



## United States Department of the Interior

FISH AND WILDLIFE SERVICE  
South Florida Ecological Services Office  
1339 20<sup>th</sup> Street  
Vero Beach, Florida 32960



May 5, 2006

Frank Gillespie  
Office of Nuclear Reactor Regulation  
U.S. Nuclear Regulatory Commission  
Mail Stop O-11F1  
Washington, D.C. 20555-0001

Service Federal Activity Code: 41420-2006-FA-0478  
Service Consultation Code: 41420-2006-F-0125  
Project: Renewal of Operating Licenses for the  
Nuclear-Powered Generating Units at  
the Turkey Point Power Plant  
Applicant: Florida Power and Light  
Formal Consultation Initiation Date: April 11, 2006  
County: Miami-Dade

Dear Mr. Gillespie:

This document transmits the Fish and Wildlife Service's (Service) biological opinion of the U.S. Nuclear Regulatory Commission's (NRC) renewal of operating licenses for the two nuclear-powered generating units located at the Turkey Point Power Plant in Miami-Dade County, Florida, and its effects on the endangered American crocodile (*Crocodylus acutus*). The Turkey Point Power Plant is operated by Florida Power and Light (FPL), and the NRC renewed FPL's operating licenses for the two nuclear-powered generating units on June 6, 2002. The discovery of a dead juvenile crocodile (presumably unintentionally crushed by a vehicle) at the Turkey Point Power Plant site on December 21, 2005, prompted the NRC to request that the Service reinitiate consultation and initiate formal consultation on the action. This biological opinion was prepared in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

This biological opinion is based on information provided by FPL, the NRC, emails, telephone conversations, field investigations, and other sources of information. A complete administrative record of this consultation is on file at the South Florida Ecological Services Office.

### Consultation History

In a letter to the Service dated August 28, 2001, the NRC provided a biological assessment on their proposal to renew the operating licenses for the two nuclear-powered generating units (Units 3 and 4) located at FPL's Turkey Point Power Plant. FPL has requested that their licenses to operate these units be renewed for a period of 20 years. In accordance with section 7 of the



Act, the NRC determined that the action will have "no effect" or "may affect, but is not likely to adversely affect" federally listed species, including the American crocodile. The NRC requested the Service concur with their determination.

In a correspondence to the NRC dated December 7, 2001, the Service concurred with the NRC's determination that their proposed renewal of the operating licenses for Units 3 and 4 at the Turkey Point Power Plant will have "no effect" or "may affect, but are not likely to adversely affect" federally listed species, including the American crocodile.

On December 21, 2005, FPL notified the Service that a juvenile crocodile was found dead on Bechtel Road near the test canals at the Turkey Point Power Plant site at approximately 1,645 hours. The female crocodile (total length = 47.2 centimeters, weight = 230.4 grams) was presumably crushed by a vehicle using the roadway. Immediately following the incident, FPL posted several warning signs in the area where the incident occurred and notified all employees of the presence of crocodiles on the power plant site and need for caution when driving onsite. The area where the dead crocodile was discovered was being used as a storage area for materials related to the construction of a new 1,150-megawatt natural gas-powered generation plant known as Unit 5. The Unit 5 project site is located immediately north of the existing Unit 1 power facility. The Service reviewed the Unit 5 project in a biological opinion issued to the U.S. Army Corps of Engineers (Corps) on October 6, 2004 (Service Log Number 4-1-04-PL-7414). The biological opinion provided terms and conditions to be followed by the Corps to reduce take and to minimize the direct and indirect effects of the project on the American crocodile.

On February 16, 2006, the Service met with representatives of FPL, the Corps, and the NRC. The purpose of the meeting was to discuss the recent crocodile mortality, the measures implemented to minimize the potential for future crocodile mortalities, and to request that the Service anticipate incidental take for potential future crocodile mortalities.

On March 3, 2006, a telephone conference call was conducted among representatives of the Service and the NRC to determine if the NRC or the Corps would be agency responsible for consulting with the Service on the ongoing operation of the Turkey Point Power Plant, and its potential impacts to the American crocodile. As a result of this conference call, the Service and the NRC agreed that since the NRC is responsible for licensing and regulating the operation and activities of nuclear power plants, the NRC should consult with the Service on potential effects to the American crocodile resulting from the ongoing operation of the Turkey Point Power Plant.

In a letter to the Service dated March 24, 2006, and an email dated April 11, 2006, the NRC requested reinitiation of consultation on their renewal of the operating licenses for Units 3 and 4 at the Turkey Point Power Plant granted to FPL on June 6, 2002. The NRC noted that a dead juvenile crocodile was found at the Turkey Point Power Plant on December 21, 2005, and determined that the ongoing operation of the facility, through these license renewals, has the potential to adversely affect the American crocodile. The NRC also changed its determination for the American crocodile from "may affect, not likely to adversely affect" to "may affect, likely to adversely affect," and requested that the Service initiate formal consultation on the action.

The Service concurs with the NRC's determination on the American crocodile. As of April 11, 2006, we received all information necessary for initiation of formal consultation on the American crocodile for this project as required in the regulations governing interagency consultations (50 CFR § 402.14). The Service is providing this biological opinion in conclusion of formal consultation.

## **BIOLOGICAL OPINION**

### **DESCRIPTION OF THE PROPOSED ACTION**

The NRC is the federal agency responsible for the licensing and regulation of nuclear power plants in the United States. On June 6, 2002, the NRC renewed the operating licenses for the nuclear-powered generating units (Units 3 and 4) at the Turkey Point Power Plant for a period of 20 years. On December 21, 2005, FPL notified the Service and the NRC that at about 16:45 hours a juvenile crocodile was found dead on Bechtel Road near the test canals on the Turkey Point Power Plant site. This female crocodile (total length = 47.2 centimeters, weight = 230.4 grams) was presumably crushed by a vehicle using the roadway. Based on this event, the NRC determined that the ongoing operation of the Turkey Point Power Plant, in accordance with the NRC's 2002 license renewal action, has the potential to adversely affect the American crocodile and decided to reinstate consultation with the Service.

The Turkey Point Power Plant is located on an 11,000-acre project site (Figure 1). The purpose of the plant is to generate electricity for the residents of Florida. The power plant consists of two fossil fuel-powered generating units (Units 1 and 2, not under the jurisdiction of the NRC), and two nuclear-powered generating units (Units 3 and 4). In addition, FPL is currently constructing a new natural gas-fired power plant known as Unit 5 that will provide approximately 1,150 megawatts of electricity on a site immediately north of Unit 1. The power plant site also includes a number of administration buildings, roads, parking lots, oil storage tanks, barge turning basin, switchyard, transmission lines, and a 6,700-acre cooling canal system. The project site is also immediately adjacent to FPL's 13,000-acre Everglades Mitigation Bank. A description of Turkey Point Power Plant and its operation is presented in Appendix A (NRC 2002). The project site is located on the shores of Biscayne Bay in Sections 27, 28, 29, 31, 32, 33, and 34, Township 57 South, Range 40 East in Miami-Dade County Florida. The majority of the Turkey Point Power Plant site is designated as critical habitat for the American crocodile (Figure 2).

To minimize the potential adverse effects of ongoing operations of the Turkey Point Power Plant to the American crocodile, FPL has posted additional warning signs (in English and Spanish) in the area where the incident occurred. The signs make clear to road users that crocodiles may be crossing the roadway. In addition, FPL has agreed to send out a memorandum to all employees at the Turkey Point Power Plant site that crocodiles occur on the site, to watch for crocodiles on roads at all times, and to observe posted speed limits. The memorandum will be sent out on a biannual basis. FPL will also give a presentation on the American crocodile to all employees twice a year as part of the monthly safety meeting that all employees are required to attend. The

presentations will be made during the crocodile mating and nesting season when the activity of crocodiles at the site is greatest.

## **STATUS OF THE SPECIES**

This section summarizes American crocodile biology and ecology as well as information regarding the status and trends of the American crocodile throughout its entire range within the United States of America. The Service uses this information to assess whether a Federal action is likely to jeopardize the continued existence of the species. The Environmental Baseline section summarizes information on status and trends of the American crocodile specifically within the action area. This summary provides the foundation for the Service's assessment of the effects of the proposed action, as presented in the Effects of the Action section. A thorough treatment of the biology and ecology of the American crocodile, both in south Florida and throughout its range, can be found in the *South Florida Multi-Species Recovery Plan* (Service 1999).

The American crocodile was listed as endangered throughout its range in 1975 (40 CFR 44151) and critical habitat was established in 1979 (Figure 2) (44 CFR 75076). The listing of the American crocodile and protection of crocodile habitat was due to significant population declines likely associated with habitat alternations and direct human disturbances to crocodiles and their nests. The designated critical habitat for the American crocodile in Florida is defined as all land and water within the following boundary:

Beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; thence southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; thence southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Anglefish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key; thence to the westernmost tip of Middle Cape; thence northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; thence eastward along a straight line to the northernmost point of Nine-Mile Pond; thence northeastward along a straight line to the point of beginning.

## **Description**

The American crocodile is a large greenish-gray reptile. At hatching, crocodiles are yellowish-tan to gray in color with vivid dark bands on the body and tail. As they grow older, their overall coloration becomes more pale and uniform and the dark bands fade. All adult crocodiles have a hump in front of the eye, and tough, asymmetrical armor-like scutes (scale-like plates) on their backs. The American crocodile is distinguished from the American alligator by a relatively narrow, more pointed snout and by an indentation in the upper jaw that leaves the fourth tooth of the lower jaw exposed when the mouth is closed. Moreover, alligators have two nostrils separated by a bony septum covered in skin, while American crocodiles have two nostrils that touch each other in a single depression on the tip of the snout (P. Ross, University of Florida,

personal communication 2005). In Florida, the crocodile ranges in total length from 26.0 centimeters (10.3 inches) at hatching to 3.8 meters (12.5 feet) as adults (Moler 1991a). Larger specimens in Florida were reported in the 1800s (Moler 1991a), and individuals as large as 6 to 7 meters (19.7 to 23.0 feet) have been reported outside the United States (Thorbjarnarson 1989).

## **Distribution**

The present distribution of the American crocodile includes coastal wetlands and rivers of south Florida, Cuba, Jamaica, and Hispaniola (along the Caribbean coast from Venezuela north to the Yucatan peninsula, and along the pacific coast from Sinaloa, Mexico to the Rio Tumbes of Peru [Moler 1992]).

Within Florida, the American crocodile historically occurred as far north as Indian River County on the east coast and Tampa Bay on the west coast, and as far south as Key West (DeSola 1935; Hornaday 1914; Kushlan and Mazzotti 1989; Allen and Neill 1952; Neill 1971). The current range of the American crocodile in Florida largely consists of coastal areas of Miami-Dade, Monroe, Collier, and Lee Counties. Crocodiles are regularly observed in the Everglades National Park (ENP) along the shoreline of Florida Bay, on north Key Largo, and at the Turkey Point Nuclear Power Plant. Crocodiles are still known to occur on the west coast of Florida as far north as Sanibel Island. Sightings of crocodiles are also infrequently reported north of Miami-Dade County on the east coast (a crocodile was documented in Indian River County in October 2004) and in the lower Florida Keys (Moler 1992). It was thought that the American crocodile no longer regularly occurred in the Keys south of Key Largo (Jacobsen 1983; P. Moler, Florida Fish and Wildlife Conservation Commission [FWC], personal communication 2002). However, confirmed sightings have been reported with increasing frequency in many of the lower Keys, and we believe that these observations may indicate that crocodiles are expanding their range back into the Keys. A crocodile was also observed as far south as Fort Jefferson in the Dry Tortugas in May 2002 (O. Bass, ENP, personal communication 2002).

The breeding range of the American crocodile in Florida is still restricted relative to its reported historic range (Kushlan and Mazzotti 1989), with most breeding occurring on the mainland shore of Florida Bay between Cape Sable and Key Largo (Mazzotti et al. 2002). Nesting occurs in three primary locations: Key Largo at the Crocodile Lake National Wildlife Refuge, ENP, and the cooling canal system of the Turkey Point Power Plant. The observed increase in nesting during the last 30 years (see below) is largely due to increased nesting at the Turkey Point site (Tucker et al. 2004). Nesting has also been recently documented in the Keys. A crocodile nest has been observed on Lower Matecumbe Key during 2003, 2004, and 2005 (M. Cherkiss, University of Florida, personal communication 2005).

## **Habitat**

The American crocodile in south Florida occurs primarily in mangrove swamps and along low-energy mangrove-lined bays, creeks and inland swamps (Kushlan and Mazzotti 1989). Deep water habitats (>1.0 meter) are also known to be an important component of crocodile habitat

(Mazzotti 1983). Crocodiles exhibit seasonal differences in habitat use. For example, during the breeding and nesting season, adults outside of Key Largo and Turkey Point can be found along the shoreline of Florida Bay with males located further inland than females (L. Brandt and F. Mazzotti, University of Florida, personal communication 1998; P. Moler, FWC, personal communication 1998). During the non-nesting season, crocodiles are usually found further inland in fresh and brackish water swamps, creeks, and bays (Kushlan and Mazzotti 1989).

Nesting habitat includes sites with sandy shorelines or raised marl creek banks adjacent to deep water (Service 1999). Crocodiles also nest on berms and other sites where fill has been placed. Sites optimal for nesting provide appropriate soils for incubation, are generally protected from wind and wave action, and have access to deep water (Service 1999).

### **Reproductive biology**

Female crocodiles reach sexual maturity at approximately 10 to 13 years of age (about 2.25 meters total length) (Mazzotti 1983; LeBuff 1957). The size and age that male crocodiles reach sexual maturity is not currently known (Ogden 1978).

Courtship and breeding occur in late winter and early spring, and nests are usually built in late April or early May (Moler 1992). Females will only produce one clutch of eggs per year, although it is not known if a female will produce clutches in consecutive years. Nests are constructed on beaches, stream banks, and levees, and many nest sites are used recurrently. Female crocodiles may simply dig a hole at the nest site, but usually construct a nest mound at the nesting site by scraping together soil. If a mound is constructed, a hole is dug in the middle of the nest mound prior to egg laying. Approximately 20 to 50 eggs are deposited in the nest mound or nest hole. The average clutch size is about 35 eggs. Following laying, the female covers up the eggs with soil and the eggs incubate at the nest site for approximately 85 to 90 days (Moler 1992). In Florida, female crocodiles have not been observed to defend their nest during incubation (Kushlan and Mazzotti 1989). However, once the eggs begin hatching, the female usually opens the nest and carries the hatchlings to water in her mouth. Hatchlings are not able to escape the nest cavity without assistance from their mother. Crocodile hatchlings remain together in a loose aggregation for several days to several weeks following hatching. Parental care of young crocodiles has not been observed in Florida, although it has been reported in other parts of the American crocodiles range (Moler 1992).

### **Foraging**

American crocodiles are opportunistic feeders and will eat whatever they can catch and consume. Hatchlings feed largely on small fish but will also eat crabs, snakes, insects, and other invertebrates (Moler 1992). Adult crocodiles are capable of taking large prey but generally do not capture prey larger than a raccoon (*Procyon lotor*) or cormorant (*Phalacrocorax auritus*). The diet of adult crocodiles consists of snakes, fish, crabs, small mammals, turtles, and birds (Moler 1992). Crocodiles usually forages from immediately prior to sunset to just after sunrise (Lang 1975; Mazzotti 1983).

## Relationships with other species

The American crocodile may co-occur with the American alligator (*Alligator mississippiensis*) in south Florida. Co-occurrence of these species is most likely during the non-nesting season or when salinities are low. Most crocodilians are known to tolerate the presence of other crocodilian species provided food and other habitat requirements are not limiting (Service 1999). However, little is known concerning the interspecific interactions that occur between crocodiles and alligators. Alligators and crocodiles both occur within the vicinity of the cooling canal system at Turkey Point Power Plant. Anecdotal evidence suggests that crocodiles may aggressively exclude alligators from using a freshwater canal favored by crocodiles known as the Interceptor Ditch (J. Wasilewski and J. Lindsay, FPL, personal communication 2004). Nevertheless, crocodiles and alligators have both been reported to construct nests on the same canal berm located in the vicinity of Marco Island in Collier County, Florida (Service 1999).

American crocodiles are most susceptible to predation during incubation and as juveniles. American crocodile eggs are taken primarily by raccoons, although depredation rates of crocodile nests are typically low in south Florida. Hatchlings and subadults are known to be taken by a variety of predators including wading birds, gulls, crabs, sharks, alligators (in areas where they co-occur) and adult crocodiles (Service 1999). Adult crocodiles have no known predators other than humans.

## Status and trends

The number of American crocodiles that occurred historically in south Florida is difficult to determine because many records are anecdotal and observers may have confused crocodiles with alligators. Moreover, the remoteness and inaccessibility of estuarine habitats to humans made obtaining a reliable estimate of the crocodile population problematic. Ogden (1978) estimated a population of 1,000 to 2,000 American crocodiles within south Florida during the early 1900s. The crocodile population was depleted due to hunting (crocodiles were legally hunted until 1962), and habitat modification and destruction due to on-going urbanization of south Florida by humans. By the mid 1970s the American crocodile population was thought to be reduced to about 100 to 400 animals (not including hatchlings) (Ogden 1978).

The population of the American crocodile in south Florida has increased substantially during the last 30 years. The current population is estimated to contain 1,400 to 2,000 individuals (not including hatchlings) (P. Moler, FWC, personal communication 2005; F. Mazzotti, University of Florida, personal communication 2005). This estimate was derived using American crocodile nesting data and by applying demographic characteristics observed in other crocodilian species (*i.e.*, Nile crocodiles [*Crocodylus niloticus*] and American alligators) suggesting that breeding females make up 4 to 5 percent of the non-hatchling population and about 75 percent of reproductively mature females breed and nest each year. We believe this is a reasonable, but conservative, estimate of the current American crocodile population in Florida due to the observed increase in nesting described below.

Nest survey data collected in south Florida also suggest that the American crocodile population is increasing. Nesting effort has increased from about 20 nests per year in the late 1970s to about 91 to 94 nests in 2005 (S. Klett, Service, personal communication 2005; M. Cherkiss, University of Florida, personal communication 2005; J. Wasilewski, FPL, personal communication 2005a). Surveys detect approximately 80 to 90 percent of nests (F. Mazzotti, University of Florida, personal communication 2005; J. Wasilewski, FPL, personal communication 2006) and are generally unable to distinguish those nests that contain more than one clutch of eggs from different females without excavating the nests. In some instances, surveyors are able to determine that more than one female has laid eggs at a communal nest by visiting the nest over a series of days and observing hatching of separate nests (J. Wasilewski, FPL, personal communication 2005b). Communal nests that are not distinguishable result in a possible underestimation of nests and/or females.

### Threats

Modification and destruction of nesting habitat was the primary threat to the American crocodile during the 20th century. Nesting habitats that were formerly occupied (*e.g.*, Lake Worth, Palm Beach County, central Biscayne Bay, middle and lower Keys etc.) were destroyed or degraded due to urbanization, and the crocodile has been largely extirpated from many of these areas (DeSola 1935; Service 1984). Although, recent observations of crocodile nesting at Chapman Field Park (J. Maquire, personal communication 1998) indicate that crocodiles may be reoccupying portions of their former range in central Biscayne Bay. However, continued habitat loss and degradation reduces the likelihood that crocodiles will be able to persist in these areas.

Disturbance due to human encroachment into crocodile habitat may alter normal behavioral patterns of crocodiles. Observations suggest that repeated human disturbances of crocodiles may cause females to abandon nests or relocate nest sites (Kushlan and Mazzotti 1989). The rising demand for recreational opportunities (*e.g.*, camping, boating, and fishing) is expected to bring more people into contact with crocodiles. Pressure on Federal and State agencies to provide more recreational opportunities on public lands that provide habitat for crocodiles is also expected to increase. An increase in human disturbance due to recreational activities could adversely affect the crocodile.

Crocodile mortality due to collisions with vehicles has been an ongoing problem along U.S. Highway 1 and Card Sound Road in Miami-Dade and Monroe Counties (Service 1999). This problem has been particularly acute within the segment of U.S. Highway 1 from Homestead to Key Largo. Wetlands providing habitat for crocodiles are located on both sides of the roadway. However, the only structures that currently allow movement of crocodiles under the roadway are three small culverts that are usually submerged. Consequently, approximately three to four crocodiles per year have been killed while attempting to cross the roadway (Mazzotti 1983; Moler 1991a). The Florida Department of Transportation is attempting to reduce vehicle-related crocodile mortality along this section of U.S. Highway 1 by installing a series of wildlife underpasses consisting of large culverts, bridges, and associated fencing. The locations for these structures were determined from discussions with the Service and the FWC. The wildlife underpasses are being installed as part of roadway improvements currently being constructed



along this stretch of U.S. Highway 1. The purpose of the improvements is to provide a safer roadway for the public and improve an evacuation route in the event of hurricanes.

Natural climatic events also have the potential to affect the American crocodile. For example, tropical storms and hurricanes affecting south Florida can result in high winds, large waves, and tidal surges that could result in either direct mortality of adults, and/or the loss of nests, nesting habitat, and other important habitat features (Service 1999). Ogden (1978) suggested hurricanes occurring at regular intervals may serve to regulate the American crocodile population in Florida. South Florida infrequently experiences cold fronts where ambient temperatures drop below 0°C. Such temperatures are likely lethal to crocodiles, although the effects of subfreezing temperature are not well known because crocodiles killed during freezes are rarely found (Dimock 1915; Barbour 1923; Mazzotti 1983). Moler (1991b) suggested that a decline in crocodile nesting effort observed in 1989 may be the result of adult mortality due to a hard freeze that occurred during the previous winter. Drought may also adversely affect crocodiles. Mazzotti and Dunson (1984) suggest that hatchling crocodiles are susceptible to osmotic stress and require access to low salinity water. The freshwater needs of hatchlings are usually met by rainfall depositing a lens of freshwater on the water surface of estuarine environments that may last for days. Hatchlings are likely stressed and occasionally die during periods of low rainfall. Crocodiles greater than 200 grams have sufficient mass to withstand osmoregulatory stress and are not believed to be affected by drought.

## **ENVIRONMENTAL BASELINE**

The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions, which are contemporaneous with the consultation in progress.

### **Status of the species within the action area**

For the purposes of this consultation the action area is defined as the existing 11,000-acre Turkey Point Power Plant site (Figure 1). The site provides important habitat for the American crocodile in the action area. FPL has monitored crocodile nesting and the crocodile population at the Turkey Point site since the late 1970s. Crocodile nesting occurs primarily within the 5,900-acre cooling canal system. Nesting within the cooling canals has increased from 1 to 2 nests (producing 30 hatchlings) in the late 1970s to 24 nests (producing 282 hatchlings) in 2005 (FPL 2005). Concurrently, the crocodile population (excluding hatchlings) at the Turkey Point Power Plant has increased from less than 10 in the late 1970s to 50-60 in 2004 (J. Wasilewski, FPL, personal communication 2004).

### **Factors affecting the species environment within the action area**

The construction of the power facilities at Turkey Point in the 1960s and early 1970s has had a significant effect on the American crocodile in the action area. The installation of the existing

fossil fuel and nuclear power facilities, as well as 5,900-acre cooling canal system, has resulted in filling and excavation of a large proportion of the natural wetlands on the 11,000-acre site. Accordingly, development of the site resulted in a considerable loss of native habitat available to the American crocodile.

Ironically, the establishment of the Turkey Point Power Plant has also benefited the American crocodile. The 5,900-acre cooling canal system has become particularly important to crocodiles as nesting habitat. The berms located in the cooling canal system are comprised of materials that seem to be preferred by crocodiles as nesting substrate. In 1978, crocodiles were first observed to build nests on these berms. Nesting activity within the cooling canal system has been observed to increase since it was first documented. As indicated above, a total of 24 crocodile nests were observed during surveys conducted in 2005 (FPL 2005). Crocodile nesting occurring in the cooling canal system makes up roughly a third of the annual nest production in all of south Florida.

After consulting with the Service, FPL initiated a management program at the Turkey Point Power Plant site in the early 1980s to benefit the American crocodile. The management program includes: (1) preserving and creating habitat suitable for crocodile nesting and basking; (2) establishment of exclusions zones during the nesting season; (3) monitoring surveys to document population size, activity, growth, and survival; (4) relocation of hatchlings to low salinity areas to increase survival; (5) the construction of freshwater ponds for use as hatchling refugia; (6) implementation of an educational program for the public; and (7) prohibiting automobile use, road maintenance, and other construction activities with the cooling canals at night and during critical periods of the nesting season. The management activities instituted by FPL have resulted in an increase in the crocodile population in the action area and have largely been responsible for the increase in American crocodile population in south Florida that has occurred over the last 25 years (Tucker et al. 2004).

## **EFFECTS OF THE ACTION**

This section deals with analyzing the direct and indirect effects of the project on the American crocodile and its habitat.

### **Factors to be considered**

A large portion of the Turkey Point Power Facility site contains habitat suitable for the American crocodile. The project site is located in the northeast portion of the geographic range of the American crocodile, and a majority of the site occurs within designated critical habitat for this species. Crocodiles may be found within and adjacent to the Turkey Point power facility site year-round. Operation of the power plant is continuous and activities on the Turkey Point site have the potential to adversely affect the American crocodile.

**Beneficial Effects** - The beneficial effects of the ongoing operation of the Turkey Point Power facility to the American crocodile have been discussed above and include the construction of the cooling canal system and on the ongoing crocodile management plan at Turkey Point facility

conducted by FPL. In addition, the ongoing management and removal of exotic vegetation in the cooling canal system also benefits the American crocodile by maintaining high-quality nesting habitat.

On-site mitigation activities associated with the current construction of FPL's Unit 5 (a 1,150 megawatt natural gas-powered electric generation plant) on the Turkey Point Power Plant site have benefited the crocodile. The Service consulted on this project in an October 6, 2004, biological opinion (Service Log Number 4-1-04-PL-7414) issued to the Corps. The new plant is being constructed immediately north of Unit 1. The project has resulted in impacts to 78.7 acres of largely developed uplands and 24.6 acres of wetlands. Mitigation activities for this project have already been conducted and included off-site and on-site mitigation. The on-site wetland mitigation included: (1) the creation of 1.1 acres of mangrove lagoon adjacent to the project footprint; (2) the improvement of hydrological flow in wetlands located west of the powerline access road and southwest of the paved access road due the installation of culverts; (3) the enhancement of 8.05 acres of potential crocodile nesting habitat due to the removal of exotic vegetation on three berms (Ribs 3, 4, and 5) associated with the test cooling canals; (4) the construction of 1.35 acres of freshwater lagoon for juvenile crocodiles on two berms (Ribs 3 and 4) associated with the test cooling canals; and (5) the restoration of 5.6 acres of wetland habitat resulting from the removal of and grading of two berms (Ribs 1 and 2) associated with the test cooling canals.

The potential for human disturbance to crocodiles at the Turkey Point Power Plant site has been greatly reduced because FPL does not allow unescorted access to the site. Formerly, FPL allowed groups to reserve and use the Girl Scout Camp facility located on the northern portion of the property for picnics and outdoor events. This practice was discontinued following the terrorists attacks on September 11, 2001, due to security concerns.

**Direct Effects** - Direct effects are those effects that are caused by the proposed action, at the time the action is implemented, and are reasonably certain to occur. The direct effects that this project will have on the American crocodile within the action area are discussed below.

#### **Ongoing operation of existing power generation facilities (Units 1, 2, 3 and 4)**

The operation of the two nuclear units (Units 3 and 4) and the two fossil fuel units (Units 1 and 2) provide a potential hazard to crocodiles. Presumably, injuries and mortalities of crocodiles could occur when water used for cooling is withdrawn from the intake canal or deposited in the discharge canal (the new power generating unit currently under construction, Unit 5, is air-cooled and will not discharge into the cooling canal system). FPL has installed a system of grates and screens to prevent large objects from entering the power units. On occasion, a crocodile carcass has been observed to wash up on the grates at the intake structures of the power units (there have been four instances recorded from 1998 through 2000 where dead crocodile have been discovered). However, the condition of these carcasses indicate that the animals had died from natural causes long before they had reached the vicinity of the intake structures (NRC 2002). The Service believes it is unlikely that crocodiles will be injured or killed by the existing intake and discharge systems used in the ongoing operation of power generating Units 1, 2, 3 and 4.

### **Cooling canal system**

The cooling canal system constructed for Units 1, 2, 3 and 4 contains hypersaline water. Seawater was used to originally used to fill the cooling canal system. However, the water within the cooling canal system has become hypersaline because the system does not allow the influx of seawater from Biscayne Bay, and the only other input of water to the system is from precipitation and ground water. The hypersalinity of the cooling canal system waters could affect the American crocodile because hatchlings require a source of freshwater. To provide a source of freshwater for crocodiles within the cooling canal system, FPL has constructed ponds within the berms that capture precipitation. Based on the success of crocodile reproduction documented in the cooling canal system over the last 30 years, the Service does not believe that the hypersalinity of the cooling canals waters has adversely affected crocodiles or will adversely affect crocodiles in the future.

### **Maintenance activities, motor vehicle traffic and other ancillary activities**

The ongoing operation of the Turkey Point Power Plant includes a variety of maintenance activities, motor vehicle traffic, and other activities that occur in areas occupied by crocodiles. These activities could result in injury and mortality to crocodiles. For example, the cooling-canal system requires periodic dredging to function efficiently. Moreover, exotic vegetation must be removed from the cooling canal system and underneath on-site transmission lines. Motor vehicles are operated on the site by employees and escorted visitors traveling to and from parking lots, offices and power plant facilities. Security personnel also use vehicles to patrol the Turkey Point Power Plant site. Other ancillary activities also occur within the power facility grounds from time to time. As previously indicated, FPL is currently constructing a natural gas powered generating unit that would provide approximately 1,150 megawatts of electricity immediately north of Unit 1. Materials and equipment for the new facility are stored at various locations on the Turkey Point Power Plant site. This project is a separate federal action permitted by the Corps that has already been consulted on by the Service (a biological opinion on the project was issued to the Corps on October 6, 2004 [Service Log Number 4-1-04-PL-7414], that provided terms and conditions to reduce take and minimize the direct and indirect effects of the project on the American crocodile). Moreover, Unit 5 does not occur within designated critical habitat for the American crocodile.

FPL has employed several protection measures to greatly minimize the likelihood that the activities discussed above will minimize the potential impacts to crocodiles. FPL provides maintenance personnel with detailed training in appropriate crocodile protection techniques. Moreover, FPL does not schedule road maintenance and other construction activities during the crocodile breeding and nesting season (March through September) or at night when crocodile activity is greatest. To reduce the potential for vehicle collisions, FPL has posted crocodile "warning signs" along various roadways on the site and automobile use (except for security patrols) within the cooling canal system is prohibited at night and during the crocodile breeding season. A 10 mph speed limit is in effect and is being strictly enforced for all vehicles associated with the construction of the new power plant. Finally, FPL has provided memorandums and

pamphlets to all permanent and temporary employees advising of the presence of crocodiles and the need for caution when working and traveling onsite.

Despite the exemplary efforts of FPL to protect crocodiles, accidental impacts to crocodiles may still occur. This was illustrated by the juvenile crocodile found dead on the Turkey Point Power Plant site by FPL personnel. The animal was discovered on Bechtel Road near the test canals in an area used as a storage area for materials related to the construction of the new Unit 5 power facility. The female crocodile was presumably crushed by a vehicle using the roadway. Accordingly, the Service believes that ongoing maintenance activities, motor vehicle traffic, and other activities at the Turkey Point Power Plant are likely to result in injuries or mortalities to crocodiles. However, the Service does not believe that the maintenance activities, motor vehicle traffic, and other ancillary activities at the Turkey Point Power Facility will adversely affect critical habitat designated for the American crocodile.

**Interrelated and Interdependent Actions** - An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Interrelated or interdependent actions are not expected to result from the action.

**Indirect Effects** - Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside the area directly affected by the action. Indirect effects may include other Federal actions that have not undergone section 7 consultation, but will result from the action under consideration. Indirect effects are not expected to result from the action.

### **Species response to the proposed action**

The proposed action is not expected to change environmental conditions in the project area that effect crocodiles. Disturbance associated with the continued operation of the Turkey Point Power Facility should not increase from the level the disturbance that already occurs. Crocodiles have already acclimated to the noise and lighting associated with plant operation, and further negative affects to crocodiles other than those discussed above are not anticipated. In fact, crocodiles in the project area should continue to benefit from FPL's ongoing crocodile management program.

### **CUMULATIVE EFFECTS**

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. The Service has considered cumulative effects of this project on the American crocodile, and in this instance, there are no cumulative effects.

## **CONCLUSION**

After reviewing the current status of the American crocodile, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the project as proposed, is not likely to jeopardize the continued existence of the American crocodile. The majority of the project site (except for the extreme northern section of the project site) is located within designated critical habitat for the American crocodile. The action is not likely to result in destruction or adverse modification of critical habitat. Therefore, critical habitat will not be affected.

Monitoring efforts conducted at the Turkey Point Power Plant site suggest that the crocodile population has increased substantially since the late 1970s. The license renewals of Units 3 and 4 at the Turkey Point Power Plant will not result in any additional loss of crocodile habitat and is not expected to appreciably affect the overall survival and recovery of the American crocodile in Florida.

## **INCIDENTAL TAKE STATEMENT**

Sections 4(d) and 9 of the Act, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct) of Act-listed species of fish or wildlife without a special exemption. "Harm" and "harass" are further defined in Service regulations (50 CFR 17.3). "Harm" is defined to include significant habitat modification or degradation that results in death or injury to Act-listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. "Harass" is defined as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering.

Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement. The measures described below are nondiscretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply.

The Federal agency has a continuing responsibility to regulate the activity that is covered by this incidental take statement. If the agency (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

## **AMOUNT OR EXTENT OF TAKE ANTICIPATED**

The Service anticipates the incidental take of one American crocodile every 5 years as result of the proposed action. The incidental take is expected to be in the form of accidental direct

mortality resulting from the ongoing operations at the Turkey Point Power Facility site. The action will not result in the loss of additional habitat for the American crocodile. In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

## **REASONABLE AND PRUDENT MEASURES**

When providing an incidental take statement, the Service is required to give reasonable and prudent measures it considers necessary or appropriate to minimize the take along with terms and conditions that must be complied with, to implement the reasonable and prudent measures. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individuals taken. The Service believes the following reasonable and prudent measure is necessary and appropriate to reduce take and to minimize the direct and indirect effects of the proposed project on the American crocodile:

Minimize the adverse effects of the ongoing operation of the Turkey Point Power facility by implementing measures to increase employee awareness of the presence of the American crocodile on the site.

## **TERMS AND CONDITIONS**

To implement the above reasonable and prudent measures, the Service has outlined the following terms and conditions. In accordance with the Interagency Cooperation Regulation (50 CFR 402), these terms and conditions must be complied with to implement the reasonable and prudent measures:

1. The applicant must install four warning signs labeled as "Slow Crocodile Crossing" along Bechtel Road near the test canals on the Turkey Point Power Plant site. The signs will be installed at approximately 500-foot intervals. Based on our field inspection of the Turkey Point Power Plant site, we are aware that FPL has already installed these signs
2. The applicant must provide an informational bulletin on the American crocodile to all employees at the Turkey Point Power Plant once every 6 months. The bulletin should remind employees that crocodiles occur on the Turkey Point Facility grounds, include a photograph of an American crocodile, and note that crocodile hatchlings can be small (12 to 18 inches total length) making them more difficult to detect. In addition, the bulletin should remind employees to be alert for crocodiles when driving or conducting activities on the site, to observe speed limits at all times, to not interact with a crocodile in any way, and to contact their supervisor if a crocodile is observed on or near a road.
3. The applicant must conduct a presentation on the American crocodile twice a year at the monthly safety meeting that all plant personnel are required to attend. The presentations will be made during the crocodile mating and nesting season when the activity of crocodiles at the site is greatest. The presentation will focus on the identification of crocodiles, and areas on the Turkey Point Power Plant site where crocodiles may occur. The presentation will also

remind employees to: be alert for crocodiles when driving or conducting activities on the site, observe speed limits at all times, not interact with a crocodile in any way, and contact their supervisor if a crocodile is observed on or near a road

4. Upon locating a dead or injured crocodile, initial notification must be made to the Service's Law Enforcement Office located at 10426 NW 31st Street Terrace; Miami, Florida 33172-1200; telephone 305-526-2695. Secondary notification should be made to the FWC's South Regional Office located at 8535 Northlake Boulevard; West Palm Beach, Florida 33412; telephone 561-625-5122.

### **CONSERVATION RECOMMENDATIONS**

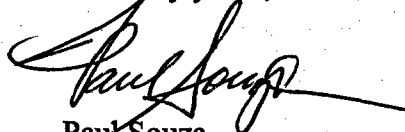
Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service is not proposing any conservation recommendations at this time.

### **REINITIATION - CLOSING STATEMENT**

This concludes formal consultation on the license renewals of the nuclear generating Units 3 and 4 at the Turkey Point Nuclear Power Facility. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your cooperation and effort in protecting fish and wildlife resources. If you have any questions regarding this project, please contact Allen Webb at 772-562-3909.

Sincerely yours,



Paul Souza

Acting Field Supervisor

South Florida Ecological Services Office



cc:

District, West Palm Beach, Florida

EPA, West Palm Beach, Florida (Richard Harvey)

FWC, Tallahassee, Florida

FWC, Vero Beach, Florida (Joe Walsh)

Service, Atlanta, Georgia (Dave Flemming) (electronic copy only)

FPL, Juno Beach, Florida (Barbara Linkiewicz)

## LITERATURE CITED

- Allen, E.R. and W.T. Neill. 1952. The Florida crocodile. *Florida Wildlife* 6(2):6, 33.
- Barbour, T. 1923. The crocodile in Florida. Occasional papers of the University of Michigan, Museum of Zoology 131:1-6.
- Desola, C.R. 1935. Herpetological notes from southeastern Florida. *Copeia* 1935(1):151-156.
- Dimmock, A.W. 1915. Florida enchantments (Revised edition). Outing Publishing Company; Peekmose, New York.
- Florida Power and Light. 2005. Turkey Point Plant Annual Crocodile Report. Florida Power and Light Company; Homestead, Florida.
- Hornaday, W.T. 1914. The American Natural History. Volume IV. Reptiles, Amphibians, and Fishes. Charles Scribner's Sons; New York, New York.
- Jacobsen, T. 1983. Crocodiles and Alligators: Status of the American Alligator and the American Crocodile in the lower Florida Keys. *Florida Field Naturalist* (11): 1-24.
- Kushlan, J.A. and F.J. Mazzotti. 1989. Historic and present distribution of the American crocodile in Florida. *Journal of Herpetology* 23(1):1-7.
- Lang, J.W. 1975. The Florida crocodile: Will it survive? Chicago (Field) Museum of Natural History Bulletin 46(8):4-9.
- LeBuff, D.R. 1957. Observations on captive and wild North American crocodilians. *Herpetologica* 12:25-28.
- Mazzotti, F.J. 1983. The ecology of *Crocodylus acutus* in Florida. Ph.D. dissertation. Pennsylvania State University; State College, Pennsylvania.
- Mazzotti, F.J. and M.S. Cherkiss. 2003. Status and Conservation of the American Crocodile in Florida: Recovering an Endangered Species While Restoring an Endangered Ecosystem. Technical Report to National Park Service. University of Florida, Ft. Lauderdale Research and Education Center; Ft. Lauderdale, Florida.
- Mazzotti, F.J. and W.A. Dunson. 1984. Adaptations of *Crocodylus acutus* and *Alligator mississippiensis* for life in saline water. *Comparative Biochemical Physiology* 79(4):641-646.
- Moler, P.E. 1991a. American crocodile population dynamics. Final report to study number 7532. Florida Game and Fresh Water Fish Commission, Bureau of Wildlife Research; Tallahassee, Florida.

- Moler, P.E. 1991b. American crocodile nest survey and monitoring. Final report to study number 7533. Florida Game and Fresh Water Fish Commission, Bureau of Wildlife Research; Tallahassee, Florida.
- Moler, P.E. 1992. American crocodile. Pages 83-89 in P.E. Moler editor. Rare and endangered biota of Florida, Volume III, Amphibians and Reptiles. University Press of Florida; Gainesville, Florida.
- Neill, W.T. 1971. The Last of the Ruling Reptiles. Columbia University Press; New York, New York.
- Ogden, J.C. 1978. Status and nesting biology of the American crocodile, *Crocodylus acutus* (Reptilia, Crocodylidae) in Florida. Journal of Herpetology 12(2):183-196.
- Thorbjarnarson, J. 1989. Ecology of the American crocodile, *Crocodylus acutus*. Pages 228-259 in P. Hall, editor. Crocodiles. Their ecology, management and conservation. A Special Publication of the Crocodile Specialist Group. IUCN; Gland, Switzerland.
- Tucker, W.A., F. Mazzotti, E. Xillioux, and A.B. Shortelle. 2004. Assessment of American crocodile populations in southern Florida: trends in population and reproduction rates. In preparation.
- U.S. Fish and Wildlife Service. 1984. American crocodile recovery plan. U.S. Fish and Wildlife Service; Atlanta, Georgia.
- U.S. Fish and Wildlife Service. 1999. Multi-species recovery plan for south Florida. U.S. Fish and Wildlife Service; Vero Beach, Florida.
- U.S. Nuclear Regulatory Commission. 2002. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 5, Turkey Point Units 3 and 4.

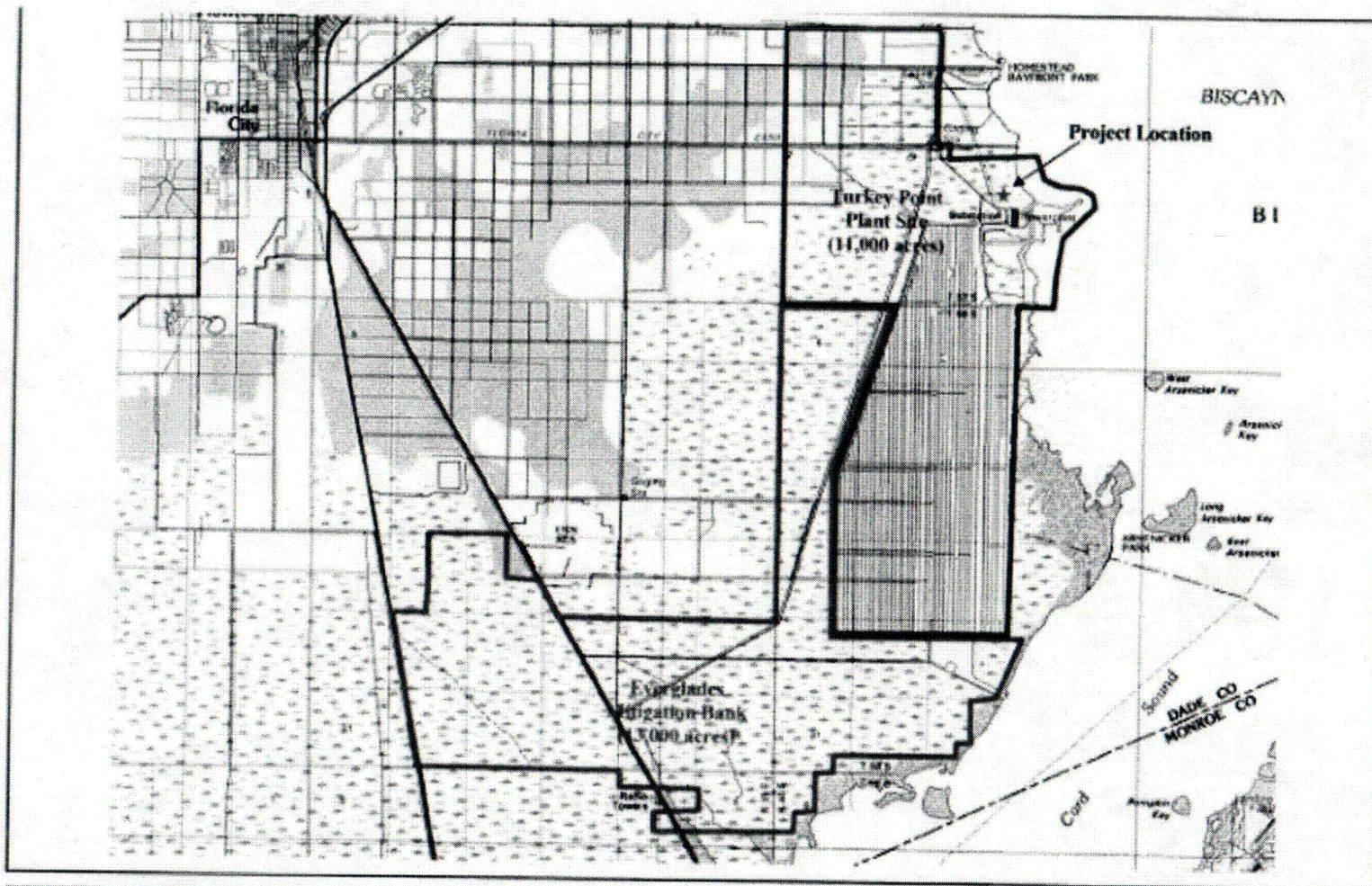


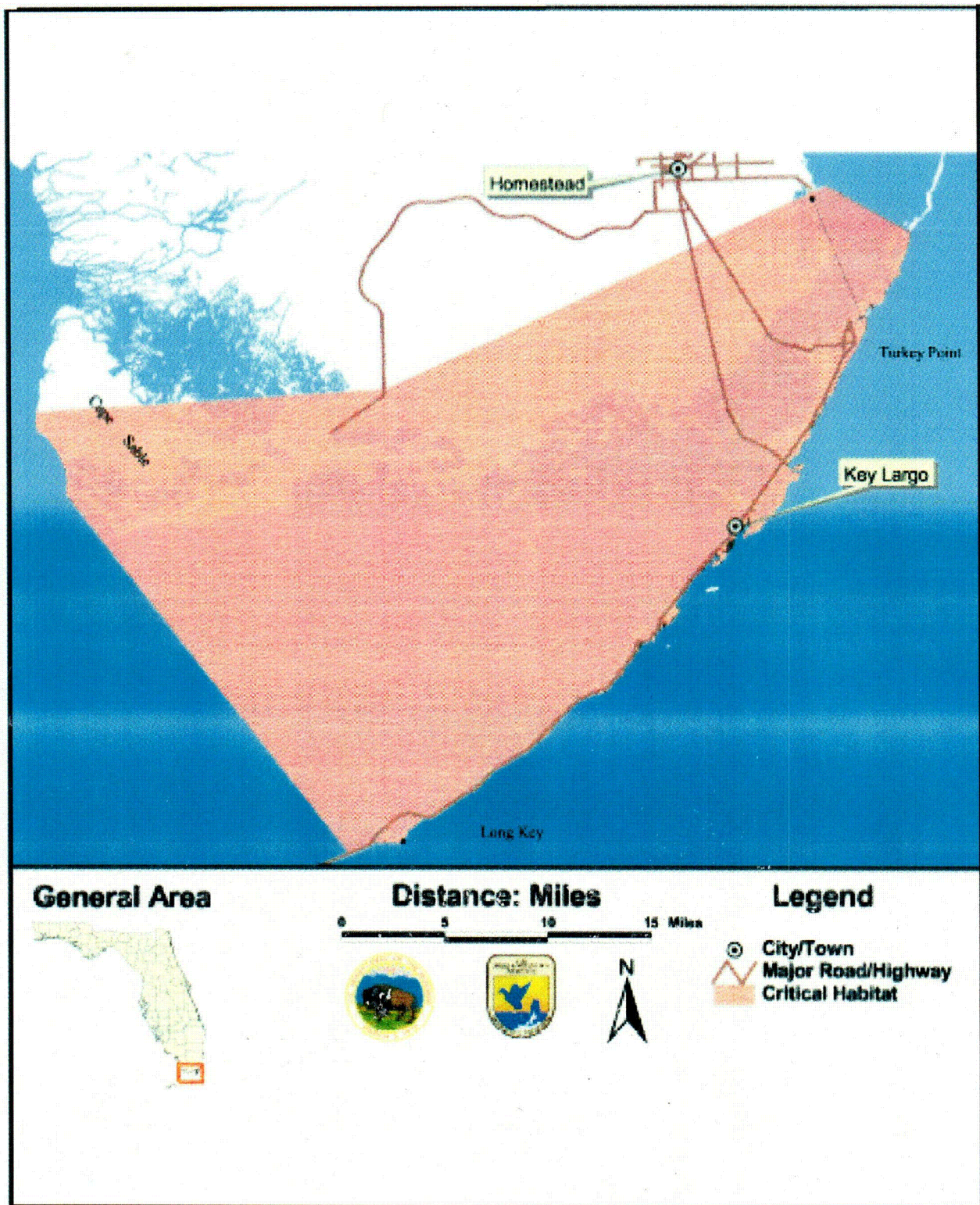
Figure 1. FPL Turkey Point Plant Site Location, Project Location, and Everglades Mitigation Bank

Source: National Geographic, 2003; Golder, 2003.



Figure 1. Location Map of FPL's Turkey Point Power Plant site.





**Figure 2.** Map of designated critical habitat for the American crocodile.

**Appendix A.**

**Description of Turkey Point Nuclear Power Plant Site  
(Pages 2-1 to 2-15 in NRC [2002]).**

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

The Florida Power & Light Company's (FPL's) Turkey Point Plant is located on the shore of Biscayne Bay in Florida's South Miami-Dade County. The plant consists of four units. Units 3 and 4 are nuclear reactors and are the subject of this action. Units 1 and 2 are fossil-fuel units and are not covered by this action. Each nuclear reactor is a pressurized light-water reactor (LWR) with three steam generators producing steam that turns turbines to generate electricity. In addition to the nuclear and fossil-fuel units, the site features a 2711-ha (6700-ac) system of closed, recirculating cooling canals that all four units use for heat rejection. The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

### 2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term

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

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

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

---

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



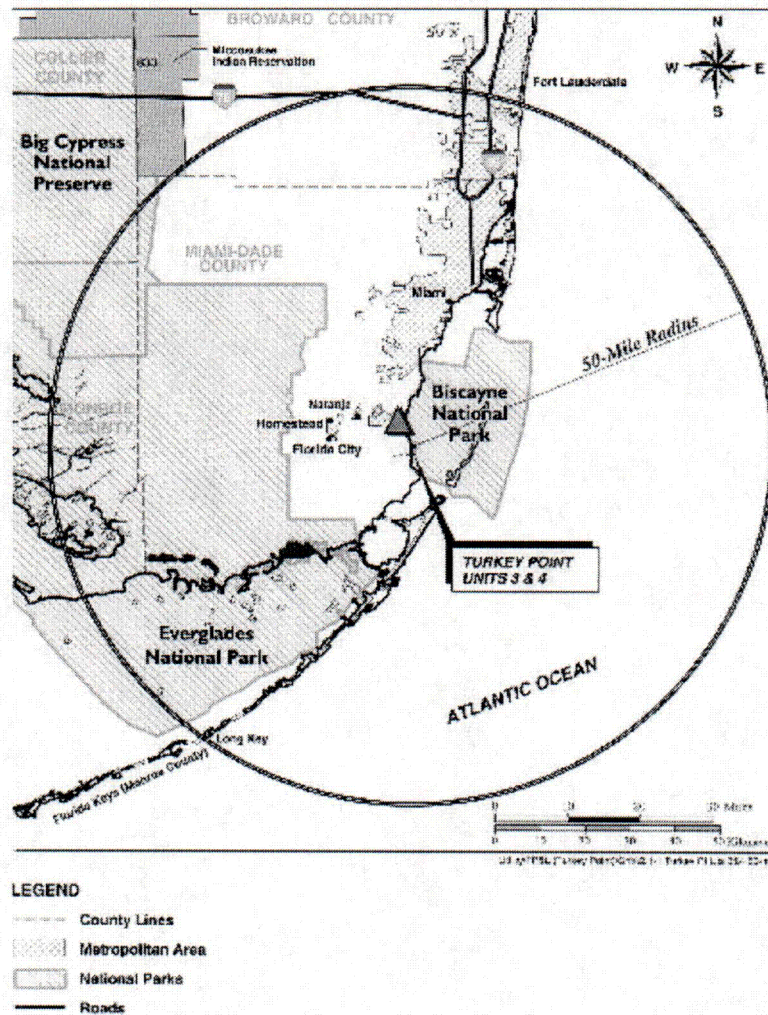
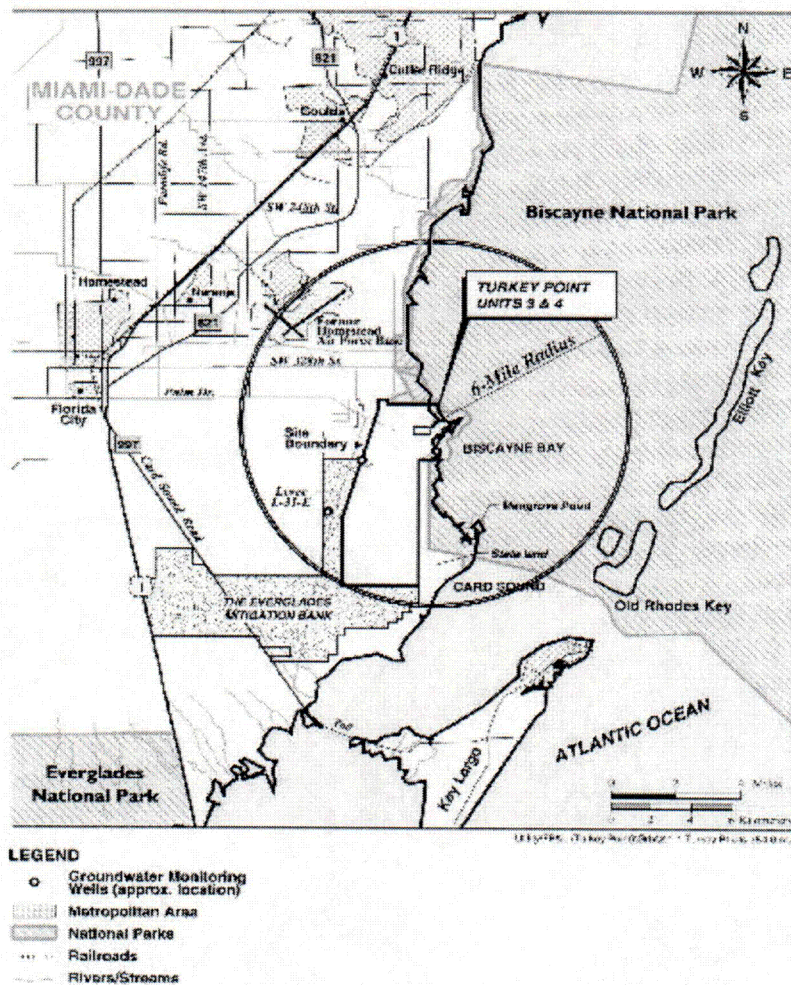


Figure 2-1. Location of Turkey Point Units 3 and 4, 80-km (50-mi) Region

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





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

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

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

## **Plant and the Environment**

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

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

### **2.1.1 External Appearance and Setting**

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

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

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

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

### 2.1.2 Reactor Systems

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

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

### 2.1.3 Cooling and Auxiliary Water Systems

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

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

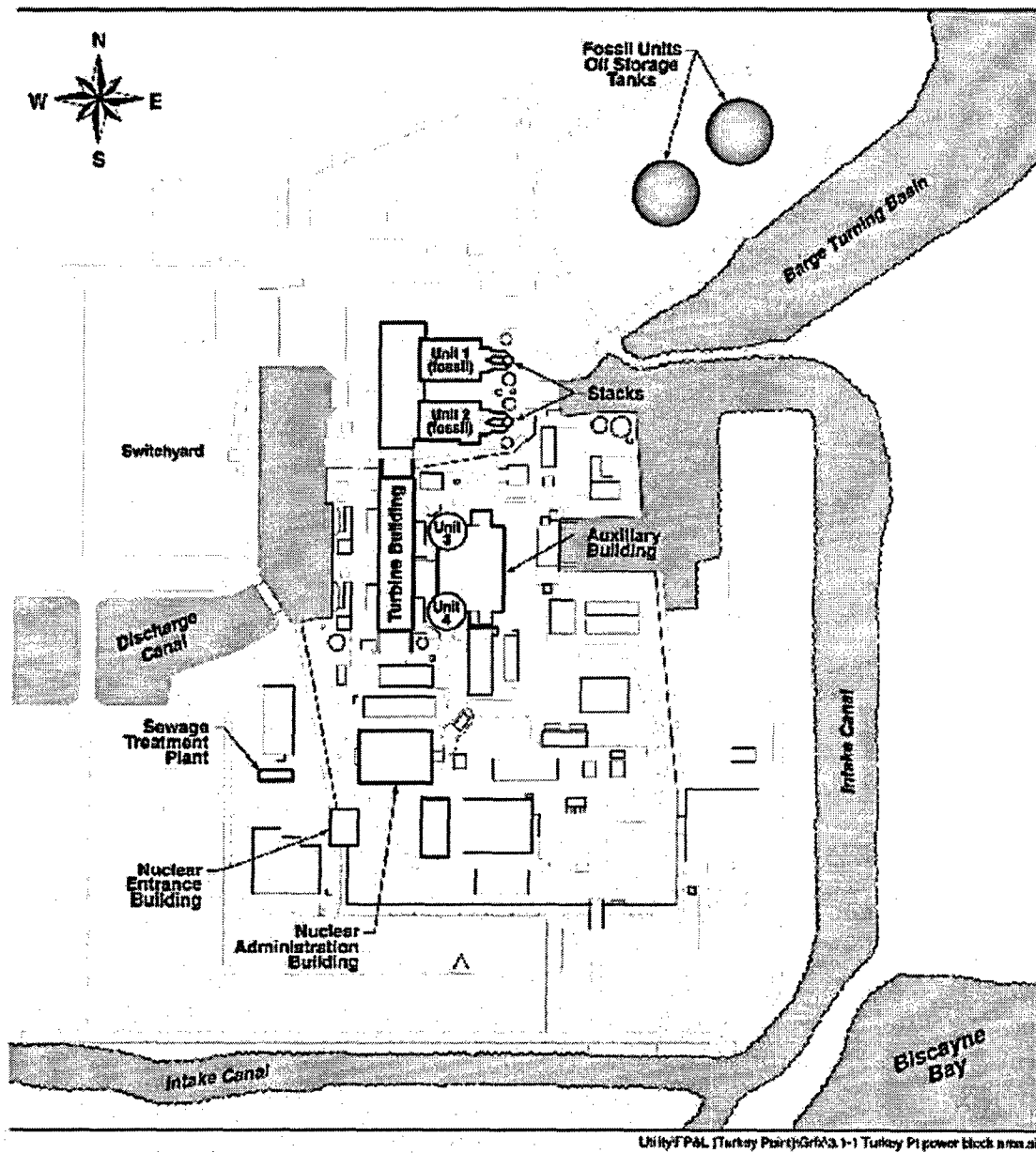


Figure 2-3. Turkey Point Site Powerblock Area

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

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

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

#### **2.1.4 Radioactive Waste Management Systems and Effluent Control Systems**

FPL uses liquid, gaseous, and solid radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes that are the by-products of the Turkey Point Units 3 and 4 operation. These systems reduce radioactive liquid, gaseous, and solid effluents before they are released to the environment. The Turkey Point Units 3 and 4 waste disposal system meets the design objectives of 10 CFR Part 50, Appendix I, and controls the processing, disposal, and release of radioactive liquid, gaseous, and solid wastes. Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive wastes in LWRs. Radioactive fission products build up within the fuel as a consequence of the fission process.



## Plant and the Environment

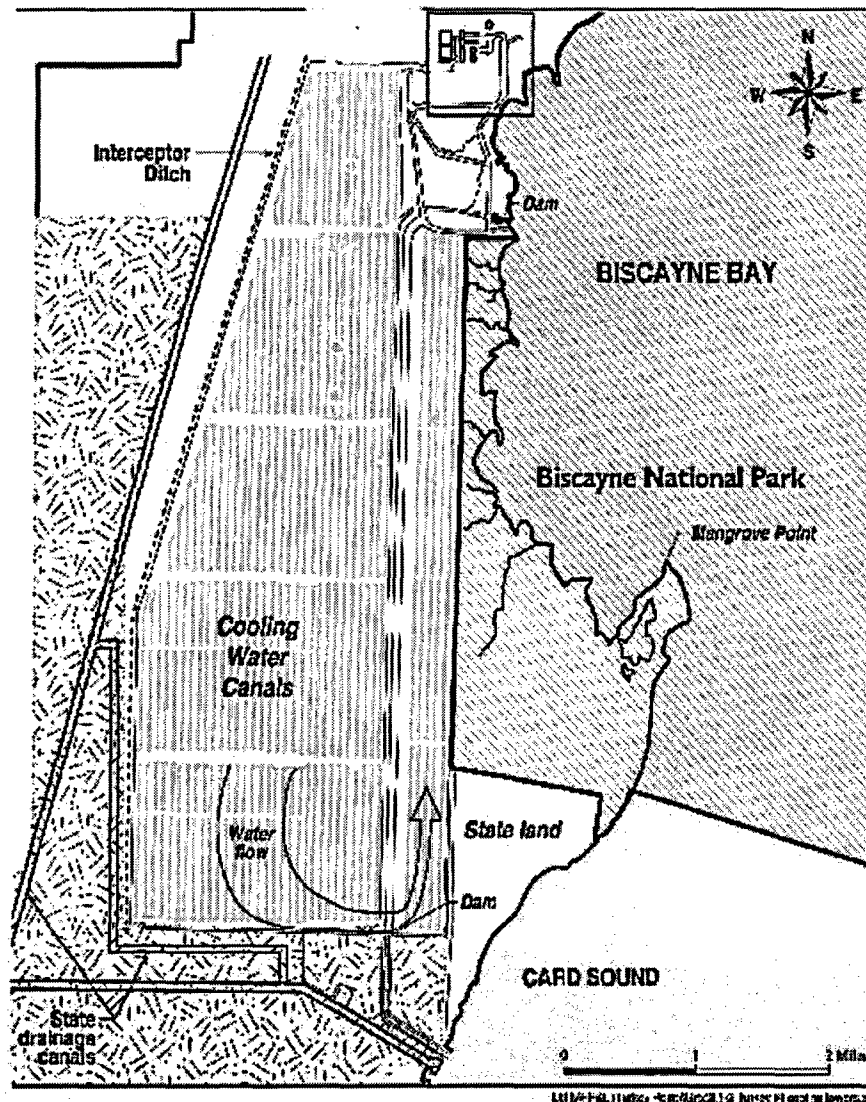


Figure 2-4. Turkey Point Site Cooling Canal System

These fission products are contained in the sealed fuel rods, but small quantities escape from the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system is also responsible for coolant contamination.

Nonfuel solid wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant design and operations modifications and routine maintenance activities. Solid wastes may be shipped to a waste processor for volume reduction before disposal or they may be sent directly to the licensed burial site. Spent resins and filters are stored or packaged for shipment to an offsite processing or disposal facility.

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

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

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

- The concentration of radioactive liquid effluents released from the site to the unrestricted area will not exceed 10 times the concentration specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained gases. For dissolved or entrained noble gases, the concentration shall not exceed 7.4 Bq/mL (2 E-04  $\mu$ Ci/mL).
- The dose or dose commitment per reactor to a member of the public from any radioactive materials in liquid effluents released to unrestricted areas shall be limited to (1) less than or equal to 15  $\mu$ Sv (1.5 mrem) to the total body and less than or equal to 50  $\mu$ Sv (5 mrem) to any organ during any calendar quarter, and (2) less than or equal to 30  $\mu$ Sv (3 mrem) to the total body and less than or equal to 100  $\mu$ Sv (10 mrem) to any organ during any calendar year.
- The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to (1) less than or equal to 5 mSv/yr (500 mrem/yr) to the total body and less than or equal to 30 mSv (3000 mrem/yr) to the skin

## Plant and the Environment

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

- The air dose per reactor to areas at and beyond the site boundary due to noble gases released in gaseous effluents shall be limited to (1) less than or equal to 50  $\mu$ Gy (5 mrad) for gamma radiation and less than or equal to 100  $\mu$ Gy (10 mrad) for beta radiation during any calendar quarter, and (2) less than or equal to 100  $\mu$ Gy (10 mrad) for gamma radiation and less than or equal to 200  $\mu$ Gy (20 mrad) for beta radiation during any calendar year.
- The dose to any individual member of the public from the nuclear facility operations will not exceed the maximum limits of 40 CFR Part 190 ( $<0.25$  mSv [25 mrem]) and 10 CFR Part 20 ( $\leq 5$  mSv [0.5 rem] in a year and  $\leq 20$   $\mu$ Sv [2 mrem] in any hour).

### 2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

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

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



The ODCM prescribes the alarm/trip setpoints for the liquid effluent radiation monitors, which are derived from 10 times the effluent concentration limits provided in 10 CFR Part 20, Appendix B, Table 2, Column 2. The alarm/trip setpoint for each liquid effluent monitor is based on the measurements of radioactivity in a batch of liquid to be released or in the continuous liquid discharge (FPL 1999a).

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

#### 2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

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

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

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

## Plant and the Environment

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

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

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

### 2.1.4.3 Solid Waste Processing

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

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

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

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

### 2.1.5 Nonradioactive Waste Systems

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

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

### **2.1.6 Plant Operation and Maintenance**

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear power plant. Maintenance activities conducted at Turkey Point include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. FPL refuels each of the Turkey Point nuclear units on a staggered 18-month schedule, resulting in at least one refueling every year and two refuelings every third year (FPL 2000a). A third of the core is offloaded at each refueling. Up to an additional 800 to 900 workers are onsite during a typical 30- to 40-day outage. FPL provided an appendix in the Updated Final Safety Analysis Report (UFSAR) regarding the aging management review to manage the effects of aging on systems, structures, and components in accordance with 10 CFR Part 54 (FPL 1999b). Chapter 3 and Appendix B of the Turkey Point license renewal application describe the programs and activities that will manage the effects of aging during the license renewal period (FPL 2000c). FPL expects to conduct the activities related to the management of aging effects during plant operation or normal refueling and other outages, but plans no outages specifically for the purpose of refurbishment. FPL has no plans to add additional full-time staff (non-outage workers) at the plant during the period of the renewed licenses.

### **2.1.7 Power Transmission System**

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

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

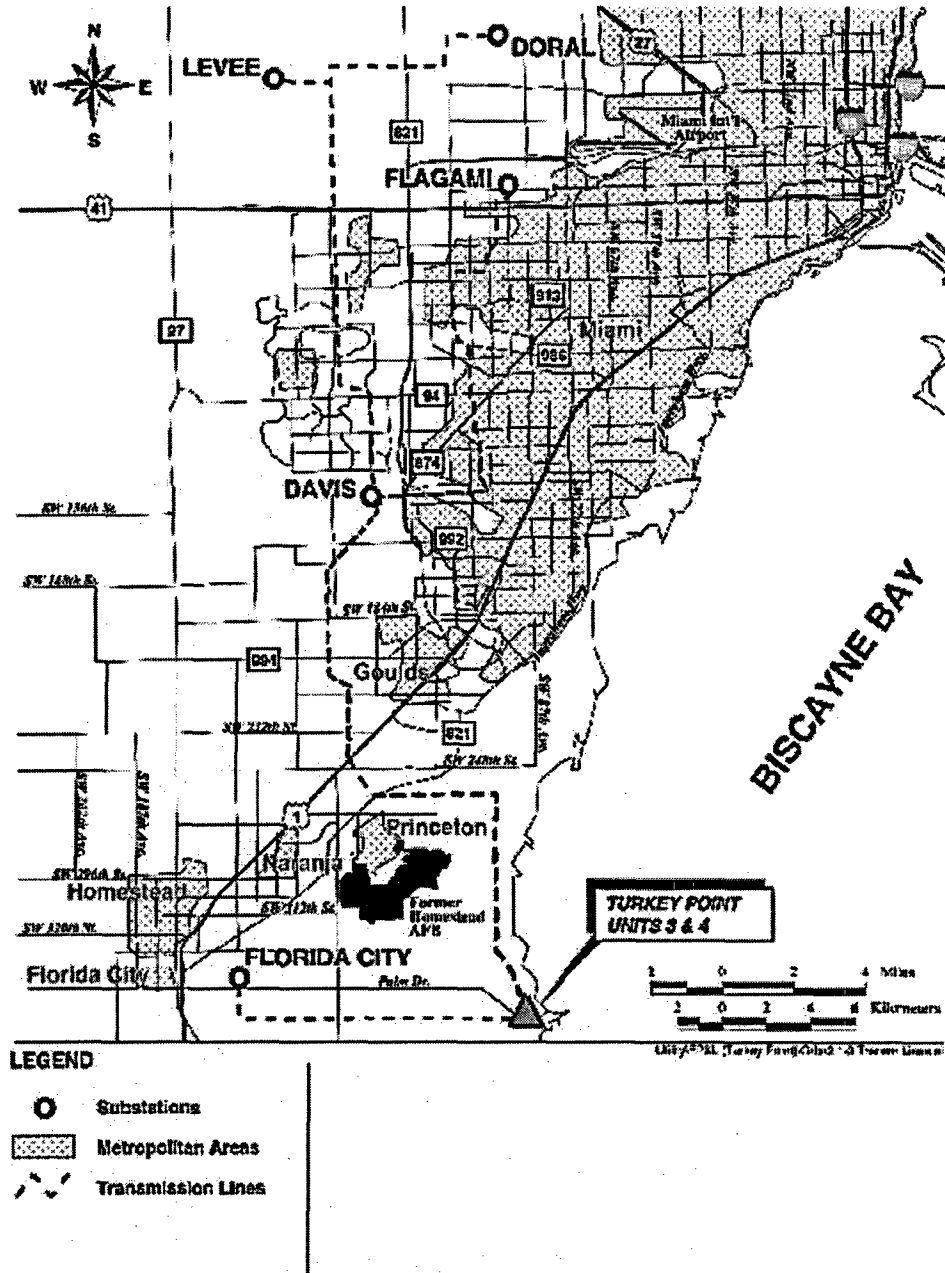


Figure 2-5. Turkey Point Transmission Lines

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

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

Table 2-1. Turkey Point Transmission Line Corridors

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

Source: FPL 2000a.