of CR-3, the annual average daily traffic volumes (AADT), and the LOS determinations, as determined by Citrus County.

2.10 METEOROLOGY AND AIR QUALITY

CR-3 is located in Citrus County, Florida near the City of Crystal River. The climate of the region around the CR-3 site is humid subtropical, which is characterized by relatively dry winters and rainy summers, a high annual percentage of sunshine, a long growing season, and high humidity. The terrain is generally flat and featureless with the Gulf of Mexico being the major climatic influence. Snowfall is virtually non-existent, but rainfall averages about 50-60 inches per year, with more than 50 percent of the total rainfall occurring during the months of June through September (Florida Power 2005). Temperatures in the site region (modified by the waters of the Gulf of Mexico) seldom exceed 90°F or fall below 32°F. Fog has a high frequency of occurrence at night during the winter season. Prevailing winds are from the east, but the winds are somewhat erratic since the coastal regions experience frequent local circulations caused by the land-sea breeze. The coastal location of the site also results in vulnerability to tropical storms and hurricanes. In addition, tornadoes occur quite frequently in this region. Meteorological information, as it relates to analysis of severe accidents, is included in Attachment F.

Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter with aerodynamic diameters of 10 microns or less (PM_{10}), particulate matter with aerodynamic diameters of 2.5 microns or less ($PM_{2.5}$), ozone, sulfur dioxide (SO_2), lead, and nitrogen dioxide (NO_2). Areas of the United States having air quality as good as or better than the NAAQS are designated by EPA as attainment areas. Areas having air quality that is worse than the NAAQS are designated by EPA as non-attainment areas.

CR-3 is located in the West Central Florida Intrastate Air Quality Control Region (AQCR) (40 CFR 81.96). The West Central Florida AQCR is designated as in attainment or unclassifiable for all air quality standards as are all counties in the State of Florida (40 CFR 81.310). The nearest non-attainment area is Bibb County, Georgia, approximately 275 miles north of CR-3, which is designated as a non-attainment area under the $PM_{2.5}$ and the 8-hour ozone NAAQS (40 CFR 81.311). The Chassahowitzka National Wildlife Refuge, approximately 13 miles south of CR-3 is designated as a mandatory Class I Federal area in which visibility is an important value (40 CFR 81.407). No other Class I areas are located within 100 miles of the site.

2.11 HISTORIC AND ARCHAEOLOGICAL RESOURCES

Area History in Brief

Pre-History

Humans first reached Florida approximately 12,000 years ago. The Florida coastline was more than twice as large as it is now as the sea level was much lower than it is today. The people who inhabited Florida at that time were hunter-gatherers, whose diets consisted of small animals, plants, nuts, and shellfish. The animal population included most present-day mammals and many that are now extinct, including the saber-tooth tiger, mastodon, giant armadillo, and camel (FDOS 2006).

These populations settled in areas with steady fresh water supplies, good stone resources for tool making, and firewood. Over the centuries, these people developed complex cultures. During the period prior to contact with Europeans, native societies developed cultivated agriculture, engaged in a trading systems, and increased their social organization, reflected in large temple mounds and village complexes (FDOS 2006).

The first humans (nomadic hunter-gatherers) moved into the Crystal River area approximately 10,000 years ago during the Paleo period. The area was not actually settled, however, until 2,500 years ago, when the river system and local marine estuary had matured (as a result of rising seas) and was able to support a larger, less nomadic, human population (FDEP 2005).

In the early 1900s, a pre-Columbian archaeological site generally referred to as the Crystal River Indian Mounds was discovered near the mouth of Crystal River, approximately 5 miles southwest of CR- 3. Material found at this site suggests that it was established as a ceremonial center or gathering place around 200 BC. The site was occupied for approximately 1,600 years by Native Americans, but was abandoned some time before the arrival of Europeans. Over this period, the population occupying the Crystal River ceremonial complex and environs grew larger and more socially complex (FDEP undated). Archaeological evidence suggests that activities at the Crystal River site encompassed three cultural periods: Deptford (to 300 AD), Weedon Island (300 to 1300 AD), and Safety Harbor (1300 AD to European contact) (FDEP undated).

The Crystal River Indian Mounds site, discovered and first excavated by archaeologist, Clarence B. Moore, in 1903, was purchased from private owners by the state of Florida in the mid-1960s. Since that time it has been under the protection of the Florida State Park Service (FDEP 2005). The mound complex was listed in the National Register of Historic Places in 1970 and designated a National Historic Landmark site in 1990 (FDEP 2005). The Crystal River Indian Mounds site is managed and protected as Crystal River Archaeological State Park, a 61-acre preserve within the larger Crystal River Preserve State Park (FDEP 2005).

In the CR-3 area, the native groups that were encountered by the first European explorers were the Timucuan-speaking tribes, which inhabited the east-central region of the Florida peninsula (MacRae 1993). Near the CR-3, there was a Timucuan village called Ocali, in the vicinity of present-day Ocala (MacRae 1993).

History

The first written records chronicling European contact with the Gulf Coast of Florida began with the Spanish conquistadores who were in search of precious metals. In 1528, Spaniard, Panfilo de Narvaez, brought an army of 300 men and 80 horses and traversed northward on the Gulf Coast in search of gold, finding none (MacRae 1993). In 1539 Hernando de Soto began another expedition in search of gold and silver, to no avail. In 1559, Tristán de Luna y Arellano attempted to colonize Florida. He established a settlement at Pensacola Bay, but failed after two years (FDOS 2006).

From the mid 16th century until 1821, England, France, and Spain fought for control of Florida. Spain had control from 1565 until 1763 and then, again, from 1784 until 1821. England had control from 1763 until 1784 and the United States took control in 1821 (FDOS 2006).

After the United States took control of Florida, the area between the Withlacoochee and Crystal Rivers became settled. Port Inglis and Red Level were among the first settlements. Settlements in the area were developed around the phosphate mining, cattle ranching, citrus farming, and timber production industries and, at Port Inglis, there was considerable business and commerce (AEC 1973).

The Seminole Wars

Over the three centuries after the first European contact with the Indians of Florida, there were changes in Indian occupation. In the CR-3 area, the Timucuans were killed or absorbed by the Creeks known as Seminoles who had migrated from Georgia and Alabama (MacRae 1993).

As the United States was attempting to gain control of Florida, the British enlisted the Seminole Indians in their defense. Additionally, the Seminole Indians provided a safe-haven for black slaves that escaped from other southern states. Because of this, United States General, Andrew Jackson, attacked the Seminoles and defeated them in 1817 and 1818. This was the first Seminole War (FDOS 2006).

The second Seminole War took place in 1835, when the United States and a small number of Seminoles signed the Treaty of Payne's Landing, requiring the Indians to give up their Florida land within three years and move west. Because many Seminoles refused to leave, the United States Army went to war to enforce the treaty. Ultimately, the United States prevailed (FDOS 2006).

A third Seminole War broke out in 1855, when conflicts over land arose between the settlers and remaining Seminoles in Florida. Via military patrols and rewards for the capture of Indians, the Seminole population in Florida was reduced to 200 and the war ended in 1858 (FDOS 2006).

In the CR-3 area, there were several smaller battles between the settlers and the Seminoles. These occurred along the lower Withlacoochee River and took place during the second Seminole War (MacRae 1993).

Initial Construction and Operation

In the *Crystal River Unit 3 Environmental Report: Operating Stage*, published in January 1972, Florida Power Corporation asserted that there was only one historically significant site, the Crystal River Indian Mounds, in the immediate vicinity of the Crystal River project area. In a comment letter on the Environmental Report dated March 30, 1972, Mr. Robert Williams (Director, Florida Division of Archives, History, and Records Management) evidenced concern that the Crystal River area had not been adequately surveyed, noting that "…the coastal salt marshes and adjacent estuarine areas in this part of Florida furnished one of the most favorable ecological niches available to the prehistorical inhabitants of the region." Mr. Williams went on to recommend that "Florida Power Corporation contract for an intensive archaeological survey of their Crystal River properties" in order to facilitate the Division's review of the project.

Florida Power Corporation subsequently sought the assistance of the Division of Archives, History, and Records Management's archaeologists, who conducted a survey of the site in the summer of 1972. Consistent with the concerns of the Director, the survey focused on islands, coastal marshes, and coastal streams north and south of the developed core of the Crystal River site. The developed part of the site received very little attention because it was so thoroughly altered during the construction of Crystal River Units 1 and 2.

The results of the survey, entitled *An Archaeological Survey of the Florida Power Corporation Crystal River Tract, Citrus County, Florida,* were published in June 1973. Survey results indicated that there were 20 archaeological sites on Florida Power Corporation property (the Crystal River site) and an additional 23 sites within 5 miles of the project site on land not owned by Florida Power (Miller 1973). The 20 archaeological sites on the (now Progress Energy-owned) Crystal River site are all associated with coastal marshlands and creeks outside of the developed portion of the CREC. The site nearest to CREC facilities, 8Ci105, is approximately one-half mile northwest of the Unit 4 cooling tower.

All of these archaeological sites were associated with shell middens. The sites were quite variable in size and in terms of the variety and number of artifacts present. The site that yielded the largest number of artifacts, designated 8Ci113, appeared to have been occupied intermittently between 1,500 BC and 1,000 AD.

After conferring with the Advisory Council on Historic Preservation, the United States Department of the Interior, and the State of Florida's Division of Archives, History, and Records Management, the AEC concluded that the construction and operation of CR-3 "should not result in alteration of any site of historical or scientific value" (AEC 1973). The AEC noted further (AEC 1973, page 12-6) that having conducted a complete archaeological and historical inventory of the Crystal River site and adjacent areas, the State of Florida's Division of Archives, History, and Records Management "has certified complete satisfaction with the procedures instituted by the applicant in assessing the potential adverse effects results from this project, relative to historic preservation."

Current Status

Progress Energy commissioned a review of cultural resources investigations that have been conducted in the vicinity of Crystal River site in December 2006. Background research included an examination of maps and site data from the Florida Master Site File (FMSF), records maintained by the Survey and Registration Section of the Bureau of Historic Preservation, and historical maps and records of the Florida Department of Environmental Protection (New South Associates 2006).

FMSF records list 37 archeological studies that have been conducted in the project vicinity. Two of these studies appear to have been conducted in support of CR-3 projects and activities. Of particular interest is the previously discussed archeological survey conducted in 1972 of the CREC that included some additional investigations within a 5-mile radius of the facility. As a result of this survey, 43 archeological sites were inventoried, 20 within the boundary of the CREC. With regard to the 20 sites identified on the Crystal River property, 18 were prehistoric, one was prehistoric and historic, and one was unspecified. None of these sites has been evaluated by the SHPO for National Register eligibility.

Known cultural resources within the 6-mile study area are primarily archeological, and include both historic and prehistoric sites. In addition to archeological sites, there are three cemeteries recorded with the FMSF, two in Citrus County and one in Levy County. Nine structures in the 6-mile study area are listed in the FMSF. Eight of these structures are in Citrus County and one is in Levy County.

FMSF records list 195 sites within the study area (New South Associates 2006). Of these, 174 are in Citrus County and 21 are in Levy County. With respect to the primary cultural contexts represented, 173 of the sites were designated Prehistoric, four as Historic, and 18 as Unspecified. The historic sites included two homesteads, one shipwreck, and one fort.

As of October 2008, the National Register of Historic Places listed 8 properties in Citrus County (NPS 2008). Of these 8 locations, 2 fall within a 6 mile radius of CR-3, the Crystal River Indian Mounds and the Mullet Key site. Another, the old Crystal River Town Hall, lies just outside of the 6-mile radius. Table 2-8 lists the National Register of Historic Places sites within the 6-mile radius of CR-3.

As of 2008, the Department of the Interior listed 1 property (group of properties, to be precise) that is currently determined eligible for listing (DOE) on the National Register of

Historic Places in Citrus County (NPS 2008). This property does not fall within a 6 mile radius of CR-3.

Progress Energy has written the Director of the Division of Historical Resources, Florida's State Historic Preservation Officer (SHPO), to solicit the Division's concerns regarding potential impacts to cultural resources from refurbishment or license renewal activities. This letter is included as Attachment D.

2.12 KNOWN OR REASONABLY FORESEEABLE PROJECTS IN SITE VICINITY

Council on Environmental Quality

> "'Cumulative impact' is the impact on the environment which results from the incremental impact of the action when added to 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." 40 CFR 1508.7

This section briefly describes federal and other activities in the area and the cumulative impacts that may occur as a result of the proposed action, renewal of the CR-3 operating license for an additional 20 years. Potential impacts of the proposed action are examined in light of other known and foreseeable projects to determine if significant incremental impacts could occur that would result in required mitigation.

2.12.1 CR-3 EXTENDED POWER UPRATE

Progress Energy plans to increase CR-3's licensed power level and electrical output by approximately 20 percent in an Extended Power Uprate (EPU) scheduled to be carried out during fall 2009 and fall 2011 refueling outages. The EPU would involve a number of modifications to the secondary side of the plant, including replacing the turbine generator set (generator, high pressure turbine rotor, low pressure turbine rotors); upgrading feedwater heaters, feedwater and condensate pumps and motors to operate at higher capacity; adding supplemental cooling to some plant systems; and implementing electrical upgrades to accommodate higher loads and ensure electrical stability. There would also be a number of associated instrumentation upgrades.

An environmental evaluation of the EPU would be performed by Progress Energy in mid-2009 pursuant to 10 CFR 51.41 ("Requirements to Submit Environmental Information") and 10 CFR 51.45 ("Environmental Report") and would be intended to support the NRC environmental review of the proposed uprate. The uprate would require the issuance of an operating license amendment for CR-3. The regulation (10 CFR 51.41) requires that applications to the NRC be in compliance with Section 102(2) of NEPA and consistent with the procedural provisions of NEPA (40 CFR 1500-1508).

The CR-3 EPU would involve changes to plant systems that directly or indirectly interface with the human and natural environment. However, all necessary plant modifications would be made within existing CR-3 facilities, and no physical expansion of the plant's footprint would be required. As a consequence, EPU would have little or no impact on land use, groundwater, terrestrial resources (including threatened and endangered species), or cultural resources. The influx of additional outage workers in fall 2009 and fall 2011 would have a modest effect on air quality, housing availability, and traffic in the area, but impacts would be SMALL and would not warrant mitigation. Because EPU would be associated with greater thermal output from the reactor, there would be additional waste heat rejection to the CR-3 discharge canal. In order to remain in compliance with the plant's NPDES permit, it may be necessary to take measures to mitigate higher discharge temperatures. Progress Energy is currently considering a number of alternatives for mitigating these higher discharge temperatures.

2.12.2 CRYSTAL RIVER UNITS 4 AND 5 CAIR COMPLIANCE AND ESP REBUILD PROJECT

The Crystal River Units 4 and 5 Clean Air Interstate Rule (CAIR) Compliance and Electrostatic Precipitator (ESP) Rebuild Project, permitted in 2007, is fully under way, and is scheduled to run through 2010. This project, which was intended to provide flexibility in implementing the federal cap and trade program for nitrogen oxides (NO_x) and sulfur dioxide (SO_2) under the Clean Air Interstate Rule (CAIR), involves the installation of new low-NO_x burners (LNB), new selective catalytic reduction (SCR) systems, new flue gas desulfurization (FGD) systems, and new stacks for existing coal-fired Units 4 and 5. The FGD systems will remove 97 percent of the $S0_2$ from the flue gasses by converting a limestone slurry into gypsum (produced as a by-product). The combined effect of the LNB and SCR systems will be to remove 93 percent of the NO_x from the flue gases. A combined effect of the SCR and FGD systems will be the removal of 70 to 80 percent of the mercury in the flue gasses.

In addition to the new control equipment, Progress Energy sought and received approval from the Florida Department of Environmental Protection to burn additional fuel blends (sub-bituminous coal and petroleum coke) in the two coal-fired units. Finally, Progress Energy was given approval to install a new carbon burnout system to reburn fly ash generated at Crystal River, to recover the remaining heating value in this material and minimize the offsite landfilling of fly ash.

The CAIR Compliance and ESP Rebuild Project workforce will number about 750 when the fall 2009 outage begins, in October 2009, and about 300 when the fall outage ends, in December 2009. The project will be completed by the time the fall 2011 outage begins. The additional workers associated with this project could affect housing availability and traffic in the Crystal River area in late 2009, but impacts would be SMALL and temporary and would not warrant mitigation.

The CAIR Compliance and ESP Rebuild Project would have little or no impact on land use, groundwater, terrestrial resources (including threatened and endangered species), or cultural resources. The CAIR Compliance and ESP Rebuild Project would substantially reduce emissions of nitrogen oxides, sulfur dioxide, and mercury, improving air quality in the Crystal River region.

2.12.3 OTHER ACTIVITIES

As indicated on Figure 2-2, there are three urban areas, Crystal River, Inglis, and Yankeetown, and little industrial development within the 6-mile radius of CR-3. The only federal project nearby is the United States Coast Guard Station, a small 35-man facility, in Yankeetown, FL (USCG 2007).

Also, as discussed in Section 2.9.2 of this report, the Florida Department of Transportation is considering building an extension of the Suncoast Parkway, a four-lane toll road that terminates in Hernando County. The extension, which has been dubbed Suncoast Parkway 2, would extend 27 miles into Citrus County and connect with US Highway 19 in the Red Level area, approximately one mile north of the entrance to West Power Line Street, the main plant access road. The Suncoast Parkway 2 schedule calls for completion of 60 percent design plans by spring 2009 and completion of a final feasibility analysis by summer 2009. Given the controversial nature of this project, its history of delays and schedule changes, and the fact that the highway design is in its early stages, there is no practical way to evaluate the project's potential impacts, thus no way to evaluate potential cumulative impacts.

EPA-Regulated Facilities in Citrus County

In its "Envirofacts Warehouse" online database, EPA identifies permitted dischargers to air, land, and water. A search in Citrus County revealed 45 facilities that are permitted to discharge to the waters of the United States, 20 facilities that produce and release air pollutants, 5 facilities that have reported toxic releases, 152 facilities that have reported hazardous waste activities, and two potentially hazardous waste sites that are part of Superfund (USEPA 2006). Detailed information concerning these facilities may be accessed through EPA's "Envirofacts Warehouse."

TABLE 2-1
ENDANGERED AND THREATENED SPECIES IN CITRUS COUNTY OR COUNTIES CROSSED BY TRANSMISSION LINES

Scientific Name	Common Name	Federal Status[a]	State Status[a]	County[b]
Birds				
Aphelocoma coerulescens	Florida scrub-jay	T	T	Citrus, Hernando, Marion, Pasco, Pinellas, Sumter
Charadrius alexandrinus	Snowy plover	-	T	Pinellas
Charadrius melodus	Piping plover	T	T	Citrus, Hernando, Pasco, Pinellas
Falco peregrinus	Peregrine falcon	-	E	Citrus, Hernando, Marion, Pasco, Pinellas, Sumter
Falco sparverius paulus	Southeastern American kestrel	-	T	Citrus, Pasco, Hernando, Marion, Pinellas, Sumter
Grus canadensis pratensis	Florida sandhill crane	-	T	Citrus, Hernando, Marion, Pasco, Sumter
Haliaeetus leucocephalus	Bald eagle	-	T	Citrus, Hernando, Marion, Pasco, Pinellas, Sumter
Mycteria americana	Wood stork	E	E	Citrus, Hernando, Marion, Pasco, Pinellas, Sumter
Picoides borealis	Red-cockaded woodpecker	E	S	Citrus, Hernando, Marion, Pasco, Pinellas, Sumter
Rostrhamus sociabilis plumbeus	Everglade snail kite	E	E	Citrus, Marion, Sumter
Sterna antillarum	Least tern	-	T	Citrus, Hernando, Pasco, Pinellas
Mammals				
Puma concolor coryi	Florida panther	E	E	Citrus, Marion
Trichechus manatus	Florida manatee	E	E	Citrus, Hernando, Marion, Pasco, Pinellas
Ursus americanus floridanus	Florida black bear	-	T	Citrus, Hernando, Marion, Pasco, Sumter
Reptiles				
Alligator mississippiensis	American alligator	SAT	S	Citrus, Hernando, Marion, Sumter, Pasco, Pinellas

**TABLE 2-1
ENDANGERED AND THREATENED SPECIES IN CITRUS COUNTY OR COUNTIES CROSSED BY TRANSMISSION LINES (Continued)**

Scientific Name	Common Name	Federal Status[a]	State Status[a]	County[b]
Caretta caretta	Loggerhead sea turtle	T	T	Citrus, Hernando, Pasco, Pinellas
Chelonia mydas	Green sea turtle	E	E	Citrus, Hernando, Pasco, Pinellas
Dermochelys coriacea	Leatherback sea turtle	E	E	Citrus, Hernando, Pasco, Pinellas,
Drymarchon couperi	Eastern indigo snake	T	T	Citrus, Hernando, Marion, Sumter Pasco, Pinellas
Eretmochelys imbricata	Hawksbill sea turtle	E	E	Citrus
Gopherus polyphemus	Gopher tortoise	-	T	Citrus, Hernando, Marion, Pasco, Pinellas, Sumter
Lepidochelys kempii	Kemp's ridley sea turtle	E	E	Citrus, Hernando, Pasco, Pinellas
Neoseps reynoldsi	Sand skink	T	T	Marion
Stilosoma extenuatum	Short-tailed snake	-	T	Citrus, Hernando, Marion, Pasco, Pinellas, Sumter
Amphibians				
Ambystoma cingulatum	Flatwoods salamander	T	S	Marion
Fish				
Acipenser oxyrinchus desotoi	Gulf sturgeon	T	S	Citrus, Hernando Pasco, Pinellas
Vascular Plants				
Acrostichum aureum	Golden leather fern	-	T	Pinellas
Adiantum tenerum	Brittle maidenhair fern	-	E	Citrus, Hernando, Marion
Agrimonia incisa	Incised groove-bur	-	E	Citrus, Hernando, Marion
Asplenium erosum	Auricled spleenwort	-	E	Hernando, Pasco, Sumter
Asplenium pumilum	Dwarf spleenwort	-	E	Citrus, Hernando, Marion
Asplenium verecundum	Modest spleenwort	-	E	Citrus, Sumter
Bigelowia nuttallii	Nuttall's rayless goldenrod	-	E	Pinellas
Blechnum occidentale	Sinkhole fern	-	E	Citrus, Hernando, Pasco
Bonamia grandiflora	Florida bonamia	T	E	Marion
Calamintha ashei	Ashe's savory	-	T	Marion

TABLE 2-1
ENDANGERED AND THREATENED SPECIES IN CITRUS COUNTY OR COUNTIES CROSSED BY TRANSMISSION LINES (Continued)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	County[b]
Campanula robinsiae	Brooksville bellflower	E	E	Hernando
Carex chapmaii	Chapman's sedge	-	E	Marion
Centrosema arenicola	Sand butterfly pea	-	E	Citrus, Hernando, Marion, Pasco, Sumter
Chamaesyce cumulicola	Sand-dune spurge	-	E	Pinellas
Cheilanthes microphylla	Southern lip fern	-	E	Citrus
Coelorachis tuberculosa	Piedmont jointgrass	-	T	Hernando, Marion
Chrysopsis floridana floridana	Florida golden aster	E	E	Pinellas
Dicerandra cornutissima	Longspurred mint	E	E	Marion, Sumter
Drosera intermedia	Spoon-leaved sundew	-	T	Marion
Eragrostis pectinacea tracyi	Sanibel lovegrass	-	E	Pinellas
Erigonum longifolium gnaphalifolium	Scrub buckwheat	T	E	Marion, Sumter
Euphorbia communta	Wood spurge	-	E	Marion
Fostiera godfreyi	Godfrey's privet	-	E	Marion
Glandularia maritima	Coastal vervain	-	E	Citrus
Glandularia (=Verbena) tampensis	Tampa vervain	-	E	Citrus, Pasco, Pinellas
Gossypium hirsutum	Wild cotton	-	E	Pinellas
Hartwrightia floridana	Hartwrightia	-	T	Marion
Illicium parviflorum	Star anise	-	E	Marion
Justicia cooleyi	Cooley's water-willow	E	E	Hernando, Sumter
Lechea cernua	Nodding pinweed	-	T	Pinellas
Lechea divaricata	Pine pinweed	-	E	Hernando, Pinellas
Litsea aestivalis	Pondspice	-	E	Marion, Pasco
Matelea floridana	Florida spiny-pod	-	E	Citrus, Marion, Sumter
Monotropa hypopthys	Pinesap	-	E	Marion
Monotropsis reynolsiae	Pygmy pipes	-	E	Citrus, Hernando, Marion, Pasco
Najas filifolia	Narrowleaf naiad	-	T	Marion
Nemastylis floridana	Celestial lily	-	E	Pasco
Nolina atopocarpa	Florida beargrass	-	T	Marion
Nolina brittoniana	Britton's beargrass	E	E	Hernando, Marion, Pasco
Ophioglossum palmatum	Hand fern	-	E	Pasco

TABLE 2-1
ENDANGERED AND THREATENED SPECIES IN CITRUS COUNTY OR COUNTIES CROSSED BY TRANSMISSION LINES (Continued)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	County[b]
Parnassia grandifolia	Large-leaved grass-of-parnassus	-	E	Marion
Pecluma disperssa	Widespread polypody	-	E	Hernando, Marion
Pecluma plumula	Plume polypody	-	E	Hernando, Marion, Sumter
Pecluma ptilodon	Swamp plume polypody	-	E	Citrus, Marion, Sumter
Peperomia humilis	Terrestrial peperomia	-	E	Citrus, Hernando, Sumter
Polygala lewtonii	Lewton's milkwort	E	E	Marion
Pteroglossaspis ecristata	Giant orchid	-	T	Citrus, Hernando, Marion, Pinellas
Pycnanthemum floridanum	Florida mountain-mint	-	T	Hernando, Marion
Salix floridana	Florida willow	-	E	Marion
Schizachyrium niveum	Scrub bluestem	-	E	Hernando
Sideroxylon alachuense	Silver buckthorn	-	E	Marion
Sideroxylon lycoides	Buckthorn	-	E	Marion
Spigelia loganoides	Pinkroot	-	E	Marion, Sumter
Spiranthes polyantha	Green Ladies'-tresses	-	E	Citrus
Stylisma abdita	Scrub stylisma	-	E	Citrus, Marion
Thelypteris reptans	Creeping maiden fern	-	E	Citrus
Trichomanes puctatum ssp. floridanum	Florida filmy fern	-	E	Sumter
Triphora craigheadii	Craighead's noddingcaps	-	E	Citrus, Hernando, Sumter
Vicia ocalensis	Ocala vetch	-	E	Marion

a. E = Endangered; T = Threatened; - = Not listed; SAT =threatened due to similarity of appearance; S = species of special concern (FNAI 2008b, USFWS 2007a).
b. Source of County Occurrence: FNAI 2008b, USFWS 2007a

TABLE 2-2
ESTIMATED POPULATIONS AND ANNUAL GROWTH RATES

	Population and Decennial Growth Rate			
	Citrus County		Florida	
Year	Number	Percent	Number	Percent
1980	54,703	N/A	9,746,961	N/A
1990	93,513	70.9	12,938,071	32.7
2000	118,085	26.3	15,982,824	23.5
2010	144,772	22.6	19,655,064	23.0
2020	168,505	16.4	22,894,140	16.5
2030	190,416	13.0	25,898,476	13.1

Source: Florida Legislature 2005
Note: Data for 1980-2000 are slightly different from those reported by the US Census Bureau, but the differences are minor and would not materially affect growth rates.

TABLE 2-3
MINORITY AND LOW-INCOME POPULATION CENSUS BLOCK GROUPS WITHIN 50-MILE RADIUS OF CR-3

Block Groups within 50 miles of CR-3 with minority or low-income populations more than 20% greater than the state percentage.

COUNTY	FIPS	NUMBER OF BLOCK GROUPS	BLACK	AMERICAN INDIAN OR ALASKAN NATIVE	ASIAN	NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	SOME OTHER RACE	MULTI RACIAL	AGGREGATE	HISPANIC	LOW-INCOME HOUSEHOLDS
Alachua	12,001	29	1	0	0	0	0	0	1	0	4
Citrus	12,017	76	1	0	0	0	0	0	1	0	0
Dixie	12,029	7	0	0	0	0	0	0	0	0	0
Gilchrist	12,041	4	0	0	0	0	0	0	0	0	0
Hemando	12,053	87	3	0	0	0	0	0	3	0	1
Lake	12,069	25	3	0	0	0	0	0	2	0	1
Levy	12,075	26	3	0	0	0	0	0	3	0	1
Marion	12,083	114	16	0	0	0	0	0	16	0	6
Pasco	12,101	85	0	0	0	0	1	0	2	3	2
Sumter	12,119	30	5	0	0	0	0	0	3	0	1
	TOTAL	**483**	**32**	**0**	**0**	**0**	**1**	**0**	**31**	**3**	**16**

Block Groups within 50 miles of CR-3 with minority or low-income populations greater than 50%.

COUNTY	FIPS	NUMBER OF BLOCK GROUPS	BLACK	AMERICAN INDIAN OR ALASKAN NATIVE	ASIAN	NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	SOME OTHER RACE	MULTI RACIAL	AGGREGATE	HISPANIC	LOW-INCOME HOUSEHOLDS
Alachua	12,001	29	0	0	0	0	0	0	1	0	2
Citrus	12,017	76	0	0	0	0	0	0	0	0	0
Dixie	12,029	7	0	0	0	0	0	0	0	0	0
Gilchrist	12,041	4	0	0	0	0	0	0	0	0	0
Hemando	12,053	87	3	0	0	0	0	0	3	0	0
Lake	12,069	25	2	0	0	0	0	0	2	0	0
Levy	12,075	26	2	0	0	0	0	0	2	0	0
Marion	12,083	114	11	0	0	0	0	0	12	0	0
Pasco	12,101	85	0	0	0	0	0	0	0	2	1
Sumter	12,119	30	2	0	0	0	0	0	2	0	0
	TOTAL	**483**	**20**	**0**	**0**	**0**	**0**	**0**	**22**	**2**	**3**
Florida Percentages			14.61	0.34	1.67	0.05	2.99	2.35	22.01	16.79	11.73

	Population	Density
20-Mile	89,490.5	124.8
50-Mile	825,846.8	169.6

Source: TtNUS 2006
(Shaded cells represent counties completely contained by 50 mile radius)

TABLE 2-4
CR-3 TAX INFORMATION 2005-2007

Year	Citrus County Tax Revenues[a]	Property Tax Paid by Progress Energy	Percent of Citrus County Revenues
2005	$157,764,712	$8,445,007	5.4
2006	$190,064,953	$8,998,384	4.7
2007	$194,188,833	$10,072,127	5.2

a. Waldemar 2008

TABLE 2-5
EXISTING LAND USE IN UNINCORPORATED CITRUS COUNTY, 2004

Land Use Categories	Acres	Percent of Total Land Area
Residential	68,727	18.01
Commercial	2,487	0.65
Industrial	464	0.12
Extractive	66	0.02
Transportation/Communications/Utility	5,416	1.42
Public/Semi-Public	1,588	0.42
Recreation	5,052	1.32
Conservation	124,498	32.63
Agriculture	74,306	19.47
Vacant -- Committed	51,162	13.41
Vacant – Undeveloped	47,790	12.53
Total Land Area	381,556	100.00
Water Bodies	66,233	--
Total Area	447,789	--

Source: Citrus County 2006

TABLE 2-6
MAJOR CITRUS COUNTY PUBLIC WATER SUPPLIERS AND 2007 WATER SUPPLY DATA

Water Supplier (Owner)[a]	Plant Name	Water Source[a]	Maximum Daily Flow during Highest Month in 2007 (gallons/day)[b]	Average Daily Flow during Highest Month in 2007 (gallons/day)[b]	Design Capacity (gallons/day)[b]
Citrus County Utilities Department (CAB-1, CAB-2, Lecanto Water Treatment Plant)		Ground water			14,544,000
	CAB I (FKA Hampton Hills)		6,460,000	5,355,484	
	CAB II (FKA Meadow Crest)		1,333,000	728,258	
	Lecanto Water Treatment Plant		23,000	1,133	
Beverly Hills Subdivision (Rolling Oaks Utilities)		Ground water			5,600,000
	Rolling Oaks		706,000	502,516	
	Well # 2		611,000	481,258	
	Well # 4		756,000	187,767	
	Well # 5		363,000	38,300	
	Well # 6		584,000	316,267	
	Well # 7		882,000	388,161	
	Well # 8		1,077,000	598,866	
	Well # 9		1,291,000	720,516	
	Well # 10		1,258,000	767,000	
Citrus Springs (FGUA)		Ground water			5,158,000
	Well # 7		1,599,000	909,871	
	Well # 2		650,000	353,600	
	Well # 3		392,000	128,233	
	Well # 8		1,963,300	1,159,784	
	Pine Ridge Plant # 2		0	0	
	Pine Ridge Plant # 3		446,000	317,581	
	Pine Ridge Plant # 4		1,457,000	818,452	

TABLE 2-6
MAJOR CITRUS COUNTY PUBLIC WATER SUPPLIERS AND 2007 WATER SUPPLY DATA (CONTINUED)

Water Supplier (Owner)[a]	Plant Name	Water Source[a]	Maximum Daily Flow during Highest Month in 2007 (gallons/day)[b]	Average Daily Flow during Highest Month in 2007 (gallons/day)[b]	Design Capacity (gallons/day)[b]
	Pine Ridge Plant # 5		686,000	367,387	
City of Crystal River		Ground water			2,232,000
	Crystal River Plant		1,367,000	900,613	
	Fifth Street Plant		0	0	
	United Methodist Church		9,666	3,150	
Floral City Water Association		Ground water			1,840,000
	Plant #1		565,000	388,419	
	Plant #2		279,000	48,032	
Homosassa Special Water District		Ground water			1,580,000
	Bradshaw Water Treatment Plant		531,000	139,000	
	Norin Water Treatment Plant		311,000	159,000	
	Peach Orchard Water Treatment Plant		9,810,000	831,000	
Inverness Water Department		Ground water			3,450,000
	581 Water Treatment Plant		1,937,000	1,522,000	
Ozello Water Association		Purchased Ground water (from CCUD)			720,000
	Ozello Water Association		545,000	468,000	
Sugarmill Woods Subdivision (FGUA)		Ground water			4,960,000
	Plant # 1 / Well 2		471,000	98,387	
	Plant # 2 / Wells 5, 6, 10, 11, 12		4,162,000	3,212,871	
	Plant # 3 / Wells 8 and 9		4,711,000	2,750,097	

a. EPA 2006; FDEP 2005
b FDEP 2007

TABLE 2-7
TRAFFIC COUNTS AND LOS DETERMINATIONS FOR ROADS IN THE VICINITY OF CR-3

Road Number	Road Name	From	To	Area Type	Distance (mi)	AADT[a] (2004)	LOS[b] (2007)
US 19	Suncoast Blvd., N	CR 494, W	Venable Street, W	Urban	0.6	30,768	C
US 19	Suncoast Blvd., N	Venable Street, W	CR 44, W	Urban	1.2	33,115	B
US 19	Suncoast Blvd., N	CR 44, W	SR 44	Urban	1.1	35,584	B
US 19	Suncoast Blvd., N	SR 44	CR 495, N	Urban	0.4	36,698	B
US 19	Suncoast Blvd., N	CR 495, N	19th Street/Turkey Oak Drive N	Urban	1.4	19,100	B
US 19	Suncoast Blvd., N	19th Street/Turkey Oak Drive N	State Park Street, W	Urban	0.5	19,100	B
US 19	Suncoast Blvd., N	State Park Street, W	Ashburn Lane, W	Urban	N/A	14,077	B
US 19	Suncoast Blvd., N	Ashburn Lane, W	Emerald Oaks Drive, W	Rural	2.4	14,077	A
US 19	Suncoast Blvd., N	Emerald Oaks Drive, W	Powerline Street, W	Rural	0.7	14,355	A
US 19	Suncoast Blvd., N	Powerline Street, W	CR 488, W	Rural	0.7	14,355	A
US 19	Suncoast Blvd., N	CR 488, W	Basswood Avenue, N	Rural	0.3	8,914	A
US 19	Suncoast Blvd., N	Basswood Avenue, N	Levy County Line	Rural	3.9	10,507	A
SR 44	Gulf to Lake Highway, W	US-19, N	Turkey Oak Drive, N	Urban	0.9	38,000	B
SR 44	Gulf to Lake Highway, W	Turkey Oak Drive, N	CR 486, W	Urban	1.3	29,747	B

Source: Citrus County 2006; Citrus County 2008

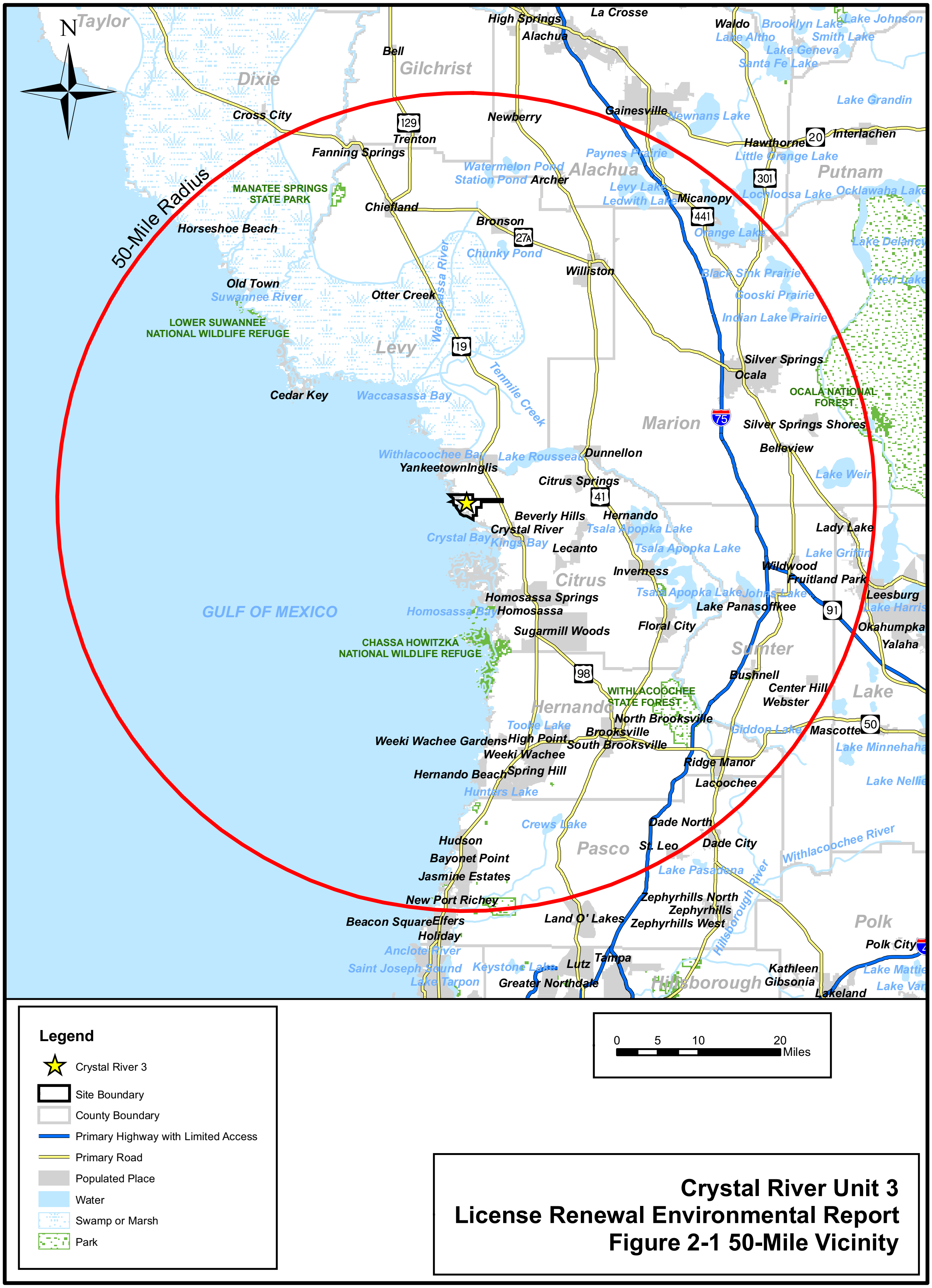
a. The 2004 traffic volumes were obtained from the Citrus County Department of Public Works and the Florida Department of Transportation (FDOT). Traffic counts from both sources were adjusted to Annual Average Daily Traffic (AADT) volumes where necessary.

b. LOS A = Primarily free-flow operations; vehicles are completely unimpeded.
LOS B = Reasonably unimpeded operations; ability measure only slightly restricted
LOS C = Stable operations; ability to maneuver and change lanes may be restricted.

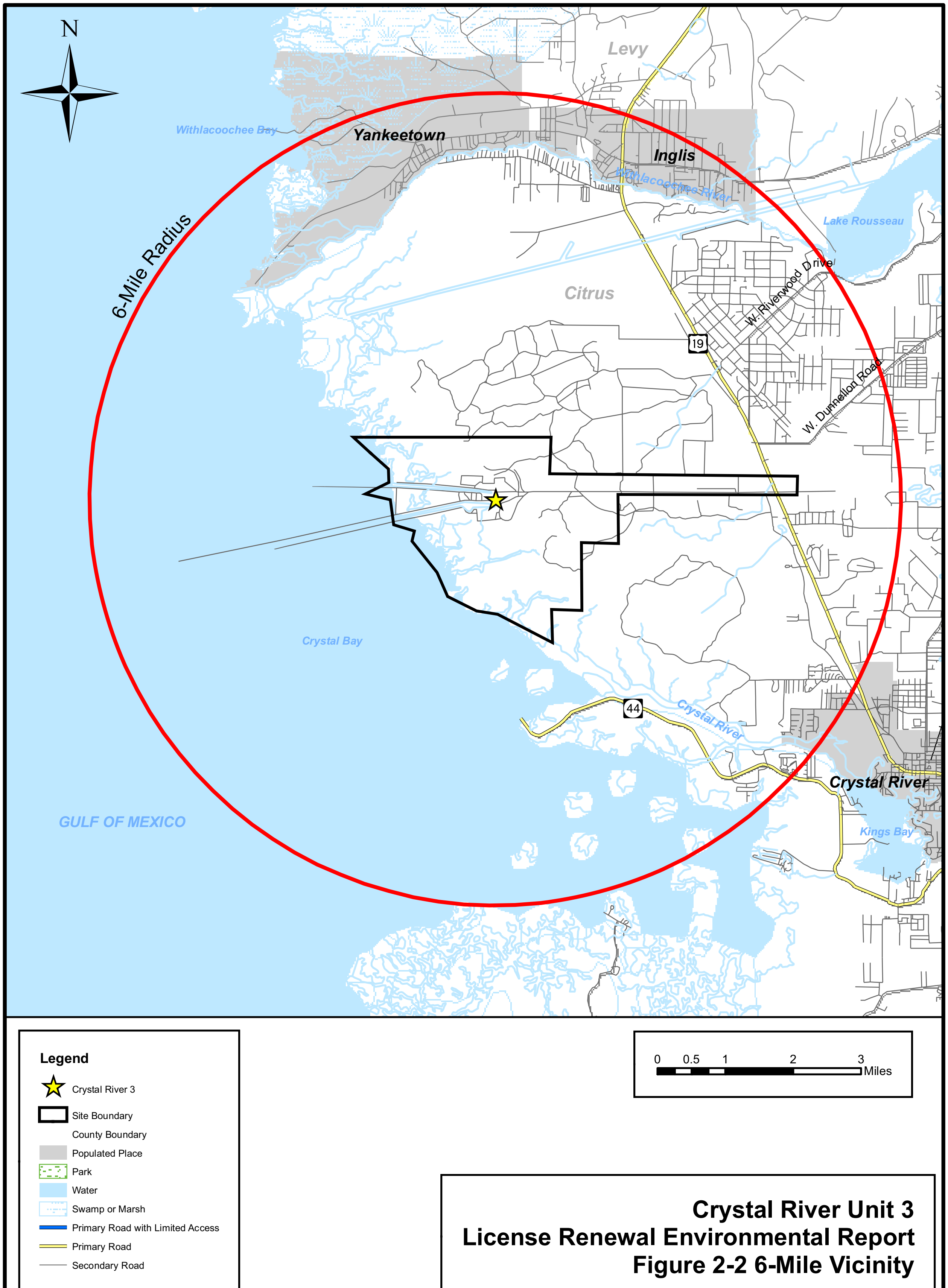
TABLE 2-8
SITES LISTED IN THE NATIONAL REGISTER OF HISTORIC PLACES THAT FALL WITHIN A 6-MILE RADIUS OF CR-3

Site Name	Location
Crystal River Indian Mounds	2 miles NW of Crystal River on U.S. 19-98, Crystal River
Mullet Key	Address Restricted, Crystal River

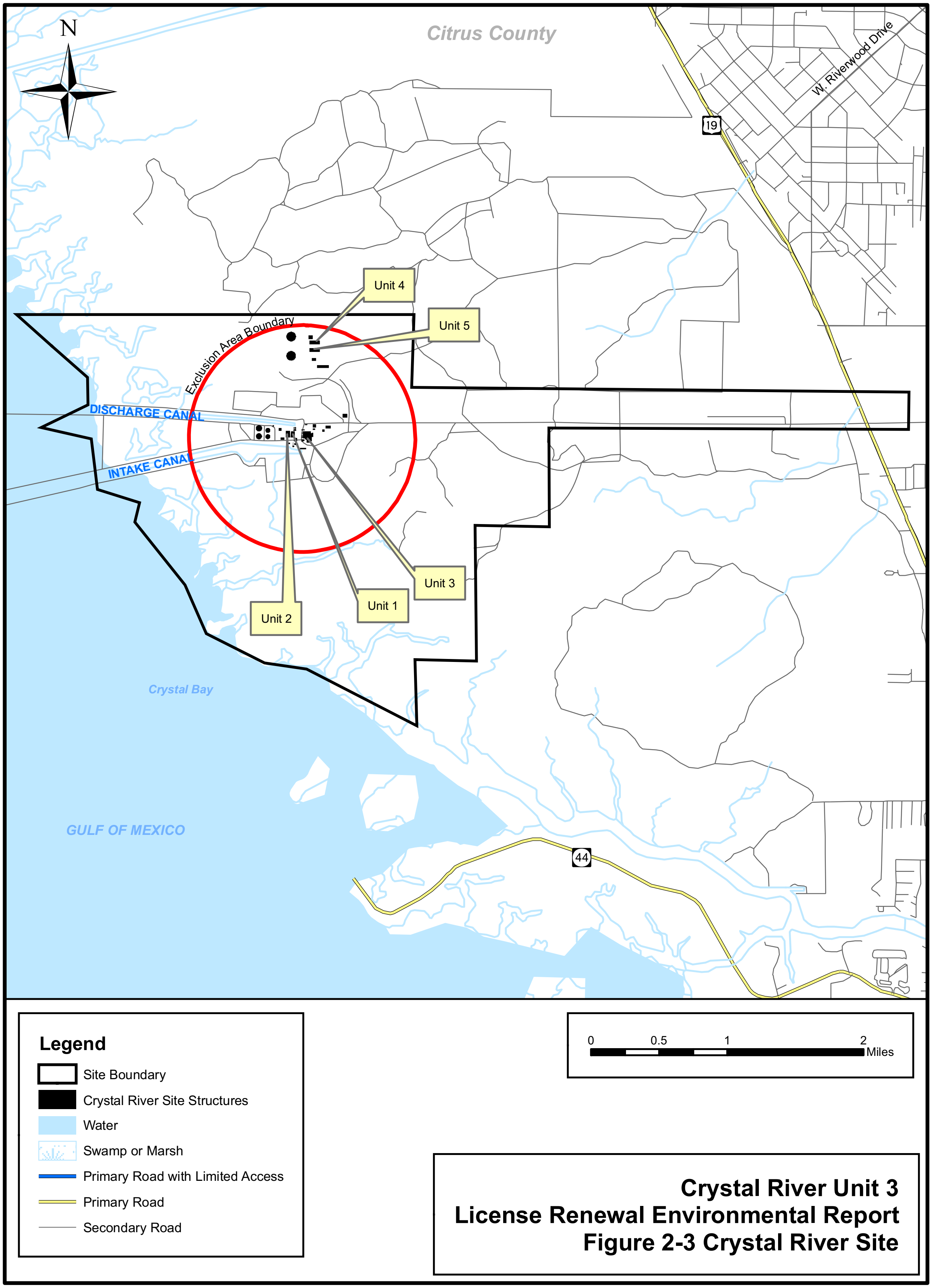
Source: NPS 2008



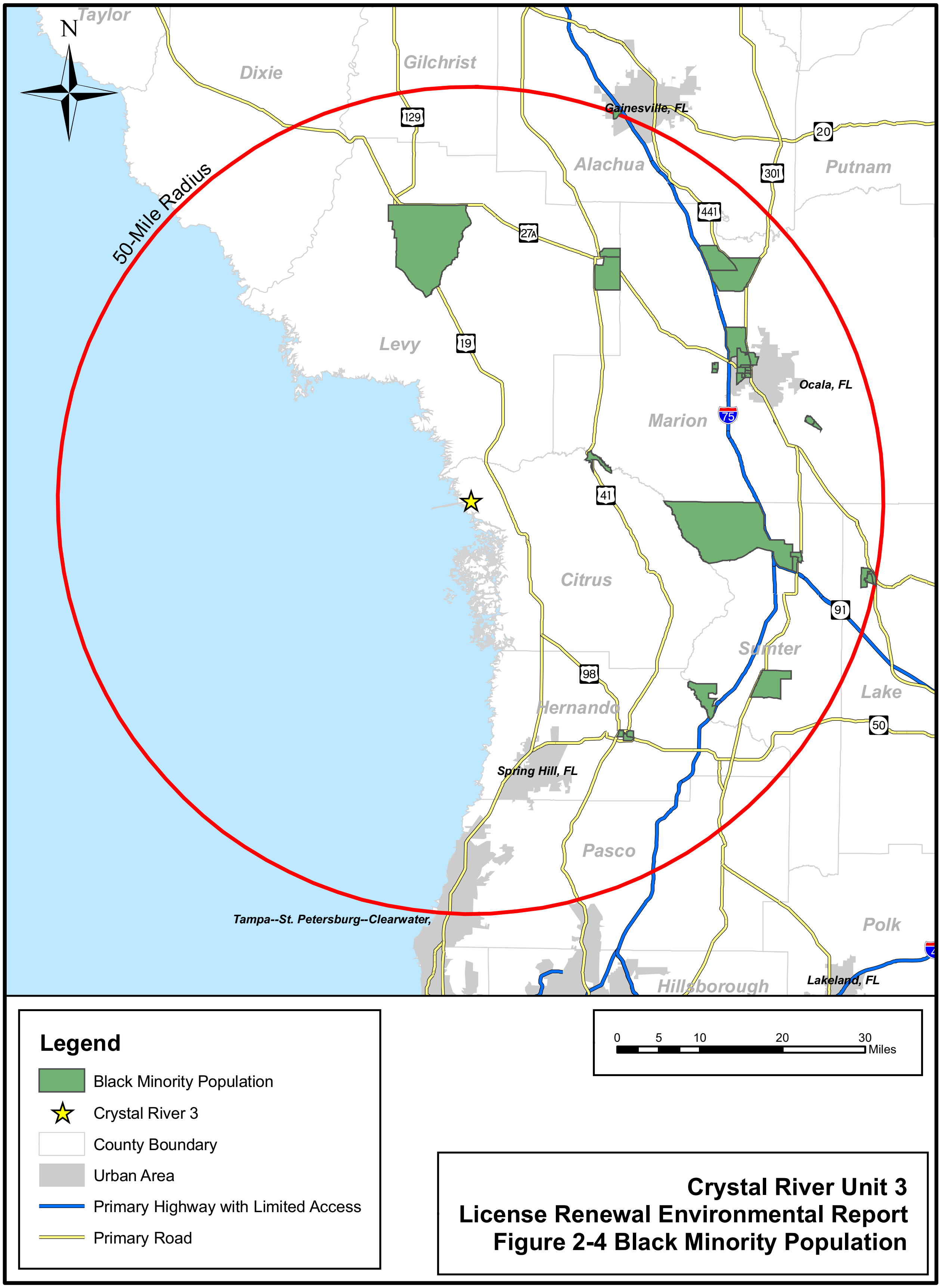
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-1 50-Mile Vicinity



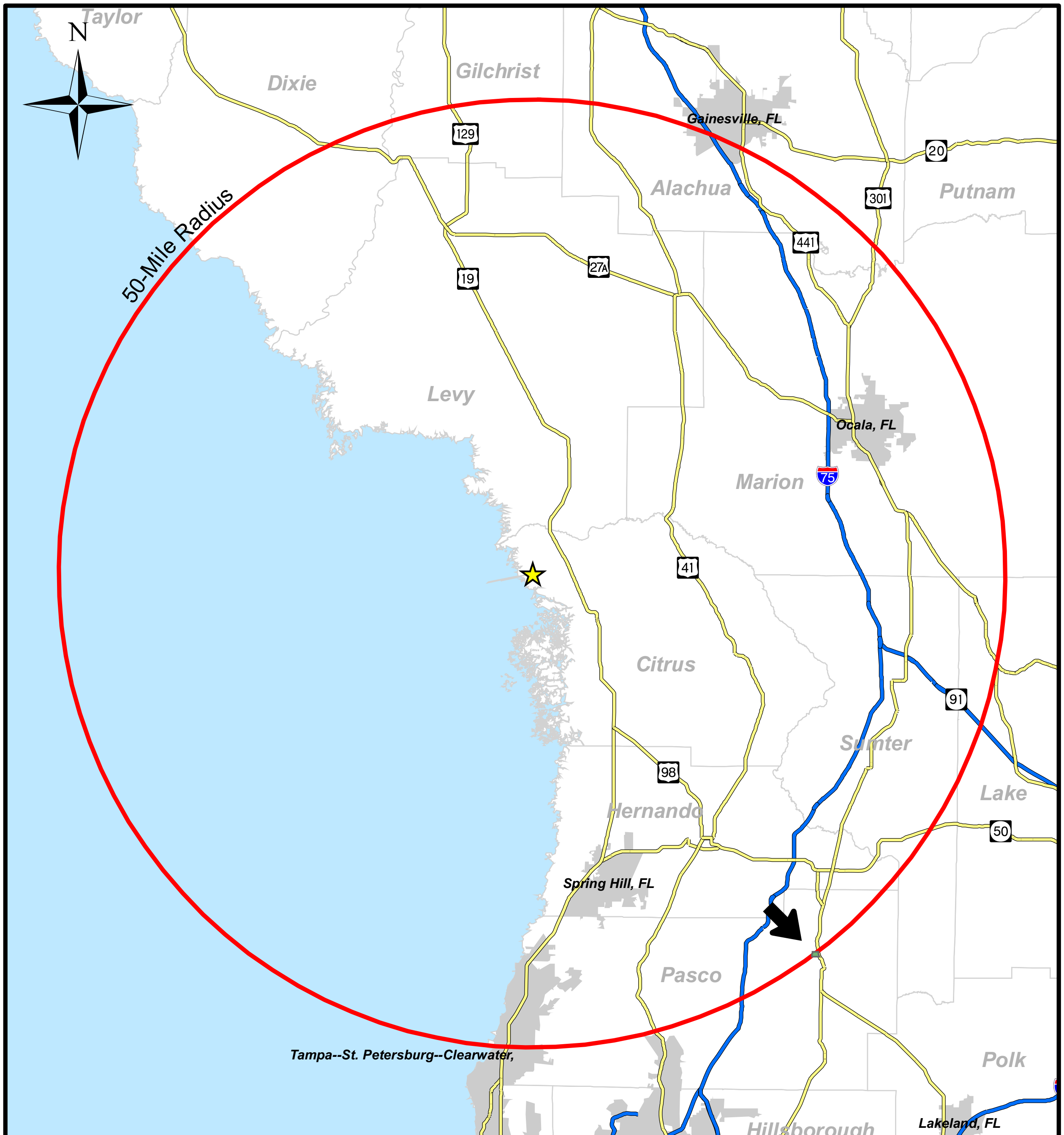
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-2 6-Mile Vicinity



Crystal River Unit 3
License Renewal Environmental Report
Figure 2-3 Crystal River Site



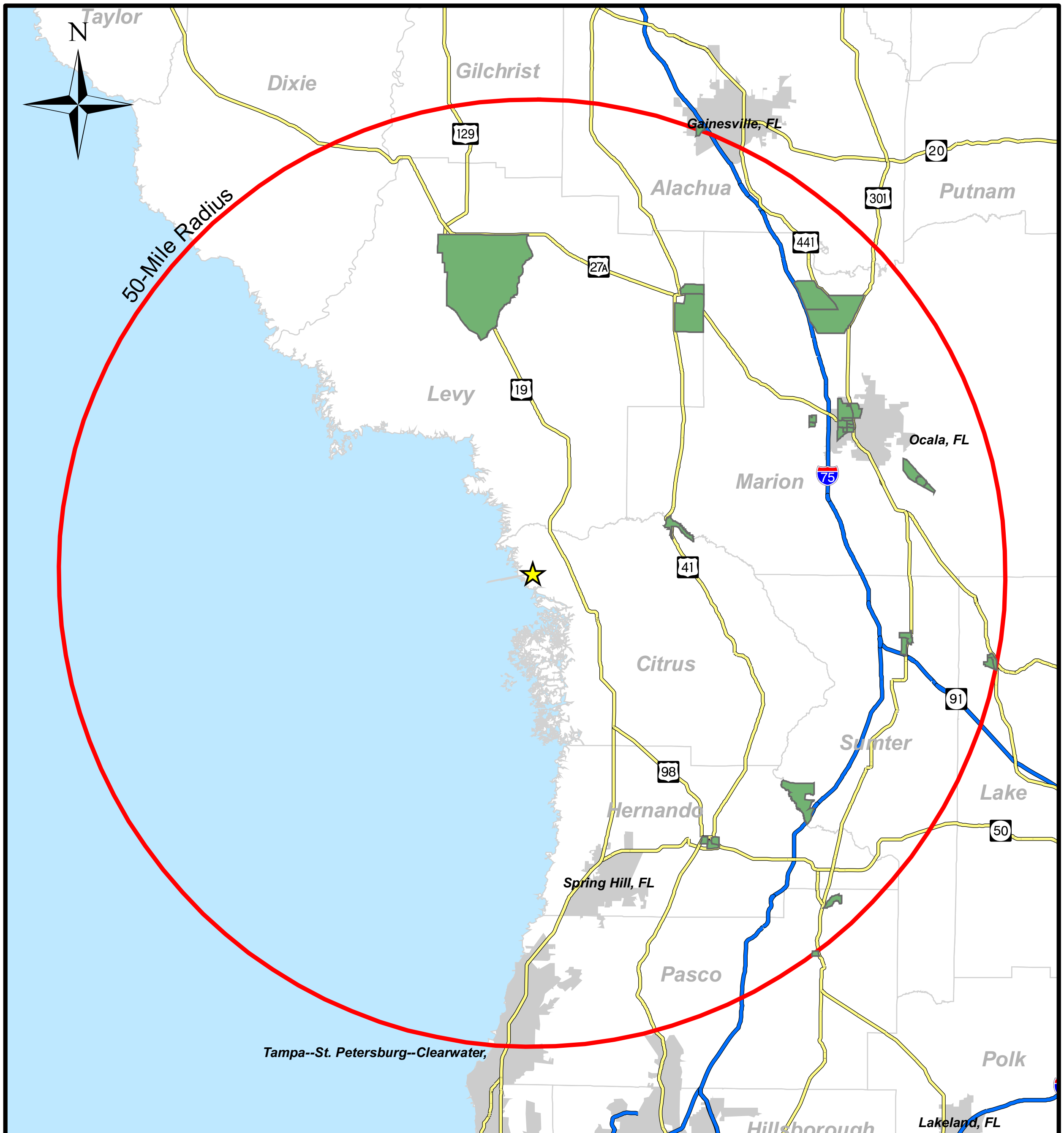
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-4 Black Minority Population



Legend

- Other Minority Population
- Crystal River 3
- County Boundary
- Urban Area
- Primary Highway with Limited Access
- Primary Road

Crystal River Unit 3
License Renewal Environmental Report
Figure 2-5 Other Minority Population

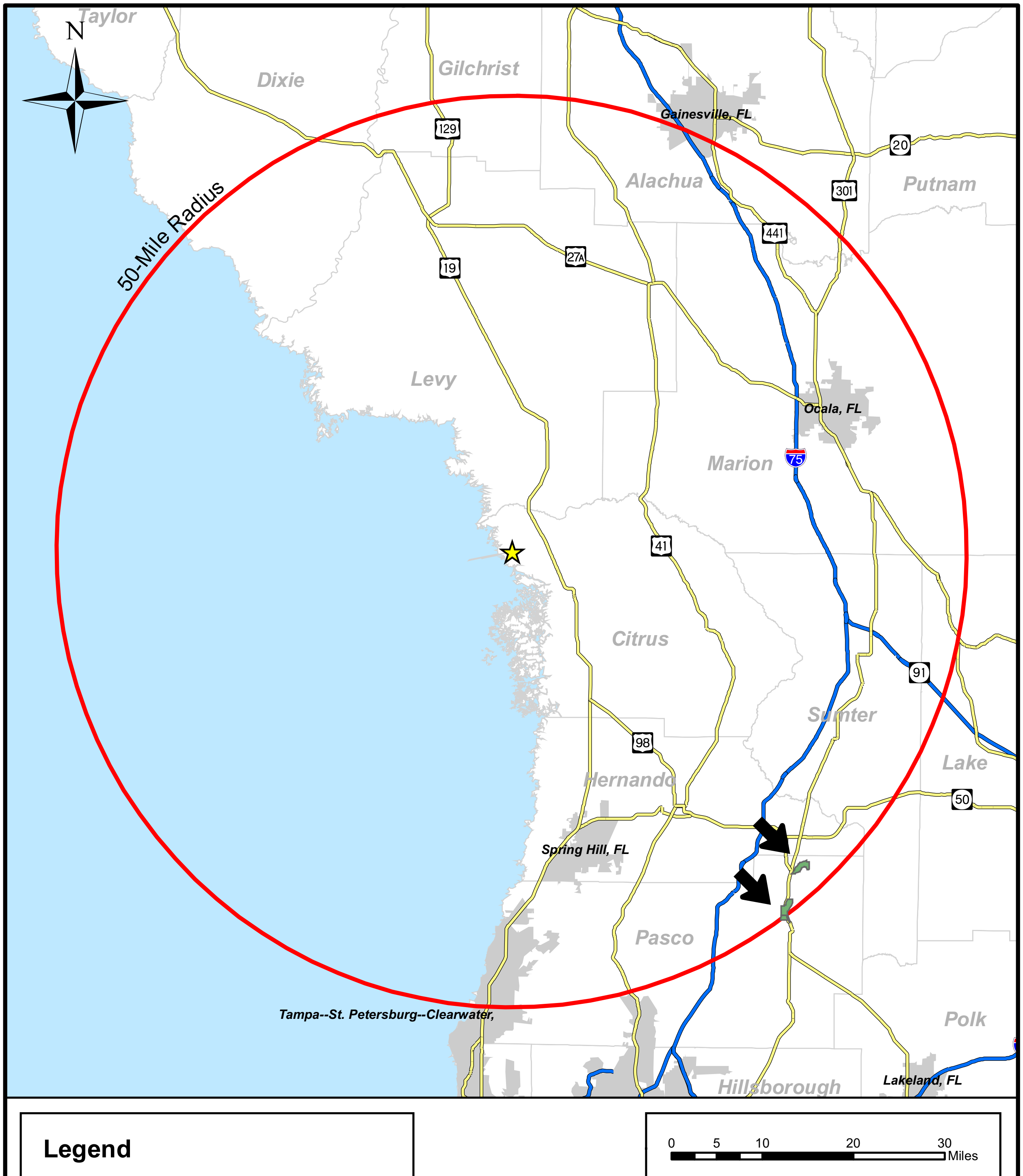


Legend

- Aggregate of Minority Population
- Crystal River 3
- County Boundary
- Urban Area
- Primary Highway with Limited Access
- Primary Road

0 5 10 20 30 Miles

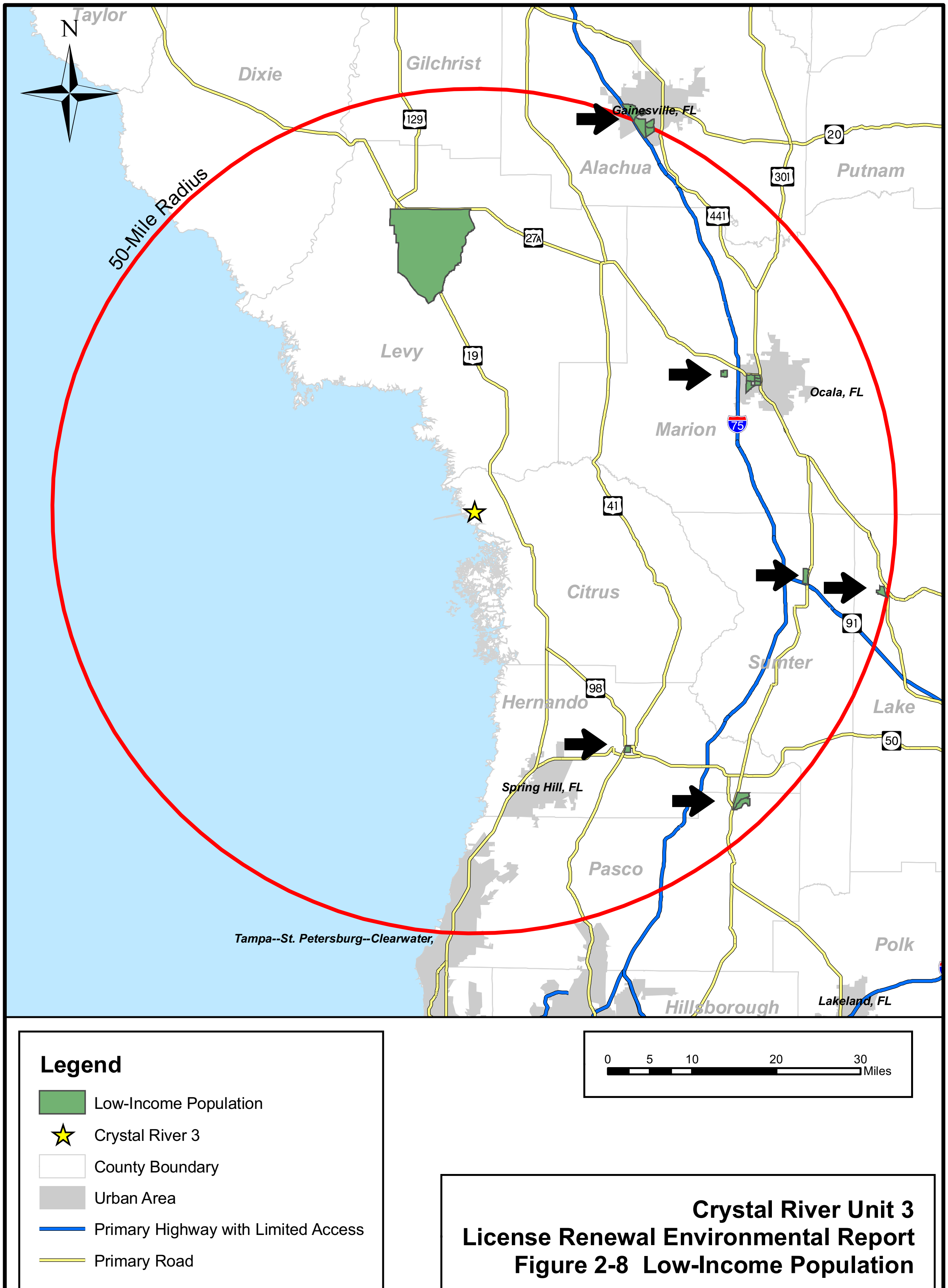
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-6 Aggregate of Minority Population



Legend

- Hispanic Ethnicity Population
- Crystal River 3
- County Boundary
- Urban Area
- Primary Highway with Limited Access
- Primary Road

Crystal River Unit 3
License Renewal Environmental Report
Figure 2-7 Hispanic Ethnicity Population



Crystal River Unit 3
License Renewal Environmental Report
Figure 2-8 Low-Income Population

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3.0 PROPOSED ACTION

NRC

"…The report must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures…. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…." 10 CFR 51.53(c)(2)

Progress Energy proposes that the U.S. Nuclear Regulatory Commission (NRC) renew the operating licenses for Crystal River Unit 3 (CR-3) for an additional 20 years. Renewal would give Progress Energy and the state of Florida the option of relying on CR-3 to meet future electricity needs. Section 3.1 provides basic information on plant design and operation, including reactor and containment systems, cooling and auxiliary water systems, and transmission facilities. Sections 3.2 through 3.4 discuss whether facility modifications or administrative controls could occur as a result of license renewal.

3.1 GENERAL PLANT INFORMATION

Much of the information in this Environmental Report about the history, construction, original design, and operation of CR-3 was obtained from the *Final Environmental Statement related to the proposed Crystal River Unit* 3 (FES) (AEC 1973). The NRC Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) (NRC 1996) also describes certain CR-3 features and, in accordance with NRC requirements, Progress Energy maintains the Final Safety Analysis Report (FSAR) (Florida Power 2005) for CR-3. Progress Energy referred to each of these documents while preparing this environmental report for license renewal.

Florida Power Corporation applied to the AEC for licenses to build and operate a nuclear power plant at the Crystal River site in 1967. The AEC issued a construction permit for the Crystal River plant on September 25, 1968 (AEC 1973, page 1-1). Florida Power Corporation submitted an Environmental Report in February 1971, supplemental information in November 1971, and a revised Environmental Report, Operating License Stage, in January 1972. In May 1973, the U.S. Atomic Energy Commission (AEC), the NRC's predecessor agency, prepared the *Final Environmental Statement related to the proposed Crystal River Unit 3* (AEC 1973). The FES analyzed impacts of (continued) construction and operation of an 855 MWe nuclear plant at a site already occupied by two oil-fired units built in the late 1960s. Aside from extensive excavation and foundation engineering for the new reactor containment building, auxiliary building, and turbine building, it was necessary to extend the intake and discharge canals originally built for Units 1 and 2 and construct two new 500 kilovolt (kV) transmission lines totaling 125 miles to service the regional electric grid (AEC 1973, p. 3-2). The plant's operating license was issued on December 3, 1976 (Scientech 2007). CR-3 achieved initial criticality on January 14, 1977 and began commercial operation on March 13, 1977 (Scientech 2007).

3.1.1 REACTOR AND CONTAINMENT SYSTEMS

CR-3 is a single-unit plant with a conventional domed concrete containment building. The plant includes a pressurized light-water reactor nuclear steam supply system supplied by Babcock & Wilcox and turbine generator designed and manufactured by Westinghouse Electric Company (Scientech 2007).

The reactor containment structure is a steel-lined, reinforced-concrete structure in the shape of a (192-foot high X 130-foot diameter) cylinder, capped with a hemispheric dome (Florida Power 2005). The walls of the containment structure are 3.5 feet thick. The containment is designed to withstand internal pressure of 55 pounds per square inch above atmospheric pressure (55 psig). With its engineered safety features, the containment structure (reactor building) is designed to withstand severe weather (e.g., tornadoes and hurricanes) and provide radiation protection during normal operations and design-basis accidents.

Figure 3-1 shows the plant layout, including the location of the reactor building, the turbine building, and the control building.

CR-3 was initially licensed to operate at a maximum of 2,452 megawatts-thermal (MWt) (Florida Power 2002). In 1981, the NRC approved operation of CR-3 at up to 2,544 MWt. On June 5, 2002 Florida Power submitted a License Amendment Request, seeking NRC approval to operate at a power level of 2,568 MWt (Florida Power 2002). The letter accompanying the License Amendment Request noted that this was a “stretch” uprate involving changes in setpoints, and would not have a significant effect on health, safety, or the environment. On December 6, 2002, NRC approved the request, noting that it would increase the generating capacity of the plant by 0.9 percent, from 895 megawatts electric to 903 megawatts electric (NRC 2002). The CR-3 FSAR is more specific, referring to the 903 megawatts electric value as the plant’s “maximum continuous gross electrical output.” Until December 2007, Progress Energy reported the plant’s generating capacity as 838 MWe (net summer capacity), which is the amount of power actually supplied to the regional grid in summer, the time of peak demand (Progress Energy 2006a). On December 26, 2007, the NRC approved a Progress Energy request to increase the licensed core power level of CR-3 by 1.6 percent, to 2,609 MWt. This “measurement uncertainty recapture power uprate” was achieved by employing enhanced techniques for calculating reactor power. This involves state-of-the-art instrumentation to more precisely measure feedwater flow, which is factored into the calculation of reactor power. The measurement uncertainty uprate for CR-3 increased the reactor’s generating capacity (net summer capacity) from approximately 838 to 850 megawatts electric (NRC 2008).

3.1.2 COOLING AND AUXILIARY WATER SYSTEMS

As discussed in Section 2.1, Crystal River Unit 3 (CR-3) is part of the larger Crystal River Energy Complex, which includes the single nuclear unit and four fossil-fueled units, Crystal River Units 1, 2, 4, and 5. The Crystal River Energy Complex (CREC) is the largest power producing facility in Florida and the eighth largest power producing facility in the U.S., with a total generating capacity of 3,163 MWe. Crystal River Units 1 and 2, built in the 1960s, produce 379 and 491 MWe, respectively, while Crystal River Units 4 and 5, larger units built in the early 1980s, produce 721 and 722 MWe, respectively (EIA 2007).

Units 1, 2, and 3 employ once-through cooling, withdrawing from and discharging to the Gulf of Mexico. Units 4 and 5 are closed-cycle units that withdraw water for cooling tower makeup from the discharge canal for Units 1, 2, and 3. During certain times of the year (May 1 through October 31), a portion of the heated discharge from Units 1, 2, and 3 is routed through helper cooling towers designed to lower discharge temperatures (Golder Associates 2006). The helper cooling towers are operated as necessary to ensure that the discharge temperature does not exceed 96.5°F (as a three-hour rolling average) at the point of discharge to the Gulf of Mexico.

Cooling water for Units 1, 2, and 3 is withdrawn by way of an intake canal south of the units that extends into the Gulf of Mexico. The 14-mile-long intake canal is dredged to a depth of approximately 20 feet to accommodate coal barges, which dock on the south side of the canal, just west of the intakes for Units 1 and 2 (SWEC 1985; Golder Associates 2006). The intake canal is defined by northern and southern dikes that parallel the channel for about 3.4 miles, at which point the southern dike terminates. The northern dike continues along the channel for another 5.3 miles. There are openings in the dikes at irregular intervals to allow north-south boat traffic in the area of the plant. Movement of water into the canal is tidally influenced; at the mouth of the canal current velocities ranged from 0.6 to 2.6 feet per second when last measured, in 1983-1984 (Golder Associates 2006).

The head of the common discharge canal for all units is located just north of Units 1, 2, and 3 (see Figure 3-1). The canal extends west for approximately 1.6 mile to the point-of-discharge, at which point it opens into a bay (SWEC 1985). The dredged channel, bordered to the south by a spoil bank, continues for another 1.2 mile. Water in the discharge canal is dredged to maintain a depth of approximately 10 feet (SWEC 1985).

The cooling water intakes for Units 1 and 2 are located on the north bank of the canal (see Figure 3-1). A floating barrier and a coarse-mesh wire fence extend across the embayment of the intake canal to keep trash and debris out of the intake area. The intake structure for Units 1 and 2 is of conventional design, with external (4-inch openings) bar/trash racks, and eight intake bays (four per unit) with circulating water pumps and (3/8-inch mesh) traveling screens (Golder Associates 2006). Debris and organisms are washed from the traveling screens onto troughs that convey them to sumps adjacent to the intakes.

Unit 1 is equipped with four circulating water pumps, each rated at 77,500 gallons per minute (gpm) (Golder Associates 2006). Unit 2 is equipped with four circulating water pumps, each rated at 82,000 gpm. Depending on operational needs and environmental constraints, these coal-fired units may operate with 3 or 4 pumps. The design flow for Units 1 and 2 is 638,000 gpm or 919 million gallons per day (Golder Associates 2006).

The cooling water intake structure for CR-3 is located approximately 400 feet east of the intake for Units 1 and 2 (see Figure 3-1). A chain link fence extends across the entire width of the intake canal downstream of the intakes for Units 1 and 2. It is intended to intercept floating and partially submerged debris and restrict access to the Unit 3 intake. The Unit 3 intake is 118 feet across and fitted with external trash racks with 4 inch openings between bars. There are four pump bays, each with conventional traveling screens with 3/8-inch mesh. The screens are rotated and washed every 8 hours. Material from the traveling screens is washed onto a trough and sluiced to a sump adjacent to the intake canal.

Unit 3 uses four circulating water pumps, two rated at 167,000 gpm and two rated at 179,000 gpm (Golder Associates 2006). The design intake flow for Unit 3 is 680,000 gpm or 979 million gallons per day (MGD). Service water pumps at Unit 3 withdraw an additional 10,000-20,000 gpm, depending on system demand (Golder Associates 2006).

Units 1, 2, and 3 have a design flow of approximately 1,318,000 gallons (gpm) per minute and 1,898 MGD. The NPDES permit for Units 1, 2, and 3 limits the combined condenser flow to 1897.9 MGD over the May 1 – October 31 period, and 1613.2 MGD from November 1 through April 30. The discharge from the once-through cooling systems of Units 1, 2, and 3 is used as cooling tower makeup for Units 4 and 5.

As noted previously in this section, four permanent helper cooling towers (36 cells) line the northern bank of the discharge canal and receive a portion of the circulating water flow. The helper cooling towers were installed to allow Units 1, 2, and 3, which have a combined discharge, to meet the NPDES (daily maximum) discharge limit of 96.5°F in warmer months. In April 2006, Progress Energy received approval from the state of Florida to install up to 70 additional modular cooling towers. Sixty-seven of the modular cooling towers were ultimately put into service. During hot summers in recent years, Progress Energy has, occasionally chosen to reduce power at coal-fired Units 1 and 2 to stay within NPDES permit thermal limits. The additional towers should allow Units 1 and 2 to operate during the warmest times of the year without reducing power.

3.1.3 TRANSMISSION FACILITIES

The FES (AEC 1973) identifies two 500-kilovolt transmission lines that were built to connect CR-3 to the electric grid: (1) the Central Florida line terminating at the Central Florida Substation and (2) the Lake Tarpon line terminating at the Lake Tarpon Substation. The lines are contained in a common corridor for the first 5.3 miles of corridor, then diverge, with the Central Florida line continuing east and the Lake Tarpon line angling southeast, continuing directly south, and turning southwest toward Tarpon Springs (Figure 3-2).

After publication of the FES, the Brookridge Substation was constructed in 1984 on the Lake Tarpon line in conjunction with Crystal River Unit 5 coming on-line. The Final Safety Analysis Report now identifies this line as the Brookridge line (FSAR, Figure 8-1). Nevertheless, in accordance with 10 CFR 51.53(c)(3)(ii)(H), the transmission lines of interest are those originally constructed to connect CR-3 to the electrical grid. Figure 3-2 is a map of the transmission system of interest. These lines are described more fully as follows:

- Central Florida – Placed into service in 1973, this line extends from the 500-kilovolt switchyard and runs generally eastward for 52.9 miles to the Central Florida Substation west of Leesburg, Florida. The corridor is approximately 150 feet wide and is within an easement already established for lines from the 230-kilovolt switchyard (not connected to CR-3).

- Lake Tarpon – This line runs generally south for 43.4 miles to the Brookridge Substation near Brooksville, Florida and then another 37.6 miles to the Lake Tarpon Substation near Tarpon Springs, Florida. The total line length is 81 miles and the corridor width is approximately 150 feet. Like the Central Florida line, the line follows an existing corridor from the 230-kilovolt switchyard. This line was placed into service in 1973.

The transmission corridors of interest are therefore approximately 134 miles long and occupy approximately 2,440 acres. Both lines are owned and operated by Progress Energy. The corridors pass through low population areas that are primarily forest and agricultural land (EPA 1994). The lines cross numerous state and U.S. highways and the Withlacoochee, Pithlachascotee, and Anclote rivers. Corridors that pass through agricultural land generally continue to be used as such. Progress Energy plans to maintain these transmission lines, which are integral to the larger transmission system, indefinitely. These transmission lines will remain a permanent part of the transmission system after Unit 3 is decommissioned.

Florida Power Corporation designed and constructed the CR-3 transmission lines in accordance with the National Electrical Safety Code (for example, IEEE 1997) and industry guidance that was current when the lines were built. Ongoing right-of-way surveillance and maintenance of Progress Energy transmission facilities ensure continued conformance to design standards. Section 4.13 examines the conformance of the lines with the National Electric Safety Code requirements on line clearance to limit shock from induced currents (IEEE 1997).

Progress Energy uses a variety of methods to ensure that transmission corridors are kept free of brush and fast-growing trees that could interfere with transmission facilities. Progress Energy has developed and implemented a comprehensive rights-of-way vegetation-management plan that includes physical as well as chemical methods to maintain acceptable clearance between energized wires and tree branches. Tree pruning, tree removals, brush cutting, herbicide application, and tree growth regulators are used periodically to ensure reliable operation of the lines and safety of employees and the public (Progress Energy 2006b).

3.2 REFURBISHMENT ACTIVITIES

NRC

"… The report must contain a description of … the applicant's plans to modify the facility or its administrative control procedures…. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…." 10 CFR 51.53(c)(2)

"… The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40 year license term will be from one of two broad categories: ... and (2) major refurbishment or replacement actions, which usually occur fairly infrequently and possibly only once in the life of the plant for any given item…." NRC 1996

Progress Energy has addressed refurbishment activities in this environmental report in accordance with NRC regulations and complementary information in the NRC GEIS for license renewal (NRC 1996). NRC requirements for the renewal of operating licenses for nuclear power plants include the preparation of an integrated plant assessment (IPA) (10 CFR 54.21). The IPA must identify and list systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, piping, supports, and pump casings (see 10 CFR 54.21 for details), as well as those that are not subject to periodic replacement.

In turn, NRC regulations for implementing the National Environmental Policy Act require environmental reports to describe in detail and assess the environmental impacts of refurbishment activities such as planned modifications to systems, structures, and components or plant effluents [10 CFR 51.53(c)(2)]. Resource categories to be evaluated for impacts of refurbishment include terrestrial resources, threatened and endangered species, air quality, housing, public utilities and water supply, education, land use, transportation, and historic and archaeological resources.

The GEIS (NRC 1996) provides helpful information on the scope and preparation of refurbishment activities to be evaluated in this environmental report. It describes major refurbishment activities that utilities might perform for license renewal that would necessitate changing administrative control procedures and modifying the facility. The GEIS analysis assumes that an applicant would begin any major refurbishment work shortly after NRC grants a renewed license and would complete the activities during five outages, including one major outage at the end of the 40th year of operation. The GEIS refers to this as the refurbishment period.

GEIS Table B.2 (NRC 1996) lists license renewal refurbishment activities that NRC anticipated utilities might undertake. In identifying these activities, the GEIS intended to encompass actions that typically take place only once, if at all, in the life of a nuclear plant. The GEIS analysis assumed that a utility would undertake these activities solely for the purpose of extending plant operations beyond 40 years, and would undertake them during the refurbishment period. The GEIS indicates that many plants will have undertaken various refurbishment activities to support the current license period, but that some plants might undertake such tasks only to support extended plant operations. Examples of refurbishment activities include pressurized water reactor steam generator replacement and boiling water reactor recirculation piping replacement when these activities are carried out to ensure safe operations for 20 additional years. The GEIS assumes that refurbishment activities would take place within the 10 years prior to current license expiration and would culminate in a major outage immediately prior to the extended (license renewal) term. Because the situation at Crystal River is analogous, Progress Energy is analyzing CR-3 steam generator replacement in this environmental report as a refurbishment activity, pursuant to 10 CFR 51.53(c)(3)(ii).

The new steam generators will be manufactured at Babcock and Wilcox (B&W) Canada's Cambridge, Ontario facility. The current schedule calls for delivery of the steam generators on July 19, 2009. Installation is to take place during a fall outage that will begin on September 26, 2009 and end 74 days later, on December 9, 2009.

The new steam generators will be transported by rail from Canada, arriving in the Crystal River area on a main Seaboard Coast (CSX system) line that extends north from the Tampa-St. Petersburg area. From the CSX line, the steam generators will be moved to the Crystal River site on a nine-mile-long rail spur that serves the Crystal River Energy Complex and is owned by Progress Energy. The steam generators will be offloaded and temporarily stored next to existing CR-3 warehouse facilities, approximately 500 feet east of the CR-3 containment building. The new steam generators will be moved by multi-axle transporter ("crawler") to the containment building and passed into containment by means of a hole cut in the containment dome. The transporter will follow existing site roads from the temporary storage area to the containment building. Once removed, the old steam generators will be placed in a yet-to-be-built once-through steam generator (OTSG) storage building, which will be located in the general vicinity of the Temporary Assembly Building, which is approximately 1,100 feet east of the CR-3 containment building.

Current plans call for the establishment of materials storage area and concrete batch plant approximately 1,800 feet north-northeast of the CR-3 containment building and a construction laydown area approximately 1,200 feet east-northeast of the CR-3 containment building. Temporary offices will be erected in the area known as "the Swamp," which is immediately adjacent to and east of the CR-3 powerblock.

Any land clearing or construction will occur within the existing plant boundaries. There will be no clearing of previously-undisturbed areas. No road improvements will be required because the steam generators will arrive by rail and be offloaded to a multi-axle transporter capable of traveling on existing site roads and graveled areas without doing any damage. Progress Energy estimates that a peak number of approximately 900 workers will be engaged in steam generator replacement work during the fall 2009 outage in addition to approximately 1,100 workers who will be engaged in normal refueling and maintenance activities.

3.3 PROGRAMS AND ACTIVITIES FOR MANAGING THE EFFECTS OF AGING

NRC

"…The report must contain a description of … the applicant's plans to modify the facility or its administrative control procedures…. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…." 10 CFR 51.53(c)(2)

"…The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40 year license term will be from one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals …." NRC 1996 (SMITTR is defined in NRC 1996 as surveillance, monitoring, inspections, testing, trending, and recordkeeping.)

The IPA required by 10 CFR 54.21 identifies the programs and inspections for managing aging effects at HNP. These programs are described in the Crystal River Unit 3 License Renewal Application, Appendix B, Aging Management Programs. Other than implementation of programs and inspections identified in the IPA, Progress Energy has no plans to modify administrative controls that are associated with license renewal.

3.4 EMPLOYMENT

Current Workforce

Progress Energy employs approximately 455 permanent employees and 85 long-term contract employees at CR-3, a one-unit facility. The permanent staff at a nuclear plant with one reactor normally ranges between 600 and 800 employees (NRC 1996). Approximately 83 percent of the employees live in Citrus County, Florida. The remaining employees are distributed across 10 counties in Florida, with numbers ranging from 1 to 32 employees per county.

CR-3 is on a 24-month refueling cycle (Progress Energy 2005). During refueling outages, the normal plant staff of approximately 540 is supplemented by approximately 1,000 “shared resources,” contract workers and technical specialists who come from other Progress Energy power plants (Progress Energy 2005). Refueling outages in recent years have lasted approximately 40 days.

3.4.1 LICENSE RENEWAL INCREMENT

Performing the license renewal activities described in Section 3.3 would necessitate increasing the CR-3 staff workload by some increment. The size of this increment would be a function of the schedule within which Progress Energy must accomplish the work and the amount of work involved. The analysis of the license renewal employment increment focuses on programs and activities for managing the effects of aging.

The GEIS (NRC 1996) assumes that NRC would renew a nuclear power plant license for a 20-year period, plus the duration remaining on the current license, and that NRC would issue the renewal approximately 10 years prior to license expiration. In other words, the renewed license would be in effect for approximately 30 years. The GEIS further assumes that the utility would initiate surveillance, monitoring, inspections, testing, trending, and recordkeeping (SMITTR) activities at the time of issuance of the new license and would conduct license renewal SMITTR activities throughout the remaining 30-year life of the plant, sometimes during full-power operation (NRC 1996), but mostly during normal refueling and the 5- and 10-year in-service inspection and refueling outages (NRC 1996).

Progress Energy has determined that the GEIS scheduling assumptions are reasonably representative of CR-3 incremental license renewal workload scheduling. Many CR-3 license renewal SMITTR activities would have to be performed during outages. Although some CR-3 license renewal SMITTR activities would be one-time efforts, others would be recurring periodic activities that would continue for the life of the plant.

The GEIS estimates that the most additional personnel needed to perform license renewal SMITTR activities would typically be 60 persons during the 3-month duration of a 10-year in-service inspection and refueling outage. Having established this upper value for what would be a single event in 20 years, the GEIS uses this number as the expected number of additional permanent workers needed per unit attributable to license renewal. GEIS Section C.3.1.2 uses this approach in order to "...provide a realistic upper bound to potential population-driven impacts…."

Progress Energy has identified no need for significant new aging management programs or major modifications to existing programs. Progress Energy anticipates that existing "surge" capabilities for routine activities, such as outages, will enable Progress Energy to perform the increased SMITTR workload without increasing CR-3 staff. Therefore, Progress Energy has no plans to add non-outage employees to support CR-3 operations during the license renewal term. In recent years, refueling and maintenance outages have typically lasted around 40 days and, as described above, result in a large temporary increase in employment at CR-3. Progress Energy believes that increased SMITTR tasks can be performed within this schedule and employment level. Therefore, Progress Energy has no plans to add outage employees for license renewal term outages.

3.4.2 REFURBISHMENT INCREMENT

Performing the refurbishment activities described in Section 3.2 would necessitate increasing the CR-3 staff workforce by some increment. The size of this increment would be a function of the schedule within which Progress Energy must accomplish the work and the amount of work involved.

In the GEIS (NRC 1996), NRC analyzed seven case study sites with respect to typical refurbishment scenarios. NRC selected a variety of nuclear plant sites that would represent the range of plant types in the United States. Then, NRC based its analyses on bounding work force estimates derived from these typical refurbishment scenarios at the case study sites. In the GEIS, NRC estimates that, at peak, the most additional personnel (over the current operations workforce) needed to perform refurbishment activities at a pressurized water reactor would typically be 2,273 persons during a 9-month major refurbishment outage immediately before the expiration of the initial operating license. NRC also estimates that, after the refurbishment workforce has reached its peak, refueling would be undertaken to prepare for continued operation of the plant. In an effort to account for uncertainty surrounding workforce numbers[1], NRC performed a sensitivity analysis where socioeconomic impacts were predicted in response to a refurbishment and refueling work force roughly 50 percent larger than the projected bounding case for a pressurized water reactor work force, or 3,400 workers. Having established this upper value for what would be a single event in the remainder of the life of the plant, the GEIS uses this number as the expected number of additional workers needed per unit attributable to refurbishment.

Progress Energy has identified one refurbishment activity for CR-3: steam generator replacement. The current schedule calls for delivery of the steam generators on July 19, 2009. Installation would take place during a fall outage that would begin on September 26, 2009 and end 74 days later, on December 9, 2009.

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[1] More overlap of the refurbishment and refueling workforces and/or schedule adjustments could cause peak work force numbers to change.

Progress Energy estimates that, during the fall 2009 outage, a peak number of approximately 900 workers would be engaged in steam generator replacement work, followed by approximately 1,100 workers who would be engaged in normal refueling and maintenance activities. Therefore, Progress Energy has determined that the GEIS's work force size and scheduling assumptions amply bound the CR-3 refurbishment and refueling work force sizes and scheduling.

The in-migration of workers to a region would have the indirect effect of creating additional jobs because of the multiplier effect. In the multiplier effect, each dollar spent on goods and services by a worker becomes income to the recipient who saves some but re-spends the rest. In turn, this re-spending becomes income to someone else, who in turn saves part and re-spends the rest. The number of times the final increase in consumption exceeds the initial dollar spent is called the “multiplier.” There are economic models that incorporate buying and selling linkages among regional industries and are used to estimate the impact of employee expenditures in a region of interest. However, while workers engaged in refurbishment (steam generator replacement) would spend money in the region, it is unlikely that they would be spending money in the region for a period long enough to create indirect jobs. Therefore, Progress Energy assumes few to no indirect jobs would be created by this project and a multiplier would not be needed.

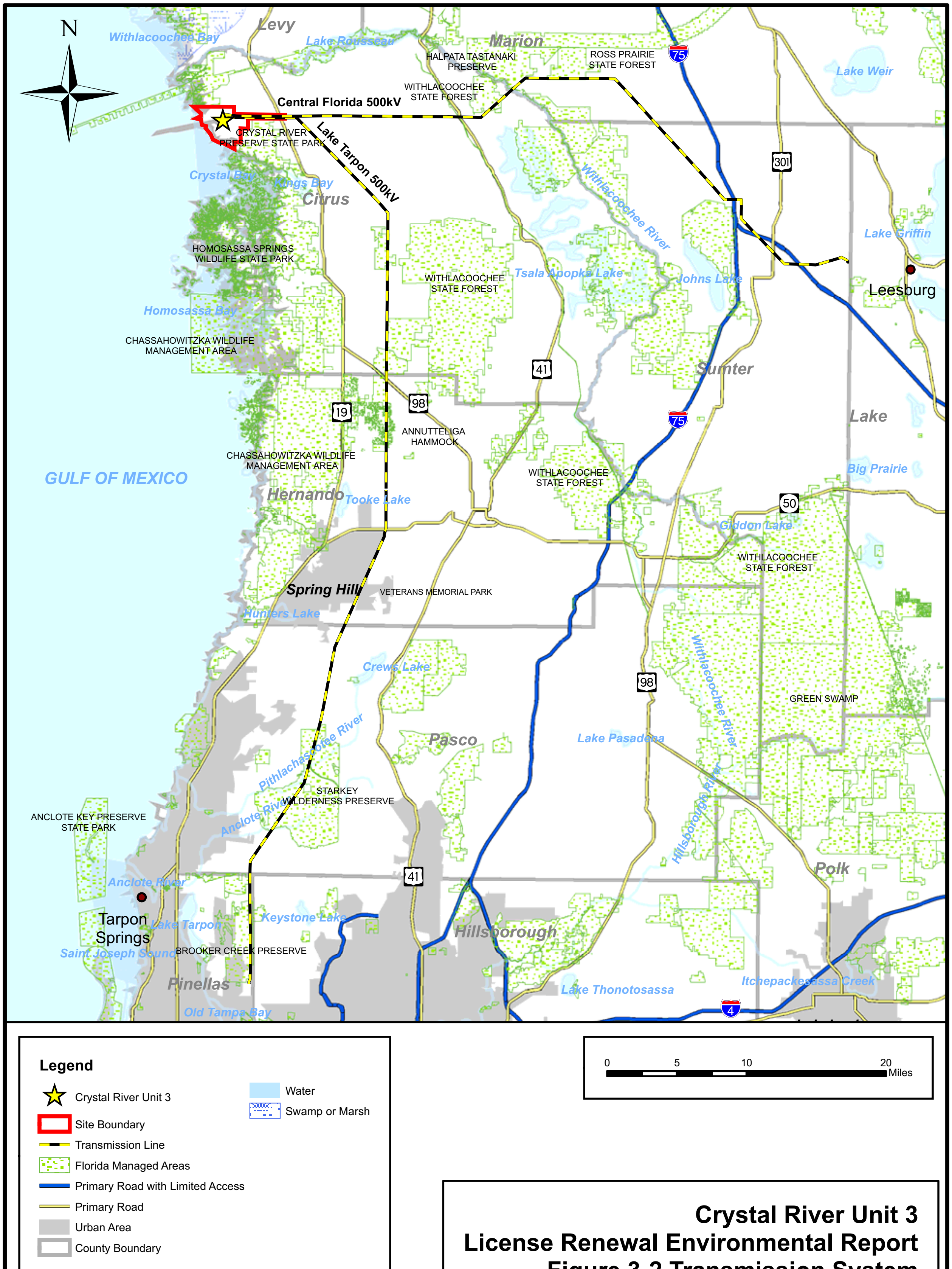
Legend

Site Boundary

Crystal River Site Structures

0 250 500 1,000 1,500 2,000 Feet

Crystal River Unit 3
License Renewal Environmental Report
Figure 3-1 Crystal River Site Layout



Crystal River Unit 3
License Renewal Environmental Report
Figure 3-2 Transmission System

3.5 REFERENCES

Note to reader: Some web pages cited in this document are no longer available, or are no longer available through the original URL addresses. Hard copies of cited web pages are available in Progress Energy files. Some sites, for example the census data, cannot be accessed through their URLs. The only way to access these pages is to follow queries on previous web pages. The complete URLs used by Progress Energy have been given for these pages, even though they may not be directly accessible.

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4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND MITIGATING ACTIONS

NRC

"The report must contain a consideration of alternatives for reducing impacts…for all Category 2 license renewal issues…." 10 CFR 51.53(c)(3)(iii)

"The environmental report shall include an analysis that considers…the environmental effects of the proposed action…and alternatives available for reducing or avoiding adverse environmental effects." 10 CFR 51.45(c) as adopted by 10 CFR 51.53(c)(2)

The environmental report shall discuss the "…impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance…." 10 CFR 51.45(b)(1) as adopted by 10 CFR 51.53(c)(2)

"The information submitted…should not be confined to information supporting the proposed action but should also include adverse information." 10 CFR 51.45(e) as adopted by 10 CFR 51.53(c)(2)

Chapter 4 presents an assessment of the environmental consequences associated with the renewal of the Crystal River Unit 3 (CR-3) operating license. The U.S. Nuclear Regulatory Commission (NRC) has identified and analyzed 92 environmental issues that it considers to be associated with nuclear power plant license renewal and has designated the issues as Category 1, Category 2, or NA (not applicable). NRC designated an issue as Category 1 if, based on the result of its analysis, the following criteria were met:

- the environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic;
- a single significance level (i.e., small, moderate, or large) has been assigned to the impacts that would occur at any plant, regardless of which plant is being evaluated (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent-fuel disposal); and
- mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely to be not sufficiently beneficial to warrant implementation.

If the NRC analysis concluded that one or more of the Category 1 criteria could not be met, NRC designated the issue as Category 2. NRC requires plant-specific analyses for Category 2 issues.

Finally, NRC designated two issues as NA, signifying that the categorization and impact definitions do not apply to these issues.

As discussed later in Chapter 5, Progress Energy is not aware of any new and significant information that would make NRC findings regarding Category 1 issues inapplicable to CR-3. An applicant may reference the generic findings or GEIS analyses for Category 1 issues. Appendix A of this report lists the 92 issues and identifies the environmental report section that addresses each issue.

CATEGORY 1 AND NA LICENSE RENEWAL ISSUES

NRC

"The environmental report for the operating license renewal stage is not required to contain analyses of the environmental impacts of the license renewal issues identified as Category 1 issues in Appendix B to subpart A of this part." 10 CFR 51.53(c)(3)(i)

"…[A]bsent new and significant information, the analyses for certain impacts codified by this rulemaking need only be incorporated by reference in an applicant's environmental report for license renewal…." 61 Federal Register 109, June 5, 1996

Progress Energy has determined that five of the 69 Category 1 issues do not apply to CR-3 because they are specific to design or operational features that are not found at the facility. Appendix A, Table A-1 lists the 69 Category 1 issues, indicates whether or not each issue is applicable to CR-3, and if inapplicable provides the Progress Energy basis for this determination. Appendix A, Table A-1 also includes references to supporting analyses in the GEIS where appropriate.

Progress Energy has reviewed the NRC findings at 10 CFR 51 (Table B-1) and has not identified any new and significant information that would make the NRC findings, with respect to Category 1 issues, inapplicable to CR-3. Therefore, Progress Energy adopts by reference the NRC findings for these Category 1 issues.

"NA" License Renewal Issues

NRC determined that its categorization and impact-finding definitions did not apply to Issues 60 and 92; however, Progress Energy included these issues in Table A-1. NRC noted that applicants currently do not need to submit information on Issue 60, chronic effects from electromagnetic fields (10 CFR 51). For Issue 92, environmental justice, NRC does not require information from applicants, but noted that it will be addressed in individual license renewal reviews (10 CFR 51). Progress Energy has included environmental justice demographic information in Section 2.6.2.

CATEGORY 2 LICENSE RENEWAL ISSUES

NRC

“The environmental report must contain analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for those issues identified as Category 2 issues in Appendix B to subpart A of this part.” 10 CFR 51.53(c)(3)(ii)

“The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues….” 10 CFR 51.53(c)(3)(iii)

NRC designated 21 issues as Category 2. Sections 4.1 through 4.20 (Section 4.17 addresses 2 issues) address each of the Category 2 issues, beginning with a statement of the issue. As is the case with Category 1 issues, six Category 2 issues apply to operational features that CR-3 does not have. If the issue does not apply to CR-3, the section explains the basis for inapplicability.

For the 15 Category 2 issues that Progress Energy has determined to be applicable to CR-3, the appropriate sections contain the required analyses. These analyses include conclusions regarding the significance of the impacts relative to the renewal of the operating license for CR-3 and, if applicable, discuss potential mitigative alternatives to the extent required. Progress Energy has identified the significance of the impacts associated with each issue as either small, moderate, or large, consistent with the criteria that NRC established in 10 CFR 51, Appendix B, 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. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission’s regulations are considered small.
>
> MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
>
> LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

In accordance with National Environmental Policy Act (NEPA) practice, Progress Energy considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are small receive less mitigative consideration than impacts that are large).

4.1 WATER USE CONFLICTS (PLANTS WITH COOLING PONDS OR COOLING TOWERS USING MAKEUP WATER FROM A SMALL RIVER WITH LOW FLOW)

NRC

"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} ft^3 / year (9×10^{10} m^3/year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided. The applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." 10 CFR 51.53(c)(3)(ii)(A)

"…The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 13

The NRC made surface water use conflicts a Category 2 issue because consultations with regulatory agencies indicate that water use conflicts are already a concern at two closed-cycle plants (Limerick and Palo Verde) and may be a problem in the future at other plants. In the GEIS, NRC notes two factors that may cause water use and availability issues to become important for some nuclear power plants that use cooling towers. First, some plants equipped with cooling towers are located on small rivers that are susceptible to droughts or competing water uses. Second, consumptive water loss associated with closed-cycle cooling systems may represent a substantial proportion of the flows in small rivers (NRC 1996, Section 4.3.2.1.).

This issue does not apply to CR-3, because as indicated in Section 3.1.2, the plant does not use a cooling pond and does not withdraw makeup water from a small river. As described in Section 3.1.2, CR-3 is equipped with a once-through heat dissipation system that withdraws water from the Gulf of Mexico for condenser cooling and discharges to the same body of water.

4.2 ENTRAINMENT OF FISH AND SHELLFISH IN EARLY LIFE STAGES

NRC

"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations…or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from…entrainment." 10 CFR 51.53(c)(3)(ii)(B)

"The impacts of entrainment are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. Further, ongoing efforts in the vicinity of these plants to restore fish populations may increase the numbers of fish susceptible to intake effects during the license renewal period, such that entrainment studies conducted in support of the original license may no longer be valid." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 25

NRC made impacts on fish and shellfish resources resulting from entrainment a Category 2 issue, because it could not assign a single significance level to the issue. The impacts of entrainment are small at many plants, but they may be moderate or large at others. Also, ongoing restoration efforts may increase the number of fish susceptible to intake effects during the license renewal period (NRC 1996, Section 4.2.2.1.2). Information needing to be ascertained includes: (1) type of cooling system (whether once-through or cooling pond), and (2) status of Clean Water Act (CWA) Section 316(b) determination or equivalent state documentation.

As Section 3.1.2 describes, CR-3 uses a once-through heat dissipation system that withdraws water from the Gulf of Mexico for condenser cooling and discharges to the same body of water. Although classified as a once-through plant in the GEIS (NRC 1996, Tables 2-1 and 2-2), Crystal River does use helper cooling towers at certain times of the year in order to meet NPDES permit thermal limits. Figure 3-1 shows the intake canal, discharge canal, and helper cooling towers used by Crystal River Units 1, 2, and 3.

Section 316(b) of the CWA requires that any standard established pursuant to Sections 301 or 306 of the CWA shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment through the condenser cooling system of fish and shellfish in early life stages is a potential adverse environmental impact that can be minimized by the best available technology.

Florida Power Corporation (FPC) conducted studies at Crystal River in the 1970s and again over the 1983-1984 period to gauge the impact of the Crystal River (Units 1, 2, and 3) cooling water intake structure (CWIS) on local and regional fish populations (SWEC 1985). Ichthyoplankton and meroplankton samples were collected bi-weekly over a 15-month period in 1983-1984 at 15 stations in the area of the plant, including three stations in the intake canal, a station in the discharge canal, stations in local tidal creeks, and stations well offshore of the plant. The station with highest densities was used to estimate entrainment, after adjusting for the plant's cooling water withdrawal rate (Golder Associates 2006).

The Bay anchovy was the species most often entrained. Using known natural mortality rates to convert the numbers of eggs, prolarvae, and postlarvae entrained to numbers of "equivalent adults" yielded 10.4 million, 0.75 million, and 6.7 million adult bay anchovies, respectively, lost per year (SWEC 1985). The number of juvenile anchovies entrained was estimated to be the equivalent of 3.8 million adults. Substantially lower numbers of other fish species (e.g., polka-dot batfish, seatrout, spot, and striped mullet) were entrained. Pink shrimp equivalent adult losses were 22, 18,830, and 10,230 for mysids (larvae), postlarvae, and juveniles, respectively.

With regard to entrainment, the 316(b) report for Crystal River Units 1, 2, and 3 concluded that for most species entrainment losses (expressed as equivalent adults) were a "small fraction" of the commercial and recreational catch and represented an "acceptable level of exploitation" (SWEC 1985). In another place in the report, the authors note that "For the majority of the species, the level of entrainment estimated represented a small percentage of the commercial landings or recreational catch."

In January 1985, FPC submitted the comprehensive 316 Demonstration study (evaluated both cooling water intake system impacts and thermal impacts) to the EPA, as required by the plant's NPDES permit. After reviewing the study, the EPA concluded that entrainment and impingement losses were unacceptably high and indicative of an "adverse impact to the biota of Crystal Bay and environs" (Golder Associates 2006, Section 5.1.3). FPC and the EPA considered a range of potential mitigation measures and ultimately determined that flow reduction and stock enhancement (rearing and stocking recreationally important fish species) showed the most potential for mitigating entrainment and impingment losses at the plant's CWIS.

The NPDES permit issued in September 1988 stipulated that cooling water withdrawals would be limited to 1,897.9 MGD over the May 1 – October 31 period and 1,613.2 MGD over the November 1 – April 30 period. Permits issued since that time have also limited cooling water withdrawals over the November – April period, when many important species move inshore to spawn. Fall, winter, and early-spring spawners in the Crystal River area include pinfish, Atlantic croaker, Gulf flounder, Gulf menhaden, striped mullet, and spot (AEC 1973).

In October 1991, as part of the negotiated settlement with EPA, FPC opened the Crystal River Mariculture Center, a multi-species marine hatchery intended to mitigate impacts of the Crystal River plant's once-through cooling system (FWC undated). The

Mariculture Center includes a 8,100 square foot hatchery building with four spawn rooms and eight one-acre grow-out ponds. Red drum, spotted seatrout, pink shrimp, and striped mullet were the species initially selected for culture. Pigfish and silver perch were added as the fifth and sixth species; blue crab and stone crab were cultured for the first time in 2003 (Progress Energy 2004). In 2004, the last year for which data are available, 15,000 red drum fingerlings were released, bringing the total to 945,394 since the Mariculture Center began operating (Progress Energy 2005). In 2004, 16,500 seatrout fingerlings were released, bringing the total to 808,164 (Progress Energy 2005). No pink shrimp were released in 2004. A total of 49,755 pink shrimp were released in 2003, however, bringing the total to 241,898 (Progress Energy 2004). Fish produced at the Mariculture Center are released in areas of the Gulf of Mexico for which they are best suited, based on time of year and water quality conditions. Fish are tagged in order to evaluate their survival and movement after release (FWC undated).

The Fact Sheet for the current NPDES permit, Permit No. FL0000159 (Major), contains the following synopsis:

> "Section 316(b) CWA requires that the location, design, construction, and capacity of a cooling water intake structure reflect the best technology available for minimizing environmental impacts. In 1988, EPA determined that a reduction of plant flow by 15 percent during the months of November through April, in conjunction with the construction and operation of a fish hatchery over the remaining operating life of the three units constituted minimization of the environmental impacts of the cooling water intake."

Thus the NPDES permit for Crystal River Units 1, 2, and 3, issued May 9, 2005, constitutes the current CWA Section 316(b) determination for CR-3. This permit, included as Appendix B, is scheduled to expire on May 8, 2010. For this reason, and because of the mitigation measures already in place, Progress Energy concludes that impacts of entrainment of fish and shellfish at CR-3 are SMALL and warrant no additional mitigation.

4.3 IMPINGEMENT OF FISH AND SHELLFISH

NRC

“If the applicant’s plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations…or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from…impingement….” 10 CFR 51.53(c)(3)(ii)(B)

“The impacts of impingement are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems.” 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 26

NRC made impacts on fish and shellfish resources resulting from impingement a Category 2 issue because it could not assign a single significance level to the issue. The impacts of impingement are small at many plants, but they may be moderate or large at others (NRC 1996, Section 4.2.2.1.3). Information needing to be ascertained includes: (1) type of cooling system (whether once-through or cooling pond), and (2) status of CWA Section 316(b) determination or equivalent state documentation.

As Section 3.1.2 describes, CR-3 has a once-through heat dissipation system that uses water from the Gulf of Mexico for condenser cooling. Although classified as a once-through plant in the GEIS (NRC 1996, Tables 2-1 and 2-2), Crystal River uses helper cooling towers at certain times of the year in order to meet NPDES permit thermal limits. Figure 3-1 shows the intake canal, discharge canal, and helper cooling towers used by Crystal River Units 1, 2, and 3.

FPC conducted studies at Crystal River in the 1970s and again over the 1983-1984 timeframe to gauge the impact of the CR-3 CWIS on local and regional fish populations (SWEC 1985). Impingement studies were conducted at Units 1, 2, and 3 for one randomly-selected 24 hour period per week for 12 months from June 1983 through May 1984. The study focused on Selected Important Organisms (SIO) chosen in consultation with resource and regulatory agencies (chiefly EPA, which administered the NPDES program in Florida at the time). The bay anchovy was the fish species most often impinged at CR-3, with 64,518 individuals in samples (SWEC 1985). The polka-dot batfish was second in number impinged (40,728 fish), but first in terms of biomass (1,978 kilograms). Substantial numbers of spot (12,744), silver perch (6,214) and pinfish (6,189) were also impinged. Shellfish were impinged at a much higher rate than finfish: 391,457 pink shrimp weighing 1,953 kilograms and 255,518 blue crab weighing 9,186 kilograms were impinged over the 12-month period (SWEC 1985).

In January 1985, FPC submitted a comprehensive 316 Demonstration study (evaluated both cooling water intake system impacts and thermal impacts) to the EPA, as required by the plant's NPDES permit. After reviewing the study, the EPA concluded that entrainment and impingement losses were unacceptably high and indicative of an "adverse impact to the biota of Crystal Bay and environs" (Golder Associates 2006, Section 5.1.3). FPC and the EPA considered a range of potential mitigation measures and ultimately determined that flow reduction and stock enhancement (rearing and stocking recreationally important fish species) showed the most potential for mitigating entrainment and impingement losses at the plant's CWIS.

The NPDES permit issued in September 1988 stipulated that cooling water withdrawals would be limited to 1,897.9 MGD over the May 1 – October 31 period and 1,613.2 MGD over the November 1 – April 30 period. Permits issued since that time have also limited cooling water withdrawals over the November – April period, when many important species move inshore to spawn. Fall, winter, and early-spring spawners in the Crystal River area include pinfish, Atlantic croaker, Gulf flounder, Gulf menhaden, striped mullet, and spot (AEC 1973).

The Fact Sheet for the current NPDES permit, Permit No. FL0000159 (Major), contains the following synopsis:

> "Section 316(b) CWA requires that the location, design, construction, and capacity of a cooling water intake structure reflect the best technology available for minimizing environmental impacts. In 1988, EPA determined that a reduction of plant flow by 15 percent during the months of November throufh April, in conjuction with the construction and operation of a fish hatchery over the remaining operating life of the three units constituted minimization of the environmental impacts of the cooling water intake."

Thus the current NPDES permit for Crystal River Units 1, 2, and 3 issued on May 9, 2005 constitutes the current CWA Section 316(b) determination for CR-3. This permit, included as Appendix B, is scheduled to expire on May 8, 2010. For this reason, and because of the mitigation measures already in place, Progress Energy concludes that impacts of impingement of fish and shellfish at CR-3 are SMALL and warrant no additional mitigation.

4.4 HEAT SHOCK

NRC

"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act… 316(a) variance in accordance with 40 CFR 125, or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from heat shock …." 10 CFR 51.53(c)(3)(ii)(B)

"…Because of continuing concerns about heat shock and the possible need to modify thermal discharges in response to changing environmental conditions, the impacts may be of moderate or large significance at some plants…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 27

NRC made impacts on fish and shellfish resources resulting from heat shock a Category 2 issue, because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996). Information to be ascertained includes: (1) type of cooling system (whether once-through or cooling pond), and (2) evidence of a CWA Section 316(a) variance or equivalent state documentation.

As Section 3.1.2 describes, CR-3 has a once-through heat dissipation system that withdraws water from the Gulf of Mexico for condenser cooling and discharges to the same body of water. Although classified as a once-through plant in the GEIS (NRC 1996, Tables 2-1 and 2-2), Crystal River does use helper cooling towers at certain times of the year in order to meet NPDES permit thermal limits. Figure 3-1 shows the intake canal, discharge canal, and helper cooling towers used by Crystal River Units 1, 2, and 3.

Section 316(a) of the Clean Water Act establishes a process whereby a thermal effluent discharger can demonstrate that thermal discharge limitations are more stringent than necessary to assure the protection and propagation of balanced, indigenous population of fish and wildlife in and on the receiving waters and can obtain facility-specific thermal discharge limits (33 USC 1326). FPC submitted a comprehensive 316 Demonstration study (evaluated both cooling water intake system impacts and thermal impacts) to the EPA in January 1985, as required by the plant's NPDES permit. The EPA issued an NPDES permit to the facility in 1988 with an alternative thermal limit (daily maximum discharge temperature of 96.5°F based on a three-hour rolling average), an alternative limit that has been part of every NPDES permit issued since that time. The Fact Sheet for the current Crystal River NPDES permit (FL0000159) presents this history and explains that the variance is still in effect because "there have been no physical or operational changes since the last permit renewal and no changes are expected in the upcoming permit cycle that will materially change the plant cooling water intake and discharge characteristics.”

Based on the fact that FPC was granted a thermal variance for Crystal River Units 1, 2, and 3 in accordance with Section 316(a) of the Clean Water Act in 1988 and this variance remains a part of the current NPDES permit, issued to Progress Energy in May 9, 2005, Progress Energy concludes that impacts to fish and shellfish from heat shock at CR-3 are SMALL and warrant no additional mitigation.

4.5 GROUNDWATER USE CONFLICTS (PLANTS USING > 100 GPM OF GROUNDWATER)

NRC

"If the applicant's plant…pumps more than 100 gallons (total onsite) of ground water per minute, an assessment of the impact of the proposed action on groundwater use must be provided." 10 CFR 51.53(c)(3)(ii)(C)

"…Plants that use more than 100 gpm may cause ground-water use conflicts with nearby ground-water users…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 33

NRC made groundwater use conflicts a Category 2 issue because, at a withdrawal rate of more than 100 gallons per minute (gpm), a cone of depression could extend offsite. This could deplete the groundwater supply available to offsite users, an impact that could warrant mitigation. Information to be ascertained includes: (1) CR-3 groundwater withdrawal rate (whether greater than 100 gpm), (2) drawdown at offsite location, and (3) impact on neighboring wells.

As discussed in Section 2.3, over the 2001-2005 period, CR-3 used groundwater supplied to the South water treatment facility from wells SPW-3, SPW-4, and SPW-5 at a total rate of 227 gallons per minute (gpm). Therefore, the issue of groundwater use conflicts does apply.

In order to determine potential offsite impacts to wells, the 227 gpm average cumulative groundwater use by CR-3 was used to calculate drawdown as though it had been pumped from a single onsite well. The Well CR3P (SPW-3) location was used, due to its close proximity to the CREC property boundary (approximately 330 feet from the well). Data used to input to an analytical distance-drawdown model was taken from a 1979 hydrogeologic report. A groundwater evaluation was performed to determine the hydrogeologic impact of a proposed well field at the Crystal River complex. Pump tests were performed in four wells (PW-1, PW-2, PW-3, and PW-4) simultaneously to determine whether the surfial aquifer (upper Floridan) could supply sufficient water to supply the operation of the proposed facilities.

The results of the pump tests were used to make the following assumptions: (1) the water was pumped from four adjacent wells (located 500 feet apart) and each well was pumped at 525 gpm, (2) no groundwater recharge (rain) occurred during a 90-day period, (3) the aquifer transmissivity was 1,000,000 gpd/ft, and (4) the storage coefficient was 0.05. The maximum predicted drawdown at the CREC property boundary approximately 330 feet south of the well field was calculated to be approximately 1.78 feet with a maximum predicted drawdown in the production wells of 2.51 feet (Geraghty and Miller 1979).

These same assumptions were used to determine the potential impact from pumping a single well at a rate of 227 gpm to determine potential impacts for CR-3.

The drawdown in the wells used in the Geraghty and Miller study was less than three feet and represented a small portion of the saturated thickness of the unconfined aquifer. This allowed a confined aquifer scenario to be used to simulate site conditions to evaluate CR-3's water use. The equations used in the calculations assume that the aquifer is homogeneous, isotopic, with negligible recharge and gradient, and that boundary impacts do not occur. Assuming minimal recharge made the scenario very conservative. It was also assumed that the pumping rate used in the modeling (227 gpm) was consistent from the initial startup period.

Employing these conservative assumptions, modeling indicates that pumping at a rate of 227 gpm from Well CR-3 (PW-3) would create a 0.3-foot drawdown during the first 30 years of plant operations. Based on the modeling performed, 0.4 foot of drawdown would occur over the period of the current operating license (40 year period) with no additional increase in drawdown during the license renewal period (additional 20 years) (TtNUS 2008a). Based on the predicted conservative drawdown (0.4 foot) that would occur during the life of the current operating permit and remain stable during the license renewal period, Progress Energy concludes that the impacts to the aquifer system over the license renewal period will be SMALL and mitigation, such as drilling wells deeper, would be unwarranted.

4.6 GROUNDWATER USE CONFLICTS (PLANTS USING COOLING TOWERS WITHDRAWING MAKEUP WATER FROM A SMALL RIVER)

NRC

"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} ft^3 / year...[t]he applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." 10 CFR 51.53(3)(ii)(A)

"…Water use conflicts may result from surface water withdrawals from small water bodies during low flow conditions which may affect aquifer recharge, especially if other groundwater or upstream surface water users come on line before the time of license renewal…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 34

NRC made this groundwater use conflict a Category 2 issue because consumptive use of withdrawals from small rivers could adversely impact aquatic life, downstream users of the small river, and groundwater-aquifer recharge. This is a particular concern during low-flow conditions and could create a cumulative impact due to upstream consumptive use. Cooling towers and cooling ponds lose flow due to evaporation, which is necessary to cool the heated water before it is discharged to the environment.

The issues of groundwater conflicts stated above do not apply to CR-3. As discussed in Section 3.1.2, CR-3 withdraws its cooling water from the Gulf of Mexico and not from a small river.

4.7 GROUNDWATER USE CONFLICTS (PLANTS USING RANNEY WELLS)

NRC

"If the applicant's plant uses Ranney wells…an assessment of the impact of the proposed action on groundwater use must be provided." 10 CFR 51.53(c)(3)(ii)(C)

"…Ranney wells can result in potential ground-water depression beyond the site boundary. Impacts of large ground-water withdrawal for cooling tower makeup at nuclear power plants using Ranney wells must be evaluated at the time of application for license renewal…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 35

NRC made this groundwater use conflict a Category 2 issue because large quantities of groundwater withdrawn from Ranney wells could degrade groundwater quality at river sites by induced infiltration of poor-quality river water into an aquifer.

The issue of groundwater use conflicts does not apply to CR-3 because the plant does not use Ranney wells. As Section 3.1.2 describes, CR-3 withdraws its cooling water from the Gulf of Mexico.

4.8 DEGRADATION OF GROUNDWATER QUALITY

NRC

"If the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on groundwater quality must be provided." 10 CFR 51.53(c)(3)(ii)(D)

"…Sites with closed-cycle cooling ponds may degrade ground-water quality. For plants located inland, the quality of the ground water in the vicinity of the ponds must be shown to be adequate to allow continuation of current uses…." 10 CFR 51, Subpart A, Appendix B, Table B 1, Issue 39

NRC made degradation of groundwater quality a Category 2 issue because evaporation from closed-cycle cooling ponds concentrates dissolved solids in the water and settles suspended solids. In turn, seepage into the water table aquifer could degrade groundwater quality.

The issue of groundwater degradation does not apply to CR-3 because the plant does not use cooling ponds. As Section 3.1.2 describes, CR-3 withdraws cooling water from the Gulf of Mexico.

4.9 IMPACTS OF REFURBISHMENT ON TERRESTRIAL RESOURCES

NRC

The environmental report must contain an assessment of "…the impacts of refurbishment and other license renewal-related construction activities on important plant and animal habitats…." 10 CFR 51.53(c)(3)(ii)(E)

"…Refurbishment impacts are insignificant if no loss of important plant and animal habitat occurs. However, it cannot be known whether important plant and animal communities may be affected until the specific proposal is presented with the license renewal application…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 40

"…If no important resources would be affected, the impacts would be considered minor and of small significance. If important resources could be affected by refurbishment activities, the impacts would be potentially significant…." NRC 1996

NRC made impacts to terrestrial resources from refurbishment a Category 2 issue, because the significance of ecological impacts cannot be determined without considering site- and project-specific details (NRC 1996, Section 3.6). Aspects of the site and project to be ascertained are: (1) the nature of refurbishment activities, (2) the identification of important ecological resources, and (3) the extent of impacts to plant and animal habitats.

The only license-renewal related construction activities anticipated are those associated with the replacement of the CR-3 steam generators in late-fall 2009, as discussed in Section 3.2. Current plans call for the establishment of a materials storage area and concrete batch plant approximately 1,800 feet north-northeast of the CR-3 containment building and a construction laydown area approximately 1,200 feet east-northeast of the CR-3 containment building. The area planned for materials storage and a batch plant is a grassy, frequently-mowed 3.5-acre area adjacent to a transmission right of way. The 0.9-acre area slated to be a construction laydown area is a low-quality wetland that was drastically altered by post-September 11, 2001 security enhancements that included felling of all trees in the area and installation of a berm and vehicle barrier system. Progress Energy does not intend to restore these two areas after steam generator replacement. They will be either be used as laydown/storage/parking areas or "reserved" as open space to support future outages.

Both of these areas are in the central, developed portion of the Crystal River site, an area surrounded by roads and railroad tracks and buildings and subject to constant noise ranging from coal trains to diesel generators to the CR-3 public address system. There are also plans to erect a mausoleum (OTSG Storage Building) for the old steam generators in the area currently occupied by the Temporary Assembly Building (TAB), which is approximately 1,100 feet east of the CR-3 containment building.

Sites slated for temporary use during the outage are all located within the developed portion of the Crystal River site. Other than a few grass plots and shrubs, there are no plant communities present. The developed core of the CREC provides potential habitat for only those animal species classified as "urban wildlife." Species commonly encountered in urban landscapes in Florida include the Southern toad, green anole, rat snake, house sparrow, mockingbird, blue jay, cotton rat, and gray squirrel. Any such urban wildlife present would be temporarily displaced by noise, machinery, and personnel associated with refurbishment activities, but would re-colonize (suitable) areas as construction activities end and conditions return to normal.

Any disturbance of wildlife would be limited to the relatively-brief period during which refurbishment-related activities are carried out. These activities would peak over the October-December 2009 outage period, when approximately 2,000 workers would be involved in steam generator replacement, refueling, and maintenance work. Even during the period of peak refurbishment activity, impacts to wildlife would be small, and would consist mostly of rendering marginal wildlife habitat temporarily unsuitable for small numbers of common songbirds and small mammals.

In summary, Progress Energy concludes that impacts to terrestrial resources from refurbishment activities would be SMALL and do not warrant mitigation.

4.10 THREATENED AND ENDANGERED SPECIES

NRC

"Additionally, the applicant shall assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act." 10 CFR 51.53(c)(3)(ii)(E)

"Generally, plant refurbishment and continued operation are not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies would be needed at the time of license renewal to determine whether threatened or endangered species are present and whether they would be adversely affected." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 49

NRC made impacts to threatened and endangered species a Category 2 issue because the status of many species is being reviewed, and site-specific assessment is required to determine whether any identified species could be affected by refurbishment activities or continued plant operations through the renewal period. In addition, compliance with the Endangered Species Act requires consultation with the appropriate federal agency (NRC 1996, Sections 3.9 and 4.1).

Section 2.2 of this Environmental Report describes the aquatic communities at the CREC and in the adjacent Gulf of Mexico. Section 2.4 describes important terrestrial habitats at CREC and along the associated transmission corridors. Section 2.5 discusses threatened or endangered species that occur or may occur in the vicinity of the CREC and along CR-3 associated transmission corridors.

With the exception of the species identified in Section 2.5, Progress Energy is not aware of any threatened or endangered terrestrial species that could occur at the CREC or along the associated transmission corridors. Current operations of CR-3 and Progress Energy vegetation management practices along transmission line rights-of-way are not believed to affect any listed terrestrial or aquatic species or their habitat. Furthermore, plant operations and transmission line maintenance practices are not expected to change significantly during the license renewal term. Therefore, no adverse impacts to threatened or endangered terrestrial or aquatic species from current or future operations are anticipated.

As discussed in Section 4.9, refurbishment activities at CR-3 during the license renewal term are expected to have little or no effect on local wildlife. Even during the period of peak refurbishment activity, impacts to wildlife would be small, and would consist mostly of rendering marginal wildlife habitat temporarily unsuitable for small numbers of common songbirds and small mammals.

Progress Energy has initiated contacts with the Florida Fish and Wildlife Conservation Commission, National Marine Fisheries Service, and the U.S. Fish and Wildlife Service requesting information on any listed species or critical habitats that might occur on the Crystal River site or along the associated transmission corridors, with particular emphasis on species that might be adversely affected by continued operation over the license renewal period. Contact letters are provided in Attachment C.

Renewal of the CR-3 license is not expected to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of any critical habitat. Because current operational practices will not be affected by license renewal, Progress Energy concludes that impacts to threatened or endangered species from license renewal would be SMALL and do not warrant mitigation.

4.11 AIR QUALITY DURING REFURBISHMENT (NON-ATTAINMENT AREAS)

NRC

"…If the applicant's plant is located in or near a nonattainment or maintenance area, an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment workforce must be provided in accordance with the Clean Air Act as amended…." 10 CFR 51.53(c)(3)(ii)(F)

"…Air quality impacts from plant refurbishment associated with license renewal are expected to be small. However, vehicle exhaust emissions could be cause for concern at locations in or near nonattainment or maintenance areas. The significance of the potential impact cannot be determined without considering the compliance status of each site and the numbers of workers expected to be employed during the outage…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 50

NRC made impacts to air quality during refurbishment a Category 2 issue because vehicle exhaust emissions could be cause for some concern, and a general conclusion about the significance of the potential impact could not be drawn without considering the compliance status of each site and the number of workers expected to be employed during an outage (NRC 1996).

CR-3 is located in the West Central Florida Intrastate Air Quality Control Region (AQCR) (40 CFR 81.96). The West Central Florida AQCR is designated as in attainment or unclassifiable for all air quality standards as are all counties in the State of Florida (40 CFR 81.310). The nearest nonattainment area is Bibb County, Georgia, approximately 275 miles north of CR-3, which is designated as a nonattainment area under the $PM_{2.5}$ and the 8-hour ozone National Ambient Air Quality Standards (NAAQS) (40 CFR 81.311).

Air quality during refurbishment is not applicable to CR-3 because, as discussed in Section 2.10, the plant is not located in or near a nonattainment area or maintenance area. Every county in Florida is either in attainment or is unclassifiable with respect to the NAAQS.

4.12 MICROBIOLOGICAL ORGANISMS

NRC

"If the applicant's plant uses a cooling pond, lake, or canal or discharges into a river having an annual average flow rate of less than $3.15 \times 10^{12} ft^3$/year ($9 \times 10^{10} m^3$/year), an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided." 10 CFR 51.53(c)(3)(ii)(G)

"…These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals that discharge to small rivers. Without site-specific data, it is not possible to predict the effects generically…." 10 CFR 51, Subpart A, Table B-1, Issue 57

The NRC made impacts on public health from thermophilic organisms a Category 2 issue because there was insufficient data on facilities using cooling ponds, lakes, or canals that discharge to small rivers.

This issue does not apply to CR-3 because, as indicated in Section 3.1.2, the plant does not use cooling ponds, lakes, or canals (as defined in the GEIS and used in the regulation) and does not discharge to a small river. CR-3 withdraws cooling water from the Gulf of Mexico and discharges to the same body of water.

4.13 ELECTRIC SHOCK FROM TRANSMISSION-LINE-INDUCED CURRENTS

NRC

The environmental report must contain an assessment of the impact of the proposed action on the potential shock hazard from transmission lines ". ...[i]f the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents." 10 CFR 51.53(c)(3)(ii)(H)

"Electrical shock resulting from direct access to energized conductors or from induced charges in metallic structures have not been found to be a problem at most operating plants and generally are not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential at the site." 10 CFR 51, Subpart A, Appendix B, Table B 1, Issue 59

NRC made impacts of electric shock from transmission lines a Category 2 issue because, without a review of each plant's transmission line conformance with the National Electrical Safety Code (NESC) (IEEE 2007) criteria, NRC could not determine the significance of the electrical shock potential. In the case of CR 3, there have been no previous NRC or NEPA analyses of transmission-line-induced current hazards. Therefore, this section provides an analysis of the plant's transmission lines' conformance with the NESC standard. The analysis is based on computer modeling of induced current under the lines.

Objects located near transmission lines can become electrically charged due to their immersion in the lines' electric field. This charge results in a current that flows through the object to the ground. The current is called "induced" because there is no direct connection between the line and the object. The induced current can also flow to the ground through the body of a person who touches the object. An object that is insulated from the ground can actually store an electrical charge, becoming what is called "capacitively charged." A person standing on the ground and touching a vehicle or a fence receives an electrical shock due to the sudden discharge of the capacitive charge through the person's body to the ground. After the initial discharge, a steady-state current can develop of which the magnitude depends on several factors, including the following:

- the strength of the electric field which, in turn, depends on the voltage of the transmission line as well as its height and geometry
- the size of the object on the ground

- the extent to which the object is grounded.

In 1977, a provision to the NESC was adopted that describes how to establish minimum vertical clearances to the ground for electric lines having voltages exceeding 98-kilovolt alternating current to ground[1]. The clearance must limit the induced current [2] due to electrostatic effects to 5 milliamperes if the largest anticipated truck, vehicle, or equipment were short-circuited to ground. By way of comparison, the setting of ground fault circuit interrupters used in residential wiring (special breakers for outside circuits or those with outlets around water pipes) is 4 to 6 milliamperes.

As described in Section 3.1.3, there are two 500-kilovolt lines that were specifically constructed to distribute power from CR-3 to the electric grid: Lake Tarpon and Central Florida. Progress Energy's analysis of these transmission lines began by identifying the limiting case for each line. The limiting case is the configuration along each line where the potential for current-induced shock would be greatest. Once the limiting case was identified, Progress Energy calculated the electric field strength for each transmission line, then calculated the induced current.

Progress Energy calculated electric field strength and induced current using a computer code called ACDCLINE, produced by the Electric Power Research Institute. The results of this computer program have been field-verified through actual electrostatic field measurements by several utilities. The input parameters included the design features of the limiting-case scenario, the NESC requirement that line sag be determined at 120ºF conductor temperature, and the maximum vehicle size under the lines (a tractor-trailer).

The analytical results for the two transmission lines are summarized in Table 4-1. Maximum induced current values for both lines are in compliance with the NESC and below the NESC limit of 5.0 milliamperes (TtNUS 2008b). The maximum induced current was calculated to be 4.9 milliamperes, which corresponded with a section of the Central Florida line.

Progress Energy has surveillance and maintenance procedures that provide assurance that design ground clearances will not change. These procedures include routine aerial inspections that include checks for encroachments, broken conductors, broken or leaning structures, and signs of trees burning, any of which would be evidence of clearance problems. Periodic ground inspections include examination for clearance at questionable locations, integrity of structures, and surveillance for dead or diseased trees that might fall on the transmission lines. Problems noted during any inspection are brought to the attention of the appropriate organization(s) for corrective action.

Progress Energy's assessment under 10 CFR 51 concludes that electric shock is of SMALL significance for the CR-3 transmission lines because the magnitude of the

[1] Part 2, Rules 232C1c and 232D3c.
[2] The NESC and the GEIS use the phrase "steady-state current," whereas 10 CFR 51.53(c)(3)(ii)(H) uses the phrase "induced current." The phrases mean the same here.

induced currents does not exceed the NESC standard. Mitigation measures are not warranted because there is adequate clearance between energized conductors and the ground. These conclusions will remain valid for the foreseeable future, provided there are no changes in line use, voltage, maintenance practices, or land use under the transmission lines.

4.14 HOUSING IMPACTS

4.14.1 HOUSING – REFURBISHMENT

NRC

The environmental report must contain "...[a]n assessment of the impact of the proposed action on housing availability…" 10 CFR 51.53(c)(3)(ii)(I)

"…Housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or areas with growth control measures that limit housing development…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 63

NRC made housing impacts a Category 2 issue because impact magnitude depends on local conditions that NRC could not predict for all plants at the time of GEIS publication (NRC 1996). Local conditions that need to be ascertained are: (1) population categorization as small, medium, or high, (2) applicability of growth control measures, (3) the size and growth rate of the housing market.

In 10 CFR 51, Subpart A, Appendix B, Table B-1, NRC concluded that impacts to housing are expected to be of small significance at plants located in medium or high population areas where growth control measures are not in effect.

In Supplement 1 to Regulatory Guide 4.2 (NRC 2000), Section 4.14.1, NRC states that, if the conditions related to housing in Table B-1 are met and the number of additional on-site workers associated with refurbishment for both the license renewal and current term operation/refueling periods does not exceed the peak workforce estimate of 2,273 persons used for the socioeconomic impact analysis reported in Section 3.7 of NUREG 1437, the finding of "small significance" may be adopted without further analysis.

As described in Section 2.6, CR-3 is located in a medium population area. As noted in Section 2.8, Land Use Planning, Citrus County is not subject to growth control measures that limit housing development. As stated in Section 3.4, during peak refurbishment activities, about 900 refurbishment workers and 1,100 refueling workers would be on site during the refurbishment period. Therefore, Progress Energy concludes that impacts to housing availability resulting from refurbishment-related population growth would be SMALL and would not warrant mitigation.

4.14.2 HOUSING – LICENSE RENEWAL TERM

NRC

The environmental report must contain "...[a]n assessment of the impact of the proposed action on housing availability…" 10 CFR 51.53(c)(3)(ii)(I)

"…Housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or areas with growth control measures that limit housing development…." 10 CFR 51, Subpart A, Table B-1, Issue 63

"...[S]mall impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion occurs…." (NRC 1996)

NRC made housing impacts a Category 2 issue because impact magnitude depends on local conditions that NRC could not predict for all plants at the time of GEIS publication (NRC 1996). Local conditions that need to be ascertained are: (1) population categorization as small, medium, or high and (2) applicability of growth control measures.

In 10 CFR 51, Subpart A, Appendix B, Table B-1, NRC concluded that impacts to housing are expected to be of small significance at plants located in medium or high population areas where growth control measures are not in effect.

Sections 2.6 and 2.8 indicate that CR-3 is located in a medium population area that is not subject to growth control measures that limit housing development. Using the NRC regulatory criteria, CR-3 license renewal housing impacts would be expected to be small. Continued operations could result in housing impacts due to increased staffing. However, Progress Energy estimates that no additional workers would be needed to support CR-3 operations during the license renewal term (Section 3.4). Progress Energy therefore concludes that since there is no increase in staffing, no housing impacts would be experienced and, therefore, the appropriate characterization of CR-3 license renewal housing impacts is SMALL.

4.15 PUBLIC UTILITIES: PUBLIC WATER SUPPLY

4.15.1 PUBLIC WATER SUPPLY – REFURBISHMENT

NRC

The environmental report must contain "…an assessment of the impact of population increases attributable to the proposed project on the public water supply." 10 CFR 51.53(c)(3)(ii)(I)

"…An increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 65

"Impacts on public utility services are considered small if little or no change occurs in the ability to respond to the level of demand and thus there is no need to add capital facilities. Impacts are considered moderate if overtaxing of facilities during peak demand periods occurs. Impacts are considered large if existing service levels (such as quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services." (NRC 1996)

NRC made public utility impacts a Category 2 issue because an increased problem with water availability, resulting from pre-existing water shortages, could occur in conjunction with plant demand and plant-related population growth (NRC 1996). Local information needed would include: (1) a description of water shortages experienced in the area, and (2) an assessment of the public water supply system's available capacity.

NRC's analysis of impacts to the public water supply system considered both plant demand and plant-related population growth demands on local water resources. As Section 3.4 indicates, Progress Energy estimates that 900 refurbishment workers and 1,100 refueling workers would be attributed to the CR-3 refurbishment project. Though these two workforce peaks are not expected to overlap, Progress Energy conservatively combines the peaks for this analysis, for a total of 2,000 workers. Section 2.9.1 describes the public water supply systems in the area, their permitted capacities, and current demands. The following discussion focuses on impacts of refurbishment on local public utilities, based on the assumption that CR-3 would add up to 2,000 employees for a period of 74 days.

Plant Demand

Section 2.3 details water resources for the plant. The CREC is not on a municipal water system. The CREC maintains seven active production groundwater wells located linearly eastward away from the complex. CR-3 and CREC Units 1 and 2 receive water from the South Treatment facility. This facility is served by the three most western wells, SPW-3, SPW-4, and SPW-5. Wells SPW-3, SPW-4, and SPW-5 are permitted to withdraw an average of 380,000 gpd, 285,000 gpd, and 285,000 gpd, respectively. Another well, Well PW-1A/B, provides brackish water for ash processes. Well PW-1A/B operation is contained in the permit with SPW-3, SPW-4 and SPW-5. The combined permit allows for a maximum combined pumping of one MGD. The wells are installed in the Floridan aquifer at depths ranging from 72 to 125 feet.

Plant-related Population Growth

The maximum impact to area public water supplies is calculated using the following assumptions: (1) all direct jobs would be filled by in-migrating residents; (2) there would be few to no indirect jobs and the few indirect jobs that would be created would be filled by workers already residing within the 50-mile radius (because most jobs would be service-related), (3) the refurbishment work force would reside in the 50-mile radius; and (4) refurbishment-related workers would not bring families due to the temporary nature of the refurbishment projects (i.e., 74 days or less).

The impact to the local water supply systems from plant-related population growth can be determined by calculating the amount of water that would be required by these individuals. The average American uses about 90 gallons per day for personal use (EPA 2003). As described above, CR-3 estimates an additional 2,000 employees (refurbishment and refueling) attributable to refurbishment. The plant-related population increase could require an additional 180,000 gallons per day (2,000 employees multiplied by 90 gallons per day) within the 50-mile radius. With the exception of the Sugarmill Woods Subdivision, a stable year-round community, where temporary workers are unlikely to stay, there is ample excess capacity in every major water system in Citrus County (see Table 2-6). Therefore, Progress Energy concludes that impacts resulting from plant-related population growth to public water supplies would be SMALL, requiring no additional capacity and not warranting mitigation.

4.15.2 PUBLIC WATER SUPPLY – LICENSE RENEWAL TERM

NRC

The environmental report must contain "…an assessment of the impact of population increases attributable to the proposed project on the public water supply." 10 CFR 51.53(c)(3)(ii)(I)

"An increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 65

"Impacts on public utility services are considered small if little or no change occurs in the ability to respond to the level of demand and thus there is no need to add capital facilities. Impacts are considered moderate if overtaxing of facilities during peak demand periods occurs. Impacts are considered large if existing service levels (such as quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services." (NRC 1996)

NRC made public utility impacts a Category 2 issue because an increased problem with water availability, resulting from pre-existing water shortages, could occur in conjunction with plant demand and plant-related population growth (NRC 1996). Local information needed would include: (1) a description of water shortages experienced in the area, and (2) an assessment of the public water supply system's available capacity.

NRC's analysis of impacts to the public water supply system considered both plant demand and plant-related population growth demands on local water resources. At this time, CR-3 obtains potable water from three of seven groundwater wells on the plant site. Plant usage does not stress resource capacity and all but one local public water supplier have ample capacity (Section 2.9.1 describes the public water supply systems in the area, their production capacities, and current demands). Progress Energy has identified no operational changes during the CR-3 license renewal term that would increase plant water use.

Because Progress Energy has no plans to increase plant groundwater usage or employment for license renewal purposes, Progress Energy concludes that impacts on public water supply would be SMALL and not require mitigation.

4.16 EDUCATION IMPACTS FROM REFURBISHMENT

NRC

The environmental report must contain "…[a]n assessment of the impact of the proposed action on…public schools (impacts from refurbishment activities only) within the vicinity of the plant…." 10 CFR 51.53(c)(3)(ii)(I)

"…Most sites would experience impacts of small significance but larger impacts are possible depending on site- and project-specific factors…." 10 CFR 51, Subpart A, Table B-1, Issue 66

"…[S]mall impacts are associated with project-related enrollment increases of 3 percent or less. Impacts are considered small if there is no change in the school systems' abilities to provide educational services and if no additional teaching staff or classroom space is needed. Moderate impacts are generally associated with 4 to 8 percent increases in enrollment. Impacts are considered moderate if a school system must increase its teaching staff or classroom space even slightly to preserve its pre-project level of service….Large impacts are associated with project-related enrollment increases above 8 percent…." (NRC 1996)

NRC made refurbishment-related impacts to education a Category 2 issue because site- and project-specific factors determine the significance of impacts (NRC 1996). Local factors to be ascertained include: (1) project-related enrollment increases and (2) status of the student/teacher ratio.

Progress Energy estimates that, during the 74-day fall 2009 outage, a peak number of approximately 900 workers would be engaged in steam generator replacement work, along with approximately 1,100 workers who would be engaged in normal refueling and maintenance activities. Based on previous refueling and maintenance outages at CR-3, workers engaged in refurbishment, refueling, and maintenance activities would not move their families to the Crystal River area for a project of this duration. Therefore, Progress Energy estimates that few, if any, children would be relocated to the region, impacts would be SMALL, and mitigation would not be warranted.

4.17 OFFSITE LAND USE

4.17.1 OFFSITE LAND USE - REFURBISHMENT

NRC

The environmental report must contain "…an assessment of the impact of the proposed action on... land-use... (impacts from refurbishment activities only) within the vicinity of the plant…." 10 CFR 51.53(c)(3)(ii)(I)

"…Impacts may be of moderate significance at plants in low population areas…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 68

"…[I]f plant-related population growth is less than 5 percent of the study area's total population, off-site land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 60 persons per square mile, and at least one urban area with a population of 100,000 or more within 50 miles…." (NRC 1996)

NRC made impacts to offsite land use as a result of refurbishment activities a Category 2 issue because land-use changes could be considered beneficial by some community members and adverse by others. Local conditions to be ascertained include: (1) plant-related population growth, (2) patterns of residential and commercial development, and (3) proximity to an urban area with a population of at least 100,000 (NRC 1996).

In Supplement 1 to Regulatory Guide 4.2 (NRC 2000), Section 4.17.1, NRC states that impacts to off-site land use result when the development pressures resulting from the project-related population increases result in changes to local land use and development patterns. Further, NRC states that, if the following three conditions are met, the effects of refurbishment-related population growth on land use and development patterns will be small, and no further analysis is needed.

1. Project-related population growth (including direct and indirect workers and their families), when added to other anticipated or reasonably foreseeable population growth, would not increase existing area population by more than 5 percent.

2. The project area has established development patterns. Established development patterns are indicated if the community has established land use controls or infrastructure in place to support reasonably foreseeable development.

3. The project area is not extremely isolated or sparsely populated. Extreme isolation is indicated if the area is more than 50 miles from the nearest urban area with a population of 100,000 or more; sparsely populated is indicated if the

population density is less than 60 persons per square mile within a 20-mile radius from the plant.

As stated in Section 2.6, Demography, the 2000 population within a 50-mile radius was 825,847 and the 2000 population within a 20-mile radius was 89,491. Citrus County's 2000 population was 118,085.

As stated in Section 3.4, a conservative maximum of 2,000 workers would migrate into the 50-mile region for the CR-3 refurbishment and refueling project. Due to the short duration of the project, 74 days, there would be few to no indirect jobs created as a result of spending by the 2,000 workers. Also, few to no workers would relocate family members for the same reason. Therefore, the population increase attributed to the refurbishment project would be a maximum of 2,000. A 2,000 person increase in the 2000 population of the 50-mile region would result in a 0.2 percent population increase. A 2,000 person increase in the 2000 population of Citrus County would result in a 1.7 percent population increase.

Based on the residential distribution of the current operations workforce and the geographical location of the CREC, Citrus County is where the greatest percentage of refurbishment and refueling workers would be expected to temporarily reside. As stated in Section 2.8, Citrus County has a comprehensive plan and land development regulations to guide development. These tools, however, do not formally control growth. Also, according to the land use plan, the County has established patterns of residential and commercial development.

As stated in Section 2.6, Demography, CR-3 is located in a medium population area. Within the 50-mile radius, the 2000 population density was 170 persons per square mile. Within the 20-mile radius, the population density was 125 persons per square mile. Although there are no cities with a population over 100,000 within a 50-mile radius, there are several Census County Divisions (CCDs) that have populations exceeding 100,000. A CCD is a subdivision of a county that is a relatively permanent statistical area established cooperatively by the USCB and state and local government authorities. It is used for presenting decennial census statistics in those states that do not have well-defined and stable minor civil divisions that serve as local governments (USCB 2008). Two notable CCDs that fall within 50 miles of the CREC are the Ocala and the New Port Richey CCDs. Also, two cities with populations greater than 100,000 lay just outside of the 50-mile radius; Gainesville and Tampa.

Therefore, because project-related population increases are less than five percent of the 50-mile radius and Citrus County populations, there are established development patterns in Citrus County, and the project area has population densities of 125 persons per square miles or more and is not extremely isolated, Progress Energy concludes that impacts to off-site land use resulting from refurbishment would be SMALL and would not warrant mitigation.

4.17.2 OFFSITE LAND USE – LICENSE RENEWAL TERM

NRC

The environmental report must contain "…an assessment of the impact of the proposed action on …land-use…within the vicinity of the plant…" 10 CFR 51.53(c)(3)(ii)(I)

"Significant changes in land use may be associated with population and tax revenue changes resulting from license renewal." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 69

"…[I]f plant-related population growth is less than five percent of the study area's total population, off-site land-use changes would be small…" (NRC 1996, Section 3.7.5)

"If the plant's tax payments are projected to be small, relative to the community's total revenue, new tax-driven land-use changes during the plant's license renewal term would be small, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development." (NRC 1996, Section 4.7.4.1)

NRC made impacts to offsite land use during the license renewal term a Category 2 issue, because land-use changes may be perceived as beneficial by some community members and detrimental by others. Therefore, NRC could not assess the potential significance of site-specific offsite land-use impacts (NRC 1996, Section 4.7.4.2). Site-specific factors to consider in an assessment of land-use impacts include: (1) the size of plant-related population growth compared to the area's total population, (2) the size of the plant's tax payments relative to the community's total revenue, (3) the nature of the community's existing land-use pattern, and (4) the extent to which the community already has public services in place to support and guide development.

The GEIS presents an analysis of offsite land use for the renewal term that is characterized by two components: population-driven and tax-driven impacts (NRC 1996, Section 4.7.4.1).

Population-Related Impacts

Based on the GEIS case-study analysis, NRC concluded that all new population-driven land-use changes during the license renewal term at all nuclear plants would be small. Population growth caused by license renewal would represent a much smaller "percentage of the local area's" total population than the percent change represented by operations-related growth (NRC 1996, Section 4.7.4.2). Progress Energy agrees with the NRC conclusion that population-driven land use impacts would be SMALL. Mitigation would not be warranted.

Tax-Revenue-Related Impacts

Determining tax-revenue-related land use impacts is a two-step process. First, the significance of the plant's tax payments on taxing jurisdictions' tax revenues is evaluated. Then, the impact of the tax contribution on land use within the taxing jurisdiction's boundaries is assessed.

Tax Payment Significance

NRC has determined that the significance of tax payments as a source of local government revenue would be large if the payments are greater than 20 percent of revenue, moderate if the payments are between 10 and 20 percent of revenue, and small if the payments are less than 10 percent of revenue (NRC 1996).

Land Use Significance

> NRC defined the magnitude of land-use changes as follows (NRC 1996):
>
> Small - very little new development and minimal changes to an area's land-use pattern.
>
> Moderate - considerable new development and some changes to land-use pattern.
>
> Large - large-scale new development and major changes in land-use pattern.

NRC further determined that, "…[I]f the plant's tax payments are projected to be small relative to the community's total revenue, new tax-driven land-use changes during the plant's license renewal term would be small, especially where the community has preestablished patterns of development and has provided adequate public services to support and guide development (NRC 1996).

CR-3 Tax Impacts

Table 2-4 provides a comparison of tax payments made by CR-3 to Citrus County and the County's annual property tax revenues. For the three-year period from 2005 through 2007, CR-3's property tax payments represented 4.7 to 5.4 percent of the County's annual property tax revenues. Using NRC's criteria, CR-3's tax payments are of small significance to Citrus County.

CR-3 Land Use Impacts

As stated in Section 2.8, Citrus County has been experiencing an increase in population over the last several decades which has been largely attributed, by local officials, to an influx of retirees and a growing tourism industry. These two segments of the economy have led to the expansion of the construction, wholesale and retail trade, and service sectors. Although much of the County is still rural in nature and a large percentage of the land is undeveloped, the County is experiencing developmental growth, as is evidenced by a decrease in vacant and agricultural land and an increase in residential land.

As noted earlier, in Section 2.8, the Citrus County Comprehensive Plan characterizes the overall land use pattern in the County as "suburban sprawl." Residential and commercial developments, as well as other land uses, are sporadically located throughout the County. Citrus County uses a comprehensive land use plan and land development regulations (Citrus County Land Development Code) to guide development. For example, the County employs housing density limits to encourage growth in areas where public facilities, such as water and sewer systems, exist or are scheduled to be built in the future and to promote the preservation of the communities' natural resources. The County has no formal growth control measures, however.

Conclusion

CR-3's property taxes account for less than 10 percent of Citrus County's property tax revenues, below the lowest NRC significance level of 10 percent for taxes. As such, CR-3 has been and would likely continue a minor source of tax revenue for Citrus County. Progress Energy views the continued operation of CR-3 as a benefit to Citrus County through direct and indirect salaries and tax contributions to the County's economy.

Land use changes over the past several decades have been largely attributed to an influx of retirees and a growing tourism industry. The nuclear plant's presence is not expected to directly attract support industries and commercial development or to encourage or deter residential development. Because population growth related to the license renewal of CR-3 is expected to be small and there would be no new tax impacts to Citrus County land use, the renewal of CR-3's license would have a continued SMALL but beneficial impact on Citrus County. Therefore, mitigation would not be warranted.

4.18 TRANSPORTATION

4.18.1 TRANSPORTATION - REFURBISHMENT

NRC

The environmental report must "...assess the impact of highway traffic generated by the proposed project on the level of service of local highways during periods of license renewal refurbishment activities and during the term of the renewed license." 10 CFR 51.53(c)(3)(ii)(J)

"Transportation impacts…are generally expected to be of small significance. However, the increase in traffic associated with the additional workers and local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 70

"Small impacts would be associated with a free flowing traffic stream where users are unaffected by the presence of other users (level of service A) or stable flow in which the freedom to select speed is unaffected but the freedom to maneuver is slightly diminished (level of service B)." (NRC 1996)

NRC made impacts to transportation a Category 2 issue because impact significance is determined primarily by road conditions existing at the time of refurbishment, which NRC could not forecast for all facilities (NRC 1996). Local road conditions to be ascertained are: (1) level of service conditions, and (2) incremental increases in traffic associated with refurbishment activities and license renewal staff.

The following discussion focuses on impacts of refurbishment on transportation. In the GEIS, NRC used the Transportation Research Board's level of service (LOS) definitions to assess significance levels of transportation impacts. LOS is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists (NRC 1996). Section 2.9.2 discusses employee access routes to the CR-3 plant, and Table 2-7 presents average annual daily traffic (AADT) counts and LOS determinations for roads in the vicinity of CR-3. Progress Energy estimates that a peak number of approximately 900 workers will be engaged in the steam generator replacement work, followed by approximately 1,100 workers who would be engaged in the normal refueling and maintenance activities. The expected duration of the outage is 74 days, lasting from September 26 through December 9, 2009.

The maximum impact to area transportation was analyzed using the following assumptions: (1) all direct jobs will be filled by in-migrating residents; (2) because of the short duration of the project, there will be few to no indirect jobs created, (3) the greatest percentage of the refurbishment and refueling workers are expected to reside in Citrus

County, and (4) each new direct job created will represent one additional vehicle on the area roadways.

During the refurbishment and refueling outage, outage workers would park at the Crystal River Mall on US 19, less than 4 miles south of the intersection of US 19 with West Power Line Street, the main access road to the CR-3 site. Buses would then transport the outage workers to the CR-3 site. Therefore, most transportation impacts would be caused by the refurbishment and refueling workforce commuting to the Crystal River Mall. Excluding the normal CREC workforce (permanent employees) and buses, delivery trucks and service vehicles would be the only vehicles commuting directly to the CR-3 site.

With the exception of a portion of US 19 south of the City of Crystal River (LOS determination of C), all roads in the vicinity of the plant currently have LOS determinations of A or B. The addition of 2,000 workforce vehicles, along with a small number of delivery trucks and service vehicles on area roads would not significantly impact traffic flow because in most cases, the additional number of vehicles on the road from refurbishment and refueling activities will result in a small increase in daily traffic based on AADT numbers (Table 2-7). Assuming that the majority of the refurbishment and refueling workforce will reside in Citrus County, the workers would be commuting to the Crystal River Mall on larger roads that could handle the increase in traffic without experiencing a change in the LOS determination.

Progress Energy concludes that impacts to the overall transportation system would be SMALL, due in part to the mitigation plan to bus workers from the Crystal River Mall. The location of the mall will restrict commuter traffic to larger roads (US Highways, “numbered” state roads and highways) near the City of Crystal River instead of congesting smaller (county) roads near the CR-3 plant entrance. In addition, any increase in traffic on local roads will be temporary, given the short duration of the refurbishment period (74 days).

4.18.2 TRANSPORTATION – LICENSE RENEWAL TERM

NRC

The environmental report must "...assess the impact of highway traffic generated by the proposed project on the level of service of local highways during periods of license renewal refurbishment activities and during the term of the renewed license." 10 CFR 51.53(c)(3)(ii)(J)

"Transportation impacts…are generally expected to be of small significance. However, the increase in traffic associated with the additional workers and local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 70

"Small impacts would be associated with a free flowing traffic stream where users are unaffected by the presence of other users (level of service A) or stable flow in which the freedom to select speed is unaffected but the freedom to maneuver is slightly diminished (level of service B)." (NRC 1996)

NRC made impacts to transportation a Category 2 issue because impact significance is determined primarily by road conditions existing at the time of the project, which NRC could not forecast for all facilities (NRC 1996). Local road conditions to be ascertained are: (1) level of service conditions, and (2) incremental increases in traffic associated with refurbishment activities and license renewal staff.

As described in Section 3.4, no additional license renewal employment increment is expected. Therefore, Progress Energy expects license-renewal impacts to transportation to be SMALL and believes no mitigation would be necessary.

4.19 HISTORIC AND ARCHAEOLOGICAL RESOURCES

4.19.1 HISTORIC AND ARCHAEOLOGICAL RESOURCES – REFURBISHMENT

NRC

The environmental report must contain an assessment of "…whether any historic or archaeological properties will be affected by the proposed project." 10 CFR 51.53(c)(3)(ii)(K)

"Generally, plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the National Historic Preservation Act requires the Federal agency to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 71

"Sites are considered to have small impacts to historic and archaeological resources if (1) the State Historic Preservation Officer (SHPO) identifies no significant resources on or near the site; or (2) the SHPO identifies (or has previously identified) significant historic resources but determines they would not be affected by plant refurbishment, transmission lines, and license-renewal term operations and there are no complaints from the affected public about altered historic character; and (3) if the conditions associated with moderate impacts do not occur." (NRC 1996)

NRC made impacts of license renewal (refurbishment) to historic and archaeological resources a Category 2 issue, because determinations of impacts to historic and archaeological resources are site-specific in nature and the National Historic Preservation Act mandates that impacts must be determined through consultation with the State Historic Preservation Officer (NRC 1996).

Section 3.2 describes planned refurbishment activities, which would be associated with steam generator replacement in late-fall 2009. Steam generators would be transported by rail to the Crystal River site and moved to the containment building by a large, multi-axle, all-terrain transporter ("crawler"). The transporter would move approximately one-quarter mile across a developed portion of the site. The area through which the transporter would move was heavily altered during construction of the CREC and is surrounded by roads, parking areas, railroad tracks and other infrastructure. Most natural vegetation in the area has been removed, and replaced with either graveled areas or turf grasses. Because the area was cleared and graded during construction of Crystal River Units 1, 2, and 3, and because moving the steam generators to the containment building would require no land disturbance, doing so would have no impact on the area's archaeological or historic resources.

A mausoleum would be built in the general vicinity of the existing Temporary Assembly Building, which is approximately 1,100 feet east of the CR-3 containment building, to house the old steam generators, once they have been removed. This area was cleared and graded during original plant construction, and has been dedicated to industrial use for many years. Construction of the mausoleum would therefore have no effect on archaeological or historic resources.

Current plans call for the establishment of a materials storage area and concrete batch plant approximately 1,800 feet north-northeast of the CR-3 containment building and a construction laydown area approximately 1,200 feet east-northeast of the CR-3 containment building. Both of these areas are in the central, developed portion of the Crystal River site, an area heavily altered (filled and/or graded) during site construction. Therefore their use as storage and laydown areas during the steam generator replacement project would have no effect on archaeological or historic resources.

Several temporary buildings could be erected (or trailers brought on site) to provide office space for construction contractors, but they would be placed in previously-disturbed areas. No road improvements would be required because the steam generators would arrive by rail and be offloaded to an all-terrain, multi-axle transporter capable of traveling on existing site roads and across vacant areas without doing any damage. Additional construction personnel and additional traffic on area roadways and associated with the steam generator replacement project are not expected to impact archaeological or historical sites in the area.

In late 2004, Progress Energy issued formal guidelines ("Archaeological and Cultural Resources") for the protection of both previously-identified and heretofore-undiscovered archaeological and cultural resources that could be affected by land-disturbing activities (Progress Energy 2004). These guidelines, which are part of Progress Energy's Environmental Compliance Manual, outline responsibilities of Progress Energy employees and contractors engaged in land-disturbing activities, such as the construction or expansion of power plants, substations, and transmission lines. The guidelines also designate an organization (Environmental Services Section) within Energy Supply and an organization (Environmental Health and Safety) within Energy Delivery that is responsible for consulting with the State Historic Preservation Office if a cultural site (e.g., a cemetery) is known to be near an area to be disturbed for construction or if cultural artifacts (e.g., spear points or pottery sherds) are discovered once construction has begun.

Based on the current plans and schedule, replacement of CR-3 steam generators would have little potential for disturbing, uncovering, or harming cultural artifacts. All planned refurbishment activities would take place in an industrial setting, in areas previously disturbed by construction and operation of the Crystal River Energy Complex and associated transmission infrastructure. Therefore, Progress Energy concludes that refurbishment activities would not impact cultural resources and no mitigation measures would be warranted beyond those prescribed in the company's "Archaeological and Cultural Resources" procedure, discussed previously.

Progress Energy has written the Director of the Division of Historical Resources, Florida's State Historic Preservation Officer (SHPO), to solicit the Division's concerns regarding impacts to cultural resources from refurbishment or license renewal activities. This letter is included as Attachment D.

4.19.2 HISTORIC AND ARCHAEOLOGICAL RESOURCES – LICENSE RENEWAL TERM

NRC

The environmental report must contain an assessment of "…whether any historic or archaeological properties will be affected by the proposed project." 10 CFR 51.53(c)(3)(ii)(K)

"Generally, plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the National Historic Preservation Act requires the Federal agency to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 71

"Sites are considered to have small impacts to historic and archaeological resources if (1) the State Historic Preservation Officer (SHPO) identifies no significant resources on or near the site; or (2) the SHPO identifies (or has previously identified) significant historic resources but determines they would not be affected by plant refurbishment, transmission lines, and license-renewal term operations and there are no complaints from the affected public about altered historic character; and (3) if the conditions associated with moderate impacts do not occur." (NRC 1996, Section 3.7.7)

NRC made impacts to historic and archaeological resources a Category 2 issue, because determinations of impacts to historic and archaeological resources are site-specific in nature and the National Historic Preservation Act mandates that impacts must be determined through consultation with the State Historic Preservation Officer (NRC 1996).

As discussed in Section 2.11, the Final Environmental Statement (FES) for CR-3 listed two properties on the National Register of Historic Places (National Register) that were within the vicinity of the CR-3. The National Register sites were: the Crystal River Indian Mounds and the Yulee Sugar Mill ruins at Homosassa Springs. Additionally, Florida Power Corporation funded an archaeological survey of the Crystal River Energy Complex and environs in 1972. The survey was conducted by archaeologists from the Bureau of Historic Sites and Properties, Florida Division of Archives, History, and Records Management. Survey results indicated that there were 20 archaeological sites on the Crystal River Energy Complex site and an additional 23 sites within a five-mile radius. After conferring with the Advisory Council on Historic Preservation, the United States Department of the Interior, and the Florida Division of Archives, the AEC concluded that the construction and operation of CR-3 would not alter any cultural resources in the area (Section 2.11).

Also discussed in Section 2.11, the National Register of Historic Places listed 8 properties in Citrus County in 2008. Of these 8 locations, 3 fall within a 6 mile radius of CR-3. Additionally, the Department of the Interior listed 1 property that is currently determined eligible for listing (DOE) on the National Register of Historic Places in Citrus County. This property does not fall within a 6 mile radius of CR-3.

Progress Energy is not aware of any historic or archaeological resources that have been affected to date by CR-3 operations, including operation and maintenance of transmission lines. Progress Energy has no plans to change transmission line inspection and maintenance practices or right-of-way vegetation management practices over the license renewal term. Based on the fact that current practices are not expected to change significantly, Progress Energy concludes that operation of these same generation and transmission facilities over the license renewal term would not impact cultural resources; hence, no mitigation would be warranted.

Because Progress Energy is aware of the potential for the discovery of cultural resources during land-disturbing activities at its facilities and along its transmission line corridors, it has developed a corporate procedure ("Archaeological and Cultural Resources," EVC-SUBS-00105) that protects cultural resources at all Progress Energy-managed facilities and has instituted those procedures at CR-3. Because Progress Energy has no plans to construct new license renewal related facilities at CR-3 during the license renewal term (with the exception of the mausoleum described in Section 4.19.1) and because the policies and procedures established in the "Archaeological and Cultural Resources" procedure should protect any resources that have been previously identified or inadvertently discovered, Progress Energy concludes that operation of generation and transmission facilities over the license renewal term would not impact cultural resources; hence, no mitigation measures would be warranted beyond those prescribed in Progress Energy's "Archaeological and Cultural Resources" procedure.

Progress Energy has written the Director of the Division of Historical Resources, Florida's State Historic Preservation Officer (SHPO), to solicit the Division's concerns regarding impacts to cultural resources from refurbishment or license renewal activities. This letter is included as Attachment D.

4.20 SEVERE ACCIDENT MITIGATION ALTERNATIVES

NRC

The environmental report must contain a consideration of alternatives to mitigate severe accidents "…if the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environment assessment..." 10 CFR 51.53(c)(3)(ii)(L)

"…The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 76

Section 4.20 summarizes the Progress Energy analysis of alternative ways to mitigate the impacts of severe accidents. Attachment E provides a detailed description of the severe accident mitigation alternatives (SAMA) analysis.

The term "accident" refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in the release or a potential for release of radioactive material to the environment. NRC categorizes accidents as "design basis" or "severe." Design basis accidents are those for which the risk is great enough that NRC requires plant design and construction to prevent unacceptable accident consequences. Severe accidents are those that NRC considers too unlikely to warrant design controls.

NRC concluded in its license renewal rulemaking that the unmitigated environmental impacts from severe accidents met its Category 1 criteria. However, NRC made consideration of mitigation alternatives a Category 2 issue because not all plants had completed ongoing regulatory programs related to mitigation (e.g., individual plant examinations and accident management). Site-specific information to be presented in the license renewal environmental report includes: (1) potential SAMAs; (2) benefits, costs, and net value of implementing potential SAMAs; and (3) sensitivity of analysis to changes in key underlying assumptions.

Progress Energy maintains a probabilistic safety assessment model to use in evaluating the most significant risks of radiological release from CR-3 fuel assemblies and escape from the reactor coolant system into the containment structure. For the SAMA analysis, Progress Energy used the model output as input to an NRC-approved model that calculates economic costs and dose to the public from hypothesized releases from the containment structure into the environment (Attachment E). Then, using NRC regulatory analysis techniques, Progress Energy calculated the monetary value of the unmitigated CR-3 severe accident risk. The result represents the monetary value of the base risk of dose to the public and worker, offsite and onsite economic impacts, and replacement power. This value became a cost/benefit-screening tool for potential SAMAs; a SAMA whose cost of implementation exceeded the base risk value could be rejected as being not cost-beneficial.

CR-3 used industry and CR-3-specific information to create a list of approximately 25 SAMAs for consideration. Progress Energy analyzed this list and screened out SAMAs that would not apply to the CR-3 design or that were deemed not cost beneficial based on their implementation costs and perceived dose benefits. Progress Energy prepared cost estimates for the remaining SAMAs and used the base risk value compared with estimated risk benefits via PRA modeling techniques to screen out SAMAs that would not be cost-beneficial.

Progress Energy calculated the risk reduction that would be attributable to each remaining candidate SAMA (assuming SAMA implementation) and re-quantified the risk value. The difference between the base risk value and the SAMA-reduced risk value became the averted risk, or the value of implementing the SAMA. Progress Energy used this information in conjunction with the cost estimates for implementing each SAMA to perform a detailed cost/benefit comparison.

Progress Energy performed additional analyses to evaluate how the SAMA analysis would change if certain key parameters were changed, including re-assessing the cost benefit calculations using the 95th percentile level of the failure probability distributions. The results of the uncertainty analysis are discussed in Attachment E, Section E.7.

Based on the results of this SAMA analysis, one of the SAMAs has a positive net value:

- SAMA 34: Improve Procedures for Manual Operation of EFW Valves

However, when the 95th percentile PRA results are considered, the following (additional) three SAMAs become cost beneficial:

- SAMA 10: Proceduralize additional responses to MUV-23, MUV-24, MUV-25, and MUV-26 Failures
- SAMA 51: Upgrade or Improve Engineering Analysis to Qualify the EFIC Cabinets to a Higher Temperature
- SAMA 49: Upgrade Fire Barriers in Battery Charger Room 3A

While these results are believed to accurately reflect potential areas for improvement at CR-3, Progress Energy notes that this analysis should not necessarily be considered a formal disposition of these proposed changes, as other engineering reviews are necessary to determine the ultimate resolution. Progress Energy will consider the four SAMAs using the appropriate CR-3 design process.

TABLE 4-1
RESULTS OF INDUCED CURRENT ANALYSIS

Transmission Line	Voltage (kV)	Maximum Induced Current (milliamperes)
Lake Tarpon	500	4.5
Central Florida	500	4.9

Source: TtNUS 2008b

4.21 REFERENCES

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5.0 ASSESSMENT OF NEW AND SIGNIFICANT INFORMATION

5.1 DISCUSSION

NRC

"…The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 CFR 51.53(c)(3)(iv)

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants and provides for license renewal, requiring a license renewal application that includes an environmental report (10 CFR 54.23). NRC regulations, 10 CFR 51, prescribe the environmental report content and identify the specific analyses the applicant must perform. In an effort to streamline the environmental review, NRC has resolved most of the environmental issues generically and only requires an applicant's analysis of the remaining issues.

While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those environmental issues that have been generically resolved [10 CFR 51.53(c)(3)(i)], the regulations do require that an applicant identify any new and significant information of which the applicant is aware [10 CFR 51.53(c)(3)(iv)]. The purpose of this requirement is to alert NRC staff to such information, so the staff can determine whether to seek the Commission's approval to waive or suspend application of the rule with respect to the affected generic analysis. NRC has explicitly indicated, however, that an applicant is not required to perform a site-specific validation of Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) conclusions (NRC 1996).

Progress Energy expects that new and significant information would include:

- Information that identifies a significant environmental issue not covered in the GEIS and codified in the regulation, or
- Information that was not covered in the GEIS analyses and that leads to an impact finding different from that codified in the regulation.

NRC does not specifically define the term "significant." For the purpose of its review, Progress Energy used guidance available in Council on Environmental Quality (CEQ) regulations. The National Environmental Policy Act authorizes CEQ to establish implementing regulations for federal agency use. NRC requires license renewal applicants to provide NRC with input, in the form of an environmental report, that NRC will use to meet National Environmental Policy Act requirements as they apply to license renewal (10 CFR 51.10). CEQ guidance provides that federal agencies should prepare environmental impact statements for actions that would significantly affect the environment (40 CFR 1502.3), focus on significant environmental issues

(40 CFR 1502.1), and eliminate from detailed study issues that are not significant [40 CFR 1501.7(a)(3)]. The CEQ guidance includes a lengthy definition of "significantly" that requires consideration of the context of the action and the intensity or severity of the impact(s) (40 CFR 1508.27). Progress Energy expects that moderate or large impacts, as defined by NRC, would be significant. Chapter 4 presents the NRC definitions of "moderate" and "large" impacts.

The new and significant assessment that Progress Energy conducted during preparation of this license renewal application included: (1) interviews with Progress Energy subject experts on the validity of the conclusions in the GEIS as they relate to Crystal River Unit 3 (CR-3), (2) an extensive review of documents related to environmental issues at CR-3, and (3) correspondence with state and federal agencies to determine if the agencies had concerns not addressed in the GEIS. Progress Energy notes that state and federal regulatory agencies routinely inspect CR-3 facilities and records as part of their oversight of the plant and its operation and to ensure that permit conditions are met. These inspections (and less frequent permit reviews) have identified no new and significant information.

Progress Energy is aware of no new and significant information regarding the environmental impacts of CR-3 license renewal.

5.2 REFERENCES

NRC (U.S. Nuclear Regulatory Commission). 1996. Public Comments on the Proposed 10 CFR 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response. Volumes 1 and 2. NUREG-1529. Washington, DC. May.

6.0 SUMMARY OF LICENSE RENEWAL IMPACTS AND MITIGATING ACTIONS

6.1 LICENSE RENEWAL IMPACTS

Progress Energy has reviewed the environmental impacts of renewing the Crystal River Unit 3 (CR-3) operating license and has concluded that impacts would be small and would not require mitigation. This environmental report documents the basis for Progress Energy's conclusion. Chapter 4 incorporates by reference U.S. Nuclear Regulatory Commission (NRC) findings for the 64 Category 1 issues that apply to CR-3, all of which have impacts that are small (Table A-1). The rest of Chapter 4 analyzes Category 2 issues, all of which are either not applicable or have impacts that would be small. Table 6-1 identifies the impacts that CR-3 license renewal would have on resources associated with Category 2 issues.

6.2 MITIGATION

NRC

"The report must contain a consideration of alternatives for reducing adverse impacts…for all Category 2 license renewal issues…" 10 CFR 51.53(c)(3)(iii)

"The environmental report shall include an analysis that considers and balances…alternatives available for reducing or avoiding adverse environmental effects…" 10 CFR 51.45(c) as incorporated by 10 CFR 51.53(c)(2) and 10 CFR 51.45(c)

Impacts of license renewal are small and would not require mitigation. Current operations include monitoring activities that would continue during the license renewal term. Progress Energy performs routine monitoring to ensure the safety of workers, the public, and the environment. These activities include the biological monitoring program, radiological environmental monitoring program, air monitoring, effluent chemistry monitoring, and effluent toxicity testing. These monitoring programs ensure that the plant's permitted emissions and discharges are within regulatory limits and any unusual or off-normal emissions/discharges would be quickly detected, mitigating potential impacts.

6.3 UNAVOIDABLE ADVERSE IMPACTS

NRC

The environmental report shall discuss any "...adverse environmental effects which cannot be avoided should the proposal be implemented..." 10 CFR 51.45(b)(2) as adopted by 10 CFR 51.53(c)(2)

This environmental report adopts by reference NRC findings for applicable Category 1 issues, including discussions of any unavoidable adverse impacts (Table A-1). Progress Energy examined 21 Category 2 issues and identified the following unavoidable adverse impacts of license renewal:

- Waste heat from operation of Crystal River Units 1, 2, and 3 is discharged to the Gulf of Mexico.
- Adult and juvenile fish are impinged on the traveling screens at the CR-3 cooling water intake structure.
- Larval fish are entrained at the CR-3 cooling water intake structure.
- Procedures for the disposal of solid, radioactive, and mixed wastes are intended to reduce adverse impacts from these sources to acceptably low levels. A small impact will be present as long as the plant is in operation. Solid radioactive wastes are a product of plant operations and long-term disposal of these materials must be considered.
- Operation of CR-3 results in a very small increase in radioactivity in the air and water. However, fluctuations in natural background radiation may be expected to exceed the small incremental increase in dose to the local population. Operation of CR-3 also establishes a very low probability risk of accidental radiation exposure to inhabitants of the area.

6.4 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

NRC

The environmental report shall discuss any "...irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented…" 10 CFR 51.45(b)(5) as adopted by 10 CFR 51.53(c)(2)

Continued operation of CR-3 for the license renewal term will result in irreversible and irretrievable resource commitments, including the following:

- nuclear fuel, which is used in the reactor and is converted to radioactive waste;
- land required to dispose of spent nuclear fuel, low-level radioactive wastes generated as a result of plant operations; and sanitary wastes generated from normal industrial operations;
- elemental materials that will become radioactive; and
- materials used for the normal industrial operations of the plant that cannot be recovered or recycled or that are consumed or reduced to unrecoverable forms.

6.5 SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

NRC

The environmental report shall discuss the "...relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity..." 10 CFR 51.45(b)(4) as adopted by 10 CFR 51.53(c)(2)

The current balance between short-term use and long-term productivity at the CR-3 site was established with the decision to construct the plant. The *Final Environmental Statement related to the proposed Crystal River Unit 3* (AEC 1973) evaluated the impacts of (completing) construction and operation of CR-3 at a site previously dedicated to two fossil-fueled power plants. Because this was a previously-disturbed site already committed to industrial use, the amount of marsh- and forestland converted to industrial use was relatively small, much less than it would have been at a greenfield site. Likewise, the 500 kV transmission lines built to connect CR-3 to the regional grid were routed along existing rights-of-way, greatly reducing the amount of offsite land disturbed. As discussed in Section 3.1, it was necessary to excavate an area for the primary nuclear facilities (reactor building, auxiliary building, turbine building) and to extend the intake and discharge canals to accommodate the new nuclear unit. Otherwise, disturbance of the site and natural areas adjacent to the site was kept to a minimum.

After decommissioning, many environmental disturbances would cease and some restoration of the natural habitat would occur. Thus, the "trade-off" between the production of electricity and changes in the local environment is reversible to some extent.

Experience with other experimental, developmental, and commercial nuclear plants has demonstrated the feasibility of decommissioning and dismantling such plants sufficiently to restore a site to its former use. The degree of dismantlement will take into account the intended new use of the site and a balance among health and safety considerations, salvage values, and environmental impact. However, decisions on the ultimate disposition of these lands have not yet been made. Continued operation for an additional 20 years would not increase the short-term productivity impacts described here.

TABLE 6-1
ENVIRONMENTAL IMPACTS RELATED TO LICENSE RENEWAL AT CR-3

No.	Issue	Environmental Impact
	Surface Water Quality, Hydrology, and Use (for all plants)	
13	Water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow)	**None.** This issue does not apply because CR-3 does not use cooling ponds or cooling towers that withdraw makeup water from a small river.
	Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)	
25	Entrainment of fish and shellfish in early life stages	**Small.** Crystal River's NPDES permit (which requires seasonal flow restrictions and stock enhancement/replacement) constitutes compliance with CWA Section 316(b). These mitigation measures greatly reduce impact of cooling system operation.
26	Impingement of fish and shellfish	**Small.** Crystal River's NPDES permit (which requires seasonal flow restrictions and stock enhancement/replacement) constitutes compliance with CWA Section 316(b). These mitigation measures greatly reduce impact of cooling system operation.
27	Heat shock	**Small.** Crystal River has a CWA Section 316(a) variance, alternative thermal limitations based on studies that showed thermal impacts were localized. Plant uses helper cooling towers as necessary to ensure discharge temperatures are below those known to harm important marine organisms.
	Groundwater Use and Quality	
33	Groundwater use conflicts (potable and service water, and dewatering; plants that use > 100 gpm)	**Small.** Groundwater drawdown through the current license term is expected to be 0.4 foot at the CREC property boundary, with no additional drawdown during the license renewal term.
34	Groundwater use conflicts (plants using cooling towers or cooling ponds withdrawing makeup water from a small river)	**None.** This issue does not apply because CR-3 does not use cooling ponds or cooling towers that withdraw makeup water from a small river.
35	Groundwater use conflicts (Ranney wells)	**None.** This issue does not apply because CR-3 does not use Ranney wells.
39	Groundwater quality degradation (cooling ponds at inland sites)	**None**. This issue does not apply because CR-3 does not use cooling ponds.
	Terrestrial Resources	
40	Refurbishment impacts	**Small.** Refurbishment activities would take place in areas that provide only marginal wildlife habitat. Any impacts would be negligible and temporary.

TABLE 6-1
ENVIRONMENTAL IMPACTS RELATED TO
LICENSE RENEWAL AT CR-3 (Continued)

No.	Issue	Environmental Impact
		Threatened or Endangered Species
49	Threatened or endangered species	**Small.** Several threatened and endangered species (sea turtles, manatees, bald eagles) are occasionally found in the plant vicinity and others could occur along the plant's transmission corridors. Progress Energy has developed a procedure to ensure that sea turtles stranded in the intake canal are rescued and cared for and a manatee protection plan to ensure that manatees in the intake canal are not harmed. These and other measures mitigate impacts to threatened or endangered species.
		Air Quality
50	Air quality during refurbishment (non-attainment and maintenance areas)	**None.** This issue does not apply because there are no non-attainment or maintenance areas near CR-3, or in the state of Florida.
		Human Health
57	Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	**None.** CR-3 does not have cooling canals, cooling towers, or cooling ponds that discharge to a small river.
59	Electromagnetic fields, acute effects (electric shock)	**Small.** The largest modeled induced current under CR-3 transmission lines is less than the 5.0-milliampere limit, therefore the lines conform to the NESC standard.
		Socioeconomics
63	Housing impacts (refurbishment and license renewal term)	**Small.** Housing impacts are assumed to be small in medium and high population areas like Citrus County with no growth control measures.
65	Public services: public utilities (refurbishment and license renewal term)	**Small.** There is sufficient drinking water capacity in the ROI to supply the refurbishment workforce and the projected population growth during the license renewal period.
66	Public services: education (refurbishment)	**Small.** Given the projected length of the steam generator replacement outage (refurbishment), 74 days, workers are not expected to relocate to the area with their families. Any increase in enrollment in area schools would be small.
68	Offsite land use (refurbishment)	**Small.** The refurbishment workforce would temporarily increase the 50-mile population by 0.2 percent and the Citrus County population by 1.7 percent. This would have minimal effect on offsite land use in Citrus County, which is not isolated or sparsely populated and has established patterns of land use.
69	Offsite land use (license renewal term)	**Small.** No plant-induced changes to offsite land use are expected from license renewal. Impacts from continued operation would be positive.
70	Public services: transportation	**Small.** There would be no increase in the permanent workforce, thus no impact on traffic and transportation over the license renewal term. There would be an increase in local traffic during the steam generator replacement outage (refurbishment), but traffic flow would not be significantly impeded.

TABLE 6-1
ENVIRONMENTAL IMPACTS RELATED TO
LICENSE RENEWAL AT CR-3 (Continued)

No.	Issue	Environmental Impact
71	Historic and archaeological resources (refurbishment and license renewal term)	**Small.** License renewal would have little or no effect on historic or archaeological resources. Refurbishment activities would take place in previously disturbed areas, thus would not affect historic or archaelogical resources. In addition, Progress Energy has a cultural resources procedure in place to protect any archaeological or historic resources that might be encountered or inadvertently discovered during construction at Progress Energy facilities.
		Postulated Accidents
76	Severe accidents	**Small.** Progress Energy identified potentially cost-beneficial SAMAs that offer a level of risk reduction. However, as these SAMAs do not relate to aging management during the license renewal term, they need not be implemented as part of license renewal.

6.6 REFERENCES

AEC (United States Atomic Energy Commission). 1973. Final Environmental Statement related to the proposed Crystal River Unit 3. Directorate of Licensing, Washington, DC.

7.0 ALTERNATIVES TO THE PROPOSED ACTION

NRC

The environmental report shall discuss "Alternatives to the proposed action.…" 10 CFR 51.45(b)(3), as adopted by reference at 10 CFR 51.53(c)(2).

"...The report is not required to include discussion of need for power or economic costs and benefits of ... alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation...." 10 CFR 51.53(c)(2).

"While many methods are available for generating electricity, and a huge number of combinations or mixes can be assimilated to meet a defined generating requirement, such expansive consideration would be too unwieldy to perform given the purposes of this analysis. Therefore, NRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable…" (NRC 1996a).

"…The consideration of alternative energy sources in individual license renewal reviews will consider those alternatives that are reasonable for the region, including power purchases from outside the applicant's service area...." (NRC 1996b).

Chapter 7 evaluates alternatives to Crystal River Unit 3 (CR-3) license renewal. The chapter identifies actions that Progress Energy might take, and associated environmental impacts, if the U.S. Nuclear Regulatory Commission (NRC) chooses not to renew the plant's operating license. The chapter also addresses actions that Progress Energy has considered, but would not take, and identifies Progress Energy bases for determining that such actions would be unreasonable.

Progress Energy divided its alternatives discussion into two categories, "no-action" and "alternatives that meet system generating needs." In considering the level of detail and analysis that it should provide for each category, Progress Energy relied on the NRC decision-making standard for license renewal:

> "…the NRC staff, adjudicatory officers, and Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision makers would be unreasonable." [10 CFR 51.95(c)(4)].

Progress Energy has determined that the environmental report would support NRC decision making as long as the document provides sufficient information to clearly indicate whether an alternative would have a smaller, comparable, or greater environmental impact than the proposed action. Providing additional detail or analysis serves no function if it only brings to light additional adverse impacts of alternatives to license renewal. This approach is consistent with regulations of the Council on Environmental Quality, which provide that the consideration of alternatives (including the proposed action) should enable reviewers to evaluate their comparative merits (40 CFR 1500-1508). Progress Energy believes that Chapter 7 provides sufficient detail about alternatives to establish the basis for necessary comparisons to the Chapter 4 discussion of impacts from the proposed action.

In characterizing environmental impacts from alternatives, Progress Energy has used the same definitions of “small,” “moderate,” and “large” that are presented in the introduction to Chapter 4.

7.1 NO-ACTION ALTERNATIVE

Progress Energy uses "no-action alternative" to refer to a scenario in which NRC does not renew the CR-3 operating license. Components of this alternative include replacing the generating capacity of CR-3 and decommissioning the facility, as described below.

Progress Energy supplies as much as 47.6 terawatt hours of electricity to its 1.7-million customer base in Florida (Progress Energy 2008a). A terawatt hour is one billion kilowatt hours. CR-3 provides approximately 6.1 terawatt hours, or about 16.6 percent of the electricity Progress Energy generates and provides to its customers in Florida (Progress Energy 2008a). Progress Energy believes that any alternative would be unreasonable that did not include replacing this capacity. Replacement could be accomplished by (1) building new generating capacity, (2) purchasing power from the wholesale market, or (3) reducing power requirements through demand reduction. Section 7.2.2 describes each of these possibilities in detail, and Section 7.2.3 describes environmental impacts from feasible alternatives.

The Generic Environmental Impact Statement (GEIS) (NRC 1996a) 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 for unrestricted use and termination of the license. NRC-evaluated decommissioning options include immediate decontamination and dismantlement (DECON), and safe storage of the stabilized and defueled facility (SAFSTOR) for a period of time, followed by decontamination and dismantlement. Regardless of the option chosen, decommissioning must be completed within a 60-year period. Under the no-action alternative, Progress Energy would continue operating CR-3 until the current license expires, then initiate decommissioning activities in accordance with NRC requirements. The GEIS describes decommissioning activities based on an evaluation of a larger reactor (the "reference" pressurized-water reactor is the 1,175-megawatts-electrical [MWe] Trojan Nuclear Plant). This description is comparable to decommissioning activities that Progress Energy would conduct at CR-3.

As the GEIS notes, NRC has evaluated environmental impacts from decommissioning. NRC-evaluated impacts include: occupational and public radiation dose; impacts of waste management; impacts to air and water quality; and ecological, economic, and socioeconomic impacts. NRC indicated in the Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities; Supplement 1 (NRC 2002, Section 4.3.8) that the environmental effects of greatest concern (i.e., radiation dose and releases to the environment) are substantially less than the same effects resulting from reactor operations. Progress Energy adopts by reference the NRC conclusions regarding environmental impacts of decommissioning.

Progress Energy notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. Progress Energy will have to decommission CR-3 regardless of the NRC decision on license renewal; license renewal would only postpone decommissioning for another 20 years. NRC has established in the GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning. Progress Energy adopts by reference the NRC findings (10 CFR 51, Appendix B, Table B-1, Decommissioning) to the effect that delaying decommissioning until after the renewal term would have small environmental impacts. The discriminators between the proposed action and the no-action alternative lie within the choice of generation replacement options to be part of the no-action alternative. Section 7.2.3 analyzes the impacts from these options.

Progress Energy concludes that the decommissioning impacts under the no-action alternative would not be substantially different from those occurring following license renewal, as identified in the GEIS (NRC 1996a) and in the decommissioning generic environmental impact statement (NRC 2002). These impacts would be temporary and would occur at the same time as the impacts from meeting system generating needs.

7.2 ALTERNATIVES THAT MEET SYSTEM GENERATING NEEDS

7.2.1 GENERAL CONSIDERATIONS

7.2.1.1 Generating Capacity and Utilization

The current mix of power generation options in Florida is one indicator of what have been considered to be feasible alternatives within the Progress Energy service area.

Florida's electric utilities had a total generating capacity of 45,184 MWe in 2006. As Figure 7-1 indicates, this capacity includes units fueled by natural gas (46.6 percent); oil (23.4 percent); coal (21.2 percent); nuclear (8.6 percent); hydroelectric (0.1 percent); and renewable (0.01 percent). Approximately 8,022 MWe (15.1 percent of the State's generating capacity) was from non-utility sources in 2006. Florida's non-utility generators also use a variety of energy sources (EIA 2007a).

Based on 2006 generation data, Florida's electric utilities produced about 200 terawatt hours of electricity. As shown in Figure 7-2, electric generation by fuel type in Florida was dominated by natural gas (42.7 percent) and coal (30.2 percent), followed by nuclear (15.7 percent), oil (11.3 percent), hydroelectric (0.1 percent), and renewable (0.04 percent) (EIA 2007a).

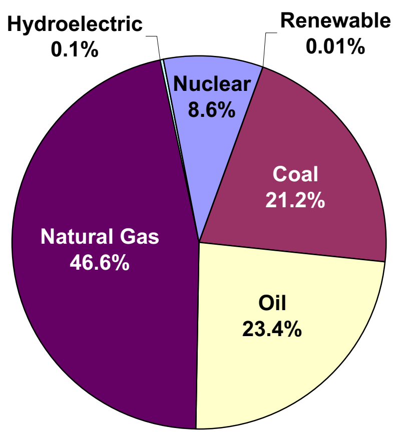

FIGURE 7-1. FLORIDA GENERATING CAPACITY BY FUEL TYPE, 2006

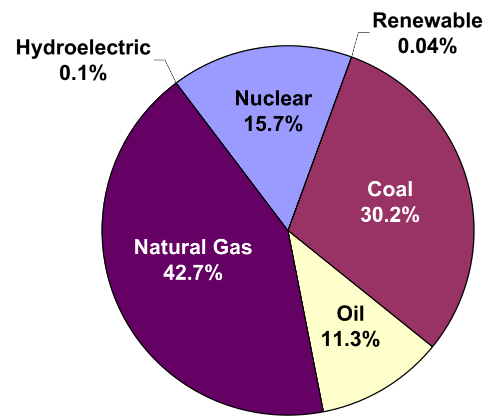

FIGURE 7-2. FLORIDA GENERATION BY FUEL TYPE, 2006

The difference between capacity and utilization is the result of optimal usage. For example, in Florida, coal represented 21.2 percent of utilities' installed capacity and nuclear energy represented 8.6 percent, but coal produced 30.2 percent of the electricity generated by utilities and nuclear produced 15.7 percent (EIA 2007a). This reflects Florida's reliance on coal and nuclear energy as base-load generating sources. Conversely, oil and gas together represented 70 percent of Florida's utility generating capacity, but only 54 percent of the electricity generated by utilities (EIA 2007a). This reflects Florida's reliance on oil and gas as fuels for intermediate-load and peaking power.

In 2007, Progress Energy had an installed summer capacity of 9,293 MWe (excluding 8.2 percent CR-3 joint ownership). Figure 7-3 illustrates the Progress Energy Florida summer capacity mix. Approximately 47.4 percent of Progress Energy's capacity was from dual-fired (gas and oil) units, 24.9 percent was from coal, 8.3 percent from nuclear, 16.8 percent from oil, and 2.7 percent from natural gas. The Progress Energy share of energy supplied by these units in 2007 was approximately 36.9 terawatt hours. Figure 7-4 illustrates the Progress Energy generation by fuel type in Florida. Coal power generated 41.5 percent of the total electricity produced, natural gas 28.7 percent, nuclear generated 16.6 percent, and oil generated 13.2 percent (Progress Energy 2008a). This reflects Progress Energy's reliance on coal and nuclear as base-load generating sources and oil and natural gas as fuels for intermediate-load and peaking power.

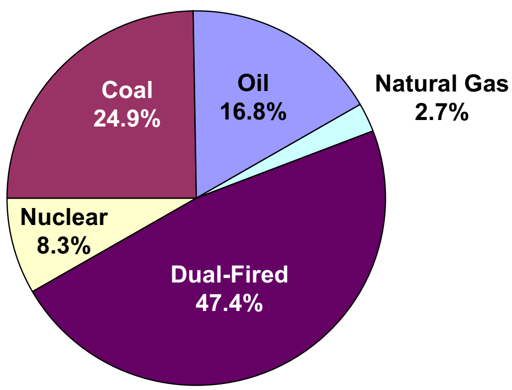

FIGURE 7-3. PROGRESS ENERGY FLORIDA CAPACITY, 2007

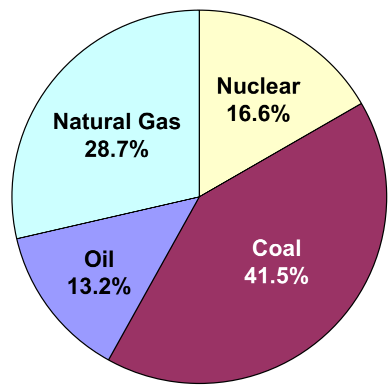

FIGURE 7-4. PROGRESS ENERGY FLORIDA GENERATION BY FUEL TYPE, 2007

7.2.1.2 Electric Power Industry Restructuring

Nationally, the electric power industry has been undergoing a transition from a regulated monopoly to a competitive market environment. Efforts to deregulate the electric utility industry began with passage of the National Energy Policy Act of 1992. Provisions of the act required electric utilities to allow open access to their transmission lines and encouraged development of a competitive wholesale market for electricity. The act did not mandate competition in the retail market, leaving that decision to the states.

Initially, 24 states and the District of Columbia pursued initiatives to restructure their electric power industry, including provisions to promote retail competition. Since the power crisis in California and the West, six of the states that passed restructuring legislation have delayed, repealed, or indefinitely postponed implementation. Currently, 16 states and the District of Columbia have restructured their electric power industry allowing full retail access for all customer groups and two states allow retail access for large customers only. Some states continue to study the issue of electric power industry restructuring, but no state has passed restructuring legislation since June of 2000 (Rose and Meeusen 2006).

Florida has not enacted major restructuring initiatives. Rather, Florida has retained the traditional regulatory model in which electric utilities are comprehensively regulated to ensure reliable electric service within pre-determined utility service territories. The Florida Public Service Commission (FPSC) has authority to ensure the provision of adequate, reliable, reasonable cost electricity to consumers. The FPSC has specific authority under Chapter 366, Florida Statutes, to regulate the rates and service of investor-owned electric utilities in the state. It also has authority to oversee the reliability of the electric grid, to determine the need for new electric generating facilities (Section 403.519, F.S.), to establish utility conservation goals (Sections 366.80-.82, F.S.) and oversight of the safety of electric facilities (Section 366.04, F.S.).

On May 5, 2006, the Florida state legislature passed a comprehensive energy bill which has been signed by the governor. The legislation created the Florida Energy Commission, which was tasked with developing a statewide energy policy, providing incentives to renewable energy sources, and fostering the construction of new nuclear power plants, including streamlining the siting of nuclear power plants and related transmission facilities, and requiring the FPSC to issue rules authorizing alternative cost-recovery mechanisms for nuclear power plant pre-construction costs and construction cost financing. The legislation called for the Commission to file an annual report by December 31 of each year beginning in 2007. (FSEC 2006)

On July 13, 2007, the governor of Florida issued executive orders to address reduction of greenhouse gas emissions (State of Florida 2008). In response to these orders, the FPSC has initiated a rulemaking requiring each investor-owned utility to supply renewable energy to its customers directly, by procuring, or through renewable energy credits. The Commission must submit a draft rule for ratification by the Legislature by February 1, 2009 (FPSC 2008). Additionally, the Florida Department of Environmental Protection (FDEP) held rulemaking workshops on the greenhouse gas emissions cap and drafts of the rule are anticipated to be issued October 1, 2008 (State of Florida 2008).

In the regulatory environment described above Progress Energy is obligated to ensure the electric power needs of customers in its service area are met and to take appropriate action (e.g., power purchase, development of new generation capacity) to accommodate any shortfall in available power resulting from a decision by NRC to not renew the CR-3 operating license. These actions would be undertaken in the context of planning and permitting requirements and activities of the FPSC, FDEP, and various other state agencies.

7.2.2 ALTERNATIVES CONSIDERED

Technology Choices

Progress Energy includes conventional technologies that utilize non-renewable resources, advanced technologies that are still being developed, and alternative technologies that utilize renewable sources of energy as potential capacity addition alternatives in its overall resource planning process. These resource alternatives are periodically reassessed and the performance characteristics updated to ensure that projections for new resource additions capture new and emerging technologies over the planning horizon. This analysis involves evaluating the generation resource alternatives based on commercial availability, technical feasibility, and cost (Progress Energy 2008a).

The most recent analysis revealed that simple-cycle combustion turbines are the most economical commercially available technology for peaking service. For base-load service (like CR-3), the most economical commercially available technologies are gas-fired combined-cycle, pulverized coal, and nuclear (Progress Energy 2008a). Based on this review, Progress Energy has concluded that feasible new plant systems that could replace the maximum dependable base-load capacity (850 MWe-net) of the CR-3 nuclear unit are limited to pulverized coal-fired boiler, natural gas-fired combined-cycle, and advanced light water reactor.

Mixtures

NRC indicated in the GEIS that, while many methods are available for generating electricity and a huge number of combinations or mixes can be assimilated to meet system needs, such expansive consideration would be too unwieldy, given the purposes of the alternatives analysis. Therefore, NRC determined that a reasonable set of alternatives should be limited to analysis of single discrete electrical generation sources and only those electric generation technologies that are technically reasonable and commercially viable (NRC 1996a). Consistent with the NRC determination, Progress Energy has not evaluated mixes of generating sources. The impacts from the generation alternatives presented in this chapter would bound the impacts from any generation mixture of technologies.

Alternatives

The following sections present fossil-fuel-fired generation (Section 7.2.2.1), advanced light water reactor (Section 7.2.2.2), and purchased power (Section 7.2.2.3), as reasonable alternatives to license renewal. Section 7.2.2.4 discusses reduced demand and presents the basis for concluding that it is not a reasonable alternative to license renewal. Section 7.2.2.5 discusses other alternatives that Progress Energy has determined are not reasonable and Progress Energy bases for these determinations.

Progress Energy analyzed locating hypothetical new generating units at the existing CR-3 site and at an undetermined greenfield site. Progress Energy concluded that

CR-3 is the preferred site for new construction because this approach would minimize environmental impacts by building on previously disturbed land and by making the most use possible of existing facilities, such as transmission lines, roads and parking areas, office buildings, and components of the cooling system. Locating hypothetical units at the existing site has, therefore, been applied to the representative new generating units.

7.2.2.1 Construct and Operate New Fossil Fuel-Fired Generation

For comparability, Progress Energy selected fossil fuel-fired units of equal electric power capacity. One coal-fired unit with a net capacity of 850 MWe could be assumed to replace the 850-MWe-net CR-3 maximum dependable capacity. Two 425-MWe gas-fired plants would provide 850-MWe net capacity. For comparability, Progress Energy set the net power of the coal-fired plant equal to the gas-fired plants (850 MWe) for estimating environmental impacts from the alternatives.

It must be emphasized, however, that these are hypothetical scenarios. Progress Energy does not have plans for such construction at CR-3.

Pulverized Coal-Fired Generation

NRC evaluated pulverized coal-fired generation alternatives for the Wolf Creek Generating Station (NRC 2008). For Wolf Creek, NRC analyzed 1,234 MWe of coal-fired generation capacity. Progress Energy has reviewed the NRC analysis, believes it to be sound, and notes that it analyzed more generating capacity than the 850 MWe discussed in this analysis. In defining the CR-3 coal-fired alternative, Progress Energy has used site- and Florida-specific input and has scaled from the NRC analysis, where appropriate.

Table 7-1 presents the basic coal-fired alternative emission control characteristics. Progress Energy based its emission control technology and percent control assumptions on alternatives that the U.S. Environmental Protection Agency (EPA) has identified as being available for minimizing emissions (EPA 1998). For the purposes of analysis, Progress Energy has assumed that coal and lime (calcium hydroxide) would be delivered via the existing rail line.

Gas-Fired Generation

Progress Energy has chosen to evaluate gas-fired generation using combined-cycle turbines because it has determined that the technology is mature, economical, and feasible. As indicated, a manufacturer's standard unit size (425 MWe net) is available and economical. Therefore, Progress Energy has analyzed 850 MWe of net power, consisting of two 425-MWe net capacity gas-fired combined cycle plants, to be located on CR-3 property. Table 7-2 presents the basic gas-fired alternative characteristics.

7.2.2.2 Construct and Operate New Nuclear Reactor

Since 1997, the NRC has certified four new standard designs for nuclear power plants under 10 CFR 52, Subpart B. These designs are the U.S. Advanced Boiling Water

Reactor (10 CFR 52, Appendix A), the System 80+ Design (10 CFR 52, Appendix B), the AP600 Design (10 CFR 52, Appendix C), and the AP1000 Design (71 FR 4464). All of these plants are light-water reactors. NRC evaluated 1,165 MWe of new nuclear generation capacity as an alternative for Wolf Creek Generating Station (NRC 2008). Progress Energy has reviewed the NRC analysis, believes it to be sound, and notes that it analyzed more generating capacity than the 850 MWe discussed in this analysis. In defining the CR-3 new nuclear reactor alternative, Progress Energy has used site- and Florida-specific input and has scaled from the NRC analysis, where appropriate.

7.2.2.3 Purchase Power

As of December 31, 2007, Progress Energy had total summer capacity resources of approximately 1,922 MWe from 16 qualifying facilities, two investor-owned utilities, and two independent power producers (Progress Energy 2008a). Progress Energy has a long-term contract with The Southern Company for approximately 414 MW of purchased power annually through 2016 (Progress Energy 2008d). Altogether, these purchased power resources account for approximately 17 percent of Progress Energy's generation resources, providing a significant amount of diversity in supply (Progress Energy 2008a). Because these contracts are part of Progress Energy's current and future capacity and no substantial new capacity additions from facilities are foreseen in the non-utility generation sector, Progress Energy does not consider such power purchases a feasible option for the purchase power alternative.

If available, purchased power from other sources could potentially obviate the need to renew the CR-3 operating license. Overall, Florida is a net importer of electricity. In 2005, Florida imported approximately 117 terawatt-hours of electricity (EIA 2008). Most of the imported power is the result of purchase contracts, including Progress Energy's contract with Southern Company. However, some of these contracts may expire before the year 2016 and Progress Energy cannot rule out the possibility that power would be available for purchase as an alternative to CR-3 license renewal. Therefore, Progress Energy has analyzed purchased power as a reasonable alternative.

Progress Energy assumes that the generating technology used to produce purchased power would be one of those that NRC analyzed in the GEIS. For this reason, Progress Energy is adopting by reference the GEIS description of the alternative generating technologies as representative of the purchase power alternative. Of these technologies, facilities fueled by coal and combined-cycle facilities fueled by natural gas are the most cost effective for providing base-load capacity. Given the amount of electricity generated by CR-3, Progress Energy believes that it is reasonable to assume that new capacity would have to be built for the purchased-power alternative.

7.2.2.4 Reduce Demand

Progress Energy has an aggressive demand-side management (DSM) program that reduces generation needs through a combination of energy conservation and load management programs. From 2005 through 2007, Progress Energy's DSM programs in Florida have reduced summer peak demand by an estimated 102 MWe, winter peak demand by 191 MWe, and annual energy consumption by an estimated 115 GWh. By the year 2014, Progress Energy plans to reduce summer peak demand by another 128 MWe, winter peak demand by another 400 MWe, and annual energy consumption by an additional 190 GWh (Progress Energy 2008a).

Progress Energy's DSM Plan is comprised of 16 individual programs, including seven residential programs, eight commercial/industrial programs, and a research and development program. These individual programs have been approved by the Florida Public Service Commission and are described in Progress Energy's Ten-Year Site Plan 2008-2017 (Progress Energy 2008a).

Because these DSM savings are part of the long-range plan for meeting projected demand, they are not available offsets for CR-3. Therefore, DSM is not considered a reasonable alternative to renewal of the CR-3 operation license.

7.2.2.5 Other Alternatives

This section identifies alternatives that Progress Energy has determined are not reasonable and the Progress Energy bases for these determinations. Progress Energy accounted for the fact that CR-3 is a base-load generator and that any feasible alternative to CR-3 would also need to be able to generate base-load power. In performing this evaluation, Progress Energy relied heavily upon NRC's GEIS (NRC 1996a).

Wind

Wind power systems produce power intermittently because they are only operational when the wind is blowing at sufficient velocity and duration (McGowan and Connors 2000). While recent advances in technology have improved wind turbine reliability, average annual capacity factors for wind power systems are relatively low (25 to 40 percent) (McGowan and Connors 2000) compared to 90 to 95 percent industry average for a base-load plant such as a nuclear plant.

The energy potential in the wind is expressed by wind generation classes ranging from 1 (least energetic) to 7 (most energetic). Wind regimes of Class 4 or higher are suitable for the advanced utility-scale wind turbine technology currently under development. Class 3 wind regimes may be suitable for future utility-scale technology (APPA 2004).

According to the Wind Energy Resource Atlas of the United States (NREL 1986), Florida does not have sufficient wind resources for wind energy applications. Onshore wind resources in Florida are generally considered to be Class 1, except for exposed sites in coastal areas which are Class 2 at best.

Estimates based on existing installations indicate that a utility-scale wind farm would require about 50 acres per MWe of installed capacity (McGowan and Connors 2000). Wind farm facilities would occupy 3 to 5 percent of the wind farm's total acreage (McGowan and Connors 2000). Assuming ideal wind conditions and a 35 percent capacity factor, a wind farm with a net output of 850 MWe would require about 121,429 acres (190 square miles) of which about 3,643 acres (6 square miles) would be occupied by turbines and support facilities. Based on the amount of land needed, the wind alternative would require a large green field site, which would result in a large environmental impact.

Based on the lack of sufficient wind speeds and the amount of land needed to replace CR-3, the wind alternative would require a large greenfield site, which would result in a large environmental impact. Additionally, wind plants have aesthetic impacts, generate noise, and harm birds.

Progress Energy has concluded that, due to the lack of area in Florida having suitable wind speeds and the amount of land needed (approximately 190 square miles), wind power is not a reasonable alternative to CR-3 license renewal.

Offshore wind farms are another source for wind energy production along the coasts of Florida; however, more than half the shore lines along the Florida coasts have been designated as Marine Protected Areas, making it difficult to site offshore wind farms directly off the coast. A 130-turbine wind farm evaluated for the west coast inner-shelf determined that an average of 169 MWe could be produced (Pimenta et al. 2005). Based on the 850 MWe of baseload capacity projected for CR-3, it would take an approximate 654-turbine wind farm to produce the equivalent baseload capacity. Based on the concerns for an offshore wind farm possibly located in a Marine Protected Area and the large area needed for equivalent CR-3 baseload capacity, an offshore wind farm would not be a reasonable alternative to CR-3 license renewal.

Solar

There are two basic types of solar technologies that produce electrical power: photovoltaic and solar thermal power. Photovoltaics convert sunlight directly into electricity using semiconducting materials. Solar thermal power systems use mirrors to concentrate sunlight on a receiver holding a fluid or gas, heating it, and causing it to turn a turbine or push a piston coupled to an electric generator (Leitner and Owens 2003).

Solar technologies produce more electricity on clear, sunny days with more intense sunlight and when the sunlight is at a more direct angle (i.e., when the sun is perpendicular to the collector). Cloudy days can significantly reduce output. To work effectively, solar installations require consistent levels of sunlight (solar insolation) (Leitner and Owens 2003).

Solar thermal systems can be equipped with a thermal storage tank to store hot heat transfer fluid, providing thermal energy storage. By using thermal storage, a solar thermal plant can provide dispatchable electric power (Leitner and Owens 2003).

The lands with the best solar resources are usually arid or semi-arid. While photovoltaic systems use both diffuse and direct radiation, solar thermal power plants can only use the direct component of the sunlight. This makes solar thermal power unsuitable for areas like Florida with high humidity which diffuses solar energy and reduce its intensity. In addition, the average annual amount of solar energy reaching the ground needs to be

6.0 kilowatt-hours per square meter per day or higher for solar thermal power systems (Leitner 2002). Florida receives 5 to 6 kilowatt hours of solar radiation per square meter per day, which is marginal for solar thermal applications (NREL 2005).

Progress Energy supports the use of solar energy. Progress Energy has projects or future initiatives representing more than 330 kW and 440,000 kWh of photovoltaic generation throughout its Florida service area. These initiatives include research and demonstration projects, educational programs, and working with customers to interconnect photovoltaic systems to the electrical grid (Progress Energy 2008b). However, capacity factors for solar applications are too low to meet base-load requirements. Average annual capacity factors for solar power systems are 24 percent for photovoltaics and 30 to 32 percent for solar thermal power compared to 90 to 95 percent for a large base-load plant such as a nuclear plant (Leitner 2002).

Land requirements for solar plants are high. The area of land required depends on the available solar insulation and type of plant, but is about 3.8 acres per megawatt for photovoltaic systems and 8 acres per megawatt for solar thermal power plants (Leitner 2002). Assuming capacity factors of 24 percent for photovoltaics and 32 percent for solar thermal power, facilities having 850 MWe net capacity are estimated to require 13,458 acres (21 square miles), if powered by photovoltaic cells, and 21,250 acres (33 square miles), if powered by solar thermal power.

Solar powered technologies, photovoltaic cells and solar thermal power do not currently compete with conventional technologies in grid-connected applications. Recent estimates indicate that in Florida, the levelized cost of electricity produced by photovoltaic cells is in the range of 19.4 to 47.4 cents per kilowatt-hour, and electricity from solar thermal systems can be produced for a levelized cost in the range of 10.8 to 18.7 cents per kilowatt-hour (FPSC & FDEP 2003).

Progress Energy has concluded that, due to the high cost, low capacity factors, and the large land area needed to produce the desired output, solar power is not a reasonable alternative to CR-3 license renewal.

Hydropower

Hydroelectric power is a fully commercialized technology. Florida currently has two hydroelectric facilities with a combined capacity of 50 MWe (FPSC & FDEP 2003). Florida has an estimated 43 MWe of undeveloped hydroelectric resource (INEEL 1998). This amount is considerably less than needed to replace the 850 MWe capacity of CR-3.

As stated in Section 8.3.4 of the GEIS (NRC 1996a), hydropower’s percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about land requirements, destruction of natural habitat, and alteration of natural river courses.

The GEIS estimates land use of 1,600 square miles per 1,000 MWe for hydroelectric power. Based on this estimate, replacement of CR-3 generating capacity would require flooding more than 1,360 square miles, resulting in a large impact on land use. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, which would impact existing aquatic communities.

Progress Energy has concluded that, due to the small amount of undeveloped hydropower resource in Florida and the large amount of land needed, in addition to the adverse environmental and ecological resource impacts, hydropower is not a reasonable alternative to renewal of the CR-3 operating license.

Geothermal

Geothermal energy is a proven resource for power generation. Geothermal power plants use naturally heated fluids as an energy source for electricity production. To produce electric power, underground high-temperature reservoirs of steam or hot water are tapped by wells and the steam rotates turbines that generate electricity. Typically, water is then returned to the ground to recharge the reservoir (NREL 1997).

Geothermal energy can achieve average capacity factors of 95 percent and can be used for base-load power where this type of energy source is available (NREL 1997). Widespread application of geothermal energy is constrained by the geographic availability of the resource. In the U.S., high-temperature hydrothermal reservoirs are located in the western continental U.S., Alaska, and Hawaii. There are no known high-temperature geothermal sites in Florida (SMU 2004).

Because there are no high-temperature geothermal sites in Florida, Progress Energy concludes that geothermal is not a reasonable alternative to renewal of the CR-3 operating license.

Wood Energy

As discussed in the GEIS (NRC 1996a), the use of wood waste to generate electricity is largely limited to those states with significant wood resources. According to the U.S. Department of Energy, Florida is considered to have good wood resource potential (Walsh et al. 2000). The pulp, paper, and paperboard industries in states with adequate wood resources generate electric power by consuming wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem. However, the largest wood waste power plants are 40 to 50 MWe in size.

Further, as discussed in Section 8.3.6 of the GEIS, construction of a wood-fired plant would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste for fuel would be built on smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage, processing, and waste (i.e., ash) disposal. Operation of wood-fired plants would have additional environmental impacts, including impacts on the aquatic environment and air. Wood has a low heat content that makes it unattractive for base-load applications. It is also difficult to handle and has high transportation costs.

While wood resources are available in Florida, Progress Energy has concluded that, due to the lack of an environmental advantage, low heat content, handling difficulties, and high transportation costs, wood energy is not a reasonable alternative to renewal of the CR-3 operating license.

Municipal Solid Waste

Florida had established the largest capacity to burn municipal solid waste (MSW) of any state in the U.S. Over 50 percent of Florida's population is served by solid waste management systems that include waste-to-energy (WTE) and over one-third of Florida's waste is disposed of through WTE facilities. Florida's existing WTE facilities have a combined capacity of nearly 600 MWe (FPSC & FDEP 2003).

Progress Energy supports the development of WTE facilities in Florida by purchasing power from four MSW plants to supply almost 134 MWe of power (Progress Energy 2008a). However, based on MSW collection estimates, WTE facilities in Florida could supply over 300 MWe of new generating capacity by the year 2018 (FPSC & FDEP 2003). This amount is considerably less than needed to replace the 850 MWe capacity of CR-3.

The initial capital costs for municipal solid waste plants are greater than for comparable steam turbine technology at wood-waste facilities. This is due to the need for specialized waste separation and handling equipment (FPSC & FDEP 2003).

The decision to burn MSW to generate electricity is usually driven by the need for an alternative to landfills, rather than by energy considerations. Combusting waste usually reduces its volume by approximately 90 percent. The remaining ash is buried in landfills (FPSC & FDEP 2003). It is unlikely, however, that many landfills will begin converting waste to energy due to the numerous obstacles and factors that may limit the growth in WTE power generation. Chief among them are environmental regulations and public opposition to siting WTE facilities near feedstock supplies.

The overall level of construction impacts from a WTE plant should be approximately the same as that for a conventional coal-fired plant. The air emission profile and other operational impacts (including impacts on the aquatic environment, air, and waste disposal) for a WTE plant would also be similar to a conventional fossil fueled unit (FPSC & FDEP 2003).

Progress Energy has concluded that, due to the high costs, the relatively low amount of available feedstock, and lack of obvious environmental advantages other than reducing landfill volume, burning MSW to generate electricity is not a reasonable alternative to renewal of the CR-3 operating license.

Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive), and gasifying energy crops (including wood waste).

Progress Energy supports the use of biomass derived fuels for generating electricity. In Florida, Progress Energy has signed a contract to purchase the entire 117 MWe output from a biomass plant that will be built in central Florida. Once built, it will be the world's first commercial-scale, closed-loop biomass facility (Progress Energy 2008b).

However, as discussed in the GEIS, none of the technologies that utilize biomass derived fuels for generating electricity has progressed to the point of being competitive on a large scale or of being reliable enough to replace a large base-load plant such as CR-3. Further, estimates in the GEIS suggest that the overall level of construction impacts from a crop-fired plant should be approximately the same as that for a wood-fired plant. Additionally, crop-fired plants would have similar operational impacts (including impacts on the aquatic environment and air). These systems also have large impacts on land use, due to the acreage needed to grow the energy crops.

Progress Energy has concluded that, due to the high costs and lack of environmental advantage, burning other biomass-derived fuels is not a reasonable alternative to renewal of the CR-3 operating license.

Petroleum

Historically, Florida's electric power industry was dominated by generating units that were fueled primarily by petroleum (oil). In 1973, oil-fired plants comprised 55 percent of the State's electricity generation mix. Use of oil as an energy source for power generation in Florida has declined substantially since that time, due in part to FPSC policies that encouraged alternatives that minimized use of oil as a generation fuel, and in part by economic considerations (FPSC 2005). In 2006, oil-fired generation provided approximately 11.3 percent of Florida's electricity (EIA 2007a). Looking towards the future, Florida's utilities forecast a continued decline in reliance on oil-fired generation; decreasing from its present level to about 7 percent of total statewide energy production by the year 2014 (FPSC 2005).

Oil-fired operation is more expensive than nuclear or coal-fired operation. In addition, future increases in petroleum prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation.

Also, construction and operation of an oil-fired plant would have environmental impacts. For example, Section 8.3.11 of the GEIS estimates that construction of a 1,000-MWe petroleum-fired plant would require about 120 acres. Additionally, operation of petroleum-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

Progress Energy has concluded that, due to the fuel high costs and lack of obvious environmental advantage, oil-fired generation is not a reasonable alternative to CR-3 license renewal.

Integrated Gasification Combined-Cycle

An integrated gasification combined-cycle (IGCC) power plant utilizes synthetic gas as a source of clean fuel. It is a method by which coal or other combustible fuel, under high pressure and temperature, is transformed into gas prior to combustion. The resultant gas is used to fire a combustion turbine. IGCC appears to offer the potential to be competitive with other baseload generation technologies with fewer environmental concerns; however, it has been demonstrated only at a handful of installations and is just now becoming commercially available (Progress Energy 2008b).

CO2 production from IGCC is similar to that of a pulverized coal unit unless carbon capture and storage (CCS) technology is implemented. CCS technology has the potential to reduce CO2 emissions, but is still in the developmental stage. It is estimated that it will be 10 to 15 years before the technology will be available for commercial applications (Progress Energy 2008b).

The main inhibiting factors for IGCC are high capital costs, reliability concerns, difficulty with financing, and lack of the CCS technology (Progress Energy 2008b). Due to these inhibiting factors, Progress Energy has concluded that IGCC generation is not a reasonable alternative to CR-3 license renewal.

Fuel Cells

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

Fuel cell power plants are in the initial stages of commercialization. While more than 850 large stationary fuel cell systems have been built and operated worldwide, the global stationary fuel cell electricity generating capacity in 2007 was approximately 175 MWe (Adamson 2007). The 11 MWe Goi Power Station in Japan is the largest stationary fuel cell power plant yet built (FC2000 2008).

Progress Energy supports the development of fuel cells for distributed generation applications. In 2005, Progress Energy announced a commitment of $1 million to Microcell Corporation, which is working to bring commercially available fuel cell applications to industrial, commercial and consumer markets. Progress Energy has also teamed with FDEP in a sustainable hydrogen generator and fuel cell demonstration project at the Homosassa Springs State Wildlife Park in Citrus County (Progress Energy 2008b).

Progress Energy believes that this technology has not matured sufficiently to support production for a facility the size of CR-3. Progress Energy has concluded that, due to cost and production limitations, fuel cell technology is not a reasonable alternative to CR-3 license renewal.

Delayed Retirement

Retired fossil fuel power generating facilities and fossil fuel power generating facilities slated for retirement tend to be ones that are old enough to have difficulty in economically meeting today's restrictions on air contaminant emissions. In the face of increasingly stringent environmental restrictions, delaying retirement or reactivating power generating facilities would require major construction to upgrade or replace facility components.

Progress Energy currently has one power generating facility (Bartow, 444 MWe, in St. Petersburg) slated for retirement that is currently being repowered by replacing existing oil-fired boilers with a combined-cycle power block fueled primarily by natural gas. This will increase the plant's output by 800 MW. The other facility (Suwannee River, 129 MWe, in Live Oak) which was scheduled for retirement is being reviewed for similar upgrades to extended its service life (Progress Energy 2008a; Progress Energy 2008e).

The Bartow plant uprate and the potential Suwannee River uprate have been considered in planning for future power needs and are not considered as an alternative to CR-3 license renewal.

7.2.3 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

This section evaluates the environmental impacts of alternatives that Progress Energy has determined to be reasonable alternatives to CR-3 license renewal: pulverized coal, gas-fired combined-cycle, new nuclear units, and purchased power.

Air Quality Considerations

All areas in Florida are designated as in attainment or unclassifiable for all ambient air quality standards under the Clean Air Act, nevertheless, in 2006 Florida ranked third highest in the nation for NOx emissions and tenth highest in the nation for SO_2 emissions (EIA 2007a).

The acid rain requirements of the Clean Air Act Amendments required NOx reductions and capped the nation's SO_2 emissions from power plants. Each company with fossil-fuel-fired units was allocated SO_2 allowances. To be in compliance with the Act, the companies must hold enough allowances to cover their annual SO_2 emissions.

In March 2005, EPA finalized the Clean Air Interstate Rule (CAIR) which addresses SO_2 and NOx emissions that contribute to non-attainment of the eight-hour ozone and fine particulate matter standards in downwind states; and the Clean Air Mercury Rule (CAMR) which addresses mercury emissions from coal-fired power plants (EPA 2008).

Both rules set emission limits and encouraged the adoption of a cap-and-trade approach to meeting those limits. On June 29, 2006, the Florida Department of Environmental Protection adopted the Florida CAIR, which is very similar to the EPA's cap-and-trade approach, and the Florida CAMR which adopts the EPA's cap-and-trade approach (FDEP 2006).

Progress Energy considered numerous options for reducing emissions and/or trading allowances in order to develop the most cost-effective, company-wide compliance strategy for the CAIR and CAMR rules. Based on the system planning models, Progress Energy has determined that emission controls need to be installed on existing coal- and oil-fired units at Crystal River, Anclote, and Bartow in order to achieve compliance in a cost-effective manner. Such controls include flue gas desulfurization (FGD) for SO_2 emissions, selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and low NOx burners/over-fire air for NOx emissions, and the combination of FGD and SCR for the reduction of mercury emissions.

In response to petitions against portions of the rules, the D.C. Circuit vacated CAMR on February 8, 2008 and CAIR on July 11, 2008 (EPA 2008). No changes have been made in Florida and while Progress Energy is reviewing available options due to these changes, the company expects to complete current emission control projects (Progress Energy 2008f).

To operate a new fossil-fired plant in Florida, Progress Energy would need to acquire enough NOx and SO_2 allowances to cover its annual emissions by purchasing allowances from the open market, installing additional emission controls at existing fossil-fired facilities, switching fuels, or decommissioning existing fossil-fired capacity and applying the allowances from that plant to the new one. To construct a new coal-fired plant Progress Energy would need to use the same methods in order acquire enough mercury allowances to cover its annual emissions.

7.2.3.1 Pulverized Coal-Fired Generation

NRC evaluated environmental impacts from pulverized coal-fired generation alternatives in the GEIS (NRC 1996a). NRC concluded that construction impacts could be substantial, due in part to the large land area required (which can result in natural habitat loss) and the large workforce needed. NRC pointed out that siting a new coal-fired plant where an existing nuclear plant is located would reduce many construction impacts. NRC identified major adverse impacts from operations as human health concerns associated with air emissions, waste generation, and losses of aquatic biota due to cooling water withdrawals and discharges.

The coal-fired alternative that Progress Energy has defined in Section 7.2.2.1 would be located at CR-3.

Air Quality

A coal-fired plant would emit sulfur dioxide (SO_2) and nitrogen oxides (NOx), particulate matter, carbon monoxide, and mercury, all of which are regulated pollutants. As Section 7.2.1.1 indicates, Progress Energy has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. Progress Energy estimates the coal-fired alternative emissions to be as follows:

SO_2 = 3,191 tons per year

NOx = 613 tons per year

Carbon monoxide = 613 tons per year

Particulates:

> PM_{10} (particulates having a diameter of less than 10 microns) = 26 tons per year
>
> $PM_{2.5}$ (particulates having a diameter of less than 2.5 microns) = 0.11 tons per year

Mercury = 0.10 ton per year

Table 7-3 shows how Progress Energy calculated these emissions.

NRC did not quantify coal-fired emissions in the GEIS, but implied that air impacts would be substantial. NRC noted that adverse human health effects from coal combustion have led to important federal legislation in recent years and that public health risks, such as cancer and emphysema, have been associated with coal combustion. NRC also mentioned global warming and acid rain as potential impacts. Progress Energy concludes that federal legislation and large-scale concerns, such as global warming and acid rain, are indications of concerns about destabilizing important attributes of air resources. However, SO_2 and NOx emission allowances, low NOx burners, overfire air, fabric filters or electrostatic precipitators, and scrubbers are regulatorily imposed mitigation measures. As such, Progress Energy concludes that the coal-fired alternative would have moderate impacts on air quality; the impacts would be noticeable, but would not destabilize air quality in the area.

Waste Management

Progress Energy concurs with the GEIS assessment that the coal-fired alternative would generate substantial solid waste. The coal-fired plant would annually consume approximately 2,452,000 tons of coal having an ash content of 9.08 percent (Tables 7-3 and 7-1, respectively). After combustion, approximately 90 percent of this ash (200,000 tons per year), would be recycled. The remaining ash, approximately 21,900 tons per year, would be collected and disposed of onsite. In addition, approximately 174,000 tons of scrubber sludge would be disposed of onsite each year (based on annual lime usage of approximately 58,800 tons). Progress Energy estimates that ash and scrubber waste disposal over a 40-year plant life would require approximately 118 acres. Table 7-4 shows how Progress Energy calculated ash and scrubber waste volumes. The CR-3 site is approximately 4,738 acres. While only half this waste volume and acreage would be attributable to the 20-year license renewal period alternative, the total numbers are pertinent as a cumulative impact.

Progress Energy believes that, with proper siting coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources. There would be space within the CR-3 property for this disposal but, as noted above, it would be necessary to clear approximately 118 acres of woodlands. After closure of the waste site and revegetation, the land would be available for other uses. For these reasons, Progress Energy believes that waste disposal for the coal-fired alternative would have moderate impacts; the impacts of increased waste disposal would be noticeable, but would not destabilize any important resource, and further mitigation would be unwarranted.

Other Impacts

Progress Energy estimates that construction of the power block and coal storage area would affect 135 acres of land and associated terrestrial habitat. Because most of this construction would require some clearing of woodland areas, impacts at the CR-3 site would be moderate, but would be somewhat less than the impacts of using a green field site. Visual impacts would be consistent with the industrial nature of the site. As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Debris from clearing and grubbing could be disposed of onsite. Socioeconomic impacts from the construction workforce would be minimal, because worker relocation would not be expected, due to the site's proximity to Tampa, Florida, 70 miles from the site. Progress Energy estimates an operational workforce of only 98 for the coal-fired alternative. The reduction in workforce would result in adverse socioeconomic impacts. Progress Energy believes these impacts would be small, due to CR-3's proximity to the Tampa metropolitan area.

Impacts to aquatic resources and water quality would be similar to impacts of CR-3, due to the plant's use of the existing natural draft cooling tower and cooling water system that withdraws from and discharges to the Gulf of Mexico via the intake and discharge canals, and would be offset by the concurrent shutdown of CR-3. The additional stacks, boilers, and rail deliveries would increase the visual impact of the existing site. Impacts to cultural resources would be unlikely, due to the previously disturbed nature of the site.

Progress Energy believes that other construction and operation impacts would be small. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these other impacts, mitigation would not be warranted beyond that previously mentioned.

7.2.3.2 Gas-Fired Generation

NRC evaluated environmental impacts from gas-fired generation alternatives in the GEIS, focusing on combined-cycle plants. Section 7.2.1.1 presents Progress Energy's reasons for defining the gas-fired generation alternative as a combined-cycle plant on the CR-3 site. Land-use impacts from gas-fired units on CR-3 would be less than those from the pulverized coal-fired and new nuclear reactor alternatives. Reduced land requirements, due to a smaller facility footprint, would reduce impacts to ecological, aesthetic, and cultural resources. A smaller workforce could have adverse socioeconomic impacts. Human health effects associated with air emissions would be of concern. Aquatic biota losses due to cooling water withdrawals would be offset by the concurrent shutdown of the nuclear generators.

NRC has evaluated the environmental impacts of constructing and operating a 1,212-MWe gas-fired facility consisting of multiple combined-cycle units as an alternative to a nuclear power plant license renewal (NRC 2008). Progress Energy has reviewed the NRC analysis, believes it to be sound, and notes that it analyzed more generating capacity than the 850 MWe-net discussed in this analysis. Progress Energy has adopted the NRC analysis with necessary Florida- and Progress Energy-specific modifications noted.

Air Quality

Natural gas is a relatively clean-burning fossil fuel; the gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Control technology for gas-fired turbines focuses on NOx emissions. Progress Energy estimates the gas-fired alternative emissions to be as follows:

SO_2 = 16 tons per year

NOx = 257 tons per year

Carbon monoxide = 53 tons per year

Filterable Particulates = 45 tons per year (all particulates are $PM_{2.5}$)

Table 7-5 shows how Progress Energy calculated these emissions.

While gas-fired turbine emissions are less than coal-fired boiler emissions, and regulatory requirements are less stringent, the emissions are still substantial. Progress Energy concludes that emissions from the gas-fired alternative at CR-3 would noticeably alter local air quality, but would not destabilize regional resources (i.e., air quality). Air quality impacts would therefore be moderate, but substantially smaller than those of coal-fired generation.

Waste Management

Gas-fired generation would result in almost no waste generation, producing minor (if any) impacts. Progress Energy concludes that gas-fired generation waste management impacts would be small.

Other Impacts

Similar to the pulverized coal-fired alternative, the ability to construct the gas-fired alternative on the existing CR-3 site would reduce construction-related impacts. A new gas pipeline would be required for the two 425-MWe gas turbine generators in this alternative. To the extent practicable, Progress Energy would route the pipeline along existing, previously disturbed, rights-of-way to minimize impacts. Approximately 10 miles of new pipeline construction would be required to connect CR-3 to the existing pipeline network. A 10-inch diameter pipeline would necessitate a 50-foot-wide corridor, resulting in the disturbance of as much as 61 acres. This new construction may also necessitate an upgrade of the State-wide pipeline network. Progress Energy estimates that 33 acres would be needed for a plant site; this much previously disturbed acreage is available at CR-3, reducing loss of terrestrial habitat. Aesthetic impacts, erosion and sedimentation, fugitive dust, and construction debris impacts would be similar to the pulverized coal-fired alternative, but smaller because of the reduced site size. Socioeconomic impacts of construction would be minimal, because worker relocation would not be expected due to the site's proximity to Tampa, Florida, 70 miles from the site. However, Progress Energy estimates a workforce of 28 for gas operations. The reduction in work force would result in adverse socioeconomic impacts. Progress Energy believes these impacts would be moderate and would be mitigated by the site's proximity to the Tampa metropolitan area.

7.2.3.3 New Nuclear Reactor

As discussed in Section 7.2.1.2, under the new nuclear reactor alternative Progress Energy would construct and operate a single unit nuclear plant using one of the four NRC certified standard designs for nuclear power plants.

Air Quality

Air quality impacts would be minimal. Air emissions are primarily from non-facility equipment and diesel generators and are comparable to those associated with the continued operation of CR-3. Overall, emissions and associated impacts would be considered small.

Waste Management

High level radioactive wastes would be similar to those associated with the continued operation of CR-3. Low level radioactive waste impacts from a new nuclear plant would be slightly greater but similar to the continued operation of CR-3. The overall impacts are characterized as small.

Other Impacts

Progress Energy estimates that construction of the reactor and auxiliary facilities would affect approximately 250 acres of land and associated terrestrial habitat. Because this construction would require some clearing of woodland areas, impacts at the CR-3 site would be moderate. For the purposes of analysis, Progress Energy has assumed that the existing rail line would be used for reactor vessel and other deliveries under this alternative. Visual impacts would be consistent with the industrial nature of the site. As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Debris from clearing and grubbing could be disposed of onsite.

Progress Energy estimates a peak construction work force of 2,500. The surrounding communities would experience moderate to large demands on housing and public services. After construction, the communities would be impacted by the loss of jobs as construction workers moved on. Long-term job opportunities would be comparable to continued operation of CR-3; therefore, Progress Energy concludes that the socioeconomic impacts during operation would be small.

Impacts to aquatic resources and water quality would be similar to impacts of CR-3, due to the plant's use of the existing cooling water system that withdraws from and discharges to the Gulf of Mexico via the intake and discharge canals, and would be offset by the concurrent shutdown of CR-3.

Impacts to cultural resources would be unlikely, due to the previously disturbed nature of the site. Progress Energy is aware, however, that the site vicinity and the surrounding environs have potential for containing cultural resources. Additionally, Progress Energy is aware of cultural resources that are within or near CR-3 boundaries. If any archaeological or historic artifacts were found during construction, work would cease in the vicinity of the find and the site environmental coordinator would be notified. The site environmental coordinator would then contact the State Historic Preservation Officer (SHPO). Progress Energy would coordinate with the SHPO to protect any potentially significant cultural resources. Progress Energy concludes that the impact on cultural resources from construction and operation of new nuclear units at CR-3 would be small and no mitigation would be warranted.

Progress Energy thinks that other construction and operation impacts would be small. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these other impacts, mitigation would not be warranted beyond that previously mentioned.

7.2.3.4 Purchased Power

As discussed in Section 7.2.1.2, Progress Energy assumes that the generating technology used under the purchased power alternative would be one of those that NRC analyzed in the GEIS. Progress Energy is also adopting by reference the NRC analysis of the environmental impacts from those technologies. Under the purchased power alternative, therefore, environmental impacts would still occur, but they would likely originate from a power plant located elsewhere within the region, nation, or another country.

Florida's peninsula limits interconnection alternatives for obtaining imported power, and the location of the CR-3 load center (i.e., central Florida) would require Progress Energy to construct additional transmission facilities from the Florida State line to central Florida, a distance of approximately 200 to 300 miles. Depending on the source of the imported power, additional transmission facilities may have to be built in other states to the Florida State line. Progress Energy believes most of the transmission lines could be routed along existing rights-of-way. Progress Energy assumes that the environmental impacts of transmission line construction would be moderate. As indicated in the introduction to Section 7.2.2, the environmental impacts of construction and operation of new coal- or gas-fired generating capacity for purchased power at a previously undisturbed greenfield site would exceed those of a coal- or gas-fired alternative located on the CR-3 site.

TABLE 7-1
PULVERIZED COAL-FIRED ALTERNATIVE

Characteristic	Basis
Unit size = 850 MWe ISO rating net[a]	Coal-fired plant that is = CR-3 net capacity of 850 MWe
Unit size = 904 MWe ISO rating gross[a]	Calculated based on 6 percent onsite power
Number of units = 1	Assumed
Boiler type = tangentially fired, dry-bottom	Minimizes nitrogen oxides emissions (EPA 1998)
Fuel type = bituminous, pulverized coal	Typical for coal used in Florida
Fuel heating value = 12,142 Btu/lb	2006 value for coal used in Florida (EIA 2007b)
Fuel ash content by weight = 9.08 percent	2006 value for coal used in Florida (EIA 2007b)
Fuel sulfur content by weight = 1.37 percent	2006 value for coal used in Florida (EIA 2007b)
Uncontrolled NOx emission = 10 lb/ton Uncontrolled CO emission = 0.5 lb/ton	Typical for pulverized coal, tangentially fired, dry-bottom, NSPS (EPA 1998)
Heat rate = 8,844 Btu/KWh	Typical for coal-fired units (Progress Energy 2008c)
Capacity factor = 0.85	Typical for large coal-fired plants
Controlled mercury emission = 8.3×10^{-5} lb/ton	EPA 1998
NOx control = low NOx burners, overfire air and selective catalytic reduction (95 percent reduction)	Best available and widely demonstrated for minimizing NOx emissions (EPA 1998)
Particulate control = fabric filters (baghouse-99.9 percent removal efficiency)	Best available for minimizing particulate emissions (EPA 1998)
SO_2 control = Wet scrubber – lime (95 percent removal efficiency)	Best available for minimizing SO_2 emissions (EPA 1998)

a. The difference between “net” and “gross” is electricity consumed onsite.

Btu = British thermal unit
CO = carbon monoxide
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
Kwh = kilowatt hour
lb = pound
MWe = megawatt electric
NOx = nitrogen oxides
NSPS = New Source Performance Standard
SO_2 = sulfur dioxide
< = less than

TABLE 7-2
GAS-FIRED ALTERNATIVE

Characteristic	Basis
Unit size = 425 MWe ISO rating net:[a]	Gas-fired combined-cycle plant that is = CR-3 net capacity of 850 MWe
Unit size = 443 MWe ISO rating gross:[a]	Calculated based on 4 percent onsite power
Number of units = 2	Assumed
Fuel type = natural gas	Assumed
Fuel heating value = 1,030 Btu/ft^3	2006 value for natural gas used in Florida (EIA 2007b)
Fuel sulfur content = 0.0007%	Typical for natural gas (INGAA 2000)
NOx control = selective catalytic reduction (SCR) with steam/water injection	Best available for minimizing NOx emissions (EPA 2000)
Fuel NOx content = 0.0109 lb/MMBtu	Typical for large SCR-controlled gas fired units with water injection (EPA 2000)
Fuel CO content = 0.00226 lb/MMBtu	Typical for large SCR-controlled gas fired units (EPA 2000)
Heat rate = 7,163 Btu/kWh	Typical for gas-fired combined-cycle units (Progress Energy 2008c)
Capacity factor = 0.85	Typical for combined-cycle units in baseload service

a. The difference between "net" and "gross" is electricity consumed onsite.

Btu = British thermal unit
CO = carbon monoxide
ft3 = cubic foot
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh = kilowatt hour
MM = million
MWe = megawatt electric
NOx = nitrogen oxides
< = less than

TABLE 7-3
AIR EMISSIONS FROM PULVERIZED COAL-FIRED ALTERNATIVE

Parameter	Calculation	Result
Annual coal consumption	$1\ \text{Unit} \times \frac{904\ \text{MW}}{\text{Unit}} \times \frac{8{,}844\ \text{Btu}}{\text{kW} \times \text{hr}} \times \frac{1{,}000\ \text{kW}}{\text{MW}} \times \frac{\text{lb}}{12{,}142\ \text{Btu}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{8{,}760\ \text{hr}}{\text{yr}} \times 0.85$	2,452,125 tons coal per year
SO_2[a,c]	$\frac{38 \times 1.37\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100 - 95}{100} \times \frac{2{,}452{,}125\ \text{tons}}{\text{yr}}$	3,191 tons SO_2 per year
NOx[b,c]	$\frac{10\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100 - 95}{100} \times \frac{2{,}452{,}125\ \text{tons}}{\text{yr}}$	613 tons NOx per year
CO[c]	$\frac{0.5\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{2{,}452{,}125\ \text{tons}}{\text{yr}}$	613 tons CO per year
PM_{10}[d]	$\frac{2.3 \times 9.08\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100 - 99.9}{100} \times \frac{2{,}452{,}125\ \text{tons}}{\text{yr}}$	26 tons PM_{10} per year
$PM_{2.5}$[e]	$\frac{0.01 \times 9.08\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100 - 99.9}{100} \times \frac{2{,}452{,}125\ \text{tons}}{\text{yr}}$	0.111 tons $PM_{2.5}$ per year
Hg[f]	$\frac{8.3 \times 10^{-5}\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{2{,}452{,}125\ \text{tons}}{\text{yr}}$	0.102 tons Hg per year

a. EPA 1998, Table 1.1-1.
b. EPA 1998, Table 1.1-2.
c. EPA 1998, Table 1.1-3.
d. EPA 1998, Table 1.1-4.
e. EPA 1998, Table 1.1-6.
f. EPA 1998, Table 1.1-18.

CO = carbon monoxide
Hg = mercury
NOx = nitrogen oxides
PM_{10} = particulates having diameter less than 10 microns
SO_2 = sulfur dioxide

TABLE 7-4
SOLID WASTE FROM PULVERIZED COAL-FIRED ALTERNATIVE

Parameter	Calculation	Result
Annual SO_2 generated[a]	$\frac{2{,}452{,}125 \text{ ton coal}}{\text{yr}} \times \frac{0.85 \text{ tons}}{100 \text{ ton coal}} \times \frac{64.1 \text{ ton } SO_2}{32.1 \text{ tons}}$	67,155 tons of SO_2 per year
Annual SO_2 removed	$\frac{67{,}155 \text{ ton } SO_x}{\text{yr}} \times \frac{95}{100}$	63,797 tons of SO_2 per year
Annual ash generated	$\frac{2{,}452{,}125 \text{ ton coal}}{\text{yr}} \times \frac{8.3 \text{ ton ash}}{100 \text{ ton coal}} \times \frac{99.9}{100}$	222,430 tons of ash per year
Annual ash recycled	$222{,}430 \text{ tons} \times \frac{90}{100}$	200,187 tons of ash recycled per year
Annual ash waste	222,430 tons - 200,187 tons	22,243 tons of ash waste per year
Annual lime consumption[b]	$\frac{67{,}155 \text{ ton } SO_2}{\text{yr}} \times \frac{56.1 \text{ ton CaO}}{64.1 \text{ ton } SO_2}$	58,773 tons of CaO per year
Annual calcium sulfate generated[c]	$\frac{63{,}797 \text{ ton } SO_2}{\text{yr}} \times \frac{172 \text{ ton } CaSO_4 \bullet 2H_2O}{64.1 \text{ ton } SO_2}$	171,187 tons of $CaSO_4 \cdot 2H_2O$ per year
Annual scrubber waste generated[d]	$\frac{58{,}773 \text{ ton CaO}}{\text{yr}} \times \frac{100 - 95}{100} + 171{,}187 \text{ ton } CaSO_4 \bullet 2H_2O$	174,126 tons of scrubber waste per year
Total volume of scrubber waste[e]	$\frac{174{,}126 \text{ ton}}{\text{yr}} \times 40 \text{ yr} \times \frac{2{,}000 \text{ lb}}{\text{ton}} \times \frac{ft^3}{102 \text{ lb}}$	136,569,051 ft^3 of scrubber waste
Total volume of ash[f]	$\frac{22{,}243 \text{ ton}}{\text{yr}} \times 40 \text{ yr} \times \frac{2{,}000 \text{ lb}}{\text{ton}} \times \frac{ft^3}{100 \text{ lb}}$	17,794,424 ft^3 of ash
Total volume of solid waste	136,569,051 ft^3 + 17,794,424 ft^3	154,363,475 ft^3 of solid waste
Waste pile area (acres)	$\frac{5{,}145{,}449 \text{ } ft^3}{30 \text{ ft}} \times \frac{\text{acre}}{43{,}560 \text{ } ft^2}$	118 acres of solid waste

Based on annual coal consumption of 2,452,125 tons per year (Table 7-2).

a. Calculations assume 100 percent combustion of coal.
b. Lime consumption is based on total SO_2 generated.
c. Calcium sulfate generation is based on total SO_2 removed.
d. Total scrubber waste includes scrubbing media carryover.
e. Density of scrubber sludge is 102 lb/ft^3 (FHA 1998).
f. Density of coal bottom ash is 100 lb/ft^3 (FHA 1998).

S = sulfur
SO_2 = oxides of sulfur
CaO = calcium oxide (lime)
$CaSO_4 \cdot 2H_2O$ = calcium sulfate dihydrate

TABLE 7-5
AIR EMISSIONS FROM GAS-FIRED ALTERNATIVE

Parameter	Calculation	Result
Annual gas consumption	$2\ \text{Units} \times \frac{443\ \text{MW}}{\text{Unit}} \times \frac{7{,}163\ \text{Btu}}{\text{kW} \times \text{hr}} \times \frac{1{,}000\ \text{kW}}{\text{MW}} \times \frac{\text{ft}^3}{1{,}030\ \text{Btu}} \times \frac{8{,}760\ \text{hr}}{\text{yr}} \times 0.85$	45,848,850,425 ft^3 per year
Annual Btu input	$\frac{45{,}848{,}850{,}425\ \text{ft}^3}{\text{yr}} \times \frac{1{,}030\ \text{Btu}}{\text{ft}^3} \times \frac{\text{MMBtu}}{10^6\ \text{Btu}}$	47,224,316MMBtu per year
SO_2[a]	$\frac{0.000658\ \text{lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000 \text{lb}} \times \frac{47{,}224{,}316\ \text{MMBtu}}{yr}$	16 tons SO_2 per year
NOx[b]	$\frac{0.0109\ \text{lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000 \text{lb}} \times \frac{47{,}224{,}316\ \text{MMBtu}}{yr}$	257 tons NOx per year
CO[b]	$\frac{0.00226\ \text{lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000 \text{lb}} \times \frac{47{,}224{,}316\ \text{MMBtu}}{yr}$	53 tons CO per year
$PM_{2.5}$[a]	$\frac{0.0109\ \text{lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000 \text{lb}} \times \frac{47{,}224{,}316\ \text{MMBtu}}{yr}$	45 tons filterable $PM_{2.5}$ per year

a. EPA 2000, Table 3.1-1. All particulates are less than 2.5 microns in diameter.
b. EPA 2000, Table 3.1-2.
CO = carbon monoxide
NOx = oxides of nitrogen
$PM_{2.5}$ = particulates having diameter less than 2.5 microns
SO_2 = sulfur dioxide

7.3 REFERENCES

Note to reader: Some web pages cited in this document are no longer available, or are no longer available through the original URL addresses. Hard copies of cited web pages are available in Progress Energy files. Some sites, for example the census data, cannot be accessed through their given URLs. The only way to access these pages is to follow queries on previous web pages. The complete URLs used by Progress Energy have been given for these pages, even though they may not be directly accessible.

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8.0 COMPARISON OF ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL WITH THE ALTERNATIVES

NRC

"To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form..." 10 CFR 51.45(b)(3) as adopted by 51.53(c)(2)

Chapter 4 analyzes environmental impacts of Crystal River Unit 3 (CR-3) license renewal and Chapter 7 analyzes impacts from renewal alternatives. Table 8-1 summarizes environmental impacts of the proposed action (license renewal) and the alternatives, for comparison purposes. The environmental impacts compared in Table 8-1 are those that are either Category 2 issues for the proposed action, license renewal, or are issues that the Generic Environmental Impact Statement (GEIS) (NRC 1996) identified as major considerations in an alternatives analysis. For example, although the U. S. Nuclear Regulatory Commission (NRC) concluded that air quality impacts from the proposed action would be small (Category 1), the GEIS identified major human health concerns associated with air emissions from alternatives (Section 7.2.2). Therefore, Table 8-1 compares air impacts among the proposed action and the alternatives. Table 8-2 is a more detailed comparison of the alternatives.

TABLE 8-1
IMPACTS COMPARISON SUMMARY

Impact	Proposed Action (License Renewal)	No-Action Alternative				
		Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With New Nuclear Generation	With Purchased Power
Land Use	SMALL	SMALL	MODERATE	SMALL to MODERATE	MODERATE	MODERATE
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL to MODERATE
Ecological Resources	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Threatened or Endangered Species	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL to MODERATE	SMALL	MODERATE	SMALL	SMALL	SMALL to MODERATE
Socioeconomics	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL to MODERATE
Waste Management	SMALL	SMALL	MODERATE	SMALL	SMALL	SMALL to MODERATE
Aesthetics	SMALL	SMALL	MODERATE	SMALL	SMALL	SMALL to MODERATE
Cultural Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

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, any important attribute of the resource. 10 CFR 51, Subpart A, Appendix B, Table B-1, Footnote 3.

TABLE 8-2
IMPACTS COMPARISON DETAIL

		No-Action Alternative			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With New Nuclear Generation**	**With Purchased Power**
Alternative Descriptions					
CR-3 license renewal for 20 years, followed by decommissioning	Decommissioning following expiration of current CR-3 license. Adopting by reference, as bounding CR-3 decommissioning, GEIS description (NRC 1996, Section 7.1)	New construction at the CR-3 site.	New construction at the CR-3 site.	New construction at the CR-3 site	Would involve construction of new generation capacity in Florida. Adopting by reference GEIS description of alternate technologies (Section 7.2.2.3)
		Use existing rail spur	Construct up to 10 miles of gas pipeline in a 50-foot-wide corridor, disturbing as much as 61 acres. May require upgrades to existing pipelines.	Use existing rail spur for delivery of reactor vessel and other large equipment during construction.	
		Use existing switchyard and transmission lines	Use existing switchyard and transmission lines	Use existing switchyard and transmission lines	Construct at least 200 to 300 miles of transmission lines
		One 850-MW (net) tangentially-fired, dry bottom unit; capacity factor 0.85	Two 425-MW of net power (Combined-cycle turbines to be used)		
		Existing CR-3 intake/ discharge canal system	Existing CR-3 intake/ discharge canal system	Existing CR-3 intake/ discharge canal system	
		Pulverized bituminous coal, 12,142 Btu/pound; 8,844 Btu/kWh; 9.08% ash; 1.44% sulfur; 10 lb/ton nitrogen oxides; 2,452,125 tons coal/yr	Natural gas, 1,030 Btu/ft^3; 7,163 Btu/kWh; 0.0007 lb sulfur/MMBtu; 0.0109 lb NO_x/MMBtu; 45,848,850,425 ft^3 gas/yr		

TABLE 8-2
IMPACTS COMPARISON DETAIL (Continued)

		No-Action Alternative			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With New Nuclear Generation**	**With Purchased Power**
		Low NO_x burners, overfire air and selective catalytic reduction (95% NO_x reduction efficiency). Wet scrubber – lime/limestone desulfurization system (95% SO_x removal efficiency); 58,800 tons limestone/yr Fabric filters or electrostatic precipitators (99.9% particulate removal efficiency)	Selective catalytic reduction with steam/water injection		
455 permanent and 85 long-term contract workers (Section 3.4)		98 workers (Section 7.2.3.1)	28 workers (Section 7.2.3.3)		
Land Use Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 52, 53)	SMALL – Not an impact evaluated by GEIS (NRC 1996)	MODERATE – 135 acres required for the powerblock and associated facilities. (Section 7.2.3.1)	SMALL to MODERATE – 33 acres for facility at CR-3 location; 61 acres for pipeline (Section 7.2.3.3). New gas pipeline would be built to connect with existing gas pipeline corridor.	SMALL to MODERATE – 250 acres required for the powerblock and associated facilities. (Section 7.2.3.4)	MODERATE – most transmission facilities could be constructed along existing transmission corridors (Section 7.2.3.5) Adopting by reference GEIS description of land use impacts from alternate technologies (NRC 1996)

TABLE 8-2
IMPACTS COMPARISON DETAIL (Continued)

		No-Action Alternative			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With New Nuclear Generation**	**With Purchased Power**
		Water Quality Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 3, 4 and 6-12). Four Category 2 water quality issues not applicable (Section 4.1, Issue 13; Section 4.6, Issue 34; Section 4.7, Issue 35; and Section 4.8, Issue 39).	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 89).	SMALL – Construction impacts minimized by use of best management practices. Operational impacts minimized by use of the existing cooling water system that withdraws from and discharges to the Gulf of Mexico. (Section 7.2.3.1)	SMALL – Reduced cooling water demands, inherent in combined-cycle design (Section 7.2.3.3)	SMALL – Construction impacts minimized by use of best management practices. Operational impacts minimized by use of the existing cooling water system that withdraws from and discharges to the Gulf of Mexico. (Section 7.2.2.4)	SMALL to MODERATE – Adopting by reference GEIS description of water quality impacts from alternate technologies (NRC 1996)
		Air Quality Impacts			
SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 51). Category 2 issue not applicable (Section 4.11, Issue 50).	SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issue 88)	MODERATE – 3,191 tons SO_x/yr 613 tons NO_x/yr 613 tons CO/yr 26 tons PM_{10}/yr (Section 7.2.3.1)	MODERATE – 16 tons SO_x/yr 257 tons NO_x/yr 53 tons CO/yr 45 tons $PM_{2.5}$/yr[a] (Section 7.2.3.3)	SMALL – Air emissions would be comparable to those associated with the continued operation of CR-3. (Section 7.2.3.4)	SMALL to MODERATE – Adopting by reference GEIS description of air quality impacts from alternate technologies (NRC 1996)
		Ecological Resource Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 15-24, 28-30, 41-43, and 45-48). One Category 2 issue not applicable (Section 4.9, Issue 40).	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 90)	MODERATE – 59 acres of forested land could be required for ash/sludge disposal over 20-year license renewal term. (Section 7.2.3.1)	SMALL to MODERATE – Construction of the pipeline could alter habitat. (Section 7.2.3.3)	SMALL – Impacts would be comparable to those associated with the continued operation of CR-3. (Section 7.2.3.4)	SMALL to MODERATE – Adopting by reference GEIS description of ecological resource impacts from alternate technologies (NRC 1996)

TABLE 8-2
IMPACTS COMPARISON DETAIL (Continued)

		No-Action Alternative			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With New Nuclear Generation**	**With Purchased Power**
Threatened or Endangered Species Impacts					
SMALL – Bald eagles, wood storks, sea turtles, manatees, and alligators have been observed in the vicinity of CR-3 or along transmission corridors.	SMALL – Not an impact evaluated by GEIS (NRC 1996)	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats
Human Health Impacts					
SMALL to MODERATE – Adopting by reference Category 1 issues (Table A-1, Issues 56, 58, 61, 62). The issue of microbiological organisms (Section 4.12, Issue 57) does not apply. Risk due to transmission-line induced currents is moderate because the Central Florida line exceeds the NESC standard (Section 4.13, Issue 59)	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 86)	MODERATE – Adopting by reference GEIS conclusion that risks such as cancer and emphysema from emissions are likely (NRC 1996)	SMALL – Adopting by reference GEIS conclusion that some risk of cancer and emphysema exists from emissions (NRC 1996)	SMALL – Impacts would be comparable to those associated with the continued operation of CR-3. (Section 7.2.3.4)	SMALL to MODERATE – Adopting by reference GEIS description of human health impacts from alternate technologies (NRC 1996)

TABLE 8-2
IMPACTS COMPARISON DETAIL (Continued)

		No-Action Alternative			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With New Nuclear Generation**	**With Purchased Power**
Socioeconomic Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 64, 67, 91). Two Category 2 issues are not applicable (Section 4.16, Issue 66 and Section 4.17.1, Issue 68). No increase in staffing expected; therefore, no housing impacts (Section 4.14, Issue 63). No increase in plant water use expected (Section 4.15, Issue 65). Plant property tax payment represents less than 10 percent of Citrus county's total tax revenues (Section 4.17.2, Issue 69). No additional employment and therefore, no transportation impacts (Section 4.18, Issue 70)	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 91)	SMALL – Reduction in permanent work force at CR-3 could adversely affect surrounding counties, but would be mitigated by CR-3's proximity to the Tampa metropolitan area (Section 7.2.3.1).	MODERATE – Reduction in permanent work force at CR-3 could adversely affect surrounding counties, but would be mitigated by CR-3's proximity to the Tampa metropolitan area (Section 7.2.3.3)	<u>Construction:</u> MODERATE to LARGE – Peak construction workforce of 2,500 could affect housing and public services in surrounding counties. <u>Operation</u>: SMALL – Impacts would be comparable to those associated with the continued operation of CR-3. (Section 7.2.3.4)	SMALL to MODERATE – Adopting by reference GEIS description of socioeconomic impacts from alternate technologies (NRC 1996)

TABLE 8-2
IMPACTS COMPARISON DETAIL (Continued)

		No-Action Alternative			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With New Nuclear Generation**	**With Purchased Power**
Waste Management Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 77-85)	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 87)	MODERATE – 21,900 tons of coal ash and 174,000 tons of scrubber sludge would require 59 acres over 20-year license renewal term. Industrial waste generated annually (Section 7.2.3.1)	SMALL – Almost no waste generation (Section 7.2.3.3)	SMALL – Impacts would be comparable to those associated with the continued operation of CR-3. (Section 7.2.3.4)	SMALL to MODERATE – Adopting by reference GEIS description of waste management impacts from alternate technologies (NRC 1996)
Aesthetic Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 73, 74)	SMALL – Not an impact evaluated by GEIS (NRC 1996)	MODERATE – The additional stacks, boilers, and rail deliveries would increase the visual impact of the existing site (Section 7.2.3.1).	SMALL – Steam turbines and stacks would create visual impacts comparable to those from existing CR-3 facilities (Section 7.2.3.3)	SMALL – Impacts would be comparable to those associated with the continued operation of CR-3. (Section 7.2.3.4)	SMALL to MODERATE – Adopting by reference GEIS description of aesthetic impacts from alternate technologies (NRC 1996)
Cultural Resource Impacts					
SMALL – SHPO consultation minimizes potential for impact (Section 4.19, Issue 71)	SMALL – Not an impact evaluated by GEIS (NRC 1996)	SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site (Section 7.2.3.1)	SMALL – Ten miles of pipeline construction could affect some cultural resources (Section 7.2.3.3)	SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site (Section 7.2.2.4)	SMALL – Adopting by reference GEIS description of cultural resource impacts from alternate technologies (NRC 1996)

TABLE 8-2
IMPACTS COMPARISON DETAIL (Continued)

		No-Action Alternative			
Proposed Action (License Renewal)	Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With New Nuclear Generation	With Purchased Power

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, any important attribute of the resource. 10 CFR 51, Subpart A, Appendix B, Table B-1, Footnote 3.

Btu = British thermal unit
ft^3 = cubic foot
gal = gallon
GEIS = Generic Environmental Impact Statement (NRC 1996)
kWh = kilowatt hour
lb = pound
MM = million
MW = megawatt
NO_x = nitrogen oxide
PM_{10} = particulates having diameter less than 10 microns
SHPO = State Historic Preservation Officer
SO_x = sulfur dioxide
yr = year

a. All total suspended particulates for gas-fired alternative are $PM_{2.5}$.

8.1 REFERENCES

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

9.0 STATUS OF COMPLIANCE

9.1 PROPOSED ACTION

NRC

"The environmental report shall list all federal permits, licenses, approvals and other entitlements which must be obtained in connection with the proposed action and shall describe the status of compliance with these requirements. The environmental report shall also include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection." 10 CFR 51.45(d), as adopted by 10 CFR 51.53(c)(2)

9.1.1 GENERAL

Table 9-1 lists environmental authorizations that Progress Energy has obtained for current Crystal River Unit 3 (CR-3) operations. In this context, Progress Energy uses "authorizations" to include any permits, licenses, approvals, or other entitlements. Progress Energy expects to continue renewing these authorizations during the current license period and through the U.S. Nuclear Regulatory Commission (NRC) license renewal period. Because the NRC regulatory focus is prospective, Table 9-1 does not include authorizations that Progress Energy obtained for past activities that did not include continuing obligations.

Before preparing the application for license renewal, Progress Energy conducted an assessment to identify any new and significant environmental information (Chapter 5). The assessment included interviews with Progress Energy experts, review of CR-3 environmental documentation, and communication with state and federal environmental protection agencies. Based on this assessment, Progress Energy concludes that CR-3 is in compliance with applicable environmental standards and requirements.

Table 9-2 lists additional environmental authorizations and consultations related to NRC renewal of the CR-3 license to operate. As indicated, Progress Energy anticipates needing relatively few such authorizations and consultations. Sections 9.1.2 through 9.1.5 discuss some of these items in more detail.

9.1.2 THREATENED OR ENDANGERED SPECIES

Section 7 of the Endangered Species Act (16 USC 1531 et seq.) requires federal agencies to ensure that agency action is not likely to jeopardize any species that is listed, or proposed for listing as endangered, or threatened. Depending on the action involved, the Act requires consultation with the U.S. Fish and Wildlife Service (USFWS) regarding effects on non-marine species, the National Marine Fisheries Service (NMFS) for marine species, or both. USFWS and NMFS have issued joint procedural regulations at 50 CFR 402, Subpart B, that address consultation, and USFWS maintains the joint list of threatened and endangered species at 50 CFR 17.

Although not required of an applicant by federal law or NRC regulation, Progress Energy has chosen to invite comment from federal and state agencies regarding potential effects that CR-3 license renewal might have on threatened or endangered species. Attachment C includes copies of Progress Energy correspondence with USFWS, NMFS, and the Florida Fish and Wildlife Conservation Commission.

9.1.3 HISTORIC PRESERVATION

Section 106 of the National Historic Preservation Act (16 USC 470 et seq.) requires federal agencies having the authority to license any undertaking to, prior to issuing the license, take into account the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking. Council regulations provide for the State Historic Preservation Officer (SHPO) to have a consulting role (35 CFR 800.2). Although not required of an applicant by federal law or NRC regulation, Progress Energy has chosen to invite comment by the Florida SHPO. Attachment D contains a copy of Progress Energy's letter to the Florida State Historic Preservation Officer.

9.1.4 WATER QUALITY (401) CERTIFICATION

Federal Clean Water Act Section 401 requires an applicant for a federal license to conduct an activity that might result in a discharge into navigable waters to provide the licensing agency a certification from the state that the discharge will comply with applicable Clean Water Act requirements (33 USC 1341). NRC has indicated in its Generic Environmental Impact Statement for License Renewal (NRC 1996, Section 4.2.1.1) that issuance of a National Pollutant Discharge Elimination System (NPDES) permit implies certification by the state. Progress Energy is applying to NRC for license renewal to continue CR-3 operations. Consistent with the GEIS, Progress Energy is providing CR-3's NPDES permit as evidence of state water quality (401) certification (Attachment B).

9.1.5 COASTAL ZONE MANAGEMENT PROGRAM

The federal Coastal Zone Management Act (16 USC 1451 et seq.) imposes requirements on applicants for a federal license to conduct an activity that could affects a state's coastal zone. The entire state of Florida is part of the coastal zone, so CR-3 is subject to Coastal Zone Management Act requirements. Therefore a determination is necessary from the Florida Coastal Management Program that the proposed NRC license renewal is consistent with the state of Florida's Coastal Management Program. The Florida State Clearinghouse, administered by the Florida Department of Environmental Protection's Office of

Intergovernmental Programs, coordinates consistency reviews. The consistency certification package prepared by Progress Energy will be submitted to the Clearinghouse (FDEP) in parallel with Progress Energy's application to the NRC for renewal of the CR-3 operating license. Progress Energy will provide the NRC with a copy of the Determination of Consistency when it is issued.

9.2 ALTERNATIVES

NRC

"The discussion of alternatives in the report shall include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements." 10 CFR 51.45(d), as required by 10 CFR 51.53(c)(2)

The coal, gas, nuclear, and purchased power alternatives discussed in Section 7.2.2 probably could be constructed and operated to comply with applicable environmental quality standards and requirements. Progress Energy notes that increasingly stringent air quality protection requirements could make the construction of a large fossil-fueled power plant infeasible in many locations. Progress Energy also notes that the U.S. Environmental Protection Agency has revised requirements for design and operation of cooling water intake structures at new and existing facilities (40 CFR 125 Subparts I and J). These requirements could necessitate construction of cooling towers for the coal- and gas-fired alternatives if surface water were used for once-through surface cooling.

TABLE 9-1
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT CR-3 OPERATIONS

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Federal Requirements to License Renewal					
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10	License to operate	DPR-72	Issued: 12/03/1976 Expires: 12/03/2016	Operation of CR-3
U.S. Department of Transportation	49 USC 5108, 49CFR Part 107, Subpart G	Registration	060908 551 067Q	Issued: 06/09/2008 Expires: 06/30/2009	Hazardous materials shipments
U.S. Army Corps of Engineers	Section 10 of River and harbor Act of 1899 (33 U.S.C. 403)	Permit	SAJ-2008-02893	Issued: 11/12/2008 Expires: 11/12/2013	Maintenance dredging in front of the Gulf Intake Structure
Florida Department of Environmental Protection	Clean Water Act (33 USC 1251 et seq.), Pollution Prevention Act (42 USC 13109-13109) FL Rule 62-302.520(1), F.A.C. 62-620, NPDES	NPDES Permit	FL0000159	Issued: 5/9/2005 Expires: 5/8/2010	Industrial wastewater discharges to Gulf of Mexico from Crystal River Units 1, 2, and 3
Florida Department of Environmental Protection	Clean Water Act (33 USC 1251 et seq.), Pollution Prevention Act (42 USC 13109-13109) FL Rule 62-302.520(1), F.A.C. 62-620 NPDES	Permit	FLA0169690	Issued: 1/9/2007 Expires: 1/8/2012	Treatment of industrial wastewater by land application system

TABLE 9-1
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT CR-3 OPERATIONS (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Florida Department of Environmental Protection	Clean Air Act (42 USC 7401 et seq), FL Statutes Chapter 403, FL Administrative Code Chapters 62-4, 62-210, 62-213, and 62-214.	Title V Permit	0170004-015-AV	Issued: 5/29/2006 Expires: 12/31/2009	Operation of CREC
Florida Fish and Wildlife Conservation Commission	FL Admin. Code 68B-8	Special Activity License (SAL)	06SCR-107A	Issued: 1/25/2006 Expires:1/24/2007	Harvest of broodstock and release of broodstock and captive-bred marine organisms for stock enhancement mitigation
Florida Department of Aquaculture and Consumer Services	Florida Aquaculture Policy Act, FL Statutes Chapter 597	Certificate	AQ0119007	Issued: NA Expires 6/30/2009	Aquaculture certification for production of marine fish.
Florida Department of Environmental Protection	FL Admin. Code 62-761 and 62-762	Registration	9103099	Issued: 5/23/08 Expires:6/30/2009	Storage Tank Registration
Florida Fish and Wildlife Conservation Commission	Migratory Bird Treaty Act 16USC. 703-712. FL Admin Code Chapter 68A	Migratory Bird Nest Permit	WN07371	Issued: 8/10/2007 Expires: 7/31/2009	Inactive nest removal
Florida Department of Environmental Protection	Federal Safe Drinking Water Act, FL Statutes Chapter 403, Part IV	Wastewater permit	FLA118753-003-DW3P	Issued: 4/29/2004 Expires: 4/28/2009	Operation of CR Units 1, 2, and 3 sewage treatment plant

TABLE 9-1
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT CR-3 OPERATIONS (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Southwest Florida Water Management District	FL Statutes Chapter 373, FL Admin Code 40D-2	Water Withdrawal Permit	204695.03	Issued: 10/28/1997 Expires: 10/28/2007	Groundwater withdrawal for South Plant (Units 1, 2, and 3)
Florida Department of Environmental Protection	Federal Safe Drinking Water Act, FL Statutes Chapter 403, Part IV	Wastewater Permit	FLA011909-002-DW4P	Issued: 11/29/2004 Expires: 11/28/2009	Nuclear Training center domestic wastewater system
South Carolina Department of Health and Environmental control – Division of Waste Management	South Carolina Radioactive Waste Transportation and Disposal Act (Act No. 429)	South Carolina Radioactive Waste Transport Permit	0022-09-08	Issued: 11/16/2007 Expires: 12/31/2008	Transportation of radioactive waste into the state of South Carolina
State of Tennessee Department of Environment and Conservation - Division of Radiological Health	Tennessee Department of Environment and Conservation Rule 1200-2-10.32	Tennessee Radioactive Waste License-for-Delivery	T-FL001-L08	Issued: 1/1/2008 Expires: 12/31/2008	Transportation of radioactive waste into the state of Tennessee
Utah Department of Environmental Quality – Division of Radiation Control	Utah Radiation Control Rule R313-26	Generator Site Access Permit	0109000004	Issued: 7/14/2008 Expires: 7/14/2009	Grants access to a land disposal facility in the state of Utah

1

TABLE 9-2
ENVIRONMENTAL AUTHORIZATIONS FOR
CR-3 LICENSE RENEWAL[a]

Agency	Authority	Requirement	Remarks
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011 et seq.)	License renewal	Environmental Report submitted in support of license renewal application
U.S. Fish and Wildlife Service	Endangered Species Act Section 7 (16 USC 1536)	Consultation	Requires federal agency issuing a license to consult with the U.S. Fish and Wildlife Service (Appendix C)
Florida Department of Environment Protection	Clean Water Act Section 401 (33 USC 1341)	Certification	State issuance of NPDES permit (Section 9.1.4) constitutes 401 certification (Appendix B)
Florida Department of State's Office of Cultural and Historical Programs	National Historic Preservation Act Section 106 (16 USC 470f)	Consultation	Requires federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer (SHPO). SHPO must concur that license renewal will not affect any sites listed or eligible for listing (Appendix E)

a. No renewal-related requirements identified for local or other agencies.

9.3 REFERENCES

Note to reader: Some web pages cited in this document are no longer available, or are no longer available through the original URL addresses. Hard copies of cited web pages are available in Progress Energy files. Some sites, for example the census data, cannot be accessed through their URLs. The only way to access these pages is to follow queries on previous web pages. The complete URLs used by Progress Energy have been given for these pages, even though they may not be directly accessible.

NRC (U.S. Nuclear Regulatory Commission). 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS). Volume 1, Section 4.2.1.1, page 4-4. NUREG-1437. Washington, DC. May.

APPENDIX A
NRC NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS

Progress Energy has prepared this environmental report in accordance with the requirements of U.S. Nuclear Regulatory Commission (NRC) regulation at 10 CFR 51.53. NRC included in the regulation a list of National Environmental Policy Act (NEPA) issues for license renewal of nuclear power plants.

Table A-1 lists these 92 issues and identifies the section in which Progress Energy addressed each applicable issue in this environmental report. For organization and clarity, Progress Energy has assigned a number to each issue and uses the issue numbers throughout the environmental report.

Table A-1. CR-3 Environmental Report Discussion of License Renewal NEPA Issues[a]

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
Surface Water Quality, Hydrology, and Use (for all plants)			
1. Impacts of refurbishment on surface water quality	1	4.0	3.4.1/3-4
2. Impacts of refurbishment on surface water use	1	4.0	3.4.1/3-4
3. Altered current patterns at intake and discharge structures	1	4.0	4.2.1.2.1/4-5
4. Altered salinity gradients	1	4.0	4.2.1.2.2/4-4
5. Altered thermal stratification of lakes	1	NA	Issue applies to a plant feature, discharge to a lake, that CR-3 does not have.
6. Temperature effects on sediment transport capacity	1	4.0	4.2.1.2.3/4-8
7. Scouring caused by discharged cooling water	1	4.0	4.2.1.2.3/4-6
8. Eutrophication	1	4.0	4.2.1.2.3/4-9
9. Discharge of chlorine or other biocides	1	4.0	4.2.1.2.4/4-10
10. Discharge of sanitary wastes and minor chemical spills	1	4.0	4.2.1.2.4/4-10
11. Discharge of other metals in waste water	1	4.0	4.2.1.2.4/4-10
12. Water use conflicts (plants with once-through cooling systems)	1	4.0	4.2.1.3/4-13
13. Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	2	NA, and discussed in Section 4.1	Issue does not apply: CR-3 has no cooling ponds and uses helper cooling towers (no makeup).
Aquatic Ecology (for all plants)			
14. Refurbishment impacts to aquatic resources	1	4.0	3.5/3-5
15. Accumulation of contaminants in sediments or biota	1	4.0	4.2.1.2.4/4-10
16. Entrainment of phytoplankton and zooplankton	1	4.0	4.2.2.1.1/4-15
17. Cold shock	1	4.0	4.2.2.1.5/4-18
18. Thermal plume barrier to migrating fish	1	4.0	4.2.2.1.6/4-19
19. Distribution of aquatic organisms	1	4.0	4.2.2.1.6/4-19
20. Premature emergence of aquatic insects	1	4.0	4.2.2.1.7/4-20

Table A-1. CR-3 Environmental Report Discussion of License Renewal NEPA Issues[a]

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
21. Gas supersaturation (gas bubble disease)	1	4.0	4.2.2.1.8/4-21
22. Low dissolved oxygen in the discharge	1	4.0	4.2.2.1.9/4-23
23. Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	1	4.0	4.2.2.1.10/4-24
24. Stimulation of nuisance organisms (e.g., shipworms)	1	4.0	4.2.2.1.11/4-25
Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)			
25. Entrainment of fish and shellfish in early life stages for plants with once-through and cooling pond heat dissipation systems	2	4.2	4.2.2.1.2/4-16
26. Impingement of fish and shellfish for plants with once-through and cooling pond heat dissipation systems	2	4.3	4.2.2.1.3/4-16
27. Heat shock for plants with once-through and cooling pond heat dissipation systems	2	4.4	4.2.2.1.4/4-17
Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)			
28. Entrainment of fish and shellfish in early life stages for plants with cooling-tower-based heat dissipation systems	1	4.0	4.3.3/4-33
29. Impingement of fish and shellfish for plants with cooling-tower-based heat dissipation systems	1	4.0	4.3.3/4-33
30. Heat shock for plants with cooling-tower-based heat dissipation systems	1	4.0	4.3.3/4-33
Groundwater Use and Quality			
31. Impacts of refurbishment on groundwater use and quality	1	4.0	3.4.2/3-5
32. Groundwater use conflicts (potable and service water; plants that use < 100 gpm)	1	NA	CR-3 uses > 100 gpm.
33. Groundwater use conflicts (potable, service water, and dewatering; plants that use > 100 gpm)	2	4.5	4.8.1.1
34. Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river)	2	NA, and discussed in Section 4.6	Issue does not apply: helper cooling towers don't require makeup from a small river.

Table A-1. CR-3 Environmental Report Discussion of License Renewal NEPA Issues[a]

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
35. Groundwater use conflicts (Ranney wells)	2	NA, and discussed in Section 4.7	Issue applies to a plant feature, Ranney wells, that CR-3 does not have.
36. Groundwater quality degradation (Ranney wells)	1	NA	Issue applies to a feature, Ranney wells, that CR-3 does not have.
37. Groundwater quality degradation (saltwater intrusion)	1	4.0	4.8.2/4-118
38. Groundwater quality degradation (cooling ponds in salt marshes)	1	NA	Issue applies to a feature, cooling ponds, that CR-3 does not have.
39. Groundwater quality degradation (cooling ponds at inland sites)	2	NA, and discussed in Section 4.8	Issue applies to a feature, cooling ponds, that CR-3 does not have.
Terrestrial Resources			
40. Refurbishment impacts to terrestrial resources	2	4.9	3.6/3-6
41. Cooling tower impacts on crops and ornamental vegetation	1	4.0	4.3.4/4-34
42. Cooling tower impacts on native plants	1	4.0	4.3.5.1./4-42
43. Bird collisions with cooling towers	1	4.0	4.3.5.2/4-45
44. Cooling pond impacts on terrestrial resources	1	NA	Issue applies to a feature, cooling ponds, that CR-3 does not have.
45. Power line right-of-way management (cutting and herbicide application)	1	4.0	4.5.6.1/4-71
46. Bird collisions with power lines	1	4.0	4.5.6.2/4-74
47. Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	1	4.0	4.5.6.3/4-77
48. Floodplains and wetlands on power line right-of-way	1	4.0	4.5.7/4-81
Threatened or Endangered Species (for all plants)			
49. Threatened or endangered species	2	4.10	4.1/4-1
Air Quality			
50. Air quality during refurbishment (non-attainment and maintenance areas)	2	NA, and discussed in Section 4.11	Issue does not apply: CR-3 is not located in a non-attainment or maintenance area.
51. Air quality effects of transmission lines	1	4.0	4.5.2/4-62

Table A-1. CR-3 Environmental Report Discussion of License Renewal NEPA Issues[a]

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
Land Use			
52. Onsite land use	1	4.0	3.2/3-1
53. Power line right-of-way land use impacts	1	4.0	4.5.3/4-62
Human Health			
54. Radiation exposures to the public during refurbishment	1	4.0	3.8.1/3-27
55. Occupational radiation exposures during refurbishment	1	4.0	3.8.2/3-42
56. Microbiological organisms (occupational health)	1	4.0	4.3.6/4-48
57. Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	2	NA, and discussed in Section 4.12	Issue does not apply: CR-3 helper cooling towers discharge to the Gulf of Mexico rather than a small river.
58. Noise	1	4.0	4.3.7/4-49
59. Electromagnetic fields, acute effects	2	4.13	4.5.4.1/4-66
60. Electromagnetic fields, chronic effects	NA	4.0	
61. Radiation exposures to public (license renewal term)	1	4.0	4.6.2/4-87
62. Occupational radiation exposures (license renewal term)	1	4.0	4.6.3/4-95
Socioeconomics			
63. Housing impacts	2	4.14	Refurbishment 3.7.2/3-10 Renewal Term 4.7.1/4-101
64. Public services: public safety, social services, and tourism and recreation	1	4.0	Refurbishment 3.7.4/3-14 (public service) 3.7.4.3/3-18 (safety) 3.7.4.4/3-19 (social) 3.7.4.6/3-20 (tour, rec) Renewal Term 4.7.3/4-104 (public safety) 4.7.3.3/4-106 (safety) 4.7.3.4/4-107 (social) 4.7.3.6/4-107 (tour, rec)

Table A-1. CR-3 Environmental Report Discussion of License Renewal NEPA Issues[a]

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
65. Public services: public utilities	2	4.15	Refurbishment
			3.7.4.5/3-19
			Renewal Term
			4.7.3/4-104
66. Public services: education (refurbishment)	2	Section 4.16	3.7.4.1/3-15
67. Public services: education (license renewal term)	1	4.0	4.7.3.1/4-106
68. Offsite land use (refurbishment)	2	4.17.1	3.7.5/3-20
69. Offsite land use (license renewal term)	2	4.17.2	4.7.4/4-107
70. Public services: transportation	2	4.18.1	Refurbishment
			3.7.4.2/3-17
		4.18.2	Renewal Term
			4.7.3.2/4-106
71. Historic and archaeological resources	2	4.19.1	Refurbishment
			3.7.7/3-23
		4.19.2	Renewal Term
			4.7.7/4-114
72. Aesthetic impacts (refurbishment)	1	4.0	3.7.3/3-24
73. Aesthetic impacts (license renewal term)	1	4.0	4.7.6/4-111
74. Aesthetic impacts of transmission lines (license renewal term)	1	4.0	4.5.8/4-83
Postulated Accidents			
75. Design basis accidents	1	4.0	5.3.2/5-11 (design basis)
			5.5.1/5-114 (summary)
76. Severe accidents	2	4.20	5.3.3/5-12 (probabilistic analysis)
			5.3.3.2/5-19 (air dose)
			5.3.3.3/5-49 (water)
			5.3.3.4/5-65 (groundwater)
			5.3.3.5/5-95 (economic)
			5.4/5-106 (mitigation)
			5.5.2/5-114 (summary)
Uranium Fuel Cycle and Waste Management			
77. Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	1	4.0	6.2/6-8

Table A-1. CR-3 Environmental Report Discussion of License Renewal NEPA Issues[a]

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
78. Offsite radiological impacts (collective effects)	1	4.0	Not in GEIS.
79. Offsite radiological impacts (spent fuel and high-level waste disposal)	1	4.0	Not in GEIS.
80. Nonradiological impacts of the uranium fuel cycle	1	4.0	6.2.2.6/6-20 (land use) 6.2.2.7/6-20 (water use) 6.2.2.8/6-21 (fossil fuel) 6.2.2.9/6-21 (chemical)
81. Low-level waste storage and disposal	1	4.0	6.4.2/6-36 (low-level def) 6.4.3/6-37 (low-level volume) 6.4.4/6-48 (renewal effects)
82. Mixed waste storage and disposal	1	4.0	6.4.5/6-63
83. Onsite spent fuel	1	4.0	6.4.6/6-70
84. Nonradiological waste	1	4.0	6.5/6-86
85. Transportation	1	4.0	6.3/6-31, as revised by Addendum 1, August 1999.
Decommissioning			
86. Radiation doses (decommissioning)	1	4.0	7.3.1/7-15
87. Waste management (decommissioning)	1	4.0	7.3.2/7-19 (impacts) 7.4/7-25 (conclusions)
88. Air quality (decommissioning)	1	4.0	7.3.3/7-21 (air) 7.4/7-25 (conclusions)
89. Water quality (decommissioning)	1	4.0	7.3.4/7-21 (water) 7.4/7-25 (conclusions)
90. Ecological resources (decommissioning)	1	4.0	7.3.5/7-21 (ecological) 7.4/7-25 (conclusions)
91. Socioeconomic impacts (decommissioning)	1	4.0	7.3.7/7-19 (socioeconomic) 7.4/7-24 (conclusions)
Environmental Justice			
92. Environmental justice	NA	2.6.2	

a. Source: 10 CFR 51, Subpart A, Appendix A, Table B-1. (Issue numbers added to facilitate discussion.)

b. Source: Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437).

APPENDIX B
NPDES PERMIT

This Appendix contains selected pages of the CR-3 National Pollutant Discharge Elimination System permit.

STATE OF FLORIDA
INDUSTRIAL WASTEWATER FACILITY PERMIT

PERMITTEE:

Progress Energy Florida
Crystal River Units 1, 2, and 3
P.O. Box 14042
St. Petersburg, FL 34428

PERMIT NUMBER:	FL0000159 (Major)
PA FILE NUMBER:	FL0000159-009 -IW1S/NR
ISSUANCE DATE:	May 9, 2005
EXPIRATION DATE:	May 8, 2010

RESPONSIBLE AUTHORITY:

Mr. Michael Olive
Manager

FACILITY:

Progress Energy Florida
Crystal River Plant Units 1,2 and 3
15760 West Powerline Street
Crystal River, FL 34428
Citrus County

Latitude: 28° 58' 2" N Longitude: 82° 41' 49" W

This permit is issued under the provisions of Chapter 403, Florida Statutes (F.S.) and applicable rules of the Florida Administrative Code (F.A.C.), and constitutes authorization to discharge to waters of the state under the National Pollutant Discharge Elimination System (NPDES). The Permittee is hereby authorized to operate the facilities shown on the application and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

Operation of an industrial wastewater treatment and disposal system to serve the referenced facility. The facility consists of two fossil fuel units (Units 1 and 2) and a nuclear fuel unit (Unit 3). These units have a combined maximum permitted daily discharge flow of 1,898 MGD and a total name plate rating of 1,854.8 MW. The facility discharge consists of once-through condenser cooling water, treated nuclear auxiliary cooling water, treated coal pile rainfall run off, intake screen washwater, and treated non-radioactive waste/radiation waste.

The radioactive component of the discharge is regulated by the U.S. Nuclear Regulatory Commission under the Atomic Energy Act and not by the U.S. Environmental Protection Agency under the Clean Water Act.

WASTEWATER TREATMENT:

Wastewater treatment at the facility consists of the following: filtration and or other biocide treatment of once-through non-contact condenser cooling water (OTCW); neutralization, settling, filtration and/or oil/water separation for low volume wastes and metal cleaning wastes..

EFFLUENT DISPOSAL:

Surface Water Discharge:

An existing discharge of OTCW to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-011,** located approximately at latitude 28° 57'30.8" N, longitude 82° 42' 00.7" W.

An existing discharge of OTCW to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-012,** located approximately at latitude 28° 57'31.2" N, longitude 82° 42' 03.0" W.

PERMITTEE: Progress Energy Florida Crystal River Units 1,2, and 3 P.O. Box 14042 St. Petersburg, FL 34428	PERMIT NUMBER: Issuance date: Expiration date:	FL0000159 May 9, 2005 May 8, 2010

An existing discharge of OTCW to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-013,** located approximately at latitude 28° 57'30.9" N, longitude 82° 41' 54.9" W.

An existing discharge of intake screen washwater to the site intake canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-091,** located approximately at latitude 28° 57'24 " N, longitude 82°42 '0.4" W.

An existing discharge of intake screen washwater to the site intake canal thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-092,** located approximately at latitude 28° 57'23.2 " N, longitude 82°42 '01.9" W.

An existing discharge of intake screen washwater to the site intake canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-093,** located approximately at latitude 28° 57'21.6 " N, longitude 82°41 '56.2" W.

An existing discharge from the ash pond to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-0C1,** located approximately at latitude 28° 57'34.7 " N, longitude 82°42 '28.8" W.

An existing discharge from the wastewater pond system to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-0C2,** located approximately at latitude 28° 57'31.0 " N, longitude 82°42 '32.4" W.

An existing discharge of Nuclear Services and Decay Heat Seawater System effluent to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-00F,** located approximately at latitude 28° 57'31.2 " N, longitude 82°41 '55.4" W.

An existing discharge of Coal Pile runoff (Units 1 and 2) to an adjacent salt marsh, a Class III marine water, via **Outfall D-0H,** located approximately at latitude 28° 57' 08.8 " N, longitude 82°42 '12.7" W.

Existing discharges of OTCW from the Helper Cooling Tower system to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfalls D-071 and D-072,** located approximately at latitudes 28° 57' 34.5 " N, longitude 82° 42 '32.0" W, and 28° 57'35.8 " N, longitude 82° 42 '48.5" W, respectively.

An existing discharge of intake screen washwater to the site discharge canal and thence to the Gulf of Mexico, a Class III marine water, via **Outfall D-094,** located approximately at latitude 28° 57'34.4 " N, longitude 82°42 '30.4" W.

Internal Discharges

An existing discharge from internal outfall **I-FG** Regeneration Waste Neutralization Tank to **Outfall D-00F.**

An existing discharge from internal outfall **I-FE** Laundry and Shower Sump Tank effluent to **Outfall D-00F.**

Stormwater Discharges

Existing discharges of stormwater from plant areas to the site intake and discharge canal and thence to the Gulf of Mexico via **Outfalls D-100, D-200, D-300, D-400, D-500. and D-600.**

IN ACCORDANCE WITH: The limitations, monitoring requirements and other conditions as set forth in Part I through Part VIII on pages 3 through 28 of this permit.

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PERMITTEE:
Progress Energy Florida
Crystal River Units 1,2, and 3
P.O. Box 14042
St. Petersburg, FL 34428

PERMIT NUMBER: FL0000159
Issuance date: May 9, 2005

Expiration date: May 8, 2010

I. Effluent Limitations and Monitoring Requirements

A. Surface Water Discharges

1. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge once-through non-contact condenser cooling water (OTCW) from **Outfalls D-011**, **D012**, **D-013** to the site discharge canal thence the Gulf of Mexico. Such discharge shall be limited and monitored by the permittee as specified below:

	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Maximum**	**Daily Average**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Flow (MGD)	See item I.A.3.	Report	--	Continuous	Pump logs [1,2]	EFF-2
Chlorination Duration (MINUTES)	See item I.A.5.	--	--	2/Week	Pump logs	EFF-1A EFF-1B EFF-1C
Oxidants, Total Residual (MG/L)	0.01[3]	Report	--	2/Week	Multiple Grabs	EFF-1A EFF-1B EFF-1C
Temperature (F), Water [Intake] (DEG.F)	Report	Report	--	Continuous	Recorder	INT-1
Temperature (F), Water [Discharge] (DEG.F)[4]	96.5, See item. I.A.4.	Report	--	Continuous	Recorder	EFF-3D
Temp. Diff. between Intake and Discharge (DEG.F)	Report	Report	--	Continuous	Recorder	INT 1, EFF 3D

2. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.1 and as described below:

Sample Point	Description of Monitoring Location
EFF-2	At combined circulating water pumps.
EFF-1A	Outlet corresponding to individual condenser for Unit 1
EFF-1B	Outlet corresponding to individual condenser for Unit 2
EFF-1C	Outlet corresponding to individual condenser for Unit 3

[1] Flow is monitored by pump logs and/or valve position (during flow reduction season).
[2] Monitoring and reporting values for temperature, pump status and/or valve position shall be recorded at ten minute intervals.
[3] Limitations and monitoring requirements for total residual oxidants (TRO) and time of TRO discharge for outfalls D-011, D-012, and/or D-013 are applicable only at times when OTCW is being chlorinated
[4] Thermal discharge from this facility is subject to the requirements of Rule 62-302.520(1), F.A.C.

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PERMITTEE:
Progress Energy Florida
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PERMIT NUMBER: FL0000159
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Sample Point	Description of Monitoring Location
INT-1	Intake at Unit 1, See item 7
EFF-3D	At the bulkhead line which is near the down stream end of the site discharge canal.

3. Combined OTCW discharge from Units 1, 2 and 3 shall not exceed 1,897.9 MGD during the period May 1st through October 31st of each year, or 1,613.2 MGD during the remainder of the year.
4. The discharge temperature monitored at Sampling Point EFF-3D shall not exceed 96.5^{0}F as a three hour rolling average.
5. Discharge of TRO from the condenser of each unit shall not exceed a maximum of 60 minutes in any calendar day, except as follows. TRO may be discharged from one or more individual condensers via outfalls D-011, D-012, D-013, provided that TRO discharge concentration is monitored continuously by recorder(s). Additionally, the maximum instantaneous TRO concentration at each outfall (D-011, D-012, or D-013) shall not exceed 0.01 mg/l.
6. Multiple grab samples shall consist of grab samples collected at the beginning of the period of chlorination discharge, and once every 15 minutes, thereafter. In addition, one grab sample shall be collected at the end of the period of chlorine discharge. The "period of chlorine discharge" refers to all chlorination conducted during a 24-hour period.
7. In the event of an equipment failure of the temperature monitor or recorder at INT-1, temperature shall be monitored by similar instrumentation at either INT-2 or INT-3, which are the intakes for Units 2 and 3, respectively. In such a situation, the Permittee shall maintain records of the change in monitoring location for the monitoring period.
8. Intake screen washwater may be discharged from **Outfalls D-091, D-092, and D-093** without limitation or monitoring requirements.
9. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge laundry and shower wastewater from **Internal Outfall I-0FE to outfall D-00F**. Such discharge shall be limited and monitored by the permittee as specified below:

	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Average**	**Daily Maximum**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Flow (MGD)	Report	Report	--	1/Per Batch	Calculation	EFF-4
Oil and Grease (MG/L)	15.0	20.0	--	1/Per Batch	Grab	EFF-4
Solids, Total Suspended (MG/L)	30.0	100.0	--	1/Per Batch	Grab	EFF-4
pH (SU)	--	9.0	6.0	1/Per Batch	Grab	EFF-4
Number of Batches	Report	Report	--	Monthly	Log	EFF-4

10. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.9 and as described below:

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PERMITTEE:
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Sample Point	Description of Monitoring Location
EFF-4	The sample port from the laundry and shower sump tank treatment system, but prior to mixing with any other waste stream.

11. The discharge of metal cleaning wastes through this outfall is not authorized.
12. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge process wastewater from **Outfall D-0C1** Ash Pond **and D-0C2-** Wastewater Pond System discharges (Unit 1 and 2 combined) to the site discharge canal thence to the Gulf of Mexico. Such discharge shall be limited and monitored by the permittee as specified below:

	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Average**	**Daily Maximum**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Flow (MGD)	Report	Report	--	Daily, when discharging	Calculation	EFF-5 EFF-6
Oil and Grease (MG/L)	--	5.0	--	Weekly	Grab	EFF-5 EFF-6
Solids, Total Suspended (MG/L)	30.0	100.0	--	3/Week	Grab	EFF-5 EFF-6
Arsenic, Total Recoverable (UG/L)	--	50.0	--	Monthly	Grab	EFF-5 EFF-6
Cadmium, Total Recoverable (UG/L)	--	9.3	--	Monthly	Grab	EFF-5 EFF-6
Chromium, Total Recoverable (UG/L)	--	50.0	--	Monthly	Grab	EFF-5 EFF-6
Copper, Total Recoverable (UG/L)	--	3.7	--	Monthly	Grab	EFF-5 EFF-6
Lead, Total Recoverable (UG/L)	--	8.5	--	Monthly	Grab	EFF-5 EFF-6
Iron, Total Recoverable (MG/L)	--	0.3	--	Monthly	Grab	EFF-5 EFF-6
Mercury, Total Recoverable (UG/L)	--	0.025	--	Monthly	Grab	EFF-5 EFF-6
Nickel, Total Recoverable (UG/L)	--	8.3	--	Monthly	Grab	EFF-5 EFF-6
Selenium, Total Recoverable (UG/L)	--	71	--	Monthly	Grab	EFF-5 EFF-6
PH Standard Units		Report	Report	Monthly	Grab	INT-1

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	Discharge Limitations			Monitoring Requirements		
Parameters (units)	Daily Average	Daily Maximum	Daily Minimum	Monitoring Frequency	Sample Type	Sample Point
PH Standard Units		8.5	6.5	Monthly	Grab	EFF-5 EFF-6
Zinc, Total Recoverable (UG/L)	--	86.0	--	Monthly	Grab	EFF-5 EFF-6

13. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.12 and as described below:

Sample Point	Description of Monitoring Location
INT-1	Intake at unit 1
EFF-5	Discharge from the ash pond prior to mixing with the receiving water.
EFF-6	Discharge from wastewater pond system prior to mixing with the receiving water.

14. Limitations and monitoring are required only when the ash pond is discharging via D-0C1 and/or the wastewater pond system is discharging via D-0C2.

15. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge process wastewater from Outfall **D-00F**- Nuclear Services and Decay Heat Seawater System effluent [includes discharges from outfall I-FE – Laundry and Shower Sump Tank; (LSST) outfall I-FG –Secondary Drain Tank (SDT); effluent from the Evaporator Condensate Storage Tank (ECST); and effluent from the Condensate System (CD) to the site discharge canal and thence the Gulf of Mexico. Such discharges shall be limited and monitored by the permittee as specified below.

	Discharge Limitations			Monitoring Requirements		
Parameters (units)	Daily Maximum	Daily Average	Daily Minimum	Monitoring Frequency	Sample Type	Sample Point
Flow (MGD)	Report	Report	--	Hourly	Recorder or calculation	INT-7A
Oil and Grease (mg/l) (CD and ECST)	20	15	--	Weekly, when discharging	Grab	EFF-7B
Oil and Grease (mg/l) (CD and ECST)	5.0[1]	--	--	Weekly, when discharging	Grab	EFF-7
Flow [ECST] (MGD)	Report	Report	--	Daily, when discharging	Recorder or Calculation	EFF-7B
Flow [CD System] (MGD)	Report	Report	--	Daily, when discharging	Recorder or Calculation	EFF-7B
Solids, Total Suspended (CD and ECST) (MG/L)	100.0	30.0	--	Weekly, when discharging	Grab	EFF-7B

[1] Monitoring requirements are only applicable if the discharge from I-FE and I-FG, the CD discharge or the ECST (following adequate mixing) exceeds the daily maximum limitation of 20.0 mg/l or a minimal dilution rate of 4 to 1 is not achieved as determined by the operator and recorded in logs maintained onsite for inspection by the Department.

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PERMITTEE:
Progress Energy Florida
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P.O. Box 14042
St. Petersburg, FL 34428

PERMIT NUMBER: FL0000159
Issuance date: May 9, 2005

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	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Maximum**	**Daily Average**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Solids, Total Suspended (CD and ECST)[D-00F] (MG/L)	100.0[2]	30.0	--	Weekly, when discharging	Grab	EFF-7
Copper, Total Recoverable (UG/L)	3.7[3]	Report	--	Daily, when discharging	Grab	EFF-7
Iron, Total Recoverable (UG/L)	300.0[3]	Report	--	Daily, when discharging	Grab	EFF-7
Total Iron, LBS/MG of Metal Cleaning Waste generated	Report	8.345[3,4]	--	Daily, when discharging	Grab	EFF-7B
Total Copper, LBS/MG of Metal Cleaning Waste generated	Report	8.345[3,4]	--	Daily, when discharging	Grab	EFF-7B
Hydrazine, MG/L	-------	Report[5]	----	Per Occurrence	Grab	EFF-7B
Hydrazine, MG/L	-------	0.341[5,6]	----	Daily, when discharging	Calculation	EFF-7
Hydroquinone, MG/L	-------	Report[5]		Per Occurrence	Grab	EFF-7B
Hydroquinone, MG/L	-------	0.12[5,6]	-----	Daily, when discharging	Calculation	EFF-7
Total Ammonia (as N), MG/L	-------	Report[5]	-----	Per Occurrence	Grab	EFF-7B
Total Ammonia (as N), MG/L	-------	0.047[5,6]	-----	Daily, when discharging	Calculation	EFF-7
Morpholine, MG/L	-------	Report[5]	------	Per Occurrence	Grab	EFF-7B
Morpholine, MG/L	-------	1.78[5,6]	------	Daily, when discharging	Calculation	EFF-7

[2] Monitoring requirements only applicable if the discharge from I-FE and I-FG, the CD discharge or the ECST (following adequate mixing) exceeds the daily maximum limitation of 100.0 mg/l or a minimal dilution rate of 4 to 1 is not achieved as determined by the operator and recorded in logs maintained onsite for inspection by the Department.
[3] Limitations and monitoring requirements for total iron of MCW, total copper of MCW, total recoverable copper and total recoverable iron are applicable only on any calendar day in which metal cleaning waste is discharged in the effluent from I-FG the Evaporator Condensate Storage Tank and/or the Condensate System.
[4] Limitations apply to the effluents from outfall I-FG, ECST and the Condensate System.

[5] Limitations apply to the ESCT, CD or I-FG discharge. containing steam generator lay up chemicals. One grab sample shall be taken from any batch potentially containing ≥1.0 mg/l of hydrazine, based on the operator's knowledge of the process. The measured concentrations of hydrazine, hydroquinone, ammonia and morpholine shall be reported monthly on the DMR.

[6] The limitations apply at D-0F. Calculation shall be used to determine the concentration of hydroquinone, hydrazine, ammonia and morpholine at D-0F.

$$\text{D-0F concentration (mg/l)} = \frac{\text{(measured concentration (mg/l)) (discharge flow)*}}{\text{flow to D-0F}}$$

* The calculation could apply to any batch which potentially contains >1.0 mg/l of hydrazine.

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PERMITTEE:
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PERMIT NUMBER: FL0000159
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	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Maximum**	**Daily Average**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
PH, Standard Units	Report	--	Report	Daily, when discharging	Grab	INT-7A
PH , Standard Units	8.5	--	6.5	Daily, when discharging	Grab	EFF-7
Spectrus CT1300, MG/L	See item I.A.18					EFF-7
Spectrus CT 1300 (MG/L)	Report	Report	Report	1/Application	Grab	EFF-7
Whole Effluent Toxicity (ACUTE)	See item I.A.19					EFF-7

16. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.15 and as described below:

Sample Point	Description of Monitoring Location
INT-7A	Intake flow at the combined water intake pumps.
EFF-3D	At the bulkhead line which is near the down stream end of the site discharge canal.
EFF-7	Prior to mixing with site discharge canal.
EFF-7B	Prior to discharge to outfall D-00F

17. Monitoring for pH in the combined discharge (D-0F) is required only during periods when I-FG and/or CD is discharging. If no discharge from I-FG or CD occurs, sampling shall be during next discharge of I-FG and/or CD into the combined discharge at D-0F.

18. Spectrus CT1300 shall be used only in accordance with the following procedures:

a.) There will be an interval of at least 21 days between any two successive applications, unless more frequent applications are requested in writing and approved in writing by the Department within 14 days of receipt of the request.

b.) CT1300 may be applied at a rate not to exceed 4.5 mg/l through the Unit 3 service water system. No application period may exceed 18 hours, unless approved in writing by the Department.

c.) Progress Energy will record and retain the following information of each CT1300 treatment

1. time of initiation and completion of treatment,
2. mass and concentration of CT1300 during the test period, and
3. results of toxicity testing, if applicable.

d.) When toxicity testing is required, PEF will submit the information specified in Condition I.A.16.d. above to the Department within fourteen days of receipt.

19. The permittee shall initiate the series of tests described below beginning within 60 days of the issuance of the permit to evaluate whole effluent toxicity of the discharge from Outfall D-00F. All test species, procedures and quality assurance criteria used shall be in accordance with Methods for Measuring Acute Toxicity of Effluents to Freshwater and Marine Organisms, 5th ed. EPA-821-R-02-012, or the most current edition.

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PERMITTEE:
Progress Energy Florida
Crystal River Units 1,2, and 3
P.O. Box 14042
St. Petersburg, FL 34428

PERMIT NUMBER: FL0000159
Issuance date: May 9, 2005

Expiration date: May 8, 2010

The control water and the effluent used will be adjusted to an appropriate salinity using artificial sea salts as described in EPA-821-R-02-012, Section 7.4.2., or the most current edition. The appropriate tests salinity shall be determined as follows:

When the salinity of the effluent is between 1 and 7 parts per thousand (ppt), the following salinity adjustment shall be used in the test of 100% effluent. For the Americamysis (**Mysidopsis) bahia** bioassays, the effluent and the control (0% effluent) shall be adjusted to a salinity of 7±1 ppt for the 100% effluent test using artificial sea salts. No salinity adjustment shall be done for the **Menidia beryllina** bioassay test of the 100% effluent. When the salinity of the effluent is greater than 7 parts per thousand, no salinity adjustment shall be made and the test shall be run at the effluent's salinity for both species.

A standard reference toxicant quality assurance (QA) acute toxicity test shall be conducted concurrently or no greater than 30 days before the date of the "routine" test, with each species used in the toxicity tests. The results of all QA toxicity tests shall be submitted with the discharge monitoring report (DMR). Any deviation from the bioassay procedures outlined herein shall be submitted in writing to the Department for review and approval prior to use.

a. (1) The permittee shall conduct 96-hour acute static renewal toxicity tests using the mysid shrimp, Americamysis (**Mysidopsis) bahia**, and the inland silverside, **Menidia beryllina**. All tests will be conducted on four separate grab samples collected at evenly-spaced (6-hr) intervals over a 24-hour period and used in four separate tests in order to catch any peaks of toxicity and to account for daily variations in effluent quality.

(2) If control mortality exceeds 10% for either species in any test, the test for that species (including the control) shall be repeated. A test will be considered valid only if control mortality does not exceed 10% for either species. If, in any separate grab sample test, 100% mortality occurs prior to the end of the test, and control mortality is less than 10% at that time, that test (including the control) shall be terminated with the conclusion that the sample demonstrates unacceptable acute toxicity.

b. (1) The toxicity tests specified above shall be conducted once every two months until 6 valid bimonthly tests are completed. These tests are referred to as "routine" tests. Upon the completion of six valid tests which demonstrate that no unacceptable toxicity (as defined in d.1.) has been identified, the permittee may petition the Department for a reduction in monitoring frequency.

(2) Results from "routine" tests shall be reported according to EPA-821-R-02-012, Section 12, Report Preparation (or the most current edition), and shall be submitted to:

Florida Department of Environmental Protection
Southwest District Office
3804 Coconut Palm Drive
Tampa, Florida 33619-8378

(3) Results from "routine" tests shall be reported on the Discharge Monitoring Report (DMR) as follows:

i. If greater than 50% mortality occurs in any of the four separate grab sample tests for the test species, "<100" (less than 100% effluent) should be entered on the DMR for that test species.
ii. If 50% or less mortality occurs in all four separate grab sample tests for the test species, ">100" (greater than 100% effluent) should be entered on the DMR for that test species.
iii. For each of the additional tests required, the calculated LC50 value should be entered on the DMR for that test species.

c. (1) All "routine" tests shall be conducted using a control (0% effluent) and one test concentration of **100%** final effluent.

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PERMITTEE: Progress Energy Florida Crystal River Units 1,2, and 3 P.O. Box 14042 St. Petersburg, FL 34428	PERMIT NUMBER: Issuance date: Expiration date:	FL0000159 May 9, 2005 May 8, 2010

(2) Mortalities of greater than 50% in any sample of 100% effluent in any "routine" test or an LC50 of less than 100% effluent in any additional definitive test will constitute a violation of these permit conditions and Rule 62-4.244(3)(a), F.A.C.

d. (1) If unacceptable acute toxicity (greater than 20% mortality in any grab sample of 100% effluent) is determined in a "routine" test, the permittee shall conduct three additional tests on each species indicating acute toxicity. The first additional test will include four grab samples taken as described in a.1. and run as four separate definitive analyses. The second and third additional definitive tests will be run on a single grab sample collected on the day and time when the greatest toxicity was identified in the "routine" test. Results for each additional test will include the determination of LC50 values with 95% confidence limits.

(2) Each additional test shall be conducted using a control (0% effluent) and a minimum of five dilutions: 100%, 50%, 25%, 12.5% and 6.25% effluent and a control (0% effluent). The dilution series may be modified in the second and third test to more accurately identify the toxicity, such that at least two dilutions above and two dilutions below the target toxicity and a control (0% effluent) are run.

(3) For each additional test, the sample collection requirements and the test acceptability criteria specified in section a. above must be met for the test to be considered valid. The first test shall begin within two weeks of the end of the "routine" tests, and shall be conducted weekly thereafter until three additional, valid tests are completed. The additional tests will be used to determine if the toxicity found in the "routine" test is still present.

(4) Results from additional tests, required due to unacceptable toxicity in the "routine" tests, shall be submitted in a single report prepared according to EPA-821-R-02-012, Section 12, or the most current edition and submitted within 45 days of completion of the third additional, valid test. If the additional tests demonstrate unacceptable toxicity, the permittee will meet with the Department within 30 days of the report submittal to identify corrective actions necessary to remedy the unacceptable toxicity.

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Progress Energy Florida
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St. Petersburg, FL 34428

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20. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge process wastewater from Internal **Outfall I-0FG** to **Outfall D-00F** Regeneration Waste Neutralization Tank. Such discharge shall be limited and monitored by the permittee as specified below:

	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Average**	**Daily Maximum**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Flow, (MGD)	Report	Report	--	l/Batch	Calculated	EFF-8
Copper, Total Recoverable, lbs/MG	--	8.345[1]	--	l/Batch	Grab	EFF-8
Iron, Total Recoverable lbs/MG	--	8.345[1]	--	l/Batch	Grab	EFF-8
Oil and Grease, (MG/L)	15.0	20.0	--	l/Batch	Grab	EFF-8
Total Suspended Solids, MG/L	30.0	100.0	---	l/Batch	Grab	EFF-8
PH , Standard Units	--	9.0	6.0	l/Batch	Grab	EFF-8

21. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.20 and as described below:

Sample Point	**Description of Monitoring Location**
EFF-8	At outfall I-FG prior to mixing with outfall D-00F

22. During the period beginning on the effective date of this permit and lasting through the expiration, the permittee is authorized to discharge stormwater from Outfall **D-00H-** Coal Pile Runoff (Units 1 and 2) to the marshy area (wetlands) west of the coal pile storage area. Such discharge shall be limited and monitored by the permittee as specified below:

	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Monthly Average**	**Daily Maximum**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Flow (MGD)	--	Report	--	Daily, when discharging	Calculated	EFF-9
Solids, Total Suspended (MG/L)	--	50.0 See cond. 24	--	Daily, when discharging	Grab	EFF-9
Arsenic, Total Recoverable (UG/L)	--	50.	--	Daily, when discharging	Grab	EFF-9
Cadmium, Total Recoverable (UG/L)	--	9.30	--	Daily, when discharging	Grab	EFF-9
Chromium, Total Recoverable (UG/L)	--	50.0	--	Daily, when discharging	Grab	EFF-9

[1] The limitation is applicable only when metal cleaning waste is discharged through outfall I-0FG

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	Discharge Limitations			Monitoring Requirements		
Parameters (units)	Monthly Average	Daily Maximum	Daily Minimum	Monitoring Frequency	Sample Type	Sample Point
Copper, Total Recoverable (UG/L)	--	3.7	--	Daily, when discharging	Grab	EFF-9
Iron, Total Recoverable (MG/L)	--	0.3	--	Daily, when discharging	Grab	EFF-9
Lead, Total Recoverable (UG/L)	--	8.5	--	Daily, when discharging	Grab	EFF-9
Mercury, Total Recoverable (UG/L)	--	0.025	--	Daily, when discharging	Grab	EFF-9
Nickel, Total Recoverable (UG/L)	--	8.30	--	Daily, when discharging	Grab	EFF-9
Selenium, Total Recoverable (UG/L)	--	71.0	--	Daily, when discharging	Grab	EFF-9
Zinc, Total Recoverable (UG/L)	--	86.0	--	Daily, when discharging	Grab	EFF-9
Vanadium, Total Recoverable (PPM)	--	Report	--	Daily, when discharging	Grab	EFF-9
PH (SU)		8.5	6.5	Daily, when discharging	Grab	INT-3B
PH (SU)		8.5	6.5	Daily, when discharging	Grab	EFF-9

23. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.22 and as described below:

Sample Point	Description of Monitoring Location
EFF-9	Point of discharge from the treatment system prior to entering wetlands area.
INT-3B	Intake at Unit 2

24. The treatment system (coal pile storage area) shall be capable of containing a 10 year, 24-hour (10Y 24H) rainfall event. The limitation for total suspended solids of 50 mg/l shall apply only to discharges resulting from rainfall less than a 10-year 24 –hour rainfall event.

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PERMITTEE:	PERMIT NUMBER:	FL0000159
Progress Energy Florida	Issuance date:	May 9, 2005
Crystal River Units 1,2, and 3		
P.O. Box 14042	Expiration date:	May 8, 2010
St. Petersburg, FL 34428		

25. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge once-through non-contact cooling water from **Outfalls D-071 and D-072** Helper Cooling Tower to the site discharge canal and thence to the Gulf of Mexico. Such discharge shall be limited and monitored by the permittee as specified below:

	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Maximum**	**Daily Average**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Intake Flow (MGD)	Report	Report	--	Continuous	Pump logs	INT-10A
Oxidants, Total Residual (MG/L)	0.01[1]	Report	--	Continuous	Recorder	EFF-10B
TRO-Discharge Time (MIN/DAY)	60.0, see cond. I.A.28.	--	--	Continuous	Recorder	EFF-10B
pH (SU)	Report	--	Report	Quarterly	Grab	INT-10A
PH (SU)	8.5	--	6.5	Quarterly	Grab	EFF-10B

26. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.25 and as described below:

Sample Point	Description of Monitoring Location
INT-10A	Common Intake for all helper cooling tower intake pumps
EFF-10A	At Outfall D-071 from helper cooling towers 1 and 2 to the site discharge canal.
EFF-10B	At Outfall D-072 from helper cooling towers 3 and 4 to the site discharge canal.

27. Cooling towers shall be operated as necessary to ensure that the discharge temperature at Sampling Location EFF-3D does not exceed 96.5 F as a three-hour rolling average.

28. TRO may be discharged from either or both Outfalls D-071 and D-072 at the same time TRO is discharged from Outfalls D-011, D-012, and D-013, provided that TRO discharge from either D-071 or D-072 does not exceed a maximum instantaneous concentration of 0.01 mg/l.

29. Monitoring requirements are only applicable during periods of discharge.

30. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge intake screen wash waste water from **Outfall D-094** to the site discharge canal thence the Gulf of Mexico without limitation or monitoring requirements.

31. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge stormwater from **Outfalls D-100, D-200, D-300, D-400, and D-500** to the site discharge canal and thence to the Gulf of Mexico without limitation or monitoring requirements.

32. During the period beginning on the issuance date and lasting through the expiration date of this permit, the permittee is authorized to discharge storm water from **Outfall D-600** Plant Area to the site intake canal and thence to the Gulf of Mexico. Such discharge shall be limited and monitored by the permittee as specified below:

[1] Limitations and monitoring requirements for TRO and time of TRO discharge for outfall D-071 and outfall D-072 are not applicable for any calendar day in which chlorine is not added.

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Progress Energy Florida
Crystal River Units 1,2, and 3
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	Discharge Limitations			Monitoring Requirements		
Parameters (units)	**Daily Average**	**Daily Maximum**	**Daily Minimum**	**Monitoring Frequency**	**Sample Type**	**Sample Point**
Flow (MGD)	--	Report	--	Monthly, when discharging	Calculated	EFF-600
Total recoverable iron (UG/L)	--	Report	--	Monthly, when discharging	Grab	EFF-600

33. Effluent samples shall be taken at the monitoring site locations listed in permit condition I.A.32 and as described below:

Sample Point	Description of Monitoring Location
EFF-600	Prior to discharge from Outfall D-600 to the intake canal.

34. Stormwater from No. 2 Fuel Oil Tank Diked Petroleum Storage or Handling Area
    a. Permittee is authorized to discharge stormwater from diked petroleum storage or handling areas, provided the following conditions are met:
    b. Such discharges shall be limited and monitored by the permittee as specified below:
        1. The facility shall have a valid SPCC Plan pursuant to 40 CFR 112.
        2. In draining the diked area, a portable oil skimmer or similar device or absorbent material shall be used to remove oil and grease (as indicated by the presence of a sheen) immediately prior to draining.
        3. Monitoring records shall be maintained in the form of a log and shall contain the following information, as a minimum:
            a.) Date and time of discharge,
            b.) Estimated volume of discharge,
            c.) Initials of person making visual inspection and authorizing discharge, and
            d.) Observed conditions of storm water discharged.
        4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of a visible oil sheen at any time.
35. As specified above, sampling for the storm water discharge shall be conducted once per discharge event.
36. There shall be no discharge of floating solids or visible foam in other than trace amounts.
37. The discharge shall not cause a visible sheen on the receiving water.

B. Underground Injection Control Systems

This section is not applicable to this facility.

C. Land Application Systems

The land application system for this facility is regulated under separate Department Permit FLA0169690

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APPENDIX C
SPECIAL-STATUS SPECIES CORRESPONDENCE

Progress Energy

September 25, 2008
LRP08-0042

Jay Herrington
Regulatory Chief
U. S. Fish & Wildlife Service
North Florida Field Office
6620 Southpoint Drive South, Suite 310
Jacksonville, FL 32216

SUBJECT: Progress Energy Crystal River Unit 3
License Renewal Project
Request for Information on Listed Species and Sensitive Habitats

Dear Mr. Herrington:

Progress Energy is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license of Crystal River Unit 3 (CR-3) for an additional 20 years. Although the current CR-3 operating license does not expire until 2016, the NRC's license renewal process and other regulatory reviews make it prudent for Progress Energy to submit the application for license renewal in early 2009.

As part of the license renewal process, the NRC requires license applicants to assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act. The NRC will consult with your office under Section 7 of the Endangered Species Act and may also seek your assistance in the identification of important species and habitats in the project area. By contacting you in advance, we hope to identify any issues that need to be addressed or information required to expedite the NRC's consultation.

CR-3 has been in operation since 1977, and is part of the larger Crystal River Energy Complex (CREC), which includes the single nuclear unit (Unit 3) and four fossil-fueled units, Crystal River Units 1, 2, 4, and 5. CREC is located in northwestern Citrus County, Florida, on Crystal Bay, an embayment of the Gulf of Mexico. The CREC site is approximately 35 miles southwest of Ocala, Florida. The nearest incorporated community is the town of Crystal River, approximately 6 miles southeast of CREC (Figure 2-2).

The CREC covers approximately 4,738 acres. Approximately 1062 acres support the generating facility and associated buildings, maintenance facilities, parking lots, roads, railroads, and transmission corridors associated with Unit 3 and the four fossil-fueled units. The remainder of the site (approximately 3,676 acres) consists of salt marsh, hardwood hammock forest, pineland, and freshwater swamp.

Two 500 kilovolt transmission lines connect CREC to the regional electric system (Figure 3-2). Both lines are owned and operated by Progress Energy. The two transmission lines share a common corridor for the first 5.3 miles eastward from the site, then diverge, with the Central Florida line continuing generally east and southeast, and the Lake Tarpon line running southeast,

Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

U. S. Fish & Wildlife Service
LRP08-0042
Page 2 of 2

south, and southwest. The Central Florida line extends 53 miles to the Central Florida substation near Leesburg, crossing portions of Citrus, Marion, and Sumter counties. The Lake Tarpon line extends 72 miles to the Lake Tarpon Substation near Tarpon Springs, crossing portions of Citrus, Hernando, Pasco, and Pinellas counties. Both transmission corridors are 150 feet wide.

Renewal of the CR-3 operating license would not involve any land disturbance, any changes to plant operations, or any modifications of the transmission system that connects the plant to the regional electric grid. There are plans, however, to replace the CR-3 steam generators in the fall of 2009, well before the current operating license expires. The steam generators, which are being manufactured in Canada, will be delivered to the CR-3 site by rail, and moved from the rail spur to the containment structure by means of a large, multi-axle transporter. No new permanent buildings or facilities will be erected to support steam generator replacement. Temporary laydown and satellite parking areas will be created to support the steam generator replacement effort, but they will be placed in previously-disturbed areas. Because, in all likelihood, Progress Energy would not replace the steam generators were it not seeking approval for an additional 20 years of operation, we have considered environmental impacts of steam generator replacement in the Environmental Report we are submitting to the NRC. In National Environmental Policy Act parlance, it is a "connected action" (40 CFR 1508.25). We would therefore appreciate your taking steam generator replacement into consideration when you conduct your review of the project's potential effect on threatened or endangered species.

Progress Energy believes that continued operation of Unit 3, including maintenance of the transmission lines, over the license renewal period (i.e., an additional 20 years) would not adversely affect any threatened or endangered species.

We would appreciate your sending a letter detailing any concerns you may have about potential impacts to threatened or endangered species (or ecologically significant habitats) in the area of CREC or along associated transmission corridors by October 15, 2008. This will enable Progress Energy to meet the current application preparation schedule. Progress Energy will include a copy of this letter and your response in the license renewal application to the NRC.

Please refer any questions regarding this submittal to Mr. Jan Kozyra, Lead Engineer – License Renewal, at (843) 857-1872.

Sincerely,

J. W. Holt

James W. Holt
Plant General Manager
Crystal River 3

Enclosures:

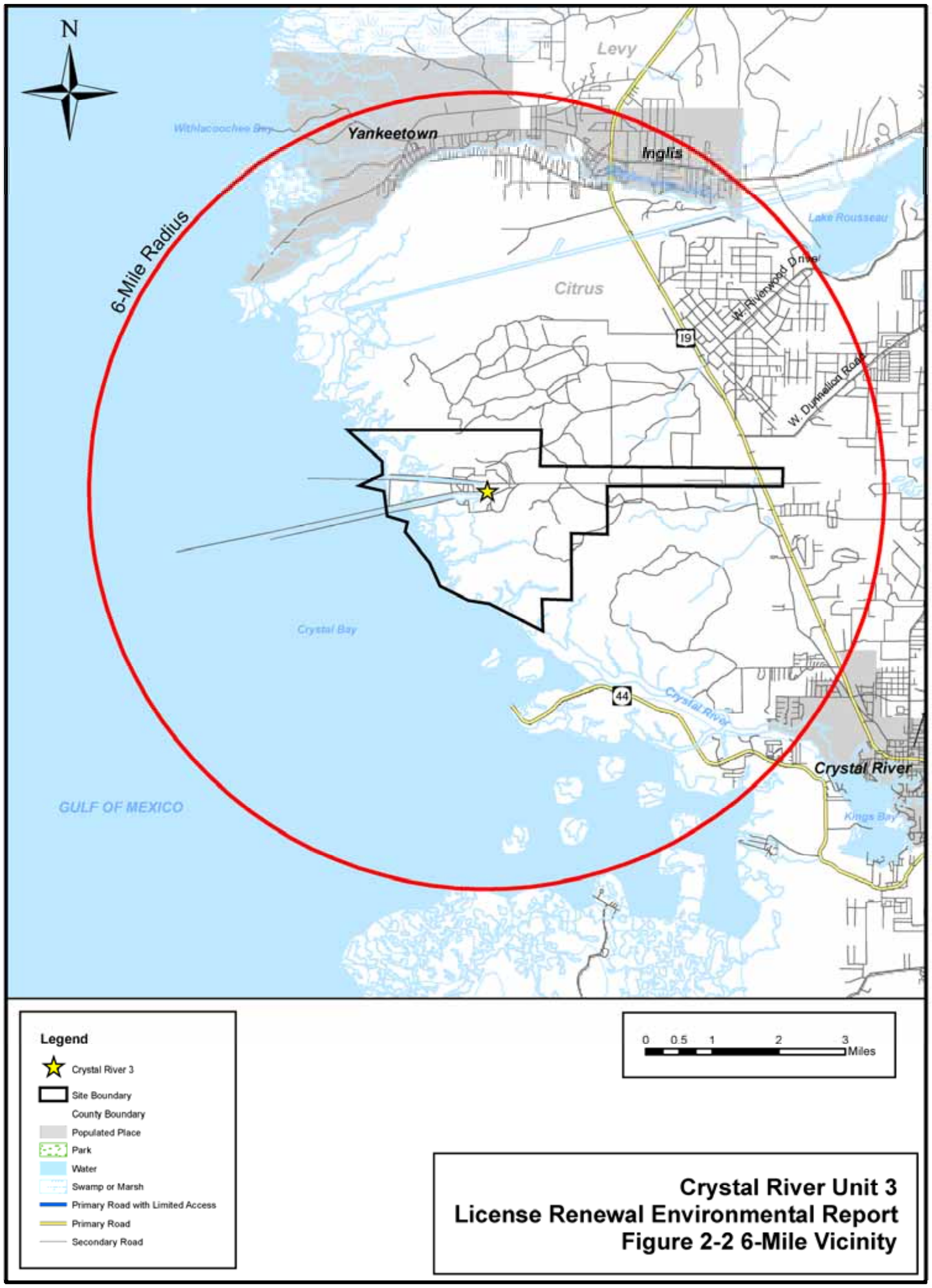
1. Figure 2-2 - Crystal River Unit 3 6-Mile Vicinity Map
2. Figure 3-2 - Crystal River Unit 3 Transmission Line Map

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON LISTED SPECIES AND SENSITIVE HABITATS

ENCLOSURE 1

FIGURE 2-2
CRYSTAL RIVER UNIT 3 6-MILE VICINITY MAP

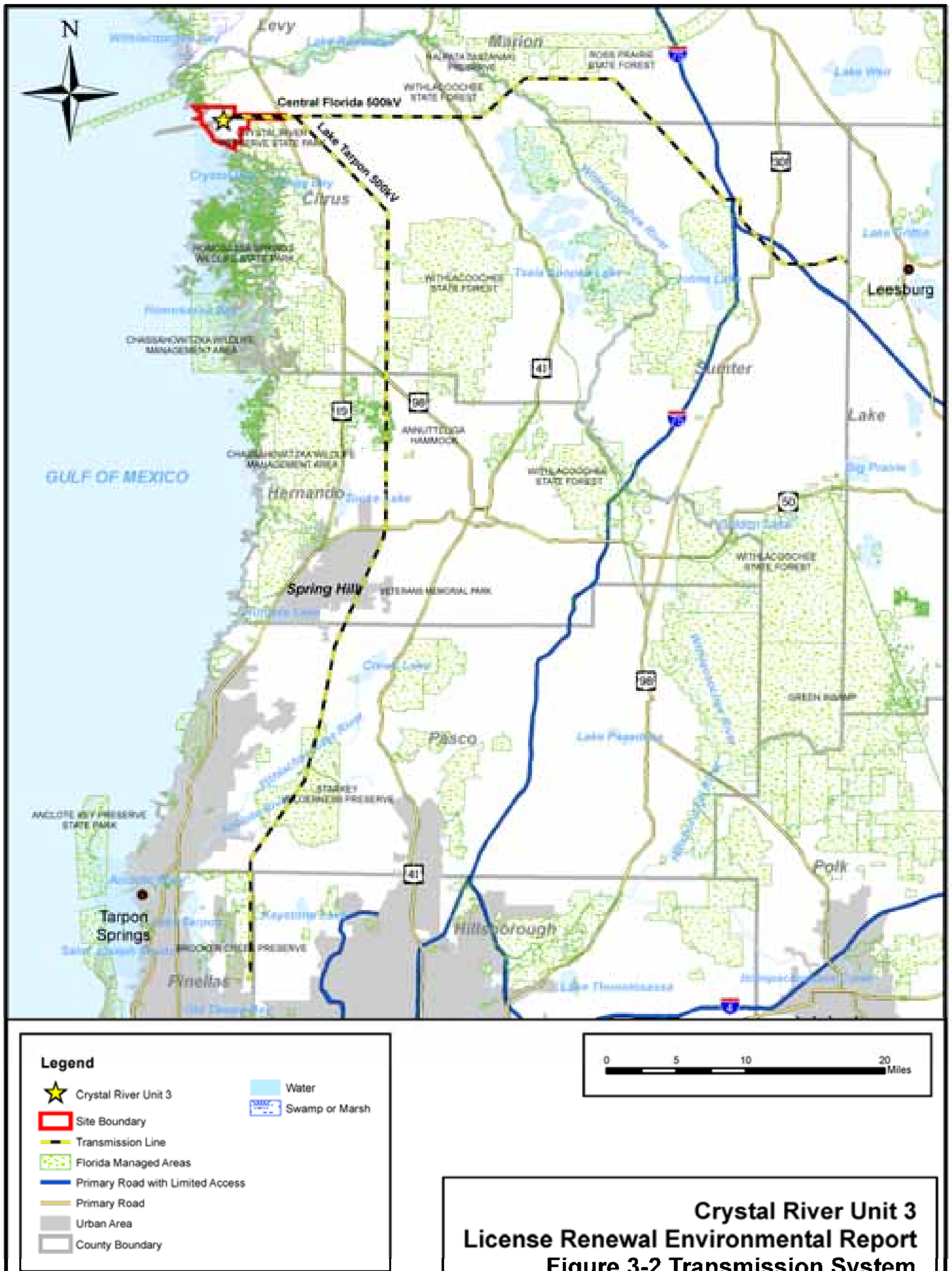

N
Levy
Withlacoochee Bay
Yankeetown
Inglis
Lake Rousseau
6-Mile Radius
Citrus
W. Riverwood Drive
19
W. Dunnellon Road
Crystal Bay
44
Crystal River
Crystal River
Kings Bay
GULF OF MEXICO
Legend
Crystal River 3
Site Boundary
County Boundary
Populated Place
Park
Water
Swamp or Marsh
Primary Road with Limited Access
Primary Road
Secondary Road
0 0.5 1 2 3 Miles
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-2 6-Mile Vicinity

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON LISTED SPECIES
AND SENSITIVE HABITATS

ENCLOSURE 2

FIGURE 3-2
CRYSTAL RIVER UNIT 3 TRANSMISSION LINE MAP



Crystal River Unit 3
License Renewal Environmental Report
Figure 3-2 Transmission System

Progress Energy

September 25, 2008
LRP08-0041

Mr. David Bernhardt
Asst. Regional Administrator for Protected Resources
NOAA Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SUBJECT: Progress Energy Crystal River Unit 3
License Renewal Project
Request for Information on Listed Species and Sensitive Habitats

Dear Mr. Bernhardt:

Progress Energy is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license of Crystal River Unit 3 (CR-3) for an additional 20 years. Although the current CR-3 operating license does not expire until 2016, the NRC's license renewal process and other regulatory reviews make it prudent for Progress Energy to submit the application for license renewal in early 2009.

As part of the license renewal process, the NRC requires license applicants to assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act. The NRC will consult with your office under Section 7 of the Endangered Species Act and may also seek your assistance in the identification of important marine species and habitats in the project area. By contacting you in advance, we hope to identify any issues that need to be addressed or information required to expedite the NRC's consultation.

CR-3 has been in operation since 1977, and is part of the larger Crystal River Energy Complex (CREC), which includes the single nuclear unit (Unit 3) and four fossil-fueled units, Crystal River Units 1, 2, 4, and 5. CREC is located in northwestern Citrus County, Florida, on Crystal Bay, an embayment of the Gulf of Mexico. The CREC site is approximately 35 miles southwest of Ocala, Florida. The nearest incorporated community is the town of Crystal River, approximately 6 miles southeast of CREC (Figure 2-2).

The CREC covers approximately 4,738 acres. Approximately 1062 acres support the generating facility and associated buildings, maintenance facilities, parking lots, roads, railroads, and transmission corridors associated with Unit 3 and the four fossil-fueled units. The remainder of the site (approximately 3,676 acres) consists of salt marsh, hardwood hammock forest, pineland, and freshwater swamp.

Two 500 kilovolt transmission lines connect CREC to the regional electric system (Figure 3-2). Both lines are owned and operated by Progress Energy. The two transmission lines share a common corridor for the first 5.3 miles eastward from the site, then diverge, with the Central Florida line continuing generally east and southeast, and the Lake Tarpon line running southeast,

Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

south, and southwest. The Central Florida line extends 53 miles to the Central Florida substation near Leesburg, crossing portions of Citrus, Marion, and Sumter counties. The Lake Tarpon line extends 72 miles to the Lake Tarpon Substation near Tarpon Springs, crossing portions of Citrus, Hernando, Pasco, and Pinellas counties. Both transmission corridors are 150 feet wide.

Renewal of the CR-3 operating license would not involve any land disturbance, any changes to plant operations, or any modifications of the transmission system that connects the plant to the regional electric grid. There are plans, however, to replace the CR-3 steam generators in the fall of 2009, well before the current operating license expires. The steam generators, which are being manufactured in Canada, will be delivered to the CR-3 site by rail, and moved from the rail spur to the containment structure by means of a large, multi-axle transporter. No new permanent buildings or facilities will be erected to support steam generator replacement. Temporary laydown and satellite parking areas will be created to support the steam generator replacement effort, but they will be placed in previously-disturbed areas. Because, in all likelihood, Progress Energy would not replace the steam generators were it not seeking approval for an additional 20 years of operation, we have considered environmental impacts of steam generator replacement in the Environmental Report we are submitting to the NRC. In National Environmental Policy Act parlance, it is a "connected action" (40 CFR 1508.25). We would therefore appreciate your taking steam generator replacement into consideration when you conduct your review of the project's potential effect on threatened or endangered species.

Progress Energy believes that continued operation of Unit 3, including maintenance of the transmission lines, over the license renewal period (i.e., an additional 20 years) would not adversely affect any threatened or endangered species.

We would appreciate your sending a letter detailing any concerns you may have about potential impacts to threatened or endangered species (or ecologically significant habitats) in the area of CREC or along associated transmission corridors by October 15, 2008. This will enable Progress Energy to meet the current application preparation schedule. Progress Energy will include a copy of this letter and your response in the license renewal application to the NRC.

Please refer any questions regarding this submittal to Mr. Jan Kozyra, Lead Engineer – License Renewal, at (843) 857-1872.

Sincerely,

J— W. Holt

James W. Holt
Plant General Manager
Crystal River 3

Enclosures:

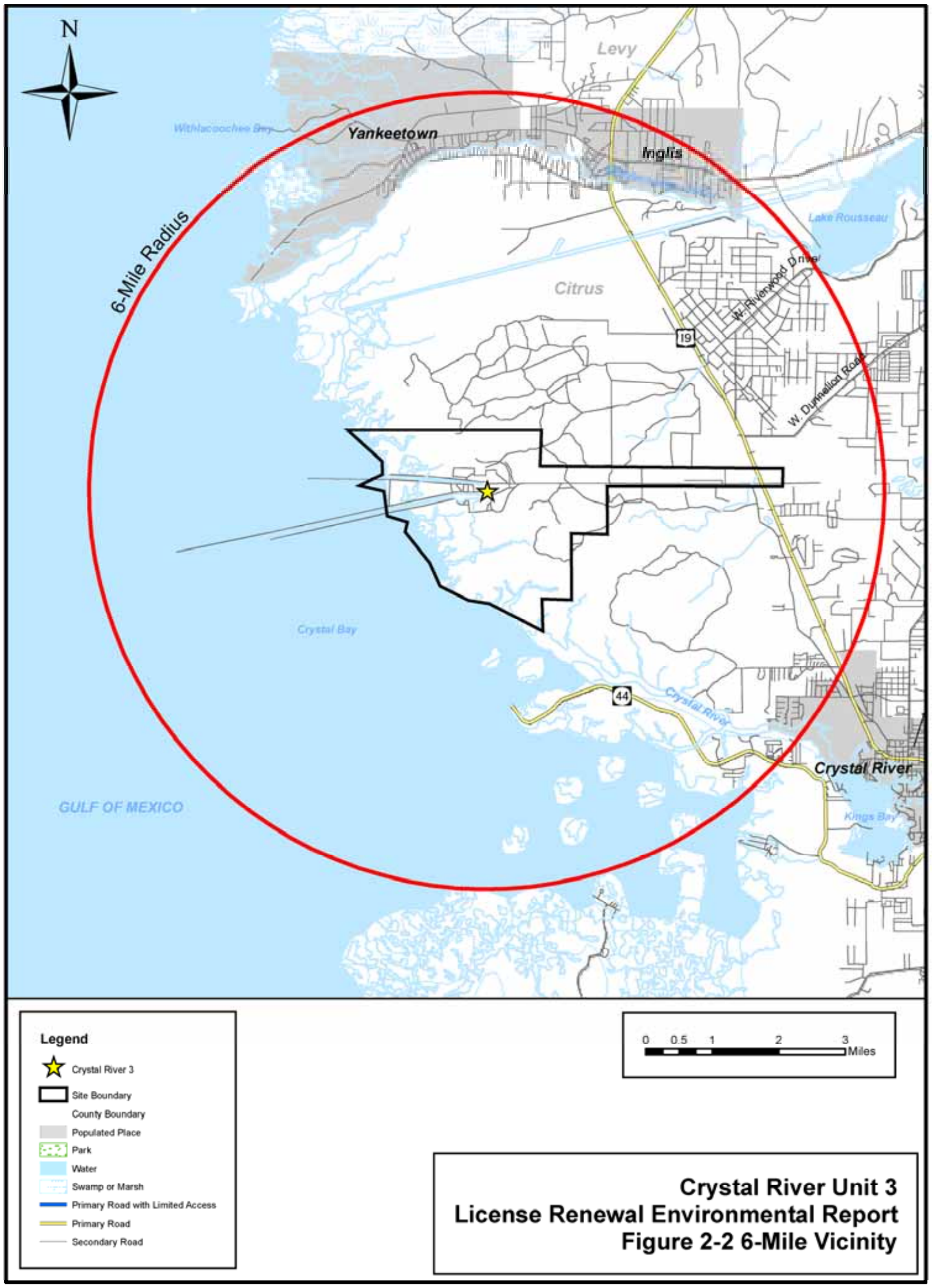
1. Figure 2-2 - Crystal River Unit 3 6-Mile Vicinity Map
2. Figure 3-2 - Crystal River Unit 3 Transmission Line Map

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON LISTED SPECIES
AND SENSITIVE HABITATS

ENCLOSURE 1

FIGURE 2-2
CRYSTAL RIVER UNIT 3 6-MILE VICINITY MAP



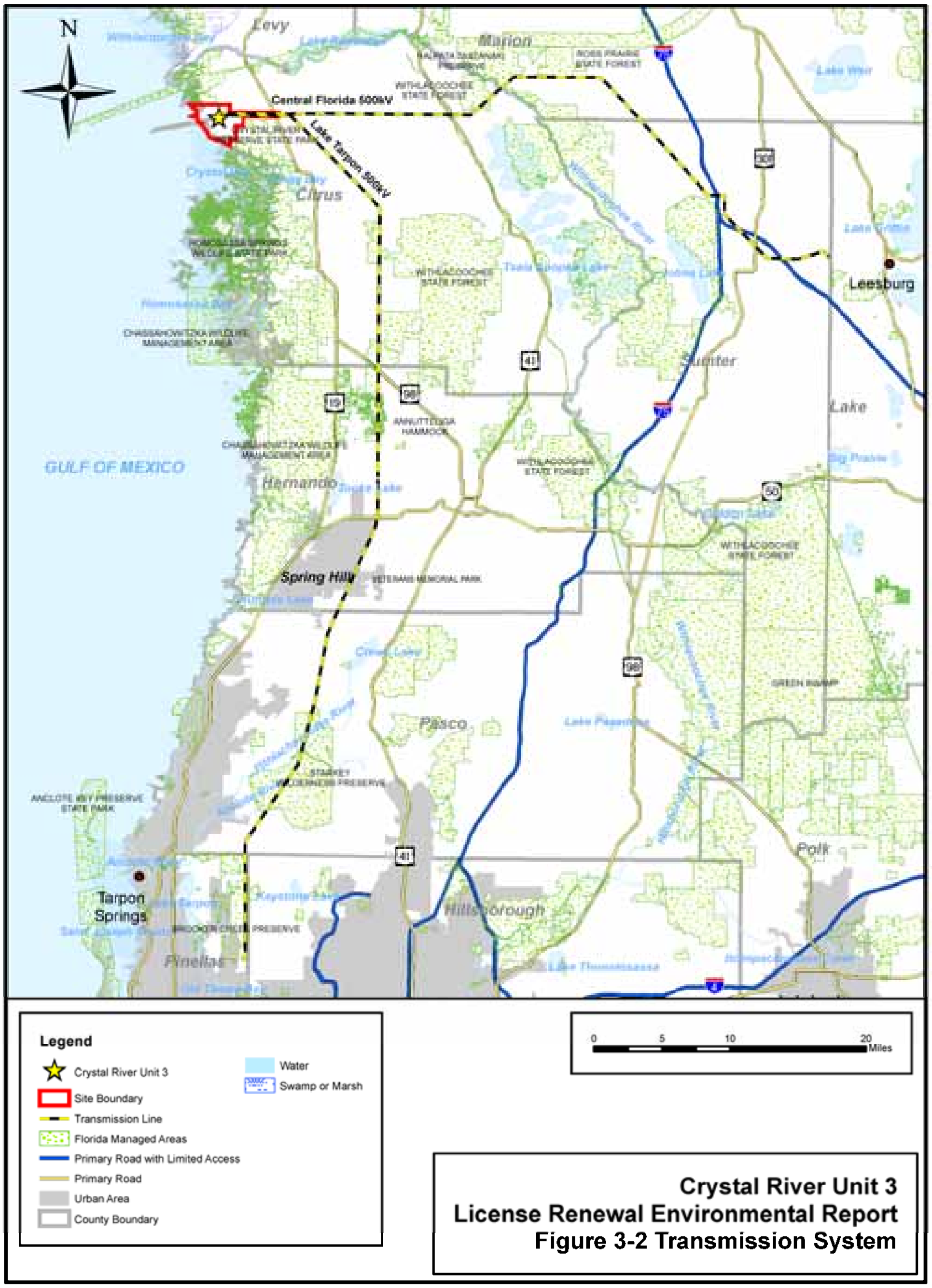
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-2 6-Mile Vicinity

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON LISTED SPECIES
AND SENSITIVE HABITATS

ENCLOSURE 2

FIGURE 3-2
CRYSTAL RIVER UNIT 3 TRANSMISSION LINE MAP



Crystal River Unit 3
License Renewal Environmental Report
Figure 3-2 Transmission System

Progress Energy

September 25, 2008
LRP08-0043

Mr. Tim Breault
Director, Division of Habitat and Species Conservation
Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, FL 32399-1600

SUBJECT: Progress Energy Crystal River Unit 3
License Renewal Project
Request for Information on Listed Species and Sensitive Habitats

Dear Mr. Breault:

Progress Energy is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license of Crystal River Unit 3 (CR-3) for an additional 20 years. Although the current CR-3 operating license does not expire until 2016, the NRC's license renewal process and other regulatory reviews make it prudent for Progress Energy to submit the application for license renewal in early 2009.

As part of the license renewal process, the NRC requires license applicants to assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act. The NRC will consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act and may also seek your assistance in the identification of important species and habitats in the project area. By contacting you in advance, we hope to identify any issues that need to be addressed or information required to expedite the NRC's consultation.

Crystal River Unit 3 has been in operation since 1977, and is part of the larger Crystal River Energy Complex (CREC), which includes the single nuclear unit (Unit 3) and four fossil-fueled units, Crystal River Units 1, 2, 4, and 5. CREC is located in northwestern Citrus County, Florida, on Crystal Bay, an embayment of the Gulf of Mexico. The CREC site is approximately 35 miles southwest of Ocala, Florida. The nearest incorporated community is the town of Crystal River, approximately 6 miles southeast of CREC (see attached Figure 2-2).

The CREC covers approximately 4,738 acres. Approximately 1,062 acres support the generating facility and associated buildings, maintenance facilities, parking lots, roads, railroads, and transmission corridors associated with Unit 3 and the four fossil-fueled units. The remainder of the site (approximately 3,676 acres) consists of salt marsh, hardwood hammock forest, pineland, and freshwater swamp.

Two 500 kilovolt transmission lines connect CREC to the regional electric system (see attached Figure 3-2). Both lines are owned and operated by Progress Energy. The two transmission lines share a common corridor for the first 5.3 miles eastward from the site, then diverge, with the Central Florida line continuing generally east and southeast, and the Lake Tarpon line running southeast, south, and southwest. The Central Florida line extends 53 miles to the Central Florida

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Crystal River, FL 34428

Florida Fish and Wildlife Conservation Commission
LRP08-0043

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substation near Leesburg, crossing portions of Citrus, Marion, and Sumter counties. The Lake Tarpon line extends 72 miles to the Lake Tarpon Substation near Tarpon Springs, crossing portions of Citrus, Hernando, Pasco, and Pinellas counties. Both transmission corridors are 150 feet wide.

Renewal of the CR-3 operating license would not involve any land disturbance, any changes to plant operations, or any modifications of the transmission system that connects the plant to the regional electric grid. There are plans, however, to replace the CR-3 steam generators in the fall of 2009, well before the current operating license expires. The steam generators, which are being manufactured in Canada, will be delivered to the CR-3 site by rail, and moved from the rail spur to the containment structure by means of a large, multi-axle transporter. No new permanent buildings or facilities will be erected to support steam generator replacement. Temporary laydown and satellite parking areas will be created to support the steam generator replacement effort, but they will be placed in previously-disturbed areas. Because, in all likelihood, Progress Energy would not replace the steam generators were it not seeking approval for an additional 20 years of operation, we have considered environmental impacts of steam generator replacement in the Environmental Report we are submitting to the NRC. In National Environmental Policy Act parlance, it is a "connected action" (40 CFR 1508.25). We would therefore appreciate your taking steam generator replacement into consideration when you conduct your review of the project's potential effect on threatened or endangered species.

Progress Energy believes that continued operation of Unit 3, including maintenance of the transmission lines, over the license renewal period (i.e., an additional 20 years) would not adversely affect any threatened or endangered species.

We would appreciate your sending a letter detailing any concerns you may have about potential impacts to threatened or endangered species (or ecologically significant habitats) in the area of CREC or along associated transmission corridors by October 15, 2008. This will enable Progress Energy to meet the current application preparation schedule. Progress Energy will include a copy of this letter and your response in the license renewal application to the NRC.

Please refer any questions regarding this submittal to Mr. Jan Kozyra, Lead Engineer – License Renewal, at (843) 857-1872.

Sincerely,

J. W. Holt

James W. Holt
Plant General Manager
Crystal River 3

Enclosures:

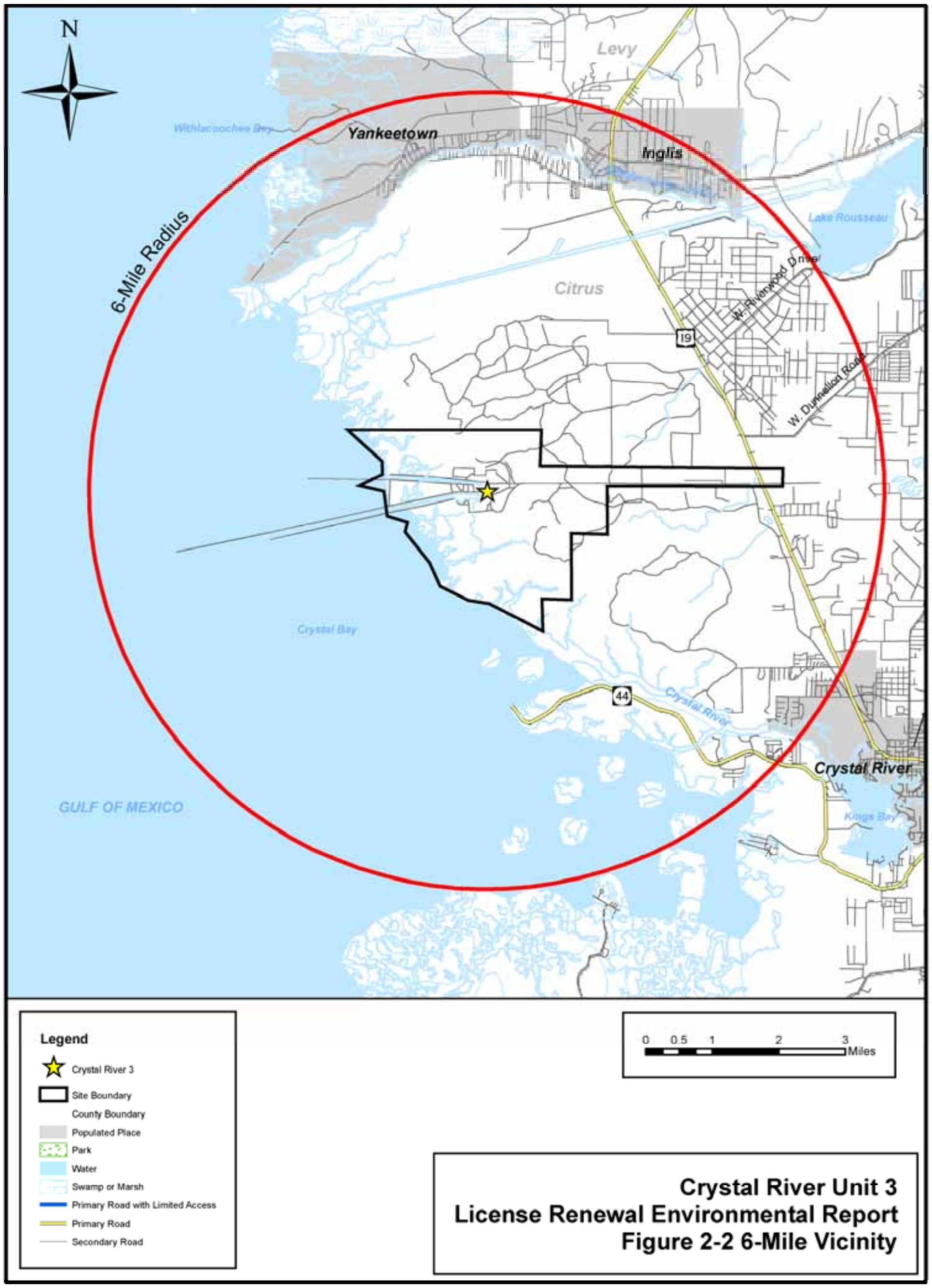
1. Figure 2-2 - Crystal River Unit 3 6-Mile Vicinity Map
2. Figure 3-2 - Crystal River Unit 3 Transmission Line Map

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON LISTED SPECIES
AND SENSITIVE HABITATS

ENCLOSURE 1

FIGURE 2-2
CRYSTAL RIVER UNIT 3 6-MILE VICINITY MAP



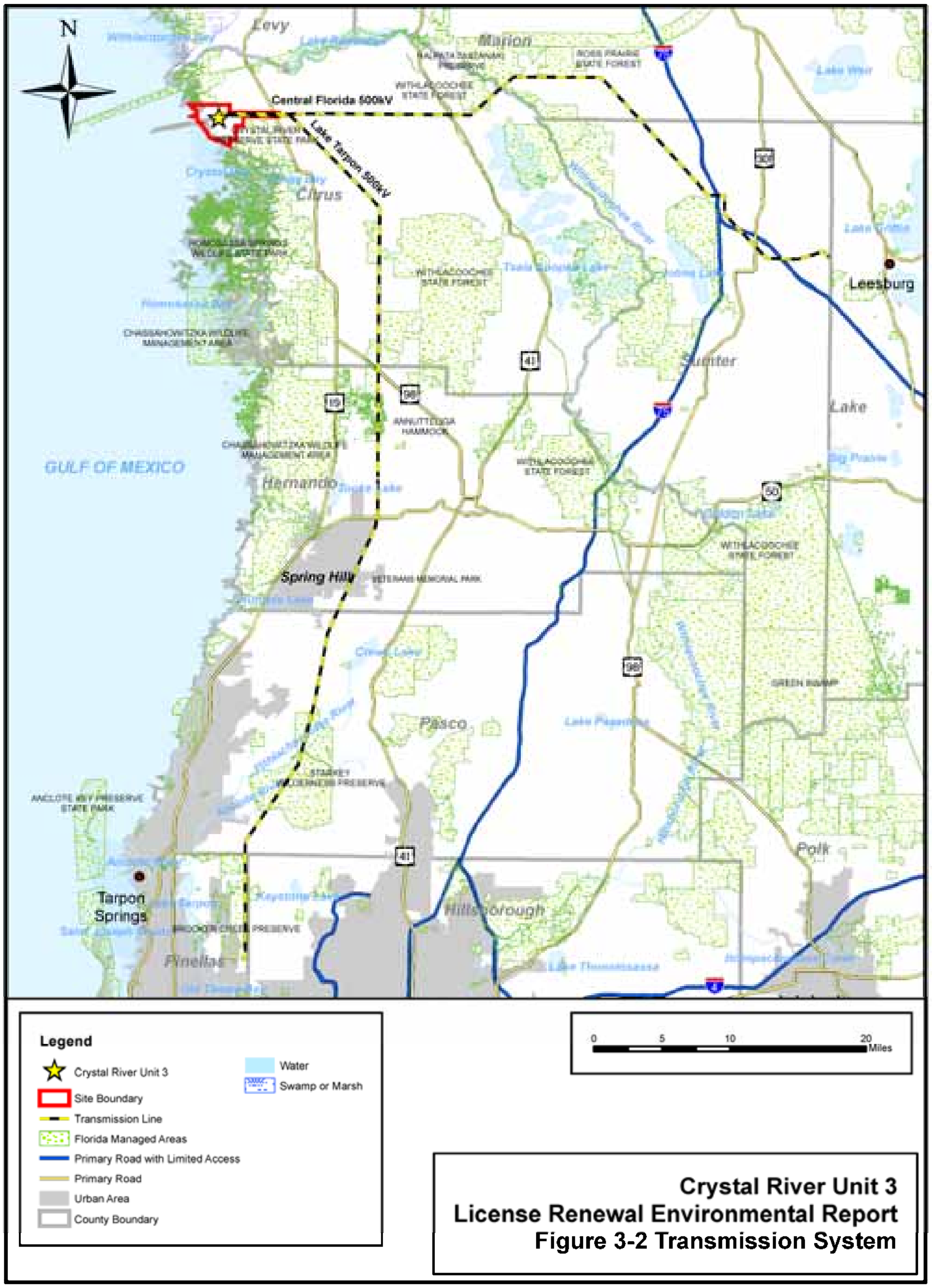
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-2 6-Mile Vicinity

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

**LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON LISTED SPECIES
AND SENSITIVE HABITATS**

ENCLOSURE 2

**FIGURE 3-2
CRYSTAL RIVER UNIT 3 TRANSMISSION LINE MAP**



Crystal River Unit 3
License Renewal Environmental Report
Figure 3-2 Transmission System

APPENDIX D
STATE HISTORIC PRESERVATION OFFICER CORRESPONDENCE

Letter **Page**

Progress Energy

September 25, 2008
LRP08-0040

Mr. Frederick P. Gaske, SHPO
Compliance & Review Section
Division of Historical Resources
500 South Bronough Street, 4th Floor
Tallahassee, FL 32399-0250

SUBJECT: Progress Energy Crystal River Unit 3
License Renewal Project
Request for Information on Cultural Resources

Dear Mr. Gaske:

Progress Energy is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license of Crystal River Unit 3 (CR-3) for an additional 20 years. Although the current CR-3 operating license does not expire until 2016, the NRC's license renewal process and other regulatory reviews make it prudent for Progress Energy to submit the application for license renewal in early 2009.

As part of the license renewal process, NRC requires license applicants to "assess whether any historic or archaeological properties will be affected by the proposed project." The NRC will formally consult with your office at a later date under Section 106 of the *National Historic Preservation Act* of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800). By contacting you, we hope to identify any issues that need to be addressed or any information your office may need to expedite the NRC consultation.

Crystal River Unit 3 has been in operation since 1977, and is part of the larger Crystal River Energy Complex (CREC), which includes the single nuclear unit (Unit 3) and four fossil-fueled units, Crystal River Units 1, 2, 4, and 5. CREC is located in northwestern Citrus County, Florida, on Crystal Bay, an embayment of the Gulf of Mexico. The CREC site is approximately 35 miles southwest of Ocala, Florida. The nearest incorporated community is the town of Crystal River, approximately 6 miles southeast of CREC (see attached Figure 2-2).

The CREC covers approximately 4,738 acres. Approximately 1,062 acres support the generating facility and associated buildings, maintenance facilities, parking lots, roads, railroads, and transmission corridors associated with Unit 3 and the four fossil-fueled units. The remainder of the site (approximately 3,676 acres) consists of salt marsh, hardwood hammock forest, pineland, and freshwater swamp.

Two 500 kilovolt transmission lines connect CREC to the regional electric system (see attached Figure 3-2). Both lines are owned and operated by Progress Energy. The two transmission lines share a common corridor for the first 5.3 miles eastward from the site, then diverge, with the Central Florida line continuing generally east and southeast, and the Lake Tarpon line running southeast, south, and southwest. The Central Florida line extends 53 miles to the Central Florida substation near Leesburg, crossing portions of Citrus, Marion, and Sumter counties. The Lake Tarpon line extends 72 miles to the Lake Tarpon Substation near Tarpon Springs, crossing portions of Citrus, Hernando, Pasco, and Pinellas counties. Both transmission corridors are 150 feet wide.

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Crystal River, FL 34428

Florida Division of Historical Resources
LRP08-0040

In December 2006, Progress Energy hired New South Associates (St. Augustine, Florida) to conduct a review of cultural resources investigations that have been conducted in the vicinity of Crystal River site. Background research included an examination of maps and site data from the Florida Master Site File (FMSF), records maintained by the Survey and Registration Section of the Bureau of Historic Preservation, and historical maps and records of the Florida Department of Environmental Protection. FMSF data indicated that there were 195 archaeological sites, 9 structures, and 3 cemeteries within a 6-mile radius of the Crystal River facility. Citrus County contained 174 of the known sites, eight of the known structures, and two recorded cemeteries. The Levy County portion of the 6-mile radius included 21 known sites, one recorded structure, and one recorded cemetery. Only two sites within a 6-mile radius are listed in the National Register of Historic Places, and both are prehistoric: the Crystal River Indian Mound site complex and Mullet Key.

Renewal of the CR-3 operating license would not involve any new construction, any changes to plant operations, or any modifications of the transmission system that connects the plant to the regional electric grid. There are plans, however, to replace the CR-3 steam generators in the fall of 2009, well before the current operating license expires. The steam generators, which are being manufactured in Canada, will be delivered to the CR-3 site by rail, and moved from the on-site rail spur to the containment structure by means of a large, multi-axle transporter. No new permanent buildings or facilities will be erected to support steam generator replacement. Temporary laydown and satellite parking areas will be created to support the steam generator replacement effort, but they will be placed in previously-disturbed areas. Because, in all likelihood, Progress Energy would not replace the steam generators were it not seeking approval for an additional 20 years of operation, we have considered environmental impacts of steam generator replacement in the Environmental Report we are submitting to the NRC. In NEPA parlance, it is a "connected action" (40 CFR 1508.25). We would therefore appreciate your taking steam generator replacement into consideration when you conduct your review of the project's potential effect on historic properties.

Because neither license renewal nor steam generator replacement would involve significant land disturbance or construction of new facilities, Progress Energy believes that continued operation of CR-3, including maintenance of the transmission lines, over the license renewal period (i.e., an additional 20 years) would not have potential to adversely affect any historic properties.

We would appreciate your sending a letter detailing any concerns you may have about potential impacts to historic properties or confirming Progress Energy's conclusion that operation of CR-3 over the license renewal term would have no adverse effects on historic properties. A response by October 15, 2008, would be greatly appreciated. Progress Energy will include a copy of this letter and your response in the license renewal application to the NRC.

Please refer any questions regarding this submittal to Mr. Jan Kozyra, Lead Engineer – License Renewal, at (843) 857-1872.

Sincerely,

J. W. Holt

James W. Holt
Plant General Manager
Crystal River 3

Enclosures:

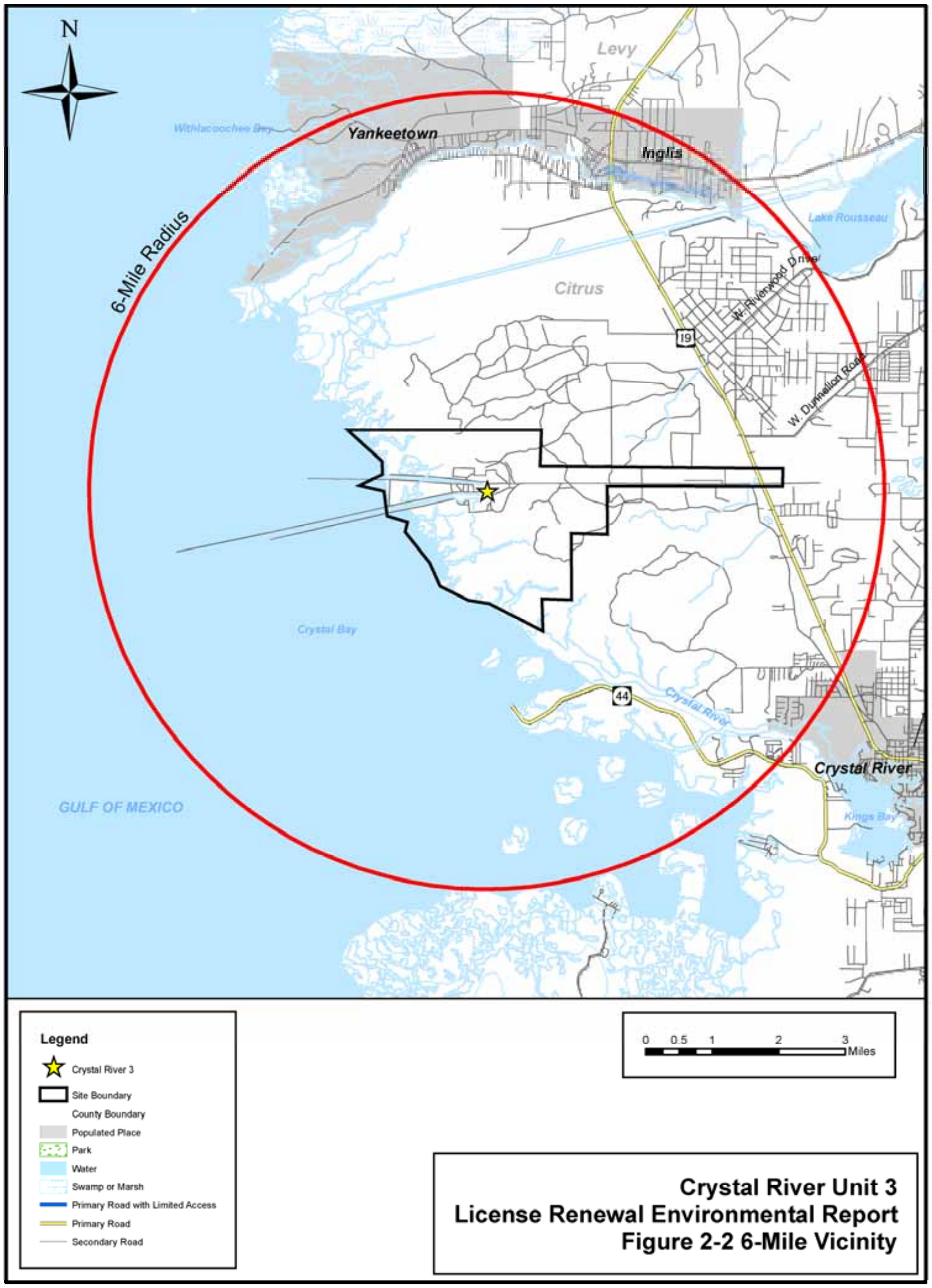
. Figure 2-2 - Crystal River Unit 3 6-Mile Vicinity Map
2. Figure 3-2 - Crystal River Unit 3 Transmission Line Map

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON CULTURAL RESOURCES

ENCLOSURE 1

FIGURE 2-2
CRYSTAL RIVER UNIT 3 6-MILE VICINITY MAP



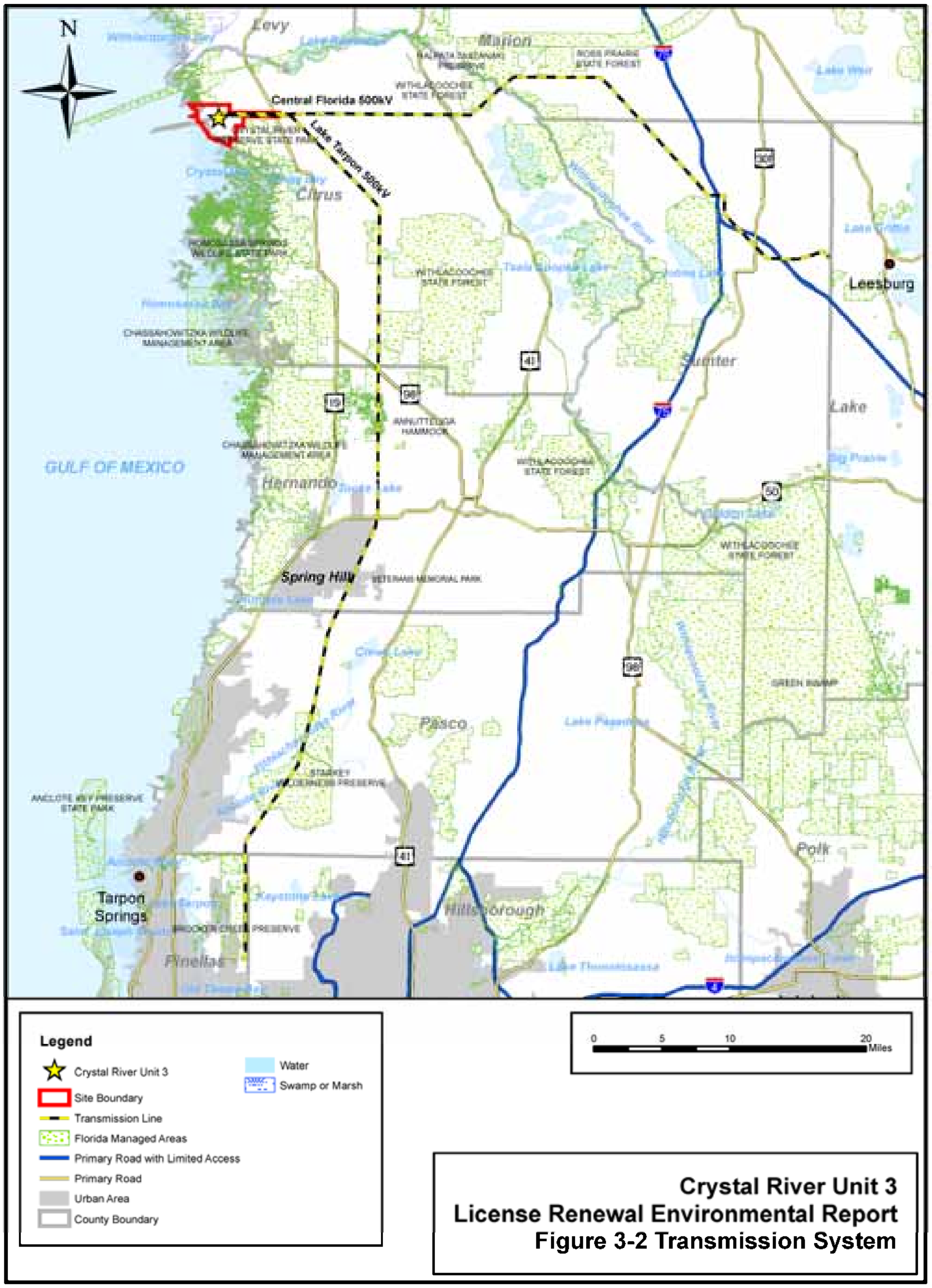
Crystal River Unit 3
License Renewal Environmental Report
Figure 2-2 6-Mile Vicinity

PROGRESS ENERGY CRYSTAL RIVER UNIT 3

LICENSE RENEWAL PROJECT
REQUEST FOR INFORMATION ON CULTURAL RESOURCES

ENCLOSURE 2

FIGURE 3-2
CRYSTAL RIVER UNIT 3 TRANSMISSION LINE MAP



Crystal River Unit 3
License Renewal Environmental Report
Figure 3-2 Transmission System

APPENDIX E
SEVERE ACCIDENT MITIGATION ALTERNATIVES

TABLE OF CONTENTS

Section **Page**

List of Tables

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Acronyms Used in Attachment E

AFW	auxiliary feedwater
ASME	American Society of Mechanical Engineers
ATWS	anticipated transient without scram
BE	basic event
BWR	boiling water reactor
BWST	borated water storage tank
CC	component cooling
CDB	core damage bin
CDF	core damage frequency
CRD	control rod drive
CRNPP	Crystal River Nuclear Power Plant
CR3	Crystal River Unit 3
CS	containment spray
CST	condensate storage tank
ECCS	emergency core cooling system
EDG	emergency diesel generator
EFIC	emergency feedwater initiation and control
EFW	emergency feedwater
EG	emergency generator
EPRI	electric power research institute
EPZ	emergency planning zone
ET	event tree
F&O	fact and observation
FP	fire protection
FPC	Florida Power Corporation
FT	fault tree
HEP	human error probability
HLCR	hot leg creep rupture
HPI	high pressure injection
HRA	human reliability analysis
HVAC	heating ventilation and air-conditioning
IA	instrument air
IPE	individual plant examination
IPEEE	individual plant examination – external events
ISLOCA	interfacing system LOCA
LERF	large early release frequency
LOCA	loss of coolant accident
LOFW	loss of feedwater
LOOP	loss of off-site power
LPI	low pressure injection
MAAP	modular accident analysis program
MACCS2	MELCOR accident consequences code system, version 2
MACR	maximum averted cost-risk
MG	motor generator

Acronyms Used in Attachment E

MMACR	modified maximum averted cost-risk
MOR	model of record
MOV	motor operated valve
MSIV	main steam isolation valve
NEI	Nuclear Energy Institute
NPSH	net positive suction head
NRC	U.S. Nuclear Regulatory Commission
OECR	off-site economic cost risk
OTSG	once-through steam generator
PORV	power operated relief valve
PRA	probabilistic risk analysis
PSA	probabilistic safety assessment
PWR	pressurized water reactor
RB	reactor building
RCP	reactor coolant pump
RCS	reactor coolant system
RDR	real discount rate
RHR	residual heat removal
RPV	reactor pressure vessel
RRW	risk reduction worth
SAMA	severe accident mitigation alternative
SBO	station blackout
SG	steam generator
SGTR	steam generator tube rupture
SI	safety injection
SRV	safety relief valve
SW	service water
SWGR	switchgear

SEVERE ACCIDENT MITIGATION ALTERNATIVES

The severe accident mitigation alternatives (SAMA) analysis discussed in Section 4.20 of the Environmental Report is presented below.

E.1 METHODOLOGY

The methodology selected for this analysis involves identifying SAMA candidates that have potential for reducing plant risk and determining whether or not the implementation of those candidates is beneficial on a cost-risk reduction basis. The metrics chosen to represent plant risk include the core damage frequency (CDF), the dose-risk, and the offsite economic cost-risk. These values provide a measure of both the likelihood and consequences of a core damage event.

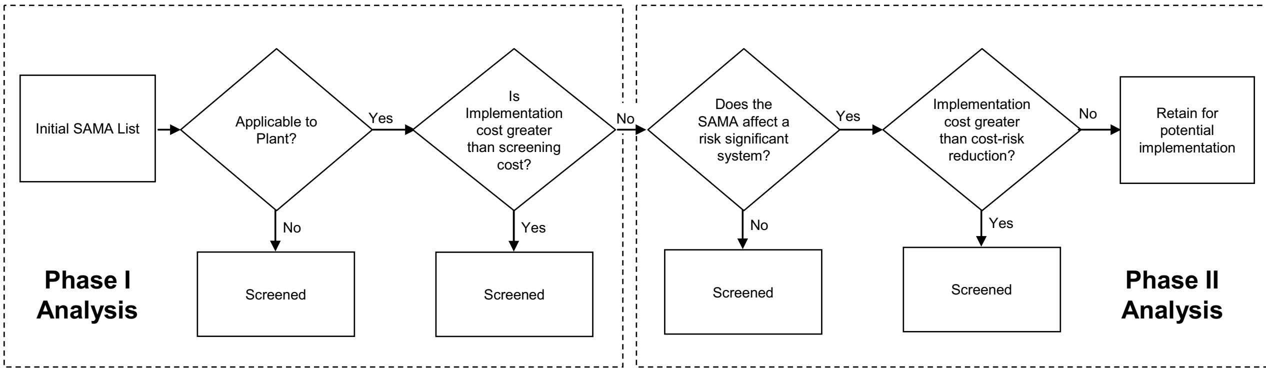
The SAMA process consists of the following steps:

- Crystal River Nuclear Power Plant (CRNPP) Probabilistic Risk Assessment (PRA) Model – Use the CRNPP Internal Events PRA model as the basis for the analysis (Section E.2). Incorporate External Events contributions as described in Section E.5.1.8.
- Level 3 PRA Analysis – Use CRNPP Level 1 and 2 Internal Events PRA output and site-specific meteorology, demographic, land use, and emergency response data as input in performing a Level 3 PRA using the MELCOR Accident Consequences Code System Version 2 (MACCS2) (Section E.3). Incorporate External Events contributions as described in Section E.5.1.8.
- Baseline Risk Monetization – Use U.S. Nuclear Regulatory Commission (NRC) regulatory analysis techniques to calculate the monetary value of the unmitigated CRNPP severe accident risk. This becomes the maximum averted cost-risk that is possible (Section E.4).
- Phase 1 SAMA Analysis – Identify potential SAMA candidates based on the CRNPP Probabilistic Risk Assessment (PRA), Individual Plant Examination – External Events (IPEEE), and documentation from the industry and the NRC. Screen out SAMA candidates that are not applicable to the CRNPP design or are of low benefit in pressurized water reactors (PWRs) such as CRNPP, candidates that have already been implemented at CRNPP or whose benefits have been achieved at CRNPP using other means, and candidates whose estimated cost exceeds the maximum possible averted cost-risk (Section E.5).
- Phase 2 SAMA Analysis – Calculate the risk reduction attributable to each of the remaining SAMA candidates and compare to a more detailed cost analysis to identify the net cost-benefit. PRA insights are also used to screen SAMA candidates in this phase (Section E.6).

- Uncertainty Analysis – Evaluate how changes in the SAMA analysis assumptions might affect the cost-benefit evaluation (Section E.7).
- Conclusions – Summarize results and identify conclusions (Section E.8).

The steps outlined above are described in more detail in the subsections of this appendix. The graphic below summarizes the high level steps of the SAMA process.

SAMA Screening Process



E.2 CRNPP PSA MODEL

The SAMA analysis is based upon the 2006 update of the CR3 PSA model for internal events (i.e. MOR 2006 model). The original IPE model submitted in1993 has been subsequently updated in 2000, 2001, 2002, 2003, 2004, 2005, and 2006 to maintain the design fidelity with the operating plant and reflect the latest PSA technology. The MOR 2000 was the model of record with which the NEI Peer Review and PRA certification was conducted. The final report was prepared by Framatone ANP, which was the lead in performing the PWR Utility peer review assessment. The peer assessment identified 11 Level A Facts and Observations (F&Os) and 27 Level B F&Os. All Level A and Level B F&Os have been addressed and closed. In addition, all Level C and Level D F&Os have been addressed and closed.

The following subsections provide more detailed information related to the evolution of the Crystal River 3 Internal Events PSA model and the current results. These topics include:

- PSA changes since the IPE
- Level 1 model overview
- Level 2 model overview
- PSA model review summary

Section E.5.1.6 provides a description of the process used to integrate external events contribution into the CR3 SAMA process; therefore, no additional discussion of the external events models is included here.

E.2.1 PSA Model Changes Since IPE Submittal

The original 1993 IPE Level 1 model was updated (section E.2.1.1) in 2000 to incorporate plant specific configurations and data as of October 1999, through refueling outage 11. The 2001 model update (section E.2.1.2) was also based upon plant configuration through the twelfth refueling outage.

During the interval between the IPE and the PSA 2000 model update, CR3 experienced an extended shutdown due to design issues. During this time a number of extensive plant modifications were made, which were reflected in the PSA but with no documentation of these changes other than CATFA fault trees and other uncontrolled documents that were typical at the time. The plant changes that were addressed include the following:

- BEST added ("A" and "B" safeguards trains powered from separate transformers)
- FWP-7 with alternate emergency diesel generator 1C installed
- Appendix R chiller installed
- EFP-3 installed
- Installed Alternate AC diesel, which can power an Essential Bus
- Low pressure injection BWST suction valves changed to normally open
- High pressure injection discharge throttle valves and cross-ties added

All of the plant changes were already incorporated into the PSA model before the PSA MOR 2000 update was initiated.

E.2.1.1 2000 PSA Model Update

The CR3 PSA IPE was submitted in March, 1993. A PSA model update was started to allow a PRA certification and Peer review of the updated PSA model. The model update described below reflects the CR3 plant configuration after the eleventh refueling outage. The major portion of this model update was to document the existing PSA model.

E.2.1.1.1 Plant Changes

The PSA model was updated to reflect plant changes from the IPE to October 1999 and refueling outage 11. The changes are as follows:

- The Service Water system fault tree was modified to reflect the plant change where a backup water supply is provided for Raw Water Pump flushing water.

E.2.1.1.2 Event Tree Changes

There were no event tree changes associated with this revision of the PSA model.

E.2.1.13 Fault Tree Model

The Service Water system fault tree was modified to reflect the plant change where a backup water supply is provided for Raw Water Pump flushing water.

E.2.1.1.4 New System Models

New systems models were not added in this revision. In this PSA model revision Systems Notebooks were developed for each of the existing system models.

E.2.1.1.5 Initiating Event Fault Tree Models

- The Service Water system fault tree was modified to reflect the plant change where a backup water supply is provided for Raw Water Pump flushing water. This resulted in removing the loss of Raw Water Pump flushing water as an initiating event in the service water system model.
- The ISLOCA detailed fault tree was added in this PSA model revision.

E.2.1.1.6 Initiating Event Update

The initiating events were updated to reflect Large Break LOCA size of greater than 6 inch pipe to be consistent with other PSAs. For Medium break LOCAs a change was made to require the actuation of at least one HPI pump can provide for core cooling with or without secondary heat removal for all postulated medium breaks. It was determined that one HPI pump is sufficient in general.

E.2.1.1.7 Initiating Event Data Update

The initiating event data was updated with plant specific information for Turbine/Reactor Trip, Loss of Feed-water, Spurious ES actuation, and Loss of Off-site Power, which includes both loss of switchyard (T3) and a loss of transformers (T15). The generic initiating events values were revised to be consistent with NUREG/CR-5750, "Rates of Initiating Events at U.S. Nuclear power Plants: 1987-1995”.

E.2.1.1.8 Component Reliability Data Update

- Plant specific data for a large variety of components was updated from 1988 to October 1999.
- The assessment of common-cause failures for the CR-3 PRA had been updated to be consistent with the methods developed jointly by the USNRC and EPRI and the data base of events collected by EPRI. The overall approach was changed from the use of beta factors alone to the evaluation and application of parameters using the multiple Greek letter (MGL) approach.

E.2.1.1.9 Human Reliability Analysis

The HRA assessment was updated based on plant modifications and procedure revisions at CR3 since 1997. It builds on previous versions dating back to the original probabilistic risk assessment completed in the mid-1980s. This update also adds the HCR/ORE analysis option to the type Cp events.

E.2.1.1.10 Level II Analysis

The Level II PSA was started in this update but was not completed in time to support the Peer Review. The draft Level II and the IPE results were available for review and this was included in the scope of the Peer Review.

E.2.1.2 PSA Model 2001 Update

The MOR 2001 completed in December 2001 updated common cause, internal flooding and HRA dependency and incorporated miscellaneous changes to improve the models. The CR3 MOR01 is based on the physical plant configuration as of October 2001 (RFO12) and component data through the end of 1999.

E.2.1.2.1 Plant Changes

No significant plant changes were incorporated into this model.

E.2.1.2.2 Event Tree Changes

No event tree changes were identified in the model update.

E.2.1.2.3 Fault Tree Model

Some minor miscellaneous changes were made to improve the model.

E.2.1.2.4 New System Models

No new systems were added to the model. A number of new system notebooks were developed in this model revision. These system notebooks include the Building Spray, Core Flood, Chilled Water, Decay Heat Closed Cycle Cooling, Decay Heat, Compressed Air System, Miscellaneous systems (BWST, Domestic Water, Demin Water, and Boric Acid), Makeup and Purification System, Reactor Building Cooling System, Reactor Building Isolation, and Reactor Coolant System.

E.2.1.2.5 Initiating Event Fault Tree Models

No changes were made to the initiating event fault trees other than data and common cause as discussed below.

E.2.1.2.6 Initiating Event Update

Internal plant flooding was updated for the internal events PSA model. This revision of the flooding analysis was based upon previous flooding studies and the IPE flooding evaluation.

E.2.1.2.7 Initiating Event Data Update

No changes were made to the initiating event data other than the data update as discussed below.

E.2.1.2.8 Component Reliability Data Update

The Common Cause data was revised and updated to improve the use of the MGL method and include plant specific data in the common cause data. Data for components was updated from October 1999 to the end of 1999.

E.2.1.2.9 Human Reliability Analysis

The human reliability analysis was revised to include more detailed dependency. The previous PSA model has a limited HRA dependency analysis and thus model revision expanded the number of HRA events with a dependency analysis. Some additional HRA Cp actions were added. These include procedure driven actions to power an ES bus from an alternate power supply and to manually start HVAC systems. Other HRA added include operator fails to manually trip reactor and refill BWST. One HRA was deleted which was to close valves to isolate an ISLOCA event.

E.2.1.2.10 Level II Analysis

No changes were made to the Level II analysis.

E.2.1.3 PSA Model 2002 Update

The MOR 2002 was completed in November 2002. This update addressed most of the facts and observations (F&Os) from the peer review and PSA certification process. The changes in this revision were added justification for ATWS modeling and some ATWS changes discussed below. There was the deletion of the ISLOCA detailed fault tree based upon analysis performed in 2001. The specific changes are listed below but there were a number of general changes and they included:

- Issuing of a Circular Logic Notebook to document the attribute of the PSA model.
- Added MAAP references for Core Flood Tank success criteria for large LOCAs.
- Changed discussions of feed and bleed cooling for small LOCAs and SGTR to reflect the requirement that the pressurizer PORV to be open to allow adequate core cooling.
- Changed the discussion of feed and bleed cooling for transients to identify that successful RCS pressure control (event P) satisfies the bleed function.
- Added references for additional thermal-hydraulic analysis.
- Changed discussion of emergency boration for requirement that HPI from BWST (event W) is needed to reach stable end state.

E.2.1.3.1 Plant Changes

No significant plant changes were required to be incorporated into this PSA model revision.

E.2.1.3.2 Event Tree Changes

The steam generator tube rupture event tree was revised to remove the event K for reactor trip. This was based upon the boric acid from the BWST is being added to the RCS, which will result in a plant shutdown and thus the ATWS portion is not a contributor to risk for this event.

E.2.1.3.3 Fault Tree Model

The system fault trees were revised based upon the peer review comments as follows:

- The PSA model revision deleted gate @B03 logic for isolation of Emergency Feed Water (EFW) to both steam generators on low pressure, since at CR3 FOGG (Feed only good generator) logic will not allow this to occur.

BS

- Added circuit breaker transfers open for BSP-1A and BSP-1B of the Building spray fault tree.

DHCCC

- Deleted mutually exclusive combination SHUMADCY and SPMDHCBM – assumed pre-alignment of MUP-1A to DC cooling which does not occur.

- Added S800_X and S801_X to top gates.

DH

- Added circuit breaker transfer open for DHP-1A and 1B to Table 6B.
- Section 6.0 - changed S800 and S801 to S800_X and S801_X, added text description of logic not including the ES actuations.

EFW

- Added transfer closed over mission time for FWV-216, 217; EFV-11, 14, 32, 33.
- Deleted RHUSTEAY.

EG

- Added EDG output breaker transfer open over mission time.

IA

- Added valves SCV-535 and SCV-536 for secondary cooling to IAP-3A.

MU

- Added circuit breaker transfer open over mission time.
- Added MOV transfer open over mission time for MUV-53 and MUV-257.
- Added MOV transfer closed over mission time for MUV-62 and MUV-69.
- Deleted HRA for pre-initiators for cooling to MUP-1A and MUP-1C based on changes to the HRA.
- Deleted mutually exclusive combination HPM001CM and SHUMADCY – basis was assumed alignment of MUP-1A cooling to DC which does not occur.

PCS

- FWV-28 – deleted from Table 6A with two year exposure time and moved to Table 6B mission time exposure.

RC

- Added MOV transfers closed over mission time for RCV-11.
- Changed RHU0158X and RHU0159X into a single common mis-calibration event RHU5859X in section 14.
- Added FL_TQR and FL_TQS to mutually exclusive table.

Decay Heat Sea Water

- Deleted 5 of 5 CCF events from CCF section.
- Added circuit breaker transfers open for RWP-3A, 3B to Table 6B.
- Deleted mutually exclusive combination SHUMADCY and SPMRW3BM – assumption that MUP-1A would be pre-aligned to DC cooling is invalid.
- Section 5.0 – added new gates S920_X and S923_X for recirculation, added text description of logic without ES actuation.

Nuclear Services Sea Water

- Deleted 3 of 3 CCF from CCF section.
- Added circuit breaker transfers open to Table 6B for RWP-2A and 2B.
- Added IE_F6A to the initiator section.

Nuclear Services Closed Cycle Cooling

- Added pneumatic valve transfer open for SWV-151, 152, 355.
- Added additional common cause failures.

E.2.1.3.4 New System Models

No new system models in this PSA model revision.

E.2.1.3.5 Initiating Event Fault Tree Models

The ISLOCA detailed fault tree was deleted and the Crystal River 3 ISLOCA Evaluation, S0218010002-1892-122801, Rev. 0, December 2001 was used instead.

E.2.1.3.6 Initiating Event Update

The initiating event notebook was revised based upon the peer review comments as follows:

- Added IE_F6A based upon internal flooding analysis revision.
- Section 1.1.1 – added disposition of spurious RCP seal LOCA and spurious relief valve LOCA from NUREG-5750.
- Section 1.1.6 – changed discussion of ISLOCA to refer directly to ERIN ISLOCA report; deleted Table 3 and renumbered subsequent tables; changed reference 11 to ERIN ISLOCA report.
- Section 1.2.1.5 – added discussion of system impacts of steam/feed line breaks.
- Section 1.2.2 – added reference to individual system notebooks for initiating events discussions, added new initiators T11 and T16 for loss of raw water and loss of makeup, respectively; added reference 20 for ERIN report; revised discussion of loss of SW impact on RCP seal integrity.
- Section 1.2.2.6 – added bus C to discussion.
- Section 2.0 – added new initiating events T11 and T16 to this section for loss of raw water and loss of makeup, respectively.
- Section 2.17 – updated ISLOCA frequency per ERIN report and as discussed in E.2.1.3.5 above.
- The steam generator tube rupture event tree was revised to remove the event K for reactor trip. This was based upon the boric acid from the BWST is being added to the RCS, which will result in a plant shutdown and thus the ATWS portion is not a contributor to risk for this event.

E.2.1.3.7 Initiating Event Data Update

Section 2.16 – changed SGTR frequency calculation, added new reference "NUREG-0651, Evaluation of Steam Generator Tube Rupture Events, U.S. Nuclear Regulatory Commission, March 1980".

E.2.1.3.8 Component Reliability Data Update

There were some changes in component reliability data as listed below:

- Changed EJ J probability and range factor based on reanalysis of generic data.
- Some minor improvements in the common cause data were completed.

E.2.1.3.9 Human Reliability Analysis

Based upon the results from the peer review process the following changes were made to the HRA:

- All of the post initiator events have been reviewed and updated as appropriate for timing and references.
- The dependency analysis was completely redone with improved documentation of the process used, and results.
- Deleted RHUSTEAY
- Changed RHU0158X and RHU0159X into a single common mis-calibration event RHU5859X
- Deleted HRA for pre-initiators for cooling to MUP-1A and MUP-1C based on changes to the HRA.

E.2.1.3.10 Level II Analysis

Based upon the results from the peer review process the following changes were made to the Level II PSA model:

- Deleted MK, SK, RK ATWS sequences which are no longer required due to low frequency.
- Revised the SGTR binning per revised ET as follows:
- Changed RQX to RQGY

- RCX – moved from bin 19 to bin 17 since cavity will be wet
- RCQX – moved from bin 20 to bin 21 since cavity will be wet
- Added new sequence RCQY in bin 21
- Added new sequence RCP in bin 22
- Changed RB1B2X to RBX, RB1B2U to RBU
- Added new sequence RBQX and RBQY in bin 21
- Added new sequence RPB in bin 22
- Added new sequence RUG in bin 18
- Deleted RB1X, RB1QX, and RB1U
- Added note for sequences with event C that SSHR is available to the intact OTSG but not used for cool down.
- Replaced with revised fault tree.
- Added IE_R into mutually exclusive combinations for PDSs other than "S," changed FL-ISLOCA to IE_V. Deleted SPLT_RA and SPLT_RB which are already included in the MTX file.

E.2.1.4 PSA Model 2003 Update

The 2003 CR3 PSA model update 2003 was completed in November 2003. This change incorporated F&Os from peer review that remained un-resolved since the last update. This revision addressed added fault tree model for loss of Service Water (T10) and loss of Makeup (T16); it simplified some fault trees to allow various equipment lineups and corrected some minor errors in the model. These changes are discussed below.

E.2.1.4.1 Plant Changes

No significant changes incorporated.

E.2.1.4.2 Event Tree Changes

No changes in this PSA model revision.

E.2.1.4.3 Fault Tree Model

- As discussed new initiating event fault trees were added for Loss of Service Water (T10) and Loss of Make-up (T16). Other changes were made to the system fault trees as discussed below.

AC Power

- Add ACDP-176 panel, transformer, and circuit breaker to and correct HVAC dependencies.

Air Handling

- Added mutually exclusive combination for EOOS events

Building Spray

- Added mutually exclusive combinations for support trains

Chilled Water

- Added mutually exclusive combination for EOOS events

DC Cooling

- Added mutually exclusive combinations not previously documented

DH

- Added mutually exclusive combinations not previously documented

DC Power (DP)

- Added mutually exclusive combinations not previously documented
- Rename DACPWAR to FLG_BATAF; same for B and C batteries

<u>EFIC (EC)</u>

- Changed signal conditioners 17, 18, 21, and 22 to mission time exposures
- Deleted ‘B’ bypass switches
- Changed to incorporate MSLI logic changes

<u>EFW</u>

- Changed support gate from D261 to D261_S for ASV-5
- Corrected exposure time from 1 to 3 months for EFV-11, 14, 32, 33, 55, 56, 57, 58
- Corrected exposure time from mission time to 2 years for CDV-289
- Added new CCF events for check valves EFV-15, 16, 17, and 18 (Table 11)
- Updated exposure times for components with plant life exposures
- Changed exposure time for FWV-216, 217 FICs to 3 months
- Added FWV-248/225/231 for FWP-7 recirc line
- Corrected EF SOV CCF events to use the fail to close factors instead of fail to open
- Renamed DACPW?NR to FLG_BAT? for battery depletion flag events

<u>EG</u>

- Added new CCF events; changed name of check valve fail to open events
- Changes were made in the EDG system to reflect the requirement to load shed certain loads.
- Added mutually exclusive combinations for EOOS events

<u>IA</u>

- Changed IAV-58 to SAV-58, showed IAFL-8B normally isolated
- Changed IADR-2 inlet to IAV-479, added air supply to control room
- Changed IAV-30 to pressure regulating valve per DBD, model, operating procedure.

- Changed IAV-12 exposure to plant life – no test or operation can detect closure of valve.
- Changed SAV-30, 33, 29, 31, 126 exposure to 2051 hours

Miscellaneous Systems

- Changed exposure time of DO flush water valves from quarterly to 2 years, added assumption to this effect.
- Changed exposure time of DOV-232 and DOV-239 from 2 years to 2900 hours.
- Changed exposure time for CAV-59 and DWV-120 from 2 years to 40 years.
- Added mutually exclusive combinations for EOOS events.

MU

- Added flags for alignments and changes were made to the Make-up system for simplification and allow various systems alignments.
- Added 120 VAC for MUV-586/587
- Changed BE names for MUVs for consistency.
- Updated mutually exclusive combinations

PCS

- Changed exposure of SP-7A/B-FE to 18 months based on SP-162.
- Added mutually exclusive combination not previously documented

Reactor Building Cooling

- Added mutually exclusive combinations for support trains

Decay Heat Sea Water

- Added mutually exclusive combination not previously documented

Nuclear Services Sea Water

- Changed exposure times for strainers and manual valves from 2 years to 3 months.

- Changed exposure times for RWV-32 and 33 to 917 days; added assumption on DC heat exchanger maintenance.
- Added mutually exclusive combinations for EOOS events
- Deleted 4/4 RW pump CCF, changed group size from 4 to 2 for RWP-2A/2B and updated factors

Nuclear Services Closed Cycle Cooling

- Added low pressure start inhibit

E.2.1.4.4 New System Models

No additional system modeled in this PSA revision.

E.2.1.4.5 Initiating Event Fault Tree Models

Implemented a fault tree initiating event model for T10 (Loss of Service Water) and T16 (Loss of Makeup).

E.2.1.4.6 Initiating Event Update

This PSA revision changed the initiator T11, loss of intake, based upon peer review comments and separated out the operator recovery action (credit no longer taken for this action); corrected SGTR data; implemented a fault tree model for initiators T10 and T16.

E.2.1.4.7 Initiating Event Data Update

This PSA revision updated loss of offsite power assessment including latest available EPRI data through 2002; updated plant-specific transient data through 2002; and changed to only use critical hours for plant-specific initiator frequency calculations per ASME standard.

E.2.1.4.8 Component Reliability Data Update

Changed one EG fail to run to fail to start due to timing of failure;

Updated CH (Chill Water) pump with 1998 to 1999 data, affected generic pump data as well;

Changed Raw Water pump run hours to correct error in baseline data.

Revised fault exposure hours as discussed in paragraph E.2.1.4.3 above.

E.2.1.4.9 Human Reliability Analysis

The Flooding mitigation actions HRAs were updated to use consistent methodology with other PRA actions.

E.2.1.4.10 Level II Analysis

The fault exposure time for SG instrumentation was changed from 24 months to 24 hours based upon examination of plant procedures, daily surveillance tests and operator rounds. This reduced the LERF metric slightly.

E.2.1.5 PSA Model 2003a Update

The CR3 PSA model update 2003a was completed in May 2004. This update of the MOR revised level 2 inputs. The level 1 results and sensitivities were unaffected by the revision. Model changes include some core damage bin re-assignments and updated LERF split fractions. The EOOS A4 model is not impacted by this revision.

E.2.1.5.1 Plant Changes

No plant changes incorporated in this PSA model revision.

E.2.1.5.2 Event Tree Changes

No event tree changes incorporated in this PSA model revision.

E.2.1.5.3 Fault Tree Model

No fault tree changes incorporated in this PSA model revision.

E.2.1.5.4 New System Models

No new systems models added in this PSA model revision.

E.2.1.5.5 Initiating Event Fault Tree Models

No initiating events fault tree changes made in this PSA model revision.

E.2.1.5.6 Initiating Event Update

No initiating event changes made in this PSA model revision.

E.2.1.5.7 Initiating Event Data Update

No initiating event data made in this PSA model revision.

E.2.1.5.8 Component Reliability Data Update

No component data changes made in this PSA model revision.

E.2.1.5.9 Human Reliability Analysis

No human reliability analysis changes incorporated in this PSA model revision.

E.2.1.5.10 Level II Analysis

Update MOR to include revised level 2 inputs. The level 1 results and sensitivities are unaffected by the revision. The Level 2 model changes include some core damage bin re-assignments and updated LERF split fractions. The specific changes are discussed below:

- Updated table 8 bin definitions. Bin 12 is now late, medium (from early, low), and bin 19 is now SSHR failed (was available).
- Sequences TBL1WX,TBL1L2X, TBP, SBP, TKBQX,RBQY were changed from CDBs 4,4,11,11,4,21 to CDBs 5,6,7,4,5,19 respectively based on cutset review.

E.2.1.6 PSA Model 2003b Update

The CR3 PSA model update 2003b was completed in June 2005. This revision is based mainly on fault tree changes to better support plant configurations which were not fully implemented in the previous model (operating with RCV-11 closed). The changes include splitting up a module which was applying inappropriate LPI failures to HPI recirculation scenarios. Also, the induced LOCA models were restructured to allow implementation of improved HPI control (AP-340) for non-LOCA scenarios.

E.2.1.6.1 Plant Changes

No plant changes incorporated in this PSA model revision.

E.2.1.6.2 Event Tree Changes

Event trees were revised to account for the split fraction of small break LOCAs that require secondary side cooling.

E.2.1.6.3 Fault Tree Model

Revised fault tree for Reactor Coolant System PORV to allow changes in the PORV block valve alignment. The associated changes with this are listed below.

AH

- Deleted MTX FLG_HVAC,QHUEFVTY

MU

- Rename line LOCA split fractions

PCS

- Deleted Gates P997 and P998

RC

- Added flag event FL_RCV11C
- Added HHUTHR1Y, HHUTHR2Y (discussed in more detail in E.2.1.5.9 below).
- Revised logic to account for potential that PORV block valve is closed and the various existing initiating events that may be impacted.

E.2.1.6.4 New System Models

No new systems models added in this PSA model revision.

E.2.1.6.5 Initiating Event Fault Tree Models

No initiating events fault tree changes made in this PSA model revision.

E.2.1.6.6 Initiating Event Update

The small LOCA initiating events were revised to account for the split fraction of small break LOCAs that require secondary side cooling.

E.2.1.6.7 Initiating Event Data Update

No initiating event data made in this PSA model revision.

E.2.1.6.8 Component Reliability Data Update

No component data changes made in this PSA model revision.

E.2.1.6.9 Human Reliability Analysis

There were a limited number of HRA events updated to incorporate Peer review comments. Two HRA events were added to address specific HPI flow control issues that show some importance in the PSA (HHUTHR1TY and HHUTHR2TY)

Revised RHURCPTY (Operator fails to trip RCPs given no seal cooling/injection). This action was revised to correct errors identified in peer review.

Revised HHUTHRTY (Operator fails to control HPI flow following ES actuation due to overcooling). This change removed recovery actions by other crew member for execution errors.

Added HHUTHR1Y, (Operator fails to control HPI following spurious actuation)

Added HHUTHR2Y, (Operator fails to control HPI before liquid relief)

Revised QHULT59X (Mis-calibration of CST level indication revised to account for daily instrument checks)

E.2.1.6.10 Level II Analysis

No changes in Level II analysis in this PSA revision.

E.2.1.7 PSA Model 2006 Update

The CR3 PSA model update 2006 was completed in April 2006. This revision reflects the installation of an alternate diesel generator EGDG-1C, the removal of MTDG-1, and the ability to align unit buses from the auxiliary transformer. This change allows EGDG-1C to provide 4160V power to FWP-7 or the engineered safeguard buses. This is the currently effective PSA model for Crystal River Unit 3.

E.2.1.7.1 Plant Changes

The plant installed a third emergency diesel generator (EGDG-1C) and removed MTDG-1, which was a dedicated diesel power supply to an auxiliary feed water pump. The new EGDG-1C has the same capability as the safety related emergency power generator. The plant also changed the normal electrical lineup to have the unit buses supplied from the auxiliary transformer, with a fast transfer to startup buses with a turbine or generator trip.

E.2.1.7.2 Event Tree Changes

This PSA model revision did not require any changes to the event trees.

E.2.1.7.3 Fault Tree Model

The major changes this PSA model revision included added EGDG-1C to the model, changing the lineup of the 4160KV buses from normally powered from the 230KV switchyard to the Auxiliary Transformer, and removing the MTDG-1 from the model. These changes are discussed in detail below. Other changes in the fault tree were minor such as breaking some emergency feed water modules up into the individual basis events.

Emergency Generator

- Added EGV-73, EGV-78, AHF-172 and AHF-173
- Added EGDG-1C
- Added EGDG-1C system components
- Added Top Gate A851
- Added EGDG-1C to HVAC System Dependencies
- Added ADGEG1CM
- Added ALBEG1CF, ATKEG3AG, ATKEG3BG, AXVEG88K
- Removed Air Intake Failures because it is not a credible failure.
- Added ADGEG1CF, ACB3245R, ATKDFT5J
- Added ADGEG1CA ACVD136N, ASVEG89N, ASVEG93N
- Added Solenoid Valves (EGV-89 and 93) Fail to Open
- Added Check Valves (DFV-23, 24 and 136) Fail to Open
- Added AHUEG1CY and AHUMT2HY
- Deleted ACVDF23N, ACVDF24N, ACC2324N, ACVDF31N, and ACVDF39N. These were deleted because it was determined that these check valves are inside the EDG component boundary and thus failures would be double counted.

Air Handling

- Added, J801, J801_C
- Added AHF-172, AHF-173
- Added JFNA172M, JFNA173M
- Added JFNA172F, JFNA173F
- Added JFNA172A, JFNA173A
- Added JCC7273A, JCC7273F
- Added AHF-172, AHF-173

AC Power

- Added A832. Deleted A801
- Added A801, A801_C
- Added ADGEG1CM
- Added ACB3245R
- Deleted MTDG-1
- Deleted AHUMTDGY
- Added 4160V AAC Aux. Bus 3

DC Power (attachment 8)

- Added DPDP-11
- Added DPDP-11, DFU1C21R, DCD1C21R

E.2.1.7.4 New System Models

No new systems models were added, but the EGDG-1C was a significant revision to the AC power and EDG system models.

E.2.1.7.5 Initiating Event Fault Tree Models

No changes required to the initiating event fault tree models this PSA model revision.

E.2.1.7.6 Initiating Event Update

No changes required to the initiating events this PSA model revision.

E.2.1.7.7 Initiating Event Data Update

No changes required to the initiating event data this PSA model revision.

E.2.1.7.8 Component Reliability Data Update

Additional component reliability data added to reflect the deletion of MTDG-1 and the addition of EGDG-1C to the PSA model.

E.2.1.7.9 Human Reliability Analysis

The following changes were made to the HRA in this PSA revision:

Added AHUMT2HY, (Operator fails to start and align EGDG-1C to bus MTSW-2H to support power to 4160 VAC ES Bus 3B). This supports use of new diesel generator to support ES bus loads.

Added AHUEG1CY, (Operator fails to start EGDG-1C for powering 4160 Reactor Aux. Bus 3). This supports the use of the new diesel generator.

Revised AHUEGDGY, (Operator fails to manually start EDG)

Deleted AHUMTDGY, (Operators fail to start MTDG to support powering FWP-7 during loss of off-site power). The MTDG has been removed and replaced by the more capable EGDG-1C and thus this HRA is replaced with the HRAs listed above.

E.2.1.7.10 Level II Analysis

This PSA model revision did not require any changes to the Level II analysis.

E.2.2 Current PSA Model of Record

The Crystal River Unit 3 PSA model of record (MOR 2006) was completed in April 2006. The SAMA analysis is based upon this PSA model. The changes incorporated into this model are discussed above. The risk insights from this model are discussed below.

E.2.2.1 MOR 2006 Results

The core damage frequency (CDF) for CR3 PSA MOR 2006 is 4.99E-06. This CDF is lower than other similar units. The reasons for the lower CDF are as follows:

- Byron Jackson N-9000 Reactor Coolant Pump (RCP) seals are installed and are assumed to maintain their integrity as long as they have seal injection, or seal cooling, or the RCPs are tripped. This greatly reduces the likelihood of an RCP seal failure causing LOCA.

- Offsite power is supplied from a 230 kV switchyard that has feeds from the grid and from three fossil plants onsite. CR-3 outputs to a separate 500 kV switchyard. Based on this, dependent loss of offsite power events occurring due to trip initiators is not considered a credible event.

- CR-3 has a third non-safety related diesel that can power an ES bus that adds additional redundancy for loss of offsite power scenarios.

- CR3 emergency diesel generators are not dependent upon a cooling water supply. The EDGs at CR3 are air cooled machines.

- CR-3 maintains a diverse secondary cooling capability, including automatically actuated steam and diesel driven emergency feedwater pumps, a backup motor driven pump powered from the Engineered Safeguards (ES) bus, and a backup motor driven pump that is powered from normal offsite power or the alternate emergency diesel generator.

- CR-3 has three high head injection/makeup pumps each capable of providing adequate primary cooling via the pressurizer power-operated relief valve or pressurizer safety valves at full Reactor Coolant System (RCS) pressure. The High Pressure Injection (HPI) pumps also have diverse support systems. Two of the pumps have backup cooling and one can be powered from either ES 4160 kV bus.

- CR-3 has separate safety-related service water systems for the decay heat removal system and nuclear services support for other systems. The nuclear services system also has a third non-safety related train that can cool normal loads.

- CR-3 has a dedicated chiller installed for 10CFR50 Appendix R (fire) considerations that is not dependent on service water.

The contribution to core damage (4.99E-06) due to initiating events shows that five initiators contribute around 65% of the CDF. These are small LOCAs (31%), Reactor Vessel rupture (10%), transients (9%), steam generator tube rupture (7%) and internal flooding (8%).

The small LOCAs dominate because the large number of mitigation systems required for preventing core damage. The vessel rupture is a single event fault. The transients include reactor trips, loss of feed water, and over feed events. As discussed above, the Crystal River site has two separate switchyards, a loss of both switchyards is required to cause a plant trip and de-energize offsite power sources. Thus the contribution to core damage due to a loss of offsite power is only 6%. The complete depiction of CDF contributions grouped by initiating events is shown in Figure E.2.1.

Figure E.2.2 displays the various systems importance impacting core damage frequency for the CR3 2006 MOR using the Fussell-Vesely measure.

E.2.2.2 Crystal River Unit 3 Level 2 PSA Model (MOR2006)

The SAMA analysis is based upon the CR3 Model of record developed in 2006 (MOR 2006). This model incorporates the resolution of all of the peer review facts and observations and reflects CR3 as designed and operated up to April 2006.

The Level 2 PRA is based on extending the Level 1 to include containment systems, and assessing the consequences of core damage and containment integrity for each sequence. In order to quantify the models for Level 2 each Level 1 sequence is assigned to a core damage bin (CDB). A resulting plant damage state (PDS) is assigned based on the combination of the CDB and the status of the containment systems for each cutset.

The fault trees are quantified using the PDS top gates and cutsets are generated. The results are CDF cutsets that include PDS flags and cutsets with additional failures due to Level 2 systems failures. The same CDF (level 1) cutset can appear more than once with different PDSs (containment system failures). As a result, the total Level 2 CDF is expected to be greater than the Level 1 result due to additional cutsets. Table E.2-1 provides a summary of the Level 2 results.

As can be seen in Table E.2-2, all of the contribution is coming from SGTR and ISLOCA sequences. Also, Figure E.2-3 shows the Fussell-Vesely importance ranking of the systems for LERF. Since SGTR is the dominant contributor for most large early releases, it is consistent that RCS depressurization, cooldown, and isolation are high.

It should be noted that for the purposes of the Phase 2 SAMA analyses performed in Section E.6, the Level 2 Release Category frequencies were evaluated using cutsets directly from all of the Level 1 accident sequence results. Specifically, each Level 1 cutset was appended with a PDS flag event set to 1.0 based on the particular accident scenario and plant equipment unavailability. Then, the contribution to CDF for each PDS flag (Fussell-Vesely value) was further multiplied by a split fraction assignment for each particular Release Category defined in Table E.2-3. That is, each PDS may have a certain percentage that applies to several different Release Categories, but all the fractions for each PDS sum to 1.0, which forces the Level 2 CDF to be identical to the Level 1 CDF summation of all PDS frequencies. This method of using pre-defined split fraction assignments for each PDS and corresponding Release Category was adopted to facilitate computation of Level 2 and subsequent Level 3 results using a consistent methodology for all phase 2 SAMAs. The split fraction assignments are based on the MOR2006 PRA model results. The frequency and number of cutsets by sequence that contribute to LERF are listed in Table E.2-2.

E.2.2.3 PSA Model of Record 2006 Summary

The sequences leading to core damage are dominated by small LOCAs with failures during the recirculation phase. As expected for a plant with significant redundancy and diversity of mitigating systems, human error is a significant contributor to the overall risk profile of the plant, with such errors appearing in 70% of the core damage sequences.

Operator actions account for about 70 percent of the overall CDF. This significant contribution is not unexpected, given the redundancy and diversity of the important mitigating systems at CR3, especially secondary cooling and backup diesel generator capabilities. Significant operator actions include initiating HPI recirculation, aligning EFW water sources, starting the chilled water, and starting FWP-7.

The LERF results are dominated by steam generator tube rupture (SGTR) and interfacing systems LOCA scenarios, which account for over 99% of the LERF. Again, human error in responding to the SGTR is a significant contributor to these sequences. Component failures have only a minimal impact on LERF.

Using a combination of the characteristics, MAAP analysis results for CR3, and engineering judgment, a set of release category definitions were developed for each containment end state grouping. Table E.2-3 lists each release category and related assumptions. The release categories that have been determined to apply to LERF are listed in Table E.2-4.

Although the same PRA model was used as the model-of-record (MOR2006) for quantification of the proposed Phase 2 SAMAs, the reported base value for CDF

(4.95E-6) was slightly different due to the SAMA quantifications being performed at a higher truncation limit of 1E-11 for a more efficient evaluation of multiple PRA model changes. The model-of-record result for CDF (4.99E-6) was performed at a truncation of 1E-12, which would tend to yield a slightly higher value for CDF. Additionally, two different yet valid methods of quantification were used. The model-of-record results were produced using EOOS software and the SAMA quantifications were performed using PRAQUANT software. In using PRAQUANT, each of the core damage accident sequences were individually quantified to retain plant damage states in order to account for all Level 2 release categories. At any event, the important aspect to note is that all SAMA calculations made use of the same method of quantification so that the relative cost difference between proposed SAMAs and the base MMACR value were kept consistent to give an appropriate relative basis for comparison.

With regard to future PSA model updates, Crystal River 3 anticipates pursuing a total extended power uprate (EPU) of approximately 17% in three phases following submittal of license renewal documentation. However, the risk model used to identify potential SAMAs and their associated cost-benefit is based on the 2006 Model of record (MOR 2006) and associated rated power level. The details and modifications necessary for implementation of this EPU were not available at the time this evaluation was performed, therefore, no attempt was made to revise the risk model to avoid assumptions and modeling changes that might be subject to change following submittal of the SAMA analysis in support of license renewal activities. As a result, it is argued that the design basis of Crystal River 3 and the success criteria for EPU conditions will still be preserved at the higher power level in order to adequately mitigate postulated accident scenarios in the same manner as for the current licensed power level, which implies that the current risk model is an adequate tool for estimating those cost-beneficial SAMAs that warrant further evaluation and implementation to support plant operation beyond the original 40-year operating license. It is certainly anticipated that any necessary revisions and enhancements following submission of the license renewal documentation will be available for further analysis when the details of plant modifications in support of the EPU are designed and approved.

E.3 LEVEL 3 RISK ANALYSIS

This section addresses the critical input parameters and analysis of the Level 3 portion of the risk assessment. In addition, Section E.7.3 summarizes a series of sensitivity evaluations to potentially critical parameters.

E.3.1 Analysis

The MACCS2 code (NRC 1998a) was used to perform the level 3 probabilistic risk assessment (PRA) for Crystal River Nuclear Power Plant (CRNPP). The input parameters given with the MACCS2 “Sample Problem A,” which included the NUREG-1150 food model (NRC 1989), formed the basis for the present analysis. These generic values were supplemented with parameters specific to CRNPP and the surrounding area. Site-specific data included population distribution, economic parameters, and agricultural production. Parameters describing the costs of evacuation, relocation and decontamination were escalated from the time of their formulation (1986) to more recent (February 2007) costs. Plant-specific release data included the time-activity distribution of nuclide releases and release frequencies. The behavior of the population during a release (evacuation parameters) was based on plant and site-specific set points (i.e., declaration of a General Emergency) and evacuation time estimates (PROGRESS 2006). These data were used in combination with site specific meteorology to simulate the probability distribution of impact risks (exposure and economic) to the surrounding (within 50 miles) population from the 11 evaluated accident sequences at CRNPP.

E.3.2 Population

The population surrounding the CRNPP site is estimated for the year 2036.

The population distribution was based on the 2000 census as accessed by SECPOP2000 (NRC 2003). The baseline population was determined for each of 160 sectors, consisting of the sixteen directions for each of ten concentric distance rings with outer radii at 1, 2, 3, 4, 5, 10, 20, 30, 40 and 50 miles surrounding the site. County population growth estimates were applied to year 2000 census data to develop year 2036 population distribution.

The total year 2036 population for the 160 sectors (10 distances × 16 directions) in the region is estimated at 1,799,414. The distribution of the population is given for the 10-mile radius from CRNPP and for the 50-mile radius from CRNPP in Tables E.3-1 and E.3-2, respectively.

E.3.3 Economy and Agriculture

MACCS2 requires the spatial distribution of certain agriculture and economic data (fraction of land devoted to farming, annual farm sales, fraction of farm sales resulting from dairy production, and property value of farm and non-farm land) in the same manner as the population. This was done by applying the data from the 2002 National Census of Agriculture (USDA 2004) for each of the 10 counties surrounding the plant, to a distance of 50 miles. The value used for each of the 160 sectors was then the data from each of the surrounding counties multiplied by the fraction of that county's area that lies within that sector. The land fraction (i.e., one minus water fraction) was analogously calculated for each sector as the sum of the individual county component areas divided by the sector area. Crop production parameters (e.g., fraction of farmland devoted to grains, vegetables, etc.) for the 50-mile region were also calculated from the county production data. Non-farm land property values were taken from reference (FDR 2006).

In addition, generic economic data that is applied to the region as a whole were revised from the MACCS2 sample problem input in order to account for cost escalation since 1986, the year that input was first specified. A factor of 1.85 (USDL 2007), representing cost escalation from 1986 to February 2007 was applied to parameters describing cost of evacuating and relocating people, land decontamination, and property condemnation. Region-wide wealth data (i.e., farm wealth and non-farm wealth) was calculated for the 50-miles surrounding the site. Farm wealth was determined from the 2002 National Census of Agriculture county data describing the value of farm lands, buildings and machinery (USDA 2004); the portion of each county within 50-miles of the site was considered. Non-farm wealth was derived from 2005 property tax valuations (FDR 2006). Both of the region-wide wealth descriptors were escalated to February 2007.

CRNPP MACCS2 economic parameters include the following:

CRNPP MACCS2 Economic Parameters

Variable	Description	CRNPP Value
DPRATE(1)	Property depreciation rate (per yr)	0.2
DSRATE(1)	Investment rate of return (per yr)	0.12
EVACST(2)	Daily cost for a person who has been evacuated ($/person-day)	49.87
POPCST(2)	Population relocation cost ($/person)	9234.31
RELCST(2)	Daily cost for a person who is relocated ($/person-day)	49.87
CDFRM0(2)	Cost of farm decontamination for various levels of decontamination ($/hectare)	1038.86 2308.50
CDNFRM(2)	Cost of non-farm decontamination per resident person for various levels of decontamination ($/person)	5540.58 14774.89
DLBCST(2)	Average cost of decontamination labor ($/man-year)	64640.15

VALWF0[3]	Value of farm wealth ($/hectare)	9760.82
VALWNF[3]	Value of non-farm wealth ($/person)	71498.14

(1) DPRATE and DSRATE are based on NUREG/CR-4551 value (NRC 1990).
(2) These parameters for CRNPP use the NUREG/CR-4551 value (NRC 1990), updated to the Feb 2007 CPI value.
(3) VALWF0 and VALWNF are based on 2002 National Agriculture Census and 2005 Real Property Assessments, respectively, updated to the Feb 2007 CPI value.

E.3.4 Nuclide Release

The core inventory corresponds to the end-of-cycle values for CRNPP operating at 2568 MWt (FRAMATOME 2000). Table E.3-3 gives the estimated CRNPP core inventory.

CRNPP nuclide release categories are related to the MACCS2 categories as shown in Table E.3-4. The containment building dimensions, 44 meters in diameter and 53 meters high (Reference 8), were used to specify building wake parameters. Releases were modeled as occurring at ground level except that sequence RC4C, a steam generator tube rupture event, release was modeled from 39.5' high building vents with building dimensions of 96' x 196.5'. The thermal content of each of the releases was assumed to be the same as ambient, i.e., buoyant plume rise was not modeled. Each of these assumptions was considered in sensitivity analyses, presented Section E.7.3.

Release frequencies, nuclide release fractions (of the core inventory), shown in Table E.3-6, and the time distribution of the release (described in the table for noble gases and Cs) were analyzed to determine the sum of the exposure (50-mile dose) and economic (50-mile economic costs) risks from 11 accident sequences (also given in Table E.3-6). Each accident frequency was chosen to represent the set of similar accidents. CRNPP nuclide release categories, as determined by the MAAP computer code, were related to the MACCS2 categories as shown in Table E.3-7. Multiple release duration periods were defined which represented the time distribution of each category's releases. Release inventories of each of the multiple chemical forms of the Cs and Te releases, as given by the MAAP code output, were incorporated into the nuclide release fractions.

A final aspect to consider is the magnitude and timing of the radionuclide releases. Multiple release duration periods were defined which represented the time distribution of each category's releases. Release inventories of each of the multiple chemical forms of the Cs and Te releases were available from the MAAP code output. Representative MAAP cases for each of the release categories were chosen based on a review of the Level 2 model cutsets and the dominant types of scenarios that contributed to the results. A brief description of each of those MAAP cases is provided in Table E.3-5, and a summary of the release magnitude and timing for those cases is provided in Table E.3-6.

E.3.5 Evacuation

Reactor trip for each sequence was taken as time zero relative to the core containment response times. A General Emergency is declared when plant conditions degrade to the point where it is judged that there is a credible risk to the public; it was assumed here that the declaration would coincide with the onset of core damage. The following table shows the resulting declaration times.

General Emergency Declaration Times (hours from reactor trip)

Sequence	IC1	RC1	RC1A	RC1B	RC1AB	RC2
G.E. Time	8.9	11.1	8.6	1.4	1.4	1.3
Sequence	RC2B	RC3	RC3B	RC4C	RC5C	
G.E. Time	11.1	1.3	1.4	11.3	.73	

The MACCS2 User's Guide input parameters of 95 percent of the population within 10 miles of the plant (Emergency Planning Zone, EPZ) evacuating and 5 percent not evacuating were employed. These values are conservative relative to the NUREG-1150 study, which assumed evacuation of 99.5 percent of the population within the Emergency Planning Zone (NRC 1989).

The evacuees are assumed to begin evacuation 30 minutes after a general emergency has been declared at a base evacuation radial speed of 1.08 m/sec. This base speed is derived from the time to evacuate the entire EPZ under adverse weather conditions for 1990, the year of the evacuation study (PROGRESS 2006). The base evacuation speed was projected to year 2036 conditions by conservatively assuming that all of the roads in 1990 transported traffic at their maximum throughput and that no new roads would be constructed (although the roads would be maintained at 1990 conditions). The 2036 evacuation speed was then the 1990 speed multiplied by the ratio of 1990 (PROGRESS 2006) to 2036 EPZ (10-mile) populations. That estimated 2036 evacuation speed, 0.48 m/sec, was used in the risk analysis. The evacuation speed was considered further in the sensitivity analyses presented in the Section E.7.3.

E.3.6 Meteorology

Annual sequential hourly meteorology onsite data sets from 2003 through 2006 were investigated for use in MACCS2. At the time of this study, 2006 data was available through November; December 2002 data was appended to the January-November 2006 data to create a pseudo-2006 data set. Of the hourly data points of interest (10-meter wind speed, 10-meter wind direction, multi-level temperatures used to simulate stability class, and precipitation), less than 2% of the data were missing for 2003-2006, respectively. Data gaps were filled in by (in order of preference): using corresponding data from another level (taking the relationship between the levels as determined from immediately preceding hours), interpolation (if the data gap was less than 4 hours), or using data from the same hour and a nearby day of a previous year.

The 2004 data set was found to result (see Section E.7.3 for discussion of sensitivity analysis) in the largest economic cost risk and was within 0.3% of the maximum dose risk. Given that it was also the most complete data set, the 2004 hourly sequential meteorology was used to create the one-year sequential hourly data set used in the baseline MACCS2 runs. The 10-meter wind speed and direction were combined with precipitation and atmospheric stability (specified according to the vertical temperature gradient as measured between the 53- and 10-meter levels) to create the hourly data. Hourly stability was classified according to the scheme used by the NRC (NRC 1983).

Atmospheric mixing heights were specified for AM and PM hours for each season of the year. These values ranged from 280 meters for Fall AM to 1800 meters for Summer PM (EPA 1972).

E.3.7 MACCS2 Results

Table E.3-7 shows the mean off-site doses and economic impacts to the region within 50 miles of CRNPP for each of eleven release categories calculated using MACCS2. The mean off-site dose impacts are multiplied by the annual frequency for each release category and then summed to obtain the dose-risk and offsite economic cost-risk (OECR) for each unit. Table E.3-7 provides these results.

E.4 BASELINE RISK MONETIZATION

This section explains how CRNPP calculated the monetized value of the status quo (i.e., accident consequences without SAMA implementation). CRNPP also used this analysis to establish the maximum benefit that could be achieved if all on-line CRNPP risk were eliminated, which is referred to as the Maximum Averted Cost-Risk (MACR).

Section E.4.6 summarizes the results for these cases.

E.4.1 Off-Site Exposure Cost

The baseline annual off-site exposure risk was converted to dollars using the NRC's conversion factor of $2,000 per person-rem, and discounted to present value using NRC standard formula (NRC 1997):

$$W_{pha} = C \times Z_{pha}$$

Where:

W_{pha} = monetary value of public health accident risk after discounting

C = $[1-\exp(-rt_f)]/r$

t_f = years remaining until end of facility life = 20 years

r = real discount rate (as fraction) = 0.03 per year

Z_{pha} = monetary value of public health (accident) risk per year before discounting ($ per year)

The Level 3 analysis showed an annual off-site population dose risk of 3.79 person-rem. The calculated value for C using 20 years and a 3 percent discount rate is approximately 15.04. Therefore, calculating the discounted monetary equivalent of accident dose-risk involves multiplying the dose (person-rem per year) by $2,000 and by the C value (15.04). The calculated off-site exposure cost is $113,979 per person.

E.4.2 Off-Site Economic Cost Risk

The Level 3 analysis showed an annual off-site economic risk of $6,624. Calculated values for off-site economic costs caused by severe accidents must be discounted to present value as well. This is performed in the same manner as for public health risks and uses the same C value. The resulting value is $99,622.

E.4.3 On-Site Exposure Cost Risk

Occupational health was evaluated using the NRC recommended methodology that involves separately evaluating immediate and long-term doses (NRC 1997).

For immediate dose, the NRC recommends using the following equation:

Equation 1:

$$W_{IO} = R\{(FD_{IO})_S - (FD_{IO})_A\}\{[1 - \exp(-rt_f)]/r\}$$

Where:

W_{IO} = monetary value of accident risk avoided due to immediate doses, after discounting

R = monetary equivalent of unit dose ($2,000 per person-rem)

F = accident frequency (events per year) (4.95E-06 (total CDF))

D_{IO} = immediate occupational dose [3,300 person-rem per accident (NRC estimate)]

$_S$ = subscript denoting status quo (current conditions)

$_A$ = subscript denoting after implementation of proposed action

r = real discount rate (0.03 per year)

t_f = years remaining until end of facility life (20 years).

Assuming F_A is zero, the best estimate of the immediate dose cost is:

$$W_{IO} = R\,(FD_{IO})_S\{[1 - \exp(-rt_f)]/r\}$$

$$= 2{,}000 * 4.95\text{E-}06 * 3{,}300 * \{[1 - \exp(-0.03 * 20)]/0.03\}$$

$$= \$491$$

For long-term dose, the NRC recommends using the following equation:

Equation 2:

$$W_{LTO} = R\{(FD_{LTO})_S - (FD_{LTO})_A\}\{[1 - \exp(-rt_f)]/r\}\{[1 - \exp(-rm)]/rm\}$$

Where:

W_{LTO} = monetary value of accident risk avoided long-term doses, after discounting, $

D_{LTO} = long-term dose [20,000 person-rem per accident (NRC estimate)]

m = years over which long-term doses accrue (as long as 10 years)

Using values defined for immediate dose and assuming F_A is zero, the best estimate of the long-term dose is:

W_{LTO} = R $(FD_{LTO})_S$ {[1 – exp(-rt$_f$)]/r} {[1 – exp(-rm)]/rm}

= 2,000∗4.95E-06∗20,000∗{ [1 – exp(-0.03∗20)]/0.03} {[1 –exp(-0.03∗10)]/0.03∗10}

= $2,571

The total occupational exposure is then calculated by combining Equations 1 and 2 above. The total accident related on-site (occupational) exposure risk (W_O) is:

W_O = W_{IO} + W_{LTO} = ($491 + $2,571) = $3,062 person-rem

E.4.4 On-Site Cleanup and Decontamination Cost

The total undiscounted cost of a single event in constant year dollars (C_{CD}) that NRC provides for cleanup and decontamination is $1.5 billion (NRC 1997). The net present value of a single event is calculated as follows. NRC uses the following equation to integrate the net present value over the average number of remaining service years:

$$PV_{CD} = [C_{CD}/mr][1-\exp(-rm)]$$

Where:

PV_{CD} = net present value of a single event

C_{CD} = total undiscounted cost for a single accident in constant dollar years

r = real discount rate (0.03)

m = years required to return site to a pre-accident state

The resulting net present value of a single event is \$1.3E+09. The NRC uses the following equation to integrate the net present value over the average number of remaining service years:

$$U_{CD} = [PV_{CD}/r][1\text{-}exp(-rt_f)]$$

Where:

PV_{CD} = net present value of a single event (\$1.3E+09)

r = real discount rate (0.03)

t_f = 20 years (license renewal period)

The resulting net present value of cleanup integrated over the license renewal term, \$1.95E+10, must be multiplied by the total CDF (4.95E-06) to determine the expected value of cleanup and decontamination costs. The resulting monetary equivalent is \$96,414.

E.4.5 Replacement Power Cost

Long-term replacement power costs were determined following the NRC methodology in NRC 1997. The net present value of replacement power for a single event, PV_{RP}, was determined using the following equation:

$$PV_{RP} = [\$1.2\times10^8/r] * [1 - exp(-rt_f)]^2$$

Where:

PV_{RP} = net present value of replacement power for a single event, (\$)

r = 0.03

t_f = 20 years (license renewal period)

To attain a summation of the single-event costs over the entire license renewal period, the following equation is used:

$$U_{RP} = [PV_{RP} /r] * [1 - exp(-rt_f)]^2$$

Where:

U_{RP} = net present value of replacement power over life of facility (\$-year)

After applying a correction factor to account for CRNPP's size relative to the "generic" reactor described in NUREG/BR-0184 (NRC 1997) (i.e., 903 megawatt electric / 910 megawatt electric, the replacement power costs are determined to be 5.48E+09 ($-year). Multiplying 5.48E+09 ($-year) by the CDF (4.95E-06) results in a replacement power cost of $27,123.

E.4.6 Total Cost-Risk

The calculations presented in Sections E.4-1 through E.4-5 provide the on-line, internal events-based MACR. Given that the CRNPP SAMA analysis is performed on a site basis and must consider the external events contributions, further steps are required to obtain a site-based maximum averted cost-risk estimate that accounts for external events. This estimate, which is referred to as the Modified Maximum Averted Cost-Risk (MMACR) is calculated according to the following steps:

1. For presentation purposes, round MACR to the next highest thousand,
2. Multiply rounded MACR from the previous step by a factor of 2 to account for External Events contributions (refer to Section E.5.1.8 for additional details related to the basis for this factor) to obtain the MMACR.

The following table summarizes the results of this process.

CRNPP MMACR DEVELOPMENT SUMMARY

Input	Unit 3
CDF (per year)	4.95E-06
Dose-Risk (person-REM, single year)	3.79
OECR ($/yr)	6,624
Plant Net MWe	903
Output	
Offsite Exposure Cost-Risk	$113,979
Offsite Economic Cost-Risk	$99,622
Onsite Exposure Cost-Risk	$3,062
Onsite Cleanup Cost-Risk	$96,414
Replacement Power Cost-Risk	$27,123
Total Unit MACR	$340,200
Rounded to Next Highest Thousand	$341,000
Site MMACR (Includes External Events (MACR x 2))	**$682,000**

E.5 PHASE 1 SAMA ANALYSIS

The Phase 1 SAMA analysis, as discussed in Section E.1, includes the development of the initial SAMA list and a coarse screening process. This screening process eliminated those candidates that are not applicable to the plant's design or are too expensive to be cost beneficial even if the risk of on-line operations were completely eliminated. The following subsections provide additional details of the Phase 1 process.

E.5.1 SAMA Identification

The initial list of SAMA candidates for CRNPP was developed from a combination of resources. These include the following:

- CRNPP PRA results and PRA Group Insights
- Industry Phase 2 SAMAs (review of the potentially cost effective Phase 2 SAMAs for selected plants)
- CRNPP Individual Plant Examination IPE (CRNPP IPE) (FPC 1993)
- CRNPP IPEEE (FPC 1997)

These resources are judged to provide a list of potential plant changes that are most likely to reduce risk in a cost-effective manner for CRNPP.

In addition to the "Industry Phase 2 SAMA" review identified above, an industry based SAMA list was used in a different way to aid in the development of the CRNPP plant specific SAMA list. While the industry Phase 2 SAMA review cited above was used to identify SAMAs that might have been overlooked in the development of the CRNPP SAMA list due to PRA modeling issues, a generic SAMA list was used to help identify the types of changes that could be used to address the areas of concern identified through the CRNPP importance list review. For example, if Instrument Air availability was determined to be an important issue for CRNPP, the industry list would be reviewed to determine if a plant enhancement had already been conceived that would address CRNPP's needs. If an appropriate SAMA was found to exist, it would be used in the CRNPP list to address the Instrument Air issue; otherwise, a new SAMA would be developed that would meet the site's needs. This generic list was compiled as part of the development of multiple industry SAMA analyses and has been provided in Addendum 1 for reference purposes.

It should be noted that the process used to identify CRNPP SAMA candidates focuses on plant specific characteristics and is intended to address only those issues important to the site. In this case, the existing capabilities of the plant preclude the need to include many of the potential SAMAs that have been identified for other PWRs. As a result, the types of changes that might be cost effective for CRNPP are reduced and the SAMA list is relatively short. For example, the following list shows some of the options that were considered:

- Improve procedures for manual operation of EFW discharge valves upon failure of the EFIC system.
- Proceduralize actions to manually align makeup injection valves given their failure to remotely open for high pressure injection.
- Provide for automatic switchover from injection of borated water from the BWST to RB sump recirculation during LOCA scenarios.
- Automate start of Auxiliary Feedwater Pump FWP-7 when required.

The fact that the CRNPP SAMA list is relatively small compared with previous SAMA submittals is due to the fact that the calculated averted cost risks were also relatively small. The CDF for CRNPP is on the order of 5E-6, which is considerably lower in comparison with other PWRs.

E.5.1.1 Level 1 CRNPP Importance List Review

The CRNPP PRA was used to generate a list of events sorted according to their risk reduction worth (RRW) values. The top events in this list are those events that would provide the greatest reduction in the CRNPP CDF if the failure probability were set to zero. The events were reviewed down to the 1.02 level, which approximately corresponds to a 2 percent reduction in the CDF given 100 percent reliability of the event. If the dose-risk and offsite economic cost-risk were also assumed to be reduced by a factor of 1.02, the corresponding averted cost-risk would be about $13,000, which also accounts for the impact of External Events after applying a factor of 2. This estimate is bounded by the dollar amount that would be expected to process a procedural change, i.e., no hardware modification. The lower end of implementation costs for SAMAs are expected to apply to procedural changes, which have previously been estimated to cost about $50,000 (CPL 2004). Given that the CRNPP importance list was reviewed down to a level corresponding to an averted cost-risk of about $13,000, all events that are likely to yield cost beneficial improvements were addressed by this review process.

Table E.5-1 documents the disposition of each event in the Level 1 CRNPP RRW list. Note that no basic events were preemptively screened from the process even if they solely represent sequence flags. Whatever the event, the intent of the process is to determine if insights can be gleaned to reduce the risk of the accident evolutions represented by the events listed. However, unique SAMAs are not identified for all of the events in the RRW list. Previously identified SAMAs are suggested as mitigating enhancements when those SAMAs (or similarly related changes) would reduce the RRW importance of the identified event. It is recognized that in some cases, additional requirements may need to be imposed on the SAMA to get a reduction in the RRW value for the basic event listed. In these cases, if an existing SAMA can approximate such an impact, then it is considered to address the relevant event and provide a first order indication of the potential benefit. If warranted, a more detailed PRA analysis may then be required to provide a better estimate of the actual potential cost-benefit.

E.5.1.2 Level 2 CRNPP Importance List Review

A review of cutsets representing LERF was conducted to determine if any potential SAMA candidates were feasible. The review included those events with a Risk Reduction Worth (RRW) greater than 1.02 with respect to LERF. Table E.5-2 lists those events and corresponding comments. The LERF cutsets were extracted from the PRA model core damage cutsets by means of assigning the Plant Damage State (PDS) flags with a certain fraction that is assigned to LERF for each cutset. The CRNPP PRA model used to generate Level 1 cutsets also contained information regarding the containment status and Level 2 accident phenomena, with each cutset being assigned to a specific PDS. Although there were potential SAMAs identified from reviewing those events important to LERF, they were subsumed by the review done for the Level 1 cutsets, since they were also important to CDF.

In addition, even though Release Categories 3B and 4C were not contributors to LERF, they were large contributors to Level 3 offsite consequences, e.g., person-rem/year. Hence, a review was made to determine if any dominant basic events or components that had not been identified in the Level 1 review should also be included in the Phase 1 SAMA list. As a result, similar to the case describe above for events important to LERF, most items that were dominant contributors to these Release Categories had already been identified in the Level 1 CDF review. Any new events that were considered important (RRW > 1.02) for these two Release Categories that were not previously identified were added to the Phase 1 list in Table E.5-3.

E.5.1.3 CRNPP PRA Group Insights

A review of the current PRA model results and insights was conducted in order to identify any additional risk reduction opportunities that could be examined as potential SAMA improvements. This review did not include potential PRA modeling enhancements (as these changes only result in enhancements to the ability to measure plant risk), but rather plant changes that reduce risk (through hardware modifications, procedural enhancements, operator training improvements, etc.). The review indicated that the large majority of risk reduction opportunities available through implementation of individual plant changes are encompassed by the previously identified listing of SAMA improvements (most of these were identified from the importance list reviews for CDF and LERF based on the current PRA model of record, as described in Sections 5.1.1 and 5.1.2 above). However, the CRNPP PRA staff identified that improvement to the EFIC room cooling analysis would be beneficial in taking credit for operation of equipment and hardware at temperatures in excess of 104 degrees F. This option is identified as SAMA 51 and its cost benefit analyzed in the Phase 2 SAMA Analysis in Section E.6.

E.5.1.4 Industry SAMA Analysis review

The SAMA identification process for CRNPP is primarily based on the PRA importance listings/insights, the IPE, and the IPEEE. In addition to these plant specific sources, selected industry SAMA analyses were reviewed to identify any potential Phase 1 SAMAs that were determined to be potentially cost beneficial at other plants. A review of selected industry SAMAs may capture potentially important changes not identified for CRNPP due to PRA modeling differences. Given this potential, it was considered prudent to include a review of selected industry SAMAs in the CRNPP SAMA identification process. These SAMAs were then included in the CRNPP Phase 1 SAMA list to determine cost estimates and whether they were potentially cost beneficial for CRNPP.

While many of these SAMAs are ultimately shown not to be cost beneficial, some are close contenders and a small number have been shown to be cost beneficial at other plants. Most of the industry SAMAs reviewed were not included in the CRNPP SAMA list. However, some industry SAMAs that were considered to have the potential to be cost effective for CRNPP were already independently identified through the CRNPP importance list reviews. The remaining industry SAMAs that were added to the Phase 1 list in Table E.5-3 were added to determine whether they should be considered for the Phase 2 analysis.

E.5.1.5 CRNPP IPE Plant Improvement Review

No plant improvements were proposed as a result of any insights gained from the CRNPP IPE analysis (FPC 1993). However, in the initial quantification phase of the IPE, a single-order cutset was found that resulted in the failure of all five raw water pumps due to a loss of flush water supply. As a result, the design of the flush water system to these pumps was modified to include a flush water supply for each pump, thereby reducing the frequency of a loss of all flush water supply to a negligible level.

Also noted in the CRNPP IPE was a unique safety feature that credited “feed and bleed” capability for heat removal of the reactor coolant system for scenarios where feedwater to the steam generators is unavailable. Only one high head makeup pump is necessary for supplying water to the primary system with coolant discharge via either the PORV or one of the safety relief valves.

As a result of reviewing the IPE analysis, no new SAMAs were identified.

E.5.1.6 CRNPP IPEEE Plant Improvement Review

On June 28, 1991, the NRC, via Generic Letter 88-20, Supplement 4 (NRC 1991), requested each utility to perform a risk assessment for external events due to fire, earthquakes, high winds, external floods, as well as transportation and nearby facility accidents. In response to the generic letter, FPC, in December 1991, committed to performing a risk assessment for internal fires only, which was to serve as CR-3's original IPEEE submittal (FPC 1991). In the letter, FPC stated that seismic risk would be sufficiently addressed in the plant-specific response to USI A-46, "Seismic Qualification of Equipment in Operating Plants," and, therefore, no additional seismic risk analysis was warranted.

In Revision 1 of the IPEEE submittal (FPC 1997), CRNPP reported that the external events for high winds, floods, transportation and nearby facility accidents were found to have minimal impact on the overall risk of core damage at CR-3. Using a bounding analysis to assess the impact of tornadoes at CR-3, the core damage frequency contribution was calculated to be 9.2E-08 per year. Using similar methodology, the core damage frequency associated with high winds other than tornadoes was calculated at 1.6E-08 per year. Application of the appropriate standard for evaluation of the hazards associated with external flooding resulted in an estimate of the annual occurrence frequency of the probable maximum hurricane (PMH) coincident with the 10% exceedance high tide which was orders of magnitude below the acceptance criterion of 1E-06 per year. Thus, there are no vulnerabilities at Crystal River 3 due to external flooding. Outside of the potential for inducing a loss of offsite power, which is addressed in the internal events analysis, no other specific vulnerabilities to lightning strikes at CR-3 were found. The frequency of an aircraft striking a category I building at the CR-3 site was calculated to be 1.8E-07 per year using the applicable standard, effectively screening this threat. A review of nearby marine, highway, and rail traffic found their potential contribution to a core damage accident to be negligible. Facilities close to the plant were also examined for their potential to impact the risk of core damage and were found not to pose a hazard. The core damage frequencies calculated for the external events other than fire were not added to the overall core damage frequency due to the bounding nature of the calculations and their relatively low frequencies.

The major contribution to external risk was dominated by the internal fire hazards analysis, which accounted for about 82% of the total external core damage risk. With regard to deficient fire barrier material, only 20 minutes of protection was credited for the one-hour Thermo-Lag fire barrier and one hour of protection for the three-hour Thermo-Lag. This analysis documented the configuration of the plant prior to Refuel 10, which began February 16, 1996.

As a result of reviewing the IPEEE analysis, section E.5.1.7 investigates the inclusion of any possible SAMAs as a result of considering upgraded fire barriers.

E.5.1.7 Use of External Events in the CRNPP SAMA Analysis

The CRNPP IPEEE (FPC 1997) was used to gain insights from the dominant risk contributors and formulate any possible SAMAs that could prove cost beneficial. Since external fires were the dominant risk contributor, a review of the analyzed fire zones was conducted to determine the zone with the highest risk contribution. Upon finding the dominant fire zone, a proposed SAMA was then postulated for further Phase 2 analysis to determine its cost benefit. The methodology used makes use of ratios and relative CDF contributions rather than absolute risk numbers from the IPEEE directly.

The contribution from internal fires to the total core damage frequency due to external events was shown in reference (FPC 1997) to be 82%. Also, from Table 1.4-1 of that same reference, it was found that zone CC-108-106 (Battery Charger Room 3A) was 35.6% of the total fire CDF, which translates to a 29.2% contribution to the entire IPEEE CDF due to all external events. The fire zone with the next highest risk contribution, which is the 4.16 kV Switchgear Bus Room 3A, comprises only 17% of the CDF due to internal fires, which implies just 14% of the total CDF due to external events. At the time the CRNPP IPEEE was performed, it was noted that the fire risk for Battery Charger Room 3B was an order of magnitude less than for Battery Charger Room 3A. The explanation given by plant personnel was that in order to comply with 10 CFR Part 50 Appendix R concerns, the deficient fire barriers, e.g., Thermo Lag, in Battery Charger Room 3B were enhanced in order to protect at least one train of equipment for safe shutdown of the plant, thus not requiring a similar modification for Battery Charger Room 3A.

Therefore, in using the insights gained from review of the CRNPP IPEEE analysis, the option to improve the fire barriers in Battery Charger Room 3A were identified as SAMA 49, with the associated cost benefit analyzed as part of the Phase 2 SAMA Analysis in

Section E.6. Analysis of the highest IPEEE risk contributor provides valuable insight and a measure for the cost benefit that could be used as a benchmark with regard to other external event risk contributors. In other words, if the highest external event risk contributor is only marginally cost beneficial, or not cost beneficial at all, then any other lower risk contributors would not be considered cost beneficial from a SAMA perspective.

E.5.1.8 Quantitative Strategy for External Events

The quantitative methods available to evaluate external events risk at CRNPP are either somewhat limited or outdated. In order to account for the external event contributions in the SAMA analysis, the assumption that the risk posed by external and internal events is approximately equal was imposed to simplify the calculation of averted cost-risk due to contributions from both internal and external event accident scenarios.

Continuing with the assumption that the internal and external events risks are assumed to be equal, the MACR calculated for the internal events model has been doubled to account for external events contributions. As identified in Section E.4.6, this total is referred to as the MMACR. The MMACR is used in the Phase 1 screening process to represent the maximum achievable benefit if all risk related to on-line power operations was eliminated. Therefore, those SAMAs with costs of implementation that are greater than the MMACR were eliminated from further review. The second stage of this strategy was to also apply the doubling factor to the Phase 2 analysis. Any averted cost-risk calculated for a SAMA was multiplied by two to account for the corresponding reduction in external events risk. The difference in the averted cost-risk estimates between the base case and the proposed SAMA were then compared with implementation costs to determine whether a particular SAMA was cost beneficial.

E.5.2 Phase 1 Screening Process

The initial list of SAMA candidates is presented in Table E.5-3. The process used to develop the initial list is described in Section E.5.1.

The purpose of the Phase 1 analysis is to use high-level knowledge of the plant and SAMAs to preclude the need to perform detailed cost-benefit analyses on them. The following screening criteria were used:

- Applicability to the Plant: If a proposed SAMA does not apply to the CRNPP design, it is not retained.
- Engineering Judgment: Using extensive plant knowledge and sound engineering judgment, potential SAMAs are evaluated based on their expected maximum cost

and dose benefits; those that are deemed not beneficial are screened from further analysis.

In general, those cost estimates for individual SAMAs that were believed to be greater than $500,000 were not considered for the Phase 2 analysis and were screened based on the MMACR for the nominal plant configuration being less than $700,000 (see Section E.4.6). Those SAMAs that showed a potential cost benefit based on their implementation costs being less than $500,000 necessitated a more detailed cost-benefit analysis, which was performed in Section E.6.

E.6 PHASE 2 SAMA ANALYSIS

The SAMA candidates identified as part of the Phase 2 analysis are listed in Table E.6-1. The base PRA model was manipulated to simulate implementation of each of the proposed SAMAs and then quantified to determine the risk benefit. In general, in order to maximize the potential risk benefit due to implementation of each of the SAMAs, the failure probabilities assigned to new basic events, such as HEPs, were optimistically chosen so as not to inadvertently screen out any potential cost-beneficial SAMAs. Also, any new model logic that was added to the PRA model in order to simulate SAMA implementation was also simplified and optimistically configured to achieve the same effect.

Determination of the cost-risk benefit for each of the Phase 2 SAMAs involved calculating what was known as the averted cost-risk, which was obtained by comparing the SAMA results with the base case MMACR value. This value is then compared with the cost of implementation to determine the overall net benefit. That is, the net value is determined by the following equation:

Net Value = (baseline cost-risk of plant operation (MMACR) – cost-risk of plant operation with SAMA implemented) – cost of implementation

If the net value of the SAMA is negative, the cost of implementation is larger than the benefit associated with the SAMA and the SAMA is not considered cost beneficial. The baseline cost-risk of plant operation was derived using the methodology presented in Section E.4. The cost-risk of plant operation with the SAMA implemented is determined in the same manner with the exception that the revised PRA results reflect implementation of the SAMA.

The implementation costs used in the Phase 1 and 2 analyses consist of CRNPP specific estimates developed by plant personnel. It should be noted that CRNPP specific implementation costs do include contingency costs for unforeseen difficulties, but do not account for any replacement power costs that may be incurred due to consequential shutdown time. Table E.5-3 provides implementation costs for each Phase 1 and Phase 2 SAMA.

Sections E.6.1 – E.6.15 describe the simplified cost-benefit analysis that was used for each of the Phase 2 SAMA candidates. It should be noted that the release category results provided for each SAMA do not include contributions from the negligible release category.

E.6.1 SAMA 34: Improve Procedures for Manual Operation of EFW Valves

The emergency feedwater (EFW) system provides makeup to the once through steam generators (OTSG) in the absence of the main feedwater (MFW) system. Once actuated, it is controlled by the EFW initiation and control (EFIC) system. The EFW system in standby during power operation and consists of a dedicated EFW tank, three EFW pumps, and valves, piping, and controls required for system operation. Each EFW pump driver is diverse. EFP-2 is a turbine-driven pump. EFP-3 is a diesel-driven pump. Both EFP-2 and EFP-3 respond automatically to an initiation signal. EFP-1 is an electric motor-driven pump that does not initiate automatically, but can be actuated manually. All pumps are 100% capacity.

In addition to the EFW pumps, an auxiliary feedwater (AFW) pump is also present (FWP-7) and can be manually actuated from the control room to provide an additional redundant water makeup source. The supply to this pump is normally from the CST, but it can also take suction from the condenser hotwell. FWP-7 is an electric motor-driven pump. It is powered normally by plant power, but can also be supplied from the EDG-1C diesel generator.

During normal operation, both the EFW and AFW systems are in standby. The discharge valves controlling flow to the OTSGs (EFV-55, EFV-56, EFV-57, and EFV-58) are normally open. During system operation, the EFIC system automatically controls level in the OTSGs, however, if this automatic level control system fails, the operators are then required to take manual control of these valves in order to maintain acceptable steam generator water levels.

Assumptions:

1. For the purposes of this SAMA, it was assumed that a human event probability (HEP) from a nuclear plant of similar design and for a similar purpose could be used as a surrogate probability to simulate adequate procedural guidance with regard to controlling OTSG water level manually. This surrogate HEP value for manual control of the EFW flow control valves was 1.7E-02.

PRA Model Changes to Model SAMA:

The operator recovery action for failure to manually control OTSG water level using the EFW discharge valves was revised from a failure probability of 0.3 to 1.7E-02. The basic event QHUEFWMR was changed from a value of 1.0 to 1.7E-02. In the recovery rules file, the recovery event QHUEFWMZ was commented out so as not to append this event with a non-recovery probability of 0.3 to cutsets containing QHUEFWMR. No other basic events or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded a reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	3.73E-06	3.50	$6,121
Percent Change	24.7%	7.5%	7.6%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.14E-06	2.36E-08	3.89E-10	1.06E-08	6.59E-10	4.65E-10	2.99E-09	9.68E-08	5.32E-08	3.42E-07	5.15E-08	**3.73E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.03	0.00	0.00	0.02	0.00	0.00	0.01	0.03	0.10	2.56	0.74	**3.50**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$20	$1	$4	$23	$6	$230	$4,828	$1,009	**$6,121**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 34 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$587,294	$94,706

The results of the SAMA 34 quantification show a large reduction in the CDF risk metrics for CRNPP, and a corresponding decrease in the frequencies for certain release categories. The release categories that showed the largest decrease in frequency relative to CDF were those categories in which containment failure due to overpressurization resulted due to failure of the OTSGs to remove heat from the reactor coolant system.

Based on a $50,000 cost of implementation for CRNPP, the net value for this SAMA is $44,706 ($94,706 - $50,000), which implies that this SAMA is cost beneficial for reducing plant risk.

E.6.2 SAMA 33: Proceduralize Manual Operation of DHV-42 and DHV-43

Following a LOCA scenario, water that has leaked from the reactor coolant system is collected in the Reactor Building (RB) sump. This provides a source of water that can be reused, or recirculated, back into the RCS system via use of the Decay Heat Removal (DHR) system. The operators are required to switch the suction of the low head Decay Heat pumps from the Borated Water Storage Tank (BWST) to the RB sump by remotely operating motor-operated valves (MOVs). However, if remote operation fails, this particular SAMA provides for local operation of the valves to effect realignment of the suction source for recirculation of the reactor coolant contained in the RB sump. This proposed SAMA postulates procedure changes and operator training to attempt mitigation of this type of MOV failure mode for the DHR system.

To simulate implementation of this particular SAMA, a new HEP event was created with the same failure rate as a previously existing HEP (LHULPRCY). The HEP event LHULPRCY that already exists within the model represents failure of the operators to switch to RB sump recirculation before the BWST empties. This SAMA makes use of a new HEP, which was named LHSAMA33 and assigned the same probability as for LHULPRCY, which was 2.5E-02. To maximize the potential benefit this SAMA may have, no joint HEP (JHEP) analysis was performed to account for dependent HEP failures associated with implementing this SAMA.

<u>Assumptions:</u>

1. For the purposes of this SAMA, it is assumed that the new HEP involved with manual operation of valves DHV-42 and DHV-43 is the same failure probability as that involving the existing HEP with switching the DHR system to RB sump recirculation before the BWST empties.

2. The new HEP that simulates implementation of this SAMA is assumed to be independent of any other HEP events within the PRA model. This will tend to maximize the potential risk benefit that would be realized by this SAMA.

<u>PRA Model Changes to Model SAMA:</u>

For valve DHV-43, a new AND gate was created with the label LMMDV43F-1 that contains the following inputs: Original OR gate LMMDV43F and new HEP event LHSAMA33. Gate LMMDV43F-1 was then used as an input to the same gates for which gate LMMDV43F was originally used, namely gates LS257, I015, L156, and L356. Similarly, for valve DHV-42, a new AND gate was created with the label LMMDV42F-1 that contains the following inputs: Original OR gate LMMDV42F and new HEP event LHSAMA33. Gate LMMDV42F-1 was then used as an input to the same gates for which gate LMMDV42F was originally used, namely gates LS258, I014, L155, and L355. No other logic or fault tree structures were affected.

The table below shows the new basic event and its probability that were included in the PRA model to represent this SAMA implementation:

SAMA 33 New Basic Event

Basic Event	Description	Probability	Comments
LHSAMA33	OPERATORS FAIL TO MANUALLY OPEN DHV-42/43	2.5E-02	Assumes same unavailability as HEP event LHULPRCY

Results of SAMA Quantification:

Implementation of this SAMA yielded a reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.66E-06	3.78	$6,616
Percent Change	5.7%	0.3%	0.1%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.83E-06	2.19E-08	4.36E-10	1.56E-08	1.24E-09	8.44E-10	3.12E-09	2.39E-07	1.57E-07	3.44E-07	5.13E-08	**4.66E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.78**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$0	$0	$29	$2	$7	$24	$15	$678	$4,856	$1,005	**$6,616**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 33 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$666,616	$15,384

The SAMA 33 results indicate a small reduction in CDF with negligible changes in dose-risk and offsite economic consequences. Even though the cost of implementation is only $50,000, the net value for this SAMA is -$34,616 ($15,384 - $50,000), which implies that this SAMA is not cost beneficial.

E.6.3 SAMA 9: Proceduralize additional responses to DHV-11 and DHV-12 Failures

In the CRNPP PRA model, the low head DHR pumps provide the necessary NPSH for the high head makeup pumps during high pressure recirculation scenarios. There is insufficient NPSH for the makeup pumps to draw suction directly from the RB sump, therefore, valves DHV-11 and DHV-12 are the valves that must be opened in order for the DHR system to supply water from the RB sump to the suction of the makeup pumps for high pressure recirculation of primary coolant.

Similar to what was done for SAMA 33 above, a new HEP event, which was named LHSAMA09, was assigned the same probability as for LHULPRCY, namely 2.5E-02. This new HEP represents failure of the operators to mitigate failure of valves DHV-11 and DHV-12 to remotely open. To maximize the potential benefit this SAMA may have, no JHEP analysis was performed to account for dependent HEP failures associated with implementing this SAMA.

Assumptions:

1. For the purposes of this SAMA, it is assumed that the new HEP involved with manual operation of valves DHV-11 and DHV-12 is the same failure probability as that involving the existing HEP with switching the DHR system to RB sump recirculation before the BWST empties.

2. The new HEP that simulates implementation of this SAMA is assumed to be independent of any other HEP events within the PRA model. This will tend to maximize the potential risk benefit that would be realized by this SAMA.

PRA Model Changes to Model SAMA:

For valve DHV-11, a new AND gate was created with the label LMMDV11F-1 that contains the following inputs: Original OR gate LMMDV11F and new HEP event LHSAMA09. Gate LMMDV11F-1 was then used as an input to the same gate for which gate LMMDV11F was originally used, namely gate LH311. Similarly, for valve DHV-12, a new AND gate was created with the label LMMDV12F-1 that contains the following inputs: Original OR gate LMMDV12F and new HEP event LHSAMA09. Gate LMMDV12F-1 was then used as an input to the same gate for which gate LMMDV12F was originally used, namely gate LH314. No other logic or fault tree structures were affected.

The table below shows the new basic event and its probability that were included in the PRA model to represent this SAMA implementation:

SAMA 9 New Basic Event

Basic Event	Description	Probability	Comments
LHSAMA09	OPERATORS FAIL TO MANUALLY OPEN DHV-11/12	2.5E-02	Assumes same unavailability as HEP event LHULPRCY

Results of SAMA Quantification:

Implementation of this SAMA yielded a reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.66E-06	3.78	$6,610
Percent Change	5.9%	0.4%	0.2%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.82E-06	2.19E-08	4.36E-10	1.56E-08	1.23E-09	8.42E-10	3.12E-09	2.39E-07	1.57E-07	3.44E-07	5.13E-08	**4.66E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.78**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$0	$0	$29	$2	$7	$24	$15	$678	$4,849	$1,005	**$6,610**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 9 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$665,872	$16,128

The SAMA 9 results indicate a small reduction in CDF with negligible changes in dose-risk and offsite economic consequences. Even though the cost of implementation is only $50,000, the net value for this SAMA is -$33,872 ($16,128 - $50,000), which implies that this SAMA is not cost beneficial.

E.6.4 SAMA 10: Proceduralize additional responses to MUV-23, MUV-24, MUV-25, and MUV-26 Failures

In the CRNPP PRA model, there are four MOVs in the high pressure injection lines from the makeup pumps that are required to open in order to inject water from the BWST into the reactor coolant system given a LOCA scenario. These MOVs are identified as MUV-23, -24, -25, and -26. This SAMA is intended to proceduralize recovery actions for the operator in the event that there is some type of common mode failure of all four MOVs that inhibit water from being injected into the RCS. This proposed SAMA postulates procedure changes and operator training to attempt mitigation of this type of MOV failure mode for the Makeup system.

To model implementation of this SAMA in the PRA, a new level of logic was inserted above the currently existing gate that models each of the MOV failures consisting of an AND gate with a newly defined HEP event named HHSAMA10 for operator failure to manually open these injection valves.

Assumptions:

1. For the purposes of this SAMA, it was assumed that the new HEP involved with manual operation of valves MUV-23, -24, -25, and -26 could be assigned the same failure probability as an HEP from a plant of similar design whereby the operator action involves local manipulation and throttling of the high pressure injection valves to prevent overpressurizing the RCS.

2. The proposed HEP event for this SAMA is assumed to correct most modes of common cause failure involving these MOVs.
3. The new HEP that simulates implementation of this SAMA is assumed to be independent of any other HEP events within the PRA model. This will tend to maximize the potential risk benefit that would be realized by this SAMA.

PRA Model Changes to Model SAMA:

For valve MUV-24, a new AND gate was created with the label HC1230-1 that contains the following inputs: Original OR gate HC1230 and new HEP event HHSAMA10. Gate HC1230-1 was then used as an input to the same gates for which gate HC1230 was originally used, namely gates H8230 and H1230.

For valve MUV-23, a new AND gate was created with the label HC1330-1 that contains the following inputs: Original OR gate HC1330 and new HEP event HHSAMA10. Gate HC1330-1 was then used as an input to the same gates for which gate HC1330 was originally used, namely gates H8330 and H1330.

For valve MUV-25, a new AND gate was created with the label HC1430-1 that contains the following inputs: Original OR gate HC1430 and new HEP event HHSAMA10. Gate HC1430-1 was then used as an input to the same gates for which gate HC1430 was originally used, namely gates H8430 and H1430.

For valve MUV-26, a new AND gate was created with the label HC1530-1 that contains the following inputs: Original OR gate HC1530 and new HEP event HHSAMA10. Gate HC1530-1 was then used as an input to the same gates for which gate HC1530 was originally used, namely gates H8530 and H1530.

No other logic or fault tree structures were affected.

The table below shows the new basic event included in the PRA model for this sensitivity analysis:

SAMA 10 New Basic Event

Basic Event	Description	Probability	Comments
HHSAMA10	OPERATOR FAILS TO OPEN MAKEUP VALVES	1.1E-02	HEP assigned a failure probability based on similar situation for a nuclear plant of similar design.

Results of SAMA Quantification:

Implementation of this SAMA yielded a slight reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.83E-06	3.59	$6,248
Percent Change	2.4%	5.3%	5.7%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	4.01E-06	2.44E-08	4.71E-10	1.50E-08	1.23E-09	7.50E-10	3.45E-09	2.45E-07	1.57E-07	3.18E-07	5.12E-08	**4.83E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.38	0.74	**3.59**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$28	$2	$6	$27	$15	$679	$4,487	$1,003	**$6,248**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 10 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$652,498	$29,502

The SAMA 10 results show a slight reduction in CDF, with slightly larger reductions to dose-risk and offsite economic consequences. Even though the cost of implementation is only $50,000, the net value for this SAMA is -$20,498 ($29,502 - $50,000), which implies that this SAMA is not cost beneficial.

E.6.5 SAMA 38: Additional Condensate Storage Tank Replacement Water Sources

The purpose of this SAMA is to investigate the risk benefit of implementing procedural practices to align alternate water sources for the EFW system when the Condensate Storage Tank (CST) is rendered unavailable. In addition to the description given in Section E.6.1 above, the EFW pumps normally take suction from the dedicated EFW tank. The CST actually serves as a backup to this water source. Additionally, EFP-1 and EFP-2 can be supplied from the condenser hotwell. What this particular SAMA proposes is an additional backup water source for the CST, which is separate and independent of any other EFW backup water source. This particular SAMA assumed that the alternate source could be associated with the fire water system, but in actuality could involve any other available water source, such as the Nuclear Services Sea Water system.

<u>Assumptions:</u>

1. For the purposes of this SAMA, the HEP involving alignment of an alternate water source for the CST was optimistically assigned a low failure rate (1E-3) in an effort to capture the maximum risk benefit.

2. A single undeveloped event representing a failure point-estimate for the alternate water source for the CST was based on the unavailability calculation of the fire water system top event at a plant of similar design.

<u>PRA Model Changes to Model SAMA:</u>

In order to model this SAMA, A new level of logic consisting of an AND gate was inserted above the OR gate QMMCST. This new AND gate was labeled QMMCST-1 and provided an input to the same gates for which QMMCST was originally used. The inputs to the AND gate QMMCST-1 consisted of the original OR gate QMMCST and a new OR gate named QMMCST-2, which contained the new HEP event (QHSAMA38) and single undeveloped basic event representing unavailability of the alternate water source.

No other logic or fault tree structures were affected.

The table below provides a listing of the new basic events included in the PRA model for this sensitivity analysis:

SAMA 38 New Basic Events

Basic Event	Description	Probability	Comments
QHSAMA38	OPERATOR FAILS TO ALIGN FIRE WATER SYSTEM	1E-03	HEP assigned an arbitrarily optimistic failure probability to maximize risk benefit.
QFIREWTR	FIRE WATER SYSTEM UNAVAILABLE	1E-4	Benchmark estimate based on system unavailability at similar plant.

Results of SAMA Quantification:

Implementation of this SAMA yielded a reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.79E-06	3.75	$6,563
Percent Change	3.1%	1.0%	0.9%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.98E-06	2.42E-08	4.51E-10	1.53E-08	1.18E-09	8.00E-10	3.39E-09	2.25E-07	1.46E-07	3.44E-07	5.13E-08	**4.79E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.28	2.57	0.74	**3.75**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$28	$2	$7	$26	$14	$632	$4,849	$1,005	**$6,563**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 38 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$670,002	$11,998

The SAMA 38 results show a negligible reduction in CDF and offsite consequences. Even though the cost of implementation is only $50,000, the net value for this SAMA is -$38,002 ($11,998 - $50,000), which implies that this SAMA is not cost beneficial.

E.6.6 SAMA 3: Automate switchover to Reactor Building Sump Recirculation

The purpose of this SAMA is to investigate the risk benefit of automating the switchover from injection of borated water from the BWST during LOCA scenarios to RB sump recirculation. During LOCA scenarios, water is injected into the primary system by either the high head Makeup pumps, i.e., High Pressure Injection (HPI), or the low head Decay Heat Removal pumps, also known as Low Pressure Injection (LPI).

Decay Heat (DH) system components will automatically align to provide LPI flow from the BWST to the reactor vessel by starting the DH pumps and opening isolation valves DHV-5 and DHV-6. Normally open valves DHV-34 and DHV-35 also receive an open signal.

When the BWST volume is depleted, the DH pumps can be aligned to take suction from the reactor building sump. In this lineup, long term cooling of the reactor is provided by cooling the sump water using the DH heat exchangers and returning the water to the reactor vessel. If the swapover from the BWST to the reactor building sump occurs while RCS pressure is greater than the shutoff head of the DH pumps, the discharge from the DH heat exchangers is directed to the HPI pumps for return to the RCS in what is referred to as "piggyback" operation. Operator action is required to accomplish this lineup (opening DHV-11 and DHV-12 to initiate "A" and "B" train lineups respectively.)

This SAMA attempts to determine the risk benefit of automating the actions the operator would normally perform in transferring suction of the DH pumps from the BWST to the RB sump. In order to simplify PRA model changes while also attempting to maximize the possible risk benefit, the HEP events associated with sump recirculation were arbitrarily reduced by two orders of magnitude.

Assumptions:

1. For the purposes of this SAMA, the two HEP events involved with RB sump recirculation were reduced by a factor of 100. This simplification was an attempt to model risk reduction by automating operator actions without involving complicated model changes that would take into account new mechanical, electrical, and control system dependencies.

PRA Model Changes to Model SAMA:

1. The failure probability for event LHULPRCY, “OPERATORS FAIL TO GO TO LOW PRESSURE RECIRCULATION,” was reduced from 2.50E-02 to 2.50E-04.

2. The failure probability for event HHUHPRCY, “OPERATORS FAIL TO SWITCH FROM HIGH PRESSURE INJECTION TO RECIRCULATION,” was reduced from 4.40E-04 to 4.40E-06.

No other logic or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded a slight reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.50E-06	3.78	$6,620
Percent Change	9.0%	0.2%	0.1%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
Frequency$_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
Frequency$_{SAMA}$	3.66E-06	2.04E-08	4.24E-10	1.53E-08	1.23E-09	8.35E-10	2.99E-09	2.45E-07	1.57E-07	3.45E-07	5.13E-08	**4.50E-06**
Dose-Risk$_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
Dose-Risk$_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.78**
OECR$_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
OECR$_{SAMA}$	$0	$0	$0	$28	$2	$7	$23	$15	$679	$4,859	$1,005	**$6,620**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 10 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$658,510	$23,490

Even though the SAMA 3 results show about a 10% reduction in CDF, the reduction to dose-risk and offsite economic consequences are minimal. With an implementation cost estimated at $350,000, the net value for this SAMA is -$326,510 ($23,490 - $350,000), which implies that this SAMA is not cost beneficial.

E.6.7 SAMA 6: Provide Ability to Rapidly Identify and Isolate Seawater Floods in Auxiliary Building

Internal flooding scenarios are a plant risk from the perspective that multiple safety-related and other plant components can be rendered inoperable. This particular flooding scenario involves a pipe rupture on elevation 95 of the Auxiliary Building (also identified by Fire Zone AB-95-X). This particular SAMA envisions that new hardware and flood sensors would be installed to facilitate quick detection and isolation of the flooding source to minimize any equipment damage that might occur. To maximize the possible risk benefit this SAMA could afford while also simplifying modifications to the PRA model, the single initiating event representing this scenario was set to 0.0, implying that all risk from this initiator could be eliminated by this SAMA.

<u>Assumptions:</u>

1. Implementation of this SAMA assumes that the risk due to the flooding scenario represented by initiating event IE_F6A (PIPE RUPTURE ON ELEVATION 95 OF THE AUX BLDG, FIRE ZONE AB-95-X) is completely eliminated.

<u>PRA Model Changes to Model SAMA:</u>

The initiating event IE_F6A, “PIPE RUPTURE ON ELEVATION 95 OF THE AUX BLDG (FIRE ZONE AB-95-X),” was reduced to a probability of 0.0 in the PRA basic event database. No other logic or fault tree structures were affected.

<u>Results of SAMA Quantification:</u>

Implementation of this SAMA yielded a slight reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	**Dose-Risk**	**OECR**
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.58E-06	3.78	$6,617
Percent Change	7.5%	0.3%	0.1%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.74E-06	2.43E-08	4.56E-10	1.42E-08	1.06E-09	7.22E-10	3.34E-09	2.45E-07	1.57E-07	3.45E-07	5.13E-08	**4.58E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.78**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$26	$2	$6	$26	$15	$676	$4,859	$1,005	**$6,617**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 6 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$662,218	$19,782

The SAMA 6 results indicate a small reduction in CDF with negligible changes in dose-risk and offsite economic consequences. With an implementation cost of $400,000, the net value for this SAMA is -$380,218 ($19,782 - $400,000), which implies that this SAMA is not cost beneficial.

E.6.8 SAMA 5: Improve Availability of Auxiliary Feedwater Pump FWP-7

Section E.6.1 above mentions the ability to use the AFW pump FWP-7 in the event that the other EFW pumps are unavailable to supply feedwater to the OTSGs. This SAMA attempts to address the issue regarding the maintenance unavailability associated with this pump by making it more reliable. To maximize the possible risk benefit this SAMA could afford while also simplifying modifications to the PRA model, the maintenance unavailability for this pump was set to 0.0, thus maximizing the risk benefit that could be realized from any improvement in maintenance practices or hardware modifications to improve the reliability of FWP-7.

Assumptions:

1. For the purposes of this SAMA, the maintenance unavailability for FWP-7 was set to 0.0, which is a bounding assumption implying that any maintenance practice or hardware modification would ensure that this pump would always be in a standby state and never be in maintenance while the plant is at power.

PRA Model Changes to Model SAMA:

As described above, the unavailability of FWP-7, represented by basic event QPMFWP7M, was set to 0.0 in the PRA basic event database. No other logic or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded a small reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	**Dose-Risk**	**OECR**
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.43E-06	3.68	$6,434
Percent Change	10.5%	3.0%	2.9%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	**IC1**	**RC1**	**RC1A**	**RC1B**	**RC1AB**	**RC2**	**RC2B**	**RC3**	**RC3B**	**RC4C**	**RC5C**	**Total**
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.69E-06	2.37E-08	3.99E-10	1.41E-08	1.05E-09	7.05E-10	3.21E-09	1.76E-07	1.22E-07	3.42E-07	5.14E-08	**4.43E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.05	0.24	2.56	0.74	**3.68**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$26	$2	$6	$25	$11	$528	$4,828	$1,007	**$6,434**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 5 Net Value

Unit	**Base Case Cost-Risk**	**Revised Cost-Risk**	**Averted Cost-Risk**
Crystal River 3	$682,000	$642,960	$39,040

The SAMA 5 results indicate a small reduction in the CDF and a slight decrease in the dose-risk and offsite economic consequences. With an implementation cost of $500,000, the net value for this SAMA is -$460,960 ($39,040 - $500,000), which implies that this SAMA is <u>not</u> cost beneficial.

E.6.9 SAMA 17: Improve Steam Generator Level Control

Failure to provide automatic water level control for both OTSGs can render the function of secondary side heat removal unavailable. The PRA model accounts for the various failure modes that can cause a malfunction of this important system, such as transmitter failures, controller failures, relay failures, etc. To mitigate failure of the currently installed OTSG level control hardware, this SAMA proposes installation of an independent and redundant backup level control system for both OTSGs. The risk benefit that could be realized by such a diverse system was implemented in the PRA model by use of a single undeveloped event that was common to both OTSGs. The details are described below.

Assumptions:

1. For the purposes of this SAMA, a single undeveloped event was used as an estimate for the overall failure probability affecting a diverse means of controlling OTSG water level for both steam generators. That is, failure of this single event would render the proposed diverse level control system unavailable for both OTSGs, since the hardware and system controls are assumed to be similar for both steam generators, thereby accounting for possible common mode failures.

PRA Model Changes to Model SAMA:

For OTSG A, a new level of fault tree logic was inserted above the OR gate PMMICSAH consisting of an AND gate labeled as PMMICSAH-1, with the original gate PMMICSAH and a new undeveloped event PMSAMA17 as inputs. The undeveloped event PMSAMA17 represents the total unavailability for the independent and diverse level control system proposed by this SAMA. The AND gate PMMICSAH-1 was used as an input to the same gates for which PMMICSAH was originally used.

For OTSG B, a new level of fault tree logic was inserted above the OR gate PMMICSBH consisting of an AND gate labeled as PMMICSBH-1, with the original gate PMMICSBH and the new undeveloped event PMSAMA17 described above as inputs. The AND gate PMMICSBH-1 was used as an input to the same gates for which PMMICSBH was originally used.

No other logic or fault tree structures were affected.

The table below shows the new basic event included in the PRA model for this sensitivity analysis:

SAMA 17 New Basic Event

Basic Event	Description	Probability	Comments
PMSAMA17	REDUNDANT/DIVERSE BACKUP LEVEL CONTROL SYSTEM	1E-04	Unavailability optimistically chosen to maximize potential risk benefit.

Results of SAMA Quantification:

Implementation of this SAMA yielded a small reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.73E-06	3.65	$6,368
Percent Change	4.5%	3.7%	3.9%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.90E-06	2.39E-08	4.50E-10	1.46E-08	1.18E-09	7.46E-10	3.37E-09	2.45E-07	1.57E-07	3.26E-07	5.16E-08	**4.73E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.44	0.74	**3.65**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$27	$2	$6	$26	$15	$679	$4,601	$1,011	**$6,368**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 17 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$654,668	$27,332

The SAMA 17 results indicate a small reduction in CDF and a measurable decrease in the dose-risk and offsite economic consequences. With an implementation cost of $500,000, the net value for this SAMA is -$472,668 ($27,332 - $500,000), which implies that this SAMA is not cost beneficial.

E.6.10 SAMA 11: Provide an Automated Crosstie/Makeup Supply for Emergency Feedwater

When the EFW system is supplying emergency feedwater to the steam generators, the depletion of the emergency feedwater tanks (EFTs) will require the operator to cross-tie suction sources to prevent cavitation of the EFW pumps. This SAMA proposes installation of an automatic control system to improve the reliability associated with maintaining a viable suction source for all three EFW pumps. The modeling changes associated with this SAMA were simplistically modeled to maximize the possible risk benefit. The details are provided below.

Assumptions:

1. The modeling change associated with automating the operator cross-tie action for EFW pump suction was assumed to affect all three EFW pumps in the same manner. That is, failure of the automated cross-tie action proposed by this SAMA was assumed to fail all three EFW pumps, similar to the failure mode associated with the HEP event QHUEFT2Y.

2. The improved reliability of implementing automated controls was assumed to optimistically result in an equivalent reduction of the HEP failure probability of QHUEFT2Y by two orders of magnitude.

PRA Model Changes to Model SAMA:

To simulate the implementation of this SAMA, the base cutset file representing all release categories was manipulated by changing the HEP failure probability of QHUEFT2Y from 7.7E-4 to 7.7E-6, i.e., two orders of magnitude reduction to account for improved reliability from use of an automated system to cross-tie EFW suction sources. No other basic events or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded small reductions in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.83E-06	3.76	$6,582
Percent Change	2.4%	0.7%	0.6%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	4.00E-06	2.38E-08	4.09E-10	1.55E-08	1.21E-09	8.29E-10	3.36E-09	2.39E-07	1.56E-07	3.42E-07	5.12E-08	**4.83E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.56	0.74	**3.76**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$29	$2	$7	$26	$15	$676	$4,824	$1,003	**$6,582**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 11 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$673,106	$8,894

The SAMA 11 results show a minimal reduction in CDF, as well as insignificant changes to dose-risk and offsite economic consequences. With an implementation cost of $250,000, the net value for this SAMA is -$241,106 ($8,894 - $250,000), which implies that this SAMA is not cost beneficial.

E.6.11 SAMA 15: Provide Control Room Capability to Realign Power to Makeup Pump 1B

The make-up and purification (MUP) system provides for inventory and water chemistry control of the reactor coolant, and for emergency makeup (high pressure injection or HPI). The system consists of three makeup pumps that are powered from two trains of engineered safeguards (ES) 4160 VAC electrical buses. MUP-1A is powered from train A of electrical power and MUP-1C is powered from train B. MUP-1B acts as a “swing” pump that can be powered from either 4160 VAC bus, but must be manually realigned if the alternate train is desired. The purpose of this particular SAMA is to simulate the ability to remotely realign the power supply for MUP-1B rather than requiring local manipulations outside the control room. In order to estimate the risk benefit of this SAMA, the operator action within the PRA model will be reassigned a lower failure probability.

Assumptions:

1. In modeling this SAMA, it was assumed that all of the necessary local actions previously performed for realignment of the MUP-1B power source can be accomplished from within control room. Therefore, the HEP event representing failure to locally realign power was optimistically reduced from a failure rate of 0.28 to 1E-03 to maximize the potential risk benefit.

2. It was assumed that the reduced HEP failure rate was independent of any other HEP events within the PRA model. This will also tend to maximize the potential risk benefit that would be realized by this SAMA.

PRA Model Changes to Model SAMA:

To model SAMA 15, the failure probability for HEP event HHUMBACY (OPERATORS FAIL TO SWITCH MUP-1B POWER SOURCE) was reduced from a value of 1.0 to 1E-3 in the PRA basic event database. Also, in the recovery rules file, the recovery event HHUMBACZ was commented out so as not to append this recovery event with a failure probability of 0.28 to cutsets containing HHUMBACY. No other basic events or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded a reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	**Dose-Risk**	**OECR**
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.81E-06	3.64	$6,336
Percent Change	2.8%	3.9%	4.4%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	4.09E-06	2.44E-08	4.70E-10	1.59E-08	1.24E-09	7.96E-10	3.42E-09	1.79E-07	9.26E-08	3.44E-07	5.15E-08	**4.81E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.05	0.18	2.57	0.74	**3.64**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$29	$2	$7	$26	$11	$400	$4,851	$1,009	**$6,336**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 15 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$657,316	$24,684

The results of the SAMA 15 sensitivity analysis showed a measurable drop in the CDF and offsite consequence risk metrics. However, with an estimated implementation cost of $300,000, the net value for this SAMA was -$275,316 ($24,684 - $300,000), which implies that this SAMA is not cost beneficial.

E.6.12 SAMA 4: Automate Start of Auxiliary Feedwater Pump (FWP-7) When Required

Section E.6.1 above describes the EFW system and AFW pump FWP-7 that can be manually started if necessary for providing a backup means of supplying feedwater to the OTSGs in the event the automated EFW system is unavailable. This SAMA investigates the risk benefit of changing FWP-7 from manual to automatic operation. Similar to what was done in Section E.6.11 above for modeling SAMA 15, the associated operator action within the PRA model will be reassigned a lower failure probability to simulate automatic operation.

Assumptions:

1. In modeling this SAMA, it was assumed that all of the necessary manual actions to start FWP-7 can be accomplished by installation of an independent automated system that requires little or no human intervention. Therefore, the HEP event representing failure to manually start FWP-7 when necessary was optimistically reduced from a failure rate of 2.6E-02 to 1E-05 to maximize the potential risk

benefit, which is approximately a reduction of three orders of magnitude in the overall failure probability.

2. It was assumed that the reduced HEP failure rate represented an overall surrogate failure probability for an automated system designed to start AFW pump FWP-7 and deliver water to the OTSGs when required, independent of any other control system currently installed to support EFW.

PRA Model Changes to Model SAMA:

To model SAMA 4, the failure probability for HEP event QHUFW7EY (OPERATORS FAIL TO START FWP-7 BEFORE PORV LIFTS) was reduced from a value of 1.0 to 1E-5 in the PRA basic event database. Also, in the recovery rules file, the recovery event QHUFW7EZ was commented out so as not to append this recovery event with a failure probability of 2.6E-02 to cutsets containing QHUFW7EY. No other basic events or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded a reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	**Dose-Risk**	**OECR**
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.48E-06	3.73	$6,529
Percent Change	9.4%	1.5%	1.4%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	**IC1**	**RC1**	**RC1A**	**RC1B**	**RC1AB**	**RC2**	**RC2B**	**RC3**	**RC3B**	**RC4C**	**RC5C**	**Total**
Frequency_{BASE}	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
Frequency_{SAMA}	3.69E-06	2.31E-08	4.44E-10	1.39E-08	1.06E-09	6.82E-10	3.19E-09	2.14E-07	1.38E-07	3.44E-07	5.15E-08	**4.48E-06**
Dose-Risk_{BASE}	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
Dose-Risk_{SAMA}	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.06	0.27	2.57	0.74	**3.73**
OECR_{BASE}	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
OECR_{SAMA}	$0	$1	$0	$26	$2	$6	$25	$13	$596	$4,852	$1,010	**$6,529**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 4 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$651,942	$30,058

The results of the SAMA 4 sensitivity analysis showed a measurable drop in the CDF by about 10%, but showed a much smaller decrease in the offsite consequence risk metrics. With an estimated implementation cost of $250,000, the net value for this SAMA was -$219,942 ($30,058 - $250,000), which implies that this SAMA is not cost beneficial.

E.6.13 SAMA 35: Update PORV Controls to Open Automatically When Operator Action Was Previously Required

The RCS pilot-operated electromatic relief valve (PORV) is normally designed to open to relieve RCS pressure during overpressure conditions, due to exceeding a pressure setpoint or by remote operation. A solenoid energizes to open the PORV, and de-energizes to allow the PORV to close. In certain plant scenarios, such as during plant transients that cause an excessive increase in RCS pressure, e.g., loss of main feedwater, the operator may be required to manually open the PORV from the control room to prevent challenging the safety relief valves. In the CRNPP PRA model, this action is particularly important with regard to SGTR and small LOCA scenarios.

Therefore, this SAMA attempts to automate the process of cooling down the plant and performing what the operators would normally do when opening the PORV for manual pressure control. In an effort to simplify model changes while at the same time maximizing the risk benefit, the associated operator action was reassigned a much lower failure probability and the PRA model requantified.

Although it was originally known that installation of such a complex automatic control system would be fairly expensive to install and probably not be cost beneficial, this particular SAMA was still considered a candidate for a sensitivity analysis due to the large impact it had on LERF.

Assumptions:

1. In modeling this SAMA, it was assumed that all of the necessary actions to manually open the PORV and control RCS pressure could be accomplished by installation of an automated system that requires little or no human intervention. Therefore, the HEP event representing failure to manually open the PORV was

optimistically reduced from a failure rate of 0.5 to 1.0E-5 to maximize the potential risk benefit.

2. It was assumed that the reduced HEP failure rate represented an overall surrogate failure probability for an automated system designed to automatically open the PORV and control RCS pressure.

PRA Model Changes to Model SAMA:

To model SAMA 35, the failure probability for HEP event RHUPORVY (OPERATORS FAIL TO OPEN PORV FOR PRESSURE RELIEF) was reduced from a value of 0.5 to 1E-5 in the PRA basic event database. Also, in the recovery rules file, the line items that reference event RHUPORVY were commented out so as not to append any recovery events associated with this HEP so the optimistic risk modeling would not be overly inflated. No other basic events or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded a modest decrease in CDF, with substantial reductions in both Dose-Risk and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.54E-06	1.75	$2,782
Percent Change	8.3%	53.8%	58.0%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.97E-06	2.33E-08	3.47E-10	1.58E-08	1.23E-09	8.42E-10	3.29E-09	2.45E-07	1.57E-07	7.23E-08	5.13E-08	**4.54E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.04	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.30	0.54	0.74	**1.75**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$1	$0	$29	$2	$7	$25	$15	$678	$1,019	$1,006	**$2,782**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 35 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$422,910	$259,090

The results for this sensitivity analysis showed that the frequency for Release Category RC-4C was dramatically reduced, as would be expected since this category is representative of a SGTR scenario with cycling SRVs and no scrubbing of fission products. However, even though the implementation cost was probably underestimated at $700,000, the net value for this SAMA is -$440,910 ($259,090 - $700,000), which implies that this SAMA is not cost beneficial.

E.6.14 SAMA 51: Upgrade or Improve Engineering Analysis to Qualify the EFIC Cabinets to a Higher Temperature

The Emergency Feedwater Initiation and Control (EFIC) system provides the initiation signal for the automatic start of the EFW pumps and for steam generator valve isolation and alignment, such as during loss of main feedwater or steamline break scenarios. Currently, the EFIC control circuitry is confined within cabinets that are only qualified to a temperature of 104°F. Above that temperature, EFW flow control is uncertain. The valves could fail as-is, transfer full open, fail closed, or could behave erratically. The PRA assumes that 50% of the time the failure will result in a loss of all EFW.

This particular SAMA is a result of a PRA Group Insight that was identified above in Section E.5.1.3. It is envisioned that with an improved engineering analysis, overly conservative assumptions and room heatup calculations could be further refined to qualify the EFIC circuitry to a much higher temperature before failure due to overheating is expected. Even though the calculational details that form the basis for this temperature threshold have not been reviewed, it is widely known that most personal computers manufactured and in use today typically function with motherboard temperatures of at least 110°F or higher.

Quantification of the risk benefit from implementation of this SAMA was estimated by adjusting the failure probability of this event associated with this particular failure mode of the EFIC system.

Assumptions:

1. In modeling this SAMA, it was arbitrarily assumed that the probability of failure associated with the EFIC cabinets overheating could be reduced by 80% with an improved engineering analysis, or possibly a minor equipment modification, e.g., cabinet fan with DC backup power supply. Equivalently stated, the basic event

would be changed from a 50% failure rate to a 10% failure rate at a temperature of 104°F.

PRA Model Changes to Model SAMA:

In modeling SAMA 51, the failure probability for basic event QSPLHVAC (SPLIT FRACTION - VALVES FAIL CLOSED ON LOSS OF HVAC) was reduced from a value of 0.5 to 0.1. No other basic events or fault tree structures were affected.

Results of SAMA Quantification:

Implementation of this SAMA yielded a reduction in the CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	3.95E-06	3.56	$6,225
Percent Change	20.2%	6.0%	6.0%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
Frequency_{BASE}	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
Frequency_{SAMA}	3.32E-06	2.38E-08	4.01E-10	1.17E-08	7.77E-10	5.35E-10	3.07E-09	1.23E-07	7.19E-08	3.44E-07	5.14E-08	**3.95E-06**
Dose-Risk_{BASE}	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
Dose-Risk_{SAMA}	0.03	0.00	0.00	0.03	0.00	0.00	0.01	0.04	0.14	2.57	0.74	**3.56**
OECR_{BASE}	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
OECR_{SAMA}	$0	$1	$0	$22	$1	$5	$24	$7	$311	$4,849	$1,006	**$6,225**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 51 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$605,224	$76,776

The results of the SAMA 51 sensitivity analysis showed a measurable drop in the CDF and offsite consequence risk metrics. However, with an estimated implementation cost of only $100,000, the net value for this SAMA was -$23,224 ($76,776 - $100,000), which implies that this SAMA is <u>not</u> cost beneficial.

E.6.15 SAMA 49: Upgrade Fire Barriers in Battery Charger Room 3A

Section E.5.1.7 above identified from the IPEEE (FPC 1997) that fire zone CC-108-106 (Battery Charger Room 3A) was the dominant risk contributor due to internal fires. However, it was found that Battery Charger Room 3B (zone CC-108-105) had enhanced fire barrier protection as a result of maintaining at least one train of equipment capable of shutting down the plant per the requirements of 10 CFR Part 50 Appendix R. The difference in fire risk between the two battery charger rooms was about a factor of ten. Thus, this particular SAMA was designed to capture the risk benefit of upgrading the fire barriers in fire zone CC-108-106 in a similar manner to what was done for zone CC-108-105.

The results of this sensitivity analysis will reveal whether it is cost beneficial to upgrade fire barriers in the fire zone having the highest risk contribution due to internal fires. If it proves convincingly cost beneficial, it may be prudent to investigate other fire zones for risk reduction, but if not, then other fire zones would be exempt from further analysis.

Since there is currently no fire PRA model capable of calculating a value for CDF, a method using ratios of risk contribution was adopted to attempt quantification of the possible risk benefit afforded by upgrading fire barriers in this particular fire zone.

Assumptions:

1. In modeling this SAMA, it was found in Section E.5.1.7 that Battery Charger Room 3A constituted a 29.2% contribution to the entire risk attributed to the IPEEE CDF due to all external events. It was assumed that improvements made to the fire barriers in Battery Charger Room 3B could also be made to Room 3A, and thus reduce the fire risk in this fire zone by a factor of ten. This would translate to a 32.0% reduction in the CDF due to fire, and subsequent 26.3% reduction to the total CDF due to external events.

2. Consistent with Section E.5.1.8 above, it was assumed that the internal and external CDF values are practically equivalent. Also, since improvement to the fire barriers would only affect the risk due to external events and not affect the internal events CDF, the 26.3% reduction in external events CDF from the above assumption would translate to an overall combined risk reduction of one-half this value, or approximately 13.1%.

3. Although somewhat conservative, it was assumed that the 13.1% risk reduction would be applied to all release categories in a uniform manner. This will serve to simplify calculations while also maximizing the possible risk benefit afforded by this SAMA.

PRA Model Changes to Model SAMA:

There were no model changes made to the PRA model for this sensitivity analysis. Quantification of the risk benefit was estimated by reducing all release category frequencies from the base case by 13.1%, i.e., all base model frequencies were multiplied by a factor of 0.869. The changes in risk metrics were then compared to the base case to determine the averted cost risk due to this SAMA.

Results of SAMA Quantification:

As expected from the method described above, implementation of this SAMA yielded a uniform decrease in CDF, Dose-Risk, and Offsite Economic Cost-Risk. The results are summarized in the following table for CRNPP:

	CDF	Dose-Risk	OECR
Base Value	4.95E-06	3.79	$6,624
SAMA Value	4.30E-06	3.29	$5,756
Percent Change	13.1%	13.1%	13.1%

A further breakdown of the Dose-Risk and OECR information is provided in the below table according to release category:

Release Category	IC1	RC1	RC1A	RC1B	RC1AB	RC2	RC2B	RC3	RC3B	RC4C	RC5C	Total
$Frequency_{BASE}$	4.10E-06	2.44E-08	4.71E-10	1.59E-08	1.25E-09	8.43E-10	3.46E-09	2.46E-07	1.57E-07	3.44E-07	5.15E-08	**4.95E-06**
$Frequency_{SAMA}$	3.56E-06	2.12E-08	4.09E-10	1.38E-08	1.08E-09	7.32E-10	3.01E-09	2.13E-07	1.37E-07	2.99E-07	4.47E-08	**4.30E-06**
$Dose\text{-}Risk_{BASE}$	0.04	0.01	0.00	0.03	0.00	0.00	0.01	0.07	0.30	2.57	0.74	**3.79**
$Dose\text{-}Risk_{SAMA}$	0.03	0.00	0.00	0.03	0.00	0.00	0.01	0.06	0.26	2.24	0.64	**3.29**
$OECR_{BASE}$	$0	$1	$0	$29	$2	$7	$27	$15	$679	$4,855	$1,009	**$6,624**
$OECR_{SAMA}$	$0	$0	$0	$26	$2	$6	$23	$13	$590	$4,219	$877	**$5,756**

This information was used as input to the cost-benefit calculation. The results of this calculation are provided in the following table:

SAMA 49 Net Value

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
Crystal River 3	$682,000	$592,868	$89,132

Even though this sensitivity analysis used an optimistic method for estimating the risk benefit, the cost of implementation of only $150,000, which was a benchmark estimate based previous work done in upgrading Battery Charger Room 3B, produced a net value for this SAMA of -$60,868 ($89,132 - $150,000), which implies that this SAMA is not cost beneficial.

E.6.16 Summary

All of the SAMAs reviewed showed at least some benefit with respect to the traditional CDF and LERF risk metrics. However, due to the relatively low plant CDF for CRNPP, the MMACR is fairly low when compared to cost estimates for significant plant modifications. Generally speaking, it was the lower cost SAMAs that showed the greatest potential for cost-risk benefit.

Based on the nominal CDF quantifications, only SAMA 34 showed a clear cost-risk benefit. This SAMA provides for enhanced procedures and training with regard to manual control of the EFW discharge flow control valves (EFV-55, -56, -57, and -58). Although not cost beneficial for the nominal case, SAMA 10 nearly showed a positive net cost benefit. SAMA 10 involves improved procedural guidance with regard to the high pressure injection valves in the Makeup and Purification system.

From a cost of implementation perspective, only SAMA 34 clearly showed a positive net value for CRNPP. However, the uncertainty analysis in Section E.7 examines whether certain SAMAs may be cost beneficial based on a 95th percentile estimate.

E.7 UNCERTAINTY ANALYSIS

The following three uncertainties were further investigated as to their impact on the overall SAMA evaluation:

- Use a discount rate of 7 percent, instead of 3 percent used in the base case analysis.
- Use the 95th percentile PRA results in place of the mean PRA results.
- Selected MACCS2 input variables.

E.7.1 Real Discount Rate

A sensitivity study has been performed in order to identify how the conclusions of the SAMA analysis might change based on the value assigned to the real discount rate (RDR). The original RDR of 3 percent, which could be viewed as conservative, has been changed to 7 percent and the modified maximum averted cost-risk was re-calculated using the methodology outlined in Section E.4.

Phase 1 SAMAs are not impacted by use of the 7 percent RDR. The Phase 1 screening process involved qualitative disposition of (9) SAMAs, and hence, no PRA requantification was generated for these SAMAs. Refer to Section E.5 and Table E.5-3 for a detailed analysis of each Phase 1 SAMA that was screened from further analysis.

The Phase 2 analysis was re-performed using the 7 percent RDR. Implementation of the 7 percent RDR reduced the MMACR by 26.4 percent compared with the case where a 3 percent RDR was used. This corresponds to a decrease in the MMACR from $682,000 to $502,000.

The Phase 2 SAMAs are dispositioned based on PRA insights or detailed analysis. All of the PRA insights used to screen the SAMAs are still applicable given the use of the 7 percent real discount rate as the change only strengthens the factors used to screen them. The SAMA candidates screened based on these insights are considered to be addressed and are not further investigated.

The remaining Phase 2 SAMAs were dispositioned based on the results of a SAMA specific cost-benefit analysis. This step has been re-performed using the 7 percent real discount rate to calculate the net values for the SAMAs.

As shown below, the determination of cost effectiveness did not change for any of the Phase 2 SAMAs when the 7 percent RDR was used in lieu of 3 percent.

Summary of the Impact of the RDR Value on the Detailed SAMA Analyses

SAMA ID	Cost of Implementation	Averted Cost Risk (3 percent RDR)	Net Value (3 percent RDR)	Averted Cost Risk (7 percent RDR)	Net Value (7 percent RDR)	Change in Cost Effectiveness?
34	$50,000	$94,706	$44,706	$71,448	$21,448	No
33	$50,000	$15,384	-$34,616	$11,864	-$38,136	No
9	$50,000	$16,128	-$33,872	$12,416	-$37,584	No
10	$50,000	$29,502	-$20,498	$21,468	-$28,532	No
38	$50,000	$11,998	-$38,002	$9,056	-$40,944	No
3	$350,000	$23,490	-$326,510	$18,158	-$331,842	No
6	$400,000	$19,782	-$380,218	$15,272	-$384,728	No
5	$500,000	$39,040	-$460,960	$29,494	-$470,506	No
17	$500,000	$27,332	-$472,668	$20,222	-$479,778	No
11	$250,000	$8,894	-$241,106	$6,722	-$243,278	No
15	$300,000	$24,684	-$275,316	$18,086	-$281,914	No
4	$250,000	$30,058	-$219,942	$22,906	-$227,094	No
35	$700,000	$259,090	-$440,910	$186,646	-$513,354	No
51	$100,000	$76,776	-$23,224	$57,952	-$42,048	No
49	$150,000	$89,132	-$60,868	$65,738	-$84,262	No

E.7.2 95th Percentile PRA Results

The results of the SAMA analysis can be impacted by implementing conservative values from the PRA's uncertainty distribution. If the best estimate failure probability values were consistently lower than the "actual" failure probabilities, the PRA model would underestimate plant risk and yield lower than "actual" averted cost-risk values for potential SAMAs. Re-assessing the cost-benefit calculations using the high end of the failure probability distributions is a means of identifying the impact of having consistently underestimated failure probabilities for plant equipment and operator actions included in the PRA model.

A Level 1 internal events model uncertainty analysis was performed for CRNPP. The availability and use of Level 2 uncertainties is unique since most plants incorporate only Level 1 analyses in their SAMA reports. The reason Level 2 analyses are not typically used is due to the differing degree of development and uncertainties between the two models. Specifically, the Level 1 model tends to represent the plant in a more thorough and comprehensive manner as opposed to the Level 2 model. Furthermore, there are more release contributors beyond those captured by LERF. As such, for the purposes of the 95th percentile analysis, only Level 1 results are used in the uncertainty process. The results of the Level 1 calculation are provided below:

In performing the sensitivity analysis, only the base case was used in determining the appropriate value for the 95th percentile. For those SAMAs that required the addition of new basic events, no new uncertainty distributions were assigned since the design and implementation of each SAMA was arbitrary and was defined by the analysis assumptions. The results of this uncertainty analysis, therefore, show the expected statistical uncertainty of the CDF risk metrics under the assumption that each SAMA was designed and implemented as it was specified in this analysis. The analysis was run using the EPRI R&R Workstation UNCERT code (version 2.2) with the following simulation settings:

- Sample size - 25,000 trials
- Random seed - AUTO
- Sampling method - Monte Carlo

The calculational results of this uncertainty calculation is shown in the below table. The term CDF_{pe} refers to the nominal CDF point estimate of 4.95E-06.

Summary of Uncertainty Distribution

Mean	5%	50%	95%	Factor > CDF_{pe}	Std Dev
4.90E-06	1.79E-06	3.85E-06	1.08E-05	2.18	5.22E-06

The above table reveals a factor that is 2.18 greater than the respective point estimate CDF, which is in agreement with industry experience. Therefore, for this analysis, the 95^{th} percentile for the base case is used to examine the change in the cost benefit for each SAMA.

E.7.2.1 Phase 1 Impact

Phase 1 SAMAs are not impacted by use of the 95^{th} percentile PRA results. The Phase 1 screening process involved qualitative disposition of (9) SAMAs, and hence, no PRA requantification data was necessary for these SAMAs. Refer to Section E.5 and Table E.5-3 for a detailed analysis of each Phase 1 SAMA that was screened from further analysis. It is not expected that Phase 1 SAMAs that were screened from further analysis would be cost beneficial at the 95^{th} percentile, since the benefit gleaned from the implementation of those SAMAs would have to be extremely large in order to be cost beneficial.

E.7.2.2 Phase 2 Impact

As discussed above, a single factor based on the 95th percentile for the base case is used to determine the impact of the cost-benefit analysis for the proposed SAMA candidates. The uncertainty analyses that are available for the Level 1 model are not available (or not used) for the Level 2 and 3 PRA models. In order to simulate the use of the 95th percentile results for the Level 2 and 3 models, the same scaling factor calculated for the Level 1 results was implicitly applied to the Level 2 and 3 models.

The Phase 2 SAMA list was re-examined by multiplying the nominal averted cost risk by the ratio of the 95th percentile to the nominal CDF value (see Section 7.2) to identify SAMAs that would be re-characterized as cost beneficial, i.e., positive net value. Those SAMAs that were previously determined to be not cost beneficial due to implementation costs exceeding their associated nominal averted cost risk may be potentially cost beneficial at the revised 95th percentile averted cost risk. In this case, three additional Phase 2 SAMAs (SAMAs 10, 49, and 51) become cost beneficial.

As explained in Section E.7.2.1 above, no Phase 1 SAMAs were retained in the Phase 2 analysis when utilizing the 95th percentile PRA results, since these SAMAs were dispositioned independently of implementation cost.

E.7.2.3 95th Percentile Summary

The following table provides a summary of the impact of using the 95th percentile PRA results on the detailed cost-benefit calculations that have been performed.

Summary of the Impact of Using the 95th Percentile PRA Results

SAMA ID	Cost of Implementation	Averted Cost Risk (Base)	Net Value (Base)	Averted Cost Risk (95th Percentile)	Net Value (95th Percentile)	Change in Cost Effectiveness?
34	$50,000	$94,706	$44,706	$206,764	$156,764	No
33	$50,000	$15,384	-$34,616	$33,587	-$16,413	No
9	$50,000	$16,128	-$33,872	$35,211	-$14,789	No
10	$50,000	$29,502	-$20,498	$64,409	**$14,409**	**Yes**
38	$50,000	$11,998	-$38,002	$26,194	-$23,806	No
3	$350,000	$23,490	-$326,510	$51,284	-$298,716	No
6	$400,000	$19,782	-$380,218	$43,188	-$356,812	No
5	$500,000	$39,040	-$460,960	$85,233	-$414,767	No
17	$500,000	$27,332	-$472,668	$59,672	-$440,328	No
11	$250,000	$8,894	-$241,106	$19,418	-$230,582	No
15	$300,000	$24,684	-$275,316	$53,891	-$246,109	No
4	$250,000	$30,058	-$219,942	$65,623	-$184,377	No
35	$700,000	$259,090	-$440,910	$565,649	-$134,351	No
51	$100,000	$76,776	-$23,224	$167,619	**$67,619**	**Yes**
49	$150,000	$89,132	-$60,868	$194,594	**$44,594**	**Yes**

When the 95th percentile PRA results are used, three of the Phase 2 SAMAs (10, 49, and 51) that were previously classified as not cost effective are now determined to be cost effective. The use of the 95th percentile PRA results is not considered to provide the most rational assessment of the cost effectiveness of a SAMA; however, these additional SAMAs should be considered for implementation to address the uncertainties inherent in the SAMA analysis.

E.7.2.4 Impact due to Thermal Power Uprate (Reduced Feedwater Uncertainty)

Although not originally considered as an input to the quantification of the cost effectiveness of identified SAMAs, Crystal River 3 proved that they were able to reduce the feedwater flow measurement uncertainty by installation of a Caldon Leading Edge Flow Meter (LEFM) ultrasonic flow measurement device. This modification to the plant was able to reduce the calorimetric core power measurement uncertainty to $\leq$ 0.4%, which translated to an increase in the reactor core thermal power output from 2568 MWt to 2609 MWt (1.6% increase). As such, The Nuclear Regulatory Commission (NRC) issued License Amendment 228 to Facility Operating License No. DPR-72 (Crystal River Unit 3) to increase core rated thermal power from 2568 MWt to 2609 MWt (NRC 2007). Subsequently, the electrical output would also be expected to change proportionately, i.e., from 903 to 917 MWe.

However, since the replacement power cost calculation in Section E.4.5 used the lower electrical output of 903 MWe as input in determining the total cost-risk, a sensitivity analysis was performed using the higher electrical output to determine the effect on the cost effectiveness of Phase 2 SAMAs at their 95th percentile. Upon using the updated electrical output of 917 MWe, the following table revealed that there were no changes to the previous conclusions regarding cost-effective SAMAs. The change in the net monetary value for all evaluated SAMAs was less than $500, which was small enough such that there were no changes to the cost effectiveness for those Phase 2 SAMAs previously analyzed using 903 MWe as the electrical power rating.

Impact of Using 917 MWe as the Electrical Power Rating at the 95th Percentile

SAMA ID	Cost of Implementation	Averted Cost Risk at 903 MWe (95th percentile)	Net Value (903 MWe)	Averted Cost Risk at 917 MWe (95th percentile)	Net Value (917 MWe)	Change in Cost Effective-ness?
34	$50,000	$206,764	$156,764	$207,218	$157,218	No
33	$50,000	$33,587	-$16,413	$33,696	-$16,304	No
9	$50,000	$35,211	-$14,789	$35,320	-$14,680	No
10	$50,000	$64,409	$14,409	$64,457	$14,457	No
38	$50,000	$26,194	-$23,806	$26,255	-$23,745	No
3	$350,000	$51,284	-$298,716	$51,450	-$298,550	No
6	$400,000	$43,188	-$356,812	$43,328	-$356,672	No
5	$500,000	$85,233	-$414,767	$85,425	-$414,575	No
17	$500,000	$59,672	-$440,328	$59,755	-$440,245	No
11	$250,000	$19,418	-$230,582	$19,466	-$230,534	No
15	$300,000	$53,891	-$246,109	$53,943	-$246,057	No
4	$250,000	$65,623	-$184,377	$65,798	-$184,202	No
35	$700,000	$565,649	-$134,351	$565,802	-$134,198	No
51	$100,000	$167,619	$67,619	$167,990	$67,990	No
49	$150,000	$194,594	$44,594	$194,835	$44,835	No

E.7.3 MACCS2 Input Variations

The MACCS2 model was developed using the best information available for the CRNPP site; however, reasonable changes to modeling assumptions can lead to variations in the Level 3 results. As such, perturbations to some MACCS2 inputs were investigated to determine their effects on annual risk. Among the parameters analyzed, release height, release heat, evacuation speed and meteorological data year have been discussed previously. The effect of building wake on the risk was also determined because the proximity of site buildings introduces uncertainty as to local air flow around these buildings.

Severe meteorological conditions in the last spatial segment of the model domain (40-50 miles) were chosen to assure conservatively high impacts and risks. Most especially, perpetual rainfall was imposed on this segment so that a conservatively large quantity of the nuclides released in each scenario were deposited (via wet deposition) within the model domain.

In order to determine how certain assumptions could impact the SAMA results, a sensitivity analysis was performed on a group of parameters that has previously been shown to impact the Level 3 results. These parameters include:

- Meteorological data
- Evacuation speed
- Release height
- Release heat
- Wake effects

The table below provides the risk sensitivity to a choice of these parameters. Release height and release heat are parameters which could affect the risk such that increases of less than 5 percent are seen. However, the baseline modeling conservatism of specifying rainfall in the spatial ring from 40-50 miles is seen to more than balance any increases that might be due to release parameter specification.

Sensitivity of CRNPP Baseline Risk to Parameter Changes

Parameter	Description	Pop. Dose Risk Δ Base (%)	Cost Risk Δ Base (%)
Annual Met Data Set	Each year 2003 to 2006	-12% to 0% (2003) (2006)	-13% to -6% (2003) (2006)
Meteorology specification in last spatial segment, LIMSPA	Rainfall imposed at all times from 40 to 50 miles from release to force conservative population exposure.	-41%	-50%
Evacuation Speed	Baseline updated 1990 study with 2036 population, assumed EPZ roads at saturation in 1990 study.	-2%	No change [(a)]

Sensitivity of CRNPP Baseline Risk to Parameter Changes

Parameter	Description	Pop. Dose Risk Δ Base (%)	Cost Risk Δ Base (%)
Release Height (top of containment)	Baseline assumed ground level release except for tube rupture (aux bldg roof vents). Ground level releases changed to top of containment building.	+1%	+1%
Release Heat (1 MW per segment)	Baseline assumed no heat. Up to 4 segments released per scenario.	+1%	+1%
Release Heat (10 MW per segment)	Baseline assumed no heat. Large value to consider severe effects.	+2%	+4%
Wake Effects, SIGYINIT, SIGZINIT	Baseline determined from release building dimensions. Uncertainty due to proximity of buildings.	-1% (1/2 baseline) +1% (2x baseline)	No change [(a)]

[(a)] "No change" indicates < 0.5% change in risk.

The risk metrics produced by MACCS2 that are evaluated in the sensitivity analyses are the 50 mile population dose and the 50 mile offsite economic cost. The subsections below discuss the changes in these results for each of the sensitivity cases shown above. The final subsection, E.7.3.6, correlates the worst case changes identified in the sensitivity runs to a change in the site's averted cost-risk and discusses the implications of the sensitivity analysis on the SAMA analysis.

E.7.3.1 Meteorological Sensitivity

In addition to the year 2004 base case meteorological data, years 2003 through 2006 were also analyzed. Analysis of these alternate data sets yielded population dose-risks that are either equal to or lower than the 2004 data by as much as 12 percent; offsite economic cost-risks are lower than the 2004 data by at least 6 percent and as much as 16 percent.

As shown in the above table for the sensitivity case involving meteorology specifications in the last spatial segment (LIMSPA), population dose-risk decreased by 41 percent and economic cost-risk dropped by 50 percent. The entire decrease is due to removing perpetual rainfall (wet deposition) and specifying measured meteorology in the ring 40 to 50 miles from the site.

As no particular criteria have been defined by the industry related to determining which meteorological data set should be used as a base case for a site, the year 2004 data is conservatively chosen for CRNPP given that it represents the most complete dataset (maximum economic risk is within 0.3 percent of maximum dose risk for 2004).

E.7.3.2 Evacuation Speed

The evacuation speed case demonstrates minor population dose-risk impacts associated with evacuation assumptions due to the relatively slow basecase CRNPP evacuation. While evacuation assumptions do impact the population dose-risk estimates, they do not impact MACCS2 offsite economic cost-risk estimates because MACCS2 calculated cost-risks are based on land contamination levels which remain unaffected by evacuation assumptions and the number of people evacuating.

For CRNPP, evacuation assumptions have a relatively minor impact on dose-risk. A 50 percent decrease in the evacuation speed increased the dose-risk by only 2 percent. Furthermore, the 0-10 mile dose-risk is a minor contributor to 50-mile dose-risk.

E.7.3.3 Release Height

The release height sensitivity case quantifies the impact of the assumptions related to the height of the release of the plume. The baseline case assumes that the release occurs at ground level (except for tube rupture) rather than at an elevation that could correspond to a release through the stack or a break high in the reactor building. The lower release height shows a small increase in dose-risk of 1 percent and a small increase in OECR of 1 percent.

Increase in release height decreases close-in deposition. Larger downwind population is affected by a relatively undepleted plume. Risk increase is damped because the major risk sequence is already elevated.

E.7.3.4 Release Heat

The baseline case assumed no thermal plume heat release. Increasing the heat content to 1 MW per segment (up to 4 segments released per scenario) yields a minor dose-risk and OECR increase of 1 percent each. The effect of buoyant plume rise is similar to an increase in release height. Further increasing thermal plume heat content to 10 MW per segment yields a dose-risk increase of 2 percent and OECR increase of 4 percent. The increase in buoyancy increases downwind dose-risk (see release height discussion above).

E.7.3.5 Wake Effects

Analysis of wake effects produced minor changes in dose very near the release and no changes to cost-risk. At one-half baseline, dose-risk decreased by only 1 percent; at two times baseline, dose-risk increased 1 percent.

E.7.3.6 Impact on SAMA Analysis

Several different Level 3 input parameters are examined as part of the CRNPP MACCS2 sensitivity analysis. The primary reason for performing these sensitivity runs is to identify any reasonable changes that could be made to the Level 3 input parameters that would impact the conclusions of the SAMA analysis. While the table in Section E.7.3 summarizes the changes to the dose-risk and OECR estimates for each sensitivity case, it is prudent to consider if any of these changes would result in the retention of the SAMAs that were screened using the baseline results.

Of all the MACCS2 sensitivity cases, the largest dose-risk and OECR increases, 2% and 4% respectively, both occurred in the Release Heat (10 MW per segment) case. Subsequently, the CRNPP MMACR was recalculated using these results to determine the impact of using the worst case for each parameter simultaneously. The resulting MMACR is a factor of 1.02 greater than the base case, which is significantly less than the average factor of 2.18 calculated in Section E.7.2 for the 95th percentile individual SAMA PRA model results. Therefore, the 95th percentile PRA results sensitivity is considered to bound this case and no SAMAs would be retained based on this sensitivity that were not already identified in Section E.7.2.

E.8 CONCLUSIONS

The benefits of revising the operational strategies in place at CRNPP and/or implementing hardware modifications can be evaluated without the insight from a risk-based analysis. Use of the PRA in conjunction with cost-benefit analysis methodologies has, however, provided an enhanced understanding of the effects of the proposed changes relative to the cost of implementation and projected impact on a larger future population. The results of this study indicate that of the identified potential improvements that can be made at CRNPP, only one has been determined to be cost beneficial at the nominal level based on the methodology applied in this analysis and warrants further review for potential implementation.

The base case analysis shows that implementation of the following SAMA would be cost beneficial:

- SAMA 34: Improve Procedures for Manual Operation of EFW Valves

SAMA 34 is a potentially cost beneficial enhancement at CRNPP. The primary benefit would be in enhancing procedures to manually open the EFW discharge valves (EFV-56, -58, -55, and -57) given that they fail to open remotely.

The 95th percentile PRA results (see Section E.7.2) show that the following additional SAMAs may also be cost beneficial and should be given further consideration for implementation:

- SAMA 10: Proceduralize additional responses to MUV-23, MUV-24, MUV-25, and MUV-26 Failures
- SAMA 49: Upgrade fire barriers in Battery Charger Room 3A
- SAMA 51: Upgrade or improve engineering analysis to qualify the EFIC cabinets to a higher temperature

SAMA 10 is a potentially cost beneficial enhancement using the 95th percentile PRA values. The primary benefit is in establishing high pressure injection to the RCS by providing procedural recovery actions during LOCA scenarios given that all four injection valves fail to remotely open.

SAMA 49 is a potentially cost beneficial enhancement at the 95th percentile level based on upgrading the fire barriers in Battery Charger Room 3A in a similar manner to what was previously done for Battery Charger Room 3B a decade ago. Battery Charger Room 3A was shown from the IPEEE (FPC 1997) to be the fire zone with the highest risk contribution to external events CDF. The implementation cost was estimated from the resources spent on improving the fire barriers in Battery Charger Room 3B.

SAMA 51 was also shown to be cost beneficial at the 95th percentile level and involves refining the assumptions and analysis made in qualifying proper operation of the EFIC control circuitry at elevated temperatures. Proper operation of the EFIC system when room cooling is lost will improve the reliability of providing the initiation signal for the EFW pumps and for valve isolation and alignment of the OTSGs for various transients and accident scenarios. Any hardware modifications that might be required were assumed to be of minimal cost.

E.9 TABLES

Table E.2-1
Level 2 Results

Containment End State		Frequency	Percent CDF	Sub-Totals	
LERF	Early Failure	6.34E-09	0.1%	3.69E-07	4.9%
	Isolation (lg)	0.00E+00	0.0%		
	Bypass (sm)	3.13E-07	4.1%		
	Bypass (lg)	5.10E-08	0.7%		
Non-LERF	Late Failure	6.47E-08	0.9%	6.61E-07	8.7%
	Isolation (sm)	3.41E-07	4.5%		
	Failure (IVR)	2.55E-07	3.4%		
Intact	Intact	4.31E-06	86.4%	4.31E-06	86.4%
	Total	5.34E-06	100.0%	100.0%	100.0%

Table E.2-2
LERF by Sequence

Sequence	LERF	# Cutsets
@RCP_P	2.79E-07	28
@ISLOC_P	5.14E-08	1
@RBP_P	2.99E-08	2128
@RUQ_P	3.95E-09	102
@RUG_P	3.24E-09	340
@RQGY_P	1.06E-09	52
@RV_P	2.37E-10	3
@SX_P	2.20E-10	126
@TBL1U_P	1.24E-10	292
@AX_P	6.21E-11	22
@RUC_P	6.08E-11	6
@TKBM_P	4.30E-11	26
@MX_P	4.23E-11	73
@SBP_P	2.67E-11	6
@AU_P	1.41E-11	25
@TKBP_P	1.19E-11	31
@TQX_P	7.27E-12	27
@TBQU_P	5.19E-12	24
@SU_P	4.90E-12	3
@TBP_P	3.04E-12	13
@MU_P	2.86E-12	1
@TBLX_P	2.65E-12	18
@TBQX_P	2.51E-12	13
@RUB_P	1.39E-12	2
@TQU_P	6.27E-13	2
@TKU_P	2.11E-13	1
@SBX_P	1.05E-13	1
@RCQGY_P	0	0
@RBQX_P	0	0
@RBQY_P	0	0
@RBX_P	0	0
@TBLWX_P	0	0
@TKBQX_P	0	0
@TKBQU_P	0	0
@TKBL_P	0	0
@TKBU_P	0	0
Total	3.69E-07	3366

Table E.2-3
Containment Release Categories

Identifier	Description	Definition
IC-1	Containment Intact	This release category represents an accident sequence in which the containment is intact. The source term for this type of sequence is very small and limited to the containment design leakage rate.
RC-1	Release Category 1	This release category is a late containment failure caused by gradual overpressurization. The core debris is assumed to be coolable. This type of gradual pressure increase is assumed to result in a benign containment failure and the duration of the release could be over a long period of time. Either the containment sprays or a pool of water over the core debris scrubs the release from the containment.
RC-1A	Release Category 1A	This release category is similar to RC-1 except that revaporization occurs. Revaporization is caused by the self-heating of radionuclides plated out on the RCS, becoming resuspended in the containment atmosphere. This revaporization is postulated to occur late in the accident sequence after the containment has failed. This allows the radionuclides to be released from the containment after only a limited holdup time. The impact of revaporization on the source terms is to increase the contribution of volatile radionuclides to the source term.
RC-1B	Release Category 1B	This release category is similar to RC-1 except that no scrubbing by containment sprays and/or water pools is available. If containment sprays function, or the BWST inventory is otherwise dumped into containment, then both debris cooling and scrubbing will be attained (unless debris uncoolability is assumed). This can be assumed because for the CR3 containment when the BWST is discharged the water level reaches several feet over the basemat (lower compartment), completely covering the debris bed for the duration of all applicable sequences studied. This, this category implies a debris bed that eventually dries up resulting in considerable core-concrete interaction (CCI).
RC-1BA	Release Category 1BA	This release category is similar to RC-1 except that both revaporization and no containment scrubbing are assumed to occur.
RC-2	Release Category 2	This release category represents a large early containment failure. The core debris is assumed to be coolable. The large failure significantly reduces radionuclide holdup time in the containment. The CR3 specific liner failure releases are assumed to belong to this category. The release from the containment is scrubbed by containment spray operation at the time following fission product releases from the primary side. In this case the releases will be driven by the prompt release of fission products at containment failure and the effect of revaporization, if any, should be small. Thus, release categories with revaporization will not be postulated for the large early containment failures. However, care will be taken when assigning source terms to pick a representative sequence for RC-2 (and RC-2B) that exhibits revaporization.
RC-2B	Release Category 2B	This release category is similar to RC-2 except that no scrubbing by containment sprays and/or water pools is assumed to happen.

Table E.2-3
Containment Release Categories

Identifier	Description	Definition
RC-3	Release Category 3	This release category represents an early containment isolation failure with a small leakage rate (4”diameter). The core debris is assumed to be coolable. Either the containment sprays or a pool of water over the core debris scrubs the release from the containment. For the larger of the small leakage failures (i.e. close to 4” in diameter) the releases will be driven by the prompt release of fission products at containment failure and the effect of revaporization, if any, should be small. Smaller diameter isolation failures will result in reduced source terms due to the longer time available for natural removal mechanisms, such as gravity settling, to take place. Thus, release categories with revaporization will not be postulated for the small early containment failures. However, care will be taken when assigning source terms to pick a representative sequence for RC-3 (and RC-3B) that exhibits revaporization.
RC-3B	Release Category 3B	This release category is similar to RC-3 except that no scrubbing by containment sprays and/or water pools is assumed to happen.
RC-4	Release Category 4	This release category represents a containment bypass accident sequence with a small leakage rate. The leakage rate that would correspond to a SGTR sequence with cycling SRVs, or an ISLOCA in which operators react in time to mitigate effects by closing the valves on the RHR suction line. The core debris is assumed to be coolable and releases from the containment scrubbed. Scrubbing by water in the faulted SG above the break is assumed to occur. Note that the operating procedures direct the operator to isolate the faulted SG. Thus, the faulted SG will be dry in the majority of the cases and no fission product scrubbing would occur. This category will be kept for future use (in case the procedures change), but for the purposes of this study, the unscrubbed source term (RC-4C) will be conservatively assigned to these low probability branches.
RC-4C	Release Category 4C	This release category is similar to RC-4 except that no scrubbing by water in the faulted SG above the break occurs. The core debris is assumed to be coolable and releases from the containment scrubbed. Note that a release category for no scrubbing by containment sprays and/or water pools is not postulated in this case. This is so because for the bypass sequences most of the release would be directly from the primary to the environment or the auxiliary building. Revaporization is also assumed to be negligible as compared to the direct releases.
RC-5	Release Category 5	The sequence represents a containment bypass accident with a large leakage rate. Such rate is representative of a SGTR accident with a stuck open SRV in the faulted SG, or an unmitigated ISLOCA accident. The core debris is assumed to be coolable and releases from the containment scrubbed. The releases from the faulted SG are assumed to be scrubbed by water above the break line. However the probability of scrubbed releases is very low due to present procedures. Thus, similarly to RC-4 the unscrubbed source term (RC-5C) will be conservatively assigned to these low probability branches.
RC-5C	Release Category 5C	This release category is similar to RC-5 except that scrubbing by water in the faulted SG above the break occurs. The releases from the faulted SG are not scrubbed by water above the break line. The core debris is assumed to be coolable and releases from the containment scrubbed.

Table E.2-4
Release Categories That Dominate LERF

Release Category	Description of Representative Scenario
RC-5C	SGTR with a stuck open SRV without scrubbing or an ISLOCA
RC-2	Early containment failure due to phenomena at the time of RPV failure
RC-2B	Large containment isolation failure resulting in early releases from the containment

Table E.3-1
Estimated Population Distribution within a 10-Mile Radius of CRNPP, Year 2036 (1)

Sector	0-1 mile	1-2 miles	2-3 miles	3-4 miles	4-5 miles	5-10 miles	10-mile total
N	0	0	0	450	95	1249	1794
NNE	0	0	0	0	249	2486	2735
NE	0	0	0	0	181	1346	1527
ENE	0	0	0	7	379	5193	5579
E	0	0	0	5	145	2652	2802
ESE	0	0	0	0	509	11103	11612
SE	0	0	0	0	0	6354	6354
SSE	0	7	0	4	0	776	787
S	0	0	0	0	0	251	251
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	4	0	4
NNW	0	0	0	0	349	278	627
Total	0	7	0	466	1911	31688	34072

(1) County population growth estimates applied to year 2000 census data to develop year 2036 estimate.

Table E.3-2
Estimated Population Distribution within a 50-Mile Radius of CRNPP, Year 2036 (1)

Sector	0-10 miles	10-20 miles	20-30 miles	30-40 miles	40-50 miles	50-mile total
N	1794	333	1090	8610	17209	29036
NNE	2735	1197	6314	18467	63971	92684
NE	1527	8503	20762	24432	27185	82409
ENE	5579	21403	43393	168185	112867	351427
E	2802	28006	14006	73304	188894	307012
ESE	11612	34080	56969	25825	76999	205485
SE	6354	32206	6138	54366	42688	141752
SSE	787	13187	18072	165760	20892	218698
S	251	4	2562	64118	271540	338475
SSW	0	0	0	0	0	0
SW	0	0	0	0	0	0
WSW	0	0	0	0	0	0
W	0	0	0	0	0	0
WNW	0	0	1505	0	0	1505
NW	4	0	1443	929	472	2848
NNW	627	53	213	9991	17199	28083
Total	34072	138972	172467	613987	839916	1799414

(1) County population growth estimates applied to year 2000 census data to develop year 2036 estimate.

Table E.3-3
Estimated CRNPP MACCS2 End of Cycle Core Inventory

Entry	Nuclide [(1)]	CRNPP MACCS2 [(2)]	Entry	Nuclide [(1)]	CRNPP MACCS2 [(2)]
1	Co-58	1.48E+16	31	Te-131m	4.66E+17
2	Co-60	1.78E+16	32	Te-132	4.00E+18
3	Kr-85	4.07E+16	33	I-131	2.81E+18
4	Kr-85m	8.29E+17	34	I-132	3.74E+18
5	Kr-87	1.51E+18	35	I-133	5.48E+18
6	Kr-88	2.10E+18	36	I-134	6.07E+18
7	Rb-86	1.28E+16	37	I-135	4.40E+18
8	Sr-89	2.80E+18	38	Xe-133	5.44E+18
9	Sr-90	3.07E+17	39	Xe-135	1.48E+18
10	Sr-91	3.64E+18	40	Cs-134	5.48E+17
11	Sr-92	3.57E+18	41	Cs-136	1.57E+17
12	Y-90	3.06E+17	42	Cs-137	4.07E+17
13	Y-91	3.74E+18	43	Ba-139	4.77E+18
14	Y-92	2.46E+18	44	Ba-140	4.74E+18
15	Y-93	3.06E+18	45	La-140	4.81E+18
16	Zr-95	3.70E+18	46	La-141	4.22E+18
17	Zr-97	4.07E+18	47	La-142	3.77E+18
18	Nb-95	3.70E+18	48	Ce-141	4.26E+18
19	Mo-99	4.88E+18	49	Ce-143	3.44E+18
20	Tc-99m	4.14E+18	50	Ce-144	3.59E+18
21	Ru-103	5.22E+18	51	Pr-143	3.36E+18
22	Ru-105	3.92E+18	52	Nd-147	1.68E+18
23	Ru-106	1.30E+18	53	Np-239	8.03E+19
24	Rh-105	1.78E+18	54	Pu-238	2.68E+15
25	Sb-127	4.37E+17	55	Pu-239	1.19E+16
26	Sb-129	7.81E+17	56	Pu-240	6.99E+15
27	Te-127	4.37E+17	57	Pu-241	3.66E+17
28	Te-127m	5.92E+16	58	Am-241	1.52E+15
29	Te-129	1.08E+18	59	Cm-242	8.73E+16
30	Te-129m	1.62E+17	60	Cm-244	1.44E+14

(1) MACCS2 allows up to 60 nuclides input
(2) Unit of measure = Becquerels.

Table E.3-4
MACCS2 Release Categories vs. CRNPP Release Categories

MACCS2 Release Categories	CRNPP Release Categories
Xe/Kr	1 – noble gases
I	2 – CsI
Cs	2 & 6 – CsI and CsOH
Te	3 & 11- TeO_2 & Te_2 (1)
Sr	4 – SrO
Ru	5 – MoO_2 (Mo is in Ru MACCS category)
La	8 – La_2O_3
Ce	9 – CeO_2 & UO_2 (1)
Ba	7 – BaO
Sb (supplemental category)	10 - Sb

(1) These release fractions are typically negligible.

Table E.3-5
Representative MAAP Level 2 Case Descriptions and Key Event Timings

Case	Release Category	Sequence	Representative Case Description	Tcd (1) (Hrs)	Thlcr (2) (Hrs)	Tvf (3) (Hrs)	Tcf (4) (Hrs)	Tend (5) (Hrs)	Noble Gas Fraction	CsI (6) Fraction
1	IC-1	SX_P	Small LOCA + SSHR success + injection success + no recirculation - oper fails to do recirc, cc and random failures of both DH trains (Successful isolation, sprays fail in injection and fans succeed)	8.88	N/A	13.74	N/A	48	1.40E-03	1.40E-05
2	RC-1	TQX_P	Transient + SSHR success + safety valve lifts and sticks open + high head injection success + failure to switch to recirc - opers fail to prevent PZ overfill, fail to recirc (Successful isolation, sprays fail in injection and fans succeed)	11.1	12.47	17.2	45.93	72	9.50E-01	5.10E-04
3	RC-1A	SBP_P	Small LOCA + operators fail to raise SG level (=inadequate SSHR) + PORV fails to open - oper fails to control level, PORV (Successful isolation, sprays fail in injection and fans succeed)	8.55	N/A	13.27	41.72	72	9.60E-01	2.10E-04
4	RC-1B	TBL1U_P	Trans + SSHR failure + injection failure - HVAC and AFW control probs (Successful isolation, sprays fail in injection and fans succeed)	1.35	1.9	5.58	23	72	9.70E-01	9.80E-04
5	RC-1BA	TBL1U_P	Trans + SSHR failure + injection failure - HVAC and AFW control probs (Successful isolation, sprays fail in injection and fans succeed)	1.35	1.9	5.58	23	72	9.70E-01	9.80E-04
6	RC-2	TBL1U_P	Trans + SSHR failure + injection failure - HVAC and AFW control probs (Successful isolation, sprays fail in injection and fans succeed)	1.35	1.9	3.12	N/A	72	1.00E+00	7.70E-02
7	RC-2B	TQX_P	Transient + SSHR success + safety valve lifts and sticks open + high head injection success + failure to switch to recirc - opers fail to prevent PZ overfill, fail to recirc (Successful isolation, sprays fail in injection and fans succeed)	11.1	12.47	15.12	N/A	72	1.00E+00	3.00E-02
8	RC-3	TBL1U_P	Trans + SSHR failure + injection failure - HVAC and AFW control probs (Small isolation failure, sprays fail in injection and fans succeed)	1.33	1.9	3.12	N/A	60	1.00E+00	6.50E-04

Table E.3-5
Representative MAAP Level 2 Case Descriptions and Key Event Timings

Case	Release Category	Sequence	Representative Case Description	Tcd (1) (Hrs)	Thlcr (2) (Hrs)	Tvf (3) (Hrs)	Tcf (4) (Hrs)	Tend (5) (Hrs)	Noble Gas Fraction	CsI (6) Fraction
9	RC-3B	TBL1U_P	Trans + SSHR failure + injection failure - HVAC and AFW control probs (Small isolation failure, sprays fail in injection and fans succeed)	1.33	1.9	3.12	N/A	60	9.80E-01	2.10E-02
10	RC-4C	RCP_P	SGTR + failure to cooldown/depressurize using secondary side + failure to depressurize using PORV - opers fail to cooldown, open PORV (Containment bypass)	11.35	13.23	18.71	N/A	48	1.00E+00	7.00E-02
11	RC-5C	ISLOC_P	LLOCA outside containment + injection failure - DHR drop line (Containment bypass)	0.74	N/A	3.51	N/A	48	1.00E+00	9.80E-01

Notes:

(1) Tcd - Time of core damage (maximum core temperature >1800°F)
(2) Thlcr – Time of hot leg creep rupture
(3) Tvf - Time of vessel breach
(4) Tcf – Time of containment failure
(5) Tend – Time at end of run
(6) CsI – Cesium Iodide release

Table E.3-6
CRNPP Source Term Summary

	Release Category										
	IC-1	RC-1	RC-1A	RC-1B	RC-1BA	RC-2	RC-2B	RC-3	RC-3B	RC-4C	RC-5C
Bin Frequency	4.15E-06	2.48E-08	3.94E-10	1.55E-08	1.18E-09	8.53E-10	3.43E-09	2.16E-07	1.58E-07	3.59E-07	5.74E-08
Run Duration	48 hr	72 hr	72 hr	72 hr	72 hr	48 hr	48 hr	60 hr	60 hr	48 hr	48 hr
Time after Scram when General Emergency is declared [3]	8.9 hr	11.1 hr	8.6 hr	1.4 hr	1.4 hr	1.3 hr	11.1 hr	1.3 hr	1.4 hr	11.3 hr	.73 hr
Fission Product Group:											
1) Noble											
Total Plume 1 Release Fraction	1.40E-03	9.50E-01	9.60E-01	9.70E-01	9.70E-01	1.00E+00	1.00E+00	1.00E+00	9.80E-01	1.00E+00	1.00E+00
Start of Plume 1 Release (hr)	8.40	47.00	42.80	23.10	23.10	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	48.00	72.00	60.00	40.00	40.00	7.00	20.00	30.00	30.00	17.00	1.10 [1]
Total Plume 2 Release Fraction [2]											
Start of Plume 2 Release (hr)											
End of Plume 2 Release (hr)											
2) CsI											
Total Plume 1 Release Fraction	1.40E-05	5.10E-04	2.10E-04	9.80E-04	9.80E-04	7.70E-02	3.00E-02	6.50E-04	2.10E-02	7.00E-02	9.80E-01
Start of Plume 1 Release (hr)	9.40	47.00	42.80	23.10	23.10	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	40.10	40.10	7.00	18.20	17.00	35.50	17.00	2.10
Total Plume 2 Release Fraction [2]				1.10E-02	1.10E-02		1.20E-01			7.00E-01	
Start of Plume 2 Release (hr)				48.20	48.20		26.00			28.00	
End of Plume 2 Release (hr)				72.00	72.00		43.00			42.00	
3) TeO2											
Total Plume 1 Release Fraction	1.40E-05	3.10E-04	2.50E-04	3.00E-04	1.30E-04	4.10E-02	2.30E-02	4.00E-04	8.10E-03	8.80E-02	9.60E-01
Start of Plume 1 Release (hr)	9.40	47.00	42.80	23.00	23.00	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	40.10	40.10	7.00	17.10	3.50	10.00	17.00	7.10
Total Plume 2 Release Fraction [2]				3.90E-03	3.90E-03		3.70E-02			1.20E-01	
Start of Plume 2 Release (hr)				62.80	62.80		26.20			28.00	
End of Plume 2 Release (hr)				72.00	72.00		42.00			42.00	
4) SrO											
Total Plume 1 Release Fraction	2.20E-06	2.80E-04	1.10E-04	1.10E-05	1.10E-05	1.50E-02	1.10E-02	1.90E-04	4.50E-03	2.50E-02	1.70E-01
Start of Plume 1 Release (hr)	9.40	47.00	42.80	3.50	3.50	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	10.00	10.00	7.00	17.10	3.50	10.00	17.00	7.10

Table E.3-6
CRNPP Source Term Summary

	Release Category										
	IC-1	RC-1	RC-1A	RC-1B	RC-1BA	RC-2	RC-2B	RC-3	RC-3B	RC-4C	RC-5C
Bin Frequency	4.15E-06	2.48E-08	3.94E-10	1.55E-08	1.18E-09	8.53E-10	3.43E-09	2.16E-07	1.58E-07	3.59E-07	5.74E-08
Run Duration	48 hr	72 hr	72 hr	72 hr	72 hr	48 hr	48 hr	60 hr	60 hr	48 hr	48 hr
Time after Scram when General Emergency is declared (3)	8.9 hr	11.1 hr	8.6 hr	1.4 hr	1.4 hr	1.3 hr	11.1 hr	1.3 hr	1.4 hr	11.3 hr	.73 hr
Fission Product Group:											
Total Plume 2 Release Fraction (2)				1.00E-04	1.00E-04						
Start of Plume 2 Release (hr)				23.10	23.10						
End of Plume 2 Release (hr)				34.80	34.80						
5) MoO2											
Total Plume 1 Release Fraction	1.20E-05	5.30E-05	1.30E-04	8.00E-06	8.00E-06	6.50E-03	1.10E-02	5.60E-05	1.60E-03	3.00E-02	7.50E-01
Start of Plume 1 Release (hr)	9.40	47.00	42.80	3.50	3.50	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	10.00	10.00	7.00	17.10	3.50	10.00	17.00	1.10 (1)
Total Plume 2 Release Fraction (2)				4.40E-05	4.40E-05						
Start of Plume 2 Release (hr)				23.10	23.10						
End of Plume 2 Release (hr)				34.80	34.80						
6) CsOH											
Total Plume 1 Release Fraction	1.40E-05	2.50E-04	2.10E-04	5.00E-04	5.00E-04	2.50E-02	1.70E-02	1.90E-04	5.40E-03	7.10E-02	9.80E-01
Start of Plume 1 Release (hr)	9.40	47.00	42.80	23.10	23.10	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	40.10	40.10	7.00	17.10	7.00	10.00	17.00	7.10
Total Plume 2 Release Fraction (2)				9.30E-03	9.30E-03		2.30E-02			1.40E-01	
Start of Plume 2 Release (hr)				40.10	40.10		26.20			28.00	
End of Plume 2 Release (hr)				72.00	72.00		42.00			42.00	
7) BaO											
Total Plume 1 Release Fraction	7.60E-06	1.90E-04	1.40E-04	1.60E-05	1.60E-05	1.30E-02	1.30E-02	1.40E-04	3.50E-03	4.20E-02	3.80E-01
Start of Plume 1 Release (hr)	9.40	47.00	42.80	3.50	3.50	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	10.00	10.00	7.00	17.10	3.50	10.00	17.00	1.10 (1)
Total Plume 2 Release Fraction (2)				1.30E-04	1.30E-04						
Start of Plume 2 Release (hr)				23.10	23.10						
End of Plume 2 Release (hr)				34.80	34.80						
8) La2O3											
Total Plume 1 Release Fraction	9.40E-08	4.00E-06	1.90E-06	4.30E-06	4.30E-06	1.50E-02	1.10E-02	1.90E-04	3.90E-03	1.20E-03	5.30E-03
Start of Plume 1 Release (hr)	9.40	47.00	42.80	23.10	23.10	1.30	15.10	1.50	1.30	11.30	1.10

Table E.3-6
CRNPP Source Term Summary

	Release Category										
	IC-1	RC-1	RC-1A	RC-1B	RC-1BA	RC-2	RC-2B	RC-3	RC-3B	RC-4C	RC-5C
Bin Frequency	4.15E-06	2.48E-08	3.94E-10	1.55E-08	1.18E-09	8.53E-10	3.43E-09	2.16E-07	1.58E-07	3.59E-07	5.74E-08
Run Duration	48 hr	72 hr	72 hr	72 hr	72 hr	48 hr	48 hr	60 hr	60 hr	48 hr	48 hr
Time after Scram when General Emergency is declared (3)	8.9 hr	11.1 hr	8.6 hr	1.4 hr	1.4 hr	1.3 hr	11.1 hr	1.3 hr	1.4 hr	11.3 hr	.73 hr
Fission Product Group:											
End of Plume 1 Release (hr)	16.00	72.00	60.00	34.80	34.80	7.00	17.10	3.50	10.00	17.00	7.10
Total Plume 2 Release Fraction (2)											
Start of Plume 2 Release (hr)											
End of Plume 2 Release (hr)											
9) CeO2											
Total Plume 1 Release Fraction	5.00E-07	2.90E-05	1.30E-05	8.50E-05	8.50E-05	1.70E-02	1.10E-02	1.90E-04	5.00E-03	6.90E-03	3.40E-02
Start of Plume 1 Release (hr)	9.40	47.00	42.80	23.10	23.10	1.50	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	34.80	34.80	7.00	17.10	3.50	10.00	17.00	7.10
Total Plume 2 Release Fraction (2)											
Start of Plume 2 Release (hr)											
End of Plume 2 Release (hr)											
10) Sb											
Total Plume 1 Release Fraction	1.30E-05	1.30E-02	4.80E-04	2.80E-02	2.80E-02	1.60E-01	4.30E-02	1.20E-03	9.50E-02	3.80E-01	9.30E-01
Start of Plume 1 Release (hr)	9.40	47.00	42.80	23.00	23.00	1.30	15.10	1.50	1.30	11.30	1.10
End of Plume 1 Release (hr)	16.00	72.00	60.00	53.00	53.00	7.00	17.10	3.50	60.00	19.50	1.10 (1)
Total Plume 2 Release Fraction (2)				3.40E-02	3.40E-02		2.00E-01			7.10E-01	
Start of Plume 2 Release (hr)				53.00	53.00		21.50			26.00	
End of Plume 2 Release (hr)				72.00	72.00		34.80			28.00	
11) Te2											
Total Plume 1 Release Fraction	7.00E-12	0.00E+00	1.30E-09	2.90E-04	2.90E-04	7.00E-05	1.30E-06	8.40E-07	5.70E-05	2.80E-06	1.60E-05
Start of Plume 1 Release (hr)	14.00		42.80	23.00	23.00	3.20	15.10	1.50	1.30	23.50	3.80
End of Plume 1 Release (hr)	48.00		60.00	53.00	53.00	4.20	17.10	3.50	60.00	42.00	12.00
Total Plume 2 Release Fraction (2)				3.60E-04	3.60E-04			1.60E-06			
Start of Plume 2 Release (hr)				53.00	53.00			17.00			
End of Plume 2 Release (hr)				72.00	72.00			40.00			
12) UO2											
Total Plume 1 Release Fraction	0.00E+00	0.00E+00	0.00E+00	4.10E-06	4.10E-06	4.40E-05	0.00E+00	0.00E+00	1.90E-05	9.90E-08	1.50E-04

Table E.3-6
CRNPP Source Term Summary

	Release Category										
	IC-1	RC-1	RC-1A	RC-1B	RC-1BA	RC-2	RC-2B	RC-3	RC-3B	RC-4C	RC-5C
Bin Frequency	4.15E-06	2.48E-08	3.94E-10	1.55E-08	1.18E-09	8.53E-10	3.43E-09	2.16E-07	1.58E-07	3.59E-07	5.74E-08
Run Duration	48 hr	72 hr	72 hr	72 hr	72 hr	48 hr	48 hr	60 hr	60 hr	48 hr	48 hr
Time after Scram when General Emergency is declared (3)	8.9 hr	11.1 hr	8.6 hr	1.4 hr	1.4 hr	1.3 hr	11.1 hr	1.3 hr	1.4 hr	11.3 hr	.73 hr
Fission Product Group:											
Start of Plume 1 Release (hr)				23.00	23.00	9.20			10.60	23.50	3.80
End of Plume 1 Release (hr)				72.00	72.00	28.00			60.00	42.00	12.00
Total Plume 2 Release Fraction (2)											
Start of Plume 2 Release (hr)											
End of Plume 2 Release (hr)											

Notes:
(1) Puff releases are denoted in the table by those entries with equivalent start and end times.
(2) Plume 2 release fraction is cumulative and includes the initial plume 1 release fraction
(3) General Emergency declaration based on time of core damage.

Table E.3-7
MACCS2 Base Case Mean Results

Source Term	Release Category	Dose (p-rem)	Offsite Economic Cost ($)	Freq. (/yr)	Dose-Risk (p-rem/yr)	OECR ($/yr)
1	IC-1	9.81E+03	1.02E+04	4.15E-06	4.07E-02	4.23E-02
2	RC-1	2.06E+05	2.17E+07	2.48E-08	5.12E-03	5.39E-01
3	RC-1A	1.51E+05	1.56E+06	3.94E-10	5.94E-05	6.14E-04
4	RC-1B	2.17E+06	1.85E+09	1.55E-08	3.36E-02	2.87E+01
5	RC-1BA	2.17E+06	1.85E+09	1.18E-09	2.57E-03	2.19E+00
6	RC-2	3.96E+06	8.55E+09	8.53E-10	3.38E-03	7.29E+00
7	RC-2B	3.76E+06	7.70E+09	3.43E-09	1.29E-02	2.64E+01
8	RC-3	3.00E+05	6.10E+07	2.16E-07	6.48E-02	1.32E+01
9	RC-3B	1.93E+06	4.32E+09	1.58E-07	3.05E-01	6.83E+02
10	RC-4C	7.47E+06	1.41E+10	3.59E-07	2.68E+00	5.06E+03
11	RC-5C	1.44E+07	1.96E+10	5.74E-08	8.26E-01	1.12E+03
FREQUENCY WEIGHTED TOTALS				**4.99E-06**	**3.98E+00**	**6.95E+03**

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
FLG_X	1.00E+00	1.793	TAG EVENT - LONG TERM COOLING (HPR/LPR/REFILL)	This is not a basic event, but a tag identifying sequences involving recirc/ refill. Basic events for those sequences are addressed separately.
IE_S	5.00E-04	1.438	SMALL BREAK LOCA	This is the initiating frequency for small LOCAs. No potential SAMA was identified to significantly change the likelihood of small LOCA but the significance of small LOCA may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
FLG_HVAC	1.00E+00	1.366	HVAC REQUIRED DUE TO AVAILABILITY OF AC POWER	This is not a basic event but a tag identifying sequences where HVAC is required, primarily to provide cooling for EFW controls. Basic events for those sequences are addressed separately.
FLG_QHUEFWMR	1.00E+00	1.33	OPERATORS FAIL TO MANUALLY OPEN CONTROL VALVE	This is not a basic event but a tag identifying sequences where HVAC is failed, control systems are potentially failed, and operator actions to manually operate valves might be helpful. Events for those sequences are addressed separately, however a SAMA is proposed to provide procedures and training for manual operation of the affected valves (EFV-55, -56, -57, -58): SAMA 34
QSPLHVAC	5.00E-01	1.325	SPLIT FRACTION - VALVES FAIL CLOSED ON LOSS OF HVAC	This is not a basic event but a split fraction. Related basic events are addressed separately.
FLG_SW	1.00E+00	1.243	TAG EVENT - LOSS OF NORMAL SW	This is not a basic event, but a tag identifying sequences involving loss of service water. Basic events for those sequences are addressed separately.
JHUCHP2R	1.00E+00	1.135	OPERATORS FAIL TO USE DEDICATED CHILLED WATER SYSTEM	Operator action related to importance of HVAC / cooling to EFW / EFIC. Related SAMAs have been identified to provide automated replacement of some of the functions, to manually perform some of the functions potentially lost (operate EFV-55, …-58), or to provide a substitute for the potentially affected AFW/ EFW equipment: SAMAs 1, 26, 34.

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
QHUFW7EY	1.00E+00	1.115	OPERATORS FAIL TO START FWP-7 BEFORE PORV LIFTS	Operator action to manually align FWP-7 AFW pump. Related SAMAs have been identified to provide autostart of FWP-7 as well as to install an alternative AFW/ EFW train with automatic start: SAMAs 4, 7.
QPMFWP7M	2.03E-02	1.114	FWP-7 IN MAINTENANCE	AFW Pump FWP-7, related SAMA has been identified to provide an alternate AFW/EVW train. Also a SAMA has been identified to reduce maintenance downtime for FWP-7: SAMAs 5, 7.
IE_Z	5.00E-07	1.111	REACTOR VESSEL RUPTURE	This is the initiating event frequency for "vessel rupture" i.e. LOCA larger than can be mitigated. No potential SAMA was identified to significantly change the likelihood of this event.
JHUCHP2Z	5.00E-02	1.108	JHUCHP2R	Sequence-specific substitution for JHUCHP2R. See discussion related to that action.
RHUPORVY	5.00E-01	1.089	OPERATORS FAILS TO OPEN PORV FOR PRESSURE RELIEF	Important action for LOOP, LOFW, etc. Related SAMA identified to auto open PORV: SAMA 35
IE_F6A	2.63E-03	1.083	PIPE RUPTURE ON ELEVATION 95 OF THE AUX BLDG (FIRE ZONE AB-95-X)	Initiator for a particular internal flood. A related SAMA has been identified to provide indication and procedures to allow isolation of flood: SAMA 6.
IE_R	3.00E-03	1.076	STEAM GENERATOR TUBE RUPTURE	This is the initiating frequency for steam generator tube ruptures. No potential SAMA was identified to significantly change the likelihood of SGTR but the significance of SGTR may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
QMMEFP3F	3.29E-02	1.07	EFP-3 PUMP TRAIN FAILS TO RUN	Basic event for EFW pump FTR. SAMA related to EFW / AFW has been identified, to provide an independent train: SAMA 7.
HHUHPRCY	4.40E-04	1.069	OPERATORS FAIL TO SWITCH FROM HIGH PRESSURE INJECTION TO RECIRCULATION	Operator action to switch to recirculation. Related SAMA has been identified to automate switchover: SAMA 3.

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
RMMRCVSC	2.50E-02	1.068	SAFETY RELIEF VALVE FAILS TO CLOSE (STEAM RELIEF)	SRV FTC. No SAMA directly related to this event was identified however SAMAs related to mitigating systems have been identified.
IE_T11	1.16E-04	1.067	LOSS OF INTAKE	This is the initiating frequency for loss of intake. No potential SAMA was identified to significantly change the likelihood of loss of intake but the significance of the event may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
IE_T3	7.27E-03	1.065	LOSS OF OFFSITE POWER	This is the initiating frequency for loss of offsite power. No potential SAMA was identified to significantly change the likelihood of LOOP but the significance of LOOPs may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
QHUFWP7Y	5.60E-03	1.063	OPERATORS FAIL TO START FWP-7	Oper action to start AFW pump FWP-7. SAMAs related to EFW/AFW have been identified, to provide autostart of FWP-7 and to provide an additional train of AFW/ EFW: SAMAs 5, 7.
RHUCOOLY	5.80E-04	1.059	OPERATORS FAIL COOLDOWN VIA OTSG	Operator action to cool down on SGTR. Some actions can be improved by improving procedures and training, however the CR3 procedures and training are believed to be adequate.
HHUMPSBY	1.00E+00	1.059	OPERATOR FAILS TO START STANDBY MAKEUP PUMP	Operator action to start / align standby makeup pump. Some actions can be improved by improving procedures and training, however the CR3 procedures and training are believed to be adequate.
IE_T1	1.10E+00	1.058	REACTOR TRIP	This is the initiating frequency for simple reactor trips. No potential SAMA was identified to significantly change the likelihood of simple reactor trips but the limited significance of reactor trip may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
SPMRW3BM	8.60E-03	1.057	RWP-3B IN MAINTENANCE	Unavailability / failure of raw water pump. A SAMA has been identified to supply water to the system from an alternate source: SAMA 8.
IE_T8	3.21E-03	1.056	LOSS OF 4160V ES BUS 3A	This is the initiating frequency for loss of an ES bus. No potential SAMA was identified to significantly change the likelihood of loss of the ES bus but the significance of the event may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
ZHUCOM2Z	2.80E-01	1.051	COND PROB OF RHUPORVY GIVEN RHUCOOLY	This is the conditional probability of failure to open a PORV given failure to initiate cooldown. No SAMA was identified to reduce the likelihood of failure at one action presuming that operators failed to take another action.
FLG_TBQR	1.00E+00	1.051	TAG EVENT - STUCK OPEN RELIEF AFTER B	This is a tag event intended to identify sequences involving a stuck-open relief valve. The basic events related to those sequences are evaluated separately.
QMMEFP2F	3.37E-02	1.044	EFP-2 FAILS TO CONTINUE TO RUN	A SAMA has been identified related to AFW / EFW, to provide an additional train: SAMA 7.
APWNR01R	6.40E-01	1.044	BOTH EDGS FTS, BOTH EFPS FTS	This is a calculated value denoting the likelihood that AC power will not be recovered in time for the specified failures. No specific SAMA was identified to change the AC power nonrecovery value but a SAMA was identified to provide an additional EDG: SAMA 18.
LPM001BM	1.03E-02	1.043	DHP-1B TRAIN IN MAINTENANCE	This is a basic event representing a decay heat removal pump being out of service for testing and maintenance. A SAMA was proposed to provide a diverse or maintenance spare train: SAMA 13.
HHUINJAY	5.00E-01	1.04	OPERATORS FAIL TO SWITCH MUV-23/24 TO BACKUP POWER	Operator action to supply backup power to high head injection valves. A SAMA was identified to proceduralize manual alignment: SAMA 10.

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
LPM001AM	1.03E-02	1.038	DHP-1A TRAIN IN MAINTENANCE	This is a basic event representing a decay heat removal pump train being failed or out of service. Proposed SAMA: provide a redundant/ diverse spare or a maintenance spare DH train: SAMA 13.
LMMDHPBF	4.90E-03	1.037	FAILURE OF DHP-1B AND ITS VALVES	This is a basic event representing a decay heat removal pump train being failed or out of service. Proposed SAMA: provide a redundant/ diverse spare or maintenance spare DH train, which could also be substituted for a failed train: SAMA 13.
SCCHDABF	2.39E-04	1.036	COMMON CAUSE FAILURE OF HXs DCHE-1A AND DCHE-1B PLUGGED	Proposed SAMA, add removable strainers ahead of heat exchangers: SAMA 37.
IE_A	5.00E-06	1.036	LARGE BREAK LOCA	This is the initiating frequency for LOCA. No potential SAMA was identified to significantly change the likelihood of LOCA but the significance of the event may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
SPLT_RA	5.00E-01	1.035	SGTR OCCURS ON OTSG-A <SPLIT FRACTION>	Split fraction, no SAMA required.
SPLT_RB	5.00E-01	1.035	SGTR OCCURS ON OTGS-B <SPLIT FRACTION>	Split fraction, no SAMA required.
LMMDHPAF	4.90E-03	1.035	FAILURE OF DHP-1A AND ITS VALVES	This is a basic event representing a decay heat removal pump train being failed or out of service. Proposed SAMA: add an additional DH train: SAMA 13.
LMMDV43F	4.65E-03	1.035	FAILURE OF TRAIN B RECIRC VALVE DHV-43	Basic event representing inability to open sump valve for recirculation. Proposed SAMAs: proceduralize either manual operation of the valve or crosstying of LHI suction: SAMA 16, 33.
LMMDV12F	4.65E-03	1.034	TRAIN B RECIRC VALVE DHV-12 FAILS	Basic event represents inability to open valve to supply HHSI/ MUP from LHI. Proposed SAMA: proceduralize either manual operation of the valve or crosstying of MUP suction: SAMA 9, 16

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
FLG_TQR	1.00E+00	1.034	TAG EVENT - STUCK OPEN RELIEF	Tag event to identify sequence. No SAMA suggested.
QMMCST	6.46E-03	1.034	FAILURE OF CST WATER SUPPLY	Module representing various CST failure modes. Proposed SAMA: proceduralize use of alternate water sources in event of CST failure: SAMA 38.
LMMDV42F	4.65E-03	1.033	FAILURE OF TRAIN A RECIRC VALVE DHV-42	Basic event representing inability to open sump valve for recirculation. Proposed SAMA: proceduralize either manual operation of the valve or crosstying of LHI suction: SAMA 16, 33.
LMMDV11F	4.65E-03	1.032	TRAIN A RECIRC VALVE DHV-11 FAILS	Basic event represents inability to open valve to supply HHSI/ MUP from LHI. Proposed SAMA: proceduralize either manual operation of the valve or crosstying of MUP suction: SAMA 9, 16.
SPMRW3AM	8.60E-03	1.032	RWP-3A IN MAINTENANCE	Unavailability / failure of raw water pump. A SAMA has been identified to supply water to the system from an alternate source: SAMA 8.
FLG_PHURMFWR	1.00E+00	1.032	OPERATORS FAIL TO RECOVER MFW	This is a flag event. Related basic events are considered separately.
H_SPLT_B	7.00E-01	1.032	FRACTION OF SLOCAS IN COLD LEG LOCATIONS REQUIRING SECONDARY COOLING	Split fraction, no SAMA suggested.
IE_T16	1.00E+00	1.032	LOSS OF MAKEUP	This is the initiating frequency for loss of makeup. No potential SAMA was identified to significantly change the likelihood of loss of makeup but the significance of the event may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately
QHUEFW9Y	2.70E-03	1.031	OPERATORS FAIL TO RAISE OTSGs LEVEL	This is an operator action required to ensure adequate “boiler-condenser” mode cooling during small LOCAs. Suggested SAMA: automate level control setpoint change: SAMA 14

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
FHUF6A1Y	1.90E-03	1.03	OPERATOR FAILS TO ISOLATE FLOOD F6A (CASE 1)	Failure to isolate certain large raw water floods in auxiliary building. Proposed SAMA: provide instrumentation and guidance to allow more rapid isolation of floods: SAMA 6
RCCDRODA	1.00E-06	1.029	MECH FAILURE OF ENOUGH CONTROL RODS TO DROP	Part of ATWS initiating event logic. No relevant SAMA identified.
HHUMBACY	1.00E+00	1.027	OPERATORS FAIL TO SWITCH MUP-1B POWER SOURCE IN	Failure to locally swap power supply to “swing” pump. Proposed SAMA: provide remote switching capability: SAMA 15.
ZHUCOM1Z	2.80E-01	1.027	COND PROB OF RHUPORVY GIVEN QHUEFW9Y	This is a conditional operator error probability, the likelihood that operators will fail to open a PORV given that they failed to raise OTSG level. A SAMA has been identified to automate the change in OTSG level setpoint. Automating that action would allow greater focus on the second action. No further SAMA is suggested.
QHUEFT2Y	7.70E-04	1.027	OPERATORS FAIL TO CROSSTIE EFW SOURCES	SAMAs have been identified to provide additional makeup / suction supplies to AFW and EFW: SAMAS 7, 38.
SMMDHCCB	2.73E-03	1.026	DHCCC TRAIN B FAULTS	Module containing various decay heat closed cooling system failures. Proposed SAMA: proceduralize crosstying of DHCC trains: SAMA 16.
PMMICSAH	7.45E-02	1.026	OTSG A LEVEL CONTROL FAULTS	This module contains basic event failures which could lead to OTSG overfeed. Proposed SAMA: add redundant /diverse level controls: SAMA 17.
PMMICSBH	7.45E-02	1.026	OTSG B LEVEL CONTROL FAULTS	This module contains basic event failures which could lead to OTSG overfeed. Proposed SAMA: add redundant /diverse level controls: SAMA 17.
SMMRW3BF	2.69E-03	1.026	RWP-3B PUMP TRAIN FAILS TO OPERATE	Unavailability / failure of raw water pump. A SAMA has been identified to supply water to the system from an alternate source: SAMA 8.

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
LHULPRCY	2.50E-02	1.026	OPERATORS FAIL TO GO TO LOW PRESSURE RECIRCULATION	Failure of operators to align plant for recirculation. Proposed SAMA: automate switchover to recirculation: SAMA 3.
SPMDHCBM	4.00E-03	1.025	DHCCC TRAIN B IN MAINTENANCE	Module containing various decay heat closed cooling system failures. Proposed SAMA: proceduralize crosstying of DHCC trains: SAMA 16.
IE_T2	2.40E-01	1.025	LOSS OF MAIN FEEDWATER	This is the initiating frequency for loss of main feedwater. No potential SAMA was identified to significantly change the likelihood of loss of main feed but the significance of the event may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately
HCCMV44N	1.43E-04	1.025	COMMON CAUSE FAILURE OF MUV-23, MUV-24, MUV-25, AND MUV-26 TO OPEN	Common-cause failure of makeup valves. Proposed SAMA: Proceduralize manual operation of these valves, which would address most modes of common-cause failure: SAMA 10.
ADGES3BM	3.37E-02	1.024	EGDG-1B IN MAINTENANCE	Proposed SAMA: add another EDG (SAMA 18).
IE_M	4.00E-05	1.022	MEDIUM BREAK LOCA	This is the initiating frequency for MLOCA. No potential SAMA was identified to significantly change the likelihood of MLOCA but the significance of the event may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
IE_T10	1.00E+00	1.022	LOSS OF NSCCC	This is the initiating frequency for Loss of nuclear services closed cooling water.. No potential SAMA was identified to significantly change the likelihood of the initiating event but the significance of the event may possibly be reduced by improving mitigation. Basic events relating to mitigation are addressed separately.
ADGEG1CF	7.68E-02	1.022	EGDG-1C FAILS TO RUN	Proposed SAMA: add another EDG (SAMA 18).
HHUINJBY	5.00E-01	1.021	OPERATORS FAIL TO SWITCH MUV-25/26 TO BACKUP POWER	Proposed SAMA, proceduralize manual operation of these valves (SAMA 10).

Table E.5-1
Level 1 Importance List Review

Event Name	Probability	Risk Reduction Worth	Description	Potential SAMAs
PMMICSCC	5.91E-02	1.02	ICS COMMON MODE FAULTS	This module contains basic event failures which could lead to OTSG overfeed. Proposed SAMA: provide redundant /diverse level controls (SAMA 17).
MTC	2.50E-01	1.02	MTC GREATER THAN 95%	Essentially a split fraction identifying the fraction of the time the moderator temperature coefficient is too high to sufficiently limit an ATWS event. No SAMA identified.
AHUEG1CY	5.00E-01	1.02	OPERATORS FAIL TO START AND ALIGN EGDG-1C	Proposed SAMA: add another EDG (SAMA 18).

Table E.5-2
Level 2 Importance List Review for RRW Greater than 1.02

Event Name	Probability	Description	Potential SAMAs
IE_R	3.00E-03	STEAM GENERATOR TUBE RUPTURE	Initiating Event - No SAMA suggested
FL_PDS22S	1.00E+00	Plant Damage State 22S	Flag to identify sequence - No SAMA suggested
RHUCOOLY	5.80E-04	OPERATORS FAIL COOLDOWN VIA OTSG	Procedures and training judged to be adequate
RHUPORVY	5.00E-01	OPERATORS FAILS TO OPEN PORV FOR PRESSURE RELIEF	Addressed by Level 1 SAMA 35
ZHUCOM2Z	2.80E-01	COND PROB OF RHUPORVY GIVEN RHUCOOLY	Addressed by Level 1 SAMA 35
SPLT_RA	5.00E-01	SGTR OCCURS ON OTSG-A <SPLIT FRACTION>	Split fraction - No SAMA suggested
SPLT_RB	5.00E-01	SGTR OCCURS ON OTGS-B <SPLIT FRACTION>	Split fraction - No SAMA suggested
FL_PDS23S	1.00E+00	Plant Damage State 23S	Flag to identify sequence - No SAMA suggested
IE_V	5.14E-08	ISLOCA - DHR DROP LINE AND INJECTION LINES	Initiating Event - No SAMA suggested
RRVRC10N	1.26E-02	PORV (MAIN VALVE) FAILS TO OPEN	Addressed by Level 1 SAMA 23
QHUFWP7Y	5.60E-03	OPERATORS FAIL TO START FWP-7	Addressed by Level 1 SAMA 4
FL_PDS18S	2.35E-01	Plant Damage State 18S	Flag to identify sequence - No SAMA suggested
HCCMV44N	1.43E-04	COMMON CAUSE FAILURE OF MUV-23, MUV-24, MUV-25, AND MUV-26 TO OPEN	Addressed by Level 1 SAMA 10
FLG_RQ	1.00E+00	TAG EVENT - UNISOLATED SGTR	Flag to provide sequence information - No SAMA suggested

Table E.5-3
CRNPP Phase 1 SAMA List Summary

SAMA Number	SAMA Title	SAMA Description	Source	Cost Estimate [1]	Retained	Phase 1 Baseline Disposition
34	Improve procedures for manual EFW op if EFIC fails	Improve procedures for manual operation of EFW discharge valves when EFIC fails (EFV-55-58)	CR3 Level 1 Importance List	$50,000	Yes	See Section E.6.1
33	Improve procedures to respond to DH-42/43 failures	Proceduralize manual operation of DHV-42 /-43	CR3 Level 1 Importance List	$50,000	Yes	See Section E.6.2
9	Proceduralize additional responses to DHV-11, DHV-12 failures	Proceduralize manual operation of DHV-11 or DHV-12	CR3 Level 1 Importance List	$50,000	Yes	See Section E.6.3
10	Proceduralize additional responses to MUV-23, -24, -25, 26 failures	Proceduralize actions to manually align MUV-23, -24, -25 and -26 if required.	CR3 Level 1 Importance List	$50,000	Yes	See Section E.6.4
38	Additional CST replacement sources	Identify/ proceduralize use of additional water sources which can be aligned to replace CST inventory	CR3 Level 1 Importance List	$50,000	Yes	See Section E.6.5
3	Automate recirc switchover	Automate switchover to recirculation	CR3 Level 1 Importance List	$350,000	Yes	See Section E.6.6
6	Provide detection and response procedures for SW floods	Provide ability to rapidly identify and isolate seawater floods in Aux Building.	CR3 Level 1 Importance List	$400,000	Yes	See Section E.6.7
5	Improve FWP-7 availability	Improve availability of FWP-7. Currently the probability that FWP-7 is unavailable when required is 2.03E-2.	CR3 Level 1 Importance List	$500,000	Yes	See Section E.6.8

Table E.5-3
CRNPP Phase 1 SAMA List Summary

SAMA Number	SAMA Title	SAMA Description	Source	Cost Estimate [1]	Retained	Phase 1 Baseline Disposition
17	Improve SG level controls	With respect to BE (module) PMMICSAH, "OTSGA level control faults." Proposed SAMA: Provide redundant /diverse level controls	CR3 Level 1 Importance List	>$500,000	Yes	See Section E.6.9
11	Automate suction crosstie / alternate makeup supply to EFW	Provide an automatic crosstie / makeup for EFW.	CR3 Level 1 Importance List	$250,000	Yes	See Section E.6.10
15	Provide control room ability to realign power to MUP-1B	This is in respect to HHUMBACY, "Operators fail to switch MUP-1B power source." Proposed SAMA: Provide remote control-room capability to perform this (currently) local action.	CR3 Level 1 Importance List	$300,000	Yes	See Section E.6.11
4	Automate FWP-7 start	Automate start of FWP-7 when required.	CR3 Level 1 Importance List	$250,000	Yes	See Section E.6.12
35	Change PORV control scheme	Update PORV controls so PORV opens reliably and automatically for pressure relief in scenarios where operator action is currently required.	CR3 Level 1 Importance List	$500,000	Yes	See Section E.6.13
51	Upgrade EFIC temperature analysis	Upgrade or improve the engineering analysis to qualify the EFIC cabinets to a higher temperature, or at least remove conservatisms that currently exist to show that the failure probability may be as low as 10%.	PRA Group Insight	$100,000	Yes	See Section E.6.14
49	Upgrade fire compartment barriers	Upgrade fire barriers in battery charger room 3A, similar to what was done for battery charger room 3B approx. 10 years ago.	Industry SAMA list	$150,000	Yes	See Section E.6.15
8	Temp pump to replace RWP	Provide a temporary pump or pump of alternate design and suction supply which can be aligned to supply cooling water in lieu of RWP	CR3 Level 1 Importance List	$500,000	No	See Section E.5.2

Table E.5-3
CRNPP Phase 1 SAMA List Summary

SAMA Number	SAMA Title	SAMA Description	Source	Cost Estimate [1]	Retained	Phase 1 Baseline Disposition
26	Install separate and independent EFIC cooling system	Install separate independent cooling for EFIC (consider DC power, self-powered fans).	CR3 Level 1 Importance List	>$500,000	No	See Section E.5.2
14	Automate SG level control requirements for SLOCA	This is in respect to HRA event QHUEFW9Y, "Operators fail to raise OTSGs level." This is needed for small LOCA response. Proposed SAMA, automate level control.	CR3 Level 1 Importance List	>$500,000	No	See Section E.5.2
37	DH HX strainers	Add removable strainers ahead of heat exchangers	CR3 Level 1 Importance List	$600,000	No	See Section E.5.2
1	Automate EFIC/inverter backup cooling	Automate alignment of dedicated chilled water system to cool inverters and EFIC when required.	CR3 Level 1 Importance List	$1,000,000	No	See Section E.5.2
7	New AFW suction source and pump	Add a new independent AFW source and pump.	CR3 Level 1 Importance List	$5,000,000	No	See Section E.5.2
16	Enhance procedures and make design changes as required to facilitate crosstying trains of DH, DHCC, etc.	With respect to SMMDHCCB, "DHCCC train B faults." (same for A, same for similar failures in other systems). Proposed SAMA: Proceduralize crosstying between train A and train B of MU, DH, DHCC trains at appropriate suction / discharge points.	CR3 Level 1 Importance List	$5,000,000	No	See Section E.5.2
18	Add another EDG	With respect to BE ADGES3BM, "EGDG-1B in maintenance." (same for A) Proposed SAMA: add another EDG.	CR3 Level 1 Importance List	>$5,000,000	No	See Section E.5.2

Table E.5-3
CRNPP Phase 1 SAMA List Summary

SAMA Number	SAMA Title	SAMA Description	Source	Cost Estimate [1]	Retained	Phase 1 Baseline Disposition
13	Add additional train of DH, of diverse design	This is in respect to BE LPM001A, DHP-1A train in maintenance. (similar for B train) Add an additional train or “maintenance” train of diverse design.	CR3 Level 1 Importance List	>$5,000,000	No	See Section E.5.2
52	Install parallel flowpath for DHR drop line	This is in respect to BE LMMDHRSF, which was an important contributor (RRW > 1.02) for sequences leading to Release Category 4C	CR3 Importance List Review for RC-4C	>$500,000	No	See Section E.5.2

Notes:

(1) Cost estimates provided / validated by CRNPP

Table E.6-1
CRNPP Phase 2 SAMA List Summary

SAMA Number	SAMA Title	SAMA Description	Source	Phase 2 Baseline Disposition
34	Improve procedures for manual EFW op if EFIC fails	Improve procedures for manual operation of EFW discharge valves when EFIC fails (EFV-55-58)	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is **greater** than the cost of implementation and the SAMA is **cost beneficial**.
33	Improve procedures to respond to DH-42/43 failures	Proceduralize manual operation of DHV-42 /-43	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
9	Proceduralize additional responses to DHV-11, DHV-12 failures	Proceduralize manual operation of DHV-11 or DHV-12	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
10	Proceduralize additional responses to MUV-23, -24, -25, 26 failures	Proceduralize actions to manually align MUV-23, -24, -25 and -26 if required.	CR3 Level 1 Importance List	The (95^{th} percentile) averted cost-risk for this SAMA is **greater** than the cost of implementation and the SAMA is **cost beneficial**.
38	Additional CST replacement sources	Identify/ proceduralize use of additional water sources which can be aligned to replace CST inventory	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
3	Automate recirc switchover	Automate switchover to recirculation	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
6	Provide detection and response procedures for SW floods	Provide ability to rapidly identify and isolate seawater floods in Aux Building.	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
5	Improve FWP-7 availability	Improve availability of FWP-7. Currently the probability that FWP-7 is unavailable when required is 2.03E-2.	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
17	Improve SG level controls	With respect to BE (module) PMMICSAH, "OTSGA level control faults." Proposed SAMA: Provide redundant /diverse level controls	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.

Table E.6-1
CRNPP Phase 2 SAMA List Summary

SAMA Number	SAMA Title	SAMA Description	Source	Phase 2 Baseline Disposition
11	Automate suction crosstie / alternate makeup supply to EFW	Provide an automatic crosstie / makeup for EFW.	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
15	Provide control room ability to realign power to MUP-1B	This is in respect to HHUMBACY, "Operators fail to switch MUP-1B power source." Proposed SAMA: Provide remote control-room capability to perform this (currently) local action.	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
4	Automate FWP-7 start	Automate start of FWP-7 when required.	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
35	Change PORV control scheme	Update PORV controls so PORV opens reliably and automatically for pressure relief in scenarios where operator action is currently required.	CR3 Level 1 Importance List	The averted cost-risk for this SAMA is less than the cost of implementation and the SAMA is not cost beneficial.
51	Upgrade EFIC temperature analysis	Upgrade or improve the engineering analysis to qualify the EFIC cabinets to a higher temperature, or at least remove conservatisms that currently exist to show that the failure probability may be as low as 10%.	PRA Group Insight	The (95^{th} percentile) averted cost-risk for this SAMA is **greater** than the cost of implementation and the SAMA is **cost beneficial**.
49	Upgrade fire compartment barriers	Upgrade fire barriers in battery charger room 3A, similar to what was done for battery charger room 3B approx. 10 years ago.	Industry SAMA list	The (95^{th} percentile) averted cost-risk for this SAMA is **greater** than the cost of implementation and the SAMA is **cost beneficial**.

E.10 FIGURES

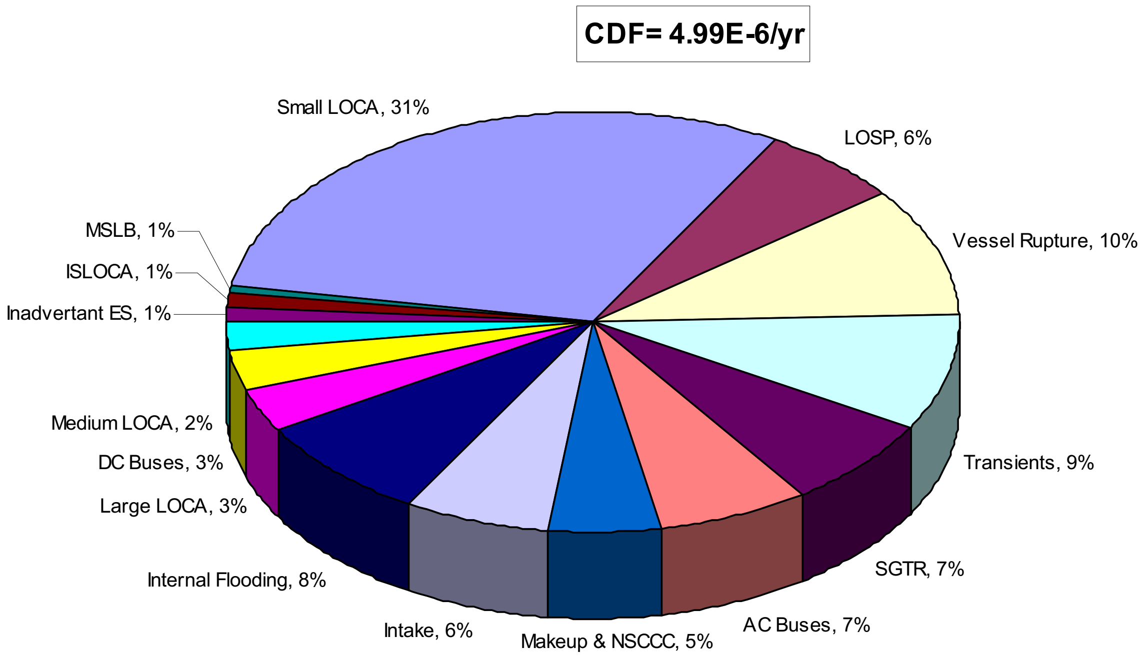


Figure E.2-1
Contribution to CDF by Initiator

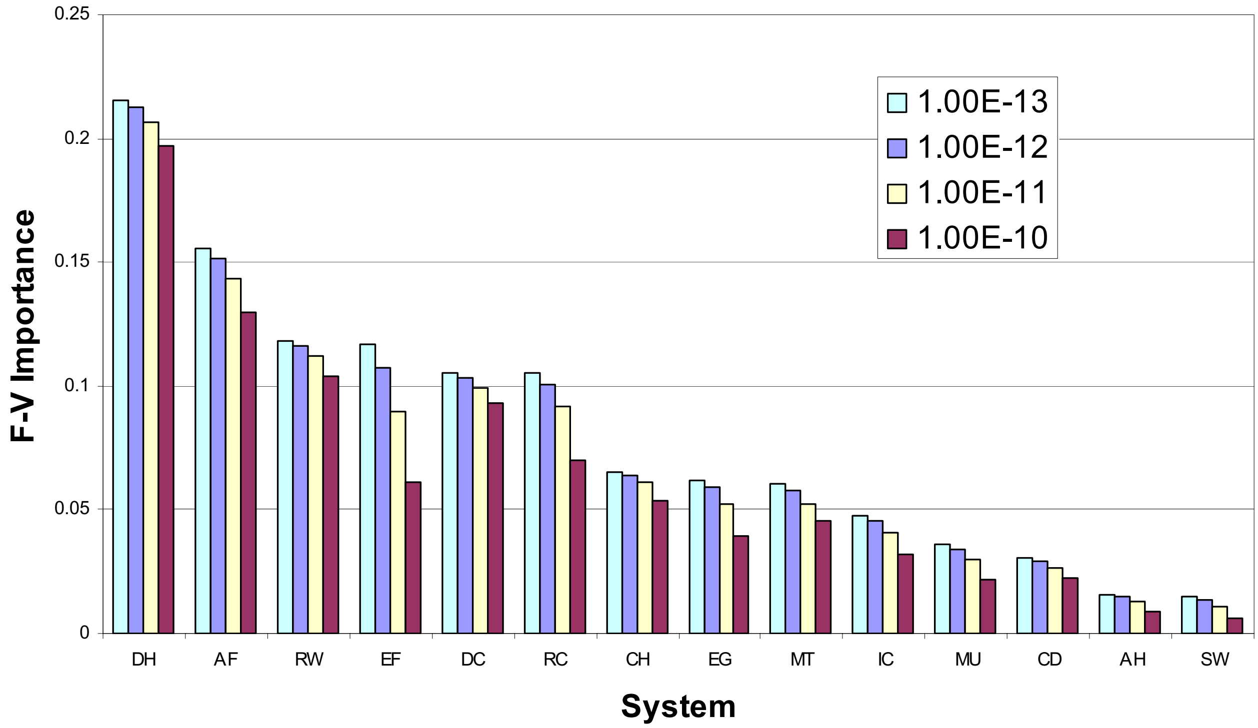


Figure E.2-2
System Importance by Fussell-Vesely

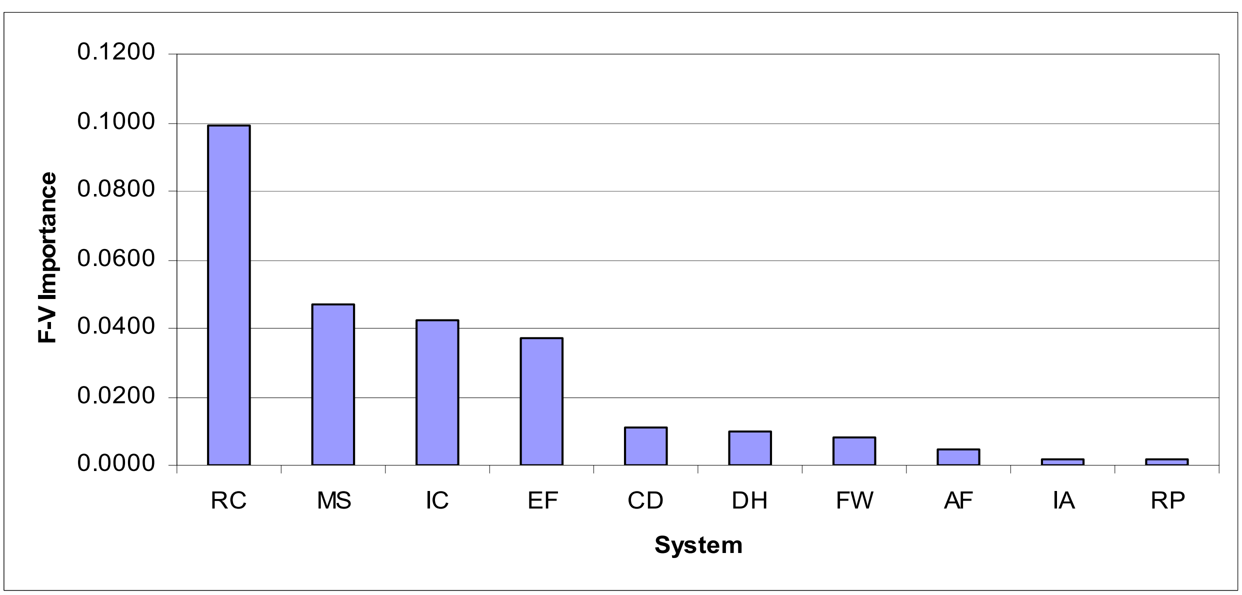


Figure E.2-3
LERF System Importance

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Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
	Improvements Related to RCP Seal LOCAs (Loss of CC or SW)	
1	Cap downstream piping of normally closed component cooling water drain and vent valves.	SAMA would reduce the frequency of a loss of component cooling event, a large portion of which was derived from catastrophic failure of one of the many single isolation valves.
2	Enhance loss of component cooling procedure to facilitate stopping reactor coolant pumps.	SAMA would reduce the potential for reactor coolant pump (RCP) seal damage due to pump bearing failure.
3	Enhance loss of component cooling procedure to present desirability of cooling down reactor coolant system (RCS) prior to seal LOCA.	SAMA would reduce the potential for RCP seal failure.
4	Provide additional training on the loss of component cooling.	SAMA would potentially improve the success rate of operator actions after a loss of component cooling (to restore RCP seal damage).
5	Provide hardware connections to allow another essential raw cooling water system to cool charging pump seals.	SAMA would reduce effect of loss of component cooling by providing a means to maintain the centrifugal charging pump seal injection after a loss of component cooling.
6	Procedure changes to allow cross connection of motor cooling for RHRSW pumps.	SAMA would allow continued operation of both RHRSW pumps on a failure of one train of PSW.
7	Proceduralize shedding component cooling water loads to extend component cooling heatup on loss of essential raw cooling water.	SAMA would increase time before the loss of component cooling (and reactor coolant pump seal failure) in the loss of essential raw cooling water sequences.
8	Increase charging pump lube oil capacity.	SAMA would lengthen the time before centrifugal charging pump failure due to lube oil overheating in loss of CC sequences.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
9	Eliminate the RCP thermal barrier dependence on component cooling such that loss of component cooling does not result directly in core damage.	SAMA would prevent the loss of recirculation pump seal integrity after a loss of component cooling. Watts Bar Nuclear Plant IPE said that they could do this with essential raw cooling water connection to RCP seals.
10	Add redundant DC control power for PSW pumps C & D.	SAMA would increase reliability of PSW and decrease core damage frequency due to a loss of SW.
11	Create an independent RCP seal injection system, with a dedicated diesel.	SAMA would add redundancy to RCP seal cooling alternatives, reducing CDF from loss of component cooling or service water or from a station blackout event.
12	Use existing hydro-test pump for RCP seal injection.	SAMA would provide an independent seal injection source, without the cost of a new system.
13	Replace ECCS pump motor with air-cooled motors.	SAMA would eliminate ECCS dependency on component cooling system (but not on room cooling).
14	Install improved RCS pumps seals.	SAMA would reduce probability of RCP seal LOCA by installing RCP seal O-ring constructed of improved materials
15	Install additional component cooling water pump.	SAMA would reduce probability of loss of component cooling leading to RCP seal LOCA.
16	Prevent centrifugal charging pump flow diversion from the relief valves.	SAMA modification would reduce the frequency of the loss of RCP seal cooling if relief valve opening causes a flow diversion large enough to prevent RCP seal injection.
17	Change procedures to isolate RCP seal letdown flow on loss of component cooling, and guidance on loss of injection during seal LOCA.	SAMA would reduce CDF from loss of seal cooling.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
18	Implement procedures to stagger high pressure safety injection (HPSI) pump use after a loss of service water.	SAMA would allow HPSI to be extended after a loss of service water.
19	Use FP system pumps as a backup seal injection and high pressure makeup.	SAMA would reduce the frequency of the RCP seal LOCA and the SBO CDF.
20	Enhance procedural guidance for use of cross-tied component cooling or service water pumps.	SAMA would reduce the frequency of the loss of component cooling water and service water.
21	Procedure enhancements and operator training in support system failure sequences, with emphasis on anticipating problems and coping.	SAMA would potentially improve the success rate of operator actions subsequent to support system failures.
22	Improved ability to cool the residual heat removal heat exchangers.	SAMA would reduce the probability of a loss of decay heat removal by implementing procedure and hardware modifications to allow manual alignment of the FP system or by installing a component cooling water cross-tie.
23	8.a. Additional Service Water Pump	SAMA would conceivably reduce common cause dependencies from SW system and thus reduce plant risk through system reliability improvement.
24	Create an independent RCP seal injection system, without dedicated diesel	This SAMA would add redundancy to RCP seal cooling alternatives, reducing the CDF from loss of CC or SW, but not SBO.
	Improvements Related to Heating, Ventilation, and Air Conditioning	
25	Provide reliable power to control building fans.	SAMA would increase availability of control room ventilation on a loss of power.
26	Provide a redundant train of ventilation.	SAMA would increase the availability of components dependent on room cooling.

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SAMA ID Number	SAMA Title	Result of Potential Enhancement
27	Procedures for actions on loss of HVAC.	SAMA would provide for improved credit to be taken for loss of HVAC sequences (improved affected electrical equipment reliability upon a loss of control building HVAC).
28	Add a diesel building switchgear room high temperature alarm.	SAMA would improve diagnosis of a loss of switchgear room HVAC. Option 1: Install high temp alarm. Option 2: Redundant louver and thermostat
29	Create ability to switch fan power supply to DC in an SBO event.	SAMA would allow continued operation in an SBO event. This SAMA was created for reactor core isolation cooling system room at Fitzpatrick Nuclear Power Plant.
30	Enhance procedure to instruct operators to trip unneeded RHR/CS pumps on loss of room ventilation.	SAMA increases availability of required RHR/CS pumps. Reduction in room heat load allows continued operation of required RHR/CS pumps, when room cooling is lost.
31	Stage backup fans in switchgear (SWGR) rooms	This SAMA would provide alternate ventilation in the event of a loss of SWGR Room ventilation
	Improvements Related to Ex-Vessel Accident Mitigation/Containment Phenomena	
32	Delay containment spray actuation after large LOCA.	SAMA would lengthen time of RWST availability.
33	Install containment spray pump header automatic throttle valves.	SAMA would extend the time over which water remains in the RWST, when full Containment Spray flow is not needed
34	Install an independent method of suppression pool cooling.	SAMA would decrease the probability of loss of containment heat removal. For PWRs, a potential similar enhancement would be to install an independent cooling system for sump water.
35	Develop an enhanced drywell spray system.	SAMA would provide a redundant source of water to the containment to control containment pressure, when used in conjunction with containment heat removal.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
36	Provide dedicated existing drywell spray system.	SAMA would provide a source of water to the containment to control containment pressure, when used in conjunction with containment heat removal. This would use an existing spray loop instead of developing a new spray system.
37	Install an unfiltered hardened containment vent.	SAMA would provide an alternate decay heat removal method for non-ATWS events, with the released fission products not being scrubbed.
38	Install a filtered containment vent to remove decay heat.	SAMA would provide an alternate decay heat removal method for non-ATWS events, with the released fission products being scrubbed. Option 1: Gravel Bed Filter Option 2: Multiple Venturi Scrubber
39	Install a containment vent large enough to remove ATWS decay heat.	Assuming that injection is available, this SAMA would provide alternate decay heat removal in an ATWS event.
40	Create/enhance hydrogen recombiners with independent power supply.	SAMA would reduce hydrogen detonation at lower cost, Use either 1) a new independent power supply 2) a nonsafety-grade portable generator 3) existing station batteries 4) existing AC/DC independent power supplies.
41	Install hydrogen recombiners.	SAMA would provide a means to reduce the chance of hydrogen detonation.
42	Create a passive design hydrogen ignition system.	SAMA would reduce hydrogen denotation system without requiring electric power.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
43	Create a large concrete crucible with heat removal potential under the basemat to contain molten core debris.	SAMA would ensure that molten core debris escaping from the vessel would be contained within the crucible. The water cooling mechanism would cool the molten core, preventing a melt-through of the basemat.
44	Create a water-cooled rubble bed on the pedestal.	SAMA would contain molten core debris dropping on to the pedestal and would allow the debris to be cooled.
45	Provide modification for flooding the drywell head.	SAMA would help mitigate accidents that result in the leakage through the drywell head seal.
46	Enhance FP system and/or standby gas treatment system hardware and procedures.	SAMA would improve fission product scrubbing in severe accidents.
47	Create a reactor cavity flooding system.	SAMA would enhance debris coolability, reduce core concrete interaction, and provide fission product scrubbing.
48	Create other options for reactor cavity flooding.	SAMA would enhance debris coolability, reduce core concrete interaction, and provide fission product scrubbing.
49	Enhance air return fans (ice condenser plants).	SAMA would provide an independent power supply for the air return fans, reducing containment failure in SBO sequences.
50	Create a core melt source reduction system.	SAMA would provide cooling and containment of molten core debris. Refractory material would be placed underneath the reactor vessel such that a molten core falling on the material would melt and combine with the material. Subsequent spreading and heat removal form the vitrified compound would be facilitated, and concrete attack would not occur
51	Provide a containment inerting capability.	SAMA would prevent combustion of hydrogen and carbon monoxide gases.

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SAMA ID Number	SAMA Title	Result of Potential Enhancement
52	Use the FP system as a backup source for the containment spray system.	SAMA would provide redundant containment spray function without the cost of installing a new system.
53	Install a secondary containment filtered vent.	SAMA would filter fission products released from primary containment.
54	Install a passive containment spray system.	SAMA would provide redundant containment spray method without high cost.
55	Strengthen primary/secondary containment.	SAMA would reduce the probability of containment overpressurization to failure.
56	Increase the depth of the concrete basemat or use an alternative concrete material to ensure melt-through does not occur.	SAMA would prevent basemat melt-through.
57	Provide a reactor vessel exterior cooling system.	SAMA would provide the potential to cool a molten core before it causes vessel failure, if the lower head could be submerged in water.
58	Construct a building to be connected to primary/secondary containment that is maintained at a vacuum.	SAMA would provide a method to depressurize containment and reduce fission product release.
59	Refill CST	SAMA would reduce the risk of core damage during events such as extended station blackouts or LOCAs which render the suppression pool unavailable as an injection source due to heat up.
60	Maintain ECCS suction on CST	SAMA would maintain suction on the CST as long as possible to avoid pump failure as a result of high suppression pool temperature
61	Modify containment flooding procedure to restrict flooding to below Top of Active Fuel	SAMA would avoid forcing containment venting

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
62	Enhance containment venting procedures with respect to timing, path selection and technique.	SAMA would improve likelihood of successful venting strategies.
63	1.a. Severe Accident EPGs/Accident Management Guidelines	SAMA would lead to improved arrest of core melt progress and prevention of containment failure
64	1.h. Simulator Training for Severe Accident	SAMA would lead to improved arrest of core melt progress and prevention of containment failure
65	2.g. Dedicated Suppression Pool Cooling	SAMA would decrease the probability of loss of containment heat removal. While PWRs do not have suppression pools, a similar modification may be applied to the sump. Installation of a dedicated sump cooling system would provide an alternate method of cooling injection water.
66	3.a. Larger Volume Containment	SAMA increases time before containment failure and increases time for recovery
67	3.b. Increased Containment Pressure Capability (sufficient pressure to withstand severe accidents)	SAMA minimizes likelihood of large releases
68	3.c. Improved Vacuum Breakers (redundant valves in each line)	SAMA reduces the probability of a stuck open vacuum breaker.
69	3.d. Increased Temperature Margin for Seals	This SAMA would reduce containment failure due to drywell head seal failure caused by elevated temperature and pressure.
70	3.e. Improved Leak Detection	This SAMA would help prevent LOCA events by identifying pipes which have begun to leak. These pipes can be replaced before they break.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
71	3.f. Suppression Pool Scrubbing	Directing releases through the suppression pool will reduce the radionuclides allowed to escape to the environment.
72	3.g. Improved Bottom Penetration Design	SAMA reduces failure likelihood of RPV bottom head penetrations
73	4.a. Larger Volume Suppression Pool (double effective liquid volume)	SAMA would increase the size of the suppression pool so that heatup rate is reduced, allowing more time for recovery of a heat removal system
74	5.a/d. Unfiltered Vent	SAMA would provide an alternate decay heat removal method with the released fission products not being scrubbed.
75	5.b/c. Filtered Vent	SAMA would provide an alternate decay heat removal method with the released fission products being scrubbed.
76	6.a. Post Accident Inerting System	SAMA would reduce likelihood of gas combustion inside containment
77	6.b. Hydrogen Control by Venting	Prevents hydrogen detonation by venting the containment before combustible levels are reached.
78	6.c. Pre-inerting	SAMA would reduce likelihood of gas combustion inside containment
79	6.d. Ignition Systems	Burning combustible gases before they reach a level which could cause a harmful detonation is a method of preventing containment failure.
80	6.e. Fire Suppression System Inerting	Use of the FP system as a back up containment inerting system would reduce the probability of combustible gas accumulation. This would reduce the containment failure probability for small containments (e.g. BWR MKI).

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SAMA ID Number	SAMA Title	Result of Potential Enhancement
81	7.a. Drywell Head Flooding	SAMA would provide intentional flooding of the upper drywell head such that if high drywell temperatures occurred, the drywell head seal would not fail.
82	7.b. Containment Spray Augmentation	This SAMA would provide additional means of providing flow to the containment spray system.
83	12.b. Integral Basemat	This SAMA would improve containment and system survivability for seismic events.
84	13.a. Reactor Building Sprays	This SAMA provides the capability to use firewater sprays in the reactor building to mitigate release of fission products into the Rx Bldg following an accident.
85	14.a. Flooded Rubble Bed	SAMA would contain molten core debris dropping on to the pedestal and would allow the debris to be cooled.
86	14.b. Reactor Cavity Flooder	SAMA would enhance debris coolability, reduce core concrete interaction, and provide fission product scrubbing.
87	14.c. Basaltic Cements	SAMA minimizes carbon dioxide production during core concrete interaction.
88	Provide a core debris control system	(Intended for ice condenser plants): This SAMA would prevent the direct core debris attack of the primary containment steel shell by erecting a barrier between the seal table and the containment shell.
89	Add ribbing to the containment shell	This SAMA would reduce the risk of buckling of containment under reverse pressure loading.

Improvements Related to Enhanced AC/DC Reliability/Availability

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
90	Proceduralize alignment of spare diesel to shutdown board after loss of offsite power and failure of the diesel normally supplying it.	SAMA would reduce the SBO frequency.
91	Provide an additional diesel generator.	SAMA would increase the reliability and availability of onsite emergency AC power sources.
92	Provide additional DC battery capacity.	SAMA would ensure longer battery capability during an SBO, reducing the frequency of long-term SBO sequences.
93	Use fuel cells instead of lead-acid batteries.	SAMA would extend DC power availability in an SBO.
94	Procedure to cross-tie high pressure core spray diesel.	SAMA would improve core injection availability by providing a more reliable power supply for the high pressure core spray pumps.
95	Improve 4.16-kV bus cross-tie ability.	SAMA would improve AC power reliability.
96	Incorporate an alternate battery charging capability.	SAMA would improve DC power reliability by either cross-tying the AC busses, or installing a portable diesel-driven battery charger.
97	Increase/improve DC bus load shedding.	SAMA would extend battery life in an SBO event.
98	Replace existing batteries with more reliable ones.	SAMA would improve DC power reliability and thus increase available SBO recovery time.
99	Mod for DC Bus A reliability.	SAMA would increase the reliability of AC power and injection capability. Loss of DC Bus A causes a loss of main condenser prevents transfer from the main transformer to offsite power, and defeats one half of the low vessel pressure permissive for LPCI/CS injection valves.
100	Create AC power cross-tie capability with other unit.	SAMA would improve AC power reliability.

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SAMA ID Number	SAMA Title	Result of Potential Enhancement
101	Create a cross-tie for diesel fuel oil.	SAMA would increase diesel fuel oil supply and thus diesel generator, reliability.
102	Develop procedures to repair or replace failed 4-kV breakers.	SAMA would offer a recovery path from a failure of the breakers that perform transfer of 4.16-kV non-emergency busses from unit station service transformers, leading to loss of emergency AC power.
103	Emphasize steps in recovery of offsite power after an SBO.	SAMA would reduce human error probability during offsite power recovery.
104	Develop a severe weather conditions procedure.	For plants that do not already have one, this SAMA would reduce the CDF for external weather-related events.
105	Develop procedures for replenishing diesel fuel oil.	SAMA would allow for long-term diesel operation.
106	Install gas turbine generator.	SAMA would improve onsite AC power reliability by providing a redundant and diverse emergency power system.
107	Create a backup source for diesel cooling. (Not from existing system)	This SAMA would provide a redundant and diverse source of cooling for the diesel generators, which would contribute to enhanced diesel reliability.
108	Use FP system as a backup source for diesel cooling.	This SAMA would provide a redundant and diverse source of cooling for the diesel generators, which would contribute to enhanced diesel reliability.
109	Provide a connection to an alternate source of offsite power.	SAMA would reduce the probability of a loss of offsite power event.
110	Bury offsite power lines.	SAMA could improve offsite power reliability, particularly during severe weather.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
111	Replace anchor bolts on diesel generator oil cooler.	Millstone Nuclear Power Station found a high seismic SBO risk due to failure of the diesel oil cooler anchor bolts. For plants with a similar problem, this would reduce seismic risk. Note that these were Fairbanks Morse DGs.
112	Change undervoltage (UV), auxiliary feedwater actuation signal (AFAS) block and high pressurizer pressure actuation signals to 3-out-of-4, instead of 2-out-of-4 logic.	SAMA would reduce risk of 2/4 inverter failure.
113	Provide DC power to the 120/240-V vital AC system from the Class 1E station service battery system instead of its own battery.	SAMA would increase the reliability of the 120-VAC Bus.
114	Bypass Diesel Generator Trips	SAMA would allow D/Gs to operate for longer.
115	2.i. 16 hour Station Blackout Injection	SAMA includes improved capability to cope with longer station blackout scenarios.
116	9.a. Steam Driven Turbine Generator	This SAMA would provide a steam driven turbine generator which uses reactor steam and exhausts to the suppression pool. If large enough, it could provide power to additional equipment.
117	9.b. Alternate Pump Power Source	This SAMA would provide a small dedicated power source such as a dedicated diesel or gas turbine for the feedwater or condensate pumps, so that they do not rely on offsite power.
118	9.d. Additional Diesel Generator	SAMA would reduce the SBO frequency.
119	9.e. Increased Electrical Divisions	SAMA would provide increased reliability of AC power system to reduce core damage and release frequencies.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
120	9.f. Improved Uninterruptible Power Supplies	SAMA would provide increased reliability of power supplies supporting front-line equipment, thus reducing core damage and release frequencies.
121	9.g. AC Bus Cross-Ties	SAMA would provide increased reliability of AC power system to reduce core damage and release frequencies.
122	9.h. Gas Turbine	SAMA would improve onsite AC power reliability by providing a redundant and diverse emergency power system.
123	9.i. Dedicated RHR (bunkered) Power Supply	SAMA would provide RHR with more reliable AC power.
124	10.a. Dedicated DC Power Supply	This SAMA addresses the use of a diverse DC power system such as an additional battery or fuel cell for the purpose of providing motive power to certain components (e.g., RCIC).
125	10.b. Additional Batteries/Divisions	This SAMA addresses the use of a diverse DC power system such as an additional battery or fuel cell for the purpose of providing motive power to certain components (e.g., RCIC).
126	10.c. Fuel Cells	SAMA would extend DC power availability in an SBO.
127	10.d. DC Cross-ties	This SAMA would improve DC power reliability.
128	10.e. Extended Station Blackout Provisions	SAMA would provide reduction in SBO sequence frequencies.
129	Add an automatic bus transfer feature to allow the automatic transfer of the 120V vital AC bus from the on-line unit to the standby unit	Plants are typically sensitive to the loss of one or more 120V vital AC buses. Manual transfers to alternate power supplies could be enhanced to transfer automatically.
	Improvements in Identifying and Mitigating Containment Bypass	

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SAMA ID Number	SAMA Title	Result of Potential Enhancement
130	Install a redundant spray system to depressurize the primary system during a steam generator tube rupture (SGTR).	SAMA would enhance depressurization during a SGTR.
131	Improve SGTR coping abilities.	SAMA would improve instrumentation to detect SGTR, or additional system to scrub fission product releases.
132	Add other SGTR coping abilities.	SAMA would decrease the consequences of an SGTR.
133	Increase secondary side pressure capacity such that an SGTR would not cause the relief valves to lift.	SAMA would eliminate direct release pathway for SGTR sequences.
134	Replace steam generators (SG) with a new design.	SAMA would lower the frequency of an SGTR.
135	Revise EOPs to direct that a faulted SG be isolated.	SAMA would reduce the consequences of an SGTR.
136	Direct SG flooding after a SGTR, prior to core damage.	SAMA would provide for improved scrubbing of SGTR releases.
137	Implement a maintenance practice that inspects 100% of the tubes in a SG.	SAMA would reduce the potential for an SGTR.
138	Locate residual heat removal (RHR) inside of containment.	SAMA would prevent intersystem LOCA (ISLOCA) out the RHR pathway.
139	Install additional instrumentation for ISLOCAs.	SAMA would decrease ISLOCA frequency by installing pressure of leak monitoring instruments in between the first two pressure isolation valves on low-pressure inject lines, RHR suction lines, and HPSI lines.
140	Increase frequency for valve leak testing.	SAMA could reduce ISLOCA frequency.
141	Improve operator training on ISLOCA coping.	SAMA would decrease ISLOCA effects.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
142	Install relief valves in the CC System.	SAMA would relieve pressure buildup from an RCP thermal barrier tube rupture, preventing an ISLOCA.
143	Provide leak testing of valves in ISLOCA paths.	SAMA would help reduce ISLOCA frequency. At Kewaunee Nuclear Power Plant, four MOVs isolating RHR from the RCS were not leak tested.
144	Revise EOPs to improve ISLOCA identification.	SAMA would ensure LOCA outside containment could be identified as such. Salem Nuclear Power Plant had a scenario where an RHR ISLOCA could direct initial leakage back to the pressurizer relief tank, giving indication that the LOCA was inside containment.
145	Ensure all ISLOCA releases are scrubbed.	SAMA would scrub all ISLOCA releases. One example is to plug drains in the break area so that the break point would be covered with water.
146	Add redundant and diverse limit switches to each containment isolation valve.	SAMA could reduce the frequency of containment isolation failure and ISLOCAs through enhanced isolation valve position indication.
147	Early detection and mitigation of ISLOCA	SAMA would limit the effects of ISLOCA accidents by early detection and isolation
148	8.e. Improved MSIV Design	This SAMA would improve isolation reliability and reduce spurious actuations that could be initiating events.
149	Proceduralize use of pressurizer vent valves during steam generator tube rupture (SGTR) sequences	Some plants may have procedures to direct the use of pressurizer sprays to reduce RCS pressure after an SGTR. Use of the vent valves would provide a back-up method.
150	Implement a maintenance practice that inspects 100% of the tubes in an SG	This SAMA would reduce the potential for a tube rupture.
151	Locate RHR inside of containment	This SAMA would prevent ISLOCA out the RHR pathway.

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SAMA ID Number	SAMA Title	Result of Potential Enhancement
152	Install self-actuating containment isolation valves	For plants that do not have this, it would reduce the frequency of isolation failure.
	Improvements in Reducing Internal Flooding Frequency	
153	Modify swing direction of doors separating turbine building basement from areas containing safeguards equipment.	SAMA would prevent flood propagation, for a plant where internal flooding from turbine building to safeguards areas is a concern.
154	Improve inspection of rubber expansion joints on main condenser.	SAMA would reduce the frequency of internal flooding, for a plant where internal flooding due to a failure of circulating water system expansion joints is a concern.
155	Implement internal flood prevention and mitigation enhancements.	This SAMA would reduce the consequences of internal flooding.
156	Implement internal flooding improvements such as those implemented at Fort Calhoun.	This SAMA would reduce flooding risk by preventing or mitigating rupture in the RCP seal cooler of the component cooling system and ISLOCA in a shutdown cooling line, an auxiliary feedwater (AFW) flood involving the need to remove a watertight door.
157	Shield electrical equipment from potential water spray	SAMA would decrease risk associated with seismically induced internal flooding
158	13.c. Reduction in Reactor Building Flooding	This SAMA reduces the Reactor Building Flood Scenarios contribution to core damage and release.
	Improvements Related to Feedwater/Feed and Bleed Reliability/Availability	
159	Install a digital feedwater upgrade.	This SAMA would reduce the chance of a loss of main feedwater following a plant trip.
160	Perform surveillances on manual valves used for backup AFW pump suction.	This SAMA would improve success probability for providing alternative water supply to the AFW pumps.

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SAMA ID Number	SAMA Title	Result of Potential Enhancement
161	Install manual isolation valves around AFW turbine-driven steam admission valves.	This SAMA would reduce the dual turbine-driven AFW pump maintenance unavailability.
162	Install accumulators for turbine-driven AFW pump flow control valves (CVs).	This SAMA would provide control air accumulators for the turbine-driven AFW flow CVs, the motor-driven AFW pressure CVs and SG power-operated relief valves (PORVs). This would eliminate the need for local manual action to align nitrogen bottles for control air during a LOOP.
163	Install separate accumulators for the AFW cross-connect and block valves	This SAMA would enhance the operator's ability to operate the AFW cross-connect and block valves following loss of air support.
164	Install a new condensate storage tank (CST)	Either replace the existing tank with a larger one, or install a back-up tank.
165	Provide cooling of the steam-driven AFW pump in an SBO event	This SAMA would improve success probability in an SBO by: (1) using the FP system to cool the pump, or (2) making the pump self cooled.
166	Proceduralize local manual operation of AFW when control power is lost.	This SAMA would lengthen AFW availability in an SBO. Also provides a success path should AFW control power be lost in non-SBO sequences.
167	Provide portable generators to be hooked into the turbine driven AFW, after battery depletion.	This SAMA would extend AFW availability in an SBO (assuming the turbine driven AFW requires DC power)
168	Add a motor train of AFW to the Steam trains	For PWRs that do not have any motor trains of AFW, this would increase reliability in non-SBO sequences.
169	Create ability for emergency connections of existing or alternate water sources to feedwater/condensate	This SAMA would be a back-up water supply for the feedwater/condensate systems.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
170	Use FP system as a back-up for SG inventory	This SAMA would create a back-up to main and AFW for SG water supply.
171	Procure a portable diesel pump for isolation condenser make-up	This SAMA would provide a back-up to the city water supply and diesel FP system pump for isolation condenser make-up.
172	Install an independent diesel generator for the CST make-up pumps	This SAMA would allow continued inventory make-up to the CST during an SBO.
173	Change failure position of condenser make-up valve	This SAMA would allow greater inventory for the AFW pumps by preventing CST flow diversion to the condenser if the condenser make-up valve fails open on loss of air or power.
174	Create passive secondary side coolers.	This SAMA would reduce CDF from the loss of Feedwater by providing a passive heat removal loop with a condenser and heat sink.
175	Replace current PORVs with larger ones such that only one is required for successful feed and bleed.	This SAMA would reduce the dependencies required for successful feed and bleed.
176	Install motor-driven feedwater pump.	SAMA would increase the availability of injection subsequent to MSIV closure.
177	Use Main FW pumps for a Loss of Heat Sink Event	This SAMA involves a procedural change that would allow for a faster response to loss of the secondary heat sink. Use of only the feedwater booster pumps for injection to the SGs requires depressurization to about 350 psig; before the time this pressure is reached, conditions would be met for initiating feed and bleed. Using the available turbine driven feedwater pumps to inject water into the SGs at a high pressure rather than using the feedwater booster alone allows injection without the time consuming depressurization.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
	Improvements in Core Cooling Systems	
178	Provide the capability for diesel driven, low pressure vessel make-up	This SAMA would provide an extra water source in sequences in which the reactor is depressurized and all other injection is unavailable (e.g., FP system)
179	Provide an additional HPSI pump with an independent diesel	This SAMA would reduce the frequency of core melt from small LOCA and SBO sequences
180	Install an independent AC HPSI system	This SAMA would allow make-up and feed and bleed capabilities during an SBO.
181	Create the ability to manually align ECCS recirculation	This SAMA would provide a back-up should automatic or remote operation fail.
182	Implement an RWT make-up procedure	This SAMA would decrease CDF from ISLOCA scenarios, some smaller break LOCA scenarios, and SGTR.
183	Stop low pressure safety injection pumps earlier in medium or large LOCAs.	This SAMA would provide more time to perform recirculation swap over.
184	Emphasize timely swap over in operator training.	This SAMA would reduce human error probability of recirculation failure.
185	Upgrade Chemical and Volume Control System to mitigate small LOCAs.	For a plant like the AP600 where the Chemical and Volume Control System cannot mitigate a Small LOCA, an upgrade would decrease the Small LOCA CDF contribution.
186	Install an active HPSI system.	For a plant like the AP600 where an active HPSI system does not exist, this SAMA would add redundancy in HPSI.
187	Change "in-containment" RWT suction from 4 check valves to 2 check and 2 air operated valves.	This SAMA would remove common mode failure of all four injection paths.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
188	Replace 2 of the 4 safety injection (SI) pumps with diesel-powered pumps.	This SAMA would reduce the SI system common cause failure probability. This SAMA was intended for the System 80+, which has four trains of SI.
189	Align low pressure core injection or core spray to the CST on loss of suppression pool cooling.	This SAMA would help to ensure low pressure ECCS can be maintained in loss of suppression pool cooling scenarios.
190	Raise high pressure core injection/reactor core isolation cooling backpressure trip setpoints	This SAMA would ensure high pressure core injection/reactor core isolation cooling availability when high suppression pool temperatures exist.
191	Improve the reliability of the automatic depressurization system.	This SAMA would reduce the frequency of high pressure core damage sequences.
192	Disallow automatic vessel depressurization in non-ATWS scenarios	This SAMA would improve operator control of the plant.
193	Create automatic swap over to recirculation on RWT depletion	This SAMA would reduce the human error contribution from recirculation failure.
194	Proceduralize intermittent operation of HPCI.	SAMA would allow for extended duration of HPCI availability.
195	Increase available net positive suction head (NPSH) for injection pumps.	SAMA increases the probability that these pumps will be available to inject coolant into the vessel by increasing the available NPSH for the injection pumps.
196	Modify Reactor Water Cleanup (RWCU) for use as a decay heat removal system and proceduralize use.	SAMA would provide an additional source of decay heat removal.
197	CRD Injection	SAMA would supply an additional method of level restoration by using a non-safety system.
198	Condensate Pumps for Injection	SAMA to provide an additional option for coolant injection when other systems are unavailable or inadequate

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
199	Align EDG to CRD for Injection	SAMA to provide power to an additional injection source during loss of power events
200	Re-open MSIVs	SAMA to regain the main condenser as a heat sink by re-opening the MSIVs.
201	Bypass RCIC Turbine Exhaust Pressure Trip	SAMA would allow RCIC to operate longer.
202	2.a. Passive High Pressure System	SAMA will improve prevention of core melt sequences by providing additional high pressure capability to remove decay heat through an isolation condenser type system
203	2.c. Suppression Pool Jockey Pump	SAMA will improve prevention of core melt sequences by providing a small makeup pump to provide low pressure decay heat removal from the RPV using the suppression pool as a source of water.
204	2.d. Improved High Pressure Systems	SAMA will improve prevention of core melt sequences by improving reliability of high pressure capability to remove decay heat.
205	2.e. Additional Active High Pressure System	SAMA will improve reliability of high pressure decay heat removal by adding an additional system.
206	2.f. Improved Low Pressure System (Firepump)	SAMA would provide FP system pump(s) for use in low pressure scenarios.
207	4.b. Clean Up Water Decay Heat Removal	This SAMA provides a means for Alternate Decay Heat Removal.
208	4.c. High Flow Suppression Pool Cooling	SAMA would improve suppression pool cooling.
209	8.c. Diverse Injection System	SAMA will improve prevention of core melt sequences by providing additional injection capabilities.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
210	Alternate Charging Pump Cooling	This SAMA will improve the high pressure core flooding capabilities by providing the SI pumps with alternate gear and oil cooling sources. Given a total loss of Chilled Water, abnormal operating procedures would direct alignment of preferred Demineralized Water or the Fire System to the Chilled Water System to provide cooling to the SI pumps' gear and oil box (and the other normal loads).
	Instrument Air/Gas Improvements	
211	Modify EOPs for ability to align diesel power to more air compressors.	For plants that do not have diesel power to all normal and back-up air compressors, this change would increase the reliability of IA after a LOOP.
212	Replace old air compressors with more reliable ones	This SAMA would improve reliability and increase availability of the IA compressors.
213	Install nitrogen bottles as a back-up gas supply for safety relief valves.	This SAMA would extend operation of safety relief valves during an SBO and loss of air events (BWRs).
214	Allow cross connection of uninterruptible compressed air supply to opposite unit.	SAMA would increase the ability to vent containment using the hardened vent.
	ATWS Mitigation	
215	Install MG set trip breakers in control room	This SAMA would provide trip breakers for the MG sets in the control room. In some plants, MG set breaker trip requires action to be taken outside of the control room. Adding control capability to the control room would reduce the trip failure probability in sequences where immediate action is required (e.g., ATWS).

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
216	Add capability to remove power from the bus powering the control rods	This SAMA would decrease the time to insert the control rods if the reactor trip breakers fail (during a loss of FW ATWS which has a rapid pressure excursion)
217	Create cross-connect ability for standby liquid control trains	This SAMA would improve reliability for boron injection during an ATWS event.
218	Create an alternate boron injection capability (back-up to standby liquid control)	This SAMA would improve reliability for boron injection during an ATWS event.
219	Remove or allow override of low pressure core injection during an ATWS	On failure on high pressure core injection and condensate, some plants direct reactor depressurization followed by 5 minutes of low pressure core injection. This SAMA would allow control of low pressure core injection immediately.
220	Install a system of relief valves that prevents any equipment damage from a pressure spike during an ATWS	This SAMA would improve equipment availability after an ATWS.
221	Create a boron injection system to back up the mechanical control rods.	This SAMA would provide a redundant means to shut down the reactor.
222	Provide an additional instrument system for ATWS mitigation (e.g., ATWS mitigation scram actuation circuitry).	This SAMA would improve instrument and control redundancy and reduce the ATWS frequency.
223	Increase the safety relief valve (SRV) reseat reliability.	SAMA addresses the risk associated with dilution of boron caused by the failure of the SRVs to reseat after standby liquid control (SBLC) injection.
224	Use control rod drive for alternate boron injection.	SAMA provides an additional system to address ATWS with SBLC failure or unavailability.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
225	Bypass MSIV isolation in Turbine Trip ATWS scenarios	SAMA will afford operators more time to perform actions. The discharge of a substantial fraction of steam to the main condenser (i.e., as opposed to into the primary containment) affords the operator more time to perform actions (e.g., SBLC injection, lower water level, depressurize RPV) than if the main condenser was unavailable, resulting in lower human error probabilities
226	Enhance operator actions during ATWS	SAMA will reduce human error probabilities during ATWS
227	Guard against SBLC dilution	SAMA to control vessel injection to prevent boron loss or dilution following SBLC injection.
228	11.a. ATWS Sized Vent	This SAMA would be providing the ability to remove reactor heat from ATWS events.
229	11.b. Improved ATWS Capability	This SAMA includes items which reduce the contribution of ATWS to core damage and release frequencies.
	Other Improvements	
230	Provide capability for remote operation of secondary side relief valves in an SBO	Manual operation of these valves is required in an SBO scenario. High area temperatures may be encountered in this case (no ventilation to main steam areas), and remote operation could improve success probability.
231	Create/enhance RCS depressurization ability	With either a new depressurization system, or with existing PORVs, head vents, and secondary side valve, RCS depressurization would allow earlier low pressure ECCS injection. Even if core damage occurs, low RCS pressure would alleviate some concerns about high pressure melt ejection.
232	Make procedural changes only for the RCS depressurization option	This SAMA would reduce RCS pressure without the cost of a new system

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
233	Defeat 100% load rejection capability.	This SAMA would eliminate the possibility of a stuck open PORV after a LOOP, since PORV opening would not be needed.
234	Change control rod drive flow control valve failure position	Change failure position to the "fail-safest" position.
235	Install secondary side guard pipes up to the MSIVs	This SAMA would prevent secondary side depressurization should a steam line break occur upstream of the main steam isolation valves. This SAMA would also guard against or prevent consequential multiple SGTR following a Main Steam Line Break event.
236	Install digital large break LOCA protection	Upgrade plant instrumentation and logic to improve the capability to identify symptoms/precursors of a large break LOCA (leak before break).
237	Increase seismic capacity of the plant to a high confidence, low pressure failure of twice the Safe Shutdown Earthquake.	This SAMA would reduce seismically -induced CDF.
238	Enhance the reliability of the demineralized water (DW) make-up system through the addition of diesel-backed power to one or both of the DW make-up pumps.	Inventory loss due to normal leakage can result in the failure of the CC and the SRW systems. Loss of CC could challenge the RCP seals. Loss of SRW results in the loss of three EDGs and the containment air coolers (CACs).
239	Increase the reliability of safety relief valves by adding signals to open them automatically.	SAMA reduces the probability of a certain type of medium break LOCA. Hatch evaluated medium LOCA initiated by an MSIV closure transient with a failure of SRVs to open. Reducing the likelihood of the failure for SRVs to open, subsequently reduces the occurrence of this medium LOCA.
240	Reduce DC dependency between high pressure injection system and ADS.	SAMA would ensure containment depressurization and high pressure injection upon a DC failure.

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
241	Increase seismic ruggedness of plant components.	SAMA would increase the availability of necessary plant equipment during and after seismic events.
242	Enhance RPV depressurization capability	SAMA would decrease the likelihood of core damage in loss of high pressure coolant injection scenarios
243	Enhance RPV depressurization procedures	SAMA would decrease the likelihood of core damage in loss of high pressure coolant injection scenarios
244	Replace mercury switches on FP systems	SAMA would decrease probability of spurious fire suppression system actuation given a seismic event+D114
245	Provide additional restraints for CO_2 tanks	SAMA would increase availability of FP given a seismic event.
246	Enhance control of transient combustibles	SAMA would minimize risk associated with important fire areas.
247	Enhance fire brigade awareness	SAMA would minimize risk associated with important fire areas.
248	Upgrade fire compartment barriers	SAMA would minimize risk associated with important fire areas.
249	Enhance procedures to allow specific operator actions	SAMA would minimize risk associated with important fire areas.
250	Develop procedures for transportation and nearby facility accidents	SAMA would minimize risk associated with transportation and nearby facility accidents.
251	Enhance procedures to mitigate Large LOCA	SAMA would minimize risk associated with Large LOCA
252	1.b. Computer Aided Instrumentation	SAMA will improve prevention of core melt sequences by making operator actions more reliable.
253	1.c/d. Improved Maintenance Procedures/Manuals	SAMA will improve prevention of core melt sequences by increasing reliability of important equipment

Addendum 1 Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
254	1.e. Improved Accident Management Instrumentation	SAMA will improve prevention of core melt sequences by making operator actions more reliable.
255	1.f. Remote Shutdown Station	This SAMA would provide the capability to control the reactor in the event that evacuation of the main control room is required.
256	1.g. Security System	Improvements in the site's security system would decrease the potential for successful sabotage.
257	2.b. Improved Depressurization	SAMA will improve depressurization system to allow more reliable access to low pressure systems.
258	2.h. Safety Related Condensate Storage Tank	SAMA will improve availability of CST following a Seismic event
259	4.d. Passive Overpressure Relief	This SAMA would prevent vessel overpressurization.
260	8.b. Improved Operating Response	Improved operator reliability would improve accident mitigation and prevention.
261	8.d. Operation Experience Feedback	This SAMA would identify areas requiring increased attention in plant operation through review of equipment performance.
262	8.e. Improved SRV Design	This SAMA would improve SRV reliability, thus increasing the likelihood that sequences could be mitigated using low pressure heat removal.
263	12.a. Increased Seismic Margins	This SAMA would reduce the risk of core damage and release during seismic events.
264	13.b. System Simplification	This SAMA is intended to address system simplification by the elimination of unnecessary interlocks, automatic initiation of manual actions or redundancy as a means to reduce overall plant risk.

Addendum 1   Selected Previous Industry SAMAs

SAMA ID Number	SAMA Title	Result of Potential Enhancement
265	Train operations crew for response to inadvertent actuation signals	This SAMA would improve chances of a successful response to the loss of two 120V AC buses, which may cause inadvertent signal generation.
266	Install tornado protection on gas turbine generators	This SAMA would improve onsite AC power reliability.

APPENDIX F
COASTAL MANAGEMENT PROGRAM CONSISTENCY CERTIFICATION

FEDERAL CONSISTENCY CERTIFICATION: COASTAL ZONE MANAGEMENT ACT OF 1972 (CZMA)

Progress Energy certifies to the U. S. Nuclear Regulatory Commission (NRC) and the State of Florida that renewal of the Crystal River Unit 3 (CR-3) operating license is consistent with enforceable policies of the federally-approved coastal zone management program for the State of Florida. This Certification is consistent with and patterned after NRC guidance relevant to the preparation of consistency certifications for federal permits and licenses, as set forth in Appendix E of the NRC Office of Nuclear Reactor Regulation's "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" (Ref. 1). It provides the Consistency Certification, set forth below, and then describes the governing statutory and regulatory requirements. The statutory background is followed by a detailed description of the proposed activity (*i.e.*, CR-3 license renewal) and a discussion of potential environmental impacts.

This Certification, in combination with the information contained in the attachments hereto, contains the necessary information and data required by the Florida Coastal Management Program (FCMP). Specifically, the Certification and attachments fully assess the probable effects of the proposed renewal of the CR-3 operating license on any land or water use or natural resource of the coastal zone based on the relevant enforceable policies of the FCMP. Based on the assessment and compliance status of CR-3, Progress Energy has provided a brief set of findings in this Certification which summarize the bases for its determination that the proposed renewal of the CR-3 and its effects are consistent with the enforceable policies of the FCMP.

CONSISTENCY CERTIFICATION

Progress Energy certifies that renewal of the CR-3 operating license is consistent with the federally-approved FCMP and all activities associated with license renewal will be conducted in a manner consistent with the FCMP.

NECESSARY DATA AND INFORMATION

Statutory and Regulatory Background

The Coastal Zone Management Act (16 USC 1451 *et seq.*) (CZMA) imposes certification requirements on an applicant for a federal license to conduct an activity that could affect a state's coastal zone. Specifically, the CZMA requires that any applicant for a federal license or permit or authorization, certification, approval, or other form of permission, which any federal agency is empowered to issue to an applicant to conduct an activity, inside or outside of the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state, shall certify in the application to the approving federal agency that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program. The CZMA also requires the applicant to provide to the state or its designated agency a copy of the certification, with all necessary information and data [16 USC 1456(c)(3)(A); 15 CFR 930.51(a)]. At the earliest practicable time, the state agency must notify the federal agency and the applicant whether the state concurs with, or objects to, the consistency certification [15 CFR 930.63(a)]. The National Oceanic and Atmospheric Administration (NOAA) has promulgated regulations implementing the CZMA which indicate that the certification requirement is applicable to renewal of federal licenses for activities not previously reviewed by the state [15 CFR 930.51(b)(1)].

NOAA approved the Florida Coastal Management Program in 1981. The FCMP is administered by the Florida State Clearinghouse within the Florida Department of Environmental Protection (FDEP). The Department maintains a website that describes the program (Ref. 2). The Florida Coastal Program Guide (Ref. 3) and its companion document, the Florida Coastal Management Reference Book (Ref. 4), document these statutes and contain guidelines for preservation and management of the coastal area.

The FCMP comprises 23 Florida statutes administered by eight state agencies and five water management districts. In order to keep the approved FCMP current, Florida periodically submits legislative amendments to these statutes to NOAA's Office of Coastal Resources Management as required by 15 CFR 923.84.

Proposed Action

The NRC operating license for CR-3 authorizes operation until December 2016. NRC regulations in 10 CFR Parts 51 and 54 provide for the renewal of existing plant operating licenses and, in fact, as of this writing, the NRC has renewed 48 operating licenses. This certification is part of the license renewal application package submitted by Progress Energy to the U.S. Nuclear Regulatory Commission seeking to extend the license term of CR-3 to December 2036. Attachment B to this certification is the Progress Energy application for license renewal to the NRC. As part of the license renewal application, Progress Energy included not only an assessment of systems, structures, and components important to continued safe plant operation, but also an assessment of the environmental impacts of continued plant operation. The following discussion is taken from the Environmental Report submitted as part of the application.

CR-3 is an electric generating station in northwestern Citrus County, on Crystal Bay, an embayment of the Gulf of Mexico. CR-3 is part of a larger power-generation complex known as Crystal River Energy Complex (CREC). CREC comprises the single nuclear unit and four fossil-fueled units. CREC is the largest power-producing facility in Florida and the eighth largest in the nation, with a total generating capacity of 3,163 MW(e). CR-3's generating capacity is 850 MW(e).

CREC is located on a 4,738-acre site between the Withlacoochee River System and Crystal River, both Outstanding Florida Waters Special Waters administered by the Southwest Florida Water Management District. The undeveloped portions of the site include upland pines, agricultural land, forested wetlands and salt marshes. Property north of the site is used for limestone/dolomite mining, citrus groves, cattle ranching, and forestry. Southwest of the site are salt marshes and southeast of the site are forested wetlands. The site is approximately 35 miles southwest of Ocala and 60 miles north of Clearwater, Florida. The nearest incorporated community is Crystal River which had a 2000 census population of 3,485. Citrus County is rural with small towns, privately-owned forest tracts, agriculture, and state and federally-owned properties. Figures F-1 and F-2 are 50- and 6-mile vicinity maps, respectively.

Three transmission lines connect CR-3 to the electric grid (Figure F-3). Two were built in conjunction with the plant, and one was constructed in conjunction with CR-5 coming on-line. In accordance with 10 CFR 51.53(c)(3)(ii)(H) only the transmission lines originally constructed to connect the plant to the grid are of interest to the license renewal process. All of Florida's 67 counties are in the coastal plain and so the impacts of these lines, although they run inland, must be considered in this certification. Those lines are as follows:

- Central Florida is a 500 kilovolt line that runs generally eastward for 52.9 miles to the Central Florida Substation west of Leesburg. The corridor is approximately 150 feet wide.

- Lake Tarpon is a 500 kilovolt line that runs generally south for 34.4 miles to the Brookridge Substation near Brookville, and then an additional 37.6 miles to the Lake Tarpon Substation near Tarpon Springs. The total length is 72 miles with a 150-foot corridor.

Progress Energy uses a variety of methods to ensure that transmission corridors are kept free of brush and fast-growing trees. Progress Energy has a comprehensive rights-of-way vegetation management plan that includes physical and chemical methods to maintain acceptable clearances between energized wires and vegetation. Tree pruning, tree removal, brush cutting, herbicide application and tree growth regulators are used periodically to ensure safe and reliable operations.

CR-3 uses a pressurized water reactor licensed to operate at up to 2,609 MW(t). Progress Energy reports the generating capacity as 850 MW(e) which is the amount of power supplied to the grid during the summer. CREC Units 1, 2 (both fossil-fired) and 3 use once-through cooling, withdrawing from and discharging to, the Gulf of Mexico. Units 4 and 5 are closed cycle and withdraw makeup water for natural draft cooling towers from the other units' common discharge canal. Figure E-4 is a layout of the CREC facility. From May 1 to October 31 a portion of the heated discharge from Units 1, 2 and 3 is routed through helper towers adjacent to the discharge canal as necessary to ensure that the temperature of the discharge to the Gulf is below 96.5°F.

Cooling water for Units 1, 2, and 3 is withdrawn by way of a 14-mile-long intake canal south of the units that extends into the Gulf of Mexico. The canal is dredged to a depth of approximately 20 feet to accommodate coal barges, which dock on the south side of the canal, just west of the intakes for Units 1 and 2. The intake canal is defined by northern and southern dikes that parallel the channel for about 3.4 miles, at which point the southern dike terminates. The northern dike continues along the channel for another 5.3 miles. There are openings in the dikes at irregular intervals to allow north-south boat traffic in the area of the plant. Movement of water into the canal is tidally influenced; at the mouth of the canal current velocities ranged from 0.6 to 2.6 feet per second when last measured, in 1983-1984.

The head of the common discharge canal for all units is located just north of Units 1, 2, and 3 (see Figure E-4). The canal extends west for approximately 1.6 mile to the point-of-discharge, at which point it opens into a bay. The dredged channel, bordered to the south by a spoil bank, continues for another 1.2 miles. The discharge canal is dredged to maintain a water depth of approximately 10 feet.

The cooling water intake structure for CR-3 is approximately 400 feet east of the intake for Units 1 and 2 (see Figure F-4). A chain link fence extends across the entire width of the intake canal downstream of the intakes for Units 1 and 2. It is intended to intercept floating and partially submerged debris and to restrict access to the Unit 3 intake. The Unit 3 intake is 118 feet across and fitted with external trash racks with 4-inch openings between bars. There are four pump bays, each with conventional traveling screens with 3/8-inch mesh. The screens are rotated and washed every 8 hours. Material from the traveling screens is washed onto a trough and sluiced to a sump adjacent to the intake canal.

Unit 3 uses four circulating water pumps, two rated at 167,000 gallons per minute (gpm) and two rated at 179,000 gpm. The design intake flow for Unit 3 is 680,000 gpm or 979 million gallons per day (MGD). Service water pumps at Unit 3 withdraw an additional 10,000 to 20,000 gpm, depending on system demand.

Together Units 1, 2, and 3 have a design flow of approximately 1,318,000 gpm and 1,898 MGD. The NPDES permit for Units 1, 2, and 3 limits the combined condenser flow to 1897.9 MGD between May 1 and October 31, and to 1613.2 MGD from November 1 through April 30. The discharge from the once-through cooling systems of Units 1, 2, and 3 is used as cooling tower makeup for Units 4 and 5.

Thirty-six permanent helper cooling towers line the northern bank of the discharge canal and receive a portion of the discharge water flow. The helper cooling towers were installed to allow Units 1, 2, and 3, which have a combined discharge, to meet the NPDES (daily maximum) discharge limit of 96.5°F in warmer months. In April 2006, Progress Energy received approval from the state of Florida to install additional modular cooling towers to allow Units 1 and 2 to operate during the warmest times of the year without reducing power. In summer 2006, 67 modular towers were brought online.

The CR-3 workforce consists of approximately 455 Progress Energy employees and 85 long-term contract employees. More than 80 percent reside in Citrus County. CR-3 is on a 24-month refueling cycle. During refueling outages, site employment increases by approximately 1,000 workers for temporary (approximately 40 days) duty. Progress Energy has no plans to add employees as a result of license renewal.

Progress Energy has identified no significant environmental impacts from programs and activities for managing the effects of aging. As such, renewal would result in a continuation of environmental impacts currently regulated, and already permitted by the state. Table F-1 lists State and Federal licenses, permits, and other environmental authorizations for current CR-3 operations and Table F-2 identifies compliance activities associated specifically with NRC license renewal.

Environmental Impacts of CR-3 License Renewal

Relevant to this certification, Progress Energy notes that the NRC has prepared a generic environmental impact statement (GEIS) in which it considered the environmental impacts of renewing nuclear power plant operating licenses for a 20-year period (Ref. 5). The results of the GEIS analysis are codified in 10 CFR Part 51. In summary, the GEIS identifies 92 potential environmental issues associated with license renewal and reaches generic conclusions related to the environmental impacts of 69 so-called Category 1 issues that apply to all plants or to plants with certain specific design or site characteristics. The NRC concluded that Category 1 issues, including the following, have SMALL[1] impacts:

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[1] The NRC employs a three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definition of "SMALL" is set forth in footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

- Surface water quality, hydrology, and use
- Aquatic ecology
- Groundwater use and quality
- Terrestrial resources
- Air quality
- Land use
- Human health
- Postulated accidents
- Socioeconomics
- Uranium fuel cycle and waste management
- Decommissioning

In its decision-making for plant-specific license renewal applications, absent new and significant information to the contrary, NRC relies on its codified findings, as amplified by supporting information in the GEIS, for assessment of environmental impacts from Category 1 issues [10 CFR 51.95(c)(4)]. For plants such as CR-3 that are located in coastal areas, many of these issues involve impacts to the coastal zone. Of the 69 Category 1 issues identified in the GEIS, 64 are applicable to CR-3. The remaining Category 1 issues do not apply to CR-3 because they are associated with design or operational features the CR-3 does not have (*e.g.*, cooling ponds).

Additional plant-specific review is required for the remaining 23 issues identified in the GEIS. Such analyses are included in plant-specific supplements to the GEIS. The NRC has identified 21 of the 23 issues as "Category 2," for which license renewal applicants must submit additional site-specific information.[2] Of these, 15 apply to CR-3[3]. Two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized by the NRC; the former is addressed in plant-specific supplements to the GEIS, and information regarding the latter was deemed inconclusive by the NRC.

Progress Energy evaluated the applicable environmental issues set forth in the GEIS in the *Crystal River Unit 3 Applicant's Environmental Report – Operating License Renewal Stage*

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

2 10 CFR 51, Subpart A, Appendix B, Table B-1 also identifies 2 issues as "NA" for which NRC could not come to a conclusion regarding categorization. Progress Energy believes that these issues, chronic effects of electromagnetic fields and environmental justice, do not affect the "coastal zone" as that phrase is defined by the Coastal Zone Management Act [16 USC 1453(1)].

3 The remaining Category 2 issues do not apply to CR-3 because they are associated with design or operational features that CR-3 does not have.

(Environmental Report*),* submitted as part of the CR-3 license renewal application to NRC and provided as an attachment to this certification. The applicable issues and conclusions for these issues are as follows:

Entrainment of fish and shellfish in early life stages – This issue addresses mortality of organisms small enough to pass through the plant's circulating cooling water system. Florida Power Corporation (FPC) performed cooling water intake studies in the 1970s and in 1983 – 1984. When EPA reviewed the 1983 – 1984 data submitted as part of the Clean Water Act Section 316 Demonstration, the agency concluded that entrainment (and impingement) losses were unacceptably high and constituted an adverse impact to the biota of Crystal Bay and environs. EPA and FPC considered a range of mitigation measures and determined that flow reduction through the cooling system and rearing and stocking recreationally important fish were the best options for mitigating entrainment (and impingement) losses. The current NPDES permit limits cooling water withdrawals between November 1 and April 30 (the period when many important species move inshore to spawn) to no more than 1613.2 MGD. In addition, in 1991, FPC opened the Crystal River Mariculture Center, a multipurpose marine hatchery. Species cultivated include red drum, spotted seatrout, pink shrimp, striped mullet, pigfish, silver perch, blue crabs and stone crabs. Fish from the Mariculture Center are released into areas of the Gulf for which they are best suited, based on time of year and water quality conditions. The current NPDES permit notes that "a reduction of plant flow by 15 percent during the months of November through April, in conjunction with the construction and operation of a fish hatchery over the remaining operating life of the three units constituted minimization of the environmental impacts of the cooling water intake" (NPDES Permit No. FL0000159 (Major) Fact Sheet; Ref. 6).

The NPDES permit for Crystal River Units 1, 2, and 3 constitutes the current CWA Section 316(b) demonstration. Because CR-3 has a valid NPDES permit and has implemented mitigation measures to ameliorate any adverse impacts of entrainment (and impingement) Progress Energy concludes that impacts of entrainment are small.

Impingement of fish and shellfish – This issue addresses mortality of organisms large enough to be caught by the intake screens protecting the plant's circulating cooling water system. Florida Power Corporation (FPC) performed cooling water intake studies in the 1970s and in 1983 – 1984. When EPA reviewed the 1983 – 1984 data submitted as part of the Clean Water Act Section 316 Demonstration, the agency concluded that impingement (and entrainment) losses were unacceptably high and constituted an adverse impact to the biota of Crystal Bay and environs. EPA and FPC considered a range of mitigation measures and determined that flow reduction through the cooling system and rearing and stocking recreationally important fish were the best options for mitigating impingement (and entrainment) losses. The current NPDES permit limits cooling water withdrawals between November 1 and April 30 (the period when many important species move inshore to spawn) to no more than 1613.2 MGD. In addition, in 1991, FPC opened the Crystal River Mariculture Center, a multipurpose marine hatchery. Species cultivated include red drum, spotted seatrout, pink shrimp, striped mullet, pigfish, silver perch, blue crabs and stone crabs. Fish from the Mariculture Center are released into areas of the Gulf for which they are best suited, based on time of year and water quality conditions. The current NPDES permit notes that "a reduction of plant flow by 15 percent during the months of November through April, in conjunction with the construction and operation of a fish hatchery over the remaining operating life of the three units constituted minimization of the environmental impacts of the cooling water intake" (NPDES Permit No. FL0000159 (Major) Fact Sheet; Ref. 6).

The NPDES permit for Crystal River Units 1, 2, and 3 constitutes the current CWA Section

316(b) Demonstration. Because CR-3 has a valid NPDES permit and has implemented mitigation measures to ameliorate any adverse impacts of impingement (or entrainment) Progress Energy concludes that impacts of impingement are small.

Heat shock – This issue addresses mortality of organisms by exposure to heated plant effluents. CR-3 has a once-through heat dissipation system that withdraws water from the Gulf of Mexico for condenser cooling and discharges to the same body of water. The once-through system uses helper cooling towers at certain times of the year in order to meet NPDES permit thermal limits.

Section 316(a) of the Clean Water Act establishes a process whereby a thermal effluent discharger can demonstrate that thermal discharge limitations are more stringent than necessary to assure the protection and propagation of balanced, indigenous population of fish and wildlife in and on the receiving waters and can obtain facility-specific thermal discharge limits (33 USC 1326). FPC submitted a comprehensive 316 Demonstration study (evaluating both cooling water intake system impacts and thermal impacts) to the EPA in January 1985, as required by the plant's NPDES permit. The EPA issued an NPDES permit to the facility in 1988 with an alternative thermal limit (daily maximum discharge temperature of 96.5°F based on a three-hour rolling average), an alternative limit that has been part of every NPDES permit issued since that time. The Fact Sheet for the current Crystal River NPDES permit (FL0000159; Ref 6) presents this history and explains that the variance is still in effect because "there have been no physical or operational changes since the last permit renewal and no changes are expected in the upcoming permit cycle that will materially change the plant cooling water intake and discharge characteristics."

Based on the fact that FPC was granted a thermal variance for Crystal River Units 1, 2, and 3 in accordance with Section 316(a) of the Clean Water Act in 1988 and this variance remains a part of the current NPDES permit, issued to Progress Energy in May 9, 2005, Progress Energy concludes that impacts to fish and shellfish from heat shock at CR-3 are small.

Groundwater use conflicts (plants using >100 gpm of groundwater) – This issue addresses the potential for groundwater withdrawal to create a cone of depression that could deplete the groundwater supply to offsite users. Modeling conducted in support of the Environmental Report indicates that the current rate of groundwater withdrawal would create an 0.4-foot drawdown over the current operating period (40 years), with no increase in drawdown over the license renewal period.

Threatened and endangered species – This addresses effects that CR-3 operations could have on species that are listed under federal law as threatened or endangered. In analyzing this issue Progress Energy also considered species that are protected under Florida law.

Eight federally-listed species are known to occur at CREC or along transmission lines associated with CR-3: manatees, bald eagles, wood storks, alligators, Kemp's Ridley sea turtles, green sea turtles, loggerhead sea turtles, and hawksbill sea turtles. Many more species are known to occur in the counties crossed by the transmission lines, but have not been reported in association with those corridors. The eight known species are discussed below.

West Indian (Florida) manatees (*Trichechus manatus latirostris*) are federally- and state-listed as endangered and are protected by the Federal Endangered Species Act, the Federal Marine Mammals Protection Act and the Florida Manatee Sanctuary Act. Citrus County has a federally-and state-approved manatee protection plan. Manatees require water temperatures greater than 68°F and tend to inhabit springs and powerplant discharge areas, including CREC's, during fall and winter.

Because manatees are sometimes found in the discharge canal at CREC, Progress Energy established a Manatee Protection Plan that has been approved by the Florida Department of Environmental Protection. The plan establishes various precautions to minimize hazards to manatees at intake and outfall areas, such as having observers on board vessels associated with in-water work, operating vessels at "no wake/idle" speeds while in the warm water refuge area, and avoiding major in-water work in the discharge canal from November 15 through March 31 unless approved by the [Florida] Fish and Wildlife Conservation Commission's (FWC) Bureau of Protected Species Management. Progress Energy cooperates with USFWS, FWC, Florida Marine Research Institute, and the U.S. Geological Survey in providing access to CREC for manatee research and monitoring by these agencies.

The bald eagle (*Haliaeetus leucocephalus*) was removed from the federal threatened and endangered species list, effective August 8, 2007 (Federal Register Volume 72, No. 130, June 28, 2007) and the FWC is scheduled to remove the species from Florida's threatened list. Florida has the largest breeding population of bald eagles of any state other than Alaska. One bald eagle nest (nest ID CI013) has been documented on the CREC and another nest (nest ID CI004) has been confirmed slightly north of the CREC. Bald eagles are occasionally observed flying and foraging along Crystal Bay and at the CREC. The FWC database indicates 138 active bald eagle nests (in the 2001-2005 period) in the counties containing CR-3 and its associated transmission lines and Levy County (slightly north of CR-3 and adjacent to Citrus County).

The wood stork (*Mycteria americana*) is listed as endangered by USFWS and FWC. Wood stork habitats include cypress/gum ponds, river swamps, marshes (freshwater and saltwater), and bays. Wood storks are highly gregarious nesters and feeders. They are tactile feeders (vision seldom used to locate or catch prey) and usually forage in shallow water (6 to 20 inches). Small fish are the primary food items, but storks also consume crustaceans, salamanders, tadpoles, and insects. The distance between nesting colonies and feeding areas can range up to 60 miles or more, although the average distance is typically 7 to 9 miles. FWC considers the "core foraging area" of wood storks to be that area within 18.6 miles (30 km) of the colony.

There are no known stork rookeries on the CREC. It is unlikely that any rookeries exist on the site, since the gregarious behavior of this species would result in numerous sightings. Wood storks are occasionally seen foraging in the percolation ponds at the CREC and they probably forage, at least occasionally, in nearby salt marshes and in suitable wetlands in or near the transmission corridors.

Five species of sea turtles have been recorded in nearshore waters of Citrus County and are discussed below. Four of these sea turtle species have been observed at or near CR-3: Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*), and hawksbill (*Eretmochelys imbricata*).

Sea turtles are sometimes seen in the CREC's intake canal and are occasionally found on the Unit 3 intake trash racks. From 1994 to 1997, eight sea turtles were stranded on the Unit 3 intake trash racks. However, monitoring for sea turtles prior to 1997 was non-systematic, and data on species, size, and age was not always obtained.

In 1998, a continuous monitoring and rescue program was initiated by FPC to reduce potential sea turtle strandings and mortalities at CR-3. Progress Energy implemented Sea Turtle Rescue and Handling Guidance, which provides instructions for sea turtle observation, rescue, handling, notifications, and reporting requirements. As per the guidelines, the bar racks are continuously inspected during times of high turtle concentrations in the intake canal. Monitoring of the bar racks drops to once every two hours in periods of low concentration.

The Kemp's Ridley is federally- and state-listed as endangered. It is the most seriously endangered of the sea turtles, with nesting primarily limited to two provinces in Mexico. It does not nest in Florida. Nearshore waters of the northern Gulf of Mexico provide important developmental habitat for juvenile and sub-adult Kemp's Ridley sea turtles. The most frequently captured, killed, and rescued sea turtles in the CR-3 cooling water intake areas are sub-adult Kemp's Ridleys, which reflects their abundance within the nearshore waters of northern Gulf coast.

In the spring of 1998, an unusually high number of Kemp's Ridleys (approximately 50) were stranded on the bar racks. As a result, a Biological Opinion was issued by the National Marine Fisheries Service in 1999; the Biological Opinion determined that the cooling water intake system was not likely to jeopardize the existence of the five sea turtle species that might be found in the area. A second Biological Opinion, issued by the National Marine Fisheries Service in 2002, stated that continued operation of CR-3 would not jeopardize any of the listed sea turtle species populations, and included an Incidental Take Statement allowing the live take of 75 sea turtles annually and three lethal takes annually that are causally related to plant operations (Ref. 7). There is no limit on non-causally related dead turtles, although there is a reporting requirement if the non-causal take reaches eight individuals (Ref. 7).

The green sea turtle is federally- and state-listed as endangered. Most green turtle nesting in Florida occurs during June through September. They require open, gradually sloping beaches and minimum disturbance for nesting. Critical Habitats have been defined for this species, but do not include areas in Florida. Green sea turtles are herbivores, preferring to feed on marine grasses and algae in shallow bays and lagoons.

The loggerhead sea turtle is federally- and state-listed as threatened. In the United States, loggerheads nest from Texas to Virginia with approximately 80 percent of the nesting occurring in southern Florida coastal counties. They nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. No Critical Habitat has been defined for this species. The nearshore waters of the Gulf of Mexico are thought to provide important developmental areas for juvenile loggerheads.

The hawksbill sea turtle is federally- and state-listed as endangered. In contrast to other sea turtles, hawksbills tend to nest in low densities on scattered small beaches. Nesting may occur on almost any undisturbed deep-sand beach, typically from April through November. Critical Habitats have been defined for this species, but do not include areas in Florida. Hawksbills prefer coral reefs and thus are uncommon in western Gulf waters (Ref. 8).

The American alligator (*Alligator mississippiensis*) is common throughout Florida. The alligator is federally listed as "threatened due to similarity in appearance" to the endangered American crocodile (*Crocodylus acutus*), and is state-listed as a species of special concern. Alligator habitat consists of swamps, marshes, ponds, lakes, and slow-moving streams and rivers.

Alligators are opportunistic feeders and eat fish, turtles, birds, snakes, frogs, insects, and small mammals. Alligators are occasionally seen in swampy areas at CREC and undoubtedly occur in wetlands, ponds, and streams along the transmission corridors.

The gopher tortoise (*Gopherus polyphemus*) is state-listed as threatened by the Florida FWC. It is not federally listed. Gopher tortoises do not occur on the CREC, but are found on the two associated transmission lines. During transmission corridor maintenance, Progress Energy policy is to avoid using heavy equipment within 25 feet of a burrow (Ref 9).

<u>Electric shock from transmission-line-induced currents</u> – This issue addresses the potential for shock from induced currents, similar to static electricity effects, in the vicinity of transmission lines. Because this human health issue does not directly or indirectly affect natural resources of concern within the Coastal Zone Management Act definition of “coastal zone” [16 USC 1453(1)], Progress Energy concludes that the issue is not subject to the certification requirement.

<u>Housing Impacts</u> – This issue addresses impacts that additional CR-3 employees hired to support license renewal, and the resulting additional indirect jobs, could have on the availability of local housing. NRC concluded, and Progress Energy concurs, that impacts would be small for plants located in medium population areas that do not have growth control measures that would limit housing development. Using the NRC definitions and categorization methodology, CR-3 is in a medium population area without restrictive growth controls. Progress Energy expects no additional employees would be required to support license renewal. Progress Energy has concluded that impacts during the CR-3 license renewal term would be small.

<u>Public utilities: public water supply</u> – This issue addresses the impacts that hiring additional employees to support license renewal could have on public water supplies. Progress Energy has analyzed the availability of public water supplies in the area and found that all but one have ample capacity which suggests that additional CR-3 employees would not cause impacts. Progress Energy expects no additional employees to support license renewal. Therefore, Progress Energy has concluded that impacts to water supply during the license renewal term would be small.

<u>Offsite land use – license renewal term</u> – This issue addresses impacts that local government spending of plant property tax dollars can have on land use patterns. CR-3 property taxes payments represented between 4.7 and 5.4 percent of Citrus County’s annual property tax revenues between 2005 and 2007. Progress Energy projects that CR-3 property taxes will remain relatively constant during the license renewal term. NRC concluded, and Progress Energy concurs, that the significance of tax payments as a source of local government revenues would be small if payments were less than 10 percent of revenues. Using the NRC definition and categorization methodology CR-3 property tax payments are small relative to local government revenues. Progress Energy has concluded that impacts to land use because of CR-3 property taxes would be small.

<u>Transportation</u> – This issue addresses impacts that license renewal workers could have on local traffic patterns. Progress Energy expects no additional employees would be required to support license renewal. Therefore, Progress Energy has concluded that impacts to local traffic during the CR-3 license renewal term would be small.

<u>Historic and archaeological resources</u> – This issue addresses impacts that license renewal activities could have on resources of historic or archaeological significance. Prior to construction of CR-3, an archaeological survey performed by the Florida Bureau of Historic

Sites and Properties identified 20 cultural resource sites on CREC property and 23 sites in the vicinity of the property. The State Historic Preservation Office (SHPO) and the U.S. Atomic Energy Commission (the precursor agency to the NRC) concluded that construction and operation of CR-3 would have no effect on cultural resources in the area. Progress Energy is not aware of any adverse or detrimental impacts to these sites from current operations and has no plans for license renewal activities that would disturb these resources, including transmission line maintenance activities. Progress Energy has written the SHPO to inquire about any issues of concern.

Severe accident mitigation alternatives – Results from Progress Energy's severe accident mitigation alternatives (SAMA) analysis suggest that four actions could be cost-beneficial and have potential to mitigate risk of potential severe accidents to public health and the regional economy, including the coastal zone. These SAMAs are unrelated to plant aging, however; and are therefore outside of the scope of license renewal and this consistency certification.

Environmental Impacts of CR-3 Steam Generator Replacement (Refurbishment)

Progress Energy has addressed refurbishment activities in this environmental report in accordance with NRC regulations and complementary information in the NRC GEIS for license renewal (NRC 1996). NRC requirements for the renewal of operating licenses for nuclear power plants include the preparation of an integrated plant assessment (IPA) (10 CFR 54.21). The IPA must identify and list systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, piping, supports, and pump casings (see 10 CFR 54.21 for details), as well as those that are not subject to periodic replacement.

In turn, NRC regulations for implementing the National Environmental Policy Act require environmental reports to describe in detail and assess the environmental impacts of refurbishment activities such as planned modifications to systems, structures, and components or plant effluents [10 CFR 51.53(c)(2)]. Resource categories to be evaluated for impacts of refurbishment include terrestrial resources, threatened and endangered species, air quality, housing, public utilities and water supply, education, land use, transportation, and historic and archaeological resources.

The GEIS (NRC 1996) provides helpful information on the scope and preparation of refurbishment activities to be evaluated in an environmental report. It describes major refurbishment activities that utilities might perform for license renewal that would necessitate changing administrative control procedures and modifying the facility. The GEIS analysis assumes that an applicant would begin any major refurbishment work shortly after NRC grants a renewed license and would complete the activities during five outages, including one major outage at the end of the 40th year of operation. The GEIS refers to this as the refurbishment period.

GEIS Table B.2 (NRC 1996) lists license renewal refurbishment activities that NRC anticipated utilities might undertake. In identifying these activities, the GEIS intended to encompass actions that typically take place only once, if at all, in the life of a nuclear plant. The GEIS analysis assumed that a utility would undertake these activities solely for the purpose of extending plant operations beyond 40 years, and would undertake them during the refurbishment period. The GEIS indicates that many plants will have undertaken various refurbishment activities to support the current license period, but that some plants might undertake such tasks only to support extended plant operations. Examples of refurbishment activities include pressurized water reactor steam generator replacement and boiling water reactor recirculation piping replacement when these activities are carried out to ensure safe operations for 20 additional years. The GEIS assumes that refurbishment activities would take place within the 10 years prior to current license expiration and would culminate in a major outage immediately prior to the extended (license renewal) term. Because the situation at Crystal River is analogous, Progress Energy analyzed CR-3 steam generator replacement in its Environmental Report as a refurbishment activity, pursuant to 10 CFR 51.53(c)(3)(ii).

The new steam generators will be manufactured at Babcock and Wilcox (B&W) Canada's Cambridge, Ontario facility. The current schedule calls for delivery of the steam generators on July 19, 2009. Installation is to take place during a fall outage that will begin on September 26, 2009 and end 74 days later, on December 9, 2009.

The new steam generators will be transported by rail from Canada, arriving in the Crystal River area on a main Seaboard Coast Line/ (CSX) system line (SCL) that extends north from the Tampa-St. Petersburg area. From the CSX line, the steam generators will be moved to the Crystal River site on a nine-mile-long rail spur that serves the Crystal River Energy Complex and is owned by Progress Energy. The steam generators will be offloaded and temporarily stored next to existing CR-3 warehouse facilities, approximately 500 feet east of the CR-3 containment building. The new steam generators will be moved by multi-axle transporter ("crawler") to the containment building and passed into containment by means of a hole cut in the containment dome. The transporter will follow existing site roads from the temporary storage area to the containment building. Once removed, the old steam generators will be placed in a yet-to-be-built once-through steam generator (OTSG) storage building, which will be located in the general vicinity of the Temporary Assembly Building, which is approximately 1,100 feet east of the CR-3 containment building.

Current plans call for the establishment of materials storage area and concrete batch plant approximately 1,800 feet north-northeast of the CR-3 containment building and a construction laydown area approximately 1,200 feet east-northeast of the CR-3 containment building. Temporary offices will be erected in the area known as "the Swamp," which is immediately adjacent to and east of the CR-3 powerblock.

Progress Energy evaluated the applicable refurbishment environmental issues established in the GEIS in the Environmental Report that was submitted as part of the CR-3 license renewal application to NRC and provided as an attachment to this certification. The applicable issues and conclusions for these issues are as follows:

<u>Terrestrial Resources (Refurbishment)</u> - Any land clearing or construction will occur within the existing plant boundaries. There will be no clearing of previously-undisturbed areas. No road improvements will be required because the steam generators will arrive by rail and be offloaded to a multi-axle transporter capable of traveling on existing site roads and graveled areas without doing any damage. Progress Energy estimates that a peak number of approximately 900 workers will be engaged in steam generator replacement work during the fall 2009 outage in addition to approximately 1,100 workers who will be engaged in normal refueling and maintenance activities.

Any disturbance of wildlife would be limited to the relatively-brief period (74 days) during which refurbishment-related activities are carried out. Even during the period of peak refurbishment activity, impacts to wildlife would be small, and would consist mostly of rendering marginal wildlife habitat temporarily unsuitable for small numbers of common songbirds and small mammals.

Housing Impacts (Refurbishment) - In Supplement 1 to Regulatory Guide 4.2 (NRC 2000), Section 4.14.1, NRC states that, if the conditions related to housing in Table B-1 are met and the number of additional on-site workers associated with refurbishment for both the license renewal and current term operation/refueling periods does not exceed the peak workforce estimate of 2,273 persons used for the socioeconomic impact analysis reported in Section 3.7 of NUREG 1437, the finding of “small significance” may be adopted without further analysis.

As described in Section 2.6 (Demography) of the Environmental Report, CR-3 is located in a medium population area. As noted in Section 2.8 (Land Use Planning), Citrus County is not subject to growth control measures that limit housing development. As stated in Section 3.4, during peak refurbishment activities, about 900 refurbishment workers and 1,100 refueling workers would be on site. Therefore, Progress Energy concludes that impacts to housing availability resulting from refurbishment-related population growth would be small and would not warrant mitigation.

Public services: public utilities (refurbishment) - There is sufficient drinking water capacity in the region of interest to supply the refurbishment workforce and the permanent workforce at CR-3 without imposing stresses on local/regional water supplies and suppliers. Any impact from refurbishment would be small.

Public services:education (refurbishment) – Given the projected length of the steam generator replacement outage (refurbishment), 74 days, workers are not expected to relocate to the area with their families. Any increase in enrollment in area schools would be small. Likewise, any impact to educational services would be small.

Offsite land use (refurbishment) - The refurbishment workforce would temporarily increase the 50-mile population by 0.2 percent and the Citrus County population by 1.7 percent. This would have minimal effect on offsite land use in Citrus County, which is not isolated or sparsely populated and has established patterns of land use.

Public services: transportation (refurbishment) - There would be an increase in local traffic during the steam generator replacement outage, but traffic flow would not be significantly impeded. Impacts would be mitigated by Progress Energy’s plan to create an offsite parking area at a local shopping mall and bus outage workers to the CR-3 site.

Historic and Archaeological Resources (refurbishment) - Refurbishment activities would take place in previously disturbed areas, thus would not affect historic or archaeological resources. In addition, Progress Energy has a cultural resources procedure in place to protect any archaeological or historic resources that might be encountered or inadvertently discovered during construction at Progress Energy facilities. Any impacts from refurbishment to historic and archaeological resources would be small, and mitigated by the company’s cultural resources procedure, which requires consulting with the SHPO in the event that artifacts are discovered.

Florida Coastal Management Program

Table F-3 identifies the Florida statutes applicable to CR-3 license renewal, discusses the applicability of each to CR-3 and explains the basis for Progress Energy's conclusion that renewal of the CR-3 Operating License will comply, or that the statute does not apply to the proposed license renewal.

Findings

In summary the information provided with certification supports the following findings:

1. NRC has determined that the significance level of GEIS Category 1 issue impacts is small. A small significance level is defined by NRC as follows:

   > For the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purpose of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small as the term is used in this table (10 CFR Part 51, Subpart A, Appendix B, Table B-1).

1. Progress Energy has adopted by reference the NRC's findings for Category 1 issues.

2. For applicable Category 2 issues, Progress Energy has determined that the environmental impacts are small, as the term is defined by NRC. Impacts to coastal zone resources, therefore, would also be small.

3. To the best of Progress Energy's knowledge CR-3 and its associated transmission lines and corridors are in compliance with Florida's licensing and permitting requirements.

4. Renewal of Progress Energy's license and continued operation of CR-3 would be consistent with the enforceable policies, statutes, and implementing regulations of the Florida Coastal Zone Management Program. CR-3 and Progress Energy are in compliance with the Coastal Zone Management Program.

STATE NOTIFICATION

By this certification that CR-3 license renewal is consistent with Florida's Coastal Management Program, Florida is notified that it has six months from receipt of this letter and accompanying information in which to concur with or object to Progress Energy's certification (15 CFR 930.62(a)).

Florida's concurrence, objection, or notification of review status shall be sent to:

Rani Franovich
Chief of Environmental Section
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
One White Flint
11555 Rockville Pike
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Michael J. Annacone
Crystal River 3 Plant General Manager
Crystal River Nuclear Plant
15760 W. Powerline St.
Crystal River, FL 34428

ATTACHMENTS

Attachment A – Florida Coastal Management Program Statutes

Attachment B – License Renewal Application; Crystal River Unit 3; Docket No. 50-302; Facility Operating License No. DPR-72.

REFERENCES

1. NRR Office Instruction No. LIC-203, "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues." U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. May 24, 2004.

2. Florida Department of Environmental Protection. 2006. Florida Coastal Management Program. Available at http://www.dep.state.fl.us/mainpage/programs/cmp.htm. Accessed September 28, October 3, and December 7, 2006, and March 14, 2008.

3. State of Florida. 1998 Coastal Program Guide, A Guide to the Federally Approved Florida Coastal Management Program. Department of Community Affairs. Available at http://www.dep.state.fl.us/cmp/publications/programguide98/index.htm. Accessed September 28, October 3, and December 7, 2006, and March 14, 2008.

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5. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, U. S. Nuclear Regulatory Commission, NUREG-1437, May 1996. Available on line at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437. Accessed June 21, 2006, and March 14, 2008.

6. Florida Department of Environmental Protection. Fact Sheet for Florida Department of Environmental Protection Industrial Wastewater Facility Permit. Permit No. FL0000159 (Major).

7. National Marine Fisheries Service. 2002. Endangered Species Act – Section 7 Consultation Biological Opinion. Cooling water intake system at Crystal River Energy Complex (F/SER/2001/01080). National Oceanic and Atmospheric Administration, Southeast Regional Office, St. Petersburg, FL. August 8.

8. U.S. Fish and Wildlife Service. 2006. North Florida Field Office, Species Accounts. Available at http://www.fws.gov/northflorida/Species-Accounts/SpeciesInfo.htm. Accessed October and November 2006.

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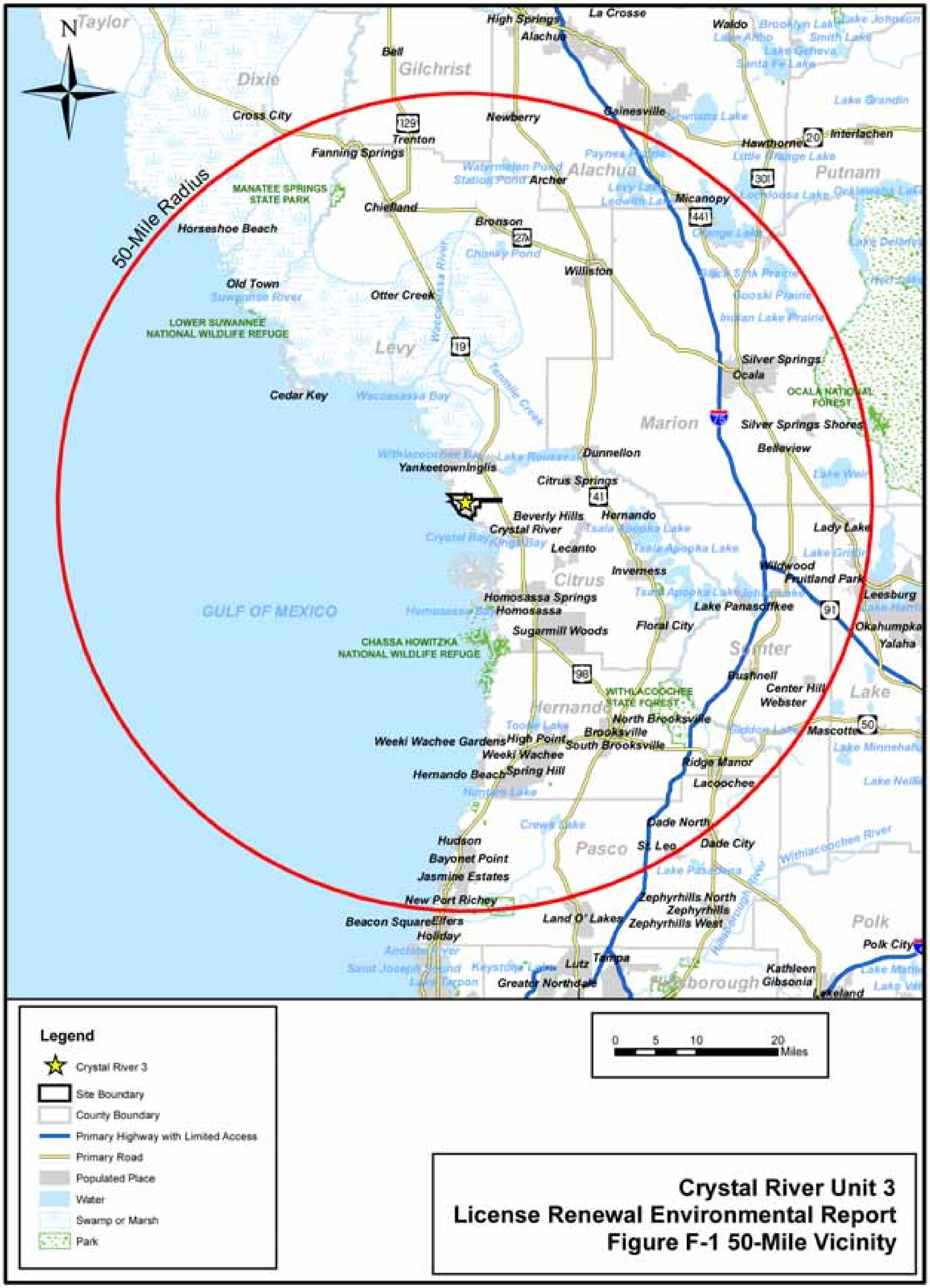
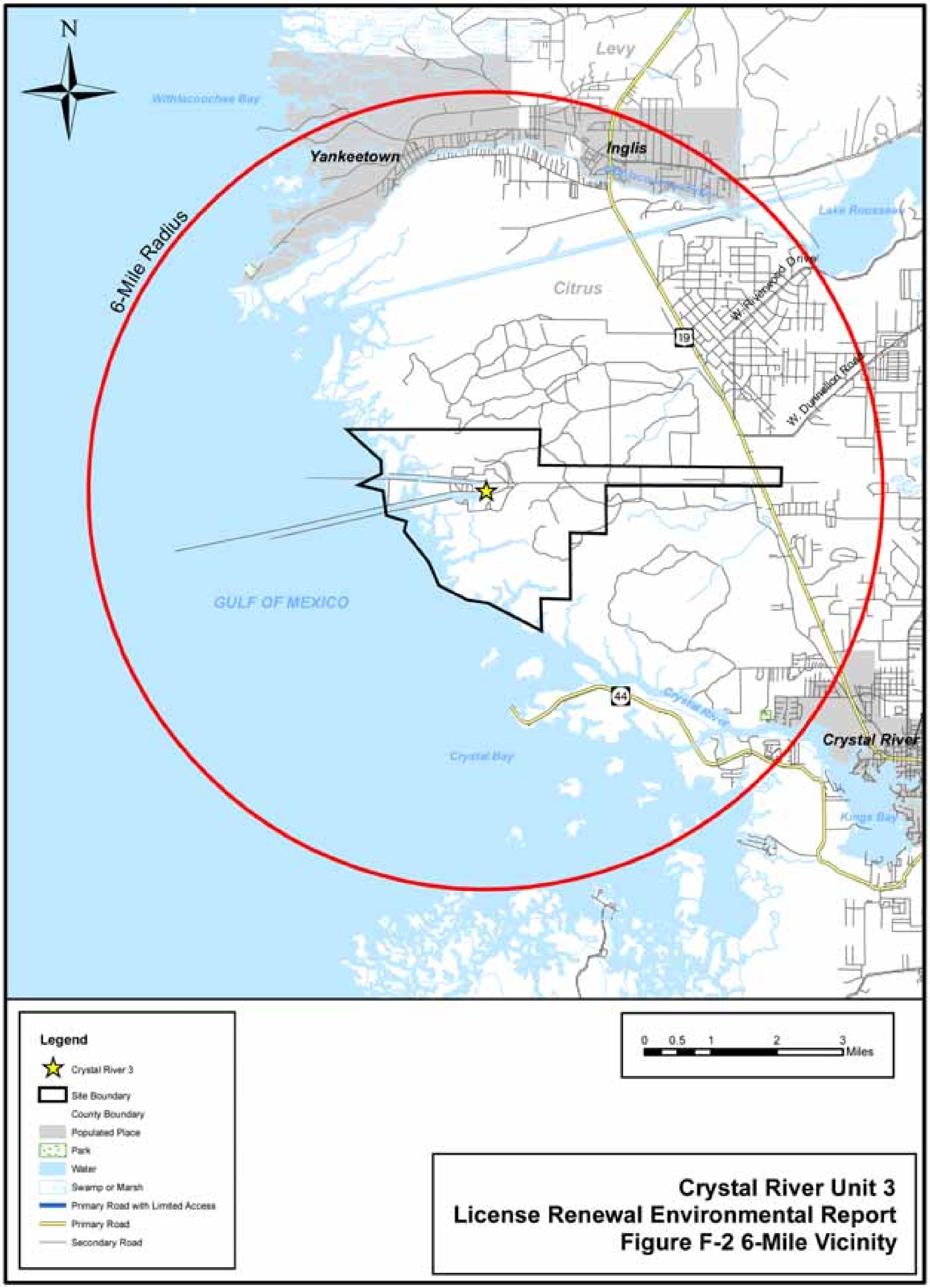
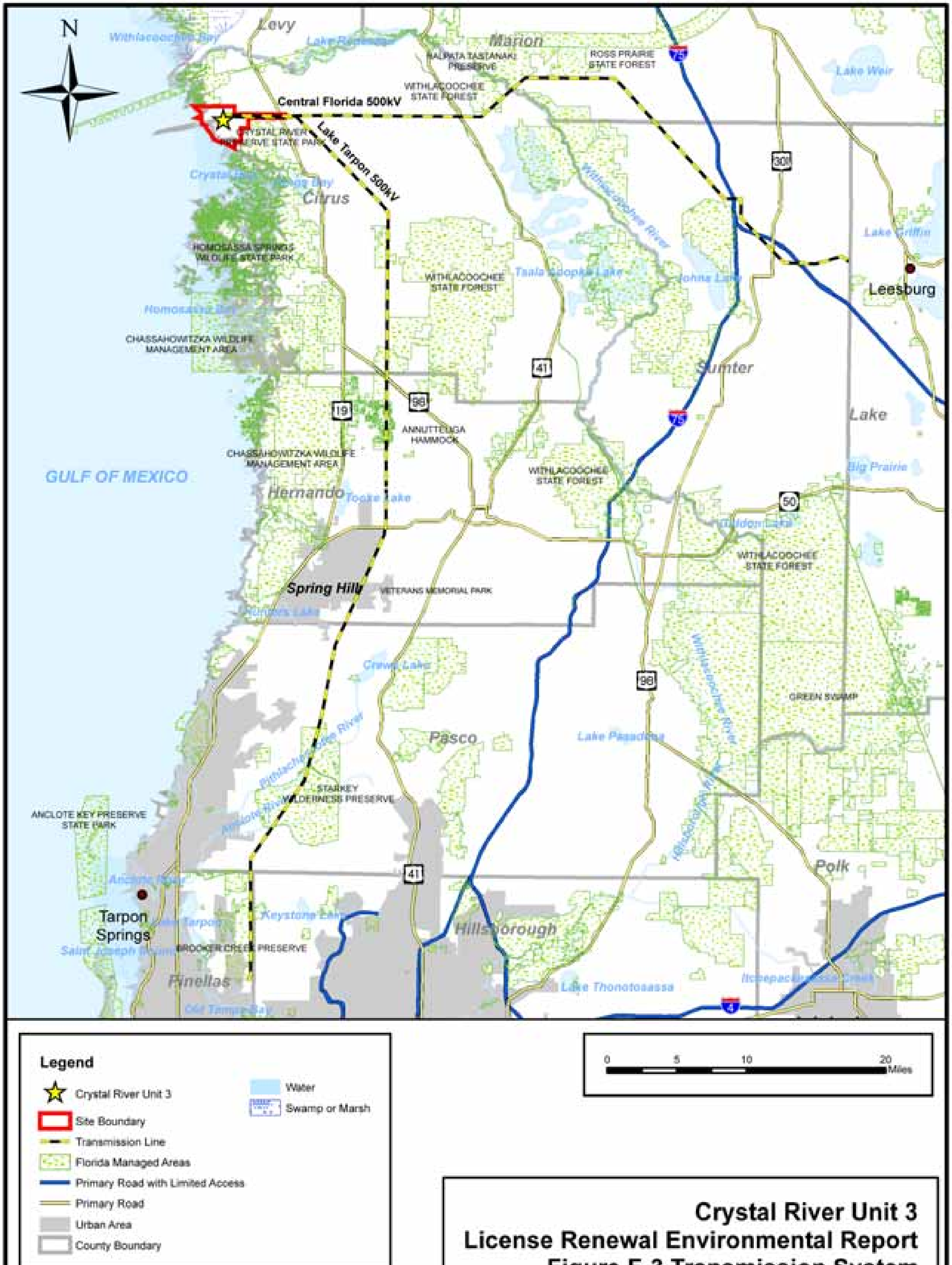


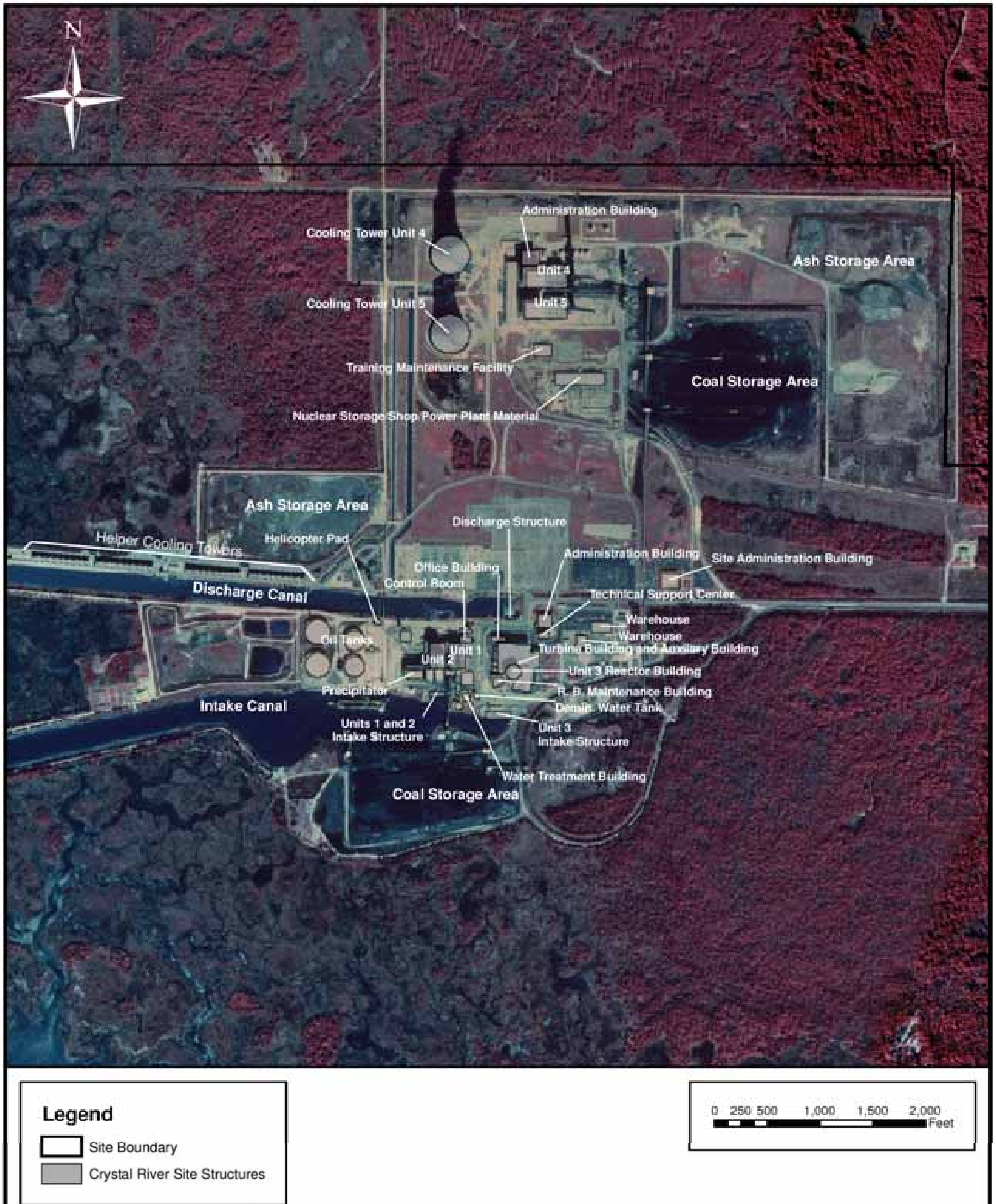
Crystal River Unit 3
License Renewal Environmental Report
Figure F-1 50-Mile Vicinity



Crystal River Unit 3
License Renewal Environmental Report
Figure F-2 6-Mile Vicinity



Crystal River Unit 3
License Renewal Environmental Report
Figure F-3 Transmission System



Crystal River Unit 3
License Renewal Environmental Report
Figure F-4 Crystal River Site Layout

TABLE F-1
STATE AND FEDERAL LICENSES, PERMITS AND OTHER ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT CR-3 OPERATIONS

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Federal Requirements to License Renewal					
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10	License to operate	DPR-72	Issued: 12/03/1976 Expires: 12/03/2016	Operation of CR-3
U.S. Department of Transportation	49 USC 5108, 49CFR Part 107, Subpart G	Registration	060908 551 067Q	Issued: 06/09/2008 Expires: 06/30/2009	Hazardous materials shipments
U.S. Army Corps of Engineers	Section 10 of River and harbor Act of 1899 (33 U.S.C. 403)	Permit	SAJ-2008-02893	Issued: 11/12/2008 Expires: 11/12/2013	Maintenance dredging in front of the Gulf Intake Structure
Florida Department of Environmental Protection	Clean Water Act (33 USC 1251 et seq.), Pollution Prevention Act (42 USC 13109-13109) FL Rule 62-302.520(1), F.A.C. 62-620, NPDES	NPDES Permit	FL0000159	Issued: 5/9/2005 Expires: 5/8/2010	Industrial wastewater discharges to Gulf of Mexico from Crystal River Units 1, 2, and 3
Florida Department of Environmental Protection	Clean Water Act (33 USC 1251 et seq.), Pollution Prevention Act (42 USC 13109-13109) FL Rule 62-302.520(1), F.A.C. 62-620 NPDES	Permit	FLA0169690	Issued: 1/9/2007 Expires: 1/8/2012	Treatment of industrial wastewater by land application system

TABLE F-1
STATE AND FEDERAL LICENSES, PERMITS AND OTHER ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT CR-3 OPERATIONS (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Florida Department of Environmental Protection	Clean Air Act (42 USC 7401 et seq), FL Statutes Chapter 403, FL Administrative Code Chapters 62-4, 62-210, 62-213, and 62-214.	Title V Permit	0170004-015-AV	Issued: 5/29/2006 Expires: 12/31/2009	Operation of CREC
Florida Fish and Wildlife Conservation Commission	FL Admin. Code 68B-8	Special Activity License (SAL)	06SCR-107A	Issued: 1/25/2006 Expires:1/24/2007	Harvest of broodstock and release of broodstock and captive-bred marine organisms for stock enhancement mitigation
Florida Department of Aquaculture and Consumer Services	Florida Aquaculture Policy Act, FL Statutes Chapter 597	Certificate	AQ0119007	Issued: NA Expires 6/30/2009	Aquaculture certification for production of marine fish.
Florida Department of Environmental Protection	FL Admin. Code 62-761 and 62-762	Registration	9103099	Issued: 5/23/08 Expires:6/30/2009	Storage Tank Registration
Florida Fish and Wildlife Conservation Commission	Migratory Bird Treaty Act 16USC. 703-712. FL Admin Code Chapter 68A	Migratory Bird Nest Permit	WN07371	Issued: 8/10/2007 Expires: 7/31/2009	Inactive nest removal

TABLE F-1
STATE AND FEDERAL LICENSES, PERMITS AND OTHER ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT CR-3 OPERATIONS (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Florida Department of Environmental Protection	Federal Safe Drinking Water Act, FL Statutes Chapter 403, Part IV	Wastewater permit	FLA118753-003-DW3P	Issued: 4/29/2004 Expires: 4/28/2009	Operation of CR Units 1, 2, and 3 sewage treatment plant
Southwest Florida Water Management District	FL Statutes Chapter 373, FL Admin Code 40D-2	Water Withdrawal Permit	204695.03	Issued: 10/28/1997 Expires: 10/28/2007	Groundwater withdrawal for South Plant (Units 1, 2, and 3)
Florida Department of Environmental Protection	Federal Safe Drinking Water Act, FL Statutes Chapter 403, Part IV	Wastewater Permit	FLA011909-002-DW4P	Issued: 11/29/2004 Expires: 11/28/2009	Nuclear Training center domestic wastewater system
South Carolina Department of Health and Environmental control – Division of Waste Management	South Carolina Radioactive Waste Transportation and Disposal Act (Act No. 429)	South Carolina Radioactive Waste Transport Permit	0022-09-08	Issued: 11/16/2007 Expires: 12/31/2008	Transportation of radioactive waste into the state of South Carolina
State of Tennessee Department of Environment and Conservation - Division of Radiological Health	Tennessee Department of Environment and Conservation Rule 1200-2-10.32	Tennessee Radioactive Waste License-for-Delivery	T-FL001-L08	Issued: 1/1/2008 Expires: 12/31/2008	Transportation of radioactive waste into the state of Tennessee
Utah Department of Environmental Quality – Division of Radiation Control	Utah Radiation Control Rule R313-26	Generator Site Access Permit	0109000004	Issued: 7/14/2008 Expires: 7/14/2009	Grants access to a land disposal facility in the state of Utah

TABLE F-2
COMPLIANCE ACTIVITIES ASSOCIATED SPECIFICALLY WITH NRC LICENSE RENEWAL[a]

Agency	Authority	Requirement	Remarks
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011 et seq.)	License renewal	Environmental Report submitted in support of license renewal application
U.S. Fish and Wildlife Service	Endangered Species Act Section 7 (16 USC 1536)	Consultation	Requires federal agency issuing a license to consult with the U.S. Fish and Wildlife Service
Florida Department of Environment Protection	Clean Water Act Section 401 (33 USC 1341)	Certification	State issuance of NPDES permit (Section 9.1.4) constitutes 401 certification
Florida Department of State's Office of Cultural and Historical Programs	National Historic Preservation Act Section 106 (16 USC 470f)	Consultation	Requires federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer (SHPO). SHPO must concur that license renewal will not affect any sites listed or eligible for listing

a. No renewal-related requirements identified for local or other agencies.

TABLE F-3
MATRIX OF FCMP ENABLING POLICIES AND LICENSE RENEWAL OF CRYSTAL RIVER-3

Florida Statute	Key Issue	Applicability and Response
Chapter 161	Beach and Shore Preservation	Not applicable. CR-3 is located outside the coastal building zone and CR-3 license renewal, including refurbishment, is not likely to have a material effect on existing coastal conditions or natural shore and inlet processes. CREC property does not include land classified as beach or shoreline.
Chapter 163, Part II	Intergovernmental Programs: County and Municipal Planning and Land Development Regulation	Applicable. License renewal, including refurbishment, will conform to county comprehensive and land development plans and land development code.
Chapter 186	State and Regional Planning	Applicable. License renewal, including refurbishment, will conform to state comprehensive plan and Withlacoochee Regional Council strategic regional policy plan and with plan implementation at the local and state level.
Chapter 252	Emergency Management	CR-3 has an approved Emergency Response Plan that it maintains in coordination with the Florida Division of Emergency Management.
Chapter 253	State Lands	Not applicable. Proposed action does not involve the acquisition, management, conservation, protection or disposal of state lands.
Chapters 253, 259, 260, and 375	Land Acquisition	Not applicable. Proposed action does not involve the acquisition, management, conservation, protection or disposal of state lands.
Chapter 258	State Parks and Preserves	Applicable. Proposed action, CR-3 license renewal, would not significantly impact three state parks (Crystal River Preserve State Park, Crystal River Archaeological State Park, Waccasassa Bay Preserve State Park) that lie within 5 miles of the plant or impair the public's ability to enjoy these resources. Progress Energy has proposed no changes in air emissions or liquid discharges in association with license renewal. There will be no change in the viewscape and no increase in noise as there are no plans to change the way the plant operates over the license renewal term. Refurbishment (steam generator replacement) will be associated with a temporary (estimated 74 days) increase in traffic and noise, but these are not expected to interfere with the public's enjoyment of the state parks.

TABLE F-3 (Continued)
MATRIX OF FCMP ENABLING POLICIES AND LICENSE RENEWAL OF CRYSTAL RIVER-3

Florida Statute	Key Issue	Applicability and Response
		Applicable. Although the Big Bend Seagrasses Aquatic Preserve is approximately 5 miles northwest of the Crystal River Energy Complex and the St Martins Marsh Aquatic Preserve is approximately 4 miles southeast of the CREC, the proposed action does not involve any activities that would infringe on these preserves or impact their ecological communities. Progress Energy dredges the intake canal at Crystal River every 5-7 years, an activity that requires FDEP and Corps of Engineers authorization as well as submittal of a Joint Environmental Resource Permit Application. Given the level of state and federal oversight and the distance from CR-3 to the preserves, maintenance dredging is expected to be consistent with preserve operations.
Chapter 260	Florida Greenways and Trails Act	Not applicable. Proposed action does not involve acquisition of land for recreational trails
Chapter 267	Historical Resources	Progress Energy has corresponded with the State Historic Preservation Officer (Florida Division of Historical Resources). Proposed action, renewal of CR-3 license, does not involve changes in operation. Refurbishment (steam generator replacement) would have no effect on archaeological or historic resources as it will take place in a previously disturbed area that is dedicated to industrial use.
Chapter 288	Commercial Development and Capital Improvements	Applicable. The Florida Legislature has found “there is a need to enhance economic activity in the cities and counties of the state by attracting manufacturing, development, redevelopment of brownfield areas, business enterprise management, and other activities conducive to economic promotion in order to provide a stronger, more balanced, and stable economy in the cities and counties of the state.” (Title XIX, Chapter 288, Section 288.9602(1). By providing electric power to Florida consumers, CR-3 supports the goal of providing a strong, balanced and stable economy.
Chapters 334 and 339	Transportation Administration and Finance	Not applicable. Proposed action does not involve the Florida transportation system.

TABLE F-3 (Continued)
MATRIX OF FCMP ENABLING POLICIES AND LICENSE RENEWAL OF CRYSTAL RIVER-3

Florida Statute	Key Issue	Applicability and Response
Chapter 370	Saltwater Fisheries	Progress Energy has corresponded with both the National Marine Fisheries Service and the Florida Fish and Wildlife Conservation Commission regarding impacts of operation. Proposed action, renewal of CR-3 license, does not involve changes in operation. Refurbishment (steam generator replacement) would have no effect on salt water fisheries as it will take place in an upland area.
Chapter 372	Wildlife	Progress Energy has corresponded with both the U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission regarding impacts of operation. Proposed action, renewal of CR-3 license, does not involve changes in operation. Refurbishment (steam generator replacement) would have little or no impacts on wildlife as it will take place in a previously disturbed area that is dedicated to industrial use.
Chapter 373	Water Resources	The proposed action would have no incremental effect on water resources. Releases to waters of the state are managed under state-issued (NPDES and Industrial Wastewater Facility) permits. The project does not involve the management or storage of surface water and does not involve dams, impoundments or reservoirs
Chapter 375	Outdoor Recreation and Conservation Lands	Not applicable. Proposed action has no relation to the state's acquisition of land for public use (recreation and conservation) and state grants to local governments for acquisition of land for recreation and conservation.
Chapter 376	Pollutant Discharge Prevention and Removal	Not Applicable. The statute addresses the transfer of pollutants between vessels, between onshore facilities and vessels, between offshore facilities and vessels, and between terminal facilities within the jurisdiction of the state and state waters.
Chapter 377	Energy Resources	Not applicable. Proposed action does not involve exploration, drilling, or production of oil, gas, or other petroleum products.
Chapter 380	Land and Water Management	Not applicable. Proposed action involves an existing facility that does not lie within or near any of the designated Areas of Critical State Concern.
Chapters 381.001, .0011, .0012, .006, .0061, .0066, .0067	Public Health, General Provisions	Applicable. Progress Energy holds one Domestic Wastewater Facility Permit for Units 1, 2, and 3 and one for the Nuclear Training Center and abides by the regulations for operation of such systems.

TABLE F-3 (Continued)
MATRIX OF FCMP ENABLING POLICIES AND LICENSE RENEWAL OF CRYSTAL RIVER-3

Florida Statute	Key Issue	Applicability and Response
Chapter388	Mosquito Control	Not applicable. The Crystal River Energy Complex, which includes CR-3, has no mosquito control program. Citrus County has a mosquito control program.
Chapter 403	Environmental Control	CR-3 operates under a Title V air permit, an NPDES permit, and an Industrial Wastewater permit (see Table F-1).
Chapter 582	Soil and Water Conservation	Renewal of the CR-3 operating license would involve no new construction, thus no potential for soil erosion. Refurbishment (steam generator replacement) could produce minimal soil erosion --- there would be some minor grading and filling --- but impacts would be small due to relatively small volume of soil that would be disturbed, level terrain, and distance from natural waterbodies. Refurbishment activities would also include the creation of new impervious surfaces (batch plant location, and expanding an existing laydown area). All construction would be carried out in compliance with section 582.04, which requires appropriate soil-conserving practices and “works of improvement” (mitigation measures). Construction at CR-3 is done in accordance with the Crystal River Units 1, 2, and 3 Best Management Practices and Storm Water Pollution Prevention Plan. Moreover, these activities are subject to Florida’s Environmental Resource Permitting (ERP) requirements which authorized such activities and impose restrictions designed to mitigate or prevent negative impacts on wetlands, soil erosion, and surface water degradation. An ERP permit is being sought for these activities as part of the SGR project.

DEP = Department of Environmental Protection
FPL = Florida Power & Light Company
FWCC = Fish and Wildlife Conservation Commission
NPDES = National Pollutant Discharge Elimination System
FCMP = Florida Coastal Program Guide