Final

environmental statement

related to operation of

TURKEY POINT PLANT

FLORIDA POWER AND LIGHT COMPANY

DOCKETS NO. 50-250 AND 50-251

July 1972

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

SUMMARY AND CONCLUSIONS

This Final Environmental Statement was prepared by the U.S. Atomic Energy Commission, Directorate of Licensing.

1. This action is administrative.

2. The proposed action is the issuance of an operating license to the Florida Power and Light Company for the operation of the Turkey Point Plant Units 3 and 4 in the State of Florida, in Dade County, at a site about 25 miles south of Miami. The Turkey Point Units 3 and 4 employ pressurized water reactors, each with initial and ultimate thermal generating capacities of 2200 MWt and 2300 MWt. The gross electrical power output of each unit is to be 760 MW. The units' steam turbines are to be cooled with salt water. Initially, a once-through cooling system will be used. This is planned to be supplemented and finally replaced in stages as a recirculating cooling system is built. Unit 3 is now due to be ready for fuel loading in July 1972; Unit 4 is expected to be ready in October 1972.

3. Summary of environmental impacts, including beneficial and adverse effects:

   a. The major benefits of this project will be the annual production of 10 billion kilowatt-hours of electricity and the addition of 760 MW gross generating capacity per unit to the Applicant's system. The latter benefit will help relieve a serious power shortage in the Florida area and lessen threats of adverse effects on the public from this shortage. Some minor benefits are expected from enhancement of recreational uses of the area adjacent to the Plant.

   b. Construction of the planned cooling channel system will destroy about 7,000 acres of salt-marsh habitat for wildlife. Some, but as yet unknown, recovery of the area is expected. About 50 acres of former marsh has been used for the part of the site where the reactor buildings and related structures are located.

   c. There is no adverse impact related to transmission lines for the nuclear units, since the right-of-way already in use for the fossil-fueled units will be used for the nuclear units with no additional construction.

   d. The impact will be negligible for releases of radioactive materials and radiation to the environment from routine operations. The estimated dose from operation of the plant to the population living within 50 miles is about 12 man-rem per year. A very low probability risk of accidental exposure to radiation will be created.

e. Interim cooling system operation may temporarily cause minor damage to marine life near the mouths of the canals in Biscayne Bay and Card Sound, particularly if temperature restrictions are relaxed under emergency conditions.

f. Loss of plankton by entrainment in the interim once-through or in the proposed channel cooling systems will have a minor, probably immeasurable, impact on the productivity of Card Sound and Biscayne Bay.

g. Benthic marine life in a small, but undefinable, area of Card Sound may be affected by an accumulation of water with salinities 5 to 10% above normal as a result of operation of the proposed channel cooling system.

h. Seepage of warm saline water from the proposed cooling channel system may have a minor impact on benthic organisms in shallow areas along several miles of shoreline.

i. Residual chlorine in the purge water from the proposed cooling channel system will be at most a minor hazard to marine life near the mouth of the Card Sound Canal. There may be a slightly greater hazard during operation of the interim once-through cooling system, but this should be adequately controlled by appropriate effluent monitoring.

j. There is a potential for minor damage to marine life in Biscayne Bay during interim cooling system operation through impingement and killing of biota on intake screens.

4. Alternatives considered were as follows:

- Other sites, at this stage, would be uneconomical and might have similar environmental impacts.

- Fossil fuels would be less desirable and uneconomical at this stage.

- Brackish water mechanical-draft cooling towers would be competitive in costs, but would have potential vapor plume and salt- deposition impacts.

- Two systems for once-through cooling with dilution water are cost competitive and appear environmentally attractive from the aspect of balancing terrestrial impacts against marine impacts.

5. The Federal, State, and local agencies listed below and the Applicant have commented on the Draft Environmental Statement and their comments have been considered in the preparation of the Final Environmental Statement.

   Advisory Council on Historic Preservation
   Department of Agriculture
   Department of the Army, Corps of Engineers
   Department of Commerce
   Environmental Protection Agency
   Federal Power Commission
   Department of the Interior
   Department of Transportation
   Department of Housing and Urban Development
   Florida Department of Air and Water Pollution Control
   Florida Department of Administration

6. This Final Environmental Statement is being made available to the public, to the Council on Environmental Quality, and to other agencies in July 1972.

7. On the basis of the evaluation and analysis set forth in this Final Statement, and after weighing the environmental, economic, technical, and other benefits against environmental costs and considering available alternatives, it is concluded that from the standpoint of environmental effects the action called for is the issuance of an operating license for Turkey Point Unit 3, as well as for Unit 4 when it is completed, subject to the following conditions for protection of the environment:

   a. Initial operation shall be with once-through cooling of the turbine condensers as proposed by the Applicant.

   b. Since the available information regarding the environmental impacts from construction and operation of the proposed cooling channel system is extremely limited in a number of areas, continuing detailed evaluations of the environmental impacts of construction and operation of this part of the channel system shall be conducted by the Applicant. The information obtained shall be in sufficient detail to enable a confident assessment of the overall impact of the proposed cooling channel system. The additional monitoring and evaluation programs as set forth in Section V.F. of this Final Statement shall be performed. Specific areas covered shall include:

(1) Completion of survey and evaluation of impacts on terrestrial environment and the rate and extent of recovery which may be achieved by (a) natural regrowth and (b) specific efforts to promote revegetation. The results of such survey and evaluation shall be submitted to the AEC not later than October 1, 1972.

(2) Impacts from continuing operation on the water quality and biota in the receiving waters of Card Sound and Biscayne Bay, including determination of chlorine residuals at points of discharge to the Bay and Sound and any effects.

(3) Completion of design and analysis of operation of control structure for cooling channel discharges and intakes, as well as the discharge leg and mouth of the Card Sound Canal.

(4) Susceptibility of cooling channel system to damage from storms or other acts of nature and capability for rapid restoration of the system to operation.

c. The Applicant shall pursue evaluations of alternatives to the proposed cooling channel system during construction, interim operation, and evaluation of the channel system. These evaluations shall include at least the following:

(1) Study of availability of groundwater or other alternative sources of surface water to use in the cooling system.

(2) Study of applicability of mechanical cooling devices, including powered spray modules and cooling towers.

(3) Study of marine environmental impacts of the once-through cooling alternatives described in Section X of this statement.

d. The Applicant shall take appropriate corrective action on any adverse effects determined as a result of monitoring and study programs. To the fullest extent practicable, the Applicant shall utilize results of study programs in improving and modifying the operation of the Plant and its cooling system so as to achieve a minimal adverse environmental impact.

e. Technical specifications will be prepared as part of the licenses to address the following matters, considerating both once-through and cooling channel operation.

(1) Operating limits for the cooling water to cover:

(a) temperature, including maximum temperature, changes, and rates of change

(b) salinity

(c) velocity

(d) flow rates

(e) residual chlorine

(2) Monitoring and surveillance programs to cover:

(a) operating limits for the above items

(b) a groundwater monitoring system

(c) impingement of aquatic organisms on intake structures

(d) entrainment of aquatic organisms in the cooling system

(3) Study and evaluation programs to determine:

(a) impact on aquatic and terrestrial flora and fauna

i. initial operating conditions

ii. cooling channel operating conditions

(b) recovery from adverse impacts

(c) trends in environmental impacts as may develop in the future

(d) ways to modify operations so as to further reduce such adverse impacts as do occur

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FOREWORD

This Final Environmental Statement on Turkey Point Plant Units 3 and 4 (Docket Nos. 50-250 and 50-251) is associated with the proposed issuance of an operating license for the units to the Florida Power and Light Company (the Applicant). Unit 3 has a scheduled startup (fuel loading date) in July 1972, with Unit 4 to follow about 3 months later.

This Final Statement was prepared by the U.S. Atomic Energy Commission's Regulatory Staff (the Staff) in accordance with the Commission's regulation, Title 10, Code of Federal Regulations, Part 50 (10 CFR 50), Appendix D, as revised on September 9, 1971 (36 FR 18071), and further revised on September 30, 1971, November 11, 1971 and January 20, 1972, and corrected on September 21, and December 16, 1971, implementing the National Environmental Policy Act of 1969. (P. L. 91-190, 83 Stat. 852).

Section 102(2) of the National Environmental Policy Act calls for all agencies of the Federal Government to utilize a systematic interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment; to identify and develop methods and procedures which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations; and to include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement on:

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

In addition, Section 102(2) of NEPA requires the Commission to study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources; and to recognize the world-wide and long-range character of environmental problems.

The Commission's Draft Environmental Statement issued on December 23, 1970 (prior to the revision of Appendix D) and the Applicant's Environmental Report -- Operating License Stage for the Turkey Point Plant submitted November 15, 1970[49] were forwarded to appropriate Federal and State agencies for review. The Applicant has responded to the comments of the agencies, which are discussed in a submittal made to the AEC on October 18, 1971 showing why construction should not be suspended pending completion of the full NEPA review[51]. A Supplemental Environmental Report submitted by the Applicant on November 8, 1971[48] in consideration of the revised Appendix D regulations also has been forwarded to appropriate agencies for review. A new Draft Statement, taking all of these reports, comments, and responses into account, as well as the information in the Applicant's Final Safety Evaluation Report[50], was issued February 1972 for review and comment by Federal, State and local agencies and members of the public. Comments were submitted on this Draft Statement, and responses to these comments and to additional questions asked by the Staff were submitted by the Applicant.

This Final Statement is based primarily on the Applicant's Environmental Report and Supplements thereto, Final Safety Analysis Report and amendments thereto, the Commission's Safety Evaluation and Supplements, as well as on the referenced documents listed in this Statement. Comments received from Federal, State, and local agencies on the Draft Environmental Statement of February 1972 have also been taken into account in the preparation of this Final Statement.

Independent calculations and public sources of information cited in the references in this Final Statement were utilized as a basis for the Commission's assessment of the environmental impact. In addition, information concerning the Turkey Point Plant, the site, and its environs was directly obtained by the Commission's representatives responsible for this assessment during several visits to the Turkey Point Plant and neighboring areas.

All material submitted by the applicant in support of its application, its Environmental Report and Supplements, and other pertinent documents are available for public inspection at the Commission's Public Document Room, 1717 H Street, N.W., Washington, D. C. and at the Lily Lawrence Row Public Library, 212 N.W. First Avenue, Homestead, Florida 33030.

The Applicant is required to comply with section 21(b) of the Federal Water Pollution Control Act, as amended by the Water Quality Improvement Act of 1970.

Mr. Richard S. Cleveland (Telephone: (301) 973-7597) is the AEC Environmental Manager for this Final Environmental Statement.

B. Applications and Approvals

A listing of Federal, State, and local applications and permits is presented in Appendices 4 and 5 of the Applicant's Environmental Report Supplement[48] and in Section XI and Appendix 10 of the Applicant's Environmental Report (November 15, 1970)[49]. In addition a number of permits have been recently received or applied for primarily in connection with the revised cooling water system[51]. These authorizations include:

- Florida Pollution Control Board -- approved October 22, 1971, the cooling system agreed to under the terms and conditions of the Consent Final Judgment (October 13, 1971)[43].
- U. S. Army Corps of Engineers -- Permit No. 70-684 to complete dredging the canal into Card Sound issued November 1971.
- Dade County -- A Zone Use Permit (W-49602) was issued March 9, 1972 for installation of the proposed cooling system.
- State of Florida -- certification issued pursuant to Section 21(b) of the Water Quality Improvement Act of 1970.
- Central and Southern Florida Flood Control District -- agreement executed providing for integration of the cooling system with existing flood control canals and drainage works.

In addition, FPL applied to the U.S. Army Corps of Engineers on October 19, 1971 for a discharge permit for all units at Turkey Point under the Refuse Act Permit Program regulations (33 CFR 209.131). Prior to final processing of that application, the Corps of Engineers was permanently enjoined from issuing any of these permits until their regulations were amended to comply with NEPA requirements for environmental impact statements. An amendment was issued February 11, 1972 to the Consent Final Judgement [43] to authorize FPL to make discharges into Biscayne Bay and Card Sound as described in the consent decree until such time as the application to the Corps of Engineers was resolved [79].

II. THE SITE

A. General

Turkey Point Plant Units 3 and 4 are located on the western shore of Biscayne Bay about 25 miles south of Miami, Florida (Figure II-1). The low, swampy land surrounding the site is extremely flat, rising from sea level at the shoreline to an elevation of only about 10 feet at a distance of 8 miles west of the site. The site itself has a similar flat natural relief of only about 1 to 2 feet above sea level.

East of the site, 5 to 8 miles across Biscayne Bay, is a series of islands running in a northeast-southwest direction between the Bay and the Atlantic Ocean.

During high tide the site, with the exception of built-up areas, is inundated with sea water. The brackish water drains slowly towards the Bay during low-tide periods through the myriad of small streams and drainage ditches crossing the area. Major work would be required to make the land suitable for agricultural, residential, or most uses other than a wildlife habitat.

B. Location of Plant

Turkey Point Units 3 and 4 are located on the eastern boundary of the Applicant's property in southeastern Dade County, Florida. The site originally was comprised of 3300 acres in a rectangle about 2 miles north-south by 3.5 miles east-west, with the section in the northwest corner of the rectangle excluded from Florida Power and Light ownership (Figure II-2). As discussed further below and in Section III, the area of the site has been extended considerably.

The Plant is about 8 miles east of Florida City and U. S. Highway No. 1, and 9 miles southeast of the City of Homestead. Land immediately north of the Applicant's property is a county-owned public park. Homestead Air Force Base is about 5 miles north-northwest of the site. The Plant, including the two operating fossil-fueled units and related facilities, occupies about 150 acres of compacted limestone fill. In addition, the canal cooling system is to occupy about 7000 acres of swampy land (4000 acres of water surface) extending a distance of about 4 miles south and southwest of the Applicant's original southern property line. Approximately one-half of the 3300-acre original site will be occupied by the canal cooling system. The location of this cooling system with respect to Biscayne Bay and Card Sound is shown in Figure II-3.

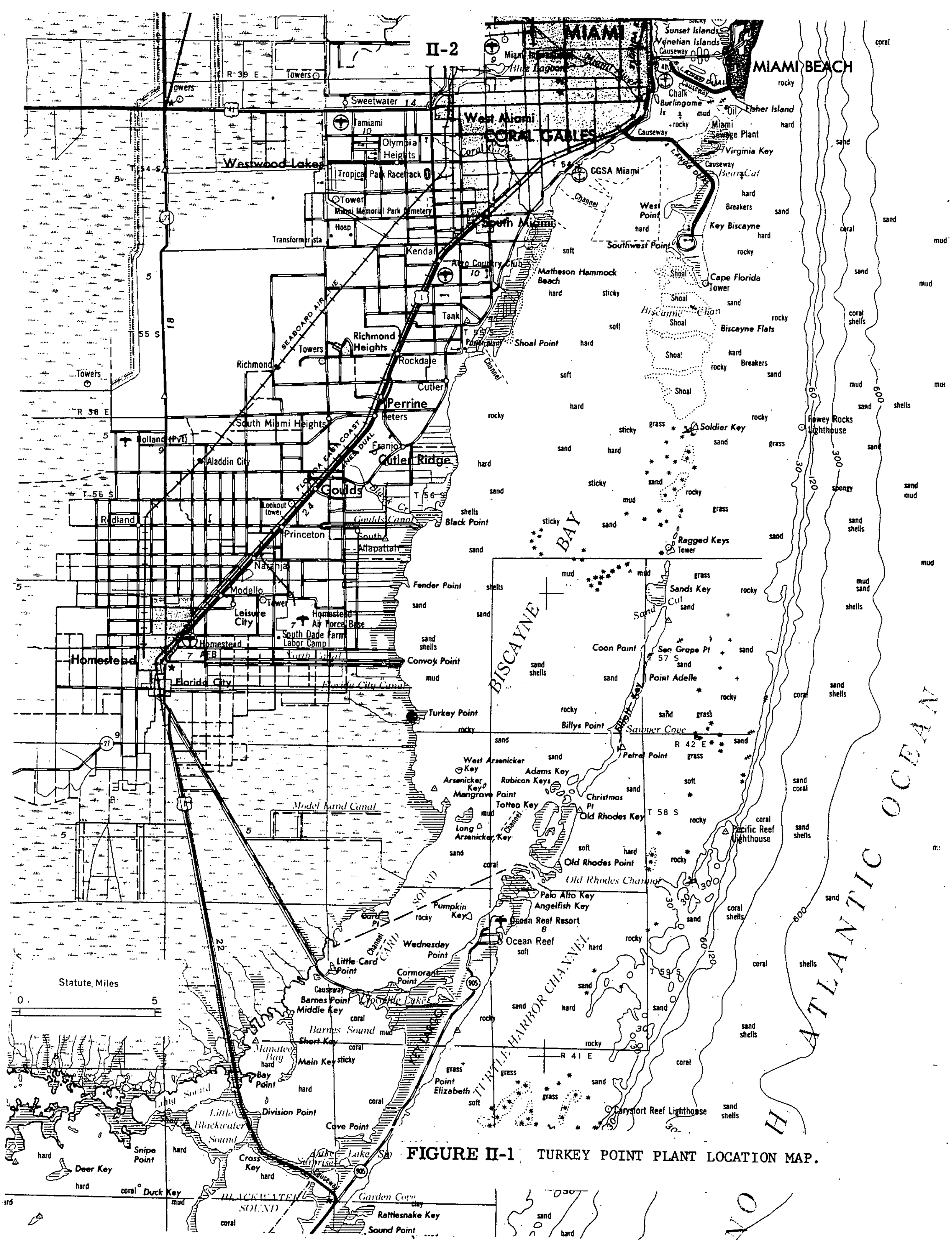

FIGURE II-1 TURKEY POINT PLANT LOCATION MAP.

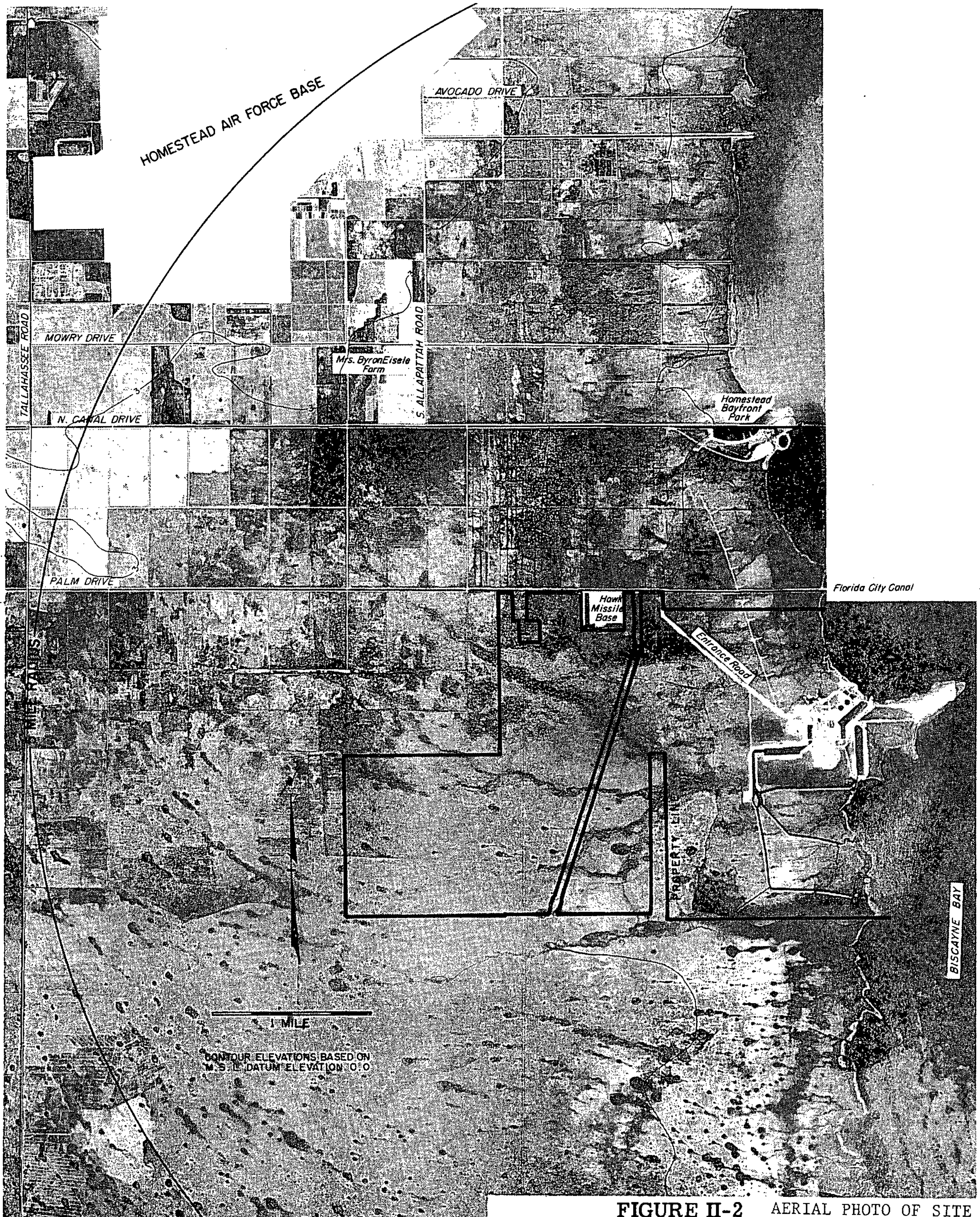

FIGURE II-2 AERIAL PHOTO OF SITE **SHOWING ORIGINAL BOUNDARIES**

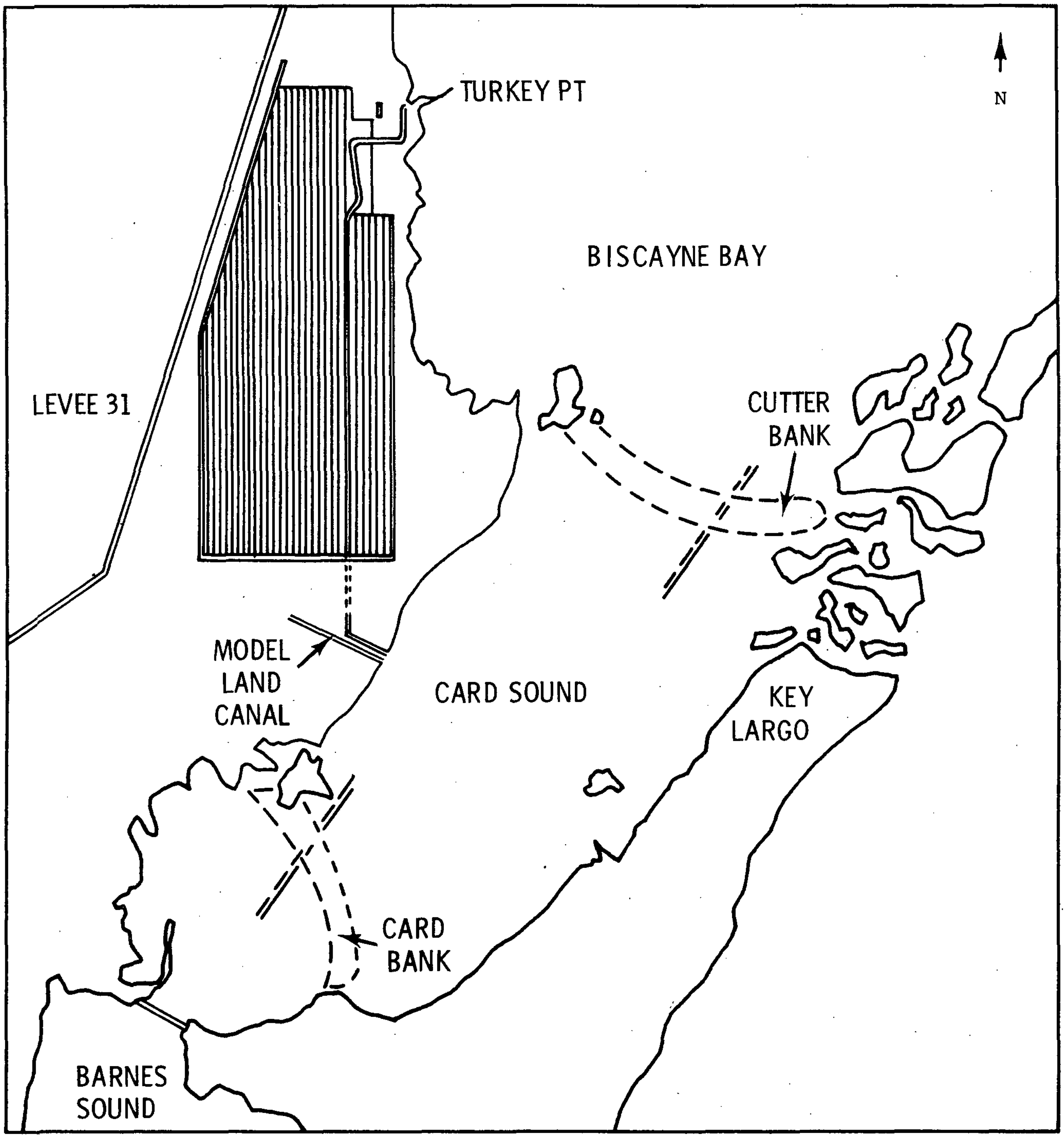

FIGURE II-3 Location of Cooling Channel System with Respect to Biscayne Bay and Card Sound

C. Regional Demography and Land Use

The general characteristics of the region are: urban development to within a distance of about seven miles north and west of the Plant site and becoming densely populated further north along the coast, essentially unihhabited land to the south, and water and uninhabited small islands to the east. There are no known permanent inhabitants within a five-mile radius of the Plant, although a farm 3.5 miles northwest of the Plant recently has been observed to be occupied. To the north and west, between urban developments and the site, land use is primarily agricultural, with the exception of Homestead Air Force Base. Dade County's Homestead Bayfront Park begins immediately north of the Plant site, and a Hawk Missile base adjoins the site near the northwest corner. The southern coast consists of uninhabited swampland extending inland from 1 to 3 miles. Biscayne Bay National Monument begins 850 feet off-shore from the plant site and extends to the east. The Dade County Master Plan (to 1986) projected continued agricultural or "vacant use" of the immediately surrounding land.

The population projections to 1986 are for large increases to the north and west and very little increase to the south and east. In view of the large population increases in the Miami area and the current close approach of urban development to the Turkey Point site, those population projections through 1986 provided by the Applicant may not be indicative of the population stresses that will exist in the vicinity of the plant over its projected lifetime of 30 to 40 years. On the other hand, the high cost of land development in the less desirable swampy land surrounding the site would be a detriment to any but high-value commercial, industrial, recreational or estate-type residential developments. Table II-1 presents information on past and future populations within a radius of 50 miles from the Plant.

TABLE II-1

Population within Various Radial Distances of the Turkey Point Plant [48]

Year	0-5 Mi	5-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi
1966	0	42,000	190,000	590,000	390,000	170,000
1976*	0	88,000	460,000	720,000	570,000	280,000
1986*	0	170,000	710,000	950,000	720,000	400,000

*Estimated

The predominant mangrove and black rush swampland in the region is a natural habitat for many species of plants and animals, but has very little direct commercial or recreational value. The principal value of the swampland lies in the role it plays in the biologic life cycle of some terrestrial and aquatic species and its use as a wilderness area. With flood control and drainage work, some of this land can be (and has been) converted into productive cropland. Underlying the salt marsh is limestone rock which could be excavated and used for fill. No other commercially valuable ores or minerals are known to exist at the site.

The development of the fossil-fuel and nuclear plants will increase the near-term recreational land uses at the site. These include tourism, fishing, camping, hiking and other activities related to such aspects as increased access to the high ground and more open water area for birds, as well as the Boy and Girl Scout camps and the two picnic areas currently developed. The Applicant proposes to preserve part of the existing site as a wildlife sanctuary.

D. Historic Significance

There are no places of historic significance within about twenty miles of the Turkey Point Plant. About twenty miles from the Plant are Viscaya (the James Deering Estate) in Miami to the north and the Cape Florida Lighthouse on Key Biscayne to the northeast (National Register of Historic Places, 1971). Appendix E is a copy of an April 13, 1972 letter giving the assessment of the Florida Division of Archives, History and Records Management that the project does not threaten any known archeological or historical sites of significance. The recently established Biscayne National Monument, which incorporates much of Biscayne Bay and several keys, is located immediately east of the plant site. Everglades National Park is located about 15 miles west and south of the plant. There are no unique fossil deposits or archeological features on the site.

E. Environmental Features

1. Geology

The site lies within the Floridian Plateau--a partly submerged peninsula of the continental shelf whose edge is about 18 miles offshore to the east. This peninsula is underlain by a thick (4,000 to 15,000 feet) series of sedimentary rocks consisting of limestones and associated formations and ranging in age from Paleozoic to Recent. These, in turn, are underlain by igneous and metamorphic basement rocks, primarily Pre-Cambrian granites.

Turkey

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.

The predominant surface feature is bedrock outcrop of Miami oolite, a deposit of permeable limestone extending to about 20 feet below sea level, overlain by organic swamp soils varying from 4 to 8 feet thick. Pockets of silt and clay separate the organic soils and bedrock in some locations.

Laboratory testing of the bedrock characteristics shows a capability to support heavy loads and competence in respect to other foundation conditions.

2. Climate

Subtropical in nature, the area's climate consists essentially of two seasons—warm, wet summers from May to October and mild, dry winters the remainder of the year. Marine influences create land-to-sea breezes and other coastal effects. Predominant winds are from the east and southeast during most of the year. There are night and early morning inversions. Night and early morning fog occurs about 12 times a year.

Measurable rainfall occurs about 125 days per year and totaled 78.1 inches in 1968. Thunderstorms appear on an average of 77 times per year. Relative humidity ranges from an average of 56 percent in the months of January to April to an average of 88 percent in September and October.

Air temperatures in June through September usually stay between 70 and 90°F. In October through March temperatures are often in the 50's and 60's with January and February being the coldest months (February 1968 recorded temperatures in the 60's about 50 percent of the time and in the 50's about 30 percent of the time). Temperatures seldom go below 50°F and almost never drop to freezing.

The site usually experiences gale force winds (41 to 74 mph) at least once in any year and hurricane force winds (greater than 74 mph) on an average of once every seven years. In 1965, Hurricane Betsy produced wind speeds estimated at 160 mph -- the severest condition reported for the site. Hurricanes have produced 6 inches of rainfall in 75 minutes, 13 inches in 24 hours, and a tide of 13.2 feet above mean sea level in the vicinity of the site.

Tornadoes, water-spouts, and hail also occur during the wet season. Tornadoes and hail are seen mostly in the afternoon, while water-spouts usually take place near sunrise. Most incidences of hail are in May.

3. Hydrology

a. Inland Waters

Natural drainage of the area is to the east and south towards Biscayne Bay. Since the shallow tidal creeks and swales are submerged, stream flow is very sluggish. This, together with the permeable limestone bedrock of the area, results in about two-thirds of the rainfall percolating directly to the groundwater aquifers. In the absence of well-defined stream channels, heavy precipitation runs off in a slow, sheet- like flow towards the bay. Some surface flow is directed away from the site by drainage and flood control canals, such as the Model Land Company Canal.

Since the ground surface at the site is less than one foot above mean sea level and the normal tide range of the bay is about two feet, the site is inundated during high tide and most of the area remains under one to three inches of water at low tide. Therefore, tidal flooding is a much more significant surface hydrological feature of the area than is rainfall runoff. Available information indicates that extreme high tides during hurricane flooding move inland several miles. Dissipation of the flood- water through sheet flow and through natural and man-made drainage channels requires several days.

Groundwater flow in the region is relatively high, and a large fraction of the annual rainfall of 60 inches is drained rapidly to the inner lagoon system within the keys. The water table aquifer extends to about 70 feet in depth and overlies the basic Floridian aquifer which extends generally under the South Florida coastal region.

The great variance of the groundwater chemistry from season to season is highly influenced by the relationship between surface recharge during rainy seasons and saline recharge from the ocean during dry periods. However, the movements are relative, and there is a general fresh water wedge near the surface that moves about five miles perpendicularly to the shore during a yearly cycle. Relatively high salinity water (higher than 28 parts per thousand, ppt) exists below 40 feet at all times at the plant site.

During the spring dry periods, the continued high level of evapo-transpiration results in large reductions in available surface water. During these periods, negative ground water gradients can occur resulting in relatively high penetration of sea water. At these times, the salinity of the coastal and related ground waters can be as high as 44 ppt at considerable distances inshore.

Approximately 50 percent of the annual groundwater recharge is removed either by surface pumping or surface tapping and is subsequently evaporated. The net discharge to the sea through the aquifer is about 30 percent (18 inches) of the annual total recharge. The local basin drainage size affecting the Bay and Sound system is estimated at about 55 square miles (35,000 acres), providing a mean annual flow of about 75 cubic feet per second (cfs). Aerial observations during the rainy period reveal very much higher instantaneous rates as sheets of shoreline flow, but no quantitative estimate has been made.

b. Marine Waters

The Turkey Point site is located at the southern end of the convergence of the upper keys with the Florida mainland near the beginning of the Intercoastal Waterway which traverses the sheltered waters between the keys and the Mainland to the south and west. Water depths are relatively shallow and the waterway area is more characteristic of estuarine than marine environment. The keys to the east restrict flow paths, causing the principal tidal movement to be to the north and south, the least favorable direction for tidal mixing. As a result, the various sounds and bays tend to have individual characteristics of circulation and physical composition accompanied by localized ecological development. The considerable research to determine the seasonal, physical, and biological characteristics of these areas has confirmed the need for consideration of the individual water bodies as independent units. However, because they are physically connected, they do have a number of oceanographic features in common.

Biscayne Bay

Lower Biscayne Bay, the area enclosed within Elliot Key, is about 100 square miles (64,000 acres) in area. Featherbed Bank (between Sands Key and Black Point) to the north and Cutter Bank to the south define and restrict the circulation. The average depth is on the order of 5 feet at mean low water (MLW), with a maximum of 13 feet at the deepest point. The volume at MLW is on the order of 1.5×10^{10} cubic feet. Mean tide is 1.65 feet on the mainland shore and 1.55 feet on Elliot Key or the eastern side. The area is roughly identical to the Biscayne National Monument, which was established by Federal action in 1968 to preserve a rare, shallow, subtropical, estuarine lagoon in the natural state. As noted previously salinities vary widely, ranging from a low of 24 ppt to a high of 44 ppt, depending on the amount of rainfall and surface drainage reaching the coastal zone. The vertical salinity gradient in the Bay is relatively low, and the water can be considered vertically homogeneous. Natural water temperatures range from 59°F to 92°F at the surface, with little or no stratification.

Studies of the Bay show the principal circulation forces to be tidal, although winds which persist for longer than complete tidal cycles of 12 to 13 hours cause relatively large water movements and represent the principal driving force for the circulation of water from outside the Bay system itself.

Card Sound

Located immediately south of Biscayne Bay, Card Sound is bounded on the north by Cutter Bank and on the south by Card Bank. These banks are sufficiently shallow that the Intercoastal Waterway is dredged to permit passage through them. The surface area of Card Sound is about 23.8 square miles (15,300 acres) and the mean volume is 6.0×10^{9} cubic feet.

The mean tidal range is 0.75 foot, less than half that of Biscayne Bay to the north, because of the reduction in energy from friction across the dividing banks. Principal circulation is north and south with a mean tidal circulation of about 1.2 miles per cycle. Very little exchange occurs with the open ocean except during periods of intense onshore wind, with the probable result that the Sound operates as a semi-independent lagoon in series with Biscayne Bay to the north and Barnes Sound to the south. Mean depth is about 10 feet and the net circulation per tidal cycle is only about 1000 acre-feet, or a continuous net flow of about 500 cfs to the north. Therefore, the mixing effect of the tidal movement is relatively low within the Sound, although the vertical structure remains essentially homogeneous.

Discharges of water from the mainland from surface runoff or canals have marked effects on the salinity patterns because of the low, net circulation. Wind drift can cause large temporary increases of interbay circulation and relatively rapid changes of salinity between connected lagoons.

Temperatures of Card Sound water range from fall lows of 59°F to highs of 94°F with little or no stratification. Like Biscayne Bay to the north, the thermal structure is essentially homogeneous vertically. Horizontally, the thermal structure reflects the flow flux between neighboring lagoons and provides a precise definition of the limits of tidal motion.

The Combined System

As a combined system, the three lagoons -- Biscayne Bay, Card Sound, and Barnes Sound - - operate as a series flow system with low inflow and outflow at the periphery. As a consequence, a given slug of water will retain its identity for several tidal cycles. During dry periods, persistent patterns of salinity difference exist along north-south lines. Measurements of cyclic tidal flow past discrete points such as Card Bank or Cutter Bank average about 50,000 acre-feet per day, or a continuous flow of 60,000 cfs per half tidal cycle. Flows into and out of the three lagoon systems to the open ocean probably are less than 10,000 acre-feet per day (5,000 cfs).

Mixing within the system is relatively poor except when winds in excess of 15 knots occur. With a constant direction, such winds promote relatively complete movement of water through the system, particularly in the fall and winter when salinities throughout the system are essentially constant during these wind periods. During periods when low wind speeds are characteristic, particularly in the summer months, a variable system of salinities and temperatures exists throughout the three lagoons.

Biscayne Bay exhibits a high degree of stability to horizontal mixing. As a result, shoreline salinities and temperature on the mainland side exhibit a distinct divide which also separates zones of ecologic difference. Card Sound, being in the central reach, appears to retain the highest degree of identity both in chemical composition and temperature. The biological productivity of Card Sound has been reported as relatively low in comparison with other South Florida ecosystems [13], which suggests that it operates as a relatively closed system in series with the three lagoons.

F. Ecology of Site and Environs

1. Terrestrial

The Turkey Point facility is located in a vegetation zone that has been described by various authorities as tropical, subtropical, grassland, savannah, and deciduous forest. The climax vegetation type, which is similar to tropical biomes, is unique to southern Florida. In part, the uniqueness is attributable to the presence of those plant species that give a tropical appearance to the region, even though the climate is not comparable to that of a tropical rain forest and the physiognomy lacks the structuring of more southern forests.

The Applicant has provided a generalized map of the site (Figure 1 of Appendix B) which separates the region into three main areas: Coastal - the land east of Card Sound Canal and along the coast to the south; Canal - the area in which canals are presently being constructed; and Inland - areas west of the canal area and other "inland" holdings of Florida Power and Light in the vicinity of Turkey Point. These arbitrary zones are mainly based upon engineering alterations of the region rather than on recognized plant associations or successional stages.

Four species of mangrove dominate the woody vegetation: red mangrove, black mangrove, white mangrove, and buttonwood. Also, there are numerous species of forbs, grasses and shrubs found in this vegetation type. The Applicant has recently completed a preliminary study of the terrestrial ecology of the site and a copy is appended to this statement (Appendix B). No rare or endangered plant species were found around the site.

One of the most striking characteristics of mangrove swamps is the zonation of the dominant species more or less parallel with the shore. The zonal structure suggests a possible successional pattern which can be observed in areas where soil buildup is rapid.

In the course of succession there are changes in many environmental factors, especially the relative level of land and water, as well as salinity. The factors interact in a complex manner and mangrove successions are, therefore, complex.

In Florida the species of the mangrove can be correlated with frequency of tidal immersion, the nature of the substrate, the rate of soil deposition and erosion and the salinity of the ground water. Growth of the vegetation in one zone prepares the way for succeeding species until eventually an inland vegetation community, not tolerant of immersion in sea water, is established. The following stages in succession can be distinguished:

- Pioneer Rhizophora Family, consisting of young plants of the red mangrove growing on almost continually submerged soil. Marine angiosperms such as Thalassia and Cymodacea as well as the marine grass Spartina often grow in association with the young red mangrove. Sedimentation and accumulation of plant and animal debris raise the level of the soil with time.

- The mature Rhizophora community is the next stage in succession. The soil level is higher and the stilt roots catch debris of all kinds. Marine angiosperms are less abundant. This community is stable and may persist for a long time. Along many parts of the coast this community does not spread by sending out seedlings; instead, the trees send out roots into deeper water, sediments may accumulate among these roots, and the swamp extends itself seaward.

- Black Mangrove. Behind the red mangrove on land which is occasionally submerged, there is a zone dominated by black mangrove. This forms an open forest with an understory of succulent shrubs and salt-marsh grasses. This black mangrove and salt marsh association develops best on soil that is not regularly flooded by the tide. Black mangrove trees are not rapidly replaced, and, if they disappear, an open salt marsh may occur.

- The Conocarpus transition occupies a zone seldom reached by the tides. It is an open stand of trees and shrubs with an understory of salt-marsh plants. Organic matter in the form of peat accumulates in the marsh. There does not appear to be any major contribution of nutrients to the estuarine food chains.

Mangroves are one of the most important elements in the ecology of tropical and subtropical areas. Energy flow, or the movement of nutrients, from the land to the estuary is the basic key to many of the lower food webs, since decomposition of the organic matter produced by the mangrove results in great quantities of food for plant and animal plankton, the beginning of all important marine food chains. Productivity and ecological importance of the red mangroves are known, but the importance or contribution of the later stages in succession are not clear.

Mangroves are also important natural barriers and help suppress the intensity of flood and hurricane tides. The mangrove fringe to the east of the cooling system site has been deeded to the State of Florida by the Applicant.

Mangroves provide nesting, resting, and feeding sites for animals, especially birds. Numerous wading and diving birds feed in the open waters of the swamp and the nearby bay, filling the secondary consumer niche.

The Applicant provided information [48] indicating that approximately 100 species of birds have been observed on the site, although a detailed species list was not available. Table 6 of the recent ecological survey (Appendix B) lists 39 species of birds observed in the three areas defined by the Applicant.

Range maps of bird species indicate that as many as 5 endangered species, 2 rare species, and 4 species classified as "peripheral" by the U. S. Fish and Wildlife Service may occur on the site. These species are listed in Table II-2.

TABLE II-2

Rare and Endangered Species of Birds
Potentially Using Turkey Point Site

Peripheral	Endangered
Wood ibis	Brown pelican
Eastern reddish egret	Southern bald eagle
Roseate spoonbill	
Florida mangrove cuckoo	
Rare	
Florida great white heron	
Florida sandbill crane	

Florida Power and Light provided information confirming the presence of the brown pelican, southern bald eagle, and the wood ibis on the site. Quantitative information was not available on use of the locale by migratory waterfowl.

About 30 species of mammals have ranges overlapping Turkey Point. These species are listed in Table II-3.

TABLE II-3

Species of Mammals with Ranges Overlapping Turkey Point[77]

Opossum	Cotton mouse	Raccoon
Short-tailed shrew	Florida mouse	Long-tailed weasel
Least Shrew	Cotton rat	Mink
Eastern mole	Round-tailed muskrat	Spotted skunk
Marsh rabbit	Black rat	Striped skunk
Eastern cottontail	Norway rat	Otter
Gray squirrel	House mouse	Florida puma
Fox squirrel	Red wolf	Bobcat
Rice rat	Gray fox	Manatee
Eastern harvest mouse	Black bear	White-tailed deer
Atlantic bottle-nosed dolphin	Bats	

Three of these mammals, the red wolf, Florida puma, and manatee, are classified as endangered species by the U. S. Fish and Wildlife Service. Earlier information from the Applicant states that both the puma and manatee are found at Turkey Point [48], but FPL notes in a March 10, 1972 letter (Appendix E) that it is unlikely that a red wolf, black bear, puma, or white-tailed deer will ever again be in range. Table 7 of the Applicant's ecological survey (AppendixB) lists 8 species of mammals observed in one or all of the three zones visited.

Several species of reptiles and amphibians may be present on the site. The reptiles probably include poisonous snakes, such as the eastern diamondback rattlesnake, copperhead, and coral snake, as well as other harmless snakes and lizards. Tables 4 and 5 of the Applicant's terrestrial survey (Appendix B) list 8 species of amphibians and 5 species of reptiles observed at Turkey Point.

Material supplied by the Applicant states that the American alligator and the Florida crocodile are present on the site. The former is classified as endangered, and the latter as "peripheral" by the U.S. Fish and Wildlife Service.

The numbers of mammals and reptiles and their importance are not known in detail. No doubt many of them are omnivores, such as the raccoon and rice rat, which allows them to eat a variety of both flora and fauna when they are available. Others are strictly predators of the different secondary consumers.

2. Aquatic

The major ecological zones in South Biscayne Bay and Card Sound are the mangrove community, the shallows bordering the Bay and Sound, and the central areas. Extensive surveys of these areas are reported by Iversen [2], Iversen and Roessler [13], and Bader and Roessler [27] of the Institute of Marine and Atmospheric Science, University of Miami.

The southwest section, especially on Card Bank, is not as fertile as the remainder of the Sound. Generally, the areas close to the shore produce more grass, algae, and animals than those toward the center of the Sound. The area near the Model Land Company Canal (see Figure II-3) is less productive than other shoreline stations and has a reduced number of flora and fauna.

a. The Mangrove Community

The zone of red mangrove trees in Card Sound is generally narrow along the west side, but from Card Point north to about the Model Land Canal the zone is fairly wide. The shoreline here is indented with many muddy bays and flats bordered by mangroves that are flooded on most high tides and probably contribute considerable organic matter to the Sound. North of the Model Land Company Canal to about Mangrove Point the mangroves are restricted to a narrow intertidal zone because of a sand barrier located close behind the shoreline. This mangrove area is probably flooded only during the higher high tides, at which time organic matter is added to the Sound from this area. In the area of Cormorant Point on the south end of the Sound, there is a large stand of mangroves, but from there north along the west shore of Key Largo there are only a few of these trees. The northern part of Key Largo is high ground bounded by rocky coast, but near the creeks between Key Largo and Old Rhodes Key the stands of mangroves are extensive. Also, there are heavy stands of mangroves on Long Arsenicker Key. Pumpkin Key is a high rocky island, similar for the most part to Key Largo, and red mangroves do not occur there.

Mangrove areas are often considered important contributors to the productivity of tropical ecosystems. However, in this area, comparative studies by the University of Miami, based on two years measurement of Thalassia growth rates and mapping by aerial photography and scuba, have produced estimates that the productivity of the existing Thalassia beds exceeds that of the mangrove areas by an order of magnitude. The fringing zone of mangroves is therefore secondary to the Thalassia beds in terms of productivity, though still an important contributor to the Bay.

Many species of fish and invertebrates use the fringe of the mangrove community ecosystem as nursery grounds. Surveys of the Turkey Point area by gill netting [20] indicate over 50 species of fish. The most abundant were the gray snapper, *Lutjanus griseus* (which made up 35.8 percent of the total), the white mullet, *Mugil curema* (12 percent), the fantail mullet, *Mugil trichodon* (6 percent), and the yellowfin mojarra, *Gerres cinereus* (6 percent). Five species of invertebrates were also taken. The blue crab, *Callinectes sapidus*, made up 90 percent of the specimens collected.

Examination of the stomach contents of the carnivorous fish caught showed that approximately 15 percent contained identifiable matter. Only the gray snapper yielded enough information from its stomach contents for conclusions to be drawn on its feeding habits. One hundred and eighty-five of the 648 gray snappers examined were found with food in the stomach; crustaceans made up 71.1 percent of this material, fish constituted the remainder. Penaeid shrimp were the most common crustacean found, followed in order by members of the genus Callinectes, Alpheus, and Panopeus. Other decapod prey included the mangrove crab (Aratus), the grass shrimp (Tozeuma), and the fiddler crab (Uca). The killifish, Fundulus confluentus, was the most common fish eaten; its occurrence in the stomachs was limited to the months of January and February. Lophogobius and the various species of mojarras were also numerous. Twenty-two (12 percent) snappers contained both fish and crustaceans and 13 (7 percent) and had two or more species of crustaceans. These results are in general agreement with those found by others working with juvenile snappers from similar habitats [56-58].

Results of trap sampling showed twenty-one species of fish. The most abundant were Pinfish (Lagodon rhomboides), Silver jenny (Encinostomus gula), Yellowfin mojarra (Gerres cinereus) and Spotfin mojarra (Encinostomus argenteus).

b. The Shallows Bordering the Bay and Sound

Seagrass beds extend from the mainland shore outward in a band that varies from several hundred to several thousand feet in width. This zone is characterized by a thick layer of highly organic, fine-grained, carbonate mud sediment (calcilutite) that overlies the calcareous bedrock. The thick sediment supports dense growths of rooted vegetation, principally turtle grass (Thalassia testudinum) with associated macroalgae and isolated patches of Cuban shoal grass (Diplanthera wrightii). This type of habitat also reaches into the tidal streams.

The most important biologic community in Biscayne Bay is that of the turtle grass (Thalassia testudinum), which serves both as a primary producer and substantial contributor to the detritus. In addition, the plants provide shelter and substrate for small organisms, including foraminifera, polychaetes, carideans, molluscs, crabs and small fishes. Also, the root system of the grass and rhizoids of the algae act as sediment accumulators and stabilizers. The grass is often thickly interspersed with macroalgae such as *Penicillus capitatus*, *Halimedia incrassata* and *Laurencia poitei*. Studies are in progress on the relative contributions to the standing crop of macroalgae and *Thalassia*.

In general, *Thalassia* and macroalgae occur all around the subtidal edge of Card Sound, with dense stands in the northwest corner. Across Card Bank, *Thalassia* is patchy with some fairly extensive open sandy areas. The west side of the Sound is nearly uniform except for the area just north of the mouth of the Model Land Canal, where there is a large area of clean sand which appears to have undergone scouring.

Scuba and aerial photography of the area around the rim of the Sound showed that most species occur in the shallow narrow band surrounding the basin. The *Thalassia* varies from patchy to very dense and grows in pockets of sediment within the firm bottom which provide suitable substrate for the many species of sessile organism found there.

c. Central Areas

In South Biscayne Bay, the third zone, which extends outward from the seagrass beds and includes most of the bay bottom, occurs where there is little or no sediment over the underlying rock. It is characterized by numerous patches of sponges, alcyonarians and corals. Vegetation is limited to various species of brown, green and red algae that appear seasonally and to scattered dense growths of turtle grass.

In Card Sound from the edge of the keys to about half-way across the Sound, the bottom is characteristically muddy with some shell fragments and scattered patches of algae and sponges. The soft calcium carbonate bottom material, easily stirred up by wind and tidal turbulence, forms an inadequate substrate for the many species of invertebrates that are found in other areas of the Sound where the bottom material is hard sand.

In the western half of Card Sound, the bottom is firm and consists of sand and shell fragments. This area is richer than the eastern portion of Sound, especially in species that require hard substrate.

- Benthic Animals and Fishes

Trawl samples have been collected in both South Biscayne Bay and Card Sound [27]. Card Sound has produced 24 species of animals not collected in Biscayne Bay. These are organisms which are associated with sponge communities. At least one economically important species, the spiny lobster, Panulirus argus, is known in its juvenile stages to utilize sponges for shelter. Biscayne Bay produced 153 species not found in Card Sound. These are generally mainland shelf forms or very uncommon organisms.

The results of trawl samples for October 1970 indicate that vegetation, fishes, molluscs, crustacea, sponges, and echinoderms are somewhat more abundant in Card Sound than in South Biscayne Bay. The abundance of the fish and crustacea appears to be directly related to the mass of the vegetation, at least at this time of year.

- Zooplankton and Diatoms

The important copepods in South Biscayne Bay are confined to six genera, each of which is dominated by a single species. These are Acartia tonsa, Paracalanus parvus, Tamora turbinata, Labidocera scotti, Oithona nana and Metis jousseaumei. Community structure differs between inshore and midbay waters, but total quantities are similar. Despite extreme and rapid fluctuations, a major pattern of summer minimum and autumn bloom is suggested. Surveys in Card Sound are in progress.

A preliminary investigation on epiphytic diatoms has defined the dominant species, the seasonal cycles, and has determined distinctions in speciation and diversity.

- Commercial and Sport Fisheries

Of the numerous species occurring in Biscayne Bay a relatively small number are of major or moderate economic importance [1]. The species caught in large quantities are the pink and brown shrimp, Penacus duorarum and P. aztecus; the spiny lobster, Panulirus argus; the stone crab, Menippe mercenaria; black and silver mullets, Mugil cephalus, M. curema, and M. Trichodon; and the king and Spanish mackerels, Scomberomorus cavalla and S. meculatus.

Shrimp are caught in a special fishery to supply the live-bait market for anglers. This fishing now produces between a third and a half-million dollars per year at the primary level. In 1970-71, 47 licenses were issued in Dade County for bait shrimp landing permits; the number in 1965-66 was 46. Considerable (but unrecorded) quantities of shrimp are also caught in Biscayne Bay in a "sport" fishery.

The commercial fishery for spiny lobsters is also of considerable importance in Biscayne Bay and it has expanded greatly in recent years. A value for total landings in Dade County at the fisherman's level in 1970 was $1.68 million. However, much of this is caught off-shore. A large and increasing sport fishery for spiny lobsters also exists in Biscayne Bay, where they are caught by hand, dip net, and bully net.

The stone crab fishery has also expanded rapidly in recent years and shows signs of continued growth. In 1970 stone crab landings in Dade County were worth $69,645 to the fishermen.

Mullet are still caught in large quantities in Biscayne Bay, although this fishery has declined in the past two decades. The largest catches are of silver mullet, although most of these are used as bait; however, some silver mullet and a large portion of black mullet catches are for human consumption.

The catches of mackerel in Biscayne Bay are sporadic. In some years, these species do not enter the Bay in great numbers, and catches are only a fraction of those in other years. However, there is a very large sport fishery for mackerel when they do enter the Bay.

It appears that larger catches are made of some species of fishes and invertebrates in Biscayne Bay by sport fishermen than by commercial gear. The size of the sport fishing fleet is impressive and considerable quantities of the following species are taken: spotted weakfish, snook, tarpon, mackerel, bonefish, jacks, mangrove snappers, groupers, lookdowns, bluefish, permit, sandperch, mojarras, grunts, pinfish and numerous other "panfish." Lesser quantities of many other species are landed.

The limited sponge fishery in Biscayne Bay yielded about 10,000 pounds in 1970, worth about $36,000. Of minor economic importance are those fish species collected and marketed as aquarium specimens.

Some species of sport and commercial value are sufficiently abundant in Card Sound to support fisheries. Anglers fish from the bank at the exit of the Model Land

Canal, while only a few fish along the west side of the Sound from small skiffs. The grass flats near the north end of Key Largo presumably serve as feeding areas for *Albula vulpes*, bonefish, during certain seasons. This area has long been used by the Key Largo Anglers Club.

Trap lines are set for stone crabs on both sides of the Intracoastal Waterway in the deep basin.

Bait shrimpers have been fishing in Card Sound recently and making good catches. Pink shrimp, *Penaeus duorarum*, have been reported from Card Sound by Salomon, Allen, and Costello [52]. Similarly, a spring lobster fishery is becoming important. Sponge fishermen work on Cutter Bank south of Long Arsenicker and Mangrove Point. Several others work an area of shallow water near Wednesday Point.

Another species of commercial value in Card Sound is the scallop (*Pecten irradians* and *P. gibbus*), although it is abundant at only a few stations.

Information from the National Marine Fisheries Service of the Department of Commerce on commercial landings of fish and shellfish at Florida ports in 1970 has been used to compile the following summary for Dade County, which includes the shore of Biscayne Bay (Table II-4).

TABLE II-4

Dade County Fish Landings

Species	Average Value in $ per pound, for Florida East Coast	Pounds Landed in Dade County	Estimated Value in Dollars for Dade County
Fish			
Ballyhoo (non-food) Hemiramphus brasiliensis	0.23	143,000	33,000
Bluefish Pomatomus saltatrix	0.11	6,000	660
Blue Runner Caranx crysos	0.05	11,000	550
Cobia Rachycentron canadum	0.13	220	29
Crevalle Caranx hippos	0.04	6,100	240
Croaker Micropogon undulatus	0.23	4,200	970
Dolphin Coryphaena hippurus	0.23	5,200	1,200
Drum, Black Pogonias cromis	0.10	590	59
Drum, Red Sciaenops ocellata	0.20	1,100	220
Groupers Epinephelus, Mycteroperca and Cephalopholis spp.	0.21	71,000	15,000
Grunts Haemulon spp.	0.10	39,000	3,900
Hogfish Lachnolaimus maximus	0.25	2,400	600
Jewfish Epinephelus itajara	0.15	700	100
King Mackerel Scomberomorus cavalla	0.23	51,000	12,000
Menhaden (non-food) Brevoortia spp.	0.01	50	0.5
Mullet, Black Mugil cephalus	0.08	5,300	420
Mullet, Silver Mugil curema	0.11	212,000	23,000
Permit Trachinotus falcatus	0.23	18	4
Pompano Trachinotus carolinus	1.21	12,600	15,000
Scup Stenotomus chrysops	0.17	2,400	410
Sea Trout, Spotted Cynoscion	0.32	8,300	2,700
Sharks (non-food) Carcharhinus spp.	0.04	3,200	130
Sheepshead Archosargus probatscephalus	0.10	1,500	150
Snapper, Lane Lutjanus synagris	0.34	980	330
Snapper, Mangrove Lutjanus griseus	0.34	26,000	8,800
Snapper, Mutton Lutjanus analis	0.51	42,000	21,000
Snapper, Red Lutjanus campechanus	0.67	108,000	72,000
Snapper, Vermilion Rhomboplites aurorubens	0.50	110	55
Snapper, Yellowtail Ocyurus chrysurus	0.40	154,000	62,000
Spanish Mackerel Scomberomorus maculatus	0.13	327,000	42,000
Unclassified: For Food	0.08	22,000	1,800

TABLE II-4 (Cont'd)

Shellfish, etc.			
Conchs *Strombus gigas*	0.27	30	8
Crabs, Blue (hard) *Callinectes sapidus*	0.08	13,000	1,000
Crabs, Stone *Menippe mercenaria*	0.63	110,000	69,000
Lobsters, Spiny *Panulirus argus*	0.61	2,767,000	1,680,000
Sponges, Grass *Spongia graminea*	1.47	4,500	6,600
Sponges, Sheepswool *Hippiospongia lachne*	5.62	4,500	25,000
Sponges, Yellow *Spongia zimocca*	2.03	2,500	5,100
Turtles, Green *Chelonia mydas*	0.16	740	120
Turtles, Loggerhead *Caretta caretta*	0.15	470	70
Total, Fish & Shellfish		4,170,000	2,105,000

For comparison, these totals and the ones for 1968 and 1969 are given below.

Year	Total Pounds Landed in Dade County	Total Estimated Value in Dollars for Dade County
1968	3,929,000	1,928,000
1969	3,878,000	2,190,000
1970	4,170,000	2,105,000

III. THE PLANT

A. External Appearance

The Plant, located at the base of the small Turkey Point peninsula, has four main structures -- the two fossil units and the two nuclear units. The nuclear units, at the south end of the north-south structural alignment, are enclosed by two 170-foot high cylindrical containment facilities. The fossil units are particularly functional in design in that the steam generating units are supported by exposed structural steel with no exterior sheathing. This absence of siding is not uncommon for power-generating and other heavy industry facilities at many locations in the South.

Other prominent structures at the site are the two stacks adjacent to the fossil-fuel units, two oil storage tanks in a revetment just northeast of the plants, the continuous four-unit turbine-generator facility immediately west of the plants, and the station switchyard west of the cooling water effluent basin. The arrangement of facilities on the site is shown in Figure III-1 (canals are shown as for operation of fossil-fueled units, prior to construction of canal to Card Sound).

The major tall structures are visible for about two or three miles on the landward side of the plant, depending on the viewer's location. The terrain is so flat that all inland ground observation is effectively blocked by any intervening vegetation. From seaward locations and along the shoreline, where low-growing vegetation is predominant, the major structures are visible over a distance of 5 to 10 miles. At several locations the stacks are visible, although low on the horizon, from a distance of about 20 miles.

No significant attempts have been made to hide or disguise the plants or to blend them into the surroundings. Concealment and blending would be a fruitless effort because of the level terrain and generally low (less than 20 feet) natural plant growth. Rather, aesthetics considerations have been toward providing the relatively wide "buffer" zone around the plant to isolate the facility from the view of urban areas and major highways. Also, the Applicant plans to reseed and otherwise landscape much of the plant area to present a clean and pleasing appearance.

B. Transmission Lines

The transmission lines right-of-way was acquired in connection with the earlier installed fossil-fuel units; no additional right-of-way land is required for the lines installed to service the

Turkey Point Site - Arrangement of Facilities

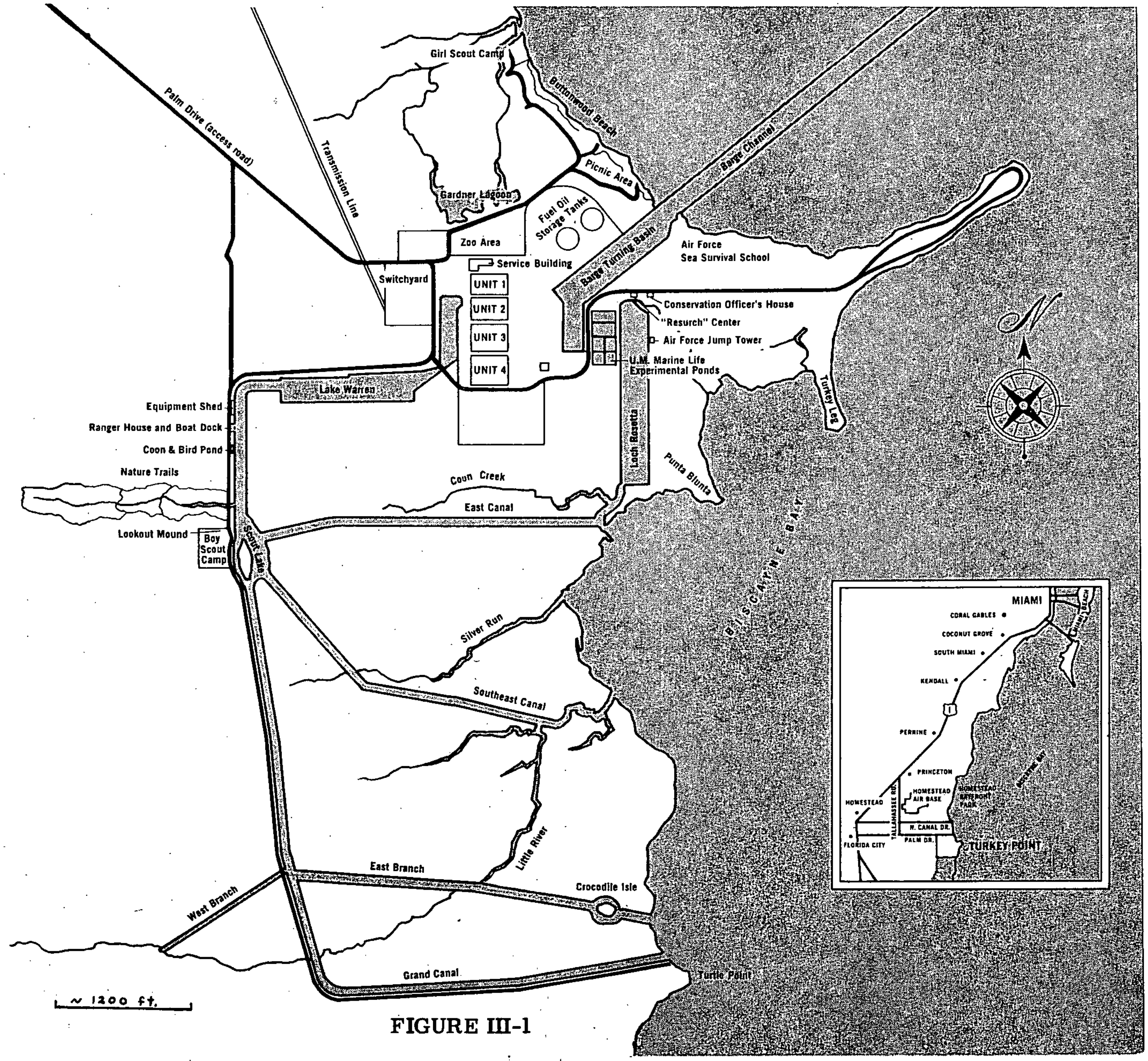

FIGURE III-1

nuclear units. These transmission facilities, placed in service in 1967, extend from the Turkey Point switchyard northwest of the Applicant's Davis substation in the western part of Miami, a distance of about 19.2 miles. The 330-foot wide right-of-way presently has three double pole structures carrying seven (7) transmission lines to the north. These seven 240 kV circuits supply power to several of the Applicant's substations.

Access roads to transmission facilities have been installed where the right-of-way crosses swampland. The flat terrain at other locations has eliminated, for the most part, the need to construct service roads.

C. Reactor and Steam-Electric System

The two Turkey Point nuclear units use identical pressurized light-water moderated and cooled reactors designed and fabricated by the Westinghouse Electric Corporation. Each reactor has the capacity to produce initially 2200 MWt with an ultimate output of 2300 MWt. Each nuclear steam supply system (NSSS) is served by a turbine-generator, also fabricated by the Westinghouse Electric Corporation, with a capacity to generate 760 MW of gross electrical power. The engineer-constructor for the project is the Bechtel Corporation and/or its subsidiary Bechtel Associates.

Each NSSS is comprised of a pressurized water reactor and three closed reactor coolant loops connected in parallel to the reactor and to the closed-cycle steam generators. Secondary steam produced in the vertical, U-tube steam generators is passed through the drive turbines on the electrical generator and then condensed back to water and recycled through the system. A separate open cooling water loop employs water from the channel-canal system to condense turbine exhaust steam; this warmed effluent is then discharged into the afterbay of the system to be circulated and reused after its heat content is dissipated to the atmosphere, as described in the following section.

D. Effluent Systems

1. Heat

In order to remove heat from the steam turbine condensers of Units 3 and 4 (a total of about 8×10^9 Btu per hour at full load), the Applicant initially planned to use salt water from Biscayne Bay and to return the heated water via canals back to Biscayne Bay. The decision to use Biscayne Bay water for cooling was a natural evolution from the decision to build at Turkey Point instead of at the Cutler Station location in South Miami. The two fossil-fueled units were originally purchased for installation at the Cutler Station. A permit issued by Dade County in June 1964 initiated action at Turkey Point and actual construction began in September 1964. Unit 1 was placed on line April 22, 1967, and Unit 2 went into operation April 25, 1968. The original canal installation was modified to the 1970 configuration (see Figure III-1) on the basis of studies of the circulation of Biscayne Bay performed by Carpenter et al. [31]. The two original fossil-fueled units circulated 1270 cfs of cooling water with a rise of 14°F at full load. Construction of two nuclear units was announced in November 1965 before the fossil units were operating and before information on circulation effects was available. On advice of consultants, the discharge through the present Grand Canal to Biscayne Bay was adopted; and, as construction progressed, alterations were made to accommodate increased flow.

Commencing in 1969, water quality was monitored by regulatory agencies and results were used as a basis for requests to restrict the recirculation flow to Biscayne Bay in April 1970. Previous studies had indicated that a 93°F limit on discharges to the Bay was desirable, and such a limit was incorporated into Florida State Board of Health criteria in 1967. An exception was granted to the Applicant pending completion of concurrent studies by the Applicant, his consultants and government agencies, including studies by the University of Miami supported by an AEC contract.

In December 1969, the Applicant received approval from Dade County to construct a diversion canal and dilution pumping system, which through subsequent revisions was to take a total of 10,650 cfs (21,400 acre feet per day) from the plant complex through a canal to Card Sound, discharging at a point five miles south of the Turkey Point plant. The total flow was to be made up of 4250 cfs which passed through the condensers and a dilution flow of 6400 cfs, all originating in Biscayne Bay. This plan limited the thermal rise in the discharge canal to 6°F; and, except for portions of the year, temperatures in Card Sound could be expected to be below 96°F. Since this was regarded as unacceptable to regulatory agencies because of the temperature increase in Card Sound, the extended time of exposure of entrained organisms, and the alteration of circulation patterns between Card Sound and Biscayne Bay, the Applicant was prevented from completing the canal which was 80 percent complete in the summer of 1971. As an interim stage, during 1970-71, the Applicant considered erection of a raised 4500 acre salt-water cooling lake, but a number of considerations, including nuclear safety, precluded adoption of this alternative.

The present plan is quite different. It involves the recirculation of salt water through an extensive system of channels and canals that communicate with Card Sound. Some features of the original system, however, are to be incorporated into this new system. The final stage of the new system is shown in Figure III-2, as proposed in November 1971[48].

Initially, water from Biscayne Bay will flow to the plant via an existing combined barge and intake channel. From the intake channel, the water will flow through steel trash racks into eight separate screen wells (four for each of the nuclear units). The water will then pass through traveling screens to remove debris that has passed the trash racks. The traveling screens will be cleaned by water spray supplied by special pumps. Marine organisms growing on the screen system will be eliminated by treatment with hypochlorite or chlorine.

Water from each of the screen wells flows to the suction of a 350 cfs (156,000 gpm) pump. All four pumps of each unit will be used while the unit is operating. After cooling the condensers, the water will, during an "interim period," be discharged to a receiving pond (Lake Warren) and then flow through the Grand Canal to Biscayne Bay (see Figure III-1). As an alternative to routing the effluent water to Biscayne Bay, the Applicant proposed to send it to Card Sound and constructed a large canal that would transport the water to Card Sound.

A subsequent alternative investigated by the Applicant was the construction of a large cooling lake in the salt marsh between Turkey Point and Card Sound. This concept involved recirculation of the cooling water through the condensers and the lake with makeup and purge water supplied from Biscayne Bay. "Purge water" is added to flush some of the cooling water out of the recirculating system so that it does not become too salty from evaporation. The cooling lake alternative was deemed not feasible because of a number of technical problems related to flow control, seepage, and requirements for reactor safeguards.

The current heat dissipation plan proposed by the Applicant (to implement a settlement of litigation with the Federal government reflected in the court order of Civil Action 70-328-CA, Final Judgment [43]) will dissipate the combined thermal loading of the two fossil-fueled units as well as the two nuclear units (14×10^9 Btu/hr at 100 percent load factor) in a recirculating multichannel system (see Figure III-2) which is to be built around the existing Card Sound Canal.

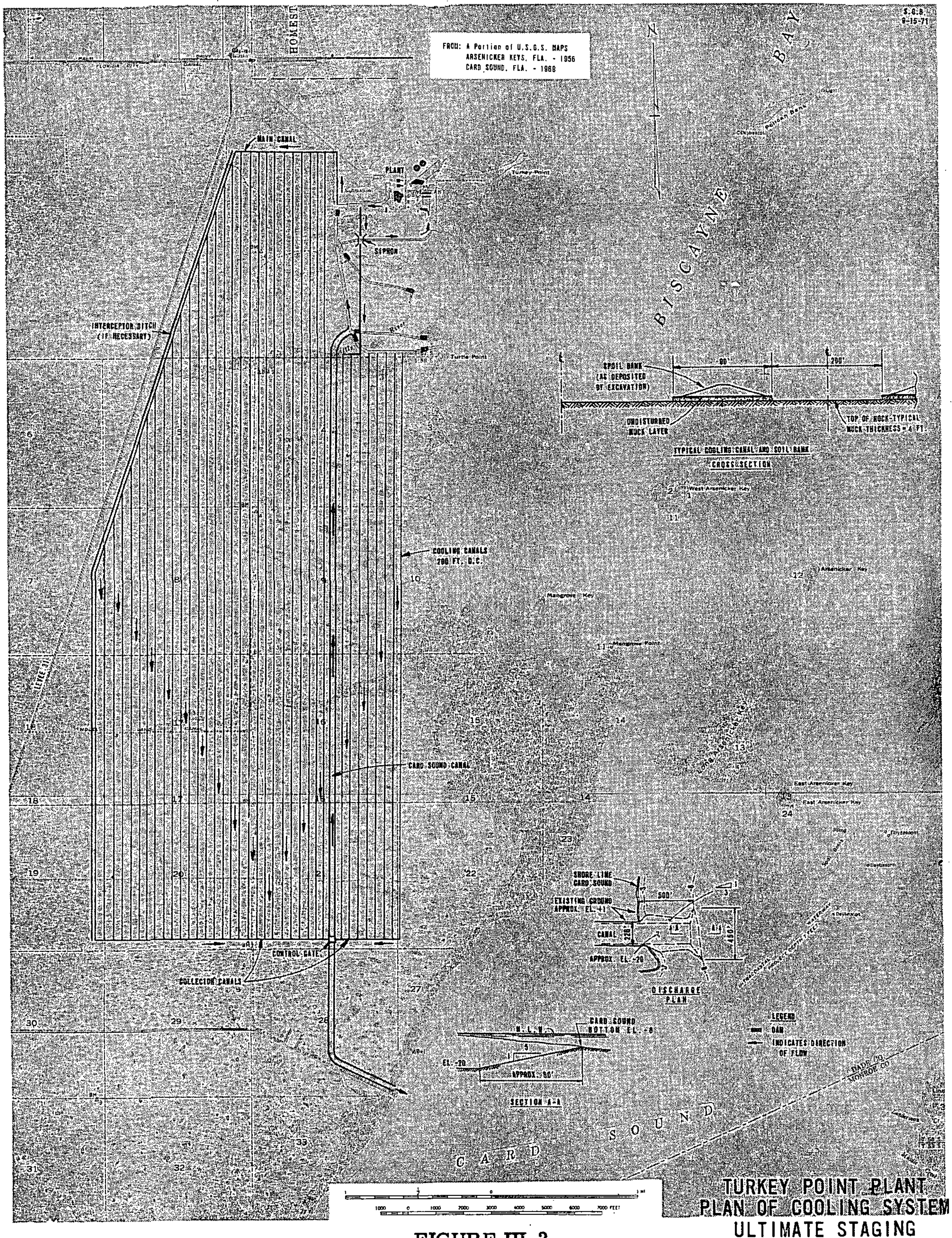

FIGURE III-2

ULTIMATE STAGING
WATER SURFACE AREA
4000 ACRES

The consent decree stipulates performance specifications for the proposed operation and defines a series of emergency actions under which alternative actions may be taken [43]. A copy of the consent decree is presented in Appendix C.

In general terms, the consent decree requires that a recirculating system be constructed with appropriate purge flow controls to hold salinity increases from evaporation to a factor of 1.10 of the Card Sound salinity at the time of discharge, and restricts the temperature differential of the purge water reaching Card Sound to 4.0°F. Purge flows are limited to a maximum of 1200 cfs and temperatures which are not greater than 90°F. In addition, a number of off-standard operational modes are outlined in the consent decree.

The proposed system consists of a series of shallow parallel ditches or channels running north and south, parallel to the Card Sound Canal. The system will cover a rectangular area of about 7,000 acres. Each channel will be 200 feet wide and about 4 feet deep with the muck spoils piled on 90-foot wide banks between the channels to an average height of about eight feet. Excavation will, in general, not go below the top of the Miami oolite formation. Return flows will be collected by an east-west interceptor system and returned to the Card Sound Canal. Flow will return to the plant via the Card Sound Canal and the existing East Canal currently used to discharge to Biscayne Bay. When the multichannel cooling system is completed, a dike is to be built across the existing barge and intake canal to block off Biscayne Bay water from the plant intake structure. At this time, all water withdrawal and discharge to Biscayne Bay will be eliminated, and Card Sound will become the source of makeup and purge water.

The arrangement of canals, spoil banks, and discharge structures is still basically to be as shown in Figure III-2, although FPL has made some revisions in number and layout of channels [74]. These revisions, including the boundaries of the enlarged site, are shown in Figure III-3. Shaded areas in Figure III-3 represent about 2500 acres of mangrove shore-fringe area donated by FPL to the State of Florida. Figures III-4 and III-5 present recent aerial pictures of the site.

After passing through the plant condensers where at full load the temperature will be raised 15°F, the effluent will pass through the existing afterbay and then to an east-west distributor canal which will supply the individual channels of the system. The total system will have 38 channels, which will give an effective water surface of about 3860 acres.

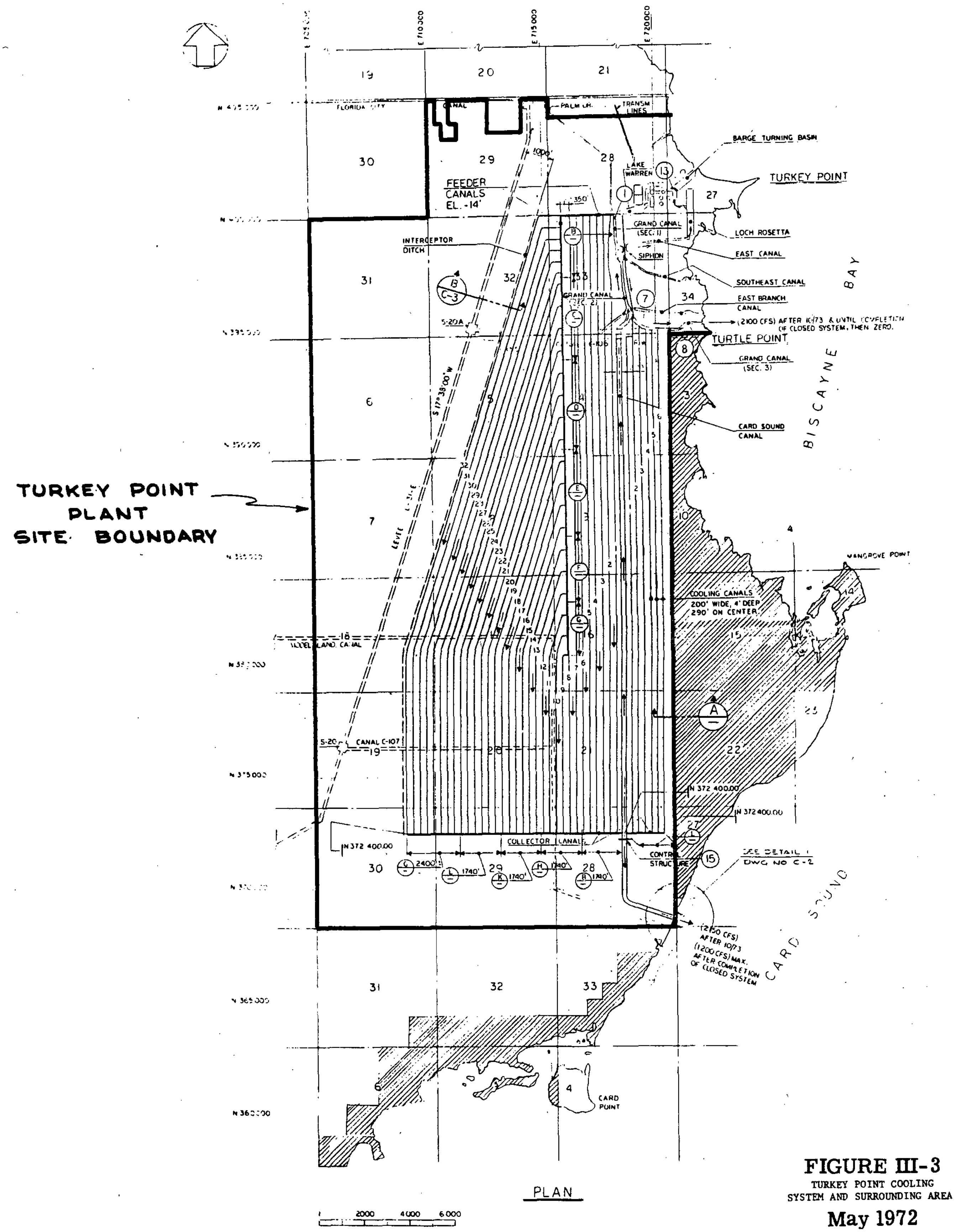

FIGURE III-3
TURKEY POINT COOLING
SYSTEM AND SURROUNDING AREA

May 1972

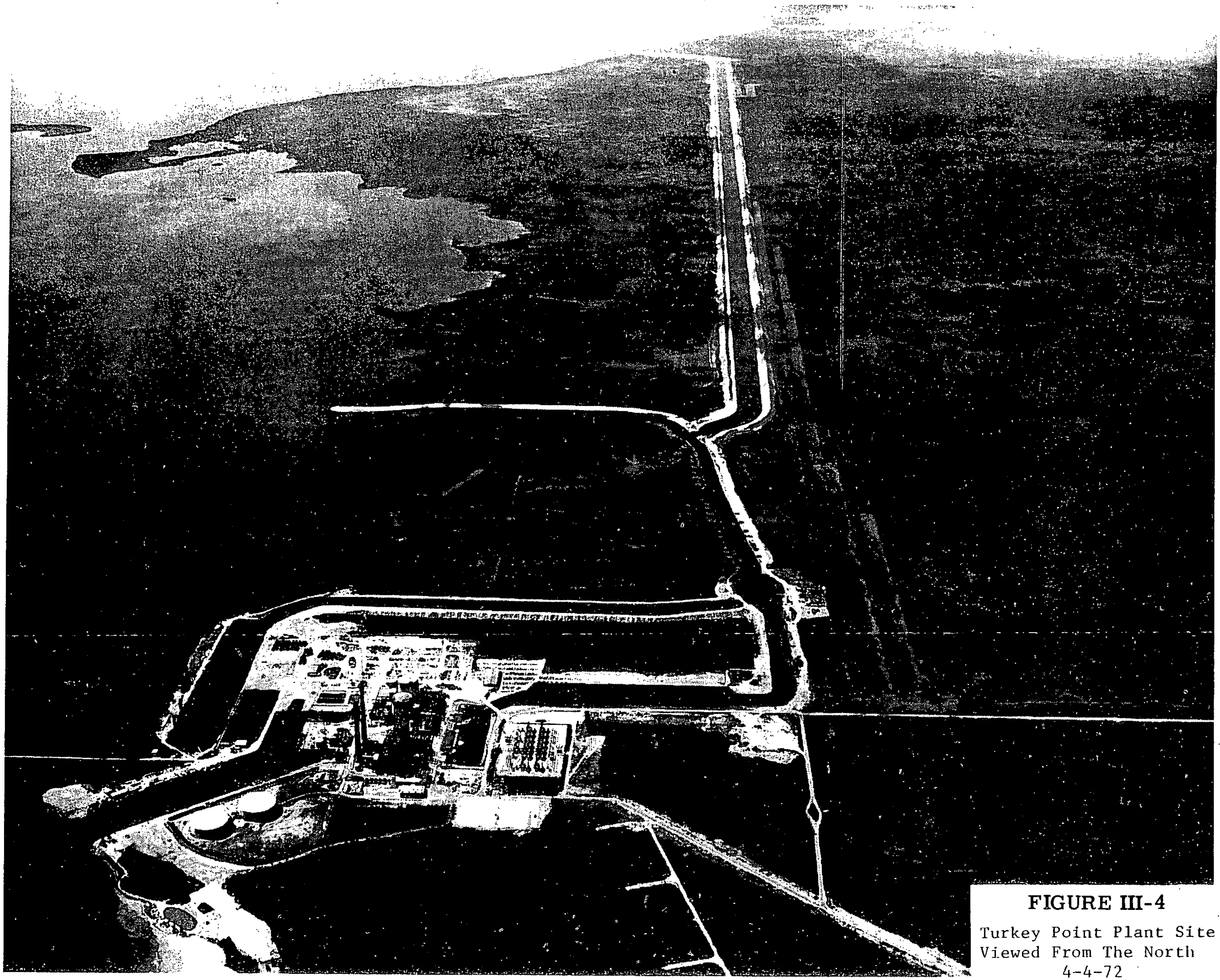

FIGURE III-4

Turkey Point Plant Site
Viewed From The North
4-4-72

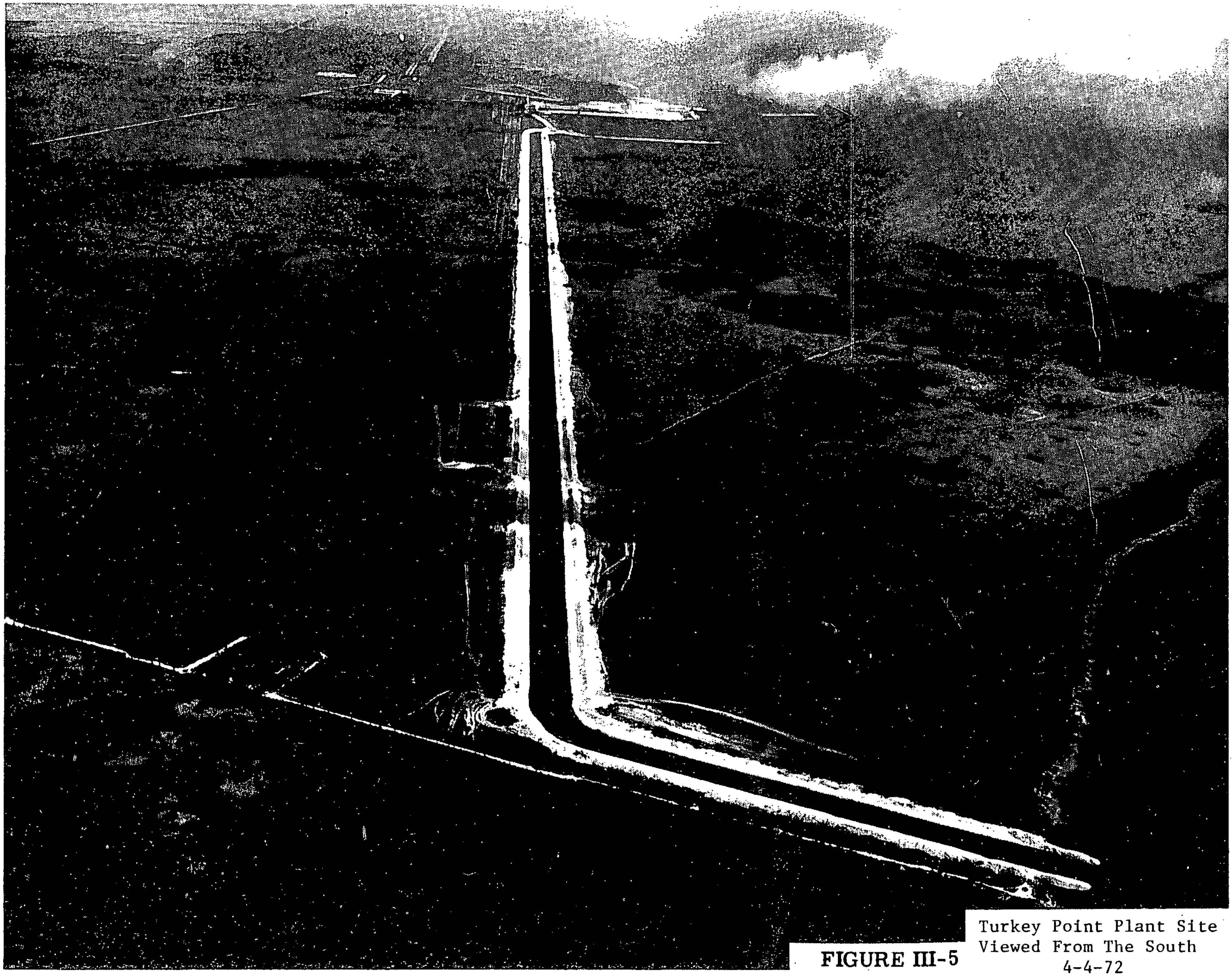

FIGURE III-5 Turkey Point Plant Site Viewed From The South 4-4-72

Purge flows into the system will occur as a result of level manipulation of the entire network in response to the tidal cycle of about 0.8 feet net elevation difference. Control and metering of purge flows will be done at the south control structure. Computations indicate that the Card Sound Canal will deliver about 8000 cfs to the plant forebay with 0.25 foot head, though the actual cooling flow is to be 4250 cfs with all four units operating and lesser amounts with lesser number of pumps and units operating. The head differential for the individual channels is very small -- on the order of 0.008 feet. Purging will occur during each tidal cycle; the average tidal cycle of the area is 12 to 13 hours. At high tide, flow will be into the system via the Card Sound Canal; at low tide, flow will be out of the system.

The south terminus of the new Card Sound Canal serves both as an inlet and outlet. The exit will be excavated to a one-on-five slope out to the -8 foot depth at MLW; the width will be increased (as the depth decreases) to a maximum of 450 feet. Under the consent decree for flow maximum, the velocity of water entering and leaving the canal mouth will be about 0.3 ft/sec, which is essentially the same as the mean tidal velocity in the Card Sound area. The relationship of the operation of the heat dissipation system to the environment is discussed in Section V.

Estimates of the operational characteristics of cooling ponds and the proposed system have been made for the Applicant by a number of consultants[48]. AEC Staff review of the Applicant's analysis of these studies indicates that the technical feasibility of the system as a thermal dissipation method is sound. However, sizing of the system is highly dependent on load factoring considerations, weather cycles, tidal cycles, and planned and unplanned outages. Also, because of the large size and the thermal inertia of the system, there will be lag and blending of parameter changes within both the surface and groundwater systems which will be difficult to predict in the early operational phase. As experience is gained, the system characteristics should become better defined, and more accurate predictions of its behavior will be possible. A number of operational characteristics pertinent to making such predictions are summarized in Table III-1.

2. Radioactive Wastes

The operation of a nuclear reactor results in the production of radioactive fission products, the bulk of which remain within the cladding of the fuel rods. During operation of the

TABLE III-1

Cooling Channel Characteristics

A. Related Climatological Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Air Temp, °F	70	70	70	75	75	80	82	80	81	76	71	70
Mean Dew Point, °F	60	61	65	65	68	73	74	74	75	70	65	60
Mean Wet Bulb, °F	63	64	66	67	70	75	76	75	76	71	66	63
Wind Speed, mph	9	10	10	10	9	8	8	7	8	9	9	9
Principal Wind Direction	NNW	E	SE	E	E	SE	SE	E	ESE	ENE	E	NNW

B. Physical Performance Data (4000 Surface Acres)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Equilibration Temp[(a)] (Mean Conditions)	68	68	73	77	82	85	87	87	84	81	73	68
Discharge Temp. at 100% L. F.[(b)]	74	75	79	83	87	90	92	90	90	88	80	75
Discharge Temp at 50% L. F.[(b)]	70	70	75	79	84	87	89	89	86	83	75	70
Card Sound Water Temp, °F (Mean Condition)	67	66	73	77	79	82	85	87	84	81	73	68

(a) This would be the temperature of the water in the channel system if the plant were not operating. Values are based on Cooling Water Studies for EEI, carried out by Edinger and Geyer, January 1, 1965.

(b) This represents the temperature of the water leaving the channel system and recirculating to the plant or being purged to Card Sound when the plant is operating at the indicated load factor (L.F.).

C. Related Water Loss Data

- Average annual evaporation from water bodies in this region -- 56 inches per year.
- Maximum monthly evaporation -- 7.5 inches per month.
- Evaporation from channel system under average weather conditions for August and Plant operating at 100% load -- 70 cfs.
- Evaporation from system under August 1968 conditions (no rain) and 100% plant load -- 120 cfs.
- Seepage from system through the ground to Biscayne Bay and Card Sound -- 60-150 cfs. **(Maintenance of low channel levels could reduce or reverse these flows.)**

reactor, small amounts of fission products may escape from the fuel cladding into the primary coolant; also, some radioactive materials are produced as a result of neutron activation of corrosion products in the coolant. Some of these materials in low concentrations may be released into the atmosphere as gases or released in liquids to the salt waters of Card Sound and Biscayne Bay by controlled processes after appropriate monitoring, treatment, and sampling. The limitations of 10 CFR Part 20 and the "as low as practicable" requirements of 10 CFR Part 50 with respect to radioactive releases will govern and will be met during the operation of the Plant at full power.

The radioactive waste treatment systems presently incorporated in the Turkey Point Plant Units 3 & 4 are described in the Florida Power and Light Company's Final Safety Analysis Report[50] and the Applicant's Environmental Report dated November 15, 1970[49], including the Supplemental Report dated November 8, 1971[48].

The radioactive waste handling and treatment systems for the Turkey Point Nuclear Plant are designed to collect and process the liquid, gaseous, and solid wastes that are byproducts of plant operation and that might contain radioactive materials. The radioactive waste treatment facilities are shared by both Units 3 and 4, with the exception of the reactor coolant drain tanks and coolant drain tank pumps. The AEC Staff evaluation assumed that modifications to the waste evaporator have been completed so that it yields a throughput of at least 3 gpm (confirmed in FPL letter of March 10, 1972, attached as Appendix E-5).

Gaseous Waste

During power operation of the facilities, radioactive materials released to the atmosphere in gaseous effluents include low concentrations of fission product noble gases (krypton and xenon), halogens (mostly iodines), tritium contained in water vapor, and particulate material including both fission products and activated corrosion products.

The primary source of gaseous radioactive waste will be from the degassing of the primary coolant during letdown of the cooling water into the various holding tanks. This is principally from the exhaust of cover gas from waste holdup tanks, venting of the Chemical and Volume Control System and from equipment vents. Additional sources of gaseous waste activity include ventilation air released from the auxiliary building, spent fuel building and the open turbine building, off-gases from the steam generator blowdown tanks, venting of the steam jet air ejectors, and purging of the reactor containment building.

As indicated, most of the gas received by the gas processing systems will be from the degassing of the primary coolant during letdown of the cooling water into the various holdup tanks. Gases collected in the vent header will flow to one of two waste gas compressors and from there pumped to one of six gas decay tanks (each tank has a unit capacity of 525 cubic feet at a pressure of 150 psig) where the gas will be heldup for radioactivity decay. The control arrangement is such that one tank will be filled at a time. Gas held in the decay tanks will either be returned to the Chemical and Volume Control System or discharged to the atmosphere. Generally, the last decay tank to receive gas will be the first tank emptied back to the CVCS liquid holdup tanks, so as to permit maximum decay of gas which may be discharged to the atmosphere. When filled, the gas decay tanks will be sampled and analyzed to determine the release rate or the need for additional holdup. Based on the AEC Staff evaluation, it appears that the gas processing system has sufficient capacity to permit a holdup time of 45 days. The gas released from the decay tanks will be combined with ventilation air exhusted from the auxiliary building, filtered through high efficiency particulate filters, and discharged to the atmosphere through the unit vent.

The ventilation systems for the reactor containment building, auxiliary buildings, and spent fuel storage buildings have been designed to ensure that air flow is from areas of low potential to areas having a greater potential for accidental release of airborne radioactivity. The auxiliary building exhaust system will draw air from the equipment rooms and open areas of the building together with air from Unit 4 spent fuel storage building through high efficiency particulate filters and discharge to the atmosphere via the plant vent. A separate fan exhausts air from Unit 3 spent fuel storage building through high efficiency particulate filter to a roof vent.

Off-gas from the condenser air ejectors (which remove radioactive gases which have collected in the condenser as a result of primary to secondary system leakage) and the steam generator blowdown tanks will be vented directly to the atmosphere without treatment. Because of the open turbine building, steam system leakage which may occur in the turbines and/or ancillary equipment will be released directly to the atmosphere.

Radioactive gases may be released inside the reactor containment building when components of the primary system are opened to the building atmosphere for operational reasons or when minor leaks occur in the primary system. The reactor containment atmosphere can be purged through roughing filters and discharged to the plant vent. The full flow rate is 35,000 CFM for each containment building, which is equivalent to 1.3 air changes per hour.

Table III-2 shows the anticipated annual release of radioactive materials in gaseous effluent for each unit. The AEC staff evaluation of the system considered operation of the reactor with 0.25 percent leaking fuel and a 20 gallon per day primary to secondary system leak rate. Anticipated noble gas releases from the waste gas processing system were based on a holdup time of 45 days. The estimated releases of radioactivity from the containment building were based on a need to purge the containment four times per year.

Liquid Waste

The liquid waste treatment system common to both units consists of tanks, piping, pumps, evaporators, process equipment, and instrumentation necessary to collect, process, store, analyze, monitor, and discharge potentially radioactive liquid wastes from Units 3 and 4. Treated liquid wastes will be handled on a batch basis (approximately 510 batches per year at 900 gallons per batch) to permit optimum control and reduce the chance of an inadvertent release of radioactive liquid. Prior to release of any treated liquid wastes, samples will be taken and analyzed to determine the type and amount of radioactivity in a batch to assure conformance with release limits. Liquid waste can be discharged to the seal wells of either Unit 3 or 4 and from there to the circulating water discharge canal.

The liquid waste treatment system is divided into two parts: (1) the Chemical and Volume Control System, which will process liquids from the reactor coolant loops and other chemically clean sources, and (2) the Waste Disposal System, which will collect and treat liquids including equipment and floor drains, laboratory and decontamination drains and laundry and shower drains.

To maintain a low level of radioactivity in the primary coolant, a sidestream of the coolant will flow to the Chemical and Volume Control System and be processed through one of two mixed-bed demineralizers to remove fission products and corrosion products (except cesium, yttrium, molybdenum, and tritium, whose isotopes are removed slowly or not at all by the demineralizers and are assumed to pass through without any removal for the purpose of this evaluation). On an intermittent basis the effluent from the demineralizers will be processed through a second deminerlizer to control cesium

TABLE III-2

ESTIMATED ANNUAL RELEASE OF RADIOACTIVE MATERIAL IN GASEOUS EFFLUENT FROM TURKEY POINT PLANT UNITS 3 AND 4

Power Level 2200 MWt

	Curies/Year/Unit				
Nuclide	Containment Purge	Gas Processing System (45-day holdup)	Auxiliary Building	Steam Generator Blowdown Vent	Total Ci/yr/Unit
Kr-85	10	630	1	5	650
Kr-87	-	-	1	5	6
Kr-88	-	50	3	15	70
Xe-131m	3	-	2	7	12
Xe-133	200	1200	300	1200	2900
Xe-135	-	-	1	5	6
Xe-138	-	-	-	3	3
TOTAL					3650
Iodine and Particulates	0.2	-	0.1	0.5	0.8

activity in the coolant. The effluent from the demineralizers will be filtered and returned to the volume control tank for reuse. In the later stages of core life the coolant effluent from the mixed bed demineralizers will be routed to one of two deborating demineralizers. This effluent will be returned to the volume control tank or sent to the monitor tanks for reuse or released to the circulating water discharge header. For the purpose of this evaluation it was assumed that 90% of this water will be reused in the reactor.

The second part of the Chemical and Volume Control System will process liquids that drain from reactor coolant pump seals, accumulators, pressurizer relief tanks, valve and flange leak-offs and the excess coolant letdown during reactor startup. These liquids will be collected in the holdup tanks and processed on a batch basis. Liquid from the holdup tanks will be routed through one of four evaporator-feed demineralizers to reduce the concentration of radioisotopes except tritium and will be filtered, degassed, and sent to a boric acid evaporator. The distillate from the evaporator will be processed through a demineralizer, filtered, and transferred to one of the two monitor tanks. Subsequent handling of the distillate is dependent on the results of the sample analysis. Liquid waste from the monitor tanks will be pumped to the water storage tank, recycled through the demineralizers, returned to the holdup tanks for reprocessing through the evaporator or discharged to the circulating water header. The values in Table III-3 were based on the release of four primary system volumes per year and an overall decontamination factor (DF) of 10^4 for the boric acid evaporator-demineralizer combination for all nuclides except isotopes of iodine, cesium, yttrium, molybdenum, and hydrogen. A DF of 10^3 was used for iodine and 2×10^2 for cesium. Yttrium and molybdenum were assumed to plate out in the system, with a DF of 10 and 100 for these, respectively. The DF for tritium was used as 1.

The Waste Disposal System will process liquids from equipments drains and leaks, laboratory and various floor drains. Liquid waste will be collected in the waste holdup tank and processed in batches through the waste evaporator (3 gpm). The evaporator concentrates are discharged to the drumming station and packaged as solid waste. The condensate is routed to one of two waste condensate tanks. When one tank is filled, it is isolated and sampled for analysis. The applicant indicates that if the activity level is suitable for discharge the condensate is pumped, monitored, metered, and released to the condensate circulating water discharge canal. Otherwise the condensate is recirculated through a mixed bed demineralizer

TABLE III-3

ANTICIPATED ANNUAL RELEASE OF RADIOACTIVE MATERIALS IN LIQUID EFFLUENTS FROM TURKEY POINT PLANT UNITS 3 AND 4 -- RECONCENTRATION FACTORS FOR COOLING CANAL SYSTEM

(Power Level 2200 MWt)

Nuclide	Steam Generator Blowdown Ci/yr/Unit	Waste Disposal System Ci/yr/Unit	Recon-centration Factor*
Rb-86	0.02	0.0002	3.9
Sr-89	0.02	0.0002	6.3
Sr-90	0.0006	0.000008	11.0
Y-90	0.001	0.00001	1.3
Y-91	0.17	0.05	6.7
Zr-95	0.003	0.00004	7.0
Nb-95	0.003	0.00004	5.4
Mo-99	0.55	0.02	1.4
Ru-103	0.002	0.00002	} 5.7
Rh-103m	0.002	0.00002	
Rh-105	0.001	0.000004	1.1
Ru-106	0.0005	0.000008	10.0
Sn-125	0.00001	0.000002	2.6
Te-125m	0.002	0.00002	7.0
Sb-127	0.001	0.0000016	1.6
Te-127m	0.01	0.0002	8.2
Te-127	0.03	0.0002	1.0
Te-129m	0.15	0.02	5.3
Te-129	0.06	0.02	1.0
Te-131m	0.10	0.0002	1.1
Te-131	0.35	0.00006	1.0
I-131	9.6	0.06	2.4
Te-132	1.2	0.01	1.5
Cs-134	6.6	0.22	10.5
Cs-136	2.2	0.08	3.2
Cs-137	4.9	0.012	} 11.0
Ba-137m	0.07	0.019	
Ba-140	0.02	0.0002	3.1
La-140	0.008	0.0002	1.2
Ce-141	0.003	0.00004	5.2
Ce-143	0.002	0.000006	1.1
Pr-143	0.003	0.00004	3.1
Ce-144	0.002	0.00002	9.7
Nd-147	0.001	0.000014	2.9
Pm-147	0.0002	0.000002	10.6

TABLE III-3 (Continued)

Nuclide	Steam Generator Blowdown Ci/yr/Unit	Waste Disposal System Ci/yr/Unit	Reconcentration Factor*
Pm-149	0.0007	0.00001	1.3
Cr-51	0.03	0.008	4.8
Mn-54	0.02	0.012	9.8
Mn-56	0.05	----	1.0
Fe-55	0.05	0.046	10.6
Co-58	0.59	0.42	7.2
Fe-59	0.11	0.012	6.0
Co-60	0.14	0.01	10.8
TOTAL	∿ 27	∿ 1	
Tritium - 1000 Ci/yr/Unit			10

*The reconcentration factor applies to the recirculating canal mode of operation and is discussed further in Section V.D.

or returned to the waste holdup tank for reprocessing. The AEC Staff evaluation of the system assumed that all liquid waste with the exception of laundry waste is processed through the demineralizer prior to discharge. It is expected that the activity level of waste liquid from the laundry and hot showers will be low enough to permit discharge from the site without treatment. However, the liquid waste can be recirculated through the demineralizer or pumped to the waste holdup tank for processing.

The steam generator blowdown system consists of a monitored header and a blowdown tank. The overflow standpipe discharges directly to the circulating water discharge at the seal well. Provisions have been incorporated into the system to divert the blowdown to the radioactive liquid waste system if the activity exceeds a level yet to be established by the applicant. Based on the limited capacity of the waste evaporator (3 gpm), the AEC Staff evaluation assumed that blowdown liquids will be released without treatment. The anticipated 27 curies per year release from each unit's steam generator blowdown shown in Table III-3 is based on a continuous primary to secondary system leakage of 20 gallons per day and a 10 gallon per minute steam generator blowdown.

The anticipated release from the Waste Disposal System shown in Table III-3 assumes 0.25 percent leaking fuel and a decontamination factor (DF) of 10^5 for the waste evaporator-demineralizer for all isotopes except iodine and tritium. A DF of 10^4 was assumed for iodine. Based on the evaluation of the liquid waste system, the anticipated releases from normal operation were calculated to be a fraction of those shown in Table III-3. Taking into account treatment equipment downtime and expected operational occurrences, the AEC Staff estimates the annual release of activity will be about 1 curie per year from each unit's waste disposal system.

Solid Waste

Radioactive solid wastes will consist mainly of spent demineralizer resins, evaporator concentrates, and filters. Concentrates from the waste evaporator will be put into steel drums, and mixed with vermiculite. Spent resins will be packaged in a similar manner. The sluice water will be separated from the resin and returned to the waste holdup tank. Each drum will be stored in a shielded area prior to being shipped offsite. Miscellaneous solid wastes such as paper, rags, clothing, and glassware will be compressed in 55-gallon drums by a baler. The filled drums will be stored in a shielded area in the drumming room until shipped off-site.

All solid waste will be packaged and shipped to a licensed burial ground in accordance with AEC and DOT regulations. Based on plants presently in operation, it is expected that approximately 300 to 600 drums of solid waste will be transported off-site each year.

3. Chemical and Sanitary Wastes

Water treatment facilities at the plant include ion exchange demineralizers which employ sulfuric acid and sodium hydroxide for regeneration of the exhausted ion exchange resins. The spent chemical regenerants are collected in a tank and neutralized to pH 6.5 to 8.5 prior to discharge into the circulating water system. The spent chemical regenerants, including flushes, contain approximately 4,000 mg/l dissolved solids, largely sodium sulfate with small quantities of other salts (e.g., calcium and magnesium salts) that were removed from the demineralized water. The total daily volume of spent chemical regenerant solutions discharged is approximately 42,000 gallons. When diluted in the circulating water system, the amount of regenerant salts will be a small fraction of the salts naturally occurring in seawater.

Chlorine will be fed to the condenser cooling water at the intake for an hour each day to control slime buildup on heat exchange surfaces. Chlorine addition is controlled so that the residual chlorine in the discharge to the canal system will be nominally 1 mg/l and no greater than 1.5 mg/l at any time during addition. Chlorine residual in the condenser cooling water is expected to dissipate during storage (about 60 hours) in the canal-channel recirculating cooling system prior to discharge with purge water.

The Applicant plans to feed water-dissolved chlorine gas to the intake of each of the 4 power units at different times to allow mixing of the treated water of one of the units with the untreated water from the other 3 units. It is anticipated that the chlorine residual of the treated water will be diluted and chemically reduced to low or non-detectable levels with the untreated water. It is recommended that the Applicant determine the actual chlorine residual at the discharge points to Biscayne Bay and Card Sound to verify the anticipated low chlorine residuals. This is particularly important with respect to operations prior to use of the canal-channel recirculating cooling system, when there will be shorter travel times to the discharge point.

During reactor operations it will be necessary at times to discharge water containing 1 to 2 mg/l boric acid to the circulating water system. The estimated annual discharge of this solution is 364,000 gallons. Boron added to the circulating water will be a very small fraction of that normally present in seawater (4 to 6 mg/l).

Small quantities of chemical stabilizers, such as cyclohexylamine, are used in the steam generator feed water. These chemicals are normally oxidized to produce ammonia. The concentration of nitrogen (as ammonia) discharged into the cooling water is expected to be a small fraction of that normally present in seawater.

Sanitary wastes collected from toilets, washroom facilities, and nonradioactive floor drains are treated with septic tanks, and the effluent from the tanks is allowed to drain into the ground. These septic tanks and treatment systems have been approved by the Florida State Board of Health.

4. Other Wastes

Runoff from roof drains and storm sewers is routed through underground tanks where oily waste is removed. The runoff is then discharged in part to the cooling water intake area and the remainder to the cooling water discharge area. Separated oils are routed to the oil storage tanks servicing the fossil fuel units.

A small amount of debris is collected on the circulating water intake screens. This material is slurried to pipes that discharge into the discharge canals.

At times the testing of two 2,500 KW diesel electric generators required for secondary emergency power will occur. During these periods, the exhaust emissions will be comparable to the passage of a large single-unit railroad locomotive. The testing occasions are expected to be limited to favorable weather conditions. Alternatively, if an emergency occurs, their operation will be in the absence of the relatively larger emissions from fossil Units 1 and 2 which would be presumed shutdown since they are the primary source of emergency power for the nuclear units. Other minor venting of miscellaneous equipment would be expected to be undetectable either by sight or measurement outside of the immediate exclusion area.

E. Transportation of Fuel and Radioactive Waste

The nuclear fuel for each of the two Turkey Point reactors consists of 80 metric tons of uranium enriched in U-235 to a range of from 1.85% to 3.10% by weight. The fuel is in the form of sintered uranium oxide pellets encapsulated in zircaloy fuel rods. Each fuel element is made up of 204 fuel rods about 12 feet long. In normal operation, about 25 metric tons of fuel is replaced each year for each reactor.

The Applicant has indicated that cold fuel and solid waste associated with the operation of the two reactors at Turkey Point will be transported by truck to and from the plant site. Cold fuel will be shipped from Columbia, S.C., a distance of 700 miles; solid wastes will probably be shipped to the burial site in Kentucky, a distance of 1,000 miles. Irradiated fuel will be transported by truck, rail, or barge to a reprocessing plant, but final plans have not been made yet. The AEC Staff assumes for the following discussions that the irradiated fuel will be shipped a distance of 700 miles to Barnwell, S.C.

1. <u>Transport of Cold Fuel</u>

The cold fuel will be shipped in Westinghouse Model RCC-1 fuel element shipping containers approved for use under DOT Special Permit #5450. Each container holds two fuel elements. About 10 truckloads of 6 or 7 containers each will be required each year to supply fuel for Units 3 and 4. The fuel for the first loading of Unit 3 has been received and is stored onsite.

2. <u>Transport of Irradiated Fuel</u>

Fuel elements removed from the reactor will have been irradiated to about 25,000 megawatt days per ton on the average; they will be unchanged in appearance and will contain some of the original U-235 (which is recoverable). As a result of the irradiation and fissioning of the uranium, the fuel elements will contain large amounts of fission products and some plutonium. As the radioactivity decays, it produces radiation and "decay heat." The amount of radioactivity remaining in the fuel varies according to the length of time after discharge from the reactor. After discharge from a reactor, the Turkey Point fuel elements are to be placed under water in a storage pool for cooling for at least 90 days prior to being loaded into a cask for transport.

Although the specific cask design has not been identified, the Applicant states that the irradiated fuel elements will be shipped in approved casks designed for transport by either truck, rail, or barge. The cask will weigh perhaps 30 tons for truck, or 100 tons for rail or barge. To transport the 25 tons of irradiated fuel removed from each reactor each year is estimated by the AEC Staff to require 15 truckload shipments or 6 rail car load shipments or 6 barge shipments per year per reactor. There would be an equal number of return shipments of the empty casks.

3. Transport of Solid Radioactive Wastes

The AEC Staff estimates the solid wastes generated by the two units will amount to about 2,000 cubic feet per year per reactor. The wastes will be shipped in 55-gallon drums or other packages approved for the transport of the activities involved. It is estimated that about 45 truckloads will be required to ship the solid wastes to the burial grounds each year from both reactors.

IV. ENVIRONMENTAL IMPACT OF SITE PREPARATION AND PLANT CONSTRUCTION

A. Summary of Plans and Schedules

Construction was initiated on the Turkey Point nuclear units in late April 1967. Work was 99 percent completed on Unit 3 and about 85 percent complete on Unit 4 in January 1972. Fuel loading now is scheduled for Unit 3 in July 1972, with Unit 4 to follow about 3 months later. Unit 3 is scheduled for commercial operation in the fall of 1972 and Unit 4 by the start of 1973.

Essentially all exterior work on the nuclear plants has been completed; however, the construction associated with the canal-channel recirculating cooling system is still to be done. This work is expected to be accomplished by the Applicant over the next three years.

The manpower peak for construction is estimated by the Applicant at about 1200 men and will be below 500 men by September 1972.

B. Impacts on Land, Water, and Human Resources

Many of the impacts on the environment at Turkey Point were attributable to the earlier construction of the fossil-fuel generating plants. A considerable amount of the fill and dredging work, including construction of three discharge canals, the turning basin, and barge canal, was associated with these plants.

Because of the advanced stage of construction of the nuclear units, most of the environmental impacts due to construction activities have already occurred -- with the exception of the reservoir cooling system. The Card Sound Canal and about one-half of the 100 acres of fill at the generating plant complex were the major construction impacts related to the two nuclear units.

Habitat destruction during construction has been localized to those sites actually required for access facilities and support platforms, and the remaining acreage has been left relatively undisturbed. Because of the unique nature of construction problems in Florida, most of the excavated material was used as fill elsewhere, so there are few, if any, real spoil banks. This is fortunate, since the limestone spoil banks, as opposed to muck banks, do not appear to have the same revegetative potential. An exception is the Card Sound Canal, which has continuous, high limestone spoil banks extending to the limit of dredging. This material has value in construction, but the Applicant feels the economics of hauling the rock to construction sites in the area do not appear to make sale of the material feasible.

The Applicant has presented plans for construction of an interconnecting series of cooling channels which will occupy about 7000 acres of the site [48]. The original site of about 3300 acres was expanded by purchase of about 23,000 acres additional area to the south. About 2500 acres of shore fringe areas has been deeded to the State of Florida [73]. The site area is now about 24,000 acres. Construction of this cooling system will constitute a major environmental impact, in that during dredging the indigenous plants and animals will be destroyed or displaced. Upon completion there will be a series of 200-foot wide channels containing heated saline water and separated by muck spoils banks 90 feet wide and about 8 feet high. Revegetation of these channels and banks is difficult to predict in terms of both the rate and plant succession. Furthermore, such predictions are complicated by generating plant operation variables and by a lack of information on the recovery of similar ecosystems that experienced like disruptions. A more detailed discussion on impact of the cooling reservoir system is presented in Section V.C.1.

Future dredging operations which are necessary for completing the Card Sound Canal will disturb about three acres of Sound bottom. This will result in the loss of benthic flora and fauna in that nearshore area.

About 40 percent of the construction force is from outside the local (including Miami) area; however, there is no indication of any significant impact on local hospitals, schools, businesses or housing facilities attributable to the influx of workers. Undoubtedly, the highly seasonal fluctuations in nonresident population to which the area has adapted compensated for what might otherwise have been a measurable impact.

C. Controls to Reduce or Limit Construction Impacts

The Applicant and contractors have attempted to limit the impact of construction activities. Construction practices include minimizing the disturbance of land through preplanning access and work routes; restricting personnel and vehicle access in undisturbed areas by posting, fencing, and locked gates; minimizing laydown areas; and removing and disposing construction debris. In addition, special precautions were taken during dredging operations to minimize turbidity; in the case of dredging the barge channel for the fossil fuel units, the removed sand was used for fill at the site and for beach replenishment and improvement in a mud-flat area. Sheet-piling and wing walls were used for erosion control during construction of the water intake for the nuclear units. Completion of the Card Sound Canal involved opening it into the Sound. This was undertaken as a "hole-through" operation to minimize the discharge of silt into the Sound.

When construction is completed, disturbed areas are to be leveled and stabilized with native vegetation, grass, concrete, or asphalt (as appropriate) to prevent erosion from heavy rains and to present an appearance that blends with the surrounding area.

V. ENVIRONMENTAL IMPACTS OF PLANT OPERATION

A. Land Use

Prior to installation of the fossil-fuel units, the area was a mangrove swampland. The land had little recreational use or potential because of inaccessibility. Construction of Units 1 and 2 altered an estimated 100 acreas of land at the plant site, including the on-shore dredging necessary for the barge turning basin and water intake area. An estimated 50 acres of natural land was altered for Nuclear Units 3 and 4 at the plant site, and a total of about 7,000 acres of natural swampland south of the plant will be altered in providing the channel cooling system, which will also serve the existing fossil fuel plants. Thus, the primary impact of the Turkey Point nuclear facility on land use is associated with the channel cooling system.

Development of the large salt-marsh area that extends southward from Turkey Point to the Everglades National Park has been slow because land more suitable for agriculture, industrial, commercial and residential purposes is available north and west of the area. Furthermore, in its present state any significant scale of land improvement would be quite expensive in comparison with development costs for adjacent areas. The General Land Use Master Plan for Dade County through 1985, a period of from one-third to one-half the expected life of the Turkey Point facilities, shows this area of roughly 50 square miles remaining as a salt marsh.

The extensive drainage-canal system now present in this part of the State is evidence of past land reclamation efforts. Conceivably, future land demands might warrant recovering much of the salt-marsh area. However, the need or desirability of reclaiming the salt marsh for some other use during the 30 to 40-year life of the power plant is not well established at this time.

The operation of the plant and cooling system will probably increase man's use of the area, since accessibility will be improved. The raised area between the channels may permit some agricultural, commercial, and residential development commensurate with nuclear safety consideration; however, the potential for such uses would be speculative at this time. Use of the site as a source of foundation rock is not precluded; however, there are abundant sources of similar rock throughout southern Florida.

The recreation potential of the site has already been increased over that of the area in its natural state, and the cooling water channel system may result in even more recreation opportunities.

A Boy Scout camp and a Girl Scout camp were established at the site by the Applicant, along with attendant nature and hiking trails. Also, some picnic and beach facilities were made available for controlled public use. Shoreline areas, which include the dominant red mangrove growth, are intended to be maintained in their natural state as a wildlife preserve. Additionally, the Applicant's site is the location of a University of Miami research facility and a sea survival school of the Air Force Tactical Command.

Since the transmission lines right-of-way was acquired, cleared (where necessary), and three of the four pole lines set in connection with the construction and operation of the fossil-fueled units, there has been essentially no environmental impact in this regard with respect to the nuclear units. The concrete double-poles are of a stylized design with a lesser visual impact than that associated with conventional lattice-steel structures. The Applicant permits use of the right-of-way for agricultural and similar purposes (except man-made structures) compatible with safety, maintenance, and reliability considerations. In the 6 years of operating experince with the existing transmission system, no problems have occurred with inductive coupling or direct fault interference with railroad signal or communication lines. The Applicant will provide the necessary filtering devices to preclude such occurrences with the new lines as required.

The Applicant, in cooperation with the Metropolitan Dade County Planning Department, is submitting a proposal to the Department of Housing and Urban Development for a demonstration grant related to the development of public recreation areas in the right- of-way.

B. Water Use

A description of the multichannel recirculating water system for heat dissipation and the operational characteristics with respect to climatic conditions was presented in Section III.D.1. Analysis of the impact of such a system on water uses is complex because of the transient nature of the plant load factor, the use of tidal power for flushing, variations in soil permeability, variable weather conditions, and the nature of the Biscayne Bay-Card Sound lagoon system. However, a number of conclusions regarding the impact on local hydrologic regimes were drawn from data supplied by the Applicant, studies performed by the University of Miami, and AEC Staff analyses.

Analytical methods referenced by the Applicant are standard techniques accepted by the technical community. Precise analysis is not achievable for a transient multivariable heat transfer problem involving climatology and many unpredictable variables. For example, there is no fully developed numerical model for simulation of boundary layer effects over a convoluted surface such as the proposed channel system. Further, if uncontrolled vegetative growth or incipient forestation occurs in the recirculating system, some of the assumptions made in the computations would be altered. For this plant, load factors and weather features could produce conditions such that the proposed system with 4000 acres of channel surface would be less than optimal. Load factors approaching 60 to 70 percent in combination with unfavorable climatic conditions (such as sustained hot dry spells) are likely to produce thermal effluent differences that exceed the 4°F limit. Thus, if the system is highly taxed by demands for power, it is likely that unfavorable conditions would become common.

Construction of the channel system would increase the salinity of some 15 square miles of what is now swampland to values equal to or greater than the salinity of the adjoining Sound and to a salinity that will be considerably higher than that of the ground water. A system of interceptor ditches is planned for the western property boundary to control intrusion of saline water into the area west of Levee 31. The permeabilities of the local soils are relatively high, and flows on the order of 600 to 800 cfs out of the system to the west can be expected. Pumps will be installed to drain the interceptor ditch system and thereby control the movement of the interface between the groundwater system under control of the Applicant and that under the control of the Central and Southern Drainage District System to the west. Data furnished by the Applicant with respect to groundwater movement to the west are relatively complete. All intercepted flows are to be returned to the channel system so that there is to be essentially no net loss from the system in this direction. Because of the dynamics of the system, surface water may at times be intercepted by the drainage and recharge system.

No provisions for control of groundwater flows to the east are planned at this time. Estimates of seepage losses in this direction range from 50 to as high as 200 cfs depending on the relative head of the channel-canal system and the water levels in Biscayne Bay and Card Sound. This head is estimated to be no more than 0.3 foot. Since the relatively deep return flow conduit of the Card Sound Canal taps the Miami oolite and the top of the Fort Thompson aquifer, it can be expected that interchange and flow from this system to the Bay will also occur. On the basis of available information and judgment, an approximate total subsurface flow of

150 cfs to the east is a reasonable design assumption, with an average travel time to the Bay or Sound of 15 to 30 days. Maintenance of low channel levels could reduce or reverse these flows.

Since the ground conveys water essentially without loss of heat, related groundwaters would become heated to some level represented by the mean channel-canal temperatures that existed 15 to 30 days earlier. For example, groundwaters seeping to Biscayne Bay in November when the Bay temperature is about 73°F could be about 89 to 94°F, depending on the plant load and operational conditions (see Table III-2). It is likely, therefore, that temperature and salinity increases will exist where the aquifer discharges into the Bay and Sound during most of the yearly cycle. The consent decree requires the Applicant to monitor groundwater south and east of the system and to report the results to the Environmental Protection Agency, which can order such remedial action as the Agency feels is needed.

Control of salinity of discharge water to a maximum increase of 10 percent over normal Sound background has been specified by court decree [43] to minimize salinity gradients on the western shore of Card Sound. AEC Staff studies indicate that the mean salinity in the channels might be about 5 percent over normal background and up to 10 percent during unfavorable conditions. A salinity increment of 5 percent is not buoyant within the 4°F temperature differential limit. Unless discharge from the adjacent Model Land Canal creates turbulent mixing in the outlet vicinity, the saline discharge will flow to the north and along the bottom of Card Sound in the direction of Cutter Bank. Since the high salinity gradient would preclude mixing except under windy conditions where general turbulence or flushing predominates, it is possible for an inventory of water of relatively high saline content and elevated temperatures of 2 - 3°F to accumulate on the bottom of Card Sound and to be spilled through the navigation dredging of the Intracoastal Waterway into either Biscayne Bay or Barnes Sound. As a matter of interest, water of 10 percent surcharge in salinity will sink where the thermal differential is as high as 14°F, well above the stipulated 4°F maximum. This situation could be mitigated by increasing the instantaneous purge rate and maintaining greater channel head differences to improve prompt mixing, but at the expense of high inlet and exit velocities, increased erosion and higher seepage rates. This situation poses a conflict with the consent decree, which requires discharge to Card Sound such that the warm water plume is on the surface.

Adequate hydraulic capacity exists for a number of operating options; however, in the main, the limitations in the consent decree [43] appear to have imposed operational problems, the magnitude of which can only be resolved by field testing or some undistorted physical modeling simulations. Some advantages appear attainable by combining the Card Sound and Model Land Canals into one. Using some of the drainage water from the Model Land Canal would both decrease the purge salinity and reduce the salinity in the recirculation system.

The Applicant has reached agreement with the Central and Southern Florida Flood Control District to add surface drainage from Canals C-106 and C-107 into the channel system, which will assist, to as yet an unknown degree, in controlling temperature and salinity in the system. Negotiations are in progress to similarly add the C-103 canal effluent to the system.

At a discharge flow of 1,200 cfs and a differential of 4°F, the thermally elevated area in Card Sound as computed by AEC Staff will be as shown in Table V-1.

TABLE V-1

AREAS OF ELEVATED TEMPERATURE IN CARD SOUND

Temperature of Isotherm °F	Area Within Isotherm (acres)
3	5
2	53
1	606

A review of available information indicates that the highest electrical loads planned for the Applicant's Turkey Point facilities may occur in the the months of January and February. A lower peak may occur in the early summer. The size of the channel system selected (4000 acres water surface area) and the consent decree stipulations appear to place a limit on the operational capability of the plant. The following table presents AEC staff predictions of capacity limitation that may result from temperature requirements of the consent decree in combination with the selected size of the multi-channel system.

TABLE V-2

PREDICTED MEAN PLANT CAPACITY UNDER RESTRICTIONS OF THE CONSENT DECREE

Month	Percent of Total Capacity
January	85
February	75
March	85
April	90
May	65
June	65
July	75
August	80
September	90
October	90
November	90
December	90

Studies by the Applicant reveal a similar capacity reduction problem under their design assumptions [59]. Table V-3 shows the Applicant's estimates of the probabilities that the consent decree conditions could not be met in months with average weather conditions if all four of the Turkey Point plants were operated at full capacity.

TABLE V-3

ESTIMATED PERCENT OF TIME THAT THE TEMPERATURE OF THE DISCHARGE FROM THE CANAL COOLING SYSTEM WILL EXCEED THE VALUES SHOWN IF ALL FOUR PLANTS ARE OPERATED AT FULL CAPACITY

Month	4°F ΔT	90°F Maximum	Combined %
January	78	-	78
February	64	-	64
March	20	-	20
April	12	6	13
May	10	-	10
June	43	29	55
July	35	30	46
August	25	40	40
September	15	15	22
October	17	-	17
November	45	-	45
December	77	-	77

The situation suggests the need for continuing research and field studies by the Applicant and regulatory agencies to permit optimal use of the plant while minimizing potential stresses on the adjacent ecological system.

Special Conditions During Interim Construction Period

During 1972, if construction of the planned cooling system facilities progresses as scheduled, a period of transitional operation will be started. The various phases planned by the Applicant in accord with the consent decree are as follows:

- Discharge to Biscayne Bay 3000 cfs; 95°F maximum . . . Sept. 1971 through Jan. 1972
- Discharge to Card Sound 2750 cfs maximum, Biscayne Bay 1500 cfs maximum; 95°F maximum . . . Feb. 1972 through Sept. 1973
- Discharge to Card Sound 2150 cfs maximum, Biscayne Bay 2100 cfs maximum; 95°F maximum . . . Oct. 1973 through Dec. 1974
- Discharge to Card Sound 1200 cfs maximum; 90°F maximum; 4°F maximum above ambient . . . Dec. 1974 onward

The phasing of the various release modes is determined by progress on the construction of the canal- channel cooling system. As cooling surface in the channel system is increased, lesser amounts of direct discharge will be made to Biscayne Bay.

It may be that rather severe load restrictions on the Turkey Point plants will be imposed during various periods of interim operation to meet the specifications in the court decree. The consent decree requires prior to completion of the cooling channel system that Florida Power and Light shall draw upon all other sources of power available to it in such combinations as to minimize discharges of heated water water from the Turkey Point site, consistent with its obligations to provide power to the areas it serves. The Applicant has agreed to meet such constraints [51].

On the basis of plant operation (all four units) at a 50 percent average load factor, the AEC Staff estimates that a jet type discharge to Biscayne Bay would result in heated areas as shown in

Table V-4. Inasmuch as part of the water is to be directed to Card Sound, the area associated with an indicated ΔT would be apportioned between the two receiving bodies of water. Because the tide will sweep the warm plume back and forth (north to south), the areas of the bottom exposed to a ΔT of 3°F or more will essentially be twice as large as shown in Table V-4. On the other hand, the bottom organisms in these zones will be exposed to the elevated temperature only half of the time. At lower or higher load factors, the sizes of the affected areas would be proportionately smaller or larger.

TABLE V-4

TEMPERATURE ELEVATION AT 50 PERCENT
LOAD FACTOR AND 4250 cfs EFFLUENT DISCHARGE

°FΔT	Acres
8	96
6	293
4	730
3	1100
2	1650
1	2250

The areas in Biscayne Bay affected by the plume of heated water discharged from the fossil-fuel units have been described in maps showing isotherms which were submitted in the Reference Reports appended to the Environmental Report Supplement[48]. There were 22 surveys made during the period of January through October 1971. Two of these surveys are shown in Figures V-1 and V-2 for the contrasting conditions during different seasons on January 26, 1971, and July 19, 1971.

C. Biological Impact

1. Terrestrial

The major impact of plant operation on the terrestrial environment is associated with the channel cooling water system and the degree and rate that the area will return to its natural state. If native vegetation or selected exotic species can be established under the conditions of substrate, salinity, and microclimatic thermal amendments which occur during plant operations, the flora may recover. However, there are no quantitative data from studies of plant succession on muck spoil banks which would assist in predicting the ultimate fate of the plant composition of the banks.

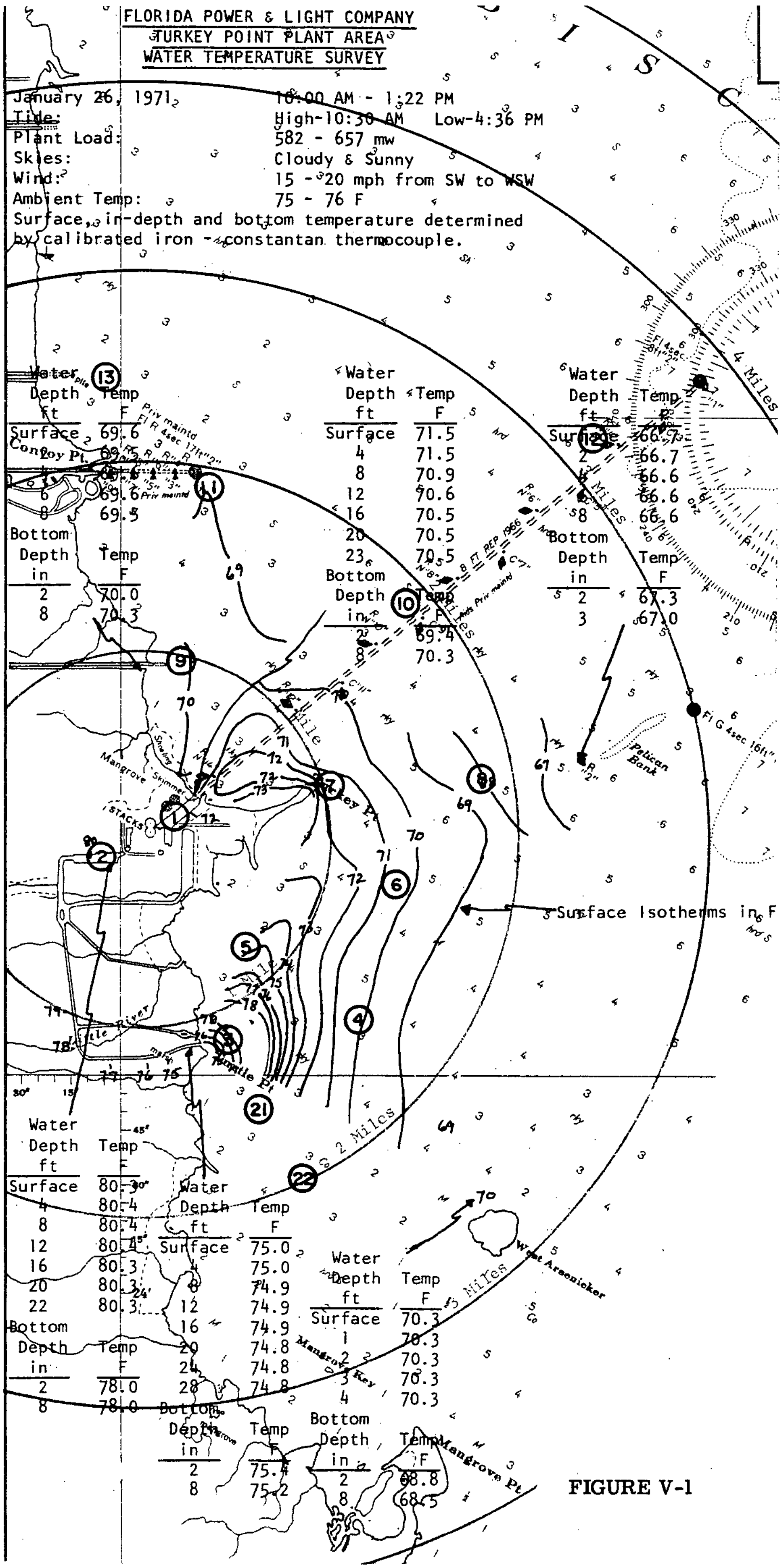
FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT AREA
WATER TEMPERATURE SURVEY
January 26, 1971
10:00 AM - 1:22 PM
Tide:
High-10:30 AM Low-4:36 PM
Plant Load:
582 - 657 mw
Skies:
Cloudy & Sunny
Wind:
15 - 20 mph from SW to WSW
Ambient Temp:
75 - 76 F
Surface, in-depth and bottom temperature determined by calibrated iron - constantan thermocouple.
Water Depth ft
Temp F
Surface 69.6
69.5
69.6
69.5
Bottom Depth in
Temp F
2 70.0
8 70.3
Water Depth ft
Temp F
Surface 71.5
4 71.5
8 70.9
12 70.6
16 70.5
20 70.5
23 70.5
Bottom Depth in
Temp F
2 69.4
8 70.3
Water Depth ft
Temp F
Surface 66.7
2 66.7
4 66.6
6 66.6
8 66.6
Bottom Depth in
Temp F
2 67.3
3 67.0
Surface Isotherms in F
4 Miles
3 Miles
2 Miles
1 Mile
Water Depth ft
Temp F
Surface 80.3
4 80.4
8 80.4
12 80.4
16 80.3
20 80.3
22 80.3
Bottom Depth in
Temp F
2 78.0
8 78.0
Water Depth ft
Temp F
Surface 75.0
4 75.0
8 74.9
12 74.9
16 74.9
20 74.8
24 74.8
28 74.8
Bottom Depth in
Temp F
2 75.4
8 75.2
Water Depth ft
Temp F
Surface 70.3
1 70.3
2 70.3
3 70.3
4 70.3
Bottom Depth in
Temp F
2 68.8
8 68.5
Pelican Bank
West Arsenicker
Mangrove Key
Mangrove Pt
Turkey Pt
Convoy Pt
Mangrove
Skimmer
STACKS
Little River

FIGURE V-1

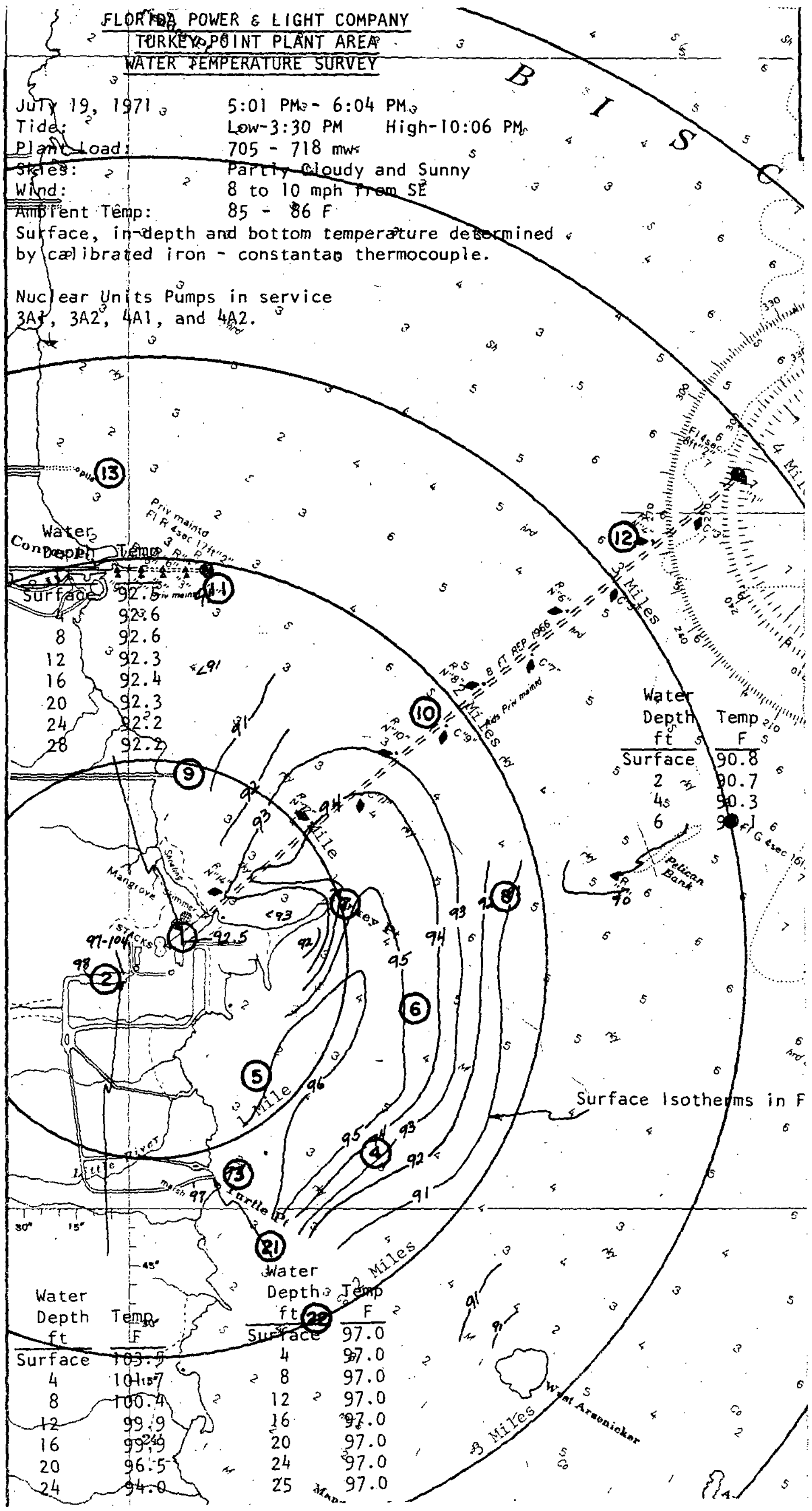
FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT AREA
WATER TEMPERATURE SURVEY
July 19, 1971 5:01 PM - 6:04 PM
Tide: Low-3:30 PM High-10:06 PM
Plant Load: 705 - 718 mw
Skies: Partly Cloudy and Sunny
Wind: 8 to 10 mph from SE
Ambient Temp: 85 - 86 F
Surface, in-depth and bottom temperature determined by calibrated iron - constantan thermocouple.
Nuclear Units Pumps in service 3A1, 3A2, 4A1, and 4A2.
Water Depth Temp
Surface 92.5
4 92.6
8 92.6
12 92.3
16 92.4
20 92.3
24 92.2
28 92.2
Water Depth ft Temp F
Surface 90.8
2 90.7
4 90.3
6 90.1
Surface Isotherms in F
Water Depth ft Temp F
Surface 103.5
4 101.7
8 100.4
12 99.9
16 99.9
20 96.5
24 94.0
Water Depth ft Temp F
Surface 97.0
4 97.0
8 97.0
12 97.0
16 97.0
20 97.0
24 97.0
25 97.0
1 Mile
2 Miles
3 Miles
4 Miles
Pelican Bank
Turtle Pt
Little River
STACKS
Mangrove Swamp
West Arsenicker
B I S C

FIGURE V-2

The Applicant has made a cursory examination of two low spoil banks near the Grand Canal which are about 7 years old. The soil, which is a sodic mixture of sand and clay with a large amount of organic matter, appears to be well packed and impermeable in appearance, although it is quite easy to dig. A test of the soil revealed that the chloride concentration in one sample was 5,000 ppm/per unit dry weight, which was higher than the concentration in a sample of soil taken from under the water. The increased salt concentration in the soil is thought to be due to a "wicking" effect possibly caused by the porosity of the soil.

The Applicant reports that the vegetation is sparse on the banks and is composed mainly of halophytic forms, including salt myrtle, dog mangrove, buttonwood, sea grape, coconut palm, saltwort, and glasswort. Most of the vegetation present is along the edges of the bank with very little growth in the center portion. Large numbers of dead salt myrtle were found on the banks. Apparently the soil salinity had exceeded the tolerance level of this species. Tall Australian pines appear to be healthy, but the smaller ones seem to be experiencing some unknown stress. The fauna of the spoil banks is sparse, being limited to a large number of land crabs, fiddler crabs, and carpenter ants.

The prognosis for revegetation of the proposed 8-foot high canal spoil banks does not look promising. Without plant revegetation the area would have to be considered virtually a write-off as regards animal habitat.

It is the opinion of consultants to the Applicant that sacrifice of approximately 7,000 acres of black rush high marsh will have little adverse effect on the bay-sound system because:

1. Studies in Everglades National Park have shown that Juncus (black rush) marshes, although biologically productive, are of minor importance as contributors of detrital material to estuarine systems unless they are effectively flushed. The marshes flourish in areas near the +1 foot contour where tidal flushing is poor unless high tides coincide with seasonally high fresh water levels.

2. Sheet flow of fresh water, which in many similar coastal areas provides significant transport of detrital material to adjacent bay systems, is now virtually absent from the area under consideration. A levee and old impoundment areas greatly impede fresh water flow (reference FPS affidavit 29 February 1972, included in FPL letter of March 10, 1972 in Appendix E).

If the mangrove can be established along the banks it should provide some of the niches destroyed during construction. The mangrove, if healthy, will begin to trap sediment, build soil, and retard water movement through the channels. This may require chronic dredging of the channels to maintain flow capacity. Such dredging would disturb the orderly plant succession.

The open water of the channels may be attractive to some species of birds if food normally associated with such bodies of water is present. However, the steep banks and depth of the water will no doubt preclude the wading birds which used the area prior to dredging. The Applicant feels that there will be an increase in gulls, terns, and red-breasted mergansers, with the possible elimination of herons, egrets and ibis.

There is no information which suggests that the flora and fauna of the site are any more or less sensitive to exposure to either external or internal radiation emitters, chemical discharges or thermal amendments proposed for the plant.

2. Aquatic

The principal factors that require evaluation with respect to marine life are associated with:

- The effects of the water intake structure during interim operation, when Biscayne Bay water is used, and under later operating conditions when a common intake-outfall structure is used at Card Sound.

- The effects of entraining very small fish and plankton in the cooling water and subjecting these organisms to passage through the condensers and to conditions in the cooling water system under both interim and final operating modes.

- The effects of discharges to Biscayne Bay and Card Sound under present, interim and final operating conditions.
- The risk of damage to marine organisms attributable to the release of radioactive materials and stable chemicals.

Ecological studies on the Turkey Point Power Plant site were started in 1966. Many of the reports resulting from these investigations are contained in Volumes 1, 2, and 3 of the Reference Reports Section of the Applicant's Supplement to the Environmental Report [48]. Although the majority of studies have been concerned with the effects of the effluent from the fossil-fuel plants (Units 1 and 2) that is discharged from Grand Canal to Biscayne Bay, the results do have application to the proposed cooling system and, to some degree, supplement the baseline data now being collected for the Card Sound area.

a. Water Intake and Outfall Structures

During the interim operation period, cooling water for the plant enters from Biscayne Bay through the Intake-Barge Canal (see Figure III-1). This main canal is approximately 300 feet wide and 22 feet deep and the intake channel for Units 3 and 4 extends from it. The average velocity in the intake channel for Units 3 and 4 is expected to be about 0.8 fps, and the water velocity across the intake structure is expected to be 2.4 fps. Inside the structure the water passes through trash racks and then through 3/8-inch mesh traveling screens. The intake structure may pose a hazard to fish and large invertebrates that swim with the current and pass into the structure. Fish escape slots have not been provided and once inside the fish may not be able to swim back into the canal. Should fish enter the structure there is a high probability that some of them may be impinged on the screens because at velocities greater than 1 fps there is a sharp drop in the ability of juveniles to swim against the current [60]. Fish that become impinged on the traveling intake screens probably will be killed by the force of the intake water or the high velocity jets used to clean the screens.

Detailed design information on the planned Card Sound intake and outfall structures is not available at this time. However, with the low flow and limitations on maximum temperature for the water, the intake- discharge canal may provide an attractive habitat for fish under normal operations. Sudden changes in temperature, flow, and possibly salinity under emergency conditions may impose stress upon the fish living in the canals or near the canal outfall resulting in some mortality. This is most apt to occur during the summer months.

b. Entrainment of Organisms

The potential impact on the ecosystem of Biscayne Bay and Card Sound of passing plankton through the condensers and cooling system is dependent upon i) the kinds and quantities of plankters involved in relation to the stocks available in the ecosystem as a whole, ii) the extent to which the entrained organisms are killed or injured while they are in the plant system, and iii) the effects of the destroyed plankton on the productivity of desired species in Biscayne Bay and Card Sound.

Until the multi-channel cooling system is completed near the end of 1974, cooling water will be withdrawn from Biscayne Bay at rates of as much as 4250 cfs. This is of the same order of magnitude as the estimated net flows of water from the open ocean into and out of the Biscayne Bay-Card Sound-Barnes Sound system. Of perhaps greater relevance to the standing crop of plankton in Biscayne Bay is that more than a month will be required for the equivalent of all of the water in the Bay (1.5×10^{10} cubic feet) to circulate through the four units of the plant.

The nutrient supply to Biscayne Bay is limited, and Dr. James Lackey, a consultant to the Applicant, points out that the density of plankton in the Bay is relatively low [48]. The quantity of plankton increases during a fall bloom; this is followed by a winter-spring plateau, and then a decrease in the summer time. The zooplankton component include significant numbers of copepods and other small crustaceans, and also the larval forms of crabs, shrimp, and molluscs.

In order to determine the effects of entrainment on zooplankton, tests have been carried out both in the field (using the cooling water system of the existing fossil-fueled units at Turkey Point) and under laboratory conditions. Direct assessment studies were carried out by the University of Miami between March 1970 and January 1971. During this period the fossil unit discharge was

1250 cfs with temperatures in excess of 97°F [27]. Comparisons of the concentrations of organisms (number of individual specimens per cubic meter of water) in the effluent as it left the plant and at the end of the canal near its terminal in Biscayne Bay did not show a consistent pattern for effects on the zooplankton. For some species there was a pronounced reduction in numbers, some other species showed no change, and in the case of crab larvae there was an anomalous increase -- possibly because of additions from crabs present in the mangroves fringing the canal.

The National Marine Water Quality Laboratory of EPA studied the effects of entrainment in July and August of 1970. Although a paucity of phytoplankton prevented assessment of potential damage associated with passage through the condensers, some quantitative data on the amount of chlorophyll a present at the upper and lower ends of the effluent canal indicated that phytoplankton cells had been damaged [22].

If the concentration of adenosine triphosphate (ATP) in canal water is used as an index, there is evidence that conditions were more favorable to planktonic species if the Δt across the condensers was less than about 13°F.

In August 1971, studies were made by EPA [26] when effluent from the fossil-fueled plants in the discharge canal to Biscayne Bay was diluted with an equal amount of Bay water supplied by pumps for nuclear Unit 3. The flow was increased from 1250 cfs to 2650 cfs and temperatures in the canal were reduced to 94°F-95°F. Salinities were about 34% lower than most of those measured during the 1970 survey, which may have reduced the over-all stress. The data were similar to the 1970 results except that mortalities were slightly lower. Although the temperature increases were less than one-half those in 1970, the zooplankton mortalities were only 10 to 20 percent less at comparable stations.

When considering all these data it is important to recognize that, although mortality is expressed in terms of temperature, additional stress factors such as chlorination and mechanical damage could also be the causative agents alone or in concert. Some evidence that other factors may apply can be presumed from the EPA 1971 studies where dilution water flow was increased and, hence, the potential for mechnical damage increased. If temperature was the sole factor, one might have expected that the plankton mortality would have been reduced by 50 percent. Additionally, the exposure time in the canal was also reduced by 50 percent.

Dr. James Lackey reports in an affidavit [51] that his studies have produced no evidence that the effects of the plant are detectable on the phytoplankton or zooplankton of the Bay. However, only limited technical data have been presented to support this contention.

Laboratory studies have also been carried out in which zooplankton that are prevalent in the Bay (e.g., the copepods _Acartia tonsa_ and _Oithona nana_) were subjected to temperatures simulating those that might exist in the effluent system [27]. Nearly all of the test organisms were killed at temperatures approximating 99°F. There was a shift in tolerance with the season, however. When the acclimation temperature (simulating ambient temperature in the Bay) was low, the organisms could withstand a greater Δt, but not a maximum as high as 99°F.

The available data suggest that considerable damage to entrained plankton can occur when temperatures are maintained above 95°F in the canal system. Studies have been carried out by Reeve and Cosper (1971) [78] on the species composition and biomass of zooplankton seasonally in South Biscayne Bay and Card Sound. In an attempt to use this survey to determine the possible effects of the thermal effluent of South Biscayne Bay, the average number of organisms at the outfall of the fossil fuel plants was compared with those at the end of the Grand Canal over 16 summer dates in 1969. In some cases (copepod _nauplii_, _Metis_, _Oithona_, gastopod and polychaeta larvae), there was some evidence of reduced numbers at the end of the canal.

However, in the Bay proper the inherent natural variability of the physical parameters, particularly salinity and temperature, the patchiness of plankton, year-to-year variation, and rapid life cycles of tropical environments all reduce the likelihood of detecting small and subtle changes in plankton populations.

EPA studies in 1971 [26] on zooplankton in and outside the canal system indicated some high mortalities.

Samples collected 500 yards east of the Grand Canal outlet indicated that dead organisms were collected in the plume. It is not clear from the data however, whether the mortalities were caused in the canal and the organisms carried out in the rapidly moving plume or whether as EPA suggests they were entrained into the plume from the surrounding bay water. Samples taken at 1000 and 1500 yards east of the Grand Canal outlet and 2000 yards east of Turkey Point showed lesser mortality.

Based upon the available data of EPA and the University of Miami, some damage to plankton organisms will occur due to entrainment in the interim modes. However, both of these research studies failed to recognize that the impact can only be defined in terms of significant reduction or increase in plankton in the receiving waters. Both have failed to demonstrate this. Under present operating conditions, the data of the Applicant's consultant, Dr. Lackey [24], and Reeve [23], indicate no evidence of detrimental effects of the phytoplankton and zooplankton populations of the South Biscayne Bay.

The AEC staff has, therefore, concluded that use of Biscayne Bay, during the interim period while the multichannel system is under construction and when discharge temperature will be limted to 95°F, is not expected to have a significant effect on the productivity of plankton in South Biscayne Bay.

When the multi-channel recirculating system is completed (late in 1974), the use of cooling water from Biscayne Bay will stop and the entrainment of organisms from the Bay will also stop. In its place will be the withdrawal of water from Card Sound to replace evaporation loss and seepage and for purging the system. The quantity of water taken into the Card Sound Canal each day for these purposes may approximate 2500 acre-feet (about 1200 cfs), which would amount to about 2% of the volume of Card Sound.

A major part of the plankton that enters the multi-channel cooling system from Card Sound will probably be killed by long retention at elevated temperatures and salinities. However, the nutrient and organic material represented by the plankton will not be lost. The AEC Staff does not expect the overall effect from these losses on the Card Sound system to be discernible.

c. Discharges to Biscayne Bay and Card Sound

A committee report sponsored by the Hoover Foundation [11] made the following recommendations with respect to the overall operation of the Turkey Point Plant:

- The maximum temperature of the outfall should not exceed 90°F;

- Since the colder months are critical for spawning for most animals, reduced temperatures should be maintained for October through June; and

- Since temperature and salinity are closely interrelated, salinities at the discharge point should not exceed 40 ppt.

On the other hand, a 1970 report on Thermal Pollution of Intrastate Waters of Biscayne Bay, Florida [17] recommends abatement to the levels recommended for estuarine waters by the Technical Advisory Committee to the Secretary of the Interior. The recommended limits are that maximum daily temperatures should not be raised more than 4°F during the fall, winter, and spring (September through May) or more than 1.5°F during the summer (June through August).

Studies conducted by the University of Miami under operating conditions for Units 1 and 2 existing before 1971 resulted in finding a strong relationship between temperature elevation and the distribution and abundance of grasses and macroalgae [27]. The normal Thalassia (turtle grass) community was virtually absent in the areas where the temperature was 9°F above ambient, and blue- green algae supplanted the normal Thalassia algae community. Since the grass and macroalgae community provide shelter and habitat for invertebrates and young fish, many of these species were absent also. Some erosion of the area had resulted from the loss of stabilization and accumulation previously maintained by the extensive root system of the grass and rhizoids of the algae.

Vegetation in the 7°F Δt zone consisted of a very sparce Thalassia community with a small number of associated species, especially when the temperature was elevated above 90°F in the spring. Growth and vigor of the plants in this area appeared to decline in the months when temperatures exceeded 90° to 92°F.

Ecological damage under the original and initial interim mode of operation has been expressed, in acres of bottom affected by the discharges, by EPA, University of Miami and the Applicant. No studies have been carried out by the applicant nor Federal Agencies to assess the significance of the effect upon the total ecosystem, and the cost per acre of Thallassia and associated flora and fauna has not been established. However, there is a history of recovery when ambient temperatures are lower in winter. This would indicate that damage need not be considered permanent. Studies on rehabilitation of damaged areas have not been attempted.

While other factors, for example velocity of the discharge stream, may have contributed to the damage, laboratory studies on thermal tolerance of the macroalgae supported the field observation.

Analysis of data collected by the University of Miami (in a study supported by the EPA) shows that at a temperature of 5° to 7°F above ambient low catches of organisms are obtained. At a temperature 4° to 5°F above ambient (when this exceeds 91°F in summer) low catches are made, but recovery exists in winter and the annual production is equal to or higher than in control areas. Further analysis of trawl data collected July 1968 to June 1970 related the catch per tow of each species to temperature over the range 57°F to 102°F.

Half of the kinds of fish present were caught in greatest abundance at a temperature of about 79°F, and on such a basis this may be considered the optimum temperature. Half of the species were no longer caught when the temperature dropped to about 66°F or increased to about 90°F. Three-fourths of the species were no longer caught in temperatures of about 100°F. Information by major taxa -- Fish, Mollusca, Crustacea, Porifera, Coelenteratea, and Echinoderms -- is being developed.

The species temperature data, together with an analysis of seasonal abundance, indicate that maximum summer temperatures in excess of 91°F reduce the productivity of the ecosystem. Temperature elevations of 5° to 7°F cause decreases in animal populations which are not reversible in the winter. Elevations of 4° - 5°F decrease populations in the summer months but result in increased numbers in the winter. It is not clear from these studies that reductions in populations are directly related to temperature, rather than to the effect of temperature on the primary producers which may cause a lack of habitat and food. Additionally, one may presume that mobile organisms, such as fish, have a behavioral response to elevated temperatures and can avoid them.

The area of damage at the mouth of the Grand Canal in 1970 was about 300 to 400 acres at its greatest, with recovery of part of this when ambient temperatures were low.

Observations of Biscayne Bay and Card Sound by the University of Miami staff continued through 1971 on the effects of increasing the dilution by 100%. Although exit temperatures have been lowered, flow velocities in the affected area have increased considerably. Because of bottom erosion, recovery may be slow. The Applicant states that no major changes occurred in 1971.

During interim operation of the proposed multi-channel cooling system, when both the Grand Canal and the Card Sound Canal will be used, discharges will be limited to 95°F. Under conditions when 2,750 cfs is discharged to Card Sound and 1,500 cfs to Biscayne Bay, the areas subjected to 4°FΔt will be approximately 1,000 acres and 500 acres, respectively (Table V-4). When the mode of discharge is changed to 2,150 cfs to Card Sound and 2,100 cfs to Biscayne Bay, the areas subjected to 4°F Δt will be about 750 acres in each region. In these cases the total affected area will exceed the present damaged area by a factor of about 5.

It is expected that the effects will parallel those that have been determined at the exit of the Grand Canal. However, one aspect that has not been clearly resolved from the on-going studies is the effect of elevated temperatures for relatively short periods of time. Much of the observed effect has been related to mean temperatures, rather than as a response to higher temperatures over short periods of time. However, the impacts have included the results of extremely high temperatures during the summer. The Applicant has asserted that operation under the court decreed tempreature limits will not yield greater effects than observed for the previous operations.

Although limitations of 95°F and 90°F during the interim and final operation of the cooling water system have been imposed by the September 1971 court decree, the Applicant is allowed under defined emergency conditions to exceed these values without further restriction on temperature or flow being defined. The effects of such discharges, even under defined emergency conditions, may result in damage to the ecosystem as great as that from a continuous discharge at a lower temperature over a long period of time.

For the final mode of operation, discharges to Card Sound are to be restricted to 1200 cfs, a maximum temperature of 90°F, and a maximum Δt of 4°F. The area of the bottom of Card Sound that will be subjected to a Δt of 3°F or more is estimated at about 10 acres -- twice the surface area shown in Table V-1. From the data derived in Biscayne Bay this thermal increment per se may have a slight effect upon the kinds and abundance of organisms that make up the populations in a limited area. However, since the discharge will on the average be of a higher salinity than Card Sound, it will tend to sink, and consequently the benthic biota will probably be exposed to relatively unmixed effluent. If these effluent streams persist, some changes in the kinds and abundance of organisms present in a larger part of Card Sound may be anticipated. It may also be anticipated that, on occasions, stratification will be produced which does not presently occur in Card Sound.

Studies are reported by Nugent [20] of the University of Miami on the effects of thermal effluents on some of the macrofauna of a subtropical estuary. He concludes that, whereas the thermal effluent contributed to the death of some organisms during periods of high ambient temperature, it protected others from cold kills in winter. The increased availability of fish in the main effluent canal in the winter was offset by the absence of fish there in the summer months. The settling and growth of barnacles was increased in winter and decreased in summer. Of greatest significance was the lower apparent abundance of the fishes, particularly the larger ones, within the heat-influenced area over the entire year. Nugent states,

> "It is concluded that the Turkey Point power plant, as it is presently operated, is detrimental to many of the economically valuable animals of the waterways of the mangrove area through which the heated discharge water flows. The evidence seems clear that the artificially heated water is directly or indirectly the cause of the results obtained in this study: the observed effects are due to the added heat, and perhaps also to the heat acting with other factors, such as lower dissolved oxygen content, and trace metals in the discharge water."

Nugent [20] studied the annual variations in salinity, dissolved oxygen concentration, and inorganic phosphate at stations within the canal discharge system (August 1968 through January 1970). The salinities throughout the study area were essentially the same at all stations on any given sample date. Seasonal fluctuations occurred as a result of freshwater run-off during peak rainfall in the spring and fall. The seasonal cycles in the dissolved oxygen content of the watere were primarily related to rainfall and run-off from the land.

Highest oxygen values were recorded from October through March when levels averaged 5 ml/l or more. Oxygen content was lowest during July when measurements averaged about 3.70 ml/l. (Saturation was about 84%). This was the only month when mean saturation values fell below 100 percent. Concentrations returned to about 5 ml/l in August. In November mean concentrations rose steadily to an annual peak of 5.90 ml/l (115 percent saturation). The power plant decreased the dissolved oxygen content of the cooling water an average of about 0.4 ml/l during passage through the condensers. At the same time saturation levels were increased usually to supersaturated conditions. An additional drop of about 0.6 ml/l of dissolved oxygen occurred as the discharge water passed down the effluent canal.

The results of these analyses indicated that the interim operation of the plant should not directly influence the levels of dissolved oxygen and inorganic phosphates in the waters around Turkey Point.

Some studies of the University of Miami[27] are concerned with the mechanisms of degradation of mangrove leaves, and the contribution these have on the food chain. Fifty-six different genera of fungi have been identified from the degrading leaves, and preferential and sequential infestations have been noted. Temperature tolerance studies suggest an inhibitory effect on the degradation process at 99°F.

d. Chemical Releases

Chemicals such as sodium, calcium, magnesium and boron will be released to the cooling water system. It is not anticipated that these will have a detrimental effect upon the biota in the receiving waters during the interim operation. Chlorine will be injected into the condenser cooling water for an hour daily to control fouling, and, if the residual levels at the plant outlet are as high as 1 ppm, there will be a substantial risk to organisms in the canal. However, residual chlorine levels of 0.2 ppm in other power plant effluents have caused no apparent effects on marine biota. The Applicant reports that there is some evidence for increases in copper and iron concentrations in the effluent; however, only very limited data are available on levels in the biota of the channel or in Biscayne Bay.

e. Radiological Impact on Biota

Terrestrial organisms in the environs of the plant would receive approximately the same radiation doses as those calculated for man. Marine organisms will receive higher doses because of their ability to concentrate radionuclides out of the water in which they live. These bioaccumulation factors are listed in Table V-5 [61]. The highest doses would be received by marine organisms living directly in the cooling water outfall during the recirculating mode of operation. Algae entrained in the condenser cooling water would receive a dose rate of about 0.6 rem/year. Crustacea and molluscs living on the sediments would receive about 4.0 rem/year, almost entirely from exposure to radionuclides deposited in the bottom sediments. A fish living in the cooling water canals close to the effluent water discharge point would receive a dose of 0.04 rem/year, mainly from radionuclides.

Annual doses on the order of those predicted for aquatic organisms living in the recirculation canals of the Turkey Point Station (4.0 rem/year) are well below the chronic dose levels that might produce demonstrable radiation damage to aquatic biota [62]. The field and laboratory studies concerned with relevant dose versus effect relationships are summarized in Chapter 9 of Radioactivity in the Marine Environment [63]. The irradiation of salmon eggs at a rate of 0.5 rem/day did not affect the number of adult fish returning from the ocean or their ability to spawn [64].

Blue crabs irradiated at the rate of 3.2 or 7.3 rads/hour for over 70 days survived as well as the controls [65]. Stocks of plaice living in the vicinity of the outfall of the British nuclear facility at Windscale on the Irish Sea have received chronic radiation at the rate of about 10 rem/year without a discernible adverse effect [68].

Chironomid larvae (blood worms) living in the bottom sediments near the Oak Ridge plant that have received irradiation at the rate of about 230 to 240 rem/year for more than 130 generations have a greater than normal number of chromosome aberrations but their abundance has not diminished [67]. The number of salmon spawning in the vicinity of the Hanford reactors on the Columbia River has not been adversely affected by dose rates in the range of 0.1-0.2 rem/week [68].

TABLE V-5

BIOACCUMULATION FACTORS FOR RADIONUCLIDES IN MARINE SPECIES [61]

Radionuclide	Fish	Crustacea	Molluscs	Algae
^{3}H	1	1	1	1
^{51}Cr	100	1,000	1,000	1,000
^{54}Mn, ^{56}Mn	3,000	10,000	50,000	10,000
^{55}Fe, ^{59}Fe	1,000	4,000	20,000	6,000
^{58}Co, ^{60}Co	100	10,000	300	100
^{86}Rb	30	50	10	10
^{89}Sr, ^{90}Sr	1	1	1	20
^{90}Y, ^{91}Y	30	100	100	300
^{95}Zr	30	100	100	1,000
^{95}Nb	100	200	200	100
^{99}Mo	10	100	100	100
$^{103}Ru\text{-}Rh$, $^{106}Ru\text{-}Rh$	3	100	100	1,000
^{105}Rh	10	100	100	100
^{125}Sn	3	3	3	10
^{127}Sb	1,000	1,000	1,000	10,000
^{125m}Te, ^{127m}Te, ^{127}Te, ^{129m}Te, ^{129}Te, ^{131m}Te, ^{131}Te, ^{132}Te	10	10	100	1,000
^{131}I	20	100	100	10,000
^{134}Cs, ^{136}Cs, ^{137}Cs	30	50	10	10
^{140}Ba	3	3	3	100
^{140}La	30	100	100	300
^{141}Ce, ^{143}Ce, $^{144}Ce\text{-}Pr$	30	100	100	300
^{143}Pr	100	1,000	1,000	1,000
^{147}Nd	100	1,000	1,000	1,000
^{147}Pm, ^{149}Pm	100	1,000	1,000	1,000

Inasmuch as the planned release of radionuclides from the Turkey Point Plant will be several orders of magnitude less than has occurred in the past at several major nuclear facilities[69] where studies have detected no adverse effects on the aquatic population, and because the estimated dose rates to aquatic biota will be several orders of magnitude less than those expected to cause radiation damage, the biota living near the Turkey Point plant's outfall are not expected to be adversely affected by the concentrations of radionuclides added by the plant.

D. Radiological Impact On Man of Routine Operation

During routine operation of the two reactors at full power, small quantities of radioactive materials will be released to the environment. The AEC licensing and inspection program is conducted to audit plant performance, to determine that radioactivity releases and doses are low as practicable, in accordance with 10 CFR Part 50, and well within 10 CFR Part 20 limits. Estimates of radioactive materials to be released from Turkey Point plant are included in Section III.D.2. of this statement. Those estimates are based on a detailed independent evaluation by the AEC Staff of the Turkey Point plant, equipment and proposed operating procedures, and on the Staff's experience with similar operating plants.

The Staff has made calculations of radiation doses, using the estimates of release rates of radionuclides to the environs and using stated assumptions relative to dilution, biological reconcentration in food chains and "use factors" by people.

1. Radioactive Materials Released in Liquid Effluent

The liquid effluents from the Turkey Point plant will empty into the salt waters of Biscayne Bay and Card Sound during the interim operation. The nearest well is 3-1/2 miles west of the facility. Groundwater flows are from west to east, so a radiological impact on any drinking water supply is not considered plausible. However, seafood caught in the vicinity of the station may be consumed in substantial amounts. Estimates were made of the concentrations of radionuclides that might build up in marine species used as food, and estimates were made of the amounts of these foods consumed by people.

During about the first two years of plant operations, the liquid effluents will be split between Biscayne Bay and Card Sound. In December 1974, the Applicant plans to have a recirculating cooling channel system in operation. With the advent of the cooling channel system, all liquid effluents will be released to Card Sound. These changes will have little effect on the quantities of radioactive materials released; only on the distribution.

During the initial mode of operation (the first two years), the radioactive liquid effluents will be diluted with cooling water from the plant. While maximum cooling water flow rates may reach 4250 cfs, the annual average flow is estimated to be 3000 cfs. Therefore, dose calculations for this initial mode of operation involving one pass cooling were made assuming dilution of the liquid wastes in 3000 cfs of water with most of the effluent discharged into Card Sound.

The Applicant has established a Boy Scout camp on the existing canal about 0.6 mile from the reactors. Postulating that an adult leader would spend 10 weeks per year at the camp participating in 200 hours of shoreline activities, 200 hours of swimming activities and 200 hours of boating activities as well as consuming 3.5 kg of fish, 1.8 kg of crustacea and 1.8 kg of molluscs grown directly in the effluent discharge, it is estimated that his total-body dose would be about 0.65 mrem/year.

For the same mode of operation, an individual spending 500 hours per year in shoreline activities near the discharge into Card Sound, 100 hours per year swimming and 100 hours per year boating as well as consuming 18 kg of fish, 9 kg of crustacea and 9 kg of molluscs grown in the same place is estimated to receive a total-body dose of about 0.65 mrem/yr.

After the first two years of reactor operation, cooling water from the plant is planned to be recirculated through a system of cooling channels to dissipate the heat (see Section III.D.1.). Liquid radioactive wastes will also be routed into this channel system. As a result of the circulation and reuse of water in the channels, the concentration of radionuclides in the water at equilibrium conditions is expected to range between 1 and about 11 times that which is present in the water during the initial one pass cooling mode of operation. The actual reconcentration factor is a function of radioactive half-life of the nuclide (shown in Section III.D.2.). This cooling channel water will be released to Card Sound at a maximum rate of 1200 cfs. The annual average release rate is expected to be 300 cfs, which was the basis for radiation dose calculations.

Using the same assumptions for the adult leader at the Boy Scout camp outlined for the initial mode of operation, the total-body dose to such an individual during the recirculation mode of operation would be about 6.1 mrem/year. The corresponding doses to the GI Tract would be about 7.8 mrem/year, to the thyroid, about 16 mrem/year; and to the bone, about 5.5 mrem/year.

The total-body dose to the individual near the Card Sound discharge, using the assumptions outlined for the initial mode of operation and assuming water entering Card Sound has taken 63 hours to travel from the reactor discharge point, would be about 5.4 mrem/year. The corresponding doses to the GI Tract would be about 7.5 mrem/year, to the thyroid about 15 mrem/year and to the bone about 4.6 mrem/year. The approximately 10-fold increase in dose rates during the recirculation mode of operation is due primarily to the build-up of long-lived radionuclides (mainly Cs-134 and Cs-137) and the higher concentration of radioiodine in the water. A summary of the doses to the individual during the recirculation mode of operation is listed in Table V-6.

2. Radioactive Materials Released to the Atmosphere

Gaseous wastes will be collected, compressed and stored in tanks at the plant. Storage capacity is adequate for a 45 day holdup period, permitting decay of the shorter half-life radionuclides prior to release. The gases are filtered at the time of release to remove particulate material. The AEC Staff estimated radiation doses to persons in the environs of the Turkey Point plant from the gaseous effluent release rates given in Section III.D.2, using meteorological data furnished by the Applicant. Since the ventilation stack is located between the two reactor containment vessels, and since the top of the stack is at the same elevation as the top of these vessels, atmospheric dilution was calculated on the assumption that the releases occurred at ground level. The highest air submersion doses will be received by members of the public living, working, or using recreational facilities in the vicinity of the plant.

During normal operation of the two reactors at full power, the highest dose rate at the plant boundary is estimated to be at the picnic area 0.4 mile northeast of the plant where the annual average atmospheric dilution factor is 3×10^{-6} sec/m^3. At this location, the total-body dose is estimated to be 0.25 mrem/year. The skin dose would be somewhat higher (0.62 mrem/year) because of the contribution from beta radiation.

TABLE V-6

RADIATION DOSE RATES TO INDIVIDUALS FROM EFFLUENTS RELEASED FROM TURKEY POINT UNITS 3 AND 4 DURING RECIRCULATING OPERATIONS

A. LEADER AT BOY SCOUT CAMP (10 weeks)

Pathway	Annual Exposure	Dose Rate, mrem/yr[a)] Skin	Total Body	GI Tract	Thyroid	Bone
Fish	3.5 kg	--	0.7	0.2	1.9	0.5
Crustacea	1.8 kg	--	0.8	2.3	4.8	0.5
Molluscs	1.8 kg	--	0.2	1.0	4.8	0.2
Shoreline	200 hr	5.	4.3	(4.3)[b)]	(4.3)	(4.3)
Swimming	200 hr	0.05	0.04	(0.04)	(0.04)	(0.04)
Boating	200 hr	0.03	0.02	(0.02)	(0.02)	(0.02)
Air Submersion	1680 hr	0.1	0.05	(0.05)	(0.05)	(0.05)
Inhalation	1400 m^3	--	--	--	0.20	--
TOTAL		5.	6.	8.	16.	6.

TABLE V-6 (Cont'd)

B. CARD SOUND

Pathway	Annual Exposure	Skin	Total Body	GI Tract	Thyroid	Bone
Fish	18 kg	--	1.0	0.23	2.0	0.75
Crustacea	9 kg	--	1.1	3.1	5.0	0.6
Molluscs	9 kg	--	0.3	1.3	5.0	0.25
Shoreline	500 hr	3.5	3.0	(3.0)	(3.0)	(3.0)
Swimming	100 hr	7×10^{-3}	6×10^{-3}	(6×10^{-3})	(6×10^{-3})	(6×10^{-3})
Boating	100 hr	4×10^{-3}	3×10^{-3}	(3×10^{-3})	(3×10^{-3})	(3×10^{-3})
Air Submersion[c)]	8766 hr	0.09	0.06	(0.06)	(0.06)	(0.06)
Inhalation[c)]	7300 m^3	--	--	--	0.2	--
TOTAL		4.	5.	8.	15.	5.

a) Assuming release rates and reconcentration factors indicated in Section III.D.2 and bioaccumulation factors listed in Section V.C.
b) ( ) indicated internal dose from external sources.
c) At nearest residence 3.5 miles NW of effluent release point.

However, this location is not continuously occupied for extended periods of time, since no camping is allowed. The Applicant has established a Boy Scout camp 0.6 mile southwest of the reactors. At the location, the atmospheric dilution is 3×10^{-6} sec/m^3. Assuming a Scout Leader lives 10 weeks per year at this camp, his annual air submersion doses would be 0.05 mrem to the total body and 0.13 mrem to the skin. The Applicant has also established a Girl Scout camp 0.5 mile north of the plant, where the atmospheric dilution is 2×10^{-6} sec/m^3. Again assuming a 10 week residence by an adult leader, the annual total-body dose and skin dose are estimated to be 0.04 and 0.10 mrem, respectively.

In addition, Dade County Homestead Bayfront Park is located on the waterfront 1.8 miles north of the plant. Total-body radiation dose has also been estimated for an assumed occupancy of 10 weeks at this park. The atmospheric dilution factor is 4×10^{-7} sec/m^3 and the annual total-body dose is 0.04 mrem.

The highest air submersion dose at a continuously occupied location occurs at the farm located 3.5 miles northwest of the reactors. At this location, the atmospheric dilution is 4×10^{-7} sec/m^3, the total-body dose is 0.06 mrem/year and the skin dose is 0.09 mrem/year.

Inhalation of radioiodine results in a radiation dose to the thyroid. The inhalation dose to a small child (2g thyroid) is only 20% higher than that for an adult because of the reduced inhalation rates of the child. The inhalation dose at the nearest occupied location 3.5 miles northwest of the reactors is estimated as 0.2 mrem/year. A similar inhalation dose was calculated for the Scout Leader (the dose rate is somewhat higher but the occupancy factor is lower). Because the nearest dairy herd is 25 miles away, the iodine-milk pathway is not a consideration.

3. Direct Radiation from the Plant

The reactor and the entire primary coolant system are enclosed in massive shielding within the containment structure and will not contribute significantly to the radiation dose at the plant boundary or at the Boy Scout and Girl Scout camps. An AEC Staff estimate of potential direct radiation doses from outdoor storage tanks which might contain radioactive liquids indicates doses of less than 0.04 mrem/year at the Girl Scout camp and 0.007 mrem/year at the Boy Scout camp from such sources. Doses at the site boundary would be lower than those calculated at the two camps. Confirming measurements will be made as a part of the Applicant's monitoring program after plant startup.

4. Population Doses from All Sources

The total radiation dose from liquid effluents to the population residing within 50 miles of the plant was calculated for four pathways, viz., consumption of locally harvested seafood and swimming, boating and shoreline activities in Card Sound. The Applicant has reported the quantities of seafood landed in Dade County[70] to include 5.75×10^5 kg/year of fin fish and 1.31×10^6 kg/year of crustacea. No harvest of molluscs was reported. The above values are for live weight, and should be reduced by a factor of 0.5 in the case of fin fish and 0.3 in the case of crustacea to obtain edible weights. The resulting values are: 2.9×10^5 kg/year of fin fish and 4.4×10^5 kg/year of crustacea. These values are considerably below the average consumption found for this region of the United States in a recent survey.[71] Thus, it is assumed that all of the seafood landed in Dade County is consumed within 50-miles of the Turkey Point plant.

In calculating the dose from consumption of seafood, it was further assumed that only 10% of the harvest came from the waters of Card Sound containing effluent radionuclides diluted to 1% of the concentrations in the discharge canal. The decay time from the reactor discharge point until consumption of the seafood was taken to be 34 hours for initial operation and 68 hours for the recirculating canal system. These calculations indicate population doses of 3.5 man-rem/year from eating seafood during the initial once-through cooling mode of operation and 2.8 man-rem/year during the cooling channel mode of operation.

In addition, the total population within a 50 mile radius of the plant was assumed to spend 3×10^5 man-hour/year swimming and boating and 2×10^5 man-hour/year in shoreline activities in Card Sound. These recreational activities would result in a total population dose of about 0.05 man-rem/year during the initial once-through cooling mode and about 0.05 man-rem/year during the cooling channel mode of operation.

The combined total-body dose from gaseous effluents to the population living within a 50 mile radius of the plant was calculated on the basis of radioactive releases presented in Section III.D.2, and using meteorological data supplied by the Applicant. The total population dose was estimated to be about 3 man-rem/year.

A summary of the population dose from all sources is given in Table V-7. Values of the population dose from gaseous effluents for the estimated 1970 population at various distances from the plant are tabulated in Table V-8.

TABLE V-7

ANNUAL RADIATION DOSE TO THE POPULATION WITHIN 50 MILES DUE TO THE OPERATION OF TURKEY POINT UNITS 3 AND 4 WITH RECIRCULATING CANALS

Pathway	Annual Exposure	Population Dose (man-rem/yr)
Fish	3×10^5 kg	0.6
Crustacea	4×10^5 kg	2.2
Shoreline	2×10^5 hr	0.05
Swimming and Boating	3×10^5 hr	0.07
Air Immersion	1.8×10^9 hr	3.
Transportation of Radioactive Materials	-	6.
	TOTAL	12.

TABLE V-8

CUMULATIVE POPULATION, ANNUAL MAN-REM DOSE AND AVERAGE ANNUAL DOSE IN SELECTED CIRCULAR AREAS AROUND THE TURKEY POINT PLANT

Cumulative Radius (Miles)	Cumulative Population (1970)	Cumulative Dose Rate (Man-rem/yr)	Average Dose Rate (manrem/yr)
5	265*	0.16	0.6
10	88,000	1.1	0.01
20	550,000	2.4	0.004
30	1,300,000	2.8	0.002
40	1,800,000	3.0	0.002
50	2,100,000	3.2	0.002

*Transient residency estimated for the Florida Power and Light Co. picnic area, Girl and Boy Scout camps, and the Dade County Homestead Bay Front Park.

5. Evaluation of Radiological Impact

Based on conservative estimates, the total dose from all pathways received each year by the approximately two million people who now live within a 50-mile radius of the plant would be about 12 man-rem during the recirculation mode of operation of the two nuclear units at full power. By comparison, the natural background dose of about 0.1 rem/year per person results in an annual total of about 200,000 man-rem to the same population.

Operation of the Turkey Point plant will contribute only an extremely small increment to the radiation dose that area residents receive from natural background. Since fluctuations of the natural background dose may be expected to exceed the small dose increment contributed by the plant, this increment will be unmeasurable in itself and will constitute no meaningful risk to be balanced against the benefits of the plant.

6. Environmental Monitoring

The Applicant initiated an environmental surveillance program in 1969 to determine preoperational background levels of radioactivity around the site. The program was developed with the cooperation of the Radiation Section of the Florida State Health Division. The offsite portion of the program is conducted by the State under a grant from the Applicant. The onsite portion of the program is conducted by the Applicant. Reports from the State are published as public information in the annual reports of the Health Division. All of the analyses of the State-collected samples are processed at the State laboratory in Orlando, Florida. The processing and analyses are handled with state-of-the-art equipment.

The Applicant's radiological monitoring program has been planned to serve two objectives: to determine background concentrations of radioactive materials in the Turkey Point environment prior to plant startup (preoperational studies) and subsequently to determine the radiological effects of plant operations on the environment (postoperational studies). This latter phase will essentially be a continuation of the preoperational phase, with modifications as indicated by the use of the preoperational program and experience in monitoring at similar nuclear station sites.

The sampling locations, types, and frequencies and the analyses were established in consideration of the potential amounts and modes of radionuclide releases, population density and distribution, food and water sources, activities (e.g., agriculture, recreation, industry, etc.) in the region, and natural biological and physical features of the region.

Air monitoring will include sampling particulates and precipitation and measurements of external exposure at appropriate on-site and off-site locations. The water monitoring program includes sampling aquatic biota, sediments, and seawater, with particular emphasis on the algae, sea grasses, and edible finfish and shellfish that are in the food chain to man. In addition, saline and potable surface and groundwaters are to be sampled. The land radiological monitoring program will include sampling and analyzing leafy vegetation, fruits, vegetables, grasses, and soils. Since there are no dairy herds within 25 miles of the facility, milk is not considered a significant exposure pathway, in this instance.

Sampling frequencies for the postoperational monitoring program will vary from weekly to semiannually. More detailed information on the Applicant's radiological monitoring is presented in Table V-9 and in the Environmental Report Supplement (Section 2.3.6.2)[48]. This program will be amplified and further defined as necessary in the technical specifications for the plant.

TABLE V-9

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

	Criteria and Sampling Locations	Collection Frequency	Analysis/Counting
I. AIR			
A. Particulate and Iodine	Comparison on-site versus off-site & reference locations 3 locations on-site in prevailing wind directions from plant 4 locations off-site within a radius of 10 miles of plant in prevailing wind directions from the plant 1 location for reference 22 miles north of plant site	Weekly	Gross beta Gamma spectral analysis of monthly composite if indicated by high beta activity Radioactive Iodine
B. Direct Radiation	Comparison of on-site versus off-site & reference locations Sampling locations same as I A, plus off-site on North Key Largo (without ion chamber)	TLD's-Monthly Ion Chambers-Bi-Weekly	Determine direct radiation exposure
C. Precipitation	Comparison of on-site versus reference locations 1 location on-site 1 location for reference 22 miles north of plant site 1 location - Florida City Substation 1 location - Dolan's farm	Monthly	Gross beta Gamma spectral analysis Tritium
II. WATER			
A. Surface Water			
1. Bay	Cutler Plant Intake Canal Homestead Bayfront Park Girl Scout Bathing Area Mouth of Discharge Canal - Biscayne Bay Card Sound, North of Causeway Mouth of Model Land Canal Mouth of Discharge Canal - Card Sound Card Sound - North Boundary	Monthly	Gamma spectral analysis Tritium Sr-90
2. Canal	Florida City Canal, west of salinity dam North branch of Model Land Canal (at 90 degree bend to south)	Quarterly	Gross alpha Gross beta Tritium

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TABLE V-9 (continued)

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

	Criteria and Sampling Locations	Collection Frequency	Analysis/Counting
B. Ground Water	Dolan Farm	Quarterly	Same as II.A.2
C. Potable Water	City of Homestead, drinking water supply Naranja Water Company, drinking water supply	Quarterly	
D. Bottom Sediment			
1. Canal	Upper Discharge Canal (2 locations)	Quarterly	Gamma spectral analysis Sr-90
2. Bay	Homestead Bayfront Park Girl Scout Bathing Area Mouth of Discharge Canal - Biscayne Bay Card Sound North of Causeway Mouth of Model Land Canal Mouth of Discharge Canal - Card Sound Card Sound - North Boundary	Quarterly (all locations)	Same as II.D.1

TABLE V-9 (continued)

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

	Criteria and Sampling Locations	Collection Frequency	Analysis/Counting
II. WATER (cont'd)			
E. Aquatic Biota			
1. Crustacea		Quarterly	Gamma spectral analysis Sr-90
a. Lobster, crab &/or shrimp	Mouth of Discharge Canal - Biscayne Bay Card Sound North of Causeway Bay side of Ceasar Creek Bay side of Ragged Keys Mouth of Model Land Canal Mouth of Discharge Canal - Card Sound Card Sound - North Boundary		
2. Fish (vertebrates)		Quarterly	Same as II.E.1
a. Carnivores Barracuda or Mangrove Snapper	Same as II.E.1		
b. Herbivores Mullet (mugil cephalus)	Same as II.E.1	Quarterly	Same as II.E.1
3. Other		Semi-annually	Gamma spectral analysis Sr-90
a. Manatee Grass &/or Turtle Grass	Same as II.E.1		
b. Algae	Same as II.A.2	Semi-annually	Same as II.E.3a
c. Sponges (porifera)	Same as II.E.1	Quarterly	Same as II.E.3a

TABLE V-9 (continued)

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

	Criteria and Sampling Locations	Collection Frequency	Analysis/Counting
F. Wells	Locations west, south and east of canal system	Quarterly	Gamma spectral analysis Tritium Sr-90
III. TERRESTRIAL			
A. Milk (future)	No herds currently in area of influence*		
B. Biota			
1. Small Animal	1 location adjacent to plant site	Semi-annually	Gamma spectral analysis Sr-90
2. Food Crops	3 locations within a 10 mile radius of plant in prevailing wind directions from plant at harvest time	Semi-annually	Gamma spectral analysis Sr-90
3. Other Vegetation (mangrove leaves)	7 locations within a 10 mile radius of plant generally where there are air particulate samplers	Quarterly	Gamma spectral analysis Sr-90
C. Soil	8 locations within a 10 mile radius of plant generally at air particulate sampler locations	Semi-annually	Same as III.B.3

* A semi-annual survey will be conducted and any change reported to the AEC.

TABLE V-9 (continued)

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

TYPES OF ANALYSIS

1. Gamma Spectroscopy

Ce-144	Ba-140
I-131	K-40
Ru-106	Ra-226
Cs-134	Th-232
Cs-137	Co-58
Zr-95	Co-60
Mn-54	Cr-51
Zn-65	

2. Beta Liquid Scintillation Spectroscopy

   H-3
   C-14
   P-32

3. Chemical Separation and Analysis

   Sr-89
   Sr-90

E. Accidents

1. Plant accidents

A high degree of protection against the occurrence of postulated accidents in the Turkey Point Units 3 & 4 is provided through correct design, manufacture, and operation, and the quality assurance program used to establish the necessary high integrity of the reactor system. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, in spite of the fact that they are extremely unlikely; and engineered safety features are installed to mitigate the consequences of these postulated events. These matters were considered in the Commission's Safety Evaluation dated February 8, 1967 and Supplement dated July 12, 1968. These reports were published in connection with the Commission's construction permit review. A Safety Evaluation covering the operating license review also has been completed and was released March 15, 1972.

The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using best estimates of probabilities and realistic fission product release and transport assumptions. For site evaluation in the AEC safety review, extremely conservative assumptions were used for the purpose of comparing calculated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR Part 100 siting guidelines. The computed doses that would be received by the population and environment from actual accidents would be significantly less than those presented in the AEC Safety Evaluation.

The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The Applicant's response was contained in the "Environmental Report Supplement," dated November 8, 1971 [48].

The Applicant's report has been evaluated, using the standard accident assumptions and guidance issued as a proposed amendment to Appendix D of 10 CFR Part 50 by the Commission on December 1, 1971. Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious were identified by the Commission. These are summarized in Table V-10. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate,

TABLE V-10

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

NO. OF CLASS	AEC DESCRIPTIONS	APPLICANT'S EXAMPLE(S)
1.	Trivial Incidents	None
2.	Misc. Small Releases Outside Containment	Gaseous release from volume control tank due to leak, operator error
3.	Radwaste System Failures	Release from waste storage tank due to pipe or relief valve failure
4.	Events That Release Radioactivity Into the Primary System (BWR)	Not applicable
5.	Events That Release Radioactivity Into the Primary and Secondary Systems (PWR)	Fuel failures and steam generator tube leakage
6.	Refueling Accidents Inside Containment	Dropped fuel assembly
7.	Accidents to Spent Fuel Outside Containment	Dropped fuel assembly
8.	Accident Initiation Events Considered in Design-Basis Evaluation in the Safety Analysis Report	(1) Steam line Break Accident (2) Rupture of Waste Gas Decay Tank (3) Loss-of-Coolant Accident (4) Control Rod Ejection
9.	Hypothetical Sequences of Failures More Severe than Class 8	None

low potential consequence end have a higher occurrence rate. The examples selected by the Applicant are reasonably consistent in terms of probability within each class. While certain assumptions made by the Applicant in the evaluation of system incidents may be questioned, the use of alternative assumptions does not significantly affect overall environmental risks.

AEC Staff estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table V-11. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table V-11. The man-rem estimate was based on the Applicant's adjustment of 1960 census data to obtain a projected population around the site for the year 1986.

To rigorously establish a realistic annual risk, the calculated doses in Table V-11 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operation and their consequences, which are very small, are considered within the framework of routine effluents from the plant. Except for a limited amount of fuel failures and some steam generator leakage, the events in Classes 3 through 5 are not anticipated during plant operation, but events of this type could occur sometime during the 40-year Plant lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5, but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table V-11 are weighted by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design basis of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

TABLE V-11

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

Class	Event	Estimated Fraction of 10 CFR 20 Limit at Site Boundary1/	Estimated Dose to Population in 50 Mile Radius, man-rem
1.0	Trivial incidents	2/	2/
2.0	Small releases outside	2/	2/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.021	8.4
3.2	Release of waste gas storage tank contents	0.084	33
3.3	Release of liquid waste storage tank contents	0.001	0.40
4.0	Fission products to primary system (BWR)	N.A.	N.A.
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	2/	2/
5.2	Off-design transients that induce fuel failure above those expected and steam generator leak	<0.001	0.19
5.3	Steam generator tube rupture	0.028	11
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.004	1.7
6.2	Heavy object drop onto fuel in core	0.076	30

Table V-11 (cont'd)

Class	Event	Estimated Fraction of 10 CFR 20 Limit at Site Boundary 1/	Estimated Dose to Population in 50 Mile Radius, man-rem
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	0.003	1.1
7.2	Heavy object drop onto fuel rack	0.011	4.4
7.3	Fuel cask drop	N.A.	N.A.
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Loss-of-coolant accidents		
	Small break	0.046	33
	Large break	0.29	720
8.1(a)	Break in instrument line from primary system that penetrates the containment	N.A.	N.A.
8.2(a)	Rod ejection accident (PWR)	0.029	72
8.3(a)	Steamline breaks (PWR's outside containment)		
	Small break	<0.001	<0.1
	Large break	<0.001	0.11

1/ Represents the calculated fraction of a whole body dose of 500 mrem, or the equivalent dose to an organ.

2/ These releases will be comparable to the design objectives indicated in the proposed Appendix I to 10 CFR Part 50 for routine effluents (i.e., 5 mrem/yr to an individual from either liquid or gaseous effluents).

Table V-11 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations of radioactive materials within the Maximum Permissible Concentrations (MPC) of Table II of 10 CFR Part 20. The table also shows that the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident would be orders of magnitude smaller than that from naturally occurring radioactivity, which corresponds to approximately 294,000 man-rem/yr based on a natural background level of 0.1 rem/yr. When considered with the probability of occurrence, the annual potential radiation exposure of the population from all the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the analysis that the environmental risks due to postulated radiological accidents are exceedingly small.

2. Transportation Accidents

a. Principles of Safety in Transport

Protection of the public and transport workers from radiation during the shipment of nuclear fuel and waste, described in Section III.E, is achieved by a combination of limitations on the contents (according to the quantities and types of radioactivity), the package design, and the external radiation levels. Shipments move in routine commerce and on conventional transportation equipment. Shipments are therefore subject to normal accident environments, just like other nonradioactive cargo. The shipper has essentially no control over the likelihood of an accident involving his shipment. Safety in transportation does not depend on special routing.

Packaging and transport of radioactive materials are regulated at the Federal level by both the Atomic Energy Commission and the Department of Transportation (DOT). In addition, certain aspects, such as limitations on gross weight of trucks, are regulated by the States.

The probability of accidental releases of low level contaminated material is sufficiently small that, considering the form of the waste, the likelihood of significant exposure is extremely small. Packaging for these materials is designed to remain leakproof under normal transport conditions of temperature, pressure, vibration, rough handling, exposure to rain, etc. The packaging may release its contents in an accident.

For large quantities of radioactive materials, the packaging design (Type B packaging) must be capable of withstanding, without loss of contents or shielding, the damage which might result from a severe accident. Test conditions for packaging are specified in the regulations and include tests for high-speed impact, puncture, fire, and immersion in water[44].

In addition, the packaging must provide adequate radiation shielding to limit the exposure of transport workers and the general public. For irradiated fuel, the package must have heat-dissipation characteristics to protect against overheating from radioactive decay heat. For cold and irradiated fuel, the design must also provide nuclear criticality safety under both normal and accident damage tests.

Each package in transport is identified with a distinctive radiation label on two sides, and by warning signs on the transport vehicle.

Based on the truck accident statistics for 1969[45], a shipment of fuel or waste from a reactor may be expected to be involved in an accident about once every six years. In case of an accident, procedures [46] which carriers are required to follow will reduce the consequences of an accident in many cases. The procedures include segregation of damaged and leaking packages from people, and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an inter-Governmental program to provide equipped and trained personnel. These teams, dispatched in response to calls for emergency assistance, can mitigate the consequences of an accident.

b. Exposures During Normal (No Accident) Conditions

(1) Cold Fuel

The transport of cold fuel for the Turkey Point reactors has been described in Section III.E.1. Since the nuclear radiations and heat emitted by cold fuel are small, there will be essentially no effect on the environment during transport under normal conditions. Exposure of individual transport workers is estimated to be less than 1 millirem (mrem) per shipment. With two drivers for each vehicle, the total dose would be about 0.01 man-rem per year. The exposure of an individual in the general population postulated to spend 3 minutes at an average distance of 3 feet from one of the transport trucks would be no more than about 0.005 mrem per shipment (the radiation level associated with each truck load of cold fuel is less than 0.1 mrem/hr at 6 feet from the truck). The dose to other persons along the shipping route would be extremely small.

(2) Irradiated Fuel

Irradiated fuel from the two reactors at Turkey Point is to be transported either by truck, rail or barge to a reprocessing plant (assumed to be Barnwell, S.C. in the following AEC Staff analysis). Based on actual radiation levels associated with shipments of irradiated fuel elements, the AEC Staff estimates the radiation level at 3 feet from the truck or rail car or from the surface of the cask on a barge to be about 25 mrem/hr.

For truck shipment:

It is estimated that the individual truck driver would be unlikely to receive more than about 30 millirem in the 700 mile shipment. For 30 shipments by truck during the year with 2 drivers on each vehicle, the cumulative annual dose would be about 2 man-rem.

For rail shipment:

Train brakemen might spend a few minutes in the vicinity of a car carrying a fuel shipment at an average distance of 3 feet, for an exposure of about 0.5 millirem on the average. With 10 different brakemen involved along the route, the total dose for 10 shipments during the year is estimated to be about 0.05 man-rem.

For barge shipment:

The cask would be moved the short distance from the reactor to the barge loading dock onsite using a land transporter. The cask would be loaded onto the barge onsite.

A barge operator or tugboat operator who picks up the loaded barge at the nuclear power plant site will probably spend no more than an hour lashing the barge down, checking lights and equipment, at a distance of 50 feet from the cask and perhaps a total of 10 minutes within 6 feet of the cask during the entire trip. His total dose would be about 3 mrem per trip. If two operators were involved, this would be a cumulative annual dose of about 0.03 man-rem for the 6 barge shipments.

The barge should dock at the port nearest the reprocessing plant and the cask will likely be carried by truck the remaining distance. It will require a specially equipped vehicle to transport the 100 ton cask, and the truck loaded with the 100 ton cask will require an overweight permit. Assuming the processing facility is Barnwell, South Carolina, the distance from the dock to the processing plant is estimated to be about 25 miles.

During the transshipment of the casks from the boat to the truck, exposure of persons will generally be limited to those untying and tying down the casks on the vehicles or vessels and hooking and unhooking the lifting-hooks. The handling must be done with cranes. The AEC Staff estimates that it may require half an hour exposure at an average distance of 3 feet from each cask or about 15 mrem exposure for each of the two persons handling the cask. For 6 shipments, the cumulative annual dose would be about 0.2 man-rem. The crane operator and other workers in the area would be unlikely to receive any significant exposure.

It would require 6 truckload shipments to transport the casks from the dock to the reprocessing plant. During this short haul, a distance of perhaps 25 miles, two truck drivers might spend on hour in the cab and perhaps 15 minutes outside the truck at an average distance of 3 feet from the cask. The AEC Staff estimates the radiation level in the cab will be about 0.2 mrem/hr and the level at 3 feet from the cask, about 25 mrem/hr. Each truck driver would receive about 6 mrem/shipment. The cumulative annual dose to all drivers would be about 0.07 man-rem.

<u>For all shipments:</u>

A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck or rail car might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the total annual dose for 30 shipments by truck would be about 0.4 man-rem; and for 10 shipments by rail, about 0.1 man-rem. No onlookers are expected for barge shipments.

Approximately 200,000 persons who reside along the 700 mile route over which the irradiated fuel is transported might receive a dose of about 0.06 man-rem if transported by truck, and 0.01 man-rem if transported by rail. If transported by barge, approximately 60,000 persons might receive a cumulative annual dose of about 0.003 man-rem. The regulatory radiation level limit of 10 mR/hr at a distance of 6 feet from the vehicle was used to calculate the integrated dose to persons in an area between 100 feet and 1/2 mile on both sides of the shipping route. It was assumed the shipment would travel 200 miles per day and the population density would average 330 persons per square mile along the route, except that for barge shipment, only about 30% of the route would be populated.

The amount of heat released to the air from each cask will vary from about 30,000 Btu for truck casks to about 250,000 Btu for rail or barge casks. For comparison, 35,000 Btu per hour is about equal to the heat released from an air conditioner in an average-sized home. Although the temperature of the air which contacts the loaded cask may be increased a few degrees, the amount of heat is small and is being released over the entire transportation route, and no appreciable thermal effects on the environment will result.

(3) Solid Radioactive Wastes

As noted in Section III.E.3., about 45 truckloads of solid wastes will be shipped each year from Turkey Point to a disposal site. Under normal conditions, the individual truck driver might receive as much as 15 mrem per shipment. If the same driver were to drive 25 truckloads per year, he would receive an estimated annual exposure of about 400 mrem. The total exposure of all drivers for the year, assuming 2 drivers for each shipment, might be as much as 1.4 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the total annual dose for the 45 shipments would be about 0.6 man-rem. Approximately 300,000 persons who reside along the

1,000 mile route over which the solid waste is transported might receive a cumulative annual dose of about 0.1 man-rem. These doses were calculated for persons in an area between 100 feet and 1/2 mile on either side of the shipping route, assuming 330 persons per square mile, 10 mR/hr at 6 feet from the vehicle, and the shipment travelling 200 miles per day.

c. Exposures Resulting from Postulated Accidents

(1) Cold Fuel

The cold fuel to be transported to Turkey Point has been described in Section III.E.1. Under accident conditions other than accidental criticality, the pelletized form of uranium fuel, its encapsulation, and the low specific activity of the fuel limit the radiologic impact on the environment to negligible levels. Even for the higher radioactivity of plutonium recycle fuel, the form and encapsulation under credible accident conditions would limit the radiation effects on the environment to negligible levels.

The packaging is designed to prevent criticality under normal and severe accident conditions. To release a number of fuel elements under conditions that could lead to accidental criticality would require severe damage or destruction of more than one package, which is unlikely to happen in other than an extremely severe accident.

The probability that an accident could occur under conditions that could result in accidental criticality is extremely remote. If criticality were to occur in transport, persons within a radius of about 100 feet from the accident might receive a serious exposure, but, beyond that distance, no detectable radiation effects would be likely. Persons within a few feet of the accident could receive fatal or near-fatal exposures unless shielded by intervening material. Although there would be no nuclear explosion, heat generated in the reaction would probably separate the fuel elements so that the reaction would stop. The reaction would not be expected to continue for more than a few seconds and normally would not recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at 3 feet. There would be little dispersion of radioactive material.

(2) Irradiated Fuel

Irradiated fuel will be shipped from Turkey Point to a licensed fuel recovery plant as described in Section III.E.2. Effects on the environment from accidental releases of radioactive materials during shipment of irradiated fuel were estimated for the situation where contaminated coolant is released and the situation where gases and coolant are released.

(a) Leakage of contaminated coolant resulting from improper closing of the cask is possible as a result of human error, even though the shipper is required to follow specific procedures which include tests and examination of the closed container prior to each shipment. Such an accident is highly unlikely during the 40-year life of the plant.

Leakage of liquid at a rate of 0.001 cc per second or about 80 drops/hour can usually be detected by visual observation of a large container. If leakage of contaminated liquid coolant were to occur and should go undetected, the amount would be so small that the individual exposure would not exceed a few mrem and only a very few people would receive such exposures.

(b) Release of gases and coolant is an extremely remote possibility. In the improbable event that a cask is involved in an extremely severe accident such that the cask containment is breached and the cladding of the fuel elements penetrated, some of the coolant and some of the noble gases might be released from the cask.

In such an accident the amount of radioactive material released would be limited to the available fraction of the noble gases in the void spaces in the fuel pins and some fraction of the low level contamination in the coolant. Persons would not be expected to remain near the accident due to the severe conditions which would be involved, including a major fire. If releases occurred, they would be expected to take place in a short period of time. Only a limited area would be affected. Persons in the downwind region and within 100 feet or so of the accident might receive doses as high as a few hundred millirem. Under average weather conditions, a few hundred square feet might be contaminated to the extent that it would require decontamination (that is, Range I contamination levels) according to the standards of the Environmental Protection Agency[47].

(3) Solid Radioactive Wastes

It is highly unlikely that a shipment of waste will be involved in a severe accident during the 40-year life of the plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some release of waste might occur, but the specific activity of the waste will be so low that the exposure of personnel would not be expected to be significant.

Other solid waste from Turkey Point will be shipped in Type B packages, according to the Applicant. The probability of release from a Type B package, in even a very severe accident, is sufficiently small that, considering the solid form of the waste and the very remote probability that a shipment of such waste would be involved in a very severe accident, the likelihood of significant exposure would be extremely small.

In either event, spread of the contamination beyond the immediate area is unlikely and, although local clean-up might be required, no significant exposure to the general public would be expected to result.

d. Severity of Postulated Transportation Accidents

The events postulated in this analvsis are unlikely but possible. More severe accidents than those analyzed can be postulated, and their consequences could be severe. Quality assurance for design, manufacture, and use of the packages, continued surveillance and testing of packages and transport conditions, and conservative design of packages insure that the probability of accidents of this latter potential is sufficiently small that the environmental risk is extremely low. For those reasons, more severe accidents have not been included in the analysis.

F. Environmental Monitoring and Research Programs

Several monitoring programs have been proposed by the Applicant to evaluate the impact of plant operations on the physical, biological and human environments. In addition, studies of a research nature, many of which were described previously, have been carried out and are proposed for continuation in order to obtain baseline (preoperational) data and other scientific information necessary for predictive analysis.

The recent decision to install a multichannel recirculating cooling-water system, instead of the earlier proposed once-through system, has shifted much of the potential impact of plant construction and operation from the marine to the terrestrial environment. Accordingly, the Applicant needs to define monitoring and research programs that place emphasis on the terrestrial as well as the marine environs. The extensive studies undertaken and continuing on the marine sector are noteworthy. Conversely, there is still a lack of quantitative scientific information on the mangrove salt-marsh section, despite the preliminary survey results shown in Appendix B.

The effects of the channels on common, as well as endangered, species depend upon the route and rate of recovery of the ecosystem to perturbation of soil, groundwater, vegetative cover, salinity, and thermal character. Although the Applicant believes that the channel spoil banks will revegetate and the area will essentially fully recover, few data are presented to support the validity of these beliefs. Prior to or early in the construction of the channel network, the Applicant needs to investigate patterns of succession on mud spoils already in place on the site. Information needed in these studies includes the following:

- Species composition as a function of time, soil depth, salinity, and water, soil, and air temperatures.

- Tolerance of red mangrove and other successional species to constant soil and groundwater salinities in the concentration projected for the channels.

- Rate of erosion during early stages of succession.

- Influence of red mangrove on soil deposition and reduction of water velocity in the channels.

- Possible need for chronic dredging of channels if reinvasion of mangroves is successful.

Preoperational surveys are in progress on an integrated study of the South Biscayne Bay and Card Sound ecosystems, which involve physical, chemical, and biological parameters. However, additional studies are in order so that better predictions can be made of the effects of the operation of the cooling channel system.

These studies should include modeling efforts to describe the extent of the Card Sound discharge in terms of temperature and salinity over the full range of operating conditions, including emergency conditions. In addition, laboratory studies are needed to evaluate the effects of temperature and salinity on the biota of Card Sound. Special attention should be given to the degree of effect of short-time exposure to the high temperatures and high salinities that might be experienced under emergency conditions, in comparison with normal operating conditions.

Studies are needed on the potential impact of groundwater seepage from the channel system on the mangrove and shoreline ecosystems, with particular emphasis on larval forms of invertebrates and fish. Predictive models should be developed to examine the relationship between the mangrove ecosystem and the Bay and Sound ecosystem. This will provide a tool for determining if effects on the mangrove area will have an impact on the Bay and Sound ecosystems in terms of nutrient contribution and cycling.

During the interim operating period, it is desirable to get more detailed data on the biota and the chemical quality of the intake water, changes in chemical quality in the channel system, and the resultant changes in the water quality and biota in the receiving waters.

Following the closure of the Grand Canal and associated interim operation canals, there should be programs to follow the recovery of those affected areas. Also, following the startup of the nuclear units, there should be studies on the circulation and turnover of the waters of Card Sound and Biscayne Bay.

Although the radiological environmental monitoring program was discussed in Section V.D.6, several points should be addressed more completely, as follows.

Additional sampling should be performed in the discharge canal (cooling channels) themselves. In view of the fact that the individual most likely to receive the highest exposure would be a Scout Leader residing 10 weeks/year near the existing discharge canal, samples of potential aquatic food from the canal and dose rates from the water and shoreline should be included.

In addition, since the estimated doses depend directly on the calculated reconcentration factors in the canals during "recirculation" operation, samples should be collected from several places in the canal system to determine the actual reconcentration factors and their increase with time.

Additional modification of the program should be undertaken from time to time as experience dictates to adequately monitor all potential pathways of exposure to man.

VI. ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

The Turkey Point Nuclear Units and related facilities will occupy about 150 acres of the 3300-acre original site. In addition, the cooling channel system currently proposed to be constructed to service both the fossil-fuel and nuclear units will occupy much of the original FPL site and about 5000 to 6000 additional acres of salt marsh acquired to the south of the original site. Thus, about 7000 acres of land will be converted from its present natural state to a system of wide channels with intervening relatively wide muck banks elevated above the existing grade.

The rate and extent of recovery of vegetation on the muck banks is considered unpredictable from existing information, because of the significant changes and perturbations in water temperature, salinity, and substrate. Also related to the conversion of this land are the effects on common, rare, and endangered birds, mammals, and reptiles which might inhabit the salt-marsh area. The degree of impact in this case needs to be assessed in terms of a number of related but not necessarily equally-weighted factors. Among these considerations are: the previously discussed vegetation and wildlife habitat recovery rate and extent; the value of the trade-off for potential near-term beneficial land uses (e.g., agriculture, recreation, cooling water systems, etc.); and the trade-off of land conversion in exchange for possible amelioration of marine life damage.

Before the multi-channel cooling system is completed, there will be an interim period during which cooling water taken from Biscayne Bay is discharged back into the Bay and into Card Sound. Should the plant need to operate under emergency conditions during this interim period, marine life near the mouths of the canals will be at risk because of high temperatures. The risk to organisms in Biscayne Bay from high temperatures and scouring action of the discharge will be eliminated upon completion of the multi-channel cooling system.

Operation of the Card Sound water intake system will result in the entrainment and loss of some plankton and other small marine organisms; however, that loss should be small and have no significant effect on the productivity or standing crop in the region. Also, the discharge of cooling system purges having higher salinity (and temperature) than Card Sound ambient waters may result in the sinking of these discharges to the bottom of the Sound and their subsequent movement toward Cutter Bank. The degree of mixing and temperature and salinity differences in the waters cannot be predicted accurately from available information, nor can the potential effects (if any) on the benthos be quantitatively predicted at this time.

Operation of the channel cooling system will result in temperature and salinity increases in the groundwater beneath the system. No significant impact is expected in connection with subsurface flows to the west, due to the planned installation of an interceptor-recycle system. However, uncontrolled flow to the east will emerge at or near the shoreline of the Bay and Sound, and may have adverse, but as yet unknown, effects on the red mangrove and shallow benthic communities.

Most of the chemicals that will be added to the condenser water system are common constituents of seawater and the increased concentrations will not be great enough to be toxic to plant or animal life. Biocides are an exception, and care should be exercised in the use of chlorine. Similarly, the releases of radioactive materials from the nuclear units will conform to the Commission's requirements that they be as low as practicable, that the resulting concentrations in air and water meet specified limits, and that the resulting dose to people in the environs is within an acceptable range. Under these conditions, there will be no significant effect from the radioactivity reaching the environment from this facility.

The aesthetics of the Turkey Point area with the two fossil units has not been changed significantly by the addition of the nuclear units. Aesthetic impact has already been incurred by installation of the fossil-fuel plants and their attendant transmission lines, but the impact is not considered significant due to the remoteness of the site.

VII. SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The land required for the Turkey Point site, including the 7,000 acres for the cooling water system, will be dedicated to the production of needed electrical energy for a period of 30 to 40 years; upon termination of use, the plant will be decommissioned. This period of use is considered short-term in comparison with the past history and potential future uses of the land. It may be speculated that the site may continue in use for generation of electricity for some time after this period, but this possibility does not greatly alter the concept of this being a relatively short-term use.

The major consideration with respect to long-term productivity is the rate and degree that the present salt- marsh land used for the cooling channel system might recover to its natural state. The existing productivity is as a wildlife habitat and nutrient supply source. If its most beneficial use, following termination of the plant operating period, is determined to still be as a natural area, then perhaps it can be restored to that state by filling the channels with muck and possibly some reseeding efforts. However, complete restoration, if possible, would likely be a long-term process. On the other hand, if conversion of the land results in beneficial uses that go beyond its employment solely as a cooling water system (e.g., long-term recreational, residential, and agricultural activities), or if conversion might result in natural habitat enhancement, then both the short-term and long-term productivity of the land will be benefited.

There are also short-term effects on the marine life of Biscayne Bay and Card Sound associated with operation of the Turkey Point plant. These are expected to be relatively minor in comparison to the above-discussed terrestrial considerations, and will be mitigated relatively rapidly upon termination of plant operation. Also, those effects attendant to the existence of plant structures per se could be alleviated to varying degrees, depending upon the extent of decommissioning operations.

Decommissioning will consist of removing and reclaiming fuel, decontaminating accessible surfaces of radioactivity or otherwise "fixing" the remaining radioactivity in place, removal of salvageable equipment, and final sealing of the reactors and components. Conceivably, much of the facility could be dismantled and the land restored to near its original condition. The degree of dismantlement, as with most abandoned industrial plants, would be contingent on a balance of benefits and costs.

VIII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The resources committed in construction and operation of the Turkey Point Plant are those common to any large industrial facility (e.g., iron, steel, concrete) with the exception of the nuclear fuel. Only that portion of the nuclear fuel which is burned up or not recovered in reprocessing is irretrievably lost to other uses. Many other resources are either left undisturbed or committed only temporarily, as during construction or during the life of the plant, and are not irreversibly or irretrievably lost.

Curtailment of the use of the area by humans as a result of plant construction and operation should be no more severe than that incident to many other heavy industrial facilities, and the recreational and other human beneficial uses of the surrounding area should not be impaired; rather, they will probably be improved.

Based on a strict interpretation of the meaning of "irreversible and irretrievable," one cannot say that the large salt-marsh area converted to the cooling system is a "lost" natural resource. Man's present capabilities have extended well into the area of changing and then restoring natural areas. However, in this case the Staff is of the opinion that within the intent of NEPA the converted salt-marsh area probably will be an irreversible and irretrievable commitment of resources.

IX. NEED FOR POWER

AEC analysis of the Applicant's need for power led to the following conclusions in the Draft Statement: "(1) the Florida Power and Light (FPL) system reserve capacity is currently low, (2) without the base-load generating capacity of Turkey Point Unit 3, serious shortages in FPL system reserve capacity will occur in 1972, and (3) without Turkey Point Unit 4, serious shortages in FPL system reserve capacity will occur in 1973. The operation of Unit 3 will be required during 1972 peak loads to bring the reserve capacity of the Florida Power Group up to 21 percent: Without Unit 3 the reserve capacity becomes 16 percent. Additionally, reliability considerations associated with the hurricane potential, regional load growth, and the physiography of the State combined to create a specific need for additional generating capacity in the Miami area." FPL now notes [73] that the above reserve capacities (21 and 16%) have declined so as to be only 14.7% and 13%, respectively.

The Federal Power Commission stated in August 1971 that "Another area of sorely needed additional generating capacity is the lower Florida Peninsula in the vicinity of Miami. Several extensive power failures have been experienced in recent years and in 1971 it has been necessary to curtail load on occasion." The Federal Power Commission further reported in November 1971 the following on the situation for the Winter of 1971-72. "Two major systems in the Florida peninsula which serve two-thirds of the area load requirements, the Florida Power Corporation and Florida Power and Light Company, have reserve margins of 1.3 and -0.2 percent respectively, based on extremely cold weather conditions. Although interruption of industrial loads and emergency purchases of supplemental power from a neighboring utility offer means of some relief if necessary, the low reserves indicate a questionable outlook for the winter peak period in the Florida peninsula. Loss of any substantial amount of generating capacity during a cold wave will create a system emergency"[54].

In commenting on the Draft Statement in a letter dated March 3, 1972 (see Appendix E-3), the Federal Power Commission noted deficiencies in the reserve margin for the Florida Subregion of 893, 175, and 634 MW for the Summer 1972, Winter 1973, and Summer 1973 peaks, respectively. In another March 1972 letter, the Federal Power Commission gave the following summary[76]. "The slippage of Turkey Point 3 commercial availability to at least August 1972 leaves Florida in a critical power situation. Since it does not have the ability to import significant power from other areas, the summer reserve margin of 11.2 percent is highly inadequate. Furthermore, the reserve on the Florida Power & Light Company system without Turkey Point 3 is only about 5.5 percent, and the concentrated load area in and around Miami may be particularly vulnerable to power supply problems during peak load periods. At this time, there are no known substitutes for the Turkey Point 3 capacity during the 1972 summer."

A growing population coupled with an increasing per capita consumption of electricity has caused a rapid increase in the demand for electrical energy in the Florida Power and Light service area [48]. Since 1965 the average annual rate of growth exceeded 11 percent in energy sales and 12 percent in peak demand. During the same period the annual rate of increase in new customers was nearly 5 percent, and the annual rate of increase in electricity consumption per residential customer exceeded 8 percent. This approximately 12% rate of annual growth in peak demand is projected to continue at least through 1975, and the most recent growth rate of sales of 13 percent in 1970 corroborates that prediction.

In 1970 the peak demand (60 minute-net) was 5000 MW, the integrated average demand was 2600 MW, and the gross generating capability was 5900 MW for the Florida Power and Light Company system. Under these conditions of growth and system size, annual additions to the system of 300-500 MW of base-load capability and 300-500 MW of peak-load capability are required through 1975.

Florida Power and Light Company's operations are closely coordinated with the other major systems in Florida[51]. The system reserve capacity of the entire Florida Power Group for the 1972 peak load is shown in Table IX-1. There exists an intertie with utility systems to the north of Florida, but these systems have insufficient reserves to allow continuous dedication of substantial power to Florida. In addition, the existing low-voltage interconnections are inadequate for importing substantial amounts of electricity. Long-range plans call for increasing the capacity of the interconnections, but this may not occur before 1980.

In summary, the most immediate need for Turkey Point Units 3 and 4 is to provide reserve capacity for meeting peak-load conditions, but the projected growth in just base-load requirements of the Florida Power and Light system will exceed the

TABLE IX-1

Estimated 1972 August Loads and Generating Capabilities
For Florida Interconnected Utilities[51]

Utility	Generating Capability, MW	Peak Load, MW[(a)]	Reserve MW	Margin[(a)] %
Florida Power Corporation	2,593	2,370	223	9.4
Florida Power & Light Company	7,431[(b)]	6,110	1,321	21.6[(b)]
Jacksonville Electric Authority	1,222	1,071	65	14.0
Orlando Utilities	430	365	65	17.8
Tampa Electric Company	2,025	1,400	625	44.6
Total	13,701[(b)]	11,316	2,385	21.0[(b]

(a) Not simultaneous values.

(b) Includes first Turkey Point nuclear unit. If it is not available, FPL capacity becomes 6,857 MW, State total becomes 13,127 MW, FPL reserve margin becomes 12.2%, and State reserve margin becomes 16%.

Note: Additional updated information is contained in Appendices E-3 and E-5 (pages E-5-2 and -3).

combined capacity of the Turkey Point Units 3 and 4 by 1975. During this time no existing plants will be shut down, and gas turbines and new fossil units will continue to be added to help meet both base-load and peaking conditions. No appreciable block of power is available either from within the Florida Power group or from the Northern Intertie.

X. ALTERNATIVES TO PROPOSED ACTION AND COST-BENEFIT ANALYSIS OF THEIR ENVIRONMENTAL EFFECTS

The Applicant has provided a discussion of alternatives and a cost-benefit analysis in the Environmental Report Supplement.[48] The AEC independent review is summarized below. In many cases, the AEC Staff found the Applicant's estimates adequate, and these were used in the AEC analysis. In other cases, estimates were made independently.

A. Summary of Alternatives

The economic costs and environmental impacts of the proposed action were described in the preceding sections. In this section, alternatives to the proposed action will be described in terms of their feasibility, economic costs, and environmental impacts. The alternative actions consist of:

- Building a new plant at an alternative site
- Using an alternative fuel at the existing site
- Once-through cooling using intake water from Biscayne Bay and discharging to Card Sound
- Once-through cooling with both intake and discharge in Card Sound
- Recirculation system using forced-draft cooling towers and brackish water make-up.

The alternative of not providing the Applicant's system with the block of power represented by Turkey Point Units 3 and 4 would have the following principal costs and social impacts: (1) shortages of power, perhaps as early as the 1972 summer peak load, (2) continued increasing shortages of power or power rationing over at least the next several years until other power sources could be established, (3) a loss of the capital investment up to \$185 million depending on salvage values and dismantling costs, and (4) the economic effects associated with the loss of jobs connected with the power plant and the loss of jobs, income, tourism, comfort, and the attendant risks associated with the shortage of power.

The economic effects of a power plant the size of Turkey Point Units 3 and 4 are substantial. At the average cost of power to customers, the annual sale of power from the two units would be \$190 million, if the plants operate at 80 percent of capacity. In addition, the operating plant would provide direct employment for about 100 persons and could increase the tax base of Dade County.

At current tax rates, the increase in revenues to all levels of government (including the Federal Government) would be almost $40 million annually in 1975, when the increase in the system base load exceeds the capacity of the two units[53].

Because the need for power was previously demonstrated (Section IX), not providing the additional power is considered an infeasible alternative.

As discussed previously, there is a shortage of reserves both in other Florida utilities and out-of-State utilities to the north. In addition, the interconnections with the other utilities to the north have low capacity and are unable to support substantial importation of power into the Applicant's system. For these reasons, the importation of power is considered an infeasible alternative.

1. Alternative Site

Constructing a new nuclear plant at an alternative site would incur large economic costs: the capital cost of the new plant, the loss of the unsalvageable sunk costs of the existing plant, and the incremental cost of replacement power during construction of the new plant.

The construction time required for a new nuclear plant is estimated to be 6 years. During the last few years, construction costs for new nuclear plants have increased sharply. Current estimates are for costs in excess of $300 per installed kw ($456 million, in the case of the Turkey Point units) for 1977 operation. The unsalvageable costs from the existing plants are estimated to be between $140 and $150 million.

The costs and source of replacement power during the delay interim would be quite variable, depending on existing conditions. For instance, in the near-term, temporary replacement power might be obtained from off-peak loads from existing fossil units for as little as 4 mills/kWh; but peaking power from gas turbines might cost as high as 20 mills/kWh, depending on the costs of new firm fuel supplies. Since the variable cost of nuclear power is 2 mills per kWh, the incremental cost of replacement power may vary from 2 to 18 mills per kWh, depending on the conditions of supply. In the subsequent analysis, a value of 5 mills per kWh is used to represent the mean incremental cost of replacement power. Since large quantities of imported power are unavailable, replacement power would largely be obtained within the Applicant's system, using peaking capacity; thus, sufficient power would probably not be available to meet all peak demands during the 6-year period. Power shortages or rationing would probably be necessary, threatening economic losses, safety and health effects, discomfort, and inconvenience to customers of the Applicant's system.

Because of the existing fossil units and advanced stage of construction of the nuclear units, many of the environmental impacts related to construction have already occurred. Roads have been built, canals dredged, land filled, and transmission lines built. Duplication of the power plant elsewhere would result in a repetition of many of these impacts. The principal reduction in environmental impact associated with an alternative site might be that related to the construction and operation of the recirculating cooling channel system in the 7,000 acres of swamp land, and a reduction in the size of the marine environment that is at risk.

2. Alternative Fuel

The alternative power sources to nuclear fuel are hydroelectric, natural gas, coal, and oil. No hydroelectric sites are available in Florida. Natural gas is used extensively in the Applicant's system, but firm supplies are not available for new base-load plants. Therefore, the only feasible alternative power sources are oil and coal.

Coal is being used in several power plants on the west coast of Florida, but high transportation costs make it economically unattractive in the Miami area. Expansion of the gas supply to the Applicant has not been possible.

Oil is widely used throughout the Applicant's system. Oil prices have risen in recent years, especially for low-sulfur oil, which is in short supply. The price and reliability of new oil supplies remain subject to many uncertainties over which utilities have little or no control. Thus, utilities need to spread the risks of fuel supply dependency through diversification.

Fossil fuel plants, both coal and oil, require very large quantities of fuel and generate large quantities of waste products compared to nuclear plants. Duplication of the power production of Turkey Point Units 3 and 4 with oil-fired units would require the combustion of over 50,000 barrels of oil per full-power day (several tanker shipments each week); and duplication with coal-fired units would require the combustion of 14,000 metric tons of coal per full-power day. The quantities of waste products emitted from the fossil-fired plants are shown in Table X-1. These emissions are assumed to meet the standards of the Clean Air Act of 1971.

TABLE X-1

Solid and Gaseous Emissions
from 1,520 MWe Oil or Coal-Fired Plant
(Metric Tons per Day)

	Oil[1]	Coal[2]
SO_2	91.5	137
NO_x	34.2	79.3
Particulate	11.6	11.6
Ash	91.0	1620

(1) 152,000 Btu/gal, 0.83% sulfur, 51,500 bbls per day.

(2) 10,000 Btu/lb, 14% ash, 0.55% sulfur

Fossil-fuel plants do presently operate at a higher thermal conversion efficiency than light water nuclear plants and dissipate about 10% of the heat directly to the atmosphere. As a result, the waste heat discharged to receiving waters by fossil plants is only about 70% of the waste heat discharged by nuclear plants.

Turkey Point Units 3 and 4 were designed and constructed to use nuclear fuel. Converting to fossil fuel would result in an unsalvageable loss of a substantial portion of the nuclear plants already constructed. Construction of new base-load fossil units is estimated to require 4 years, and replacement power would be required during this period. Since the annual expense for fossil fuel exceeds the annual expense for nuclear fuel, a continuing incremental annual fuel expense would be incurred throughout the life of the fossil plant.

To summarize, changing to an alternative fuel would result in an unsalvageable loss from the nuclear plant construction, which is estimated at between \$140 and \$150 million, and would require new capital investment for a duplicate capacity fossil plant, which is estimated at \$395 million. During the 4-year construction period, replacement power would be required at an incremental energy cost of about 5 mills/kWh or \$53 million annually. In addition, continuing annual expenses would be incurred during the operation of the fossil plant to cover incremental fossil fuel costs; these are also estimated at $53 million per year. As discussed in Section X.A.1. above, replacement power would probably not be available during all peak load conditions, possibly resulting in power rationing or shortages and other potential economic losses.

Changing to fossil fuel would allow the reduction of cooling channel complex area with a saving in land area of about 2,000 acres. Some small additional area would be required for oil tanks or coal storage. With a new oil-fired unit, the traffic and risk of oil spills in Biscayne Bay would be increased.

3. <u>Once-Through Cooling -- Biscayne Bay Intake, Card Sound Discharge</u>

In this alternative, which is the plan proposed by the Applicant in November 1970, the cooling flow of 4,250 cfs would enter the four units from Biscayne Bay via the existing intake canal. After passing through the plant condensers subsequent to screening, the water would be heated by about 15°F at full plant rating and then pass to the discharge canal. At a point about 15 minutes travel time down the canal, an additional flow of 6,000 cfs would be introduced as quenching or dilution flow. This water would also originate in Biscayne Bay. After mixing in a concrete control structure, the combined flows would pass to the south down the Card Sound Canal to be discharged into Card Sound at a temperature near 6°F above Biscayne Bay intake temperature. The dilution flow would be introduced as a means of reducing the time-integrated exposure of organisms which pass through the condenser system and enter the discharge canal.

At the point of discharge, the Canal would be dredged to permit a smooth transition flow zone out to depths of 6 feet MLW. The width of the discharge transition might be as great as 750 feet, depending on velocities which may be determined to be feasible. The warmed water would mix with Card Sound water by momentum mixing for about 1,000 feet from the point of discharge, after which dispersion would continue as a result of geostrophic and tidal forces. Steady-state plume areas computed using dispersion data available from existing plant operations and the low salinity discharges of the Model Land Canal are shown in Table X-2.

TABLE X-2

Estimates of Areas Within Various Isotherms for Once-Through Cooling -- Biscayne Bay Card Sound System

Temperature Elevation (°F)	Area (Square Feet)	Area* (Acres)	Radius of Arc (Feet)
5.5*	3×10^5	7	500
5.0*	7×10^5	16	1,000
4.0*	2.6×10^6	60	4,000
3.0*	1.3×10^7	300	7,000
2.0	8.9×10^7	2,040	18,000
1.0	4.7×10^8	11,000	42,000

* For purposes of estimating biological effects, multiply area by 2 to allow for motion of the plume during a tidal cycle.

The tidal circulation of the lagoon system has been previously described. The option described here would induce a net circulation of water from Biscayne Bay through the Plant to Card Sound and back to Biscayne Bay as a warmed stratified overflow. The total circulation to the north of approximately 1,000 acre-feet per tidal cycle would be modified substantially upwards (but by an indeterminate amount) because the northern end of Biscayne Bay is somewhat restricted in circulation. It appears probable that waters in the vicinity of the western shoreline of the Bay, and eastward for a distance of about 50% of the Bay's width, would assume a chemical and salinity identity essentially the same as the western half of Card Sound to the south. No stratification is predicted to persist beyond the 2°F isotherm, because at that point the stratifying forces are too weak to maintain a dividing interface. The system would tend to perpetuate and strengthen the mid-Bay salinity gradient because of the low saline discharges from the Model Land Canal and the western shore runoff, which at times may exceed the present 1,000 acre-feet per tidal cycle interlagoon transport. Salinity changes in the recirculation water which passes through the plant are expected to be relatively small. Circulation time through the plant canal system would be about 10 hours, and the return path circulation through the two-lagoon system would be on the order of 5 to 10 days, based on an affected zone of about 9 x 10^9 square feet or a zone volume of 180,000 acre-feet.

Because the primary flushing of both Card Sound and Biscayne Bay occurs from the seaward side, the resulting operation of the system would tend to create a relatively more permanent zone of decreased salinity on the western shore of about 3 to 5 ppt differential throughout most of the quiescent rainy periods. This would appear to reinforce natural tendencies reported in research on salinity and temperature differences in Card Sound and Biscayne Bay [21].

The temperature patterns would be somewhat independent of the salinity variation because the stratifying tendency of the plume would carry a warmed jet of water out about 10,000 feet until the 2°F isotherm was reached and mixing would occur. The circulation would then join in the joint movement of returning waters around Mangrove Point and back to the Turkey Point area.

Computations (Table X-2) of the area under the plume during steady-state conditions reveal areas for a given time frame only. The plume would shift from north to south as the tide changed and the affected area in the vicinity of the discharge point would be subjected to a changing temperature regimen, distributed in an arc having radii reported in Table X-2. Card Sound temperatures have been measured near the equilibration temperature, so there is a reasonable probability that temperatures within the 3°F isotherm might exceed 95°F during unfavorable periods of low rainfall, high solar radiation, and little or no wind circulation (the principal energy source for flushing of Card Sound waters). This would not be expected to occur for more than 10 to 15% of the time during the three summer months under worst conditions.

This cooling concept is estimated to cost about $3 million (capital costs) to finish the dilution-mixing structure and the Card Sound Canal, but would save $22 million in land and construction cost for the cooling channel system. No replacement power is required under this operation, since it is probable that construction could be completed within a short time of reactor startup.

The impact on marine life resulting from the intake of 4,250 cfs and discharge into the canal with a Δt of 15°F could be considerable in terms of mechanical and thermal damage to entrained organisms. The thermal damage could be reduced somewhat by relocating the injection of dilution water to a point in the discharge canal closer to the plant. Following discharge to Card Sound, the area subjected to a Δt of 4°F at any one time will be about 60 acres. The area affected by the plume over a tidal cycle will be roughly twice that area. This is slightly smaller than the present damaged area for the same Δt in the summer months in Biscayne Bay. It may be anticipated that the discharge will create a new circulation pattern northward which will result in a relatively stable independent system between the discharge point and Turkey Point. The diversity of organisms may be changed as a result.

The impact on the terrestrial ecology of this alternative would probably be slight, for very little additional land or construction would be required.

4. Once-Through Cooling -- Card Sound Intake and Discharge

In this alternative, which is a modification of the plan proposed by the Applicant in November 1970, the cooling water flow of 4,250 cfs would originate in a new canal to be dug from a point just below Mangrove Point. In addition, a dilution flow of 5,750 cfs would be conveyed in the same canal to a point near the existing intake forebay. At this location, 4,250 cfs would pass through the condensers with a temperature rise of 15°F and the balance would be pumped to a mixing structure adjacent to the discharge afterbay where the temperature would be reduced to a maximum of a 6°F Δt. The entire 10,000 cfs would then return to Card Sound via the existing Card Sound Canal. (Figure X-1.)

The apparent advantage of this alternative would be to reduce the possibility of upsetting the relative salinity and nutrient distribution in Biscayne Bay and Card Sound by essentially confining the entire recirculation pathway to Card Sound proper. The discharge would be released under flow and temperature conditions essentially identical to the previous alternative, and the transient mixing zones would be about the same during flood and intermediate tidal conditions.

During ebb tide the discharge plume would swing toward the inlet canal just below Mangrove Point, and a small fraction of the released water would be recirculated. This is estimated to be less than 10%, and probably less than 5%, of the total circulation based on the mixing and thermal dissipation characteristics of Card Sound. The circulation system would create a region of lower salinity on the western shore of Card Sound, except when brisk onshore winds might induce sufficient mixing to overcome the lateral stratification of the thermally elevated zone. This latter zone probably would be about the same size as that in the previous case, but it would be more concentrated to the west and most probably would have a sharper salinity transition. Since tidal movement would shift the resulting warmed area cyclically to the north and south, the plume would shift correspondingly and the thermally affected zone, as in the previous case, would travel within an arc of radii described in Table X-2.

Provisions would have to be made at the inlet of the intake canal to exclude fish and mobile organisms. This exclusion might be in the form of traveling screens or modifications of this system. The intake structure would be about 800 feet wide and 10 feet deep with a net flow velocity of 1.2 feet per second normal to the barrier surface. A dredged apron would provide a transition out to the selected depth of about 6 feet, some 400 feet into Card Sound. It is assumed that part of the pump requirements might be satisfied by those purchased earlier for use by the Applicant.

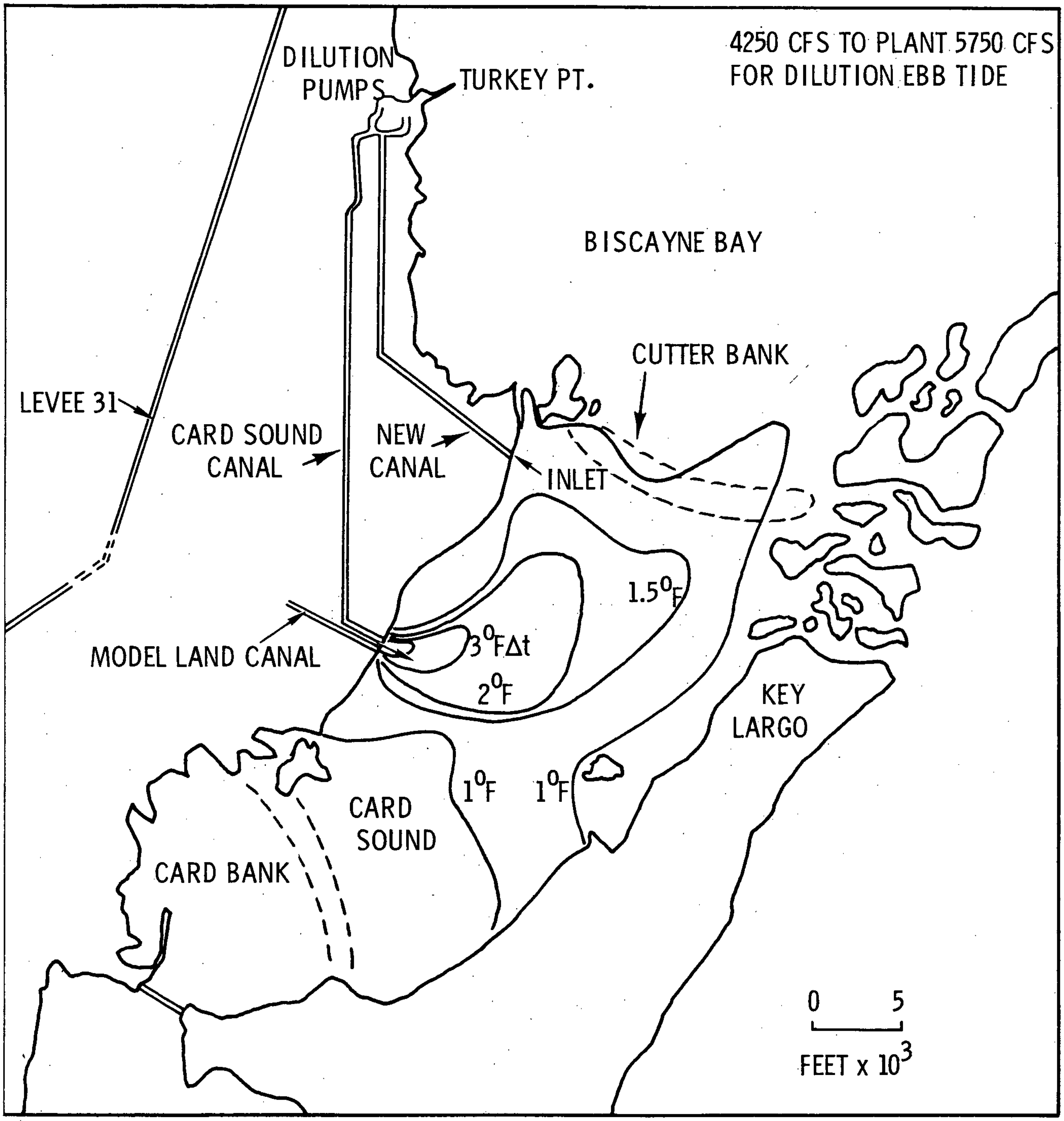

FIGURE X-1 Predicted Isotherms Once-Through Cooling--
Card Sound Intake and Discharge

The net result of this system would be to utilize the heat assimilative capacity of Card Sound as a separate lagoon essentially separated from Biscayne Bay, as evidenced by the relatively small tidal exchange of 1,000 acre-feet per tidal cycle estimated by Bader et al. and other investigators. The chemical characteristics of the Sound are predicted to remain essentially unchanged; and, outside of the plume area, the thermal regimen would also remain essentially unchanged. About 5% of the total area of the Sound would be permanently raised by 3°F or more, an area roughly 650 acres in size. This is about the size of the area affected by the present fossil plants (as reported in the literature and studies by Bader et al.[29]), and potentially appears to produce the minimum impact on the more valuable features of the local ecology of all of the systems using seawater as a coolant.

This alternative cooling concept is estimated to cost $11 million in land and construction, but will save $22 million in land and construction costs as compared to the cooling channel system. No significant change in annual operating costs is expected. The new canal is expected to take a year to construct, during which time the power levels would be held to 25%; the cost of replacement power would be $44 million for that year for this option. No replacement power would be required for succeeding years.

The impact of this alternative cooling operation on the aquatic life is predicted to be considerably less than for Alternative 3 (Biscayne Bay intake). With the addition of dilution water at the head of the existing Card Sound Canal, the exposure time of entrained organisms to a Δt of 15°F would be reduced to about 15 minutes. The organisms would then be exposed to a Δt of 6°F for 6 to 8 hours. Of more importance is the area affected in Card Sound. It is calculated that the area subjected to 4°F Δt will be approximately 60 acres, or 120 acres over a tidal cycle. This is less than half the area damaged for approximately the same temperature increment under 1970 discharge conditions to Biscayne Bay. The circulation pattern in the immediate area between the outfall and the intake structure would be changed with possibly some detrimental effects on certain species.

The impact of this alternative on land use and terrestrial ecology would be less than for the reference case but slightly more than for Alternative 3, since this alternative requires the construction of a new canal covering some 200 acres.

5. <u>Cooling Towers Using Brackish Water</u>

The Applicant has reviewed the costs and performance options of open-cycle, saltwater cooling towers in the Environmental

Report Supplement. The basis for this concept was the use of the towers in place of a cooling lake or pond situated on a direct, open-cycle cooling loop without recirculation. The Applicant covered the infeasibility of the system due to problems of corrosion and salt deposition. However, there are two aspects which appear to need additional consideration: the use of brackish water in a closed-cycle cooling system, and the appearance and effects of the vapor plume under a variety of expected weather conditions.

A number of utilities have been investigating the construction of closed-cycle systems utilizing water that is brackish or that has a salinity on the order of 1 to 2 ppt. Salinities in this range are normal concentrations for towers operating in the Lower Colorado River Basin. In the latter case, restrictions on the disposal of blow-down are especially strict; but, in the case of the Turkey Point system, sea dilution would appear to be feasible. The canal system of the Central and Southern Florida Drainage District appears to be a possible source of brackish water, if the supply is tapped at distances of from 5 to 6 miles away from the plant (e.g., in the vicinity of Homestead Air Force Base and conveyed by pipe to the plant site). However, a firm supply of 90 cfs would be required, and the canal system does not appear capable of providing this on a year-round, reliable basis. If studies on availability of deep groundwater should find sufficient water, the latter source, alone or in conjunction with the canal system, might provide ample make-up water for a cooling tower.

Operation at a 3:1 concentration factor would produce blowdown water of about 6 to 8 ppt salinity. Disposal of water of such a salinity in the existing drainage system would not be expected to produce a measurable impact on marine organisms in the Bay or Sound, if biocide concentrations are under control limits similar to those applied to other systems. However, some ground deposition of salt spray could still be expected. The carryover of salt for a tower with 0.1% drift would result in ground deposition of a substantial quantity of salt, about 5,000 lb/hr (38 million pounds per year) over an area estimated at from 3 to 10 square miles. The operation of units under similar saline conditions in the Four Corners area of New Mexico has been determined to be feasible. The feasibility of this alternative needs additional investigation in the near-term to determine if it has merit in the context of the Turkey Point situation. Some efforts along this line are planned to be undertaken by the Applicant.

Aside from the physical impact of deposited salts, of principal consideration in the selection of this alternative cooling method are the local effect on climatic conditions in the plant vicinity and questions on the aesthetics of the visible plume resulting from operation of a large cooling tower installation. The case for Turkey Point appears especially important because of the proximity to real estate developments on Key Largo, plus the anticipated growth patterns in residential development to the south of Miami. Prevailing winds are principally east or southeast, directions which would have a visible plume inland. While ground fogging, as such, is not expected to occur except under exceptional circumstances, it is appropriate to consider that a visible plume will exist for a majority of the time. The plume size will vary from a few hundred yards in length to several miles in the extreme, and the height will range between about 100 and 400 yards, depending on the thermal stabilization condition of the atmosphere. Such a plume might be of some aesthetic concern to residents of South Miami. No local climatic modification of significance would be expected.

The cooling towers alternative is estimated to cost about $22 million for towers, land, and the brackish water supply system, but would save about $22 million in land and construction cost for the cooling channels. It is estimated that 2 years would be required to complete an eight-to-ten-tower system in 4 six-month phases. The power levels could be gradually increased from 25% as new cooling towers were phased in. Under this timetable, the replacement power would be required only in the first year for the nuclear units and is estimated to cost $25 million extra. The average load factor of 80% could possibly be reached by the nuclear plants in the second year. This option would be expected to add $2.2 million to the annual operating cost.

The impact on aquatic life would be minimal under this alternative. The principal environmental impacts would be attributable to a visible plume and to salt deposition on the surrounding land. If a deep groundwater source were used for make-up water, additional evaluation would be needed for possible adverse effects from depletion of this resource.

6. Summary

In summary, five alternative actions were considered feasible in addition to the proposed action. The costs of the Applicant's proposed plan are summarized in Table X-3 and the estimated costs of the alternative actions are summarized in Table X-4. The cost of replacement power under each alternative is summarized in X-5. It is assumed in the replacement power cost calculation that, under the Applicant's proposed cooling channels system, the Plant will start at 25% of full

TABLE X-3

Costs of Turkey Point Nuclear Units as Proposed
($ Millions)

	Total Costs	Incremental Construction Costs
Nuclear Plant Construction		
Committed	169	
To be Committed	16	16
Total	185	
Estimated Salvage Value	20	
Cooling Channels System		
Land Acquisition	5	5
Channel Construction	17	17
Total	22	
Total Capital Costs	207	38
Annual Operating Costs*		
Fuel	21	
Operation and Maintenance	3	
Cooling Water System	0.4	
Total	24.4	
Present Worth for 30 Years of Operation**	256	

* At a load factor of 80% (10.7 x 10^9 kwh/yr).
** At a discount rate of 8.75%/yr.

TABLE X-4

Differential Costs of Alternative Actions
($ Millions)

	Alternative Site (Nuclear Power)	Alternative Fuel	Alternative Cooling Water Case 3	Case 4	Case 5
CAPITAL COSTS					
New Plant	456	395	3	11	22
New Cooling Water System (3000 Acres)	0	17	0	0	0
Less Salvage	(20)	(20)	0	0	0
Less Incremental Construction Cost	(16)	(16)	0	0	0
Less 4000 Acre Cooling Water System	(22)	(22)	(22)	(22)	(22)
Total New Capital	398	354	(19)	(11)	0
Present Worth[b]	287	282	(16)	(8)	0
ANNUAL COSTS					
Replacement Power	*	*	*	*	*
Fuel and Operating	24	77.4	24.4	24.4	26.6
Less Costs of Proposed Action	(24.4)	(24.4)	(24.4)	(24.4)	(24.4
Incremental Fuel & Operation Expenses	(0.4)	53	0	0	2.2
Present Worth	(2)[a]	382[c]	0	0	23

* See Table X-5.
(a) Years 7-30, parentheses represents savings.
(b) Under the economic assumptions described in Section IX.B.
(c) Years 5-30.

TABLE X-5

Replacement Power Requirements
($ Millions)

Year	Proposed Action	New Site	New Fuel	Alternative Cooling Concepts Case 3	Case 4	Case 5
1	$ 25	$ 53	$ 53	0	$ 44	$ 25
2	11	53	53	0	0	0
3	0	53	53	0	0	0
4	0	53	53	0	0	0
5	0	53	0	0	0	0
6	0	53	0	0	0	0
Present Worth						
	32	238	172	0	40	23
Differential Present Worth						
	0	206	140	(32)	8	(9)

power for the four units and increase linearly to 80% of full power at the end of the 4-year cooling channels construction and testing period, in order to minimize heat discharges to Card Sound. It is further assumed that the nuclear plants will be loaded preferentially to the fossil plants, since the incremental cost of power is less. The cost of replacement power is the penalty in efficiency incurred from operation of the nuclear plant at less than 80% load factor. This is assumed to cost 5 mills/kwh consistent with the cost of replacement power for other options.

Information in Tables X-4 and X-5 shows that the new site alternative will incur a large capital cost and a large cost for interim replacement power. Similarly, the new fuel alternative incurs a large new capital cost, a large cost for interim replacement power, and, in addition, a large continuing incremental fuel expense. The Alternative 3 cooling option results in significant savings in capital and interim replacement power and a negligible savings in operating cost. The Alternative 4 cooling option results in a small savings in capital cost, which is offset by the cost of interim replacement power; there is no significant change in operating cost. The Alternative 5 cooling option is a standoff in capital costs; the small savings in interim replacement power is offset by the increase in annual operating expense. Tables X-3, X-4, and X-5 also show the present worth of the capital cost, replacement power, and annual operating expenses.

B. Summary of Cost-Benefit Analysis

The following summary discussion includes revisions from the Draft Statement which reflect additional discussion given in Section XI.

The principal benefit from operation of the Turkey Point Units 3 and 4 is the addition of a gross generating capacity to the Applicant's system of 760 MW for each of these two nuclear units. The Applicant estimates power production from these two units of 10 billion kilowatt-hours per year[48]. The increase in generating capacity and reserve margin for the FPL system and the Florida Interconnected Utilities which will accompany full operation of Units 3 and 4 will benefit the Florida area by helping to meet the critical power needs as discussed in Section IX.

Minor benefits will also accrue through increased recreational use of the area by the public. Much of the development of recreational facilities (Scout camps, nature trails, picnic area) appears to have occurred in relation to construction and operation of the fossil-fueled Units 1 and 2, and would only partly be a benefit directly related to Units 3 and 4.

In the analysis of alternative actions only those costs and benefits which will occur in the future are considered. Although sunk costs are not relevant in the selection of alternatives, it should be realized that these costs ($150 million in this case) are real and must be recovered in some manner. The cost-benefit evaluation takes into account the different times that capital costs may be incurred as well as the various and different annual costs for each alternative. The methodology is discussed further in Appendix D.

The choice of alternative actions is made in terms of the differential costs and benefits compared to the reference design. In evaluating impacts from alternatives, one must realize that, unless rather extensive research has been done on alternative systems, the assessment of both costs and benefits has a greater degree of uncertainty than the reference case.

The feasible alternatives and their significant costs and benefits are summarized in Table X-6; only the equivalent capitalized costs are shown. The first column shows the present value of the continuing costs for the reference case, the Applicant's proposed action, and the associated significant environmental impacts. It is important to remember that these are considered statements of impact subject to qualifications and contingencies discussed in the text. In the remaining columns the differential costs and impacts of the alternative actions from the reference case are shown. The differential costs are those over and above the $323 million shown for the reference case. Thus, the $491 million differential cost of the alternative site action represents a total cost of $814 million minus the $323 million in continuing costs for the reference case.

The alternative fuel option is considered inferior to the reference case, since the costs are much higher ($804 million). Although there accrues a reduction of some 2,000 acres (25%) in land area required for the cooling system (about 1,000 acres of water surface), transportation traffic is increased greatly, there are risks of oil spill, and greater volumes of waste products are generated. The alternative site option is also inferior since the costs are much higher ($491 million), the environmental impacts of new construction would be repeated, and the environmental impacts at the alternative site are not known. Offsetting this might be the saving of 3,000 acres (75%) of cooling reservoir surface area

TABLE X-6

COST-BENEFIT SUMMARY FOR TURKEY POINT - ALTERNATIVE ACTIONS

COST [1]	REFERENCE CASE	ALTERNATIVE SITE (NUCLEAR)	ALTERNATIVE FUEL (OIL)	ALTERNATIVE HEAT DISSIPATION METHODS: ONCE-THROUGH COOLING: BISCAYNE BAY INTAKE CARD SOUND DISCHARGE	ALTERNATIVE HEAT DISSIPATION METHODS: ONCE-THROUGH COOLING: CARD SOUND INTAKE CARD SOUND DISCHARGE	ALTERNATIVE HEAT DISSIPATION METHODS: COOLING TOWERS
	CONTINUING COSTS			DIFFERENTIAL COSTS *		
CAPITAL	35	287	282	(16)	(8)	0
REPLACEMENT POWER	32	206	140	(32)	8	(9)
FUEL AND OPERATING	256	(2)	382	0	0	23
TOTAL PRESENT WORTH	323	491	804	(48)	0	14
ENVIRONMENTAL IMPACTS				DIFFERENTIAL IMPACTS		
LAND USE						
AGRICULTURAL	NO EXISTING AGRICULTURE	UNKNOWN	NOT DIFFERENT	NO SIGNIFICANT DIFFERENCE	NO SIGNIFICANT DIFFERENCE	SALT SPRAY MIGHT CAUSE SOME DAMAGE TO NEARBY AGRICULTURE FARMLAND
RECREATION	INCREASED ACCESS TO SWAMPLAND-RECREATIONAL FACILITIES CONSTRUCTED IN CONNECTION WITH EXISTING FOSSIL PLANTS-INCREASED BEACH AREA-NUCLEAR PLANTS AND CANAL SYSTEM ARE PROBABLE TOURIST ATTRACTIONS	DECREASED PUBLIC ACCESS TO SWAMP-LAND AREA	NOT DIFFERENT	DECREASED PUBLIC ACCESS TO SWAMP-LAND AREA	DECREASED PUBLIC ACCESS TO SWAMP-LAND AREA	DECREASED PUBLIC ACCESS TO SWAMP-LAND AREA
HISTORIC AND SCIENTIFIC	NO HISTORIC OR SCIENTIFIC SITES EXIST ON THE AFFECTED LAND AREA	UNKNOWN	NOT DIFFERENT	NOT DIFFERENT	NOT DIFFERENT	NOT DIFFERENT
NATURAL AREA	6500 ACRES OF NATURAL AREA PERMANENTLY AFFECTED- 4 RARE AND ENDANGERED SPECIES MAY EXIST IN THE AREA	UP TO 4500 ACRES OF EXISTING NATURAL AREA PRESERVED; UNKNOWN EFFECT AT NEW SITE	UP TO 2000 ACRES OF EXISTING NATURAL AREA COULD BE PRESERVED	UP TO 6000 ACRES OF NATURAL AREA COULD BE PRESERVED. VERY LITTLE ADDITIONAL CONSTRUCTION REQUIRED.	UP TO 6000 ACRES OF NATURAL AREA COULD BE PRESERVED--DISRUPTIONS CAUSED IN DIGGING NEW CANAL	UP TO 6000 ACRES OF NATURAL AREA COULD BE PRESERVED
LAND REQUIREMENTS	7000 ACRES TOTAL	1000 ACRES MINIMUM, POSSIBLY MORE DEPENDING ON LOCATION	7000 ACRES TOTAL	3300 ACRES TOTAL	3300 ACRES	3300 ACRES
SHORELINE	LITTLE RISK OF ALTERATION OF SHORELINE FLORA AND FAUNA CAUSED BY TEMPERATURE AND SALINITY CHANGE	REDUCED RISK OF PERMANENT ALTERATION OF EXISTING SHORELINE. UNKNOWN EFFECT AT DIFFERENT SITE.	NO SIGNIFICANT CHANGE	LITTLE RISK OF PERMANENT ALTERATION OF EXISTING SHORELINE FLORA AND FAUNA	LITTLE RISK OF PERMANENT ALTERATION OF EXISTING SHORELINE FLORA AND FAUNA	NO RISK OF PERMANENT ALTERATION OF SHORELINE OVER THAT ALREADY ALTERED.
WATER USE						
COMMERCIAL	IMPACT ON COMMERCIAL FIN AND SHELLFISHING EXPECTED TO BE MINOR	UNKNOWN	POTENTIAL OIL SPILL	IMPERCEPTIBLE IMPACT	IMPERCEPTIBLE IMPACT	NO SIGNIFICANT DIFFERENCE
RECREATION	IMPACT ON RECREATIONAL WATER USES EXPECTED TO BE MINOR; EXPANDED PUBLIC ACCESS TO FISHING SITES NEAR PLANT	UNKNOWN	POTENTIAL OIL SPILL	NO SIGNIFICANT DIFFERENCE	NO SIGNIFICANT DIFFERENCE	NO SIGNIFICANT DIFFERENCE
HISTORIC AND SCIENTIFIC	EXCEPT DURING INTERIM OPERATION OR EMERGENCY CONDITIONS, THE IMPACT ON BISCAYNE NATIONAL MONUMENT IS EXPECTED TO BE MINOR	UNKNOWN	ADDED SHIPPING AND POTENTIAL OIL SPILLS IN BISCAYNE NATIONAL MONUMENT	REQUIRES 10,000 CFS OF WATER FROM BISCAYNE BAY-ALTERS NATURAL CIRCULATION SYSTEM	NO SIGNIFICANT IMPACT ON BISCAYNE NATIONAL MONUMENT	NO SIGNIFICANT DIFFERENCE
MARINE LIFE	AFTER COOLING SYSTEM IS COMPLETE, DAMAGE TO MARINE LIFE IS EXPECTED TO BE LIMITED TO 10 ACRES SUBJECT TO +3°F ΔT, EXCEPT UNDER POTENTIAL EMERGENCY CONDITIONS; THE COMBINED AREAS IN BISCAYNE BAY AND CARD SOUND WITH A $\Delta T > 4°F$ IS ESTIMATED AT 1500 ACRES DURING INTERIM OPERATION AT 50% LOAD FACTOR.	UNKNOWN	ABOUT SAME EFFECT ON CARD SOUND AFTER COMPLETION OF COOLING SYSTEM. PLUS POTENTIAL OIL SPILLS	UP TO 120 ACRES OF CARD SOUND WILL BE SUBJECT TO +4°F ΔT. CONSIDERABLE MECHANICAL AND THERMAL DAMAGE TO ENTRAINED ORGANISMS CHANGED CIRCULATION PATTERN IN BAY AND SOUND	UP TO 120 ACRES SUBJECT TO +4°F ΔT PER TIDAL CYCLE--CHANGED CIRCULATION PATTERN LARGELY LIMITED TO CARD SOUND	NO SIGNIFICANT EFFECT ON MARINE LIFE, ASSUMING NO BIOCIDES
AESTHETICS	NO SIGNIFICANT INTRUSION BEYOND THAT FROM EXISTING UNITS	ADDED INTRUSION AT NEW SITE	TALL STACKS AND VISIBLE VAPOR AND GASEOUS EMISSIONS;	NO CHANGE	NO CHANGE	NEW STRUCTURES AND FOGGING, VISIBLE PLUME MAY RANGE IN HEIGHT FROM 100 TO 400 METER AND EXTEND UP TO SEVERAL MILES DEPENDING ON ATMOSPHERIC CONDITIONS
FUEL TRANSPORTATION	50 METRIC TONS OF NEW FUEL REQUIRED ANNUALLY	NO CHANGE	15 MILLION BARRELS OF OIL PER YEAR-2-3 LARGE TANKERS OR BARGES PER WEEK	NO CHANGE	NO CHANGE	NO CHANGE
WASTE PRODUCTS	50 METRIC TONS OF SPENT FUEL ANNUALLY--~12 MAN-rem/YR RADIATION EXPOSURE	NO CHANGE	SO_2 125 tons/day NO_x 63 tons/day PARTICULATE 18 tons/day ASH 113 tons/day	NO CHANGE	NO CHANGE	90 CFS WATER EVAPORATED TO STEAM. 38 MILLION POUNDS OF SALT PER YEAR DEPOSITED OVER 3-10 SQUARE MILES

* IN ADDITION TO $323 MILLION CONTINUING COSTS AND $20 MILLION SALVAGE VALUE (WHERE APPLICABLE) FOR THE REFERENCE CASE.

1 ALL COSTS ARE PRESENT WORTH IN MILLIONS OF DOLLARS.

( ) PARENTHESES REPRESENT SAVINGS.

and another 2,000 acres of raised and peripheral land for a total potential land savings of 5,000 acres, less the cost of whatever other cooling method was required. At nearly $500 million in added present worth costs, this would give apparent present worth to the land saved of $100,000 per acre, over 1,000-fold greater than its current market price. Although it is incorrect to attribute the entire cost to the land area, this does indicate the order of magnitude of the inferred land value under this alternative.

The once-through cooling alternative using Biscayne Bay water with discharge to Card Sound, the Applicant's 1970 plan, is the apparent least costly of all alternatives and results in a present worth savings estimated at $48 million. Most of this savings occurs because the nuclear plants would be able to operate at full capacity soon after start-up under this option. This savings is equivalent to the present worth of $4.6 million per year for 30 years, which greatly exceeds the economic value of aquatic life that might be adversely affected. This alternative, however, is not in accord with the terms of the final judgment entered in the suit between the Federal Government and the Applicant [43].

The once-through cooling alternative using Card Sound intake and discharge is an apparent stand-off in costs. The principal effect of this alternative would be to preserve some 6,000 acres of natural area in its present state. However, the effect on the Card Sound ecosystem, while postulated to be small, has not been assessed in detail, and such study might require several years to complete. Delays beyond the 1 year assumed would greatly increase the costs for replacement power for this alternative, if the nuclear plants were restricted in operation. Thus, several uncertainties are associated with this alternative which do not permit a definitive evaluation to be made at this time.

The cooling tower alternative is slightly more expensive ($14 million) than the reference case. Installation of cooling towers would permit the preservation of some 6,000 acres of natural area. Because Homestead Air Base is within 5 miles of Turkey Point in the direction of the prevailing wind, the cooling tower plume conceivably could restrict operations at the base. Although salt deposition is not expected to be of sufficient concentration to affect nearby farm crops, more detailed study would be required to affirm this tentative assessment. Therefore, largely because of a potential extensive vapor plume and uncertainties surrounding salt deposition, this alternative is not currently preferable to the reference case.

Although all of the cooling alternatives would probably reduce the impact on the natural terrestrial environment, these alternatives have potentially greater offsetting impacts on the aquatic or atmospheric environment and contain other uncertainties and risks. The main issue in the reference case is the value of the proposed 7,000-acre salt-marsh area as a natural habitat, compared to its value as a cooling system and its potential increase in value for human uses as the development of the land might present opportunities of this nature. Another issue is that performance of the proposed cooling channel system under adverse summer weather conditions may cause plant loading to be limited in order that requirements of the court decree be met (see Section XI-D). A subsidiary issue is the probability of eventual development of the land and its removal as a natural area. It is possible that population pressures might result in the development of this area during the 30 to 40 years of plant life. In that event, the reference case would probably hasten that development and also have the least probable long-term impact on the environment.

The consent decree which settled the Federal suit against the Applicant [43] requires FPL to arrange joint studies immediately with appropriate Government officials to seek ways of improving on the proposed cooling channel system. Alternative sources of groundwater and surface water are to be sought. Mechanical cooling methods to replace or supplement the system are to be examined. These methods will include both powered spray modules and mechanical draft cooling towers. The Applicant has agreed to utilize such improvements as these research programs develop, with resolution of uncertainties in favor of the environment [51].

On balance, it is concluded at this time that the Applicant's existing plant design is an acceptable proposal for providing the needed power. Although there are alternative cooling systems which may be competitive in costs and have the potential for less impact on the environment, there are uncertainties at this time that these alternatives would be better than the Applicant's current design. Continuing monitoring and study programs are to be carried out to evaluate further the environmental impact of the proposed action. Studies are also to be conducted on possible improvements over the proposed cooling system, including the once-through cooling systems described in this Section X. Results developed in the study programs are to be utilized in improving and modifying the operation of the plant and its cooling system so as to achieve a minimal environmental impact.

XI. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT STATEMENT ON ENVIRONMENTAL CONSIDERATIONS

Pursuant to paragraphs A.6 and D.1 of Appendix D to CFR Part 50, the Draft Detailed Statement was transmitted with a request for comment to:

Council on Environmental Quality
Advisory Council on Historic Preservation
Department of Transportation
Department of Commerce
Department of Health, Education and Welfare
Department of the Army, Corps of Engineers
Federal Power Commission
Department of the Interior
Department of Agriculture
Department of Housing and Urban Development
Environmental Protection Agency
Florida Department of Air and Water Pollution Control
Florida Department of Administration
County Manager of Metropolitan Dade County, Florida

In addition, the AEC requested comments from interested persons by a notice published in the Federal Register on February 16, 1972 (37 FR 3467).

Comments were received in response to the above requests from each of the listed agencies, except the Department of Health, Education and Welfare, the Council on Environmental Quality, and the Dade County Manager. In addition, comments were also received from the Applicant and from Dr. Martin Roessler and from Dr. Anitra Thorhaug, both of the University of Miami School of Marine and Atmospheric Science.

Consideration of all comments received is reflected in part by revised text in previous sections of this statement and in part by the following discussion.

A. Alternatives and Cost-Benefit Analysis

Several commentors suggested alternative methods of dissipating the heat contained in condenser effluent and alternative methods of operating the cooling channel system, including not operating the plants (producing the power) until the cooling channel system is completely installed. With respect to this latter consideration, the Staff has concluded that the effects of delay in facility operation could be adverse to the public interest. There is a serious shortage of generating capacity in the area served by the FPL system, alternative sources of power are not practically available on a reliable and timely basis, and delay would threaten consumers with power interruptions that could adversely affect public health and safety and cause economic hardships in the area. Several other comments were received along a similar vein, to wit, "the Applicant should be concerned with the lessening of demand for electricity as well as the supplying of power, as a means of adequately serving the public. Recent advertising of the Company appears to recognize this, but much more could be done." Also, "a program should be undertaken by FP&L to discourage or reduce low priority demands for power and cease to proceed on the faulty assumption that every demand for power must be granted as necessary to promote general welfare no matter how fundamental and basic or how whimsical, frivolous, or novel the intended power usage might be." This Final Environmental Statement discusses the energy demand from the standpoint of actual anticipated demand without consideration of the desirability or utility of the uses of the energy which comprise that demand.

Two cooling alternatives suggested were: Biscayne Bay Intake and Card Sound Discharge (once-through) with dilution immediately before discharge into the Sound; and alternating discharge at two or more sites (6 hours on, 6 hours off) with intake from either the Bay or Sound. The first alternative would be midway between the two once-through cooling alternatives evaluated in the Draft Statement (Cases 3 and 4) in both cost and impact, and is perhaps more properly a modification rather than a distinct alternative. The second alternative would tend to increase both the cost and terrestrial impact attributable to digging new discharge canals. Also, the impacts of alternating discharges on aquatic life would depend upon time-temperature-damage relationships which have not been adequately determined at this time.

As stated in the Summary of Cost-Benefit Analysis (Section X-B) the Applicant, through the consent decree, has agreed to work jointly with appropriate agencies to seek ways of improving on the channel cooling system. In this regard the Applicant has submitted a planned research program and matching funds grant application to the EPA for the investigation of a mechanical draft cooling tower and water spray modules as replacement or supplemental cooling for the present channel system. Also, plans are in progress to investigate brackish deep groundwater and surface water sources of supply for either the mechanical cooling devices or the channel system.

Questions were raised by several agencies on the methods and values used to determine replacement power costs. The probable cost is certainly open to some question since the source of this power cannot be defined. The cost of fossil fuel for base load plants is in the range of 4-1/2 to 6-1/2 mills/Kwh, depending on source, sulfur content, and whether spot or average prices are used. If all replacement power could be supplied from base load plants, then the differential cost would be 2-1/2 to 4-1/2 mills/Kwh. However, substantial portions of the replacement power would probably have to be derived from turbines in which the heat rate is much higher. These costs would probably run between 10 and 18 mills/Kwh, depending on whether the capital costs were included. Also, if replacement power is provided from plants far distant from the Miami load center, then the transmission losses would tend to increase the incremental cost. The Turkey Point Units 1 & 2 have a combined capacity of only about one-half that of Units 3 & 4, and thus could not possibly supply all the replacement power.

The replacement power cost in the proposed action is the differential cost from Case 3 in which no restrictions are placed on the operation of any of the Turkey Point units. In summary, although the minimum incremental fuel cost for replacement power would be about 2-1/2 mills/Kwh, the AEC Staff estimates a more reasonable average cost would be 5 mills/Kwh.

Of more significance is that Unit 4 schedule for operation has been revised to 1973. If this plant is not available for operation in 1972, then the cost of replacement power would be lowered by $26 million in the first year (1972) for all of the alternative actions except Case 3, which would remain at zero since this case assumes no operation restrictions. Although Units 3 and 4 were planned to be used for base load capacity, this base load capacity reduces the amount and usage of peaking capacity.

Information in the following Table XI-1 (supplied by the Applicant[72]), which gives data on the expected net generation for Turkey Point for 1972 through 1976, was used as a part of the cost-benefit analysis.

B. Terrestrial-Aquatic Ecological Relationships

Additional information supplied by the Applicant's consultants on the distribution of mangroves in the cooling channel area and their contribution of nutrients to the waters of the Bay and Sound has resulted in a re-evaluation by the Staff of earlier expressed concerns in this area (see Appendix E-5, pages E-5-6 thru -11 and Appendices B and E-9).

The area of the proposed cooling channel system presently occupied by mangroves appears to be on the order of 1000 acres or less.

Table XI-1. TURKEY POINT PLANT GENERATION FORECAST[1]

1972 - 1976

	1972	1973	1974	1975	1976
CAPABILITY - MW, NET					
JANUARY	-	2272	2272	2272	2272
AUGUST	960[2]	1360[2]	1660[2]	2146	2146
ENERGY - THOUSANDS OF KWH, NET					
FOSSIL	3,050,000	1,100,000	1,100,000	4,600,000	4,600,000
NUCLEAR	880,000	6,090,000	9,100,000	10,150,000	10,150,000
TOTAL	4,930,000	7,190,000	10,200,000	14,750,000	14,750,000

NOTES:

(1) Based on: Turkey Point Unit 3 in service - 7/72
Turkey Point Unit 4 in service - 1/73
Cooling surface in service - 1000 A, 11/72
- 2000 A, 7/73
- 3000 A, 3/74
- 4000 A, 11/74

(2) Reflects plant capability limitations based on 95°F maximum temperature of circulating water discharges to Card Sound and Biscayne Bay.

The bulk of the area is vegetated largely by black rush, Juncus roemerianus, which contributes less detrital material to estuarine systems unless effectively flushed, which is not the case at Turkey Point. Furthermore, the present nutrient contribution of the mangroves to the Bay and Sound appears to be rather minimal in comparison to that of the turtle grass, Thalassia, and macro-algae. Based on two years measurements of growth rates and mapping by scuba and aerial photography, it is estimated (Appendix E-9) that the turtle grass (primarily because of the greater area it occupies) contributes about 90 percent of the productivity to the aquatic community.

The Applicant has provided additional information on the movement of groundwaters in the area[72,73] that the Staff has used in re-evaluating the potential impact of channel seepage losses on shoreline and benthic communities. Warm saline seepage from the channel system is expected to flow toward Biscayne Bay in the upper portions of the Biscayne aquifer, which slopes gently toward the Bay. The top of the aquifer, at a depth of 5-10 feet, is overlain with relatively impermeable silt, marl and organic material, which provides confinement of the seepage to the Biscayne aquifer. Thus the seepage would discharge into the Bay and Sound at locations several hundred feet offshore and at water depths of 5-8 feet rather than at the more productive shoreline locations. Therefore, insofar as effects related to marine life are concerned, there appears to be little probability of measurable damage. However, the Staff recommends the implementation of a groundwater monitoring program that incorporates close observation and careful measurements to assess the potential development of damaging conditions which might occur.

C. The Cooling Water Intake System

Comments were received on the design of the cooling water intake system and potential effects of impingement of aquatic life on the intake screens. The Applicant has not yet arrived at a final design for the intake structure, and is awaiting requirements from the State of Florida, Department of Natural Resources. The Applicant has submitted a state-of-the-art report on fish diversion techniques and devices as part of the basis for selection. Studies on the effects of the existing structure (traveling screens) on biota have been limited to a one-week survey in May 1972. Samples were taken over two 30-minute periods each day for a total of six hours sampling. A total weight of 8 Kg of a variety of invertebrates was collected, though only two fish were present. Considerably more biota were collected during the night hours, 12 midnight to 6 a.m., than during the day. It can be calculated that about 32 Kg/day of biota could be trapped on the screens; however, since the sampling period was extremely limited, this time period may not be representative.

Several comments were received on the potential for plankton depletion of the Bay by entrainment. While no definitive studies were carried out by the Applicant, University of Miami, or the Environmental Protection Agency, the limited plankton surveys made (Lackey, Reeve) indicated to the Staff that significant depletion has not occurred.

Comments were received regarding the impact of emergency cooling operations on biota in the canal and at the outfall. Since there appears to be no limitations on the temperature or salinity under emergency conditions, some impact on the biota would be expected. However, assessment of impact will depend upon the length of exposure and the magnitude of the temperature and salinity increases. Sufficient data to quantify such effects are not available.

A comment was received regarding the secondary effects of the production of blue-green algae. While such species have been found at the entrance to the Grand Canal and might be expected to occur in Card Sound near the outfall, it is not anticipated that these species will significantly affect the overall productivity of the ecosystem.

The need for additional data to assess the potential impacts on aquatic life that may result from pronounced and subtle changes in operating conditions is well recognized by the Staff. In this regard, a number of definitive studies are proposed as a requirement for licensing. These include: frequent sampling, identification and measurement of biomass over an extended period to determine impingement on intake screens; comparative surveys to determine the potential depletion of the Bay due to entrainment of plankton, larvae, eggs, and juveniles in the intake system; and laboratory studies of the effects on representative biota of increased temperature and salinity, with emphasis on exposure, i.e., increased temperature and time.

D. Operational Aspects of the Cooling Channel System

Based on discussions in the Draft Statement, a number of agencies have commented on the potential need to expand the size of the system to meet 100 percent load factor operation under adverse weather conditions. The Applicant has indicated[74] that by restricting purge flow for periods of time, the system can be operated as a closed cycle, allowing the salt concentration to slowly build up and concurrently increasing the temperature to a new equilibrium value. This would increase the back pressure on the turbines and induce less efficient operation; however, quantitatively, this decay in efficiency would not be great, probably less than 2 percent from normal operations.

This mode of operation does, however, raise a number of related issues. It is most likely that the need to operate without purge would be due to an extended heat wave concurrent with a period of low precipitation. This means that, rather than 1970 conditions, the 1968 or 1969 conditions averaging 2°F higher air temperature would prevail. In addition to negligible rainfall, water supplies from Canals C-106 and C-107 could be considered as nil. Under this postulated set of extremes, system evaporation rate could reach about 240 acre-feet per day or 1.2 percent/day salinity concentration factor, taking no credit for groundwater exchange in the system. At the end of the ninth or tenth day of no-purge operation, the concentration factor could reach 1.10 over the initial condition, or an overall ratio of about 1.15 over Sound intake conditions. Since during such a protracted series of adverse weather days the Card Sound salinity also would be quite high, ranging to 40 or 42 ppt, it is possible that the system salinity might reach 48 ppt. At this point a number of significant considerations need review:

- Operation without purge for extended periods of time would saturate the groundwater to relatively high thermal and salinity values, which could induce related effects on the terrestrial and aquatic systems, particularly in years of high stress when "normal" freshwater supplies are severely depleted.

- An extended period of time would be required to flush the accumulation of high salinity from the groundwater system; and, in the concurrent absence of normal surface water supply for the control of salinity spread using the interception ditch system, an area considerably greater than the 7000-acre channel system would be involved. Estimates by the Applicant, concurred in by the Staff, show that at the 600 cfs purge rate (equivalent to a 0.375 ft. addition of new water on a tidal cycle), a 1.15 equilibrium salinity ratio would require from several weeks to as long as 2 to 3 months to bring groundwater salinities back to normal values.

- The existence of relatively high salinity concentrations tends to increase the risk attendant to flows of high salinity water to Biscayne Bay and Card Sound via the Oolite strata. Extended periods of operation might result in pooling of high salinity waters in low areas of these water bodies, although this possibility is relatively unlikely.

In summary, it appears that the 4000 acres will provide sufficient latitude for operation at 100 percent load factor but that there will be an associated incremental heat rate penalty, a risk of groundwater salinity increase, and (in the unusual coincidence of extended hot, dry spells) the added risk of disposing of a large inventory of high salinity water--greater than 20,000 acre-feet--in the event concentration factors begin to exceed values of 1.15 or higher.

E. Flood Control Canal Diversion and Connection to the Cooling System

A number of comments have arisen because of the announcement by FPL that it intends to implement an agreement with the Central and Southern Florida Flood Control District to route the discharge of Canals C-106, C-107 (and possibly C-108) into the effluent cooling system. This would provide an independent source of make-up water which could be used to supplement the Card Sound source in order to better control salinity. The total flow of these canals on an annual or seasonal basis has not been determined to date, but such an inventory is underway as part of the agreement between the parties. FPL plans to use available fresh and brackish waters to the extent that is appropriate in order to insure continuity of the system during conditions when salinity control is critical. In addition, such managed water supply is critical to the maintenance of the interceptor system which is being designed to limit the flow of high-salinity water from the canal system to the surrounding area.

In general the use of flood control canals to supply the cooling channel system appears to have advantages in reducing salinity rise to levels which would be easier to discharge to Card Sound under the Court Decree. As indicated in other commentary, discharges with salinity increases of greater than 3 percent over ambient will sink, rather than form a surface plume as required by the Court Decree. A means to minimize the differential in specific gravity in the purge water is advantageous from this and a number of other standpoints. The Staff supports the concept of water addition from the flood control canal system as a means of accomplishing salinity control in the effluent system.

F. Solubility of Limestone in Heated Seawater

Some concern was expressed regarding the effects of seawater-limestone contact on water quality. Normal surface water from the sea is essentially saturated in calcium carbonate. The solubility of calcium carbonate in seawater is predominantly influenced by temperature, alkalinity, and pH. An increase in any one or combination of these variables will generally decrease the solubility of calcium carbonate. Heating seawater to approximately 20°F above ambient temperature is not expected to alter alkalinity or pH significantly; therefore, only the effect of temperature on the solubility of calcium carbonate need be considered. An increase in the temperature of seawater is more likely to cause deposition of calcium carbonate rather than dissolution of this material from limestone. It is doubtful that significant deposition of calcium carbonate would occur in the higher temperature zones of the canals to cause undersaturation of calcium carbonate in the seawater in the cooler zones.

G. Cooling Towers

Since the initiation of the Turkey Point Project, a number of independent sources now indicate that natural-draft, saltwater cooling towers could be technically feasible at the Turkey Point site. A recent analysis by Jersey Central Power and Light suggests that saltwater towers could be operated at coastal sites without appreciably increasing the natural airborne salt concentrations and in keeping with the wind velocity requirements of the Maximum Possible Hurricane. At this time however, sufficient data to guarantee the operating characteristics of the towers and ancillary equipment do not appear to exist to make a conclusive statement as to their environmental acceptability.

It is reasonable to expect that power companies and the cooling tower manufacturers have or will initiate efforts to demonstrate the environmental acceptability of drift from saltwater natural draft towers. At this time, however, it appears that a full-scale feasibility demonstration is of the order of 2 to 3 years off. If such a demonstration were successful in two years, it is estimated that the incorporation of a saltwater tower (or towers) at Turkey Point could be done on a back-fit basis within a four-year period. Tentatively for purposes of estimation, the Staff believes that drifts of 0.00375% can be achieved in towers to be operating in 1976. The bare tower cost of such facilities would be expected to be about 30% higher than the equivalent fresh water tower. This percentage may be higher in the case of specific auxiliaries such as pumps and piping. Because of the nature of the Turkey Point plant layout, it is expected that natural-draft towers could be applied with less than 1,500 MW years of equivalent capacity reduction during the construction period.

The operating and maintenance costs for cooling towers were estimated in the Draft Statement to add $2.2 million annually, or, if capitalized, $23 million. This is somewhat higher than the $18 million estimated by the applicant for power ($6 million) and maintenance ($12 million). The capital cost estimate included $1 million for a recirculating water system. The estimate and analytical method provide for depreciation over a 30-year period.

Although the Staff estimates are felt to be typical of recent experience, these are only approximations which are subject to revision by local conditions and detailed engineering design. If the useful life of the towers is only 15 years rather than 30 years, the present worth of capital costs would be increased by $6 million.

H. Radioactivity and Radiation Emissions and Dose Assessments

These portions of this Final Statement have been revised extensively from the previous Draft Statement, reflecting more detailed evaluations of possible releases from the Plant and the ensuing radiation doses. Although the revisions are felt to result from more realistic assessments, the findings remain essentially unchanged that radiation doses from Plant operations will constitute a negligible impact and that only a very low probability risk of accidental exposure to radiation will be created.

The anticipated release of radioactive materials from steam generator blowdown is based on a system leakage of 20 gpd and a 10 gpm blowdown rate. Based on operating experience, the AEC Staff believes the values are realistic and would not lead to releases in excess of 10 CFR 20 limits. In addition, there are methods available to the Applicant to reduce this source, including a reduction in blowdown rate, isolating the leaking generator, or shutting the reactor down to repair the leak.

The doses calculated as consequences of the postulated accidents are based on airborne transport of radioactive materials resulting in both a direct and an inhalation dose. The evaluation of the accident doses assumes that the Applicant's environmental monitoring program and appropriate additional monitoring (which could be initiated subsequent to an incident detected by in-plant monitoring) would detect the presence of radioactivity in the environment in a timely manner such that remedial action could be taken if necessary to limit exposure from other potential pathways to man. The small quantities of dispersed radioactive material which might enter the food chain would not be significant in terms of endangering aquatic life.

The Applicant has indicated that releases from the Plant of gaseous radioactive wastes will be managed so that they occur only during favorable atmospheric dispersion conditions. Therefore, the use of an annual average atmospheric dispersion factor (X/Q) in the calculation of expected radiation doses was conservative, and the actual doses and dose rates are expected to be less than those listed in this Final Statement.

I. Recovery from Storm Damage

A question was raised as to the effects that might occur to the Plant and/or the cooling system from natural phenomena such as hurricanes or severe tropical storms and the amount of time that would be required for repairs. The Turkey Point Units 3 and 4 have been designed to withstand a variety of environmental conditions, including earthquakes, winds associated with hurricanes and tornadoes, and hurricane-induced flooding. The magnitude or intensity postulated for each of these conditions is as severe as is even remotely conceivable for this region. There is no significant probability that the Plant will be seriously damaged by natural phenomena.

This issue is less clear with respect to the cooling system. FPL is required by the court decree to develop and submit to the Environmental Protection Agency before October 1973 a contingency plan for rapid restoration of the cooling facilities in the event of system damage due to storms, hurricanes, and similar extraordinary acts of nature. FPL has not yet provided information on such a contingency plan to the AEC. This matter needs further resolution before a final assessment can be made on the adequacy of the cooling system with respect to its ability to withstand or recover from storm damage.

J. Location of Principal Changes in this Statement in Response to Comments

Topics Commented Upon	Sections Where Topics Are Addressed
Fuel loading schedules	Foreword, I
System reserve capacity	IX.A
Changes in site acreage and boundaries	II.B
Interaction with historic sites	II.D
Plant and animal species	II.F.1, Appendix B
Contributions of nutrients from mangrove communities	II.F.2.a

Topics Commented Upon	Sections Where Topics Are Addressed
Commercial landings of fish and shellfish in Dade County in 1970	II.F.2.c
Opening of the Card Sound Canal	III.D.1
Radioactive Wastes	III.D.2
Non-radioactive gaseous wastes	III.D.4
Turbidity control during Card Sound Canal opening	IV.C
Interference from transmission lines	V.A
Addition of drainage canal effluent to the channel system	V.B
Re-establishment of vegetation on spoil banks	V.C.1
Use of the channel cooling system by waterfowl	V.C.1
Effects of temperature, salinity and entrainment on planktonic organisms	V.C.2.b
Changes in dissolved oxygen in the canal cooling system	V.C.2.c
Radioactive exposure of aquatic organisms and bioaccumulation factors	V.C.2.d
Radiation doses to humans	V.D
Direct radiation from the plant	V.D.3
Environment Monitoring	V.D.6

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APPENDIX A

Scientific Names of Flora and Fauna Around Turkey Point, Florida

Mammals

Common Name	Scientific Name
Opossum	*Didelphis marsupialis*
Short-tailed shrew	*Blarina brevicauda*
Least shrew	*Cryptotis parva*
Eastern mole	*Scalopus aquaticus*
Marsh rabbit	*Sylvalagus palustris*
Eastern cottontail	*Sylvalagus floridanus*
Gray squirrel	*Sciurus carolenensis*
Fox squirrel	*Sciurus niger*
Rice rat	*Oryzomys palustris*
Eastern harvest mouse	*Reithrodontomys humulis*
Cotton mouse	*Peromyscus gossypinus*
Florida mouse	*Peromyscus floridanus*
Cotton rat	*Sigmodon hispidus*
Round-tailed muskrat	*Neofiber alleni*
Black rat	*Rattus rattus*
Norway rat	*Rattus norvegicus*
House mouse	*Mus musculus*

Red wolf	*Canis niger*
Gray fox	*Urocyon cinereoargenteus*
Black bear	*Ursus americanus*
Raccoon	*Procyon lotor*
Long-tailed weasel	*Mustela frenata*
Mink	*Mustela vison*
Spotted skunk	*Spilogale putorius*
Striped skunk	*Mephitis mephitis*
Otter	*Lutra canadensis*
Florida puma	*Felis concolor coryi*
Bobcat	*Lynx rufus*
Manatee	*Trichechus manatus*
White-tailed deer	*Odocoileus virginiana*
Atlantic bottle-nosed dolphin	*Tursiops truncatus*

Birds

Bird species are identified in the text by their common names. Use of common names accepted by the American Ornithological Union is preferable to use of scientific names.

Reptiles

Common Name	Scientific Name
Eastern diamond back rattlesnake	*Crotalus adamanteus*
Copperhead	*Agkistrodon mokasen*
Coral snake	*Micrurus (Elaps) euryxanthus*

Flowering Plants

Common Name	Scientific Name
Red mangrove	*Rhizophora mangle*
Black mangrove	*Aricennia tomentosa*
White mangrove	*Laguncularia* sp.
Buttonwood	*Conocarpus* sp.
Black rush	*Juncus roemerianus*

APPENDIX B

A REPORT SUBMITTED
TO
FLORIDA POWER & LIGHT COMPANY
MIAMI, FLORIDA

A SURVEY OF THE TERRESTRIAL ECOLOGY OF THE TURKEY POINT AREA

By

ENVIRONMENTAL ENGINEERING, INC.
2324 SOUTHWEST 34th STREET
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TERRESTRIAL ECOLOGY OF TURKEY POINT

INTRODUCTION

An investigation of the terrestrial ecology at Florida Power and Light's Turkey Point site has recently been performed by Environmental Engineering, Inc. The purpose of the investigation was two-fold.

1) Identify the existing ecosystem, and
2) Determine the effects of canal construction on the existing system including a determination of what plants and animals will inhabit the spoil banks created by the dredging.

Two sampling trips were made to the site; one in February, 1972, and one in May, 1972. Altogether some 40 locations were sampled and observations made of flora and fauna in the proposed canal area and adjoining areas.

GENERAL

The area is low lying land covered in large part by mangroves in the coastal areas and sawgrass in the higher regions to the north and west. The mangroves, mostly red, are quite large (20 - 30 feet) along the shore and smaller (2 - 4 feet) elsewhere. The land is dotted with mangrove "islands," that is, clumps of large mangroves in the midst of smaller ones.

Salinities range from saline on the coast and in tidal creeks to hypersaline just east of Card Sound Canal, brackish west of the canal, and fresh further west. The biota varies from area to area accordingly. For purposes of comparison, the site has been separated into three main areas as follows (see Figure 1):

I. Coastal - land east of Card Sound Canal and along the coast to the south;

II. Canal - the area in which canals are presently being constructed; and

III. Inland - areas west of the canal area, and other "inland" holdings of Florida Power and Light in the vicinity of Turkey Point.

EXISTING ECOSYSTEMS (See Tables)

Area I (The Coastal Area East and South of Card Sound Canal). This area is composed of two main ecotypes; the coastlane mangroves and the inland dwarf mangroves. The coastline mangroves are, for the most part, tall (20 - 30 feet) mangroves, the majority of which are reds. Black and white mangroves are scattered, and only a few species of ground succulents grow in open patches.

The dwarf mangrove area consists almost entirely of small (2 - 4 feet) sparse red mangroves. There are three species of succulents, two grasses, and one species of rush growing on the somewhat higher ground in the area. These also are sparse and small. There are two ecological subsystems in Area I which are different than the dwarf mangrove system. These are tidal creeks and small mangrove "islands." The tidal creeks are lined with medium sized (less than 10 feet) red mangroves. The "islands" support mainly black and white mangroves and buttonwood. The ground level appears to be slightly higher in the "islands" than in the surrounding dwarf mangroves.

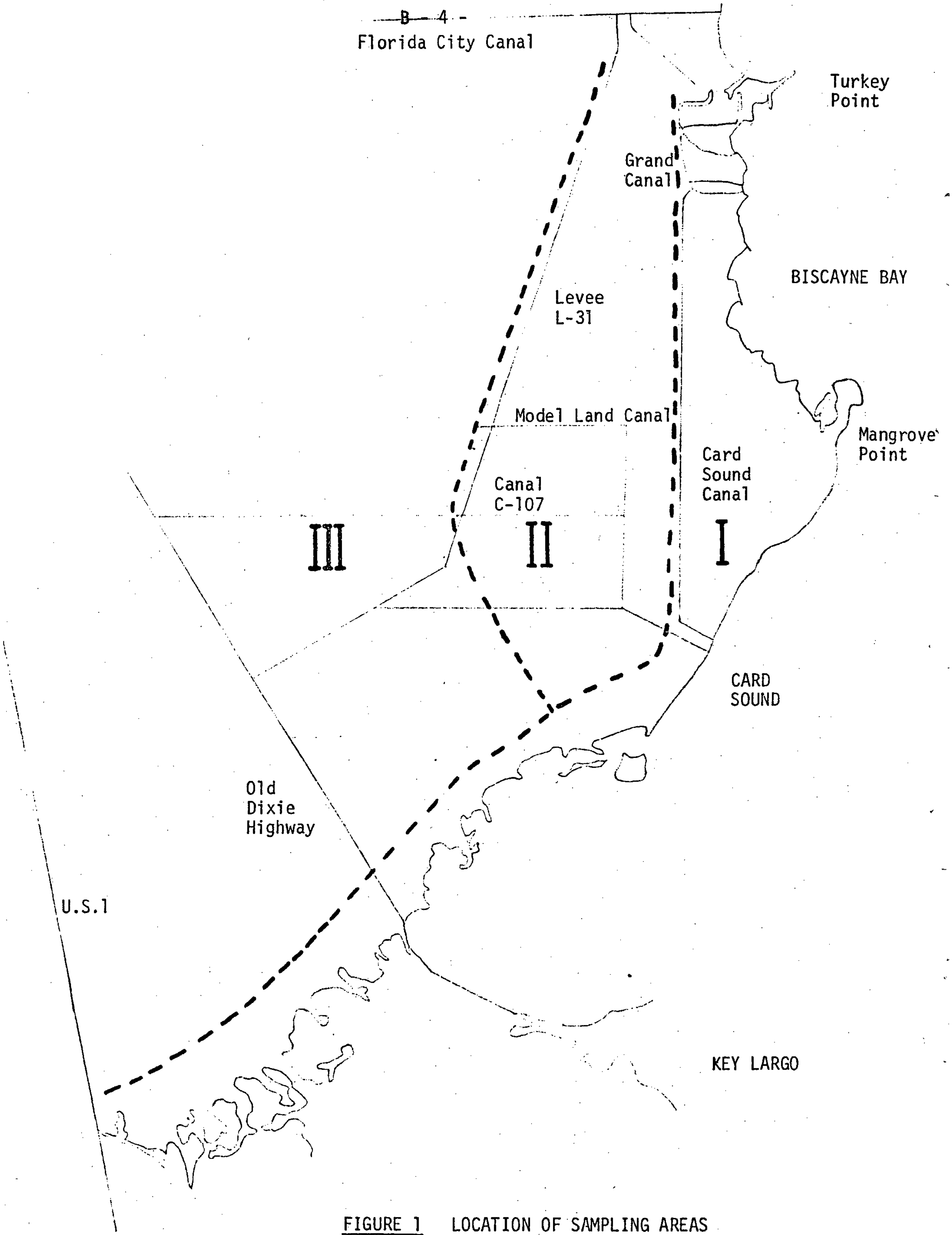

FIGURE 1   LOCATION OF SAMPLING AREAS

The fauna of Area I is quite sparse and undiversified. A few orthopterans were found in the canopy of the mangroves. The remainder of fauna present consisted of three species of snails, a few crabs, fish, and an occasional bird. Only one reptile (Key West anole) and no mammals were found.

Area II (The Canal Area). This area is somewhat higher than Area I and is not subject to tidal flooding. Dwarf red mangroves dominate the area, but small black and white mangroves and buttonwoods are very common. The ground cover is much more dense, and some freshwater plants, notably sawgrass and cattail, become very common toward the western and southern sides. The mangrove "islands" also become more common, and freshwater trees and shrubs, such as cabbage palms and Austrailian pines, were frequently found in these "islands," especially toward the southern end.

This area is roughly similar to Area I, except that many more birds, and one diamondback rattlesnake were found. Several species of frogs and tadpoles were also found. The presence of the rattlesnake indicates the probable presence of small mammals, such as rabbits, rats, and mice, as they constitute more than 90 percent of its diet. Several wood ibis' were seen in this area before the canal construction was started, but have not been seen since in this area and are not likely to be, as they are shallow-water waders, and the canals will be too deep for feeding.

Area III (West of the Canal Area). Area III is the highest of the three areas and freshwater and terrestrial plants dominate. The most common large tree is the Austrailian pine, although scattered mangroves are occasionally found. Small patches of dwarf red mangroves are also found in this area. The low ground cover approaches 100 percent and is composed almost entirely of freshwater grasses and sedges.

Area III is the richest in faunal biomass, not only in numbers but also in species. This is due to the presence of both brackish and freshwater with associated plant species.

IMPACT OF COOLING CANALS

The majority of canals to be constructed will be quite shallow, that is, only the surface muck will be removed down to the top layer of rock. The spoil material is a sodic mixture of sand and clay with a large amount of organic matter in the form of roots and detritus contained in it.

Two spoil banks made of similar material from previous dredging near Grand Canal were observed and a soil sample was analyzed for chloride content. It is assumed that these spoil banks are about 10 or more years old and that development of vegetation is essentially complete at present.

The soil is firm, and has a packed, impermeable appearance in most places, but is quite easy to dig. The soil chloride test revealed a chloride concentration of 5,000 ppm/unit dry weight, which is somewhat higher than a sample of soil taken from under water in Area I. It was expected that this value would be low due to the leaching action of rainfall, but instead it appears that some mechanism is maintaining the high salt content. This could possibly be the porosity of the soil causing it to behave somewhat like a wick, such that the saline canal water is absorbed up into the soil. The water then evaporates leaving the salt, causing an increased salt concentration in the soil. This may explain the large numbers of dead Salt Myrtle found on the banks - the soil salinity had increased to beyond their tolerance level.

Vegetation. In general, vegetation is sparse on these banks and is comprised mainly of halophytic forms. Below is a list of flora observed:

Salt Myrtle
Dog Fennel
Australian Pine
Red Mangrove
White Mangrove
Black Mangrove
Buttonwood
Sea Grape
Coconut Palm
Saltwort
Glasswort

Most of the vegetation present is along the edges of the bank with very little in the center portion. As previously stated, it ppears that at one time there was a fairly large stand of Salt Myrtle, but most of these are now dead. There are some tall Australian pines which appear healthy, however, the smaller ones seem to be experiencing some stress. The exact cause of the stress is not known at present.

Animals. The animals, other than birds, found on the spoil areas, were limited to a large number of land crabs, fiddler crabs, and carpenter ants. This low diversity is probably brought about by the sparce vegetation on the banks.

With the completion of the canals in Area II, the ecological substrate will be altered from a more or less low, flat area to one with wide, shallow canals alternating with narrow, high strips of soil composed of clay and organic (mainly mangrove roots and detritus) material.

It is expected that the canals will support plant and animal life similar to that found in Card Sound. A partial effect of the change will be to eliminate the wading herons, egrets, and ibis' from the canal area, however, there should be a corresponding increase in gulls, terns, and red-breasted mergansers. The diversity of fish should also be increased.

Vertebrates likely to increase in the canal area will be blackbirds, warblers, sparrows, woodpeckers, rats, mice, raccoons, mangrove water snakes, and Key West Anoles. Land and Fiddler crabs, locusts, and carpenter ants should also increase.

It seems quite likely that the vegetation will develop on the spoil banks comparably with that on the older banks studied. Further study may reveal a means of increasing the vegetative productivity and thus the faunal productivity on the banks. Both salt and freshwater flows accross the area have been stopped by previous construction of Levee 31 and the Card Sound Canal. No change is, therefore, expected to occur in Areas I and III as the result of the dredging, as the cooling system will not recharge from or discharge into either of these areas.

SUMMARY

1) All three areas studied are low, flat land largely covered with water which varies from hypersaline to fresh. Both vegetation and animals are moderately sparse in the saltwater and brackish water areas and more plentiful in thefreshwater areas.

2) The construction of the canal system will alter the canal area from a shallow brackish water system to a somewhat deeper sea water system and a semiterrestrial system. This change will be accompanied by the loss of many of the life forms presently in the canal area (except birds) and the introduction and development of more marine forms.

It is unlikely that either of the other two areas studied will be affected by the construction of the canal system.

3) The older spoil banks observed showed many stressed individuals and overall sparse vegetation. The exact cause of this condition is not known.

4) The growth of vegetation on spoil banks in the canal area will most probably progress similar to the older spoil banks, that is, with a moderately diverse but sparse vegetation. It is possible that desirable halophytes could be introduced to the spoil areas, resulting in a greater productivity. It is also possible that some means might be devised to increase leaching of salts out of the spoil by rainwater.

Table 1

Plants			Present now in Area: I	II	III
Caulerpa sp.			x		
Halimeda sp.			x		
Batophora sp.			x		
Acetabularia crenulata			x		
Agal Mats (Unid. sp.)				x	x
Juncus sp.	Rush		x	x	x
Distichilis spicata	Salt Grass		x	x	x
Typha angustifolia	Narrow-leaved Cattail			x	x
Cladium jamaicense	Sawgrass			x	x
	Unidentified Sedge		x	x	
Batis maritima	Saltwort	Halophytic	x	x	
Salicornia perennis	Glasswort	Halophytic	x	x	
	Unid. Succulent	Halophytic	x	x	
Baccharis angustifolia	False Willow			x	x
Baccharis halimifolia	Salt Myrtle			x	x
Rhizophora mangle	Red Mangrove		x	x	x
Avicennia germinans	Black Mangrove		x	x	x
Laguncularia racemosa	White Mangrove		x	x	x
Conocarpus erectus	Buttonwood		x	x	x
Casuarina equisetifolia	Austrailian Pine			x	x
Sabal palmetto	Cabbage Palm			x	x
Cocos nucifera	Coconut Palm		x		
	Unidentified Grasses		x	x	x

Table 2

Invertebrates		Present now in Area: I	II	III
Crassostrea virginicus	Oyster	X	X	
Littorina irrorata	Periwinkle	X	X	X
	Whelk	X		
	Rice Snail (?)	X	X	
	Tower River Snail (?)	X	X	
Cassiopea sp.	Upside-down Jelly fish	X		
Penaeus duorarum	Pink Shrimp	X		
Callinectes sapidus	Blue Crab	X		
Sesarma reticulatum	Wharf Crab	X	X	
Cardiosoma	Land Crab		X	X
Uca pugnax	Fiddler Crab	X		
Various Orthopterans	(Grasshoppers, crickets)	X	X	X

Table 3

Vertebrates

Fish

		Present now in Area: I	II	III
Cyprinodon variegatus	Sheepshead Killifish	X	X	X
Cambusia affinis	Mosquitofish	X	X	X
Sphaeroides nephelus	Spotted Puffer	X		
Eucinostomus argenteus	Mojarra	X		
Poecilia latipinna	Sailfin Molly		X	X
Adinia xenica	Diamond Killifish		X	
Fundulus confluentes	Spotfin Killifish		X	X
Strongylura sp.	Needlefish	X		
Sphyraena picndilla	Barracuda	X		
Mugil cephalus	Mullet	X		

Table 4

Amphibians		Present now in Area: I	II	III
Rana sphenocephala	Southern Leopard Frog		X	X
Rana catesbeiana	Bullfrog		X	X
Hyla cinerea	Green Treefrog		X	X
Hyla squirella	Squirrel Treefrog		X	X
Hyla ocularis	Little Grass Frog		X	X
Acris gryllus dorsalis	Florida Cricket Frog		X	X
Pseudacris nigrita verrucosa	Florida Chorus Frog		X	X
Bufo terrestris	Southern Toad		X	X

Table 5

Reptiles		Present now in Area: I	II	III
Crotalns adamanteus	Eastern Diamondback		X	X
Matrix sipedon compressicauda	Mangrove Water Snake	X		
Coluber constrictor	Blue Racer		X	X
Anolis sagrei stejnegeri	Key West Anole	X	X	X
Anolis carolinensis	Carolina Anole		X	X

Table 6

Birds	Present now in Area: I	II	III
Frigatebird	X		
American Egret		X	X
Snowy Egret		X	X
Cattle Egret			X
Great Blue Heron	X	X	X
Little Blue Heron		X	X
Louisiana Heron	X	X	X
Green Heron	X	X	X
White Ibis	X	X	
Wood Ibis (Wood Stork)		X	X
Bald Eagle		X	X
Turkey Vulture	X	X	X
Black Vulture	X	X	X
Red-Shouldered Hawk	X	X	X
Sparrow Hawk		X	X
Sharp-shinned Hawk		X	X
Fish Crow	X	X	X
Teal (Unid)		X	X
Red-breasted Merganser		X	X
Wilson's Snipe		X	X
Killdeere			X
Spotted Sandpiper		X	
Herring Gull	X	X	X
Laughing Gull	X	X	
Common Tern	X	X	
Rusty Blackbird		X	X
Redwing Blackbird		X	X
Cardinal		X	X
Mockingbird		X	X
King Fisher		X	X
Catbird	X	X	X
Boat-tailed Grackle		X	X
Flicker		X	X
Yellow-bellied Sapsucker		X	X
Red-bellied Sapsucker		X	X
Pileated Woodpecker		X	X
Warblers & Sparrows	X	X	X
Great Crested Flycatcher			X
Robin			X

Table 7

Mammals		Now present in Area: I	II	III
Oryzomys palustris	Rice Rat		x	x
Sigmodon hispidus	Cotton Rat			x
Peromyscus gossypinus	Cotton Mouse			x
Sylvilagus palustris	Marsh Rabbit		x	x
Sylvilagus Floridanus	Cottontail		x	x
Didelphis marsupialis	Opossum			x
Procyon lotor	Raccoon	x	x	x
Odocoileus virginicus	Whitetail Deer		x	x

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF FLORIDA

APPENDIX C

Civil Action No. 70-328-CA

UNITED STATES OF AMERICA,	:	
Plaintiff,	:	
v.	:	**FINAL JUDGMENT**
FLORIDA POWER AND LIGHT COMPANY,	:	
Defendant.	:	

WHEREAS the plaintiff, the United States of America, has filed a complaint and an amended complaint in the above-captioned matter, and the defendant, the Florida Power and Light Company, has appeared and denied the allegations of the complaint, and has filed affirmative defenses and a counterclaim and the plaintiff and the defendant, by their respective attorneys, have each consented to the making and entry of this Final Judgment without further pleading or trial or adjudication of or finding on any issues of fact or law raised by the complaint,

NOW, THEREFORE, without trial or adjudication of any issue of fact or law herein, and without this Final Judgment constituting evidence or an admission by any party with respect to any such issue in the pending action or in any other proceeding, and, upon consent of the parties as aforesaid, it is hereby

ORDERED, ADJUDGED, AND DECREED as follows:

I

This Court has jurisdiction of the subject matter of this action and of the parties thereto.

II

For the purposes of this Final Judgment:

(a) "Florida Power and Light" shall mean the defendant Florida Power and Light Company, a Florida corporation.

(b) "Generating facilities" shall mean Florida Power and Light's fossil fueled electric generating units 1 and 2, and nuclear powered electric generating units 3 and 4, all of which are located (or are under construction) at Turkey Point near Homestead, Florida.

(c) "Intake structures" shall mean all natural or artificial channels, structures, or devices through which Florida Power and Light draws or is able to draw water from Biscayne Bay or Card Sound for use in cooling its generating facilities.

(d) "Cooling system" shall mean any and all waterways, lakes, ponds, canals, dikes, levees, dams, barriers, or other structures, devices, or appurtenant facilities which under the provisions of this Judgment shall be constructed and employed to reduce the temperature of water discharged from Florida Power and Light's generating facilities.

(e) "Discharge canals" shall mean all natural or artificial conduits through which water from Florida Power and Light's generating facilities is discharged to Biscayne Bay or Card Sound.

(f) "A regional emergency" shall mean one of the following occurrences within the State of Florida: (1) a catastrophic natural disaster including hurricanes, floods, and tidal waves; or (2) other emergencies declared by state, county, municipal, or federal authorities during which an uninterrupted supply of electric power is vital to public health and safety.

(g) "National power emergency" shall mean any event causing authorized federal officials to require or request that Florida Power and Light supply electricity to points within or without the State of Florida.

(h) "Reactor emergency" shall mean an unanticipated equipment malfunction necessitating prompt remedial action to avoid endangering the public health or welfare.

(i) Abbreviations are as follows: (1) cfs = cubic feet per second; (2) ^{o}F = degrees farenheit; (3) fps = feet per second.

(j) Temperature, salinity, flow rate, and velocity measurements provided herein shall be instantaneous measurements and shall not be average figures.

(k) "Salinity" shall mean the total mass of dissolved solids in a one liter sample of water, referred to the temperature of the receiving water.

III

The provisions of this Final Judgment shall be binding upon Florida Power and Light, its directors, officers, agents, servants, employees, successors and assigns, and all persons, firms, and corporations acting under, through, or for it, and all persons, firms, and corporations in active concert or privity with it, providing they have actual notice of the Final Judgment by personal service or otherwise.

IV

Subject to the provisions of Paragraph VI, and commencing four years after the receipt by Florida Power and Light of all necessary construction permits, and upon receipt of the cooling system operating permits, but in no event later than five years from the date of the entry of this Final Judgment, Florida Power and Light shall not discharge into Biscayne Bay or Card Sound any water used for cooling its condensors at its generating facilities at Turkey Point, except in accordance with the provisions of Paragraph V of this Final Judgment. With respect to those same generating facilities, immediately subsequent to the entry of this Final Judgment, Florida Power and Light:

1. Shall, upon securing the necessary State and Federal permits, complete the construction of the Card Sound Canal within four years;

2. Shall continue to prosecute its application to the Corps of Engineers for a dredging permit for the Card Sound Canal, and immediately upon entry of this Final Judgment, the Corps of Engineers will commence to process Florida Power and Light's application for a permit pursuant to the regulations of the Corps of Engineers;

3. Shall not, prior to the completion of the Card Sound Canal, discharge water into Biscayne Bay at a rate in excess of 3000 cfs;

4. After completion of the Card Sound Canal and until October 1, 1973, shall not discharge water at an average 24 hour rate in excess of 2750 cfs into Card Sound and 1500 cfs into Biscayne Bay; thereafter Florida Power and Light shall not discharge water at an average 24 hour rate in excess of 2150 cfs into Card Sound and 2100 cfs into Biscayne Bay;

5. Shall not at any time discharge water into Biscayne Bay or Card Sound at a temperature in excess of 95°F;

6. Shall construct and maintain the outlet into Card Sound so that:

A. No discharge will be allowed to flow over the shallow substrate which is exposed at low tide (retaining structures or berms extending to the 8 foot bathymetric contour of Card Sound may be necessary to accomplish this purpose and are acceptable);

B. The discharge will be directed upward so that a warm water plume will form on top of the water; and

C. The rate of discharge will be controlled so that water will not enter Card Sound at a velocity greater than 1.5 fps;

7. Shall construct no later than July 1 1972, and thereafter maintain, a ground water monitoring system southward and eastward of the cooling system for the purpose of evaluating the effect of the seepage from the cooling system upon the underlying aquifer. The monitoring system shall consist of a series of observation wells, the number and location of which shall be mutually agreed upon between Florida Power and Light Company and the Environmental Protection Agency, but which will not exceed 23 wells drilled to a depth of not more than 70 feet. From July 1, 1972 to July 1, 1976, transmissivity will be evaluated in each well every three months, while temperature, concentration of biocides, and salinity will be measured in each well each month. Monitored data will be submitted to the Environmental Protection Agency within ten days following collection. Monitoring frequency requirements to be maintained after July 1, 1976, will be determined by the Environmental Protection Agency based on evaluation of the data in consultation with the United States Geological Survey. If in the judgment of the Environmental Protection Agency the monitored data reveals that substantial environmental harm is occurring, Florida Power and Light shall take such necessary remedial action as the Environmental Protection Agency may direct;

8. Shall install and maintain such protective devices at the intake structure and discharge canal as may be required by the Florida Department of Natural Resources in accordance with a reasonable construction schedule;

9. Shall not introduce biocides into the waters used to cool the condensors at its generating facility except in compliance with the specifications set out in Chapters 17-3 and 17-4 Florida Administrative Code and the applicable laws and regulations of the State of Florida;

10. Shall, consistent with good system maintenance and operating practices providing for necessary area protection, operating reserves, and over-all system reliability, provide power to the areas it serves in the State of Florida by drawing upon all sources of power available to it in such combinations as to minimize the discharges of heated water from the Turkey Point plant;

11. Shall immediately arrange with appropriate officials of the United States, the State of Florida, and other appropriate jurisdictions, to commence joint studies of: (a) the availability of groundwater from at least the depth of the Floridan aquifer (this joint study shall be completed within two years after the entry of this Final Judgment); (b) alternate sources of cooling water, particularly from nearby canals such as the Florida City Canal, the Mowry Canal, and the North Canal; (c) mechanical cooling devices such as powered spray modules and other reasonable concepts for reducing adverse environmental effects attributable to the cooling system specified in this Final Judgment; and (d) procedures for restoration of areas affected by discharges from the Turkey Point generating facilities. Florida Power and Light's financial contribution to these studies shall be limited to $500,000. The studies specified in (a), (b) and (c) above shall be directed toward the determination of the feasibility, practicability, and acceptability of utilization of such alternate sources of water as a substitute or supplement for withdrawals of make-up water from Card Sound for the cooling system described in Paragraph V below;

12. Shall utilize those waters which, as a result of the studies referred to in subparagraph 11 above, the Administrator of the Environmental Protection Agency may identify as being available to provide make-up water for Florida Power and Light's cooling system, to the extent that this can be done feasibly and practicably and at a cost which is not disproportionate to the degree of environmental protection to be achieved and to the extent that the same can be done without violating any lawful local, state, or federal rule, regulation, statute, ordinance, or order. The Administrator shall not identify groundwater as available for use without the written concurrence of the State of Florida or local agencies with jurisdiction recognized by federal or state law. Florida Power and Light shall alter its Card Sound discharge and withdrawal flow regimen based on the less saline water inputs, as directed by the Administrator, so as to achieve the least amount of environmental damage, but at no power production penalty;

13. Immediately proceed to acquire land for the construction, operation, and maintenance of a cooling system to reduce the temperature of the water discharged from the Turkey Point generating facilities consistent with the standards for operation required by this Final Judgment, and further shall commence to construct, immediately upon receipt of all necessary construction permits, the structures necessary to comply with Paragraph V of this Final Judgment, and shall submit quarterly progress reports concerning the construction of such cooling system in the four years following receipt of the necessary permits and, no later than April 1 of the fourth year after the date of the entry of this Final Judgment, a report specifying the results of trial operation and testing of the final cooling system; and

14. Shall install and operate monitoring devices at the outlet to Card Sound and at other locations, all of the foregoing to be specified by the Environmental Protection Agency, to measure temperature, salinity, flow rate, and velocity.

V

Except as otherwise provided by Paragraph IV of this Final Judgment, all water used by Florida Power and Light to cool its condensors at its generating facilities at Turkey Point shall be discharged into a cooling system, and no water shall be discharged from this cooling system into Biscayne Bay, or Card Sound, or any other navigable water of the United States or tributary thereof unless required to prevent the excessive concentration of salt in the waters of the cooling system, in which case discharges shall be made only into Card Sound and only under the following conditions:

1. Discharges to and withdrawals from Card Sound shall be made only through the Card Sound Canal;

2. The temperature of the water which is discharged as measured at the control structure (to be constructed at a point approximately one mile north of the outlet of Card Sound Canal) shall not exceed 90° F;

3. Subject to subparagraph 2 of Paragraph V, the temperature of the water which is discharged, as measured at the control structure, shall not be more than 4° F above the ambient temperature of the waters of Card Sound as measured at a station or stations to be designated by the Environmental Protection Agency;

4. Variations in the temperature of the water which is discharged shall not exceed 2° F per hour during times when the temperature is rising, or 1.0° F per hour during times when the temperature is falling;

5. The salinity of the water which is discharged, as measured at the outlet to Card Sound, may not be greater than 1.10 times the salinity of the water of Card Sound and may not exceed 44 parts per thousand;

6. The flow as measured at the control structure shall not exceed 1200 cfs;

7. Discharges and withdrawals shall be limited to a tidal regimen (which approximates a six hour period), except in the event that salinity in the cooling system approaches 1.10 times the salinity of the water of Card Sound, or 44 parts per thousand, whichever is more limiting and an additional time period for discharge is required to avoid exceeding those limits;

8. All man-made canals connecting the intake structures and the cooling system with Biscayne Bay shall be closed;

9. Final operating requirements shall include the interim operating requirements contained in subparagraphs 6, 7, 8, 9, 12 and 14, of Paragraph IV; and

10. Florida Power and Light shall develop and submit to the Environmental Protection Agency within two years from entry of this Final Judgment, a contingency plan for rapid restoration of the cooling facilities in the event of system damage due to storms, hurricanes, and similar extraordinary acts of nature.

VI

During a national power emergency, regional emergency, reactor emergency, or at any time when the health, safety, or welfare of the public may be endangered by the inability of Florida Power and Light to supply electricity from any other sources available to it, the operating limits provided in this Final Judgment shall be inapplicable. However, during such emergencies, the defendant shall not exceed the operating limits except as is necessitated by the emergency. Provided Florida Power and Light shall have made timely and proper application for all necessary licenses, permits, consents, approvals, and certifications required by law for construction or operation of the cooling system and discharge canal required to meet the standards provided for herein and shall have duly prosecuted such applications, this Court may extend the time within which Florida Power and Light is required to do any act herein by the length of any delay in completion of construction or operation of the cooling system which is shown to have been the exclusive result of physical impossibility, force majeure, or legal prohibition.

VII

In the event Florida Power and Light shall be in substantial violation of the express operating provisions of the cooling system herein, the United States shall give Florida Power and Light written notice describing said violations by certified mail to Florida Power and Light, 4200 West Flagler Street, Miami, Florida 33134, and if at the expiration of 3 days after the giving of said notice, said violation upon which said notice was based shall continue to exist, the United States may apply to this Court for an order requiring Florida Power and Light to perform such obligations and comply with such limitations as are expressly required herein and shall accompany such application with a showing of said violation notice, and noncompliance. The relief which may be granted upon a showing of noncompliance with the operating limitations contained herein shall include but not be limited to an order requiring Florida Power and Light to limit operation of its generating facilities to the extent necessary to achieve compliance with this Final Judgment.

VIII

This Final Judgment is not and shall not be interpreted to be a permit under 33 U.S.C. §§403, or 407 nor shall it in any way affect Florida Power and Light's obligation, if any, to secure a license or permit from the Corps of Engineers or the Atomic Energy Commission pursuant to 33 U.S.C. §§403, or 407, 33 U.S.C. §§1151 <u>et seq.</u>, 42 U.S.C. §2134, and 42 U.S.C. §4321, nor shall it be interpreted to affect or waive any of the conditions or requirements which may be validly imposed by the Corps of Engineers or the Atomic Energy Commission as conditions for the issuance of such a permit. The Department of the Interior and the Environmental Protection Agency have reviewed and participated in technical studies which have been used to establish the standards for operation of the generating facilities and the cooling system hereinabove set forth, and the Department of the Interior and the Environmental Protection Agency shall recommend to the Corps of Engineers and the Atomic Energy Commission that the necessary permits and/or licenses be issued for the construction and operation of generating facilities, a cooling system, discharge canals, and any structures or work in navigable waters of the United States or for discharges into such waters or tributaries thereof, consistent with the standards for operation set forth in this Final Judgment and with the standards of the Atomic Energy Commission. Also, this Final Judgment does not operate to excuse Florida Power and Light from compliance, as required by law, with any Federal or State water quality requirements now or hereafter applicable to it.

IX

For the purpose of insuring compliance with this Final Judgment, duly authorized representatives of the Department of Justice, the Environmental Protection Agency, the Department of the Interior, the Atomic Energy Commission, and the Corps of Engineers shall be permitted access, at reasonable times, to Florida Power and Light's facilities at Turkey Point for the purpose of: (1) inspecting the cooling facilities, intake structure, discharge canal(s), and monitoring devices; (2) collecting water samples therefrom; (3) conducting testing procedures which are not unduly disruptive of the operation of such facilities; (4) obtaining from Florida Power and Light records of operations and other corporate records, data pertaining to the construction, operation and maintenance of its cooling system, intake facilities and discharge canals and information concerning the distribution of electric power within the State of Florida. Information concerning the impact of the cooling system on the environment may be freely disclosed. Other information obtained under the provisions of this Paragraph will be divulged by the representatives designated thereunder to any person other than a duly authorized representative of the Department of Justice, Environmental Protection Agency, Department of the Interior, Atomic Energy Commission, or Corps of Engineers only as is provided by federal law or in the course of legal proceedings to which the United States is a party for the purpose of securing compliance with this Final Judgment.

X

Florida Power and Light agrees that it will dismiss its counterclaim in this action against the plaintiff, United States of America.

XI

Jurisdiction is retained for the purpose of enabling either party to this Final Judgment to apply to this Court at any time for such further orders and directions as may be necessary or appropriate for the construction or carrying out of this Final Judgment, or the modification or termination of any of the provisions thereof or for the enforcement or compliance therewith. In addition copies of all reports, plans and studies required to be prepared by the terms of this Final Judgment shall be promptly filed with this Court. If Florida Power and Light utilizes the provisions of the first sentence of Paragraph VI, then it shall immediately report to this Court and to the Administrator of the Environmental Protection Agency the fact of the emergency and the reasons for utilization of such provisions.

Dated: Miami, Florida
September 10th, 1971

C. Clyde Atkins
United States District Judge

Certified to be a true and correct copy of the original.
U. S. District Court
Joseph I. Bogert, Clerk
Southern Dist. of Fla.

By [signature]
Deputy Clerk

Date: 9/14/71

We hereby consent to the entry of the foregoing Final Judgment without further notice.

THE UNITED STATES OF AMERICA, Plaintiff

BY:

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SHIRO KASHIWA
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BY: William C. Steel
WILLIAM C. STEEL
Attorney
Miami, Florida 33131

APPENDIX D

COST-BENEFIT METHODOLOGY

In the first column of Table IX-6 the future costs of the Applicant's reference design are shown along with the major environmental impacts of this design. Table IX-6 was constructed using information in Tables IX-3, IX-4, and IX-5 in Section IX.A. Although the finished cost of the Applicant's plant is estimated to be $207 million, of this total an estimated $149 million is unsalvageable sunk cost at this time and is not considered in the analysis. Thus the reference design showed $38 million in incremental construction capital costs. Because the $17 million expense for the cooling system will be incurred over a 3-year period, the present value of the incremental construction costs is only $35 million. Annual fuel and operating expenses are estimated at $24.4 million. The $0.4 million is the estimated annual cost of operating the cooling system of either of the dilution pumping systems. Over the lifetime of the plant these several annual expenses are equivalent to a present capital cost of $256 million. Because it was projected in the reference case that the plant would be operated to minimize the discharge of heated waters, replacement power is required during the building of the cooling system. In this case replacement power is the difference in power generated between operating the plant at an 80% annual plant factor and the projected annual plant factor; and the cost is the penalty for this inefficient operation. The replacement power has a present value of $32 million under the assumptions used. Thus, the total future expenses of this option have a present capitalized cost of $323 million (256 + 35 + 32).

In the other columns of Table IX-6, only the differential costs and impact of the alternative actions to the reference case are shown. For illustrative purposes, examine the column of the table in which the option of building a nuclear plant at a new site is considered. The capital cost of a new plant of Turkey Point capacity if started today is estimated to be $456 million. If this $456 million is incurred uniformly over the 6-year construction period, this is equivalent to a present capital cost of $342 million as explained later. The differential cost over the present value of the reference design is $287 million ($342 less $35 less $20 salvage). Salvage value only enters into the decision in the two alternatives which foreclose use of the nuclear plants. During this 6-year delay period, replacement power will have to be supplied at an estimated annual cost of $53 million or a capitalized cost of $206 million. It is assumed that the $0.4 million operating cost penalty, which has a present value of $2 million, will be saved at the new site.

Tables D-1 and D-2 show the economic and operating assumptions and some of the factors used in deriving the equivalent present value. The present value factor for the sum of 6 uniform annual payments at 8.75% is 4.5. This multiplied by $76 million is $342 million.

TABLE D-1

Economic Assumptions Used in Cost Eavluation of Alternative Actions

Useful life of plant	30 years
Average load factor	80%
After tax cost of capital[1]	8.75%
Incremental cost of replacement power	5 mills/kwhr

(1) Based on 50% debt financing at 8% and 50% equity financing at 13.5% and 50% income tax rate.

TABLE D-2

Present Worth Factors for an 8.75% Discount Rate

Present Worth of a Uniform Series of Expenses	Factor
3 years	2.5
4 years	3.2
6 years	4.5
26 years	10.1
30 years	10.5

Present Worth of a Single Future Expense	
3 years	0.77
4 years	0.71
6 years	0.60
30 years	0.08

Operating Assumptions Used in Present Worth Analysis

The following assumptions were used in developing the present value costs. All costs are assumed to be incurred immediately or at the end of the year in which they occur.

Reference Case -

All remaining capital costs are incurred immediately except the cooling system construction costs which are incurred uniformly during the next 3 years.

Alternate Site -

The new capital costs are incurred uniformly during a 4- year construction period.

Alternate Cooling Methods -

The saving in land and construction costs for the cooling system is common to all three alternatives; the land cost is saved immediately, and the construction costs ($17 million) are saved over a 3-year period.

Existing Card Sound Canal -

The new construction cost for the discharge and mixing structures is incurred immediately.

Cooling Towers -

The costs of land, canals, and cooling towers are incurred uniformly during a 3-year construction period.

Fuel and Operating Expenses -

The fuel and operating expenses remain constant in present dollars over the next 30 years. The plants operate uniformly at 80% load factor.

ADVISORY COUNCIL
ON
HISTORIC PRESERVATION

WASHINGTON, D.C. 20240

APPENDIX E - 1

RECEIVED
FEB 25 1972
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

February 23, 1972

Dear Mr. Rogers

This is in response to your request for comments on the environmental impact statement identified by a copy of your cover letter attached to this document. The staff of the Advisory Council has reviewed the submitted impact statement and suggests the following, identified by checkmark on this form:

____ The final statement should contain (1) a sentence indicating that the National Register of Historic Places has been consulted and that no National Register properties will be affected by the project, or (2) a listing of the properties to be affected, an analysis of the nature of the effects, a discussion of the ways in which the effects were taken into account, and an account of steps taken to assure compliance with Section 106 of the National Historic Preservation Act of 1966 (80 Stat. 915) in accordance with procedures of the Advisory Council on Historic Preservation as they appear in the Federal Register, February 20, 1971.

____ In the case of properties under the control or jurisdiction of the United States Government, the statement should include a discussion of steps taken to comply with Section 2(b) of Executive Order 11593 of May 13, 1971.

✓ The final statement should contain evidence of contact with the Historic Preservation Officer for the State involved and a copy of his comments concerning the effect of the undertaking upon historical and archeological resources.

____ Specific comments attached.

Comments on environmental impact statements are not to be considered as comments of the Advisory Council in Section 106 matters.

Sincerely yours,

Robert R. Garvey, Jr.

Robert R. Garvey, Jr.
Executive Secretary

cc: Mr. Robert Williams, State Liaison Officer for Historic Preservation, w/c of inc.

THE COUNCIL is charged by the Act of October 15, 1966, with advising the President and Congress in the field of Historic Preservation, recommending measures to coordinate governmental with private activities, advising on the dissemination of information, encouraging public interest and participation, recommending the conduct of special studies, advising in the preparation of legislation, and encouraging specialized training and education. The Council also has the responsibility to comment on Federal or Federally-assisted undertakings that have an effect on cultural property listed in the National Register.

UNIVERSITY OF MIAMI

Dorothy H. and Lewis Rosenstiel

SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

10 RICKENBACKER CAUSEWAY
MIAMI, FLORIDA 33149
(305) 350-7211
Cable: UOFMIAMI

Appendix E - 2

25 February 1972

Dr. Richard S. Cleveland
Project Leader
Division of Radiological and
Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Dr. Cleveland:

I wish to congradulate you on the compilation of data and analysis in the AEC Draft Detailed Statement on the Environmental Considerations related to -- licenses -- Turkey Point Units 3 & 4. While I may choose to argue about 1 or 2 points they are purely "gut feelings" and of no scientific merit.

A few comments and/or minor corrections are as follows:

p 5 para 4 No agriculture in immediate vicinity: c.a. 2 miles away has agriculture (potatoes, corn, malanga)
secondary road to missle base was present. No river but Florida City Canal was present.

p 9 C para 1 Mangrove swampland extends 1-3 miles landward. Swampland yes but mangrove mostly restricted to narrow fringe except pocket clumps of mangrove.

p 23 para 2 grass shrimp, Tozeuma not arros shrimp

p 24 para 3 1 4 should read Thalassia
p 25 para 2 1 6 P. argus
p 26 para 2 1 6 No spear - go directly to jail!
p 86 A good point - and one which unfortunately was not considered until now. However, plans to develop the area into housing, a sea port or a refinery would cause a permanent loss. As I mentioned observations along the existing canals indicate mangrove seedlings will develop in the muck and will perhaps replace part of the productivity to Card Sound. I too, am skeptical about the point source entrance at the mouth of the canal, but don't know of a better solution.

Dr. Richard S. Cleveland
25 February 1972
Page 2

p 88 Two alternatives I would like to see considered:
A. same as 3 but dillution immediately before discharge into Sound
B. alternating discharge at two or more sites - 6 hours on 6 hours off - with 3 or 4.

115. Tabb, Dubrow and Manning
Fla. St. Bd. not Sea.

Sincerely yours,

Marty

M. A. Roessler
Assistant Professor
Division of Fisheries and
Applied Estuarine Ecology

MAR:sw

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

March 3, 1972

50-250
50-251

IN REPLY REFER TO:

PWR-ER

APPENDIX E - 3

MAR 7 1972

Mr. Lester Rogers
Director, Division of Radiological and Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

This is in response to your letter requesting comment on the Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses to the Florida Power & Light Company for Turkey Point Plant Units 3 and 4, prepared by the Division of Radiological and Environmental Protection, U. S. Atomic Energy Commission, dated February 1972.

The Federal Power Commission has previously commented on the need for the Turkey Point Units 3 and 4 in its letter dated July 2, 1971, but those comments were predicated on the then scheduled service dates of June 1971 for the Unit No. 3 and June 1972 for Unit No. 4. Due to changes in those service dates, the following comments supersede similar ones of July 2, 1971. The tabulation indicates the capacity-load-reserve margin situations that may obtain during the peak load periods in the 1972 summer, the 1972-73 winter and the 1973 summer under the conditions stated. The tabulation is for the Florida Subregion of the Southeastern Electric Reliability Council area, which includes the Applicant, and reflects the best estimate of the concerned entities as of late January 1972. The utilities within the State of Florida closely coordinate the planning and operation of the systems, thus the adequacy and reliability of electric service within the State is largely reflected in this summation.

Mr. Lester Rogers

Florida Subregion 1/ of the Southeastern Electric Reliability Council

	1972 Summer	1972-73 Winter	1973 Summer
Generating Capacity 5/ - Megawatts	13,154 2/	14,502 3/	14,881 4/
Load Forecasted - Megawatts	11,706	12,231	12,929
Reserve Margin - Megawatts	1,448	2,271	1,952
Reserve Margin - Percent of Load	12.4	18.6	15.1
Reserve Margin Requirements Based on Stated 20 Percent 6/ - Megawatts	2,341	2,446	2,586
Deficiency of Reserve Margin - Megawatts	893	175	634

1/ Florida Power & Light Company
Florida Power Corporation
Jacksonville Electric Authority
City of Lakeland
Orlando Utilities Commission
City of Tallahassee
Tampa Electric Company

2/ Includes Turkey Point No. 3 at 400 megawatts limited rating, Sanford No. 4 at 379 megawatts scheduled for June 15, 1972, and 2,096 megawatts of diesel and gas turbine peaking capacity, 674 megawatts of which is currently in various stages of installation. Excludes 175 megawatts of scheduled maintenance.

3/ Includes Turkey Point No. 3 and No. 4 at full combined rating of 1,450 megawatts and not limited by water discharge temperatures, and Sanford No. 5 at 398 megawatts. Excludes 650 megawatts of scheduled maintenance.

4/ Includes Turkey Point No. 3 and 4 at a combined summer rating of only 620 megawatts as reduced by limited water discharge temperatures, Indian River No. 3 at 335 megawatts, Big Bend No. 2 at 425 megawatts, and 296 megawatts peaking gas turbines in addition to those included in 2/ and 3/ above. Excludes 125 megawatts scheduled maintenance.

5/ Does not include 300 megawatts Northside No. 2 unit ready for service December 1971, but awaiting water discharge permit.

6/ The Florida Subregion utilities report, in their response to FPC Order 383-2, Statement of Policy on Adequacy and Reliability of Electric Service, that an overall level of reserves of about 20 percent yields an acceptable criterion of the probability of load exceeding available generation only one day in ten years.

Mr. Lester Rogers

The foregoing updated tabulation supports the AEC conclusions as stated on pages 1 and 2 of the Draft Detailed Statement that "(1) the Florida Power & Light (FPL) system reserve capacity is currently low, (2) without the base-load generating capacity of Turkey Point Unit 3, serious shortages in FPL system reserve capacity will occur in 1972, and (3) without Turkey Point Unit 4, serious shortages in FPL system reserve capacity will occur in 1973." I also concur with the summary on page 3 of the Draft Detailed Statement, which is indicated in our tabulation, that "the most immediate need for Turkey Point Units 3 and 4 is to provide reserve capacity for meeting peak-load conditions, but the projected growth in just base-load requirements of the Florida Power & Light system will exceed the combined capacity of the Turkey Point Units 3 and 4 by 1975. During this time no existing plants will be shut down, and gas turbines and new fossil units will continue to be added to help meet both base-load and peaking conditions. No appreciable block of power is available either from within the Florida Power Group or from the Northern Intertie."

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
PEACHTREE SEVENTH BUILDING, ATLANTA, GEORGIA 30323

50-250
50-251

March 6, 1972

REGION IV

APPENDIX E - 4

IN REPLY REFER TO:
4ME

Mr. Lester Rogers
Director, Division of Radiological
and Environmental Protection
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

The Department of Housing and Urban Development has reviewed the draft 102(2)(c) statement for Florida Power and Light Company's Turkey Point Plant units 3 and 4 (Docket Nos. 50-250 and 50-251) and defers to other agencies with respect to air and water quality standards, thermal pollution standards, radiation and general safety standards relative to the proposed project.

It is our understanding that the proposed project generally conforms to the metropolitan plans in the area prepared by the Dade County Planning Department. That agency has jurisdiction in land use and related activities in Metropolitan Dade County. In view of this, we have no specific comments relative to specific land use relationships. However, in view of the population pressures evolving in southern Dade County, we would propose that the Florida Power and Light Company develop the complex utilizing a multiple use concept insofar as possible.

Sincerely,

Leo J. Zuber
Acting Assistant Regional Administrator
Community Planning and Management

P.O. BOX 3100 MIAMI, FLORIDA 33101

APPENDIX E - 5

FLORIDA POWER & LIGHT COMPANY

March 10, 1972

RECEIVED

Mr. Richard C. DeYoung
Assistant Director
Division of Reactor Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Re: Docket Nos. 50-250 and 50-251
Turkey Point Units 3 and 4

Dear Mr. DeYoung:

Pursuant to Sections A.6, A.7 and D to 10 CFR Part 50, Florida Power & Light Company (the Applicant) herewith submits comments for the U. S. Atomic Energy Commission's consideration on the Draft Detailed Statement on the environmental considerations related to issuance of operating licenses for Turkey Point Plant Units 3 and 4, received with your letter of February 11, 1972.

Yours very truly,

James Coughlin

James Coughlin
Vice President

JC:rp

cc: Mr. Roy B. Snapp

Page i Item 3

It is not agreed that the cooling system will destroy about 7,000 acres of wildlife habitat. Changes will occur during construction and afterwards as regrowth of vegetation occurs. In this tropical climate swift regrowth is the norm, and the final situation may be more attractive to wildlife than the existing situation.

The statement regarding salinity "5 to 10% above normal" is noted. Actual salinity varies from 25 to 44 parts per thousand as stated in Section 2.3.6 of the Applicants Environmental Report Supplement, so salinity changes will be less than those occuring naturally.

Page ii

The terms of the consent Final Judgment (Appendix 6 of Applicants Environment Report Supplement) should be taken into account.

Pages ix, 1, 44

The fuel loading schedule for the units is now as follows:

Unit 3 - on or about 3/15/72

Unit 4 - on or about 9/13/72

Page 2

In the first paragraph, the reserve capacity figures should be updated. Change 21% to 14.7% for the Florida Power Group and 16% to 13% without Unit 3.

Page 4

Table 1 should be updated as shown on the attachment. This reflects:

1) Actual status of Turkey Point Units.

2) Applicants Port Everglades and Lauderdale gas turbine installations.

3) Tampa Electric Company rerated generation capability.

TABLE 1

Estimated 1972 August Loads and Generating Capabilities
for Florida Interconnected Utilities

Utility	Net Generating Capability MW	Net 60-min. Peak Load[(a)] MW	Reserve Margin[(a)] MW	Reserve Margin[(a)] %
Florida Power Corporation	2,492	2,410	82	3.4
Florida Power & Light Company	6,784[(b)]	5,925	859	14.5[(b)]
Jacksonville Electric Authority	1,173	1,020	153	15.0
Orlando Utilities Commission	411	345	66	19.1
Tampa Electric Company	1,670	1,330	340	25.6
City of Lakeland	259	163	96	58.9
City of Tallahassee	257	178	79	44.4
Total	13,046[(b)]	11,371	1,675	14.7[(b)]

(a) Not simultaneous values.

(b) Includes estimated 200 MW increase in Turkey Point Plant capability with operation of Turkey Point Unit 3, based on circulating water limitations (excluding emergencies affecting public health, safety and welfare) of the consent decree. If Turkey Point Unit 3 is not available, FPL capability becomes 6584 MW, peninsular Florida total becomes 12,846 MW, FPL Reserve Margin becomes 11.1%, and total reserve margin becomes 13.0%.

SOURCE: Data from 1972 SERC filing in response to Federal Power Commission Order No. 383-2 (due April 1, 1972).

Page 8, Fig. 2

After issue of the Draft Statement, FPL completed negotiations for purchase of about 23,000 acres south of the original site, less about 2,500 acres of shoreline deeded to the State of Florida. Note that the total acreage is now about 24,000 instead of 3,300 as shown at the bottom of page 6 of the Draft Statement. The Environmental Report Supplement will be revised by submittal of revised figures showing the new boundaries. The land acquisition program resulted from the need to acquire the cooling system area discussed in the consent Final Judgment (United States v. Florida Power and Light Company, Civil Action No. 70-328-CA, September 10, 1971).

Page 9, Last Paragraph

Obviously, opinions differ regarding population stresses. Despite the remarkable growth in Florida, FPL holds its opinion regarding population in the plant vicinity, i.e., urban development will not occur in the plant vicinity. The cost of fill to meet the minimum grade elevation of +10 specified by local building codes, would be prohibitive.

Page 11, Section C

FPL has acquired more land to the south of the plant site as noted above. FPL has deeded the coastal portions to Florida.

Page 14

It is to be noted that the Generating Station Area, on which Units 1-4 are situated, is at an elevation of +18 and that the nuclear units are protected from wave run-up to an elevation of +22-1/2.

Page 17

In the second line, the temperature of 96F for natural temperature of the Sound is questioned.

Page 18, Section F

In the second paragraph of this page FPL is requested to furnish information regarding terrestial floristics and rare or endangered species of plants A research program is being prepared.

Pages 20 and 21

The listing of species of mammals (Table 4) with ranges overlapping Turkey Point should include the porpoise (bottle nose dolphin). It is unlikely that a red wolf, black bear, puma or white tailed deer will ever again be in range.

It should be noted that the disturbance of birds and mammals by the Applicant is infinitesimal when compared to that created by the U. S. Government in the area discussed.

Page 18

Wherein the Draft Detailed Statement states in line 6 of the first paragraph that high tides probably contribute considerable organic matter to the sound, it should be pointed out that it mentions no references, no data, for this proposition. As a matter of fact, the Applicant is not aware of any data concerning the contribution of organic matter to Card Sound from the area which will be occupied by the cooling water system. On the contrary, an affidavit by University of Miami scientists (which is attached herewith) indicates that the area to be occupied by the cooling water system is of relatively low productivity and plays a relatively unimportant role in the ecology of Card Sound.

AFFIDAVIT

Drs. Tabb, Heald and Roessler came before me on this 29th day of February, 1972 and affirmed the following:

I, Durbin C. Tabb, am an Associate Professor at the Rosenstiel School of Marine and Atmospheric Science of the University of Miami. I am employed in the Division of Fisheries and Applied Estuarine Ecology. I received my Bachelor's degree from Park College, Parkville, Missouri in 1950, the Master's and Doctorate from the University of Miami in 1956 and 1968 respectively. I have been actively engaged in estuarine and tidal marshland research in South Florida since 1954. I have done such research for the State of Florida (1954 to 1957), the Department of Interior, National Park Service and Bureau of Sport Fisheries and Wildlife, the U. S. Public Health Service, Department of Water Supply and Pollution Control and the National Oceanographic and Atmospheric Administration, Sea Grant Program.

I, Eric J. Heald, am an Assistant Professor at the Rosenstiel School of Marine and Atmospheric Science of the University of Miami. I am employed in the Division of Fisheries and Applied Estuarine Ecology. I received my Bachelor's degree from the University of Liverpool, England, and M.S. and Ph.D. degrees from the University of Miami. I have been engaged in research on tropical estuarine ecosystems since 1964, specializing latterly in mangrove and marsh grass communities.

I, Martin Roessler, am an Assistant Professor at the Rosenstiel School of Marine and Atmospheric Science of the University of Miami. I am employed in the Division of Fisheries and Applied Estuarine Ecology. I received my education at the University of Miami and received the degree of Doctor of Philosophy in Marine Sciences in 1967. I have been actively engaged in research on the ecology of the Everglades Estuary and/or Biscayne Bay since 1960. Since June 1968, my research has been aimed at the study of the effects of thermal additions on the fishes and benthic invertebrates of the Turkey Point and I have acted as coordinator with Dr. R. G. Bader on the School's program sponsored by the United States Atomic Energy Commission, Environmental Protection Agency, National Science Foundation, National Oceanic and Atmospheric Agency (Sea Grant) and Florida Power and Light Company on the ecology of Southern Biscayne Bay and Card Sound.

Concern has been expressed over the nature of the impact on Biscayne Bay resulting from Florida Power and Light Company's plan to construct approximately 4,000 acres of cooling canals on uplands adjacent to Biscayne Bay in southeastern Dade County (see attached figure).

It is generally recognized that the proposed canal system affords an engineering alternative effective in dispersal of waste heat originating from the Turkey Point generating facility and at the same time considered least harmful to the bay biota.

In considering the alternatives (i.e., destruction of large acreages of Biscayne Bay and Card Sound versus the area given over to a cooling pond system) our primary concern has been the preservation of the water quality and biological character of Biscayne Bay and Card Sound. The chief contributors to the productivity of the bay-sound system appear to be the sea grass-algal communities found within the bay itself. The fringing zone of red and black mangroves in a secondary, though still important contributor. Boundaries of this zone are indicated by vertical cross-hatching in the attached figure.

The proposed eastern boundary of construction intersects the mangrove zone in a few areas (solid areas in figure). The area of lost mangroves is small and we feel that this loss is of minimal importance in comparison with the extent of damage which could result in Card Sound or Biscayne Bay under alternative schemes.

The majority of the area under consideration for the siting of cooling canals is presently occupied largely by black rush, *Juncus roemerianus*. It is our considered opinion that the sacrifice of approximately 7000 acres of this high marsh will have little adverse effect on the bay-sound system, for the following reasons.

1. Studies in Everglades National Park have shown that *Juncus* marshes, although biologically productive, are of minor importance as contributors of detrital material to estuarine systems unless they are effectively flushed. The marshes flourish in areas near the + 1 ft. contour where tidal flushing is poor unless high tides coincide with seasonally high fresh water levels.

2. Sheet flow of fresh water, which in many similar coastal areas provides significant transport of detrital material to adjacent bay systems, is now virtually absent from the area under consideration. A combination of the L-31 levee and old impoundment areas (horizontal hatching

in the figure) greatly impedes fresh water flow.

If adequate safeguards are provided by the Company during the actual dredging of the canals, we believe that the cooling canal system offers a workable compromise between estuarine protection and provision of needed electrical power. We thus wish to reaffirm the previous affidavit of the Rosenstiel School of Marine and Atmospheric Science scientists Drs. Bader, Voss, Roessler and de Sylva.

Durbin C. Tabb

Durbin C. Tabb

Eric J. Heald

Eric J. Heald

Martin Roessler

Martin Roessler

Sworn to and suscribed before me this 29 day of February

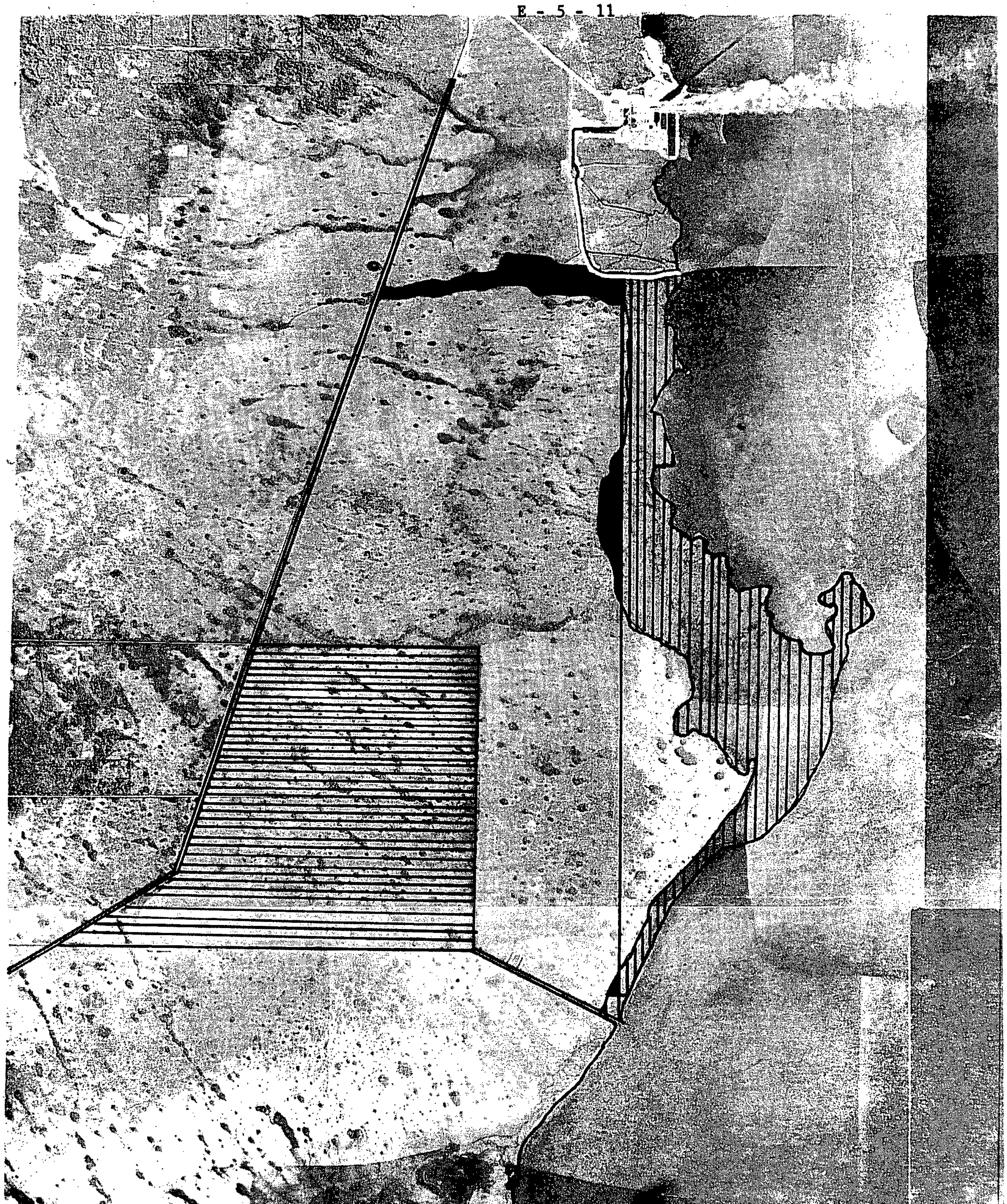
A. D. 1972.

Shari H. Green

Notary Public

My Commission expires

NOTARY PUBLIC, STATE OF FLORIDA AT LARGE
MY COMMISSION EXPIRES DEC. 1, 1978
BONDED THRU FRED W. DIESTELHORST



Pages 25 and 26

The commercial and sport fisheries discussed are affected by Dade County sewage and industrial waste discharges. As the population increases, the effects are increasing (i.e. fish catch decreases). The influence of the Applicants plant is essentially nil.

Page 27

The appearance of the fossil units and their stacks is not germane to the licensing of Units 3 and 4. The turbine generators are west of the steam generating facilities, and the switchyard is west of the cooling water discharge basin.

Page 28

Under paragraph B on page 28, the third and fourth sentences should be updated to read as follows:

> The existing 330-foot wide right-of-way presently has three double pole structures carrying seven (7) transmission lines to the north. These seven 240 kV circuits supply power to several of the Applicants substations.

Page 30

The last sentence of the first paragraph under C. should read:

> The engineer-constructor for the project is the Bechtel Corporation and/or its subsidiary Bechtel Associates.

Page 33

The enlargement of the inlet channel discussed at the top of the page is NOT planned in order to comply with requests of the Department of the Interior made in a meeting of November 8, 1971. Only the small point at the entrance to the turning basin has been removed.

In the sixth line of the first complete paragraph delete "and several other lesser canals", as these are plugged.

In the first complete paragraph, the last sentence should be amended to state that the Card Sound Canal has been opened, and is in use, with flow regulated to meet the criteria of the consent Final Judgment.

Page 34

In the fourth line the statement that purged flows are limited to a maximum of 600 cfs, etc. is incorrect. The consent Final Judgment permits purged flows of 1200 cfs and permits maximum temperatures of 90°F, and also provides for no discharges or purged flows at temperatures in excess of 90°F.

In the twelfth line, Grand Canal should be changed to East Canal.

In the tenth line of the first complete paragraph, "through a control works" should be deleted.

In the peneultimate paragraph, the surface "of 4,000 acres" should be updated to "of about 3,860 acres", and the number of channels should be thirty-eight (38).

In the sixth line of the last paragraph, it is stated that Card Sound Canal will deliver about 8000 cfs to the plant forebay. Actually it will be 4250 cfs with all four units operating and lesser amounts with lesser number of pumps and units operating.

Page 36

In the last line of Table 5, it should be noted seepage is dependent on levels and flow can be to the system.

Page 37

The second sentence of the first complete paragraph should be revised as follows:

> An evaporator, field modified to yield a throughput in excess of 3 gpm, and a 20 gpm polishing demineralizer are installed.

Page 38

The tritium estimate stated is several factors higher than that given in Table 6 of the Draft Statement.

Page 39

After the heading of the last column, there should be four instead of three asterisks.

Page 40

It is suggested that Table 2.3.7-2 of the Environmental Report Supplement be used in place of Table 7 of the Statement.

Page 42

In regard to the second paragraph under E., the Commission is advised that consideration is being given to barge shipment of spent fuel from the site. One concept being studied would utilize a cask carried on a land transporter, which would move to and from the site on a sea-going barge similar to those used to deliver reactor vessels and other heavy components.

The "barge cask" concept would utilize a 10 assembly cask weighing about 100 tons. About a dozen barge loads would leave the site annually under equilibrium conditions.

Under E.1., note that a "truckload" of fuel to date has been 12 or 14 assemblies contained in 6 or 7 shipping containers. About 10 "truckloads" will be required annually to supply fuel for units 3 and 4.

Page 44

Under IV, A., in the first paragraph note the schedule is now:

Fuel loading Unit 3 - 3/72

Unit 4 - 9/72

In the second paragraph it is stated that the work is expected to be accomplished by the Applicant over the next four years. Be advised that the work will be accomplished three years from receipt of necessary permits - in three years from November 1, 1971 per order of the Florida Pollution Control Board in their permit.

Also, the manpower peak discussed in the third paragraph has now decreased to about 1200 and will drop below 1,000 in March. By September 1972 it will be below 500.

Under IV, B., regarding the last sentence of the last paragraph, the economics of hauling the rock to contruction sites in the area do not appear to make sale of the material possible.

Page 45

The last sentence on the page is noted. As stated in the comments regarding page 33, Card Sound Canal is now in use. The "hole-through" operation was conducted when the level of Card Sound was slightly greater than Biscayne Bay, so the slight turbidity created was contained in flow toward the plant and settled out in the canal system (and was not flushed into the Bay or the Sound).

Page 49

The pump sizing given in line 9 of the first complete paragraph is not planned by the Applicant. Field tests during construction of the system will be made to set the size and number of pumps.

In the next paragraph it should be noted that flow can be toward the canal, as flow depends on canal level.

Page 50

The comment in the first line that salinity increases will occur along the bay and the sound shoreline during most of the cycle is speculative. It fails to account for the fact that the water-flow through the aquifer will not surface at the shoreline inasmuch as a layer of blanketing silt exists from the shoreline to a considerable distance into the bay and sound. It is also highly likely that the discharge from the aquifer will be diffused over a very large area and is not expected to be detectable.

In the second paragraph it is stated that use of some of the drainage water from Model Land Canal would decrease the purged salinity. The agreement with the Central and Southern Florida Flood Control requires FPL to pump surface drainage from Canals C-106 and C-107 into the system. The research program instituted by the Final Judgment requires the exploration by the Applicant of the use of surface waters and also the Applicant has committed to the exploration of the use of treated sewage effluent in the systems.

Page 52

The second column in Table 10 should be labeled 4FΔT.

Page 57

In the first paragraph under (a.), the hazard posed is not found to exist (i.e. with all circulating water pumps of units 3 and 4 in actual operation). Occasionally a 3 or 4 inch blowfish is lifted by the screens, but there is no gross trapping of fish of any size.

Page 58

In the second paragraph it is stated that 4250 CFS is of the same order of magnitude as the estimated flow of water from the open ocean into and out of the Biscayne Bay-Card Sound-Barnes Sound system. This is entirely too low inasmuch as the total in-flow and out-flow from Biscayne Bay and Card Sound is several hundred thousand CFS or about two orders of magnitude greater than the flow through the system.

Page 63

In the first complete paragraph it is stated that much of the observed effect had been related to mean temperature rather than as a response to higher temperature over short periods of time; while this is correct, the effects have actually included the impact of extremely high temperatures during the summertime period. Therefore, the Applicant does not expect greater effects by the operation of the Grand Canal and the Card Sound Canal at considerably lower temperatures than required by the Final Judgment.

The above comment applies to the second complete paragraph also.

Page 64

In the last paragraph of (c.), the statement that the movement of water to the east has a potential for creating a thermal barrier to those larvae and juvenile stages of vertebraes and fishes that use the mangrove eco-system as a nursery ground, is a highly speculative statement because, (1) it is highly probable that no increase in salinity or temperature will be experienced in the surface water adjacent to the system inasmuch as the flow from the system will take place in the aquifer which is 80 feet deep and 5 feet under the surface. The flow will be confined to the aquifer depths by the blanketing layer of silt and marl until the point of aquifer out some distance into the bay; and (2) there is no data presented concerning which juvenile stages of invertebrates use the mangrove eco-system as a nursery ground. The Applicant is aware of no data that indicates that any great number of juvenile stages actually utilize the mangrove system as opposed to achieving nutrients from it. There is no indication that even if the temperature were to be increased in the mangrove eco-system it would interrupt the flow of nutrients from it.

Pages 65 and 66

Under (D), the postulated doses are higher than the conservative estimates given in FSAR Section 11.1 and it is suggested that bases for the higher doses should be stated.

Page 67

The daily consumption assumptions in the second paragraph are unreasonably high.

Also, the calculations in the last paragraph are overly conservative, especially as regards the assumed releases of nuclides.

Page 77

As noted previously in these comments, the spent fuel discussed in (b.) may be shipped by barge from the site. Exposure to persons associated with barge handling and towing would be extremely small.

Page 81

In the second paragraph under (F.) it is stated that the absence of quantitative scientific information in the mangrove salt mile section is apparent. The Applicant is preparing to institute studies which will describe the terrestrial eco-system.

Page 82

Regarding suggestions for detailed studies, the comment concerning page 81 applies. The Applicant does not necessarily agree to the details of all of these studies. It is practically impossible to develop modeling techniques and predictive mechanisms for the highly complex subject in time for the operation of the plant or the construction of the system. It will be monitored as operation proceeds. The AEC and the Applicant are jointly conducting a monitoring study of the biological effects of the interim operation of the system. This study has been concurred in by EPA and Interior.

Pages 82 and 83

The investigation of patterns of succession on muck soils and the other studies discussed are under consideration by the Applicant.

Page 88

In the last paragraph of IX.4 on page 88, it should be pointed out that a fuel cost adjustment factor is included in the Applicant's billing of power to its customers. Savings in fuel cost are passed to customers. Since nuclear fuel is less expensive than fossil fuel (on a heating value basis) the Applicant's customers will benefit by operation of Turkey Point Units 3 and 4.

Page 92

Regarding (3), this cooling system has been specifically rejected by the Federal-State Conference on water pollution in Biscayne Bay held in Miami in February 1970 and would violate the Final Judgment entered in the Federal District Court in September 1971.

With respect to cooling towers using brackish water; (1) Mr. W. Storch, Chief Engineer has written that surface waters from the Central & Southern Florida Flood Control District are not available for long periods of the year. Consequently, should these waters be used, it would require a storage system of considerable magnitude and pumping capabilities - the cost of which has not been included in the staff estimate. Also, the cost estimate fails to include the necessary cost of a completely enclosed circulating water system from the present discharge seal wells through the cooling towers and back into the intake. This completely closed system would cost several million dollars in addition to the cost the staff has calculated. Without such a closed system it would be a futile exercise to add brackish water to a normally saline environment as it would promptly be lost into the ground water. Aside from this, the cost estimate of $22 million is not adequate inasmuch as it does not value the capitalized cost of the power required to operate pumps nor the capitalized operating and maintenance cost necessary for the system. Approximately 40,000 kw would be required to operate the cooling tower proposed. 40,000 kw at a cost of approximately $150 a kilowatt is a cost of $6 million in addition to the construction cost of the cooling towers themselves. Maintenance costs for a salt water tower are unknown, no experience is available concerning the operation of salt water towers in the similiar environment. If such costs were figured at a rate of 5%, these costs would total approximately $1 million per year. If capitalized at 8-1/2% $12 million must be added to the estimate. The estimate also fails to include depreciation of cooling towers. The present designs are constructed of wood and would very likely have to be replaced every ten to fifteen years.

Page 99

The Applicant has found information concerning the "ample supplies of brackish water" discussed in the third paragraph under (5.).

Page 108

In the last sentence of the first complete paragraph, wherein it is stated that "the reference case would probably hasten that development"; this observation flys in the face of experience wherein the location or operation of a power plant has never in the experience of the Applicant hastened or resulted in development being attracted to it.

General

In section II.F. beginning on page 18, and in other sections, the Draft Detailed Statement fails to recognize that the cooling system will occupy an area of relatively sparse mangrove growth. The dense mangrove growth on the edge of the Biscayne Bay will be left relatively untouched. The dense mangrove growth is a far more important contributor to nutrients in the bay than the sparse mangrove. In this connection the affidavit from the University of Miami scientists discussed in the comments regarding Page 18, and attached to this document, is referenced.

OFFICE OF THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

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50-251

APPENDIX E - 6

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U.S. ATOMIC ENERGY COMM.
MAIL & RECORDS SECTION

March 13, 1972

Mr. Lester Rogers, Director
Division of Radiological & Environmental
Protection
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

The draft detailed statement on the environmental considerations by the U.S. Atomic Energy Commission for the Turkey Point Plant, Units 3 and 4, of the Florida Power and Light Company, Docket Numbers 50-250 and 251, which accompanied your letter has been received by the Department of Commerce for review and comment.

In order to give you the benefit of the Department's analysis, the following comments are offered for your consideration.

The subject EIS appears to be comprehensive in scope and to give objective consideration to many of the probable and potential impacts that construction and operation of this nuclear facility will have on the environment and associated biota. In addition, several alternative systems are discussed in some detail. However, we feel that the EIS might be improved by including additional information or discussion on the following points.

Considering the vital importance of the red mangrove to the productivity of the estuarine ecosystem, perhaps it should be mentioned in the section on "The Site" on page 6 - that there will be no diminution of this contribution because the 7,000 acre cooling reservoir will not be constructed in the area covered by red mangroves, as stated on page 2. 3. 6-19 of the Environmental Report Supplement.

Several sections under the heading "Ecology of the Site and Environs" (pp. 18-27) might be strengthened. Specifically, there is a lack of detailed information concerning the biological surveys conducted in the Turkey Point area. The lack of detailed information makes it impossible to ascertain whether the sampling methods and equipment employed were technically adequate and would in fact, provide sufficiently reliable data upon which to base the conclusions presented. Additional information on the methods used and results obtained should be supplied in the final EIS It would be desirable to include a list of the common and scientific names of the species of plants and animals found in the area and referred to in the EIS.

In the section on "Commercial and Sport Fisheries," it is stated that "the species caught in large quantities are the pink and brown shrimp, the spiny lobster, the stone crab, black and silver mullets, and the king and spanish mackerels." Again, we suggest that a list of the common and scientific names of these organisms be appended to the EIS in order to avoid confusion regarding the specific identity of the animals referenced. For example, *Panulirus argus* is referred to on page 25 (and the specific name misspelled) but the common name is not given; then on p. 26, spiny lobsters are mentioned, but the scientific name is not supplied.

In the section on "Environmental Impacts of Plant Operation," perhaps it could be concluded on the basis of available information that there is a high probability that the multi-channel recirculating water system for heat dissipation will have to be expanded if the plant is going to operate at full load, and therefore, the environmental impact on land use, water use, and ecology of the area will be increased. This possibility is mentioned on p. 84 under "Adverse Effects."

The data and conclusions concerning the impact of entrainment and elevated temperature and salinity on organisms (pp. 58-64) suggest that the potential exists for adverse effects on the biota of Biscayne Bay and Card Sound. For example, it is pointed out (p. 64) that operation of the Turkey Point power plant has been "detrimental to many of the economically valuable animals of the waterways of the mangrove area through which the heated discharge water flows." In view of the uncertainty regarding the magnitude of the adverse effects discussed in this section, perhaps it would be desirable to refer the reader to the section on "Environmental Monitoring and Research Programs" (pp. 81-83) in which the monitoring program proposed by the Applicant and the AEC's recommendations for additional research are discussed.

Some questions appear relevant to radioactive effluents and the measurement of radioactive effluent both on site and in the environment outside the site. Although we are in agreement with the applicant's annual average relative concentration value of 1×10^{-6} sec m^{-3}, we do not agree that this value can be applied to gaseous releases expected to range between 6 and 20 times per year with an estimated disposal time of 1 hour (see page 38, DDES). An annual diffusion rate is applicable only to a uniform release throughout the entire year. A release of 20 hours per year can hardly be considered to fill this criteria. Consequently, we believe the average maximum concentrations listed in Table 7 are not applicable for this case.

The basis for estimating radioactive effluent from this power plant (2 units) is unclear. The applicant's estimates for liquid radionuclide release (2 units) (Table 6, page 39) is for an average annual release of 0.069 curies exclusive of tritium and for 1350 curies of tritium (equilibrium cycle). In gaseous effluent the applicant estimates (Table 7, page 41) a total average annual release of 14,758 curies, made up of 7714 Ci of ^{85}Kr and 7044 Ci of ^{133}Xe.

Thus for liquid effluent, exclusive of tritium, the AEC staff estimates about 290 times more effluent levels than the applicant, whereas for gaseous ^{85}Kr with AEC staff estimates about 11 times less than the applicant, while estimates for tritium and ^{133}Xe by the applicant and by the AEC staff are similar.

The environmental impact of these radioactivity releases have been estimated based on the generally (but not ^{85}Kr) higher effluent estimates of the AEC staff, and are thus presumably conservative. There is, however, a real concern. This concern is exemplified by the fact that the AEC staff estimates of the liquid and gaseous effluent expected (Table 12, page 66) from this plant are identical in all respects to their expected effluents from the Calvert Cliffs plant units and the Point Beach Plant units, even though there is substantial difference in the power outputs of these different units. In none of the draft statements for these various facilities has there been given any explanation of the basis for these AEC staff estimates.

It is suggested that a substantial improvement in the credibility of pressurized water reactor radioactivity effluent estimates would be generated by a specific and detailed report by the AEC staff for the basis of their effluent estimates for this type reactor, with a detailed accounting of the assumptions underlying the estimates. This report could then be attached as an appendix to draft statements on other power reactors of the same type. The only new material required would be a discussion of the differences expected from the different radioactivity waste handling systems.

The environmental radioactivity monitoring program for these two units is only mentioned in the draft statement and apparently is being reviewed by the AEC staff and will be covered in a Safety Evaluation Report to be issued soon. No information is given regarding the ability of the applicants on-site radioactivity monitoring program to satisfy the requirements of "Safety Guide 21-Measuring and Reporting of Effluents from Nuclear Power Plants," dated December 29, 1971. We believe that the monitoring program could be described and would contribute to the completeness of the statement. It also would be desirable in the final EIS to include specific details concerning the postoperational aquatic monitoring program. Information that is required includes location of sampling stations, species of organisms sampled, collection frequency, and types of analyses to be performed.

The discussion of "Alternatives" (pp. 88-104) is especially thorough, and it is pointed out in the following section on "Cost-Benefit Analysis" on page 108 that Florida Power and

Light will continue to study methods for improving the proposed cooling channel system. These methods will include powered spray modules and mechanical draft cooling towers. The company "has agreed to utilize such improvements as these research programs develop, with resolution of uncertainties in favor of the environment." We are assured that every effort will be made to ameliorate the impact of this power plant on the environment, which is a commendable approach.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

RECEIVED MAR 16 1972

APPENDIX E - 7

March 15, 1972

50-250
50-251

Mr. Lester Rogers, Director,
Division of Radiological and
Environmental Protection
U. S. Atomic Energy Commission
Washington, DC 20545

Dear Mr. Rogers:

We have had the draft environmental statement for the Florida Power and Light Company's Turkey Point Plant Units 3 and 4 reviewed in the relevant agencies of the Department of Agriculture and comments from the Soil Conservation Service, the Economic Research Service, the Forest Service, and the Agricultural Research Service, all agencies of the Department, are enclosed.

Sincerely,

T C Byerly

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Attachments

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

If the cooling channel system is accepted, the commendations under environmental monitoring and research programs for the channeled area seem adequate for site protection. Vegetative research should include identifying and developing methods of establishing or re-establishing plant life most suitable for the projected uses such as wildlife, if these uses are seriously contemplated. Before further extension of the cooling channels, other alternatives should be considered.

With 99 and 85 percent of the work completed in January, 1972 additional comments at this time seem inappropriate.

Attachment

Soil Conservation Service, USDA, Comments on Draft Environmental Statement Prepared by the Atomic Energy Commission for the Florida Power & Light Company Turkey Point Plant Units 3 & 4 AEC Docket Nos. 50-250 and 251

In accordance with the instructions received, we have reviewed the environmental impact statement for the Florida Power & Light Company Turkey Point Plant Units 3 & 4.

The only comment which we have concerns the stabilization of the spoil areas resulting from the construction of the system of canals for cooling the water discharged from the generating units.

We feel that the disturbed areas should be seeded as soon as possible after the construction is completed. Hopefully, native vegetation, rather than introduced agronomic plants, can be used for this purpose.

Native vegetation will be more hardy and will fit into the ecological patterns for this region. It is hoped that after this is accomplished, the area will be fairly similar to existing environmental conditions.

Three salt marsh type plants that may be used for this purpose are:

1. marshhay cordgrass - *Spartina patens*
2. seashore saltgrass - *Distichlis spicata*
3. seashore dropseed - *Sporobolus virginicus*

These are the primary species which should be considered. A field investigation would reveal others and might include perennial forbs and rushes. The Soil Conservation Service is available to assist in this endeavor if the Sponsors so desire.

ERS Comments on the Draft Detailed Environmental Statement for the Turkey Point Nuclear Power Plant, Florida

The statement could be made more effective by expanding the discussion of alternatives to include the alternative of waiting until the planned cooling channel system is complete before operating the plant. This alternative would eliminate the adverse effects caused by warmed water being discharged into the Bay and Card Sound.

February 25, 1972

Review of Draft Environmental Statement Related to the Proposed Issuance of Operating Licenses to the Florida Power and Light Company for Turkey Point Plant Units 3 and 4.

The Agricultural Research Service has reviewed the draft environmental statement relating to issuance of operating licenses to the Florida Power and Light Company for Turkey Point Plant Units 3 and 4. Obviously, most environmental impacts due to construction have already occurred. According to the documentation, the proposed effluent system consisting of a channel complex covering 7,000 acres still has operational characteristics that are unknown. The establishment of vegetation on the spoil banks and possible contamination of ground water of the area are two potential problem areas.

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

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16 MAR 1972

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50-251

RECEIVED
MAR 21 1972
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

APPENDIX E - 8

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

This is in response to your recent letter addressed to Mr. Herbert F. DeSimone, Assistant Secretary for Environment and Urban Systems, Department of Transportation, concerning the revised draft environmental impact statement, environmental report and other pertinent papers on the proposed issuance of an operating license for the Turkey Point Plant Nuclear Units No. 3 and No. 4 on the western shore of Biscayne Bay, Dade County, Florida.

The concerned operating administrations and staff of this Department have reviewed the material sent to us and noted in the review by the Federal Railroad Administration is the following:

> "There is no indication whether the additional power transmissions will have any adverse effects on existing railroad signal or communication lines through inductive coupling or direct fault."

It is the determination of this Department that the impact of this proposed project would be minimal insofar as transportation is concerned.

Reference is made to our review of the initial draft environmental impact statement as indicated in our letter of 18 January 1971 addressed to Mr. Harold L. Price.

We have no objection to the proposal for the issuance to Florida Power and Light Co. of an operating license for the Turkey Point Plant Units No. 3 and No. 4 nor do we have any objection with the environmental impact statement. It is requested, however, that the concern of the Federal Railroad Administration relating to transmission lines be checked into since this point was not addressed in the impact statement.

The opportunity for the Department of Transportation to review and comment on the Turkey Point Plant Nuclear Units No. 3 and No. 4 is appreciated.

Sincerely,

W. M. Benkert
W. M. BENKERT
Rear Admiral, U. S. Coast Guard
Chief, Office of Marine Environment
and Systems

UNIVERSITY OF MIAMI

Dorothy H. and Lewis Rosenstiel

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APPENDIX E - 9

17 March 1972

Mr. Richard Cleveland
Project Leader
Atomic Energy Commission
Division of Radiology and Environmental
Protection
Washington, D.C. 20545

Dear Mr. Cleveland:

In response to your request for me to review at the impact statement I have the following major comments:

1. The report in general is excellently prepared and is correct.

2. The emphasis on the mangroves as the basis of the food chain is incorrect for Biscayne Bay in the area between Turkey Point and the model land canal. The work done by Odum (1970) and Heald (1971) on mangrove detritus was done on the west coast of Florida in an extensive mangrove area of North River. The algal contribution to this food chain was thought by these workers to be very small. The Biscayne Bay mangrove fringe on the west shore of the bay below Turkey Point is sparce. The grass and macro-algae on the other hand is very prolific. Based on two years measurement of Thalassia (turtle grass) growth rates and mapping both by scuba and aerial photography we have arrived at the following estimate for the amount contributed by the mangroves and turtle grass:

	Area	Productivity g dry weight/m^2/day	
MANGROVE			
dense	1.9	2.41	4.8
thin	4.2	1.57	6.6
			11.4
THALASSIA			
dense	32.4	3.22	104.3
thin	43.3	0.38	16.5
			120.8

Mr. Richard Cleveland
page 2

The question still remains as to the contribution of the macro-algae which are quite prolific in certain areas. We have a standing crop measurement and are currently investigating the growth rates in order to obtain equivalent productivity measurements to those of Thalassia. At the moment it appears that the Laurencia complex (a red alga) and the green macro-algae have equal or possibly more productivity over a year than the Thalassia. Obviously, the mangrove contribution is small in proportion to these other detrital sources. Therefore, I would revise pages 21 to 23 in length and expand page 24.

3. Page 21, 2. Aquatic. The last line should read fauna and flora.

4. Page 23 b. The first paragraph contradicts the second. The patches of Diplanthera are not as important as the macro-algae as stated in paragraph 2.

5. Page 24, Paragraph 1 - Penicillus capitatus is misspelled as is Thalassia in the third paragraph.

6. The next paragraph may be correct, but I do not see the relevance of using the trawling example when we have such detailed underwater and aerial evidence.

7. Page 24, c. Central Areas. Vegetation is not limited to red and brown algae. This area is fairly rich in green macro-algae.

8. I disagree that the area of damage was 300 acres. I would say that 400 acres would be a fairer estimate.

9. The temperature at which death to the organism may occur has not been adequately established at this point. A short time at an elevated temperature such as 24 hours at 36°C may be far more important than 32°C for several months. We simply do not have this information yet. Thus, the statement on page 95 that 10 to 15% of the time the 3°F isotherm might exceed 95°F appears dangerous in my estimation.

If I can provide any further information, please let me know.

Sincerely,

Anitra Thorhaug

Anitra Thorhaug, Ph.D.
Division of Fisheries and
Applied Estuarine Ecology

AT:js

ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D. C. 20460

MAR 2 4 1972

OFFICE OF THE ADMINISTRATOR

APPENDIX E - 10

50-250
50-251

Mr. Manning Muntzing
Director of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muntzing:

The Environmental Protection Agency has reviewed the draft environmental statement for the Turkey Point Nuclear Power Plant, Units 3 and 4. Our detailed comments are enclosed.

We appreciate the difficult circumstances and time restrictions under which the Atomic Energy Commission must prepare a series of complex impact statements. We also recognize the difficulty in determining the appropriate degree to which an agency should go in developing and providing data to support conclusions reached in the impact statement. It is our judgment, however, that this statement should contain additional information in order to evaluate fully the environmental impact of the operation of the Turkey Point plants. This information, outlined in our detailed comments, should be contained in the final statement.

It is the position of EPA that operation of the Turkey Point plant, in accordance with the terms of the Final Judgment of the U.S. District Court, Southern District of Florida, will not result in an unacceptable impact on water quality. The draft impact statement does not, however, clearly indicate a commitment by Florida Power and Light to the requirements of the Final Judgment. In addition, the company is required to meet existing state and Federal water quality standards. The final statement should verify those commitments and specifically outline, in adequate detail, the plans and operational procedures that will be followed to meet legal requirements.

In EPA's judgement, the system for treating liquid radioactive wastes, because of its limited evaporator capacity, does not represent treatment of effluents at the lowest level practicable. We believe that the system should be upgraded prior to full commercial operation to a capacity sufficient to treat liquid effluents resulting from primary-to-secondary steam leaks.

We will be pleased to discuss our comments with you or members of your staff.

Sincerely,

Robert W. Fri
Deputy Administrator

EPA-D-AEC-00039-21

E - 10 - 3

ENVIRONMENTAL PROTECTION AGENCY

Washington, D.C. 20460

March 1972

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Turkey Point Plant Units 3 and 4

TABLE OF CONTENTS

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

TURKEY POINT PLANT UNITS 3 AND 4

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency has reviewed the draft environmental impact statement for the Turkey Point Plant Units 3 and 4 prepared by the U.S. Atomic Energy Commission and issued on February 9, 1972. It should be noted that the potential environmental impact of this facility has been the basis of a civil action in the U.S. District Court of the Southern District of Florida and that a Final Judgment has been issued by the court. Keeping in mind the court decision, we have arrived at the following conclusions:

1. Two radiological issues require futher analysis and evaluation -- transportation accidents and accidents involving reactor systems. These issues are common to all nuclear power plants and it is appropriate that they be handled on a general basis. It is our understanding that the AEC is studying the probability and consequences of such accidents and will apply their results to all licensed facilities. EPA will work closely with the AEC in the conduct of this work.

2. The capacity of the liquid waste treatment system appears inadequate to handle the volumes of liquid wastes which are expected to be generated at this facility.

3. Since the Final Judgment in Civil Action 70-328-CA, plays such a dominant role in the present formulation of this project, it is recommended that it be included in the final impact statement as an appendix. This will permit a comparison of the plants' operating characteristics with the requirements set forth by the court. In addition, the AEC should give some assurance that they will not permit a change in operation of any or all units at Turkey Point without the consent of all concerned state and Federal agencies. Further, the final statement should clearly indicate a commitment by Florida Power and Light to meet the requirements of the Final Judgment as well as the requirements of state and Federal water quality standards.

RADIOLOGICAL ASPECTS

Transportation and Reactor Accidents

In its review of nuclear power plants, EPA has identified a need for additional information on two types of accidents which could result in radiation exposure to the public: (1) those involving transportation of spent fuel and radioactive wastes, and (2) in-plant accidents involving reactor systems. Since these accidents are common to all nuclear power plants, the environmental risk for each type of accident is amenable to a general analysis. Although the AEC has done considerable work for a number of years on the safety aspects of such accidents, we believe that a thorough analysis of the probabilities of occurrence and the expected consequences of such accidents is necessary. A general study would result in a better understanding of the environmental risks than would a less-detailed examination of the questions on a case-by-case basis. An understanding has been reached with the AEC that they will conduct such analyses, with EPA participation, concurrent with reviews of impact statements for individual facilities and will make the results public in the near future. We believe that any changes in equipment or operating procedures for individual plants, required as a result of the investigations, could be included without appreciably changing the overall plant design. If major redesign of the plants to include engineering changes were expected, or if an immediate public or environmental risk were being taken while these two issues were being resolved, we will, of course, make our concerns known, and a revised impact statement may be necessary.

The statement concludes "... that the environmental risks due to postulated radiological accidents are exceedingly small and consititute a negligible hazard when compared to the benefits gained from the plant operation". This conclusion is based on the standard accident assumptions and guidance issued by the AEC for light-water-cooled reactors as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971. EPA commented on this proposed amendment in a letter to the Commission on January 13, 1972, indicating the necessity for a detailed discussion of the technical bases of the assumptions involved in determining the various classes of accidents and expected consequences. We believe that the general analysis of accidents mentioned above will be adequate to resolve these points and that the AEC will apply the results to all licensed facilities.

Radioactive Waste Management

The radioactive liquid waste treatment system as described in the Final Safety Analysis Report (FSAR) and in the statement (page 39) is inadequate when compared to other PWR plants of similar power output. It appears unlikely that radioactive wastes resulting from primary to secondary system leakage can be adequately processed with this system. In particular, the flow rate capacity of the evaporator (2 gpm) is low. Other PWR plants of similar power output have evaporator capacities ranging from about 10 to 20 times the capacity of the Turkey Point evaporator.

The FSAR states that the 50 gpm steam generator blowdown can be diverted to the waste treatment system. The available tank capacity would only contain a few hours of flow at this rate. In the event of primary to secondary leakage much larger blowdown periods can be expected and, because of the limited evaporator size, the system would be overloaded resulting in the discharge of contaminated liquids. The statement notes (page 35) that "A separate analysis of treatment of radioactive wastes is being done by the AEC Staff." The final statement should indicate the status of this analysis and describe (steps to be taken to correct this situation.)

Dose Assessment

Experience at other nuclear power stations has shown that the largest source of radiation exposure to persons in the plant vicinity may be due to direct radiation (shine) from the plant. The possibility of such direct exposure from Turkey Point should be evaluated, with special attention given to persons using the Girl and Boy Scout camps on site. The dose contribution, if any, should be included in the estimate of annual average doses.

Liquid effluents are to be discharged to the condenser cooling water. Upon completion of the proposed cooling system the cooling water will be recycled through the condenser after passing through the canals, and there will be only limited discharge to Card Sound. Since the effluents will not go directly into Card Sound as implied in the draft statement (page 67), radionuclides can be expected to buildup in the cooling water. The equilibrium concentrations should be calculated and used in the final statement as a basis for determining appropriate population exposure estimates.

NONRADIOLOGICAL ASPECTS

Water Quality and Thermal Effects

As described in the environmental impact statement on the Turkey Point Plant Units 3 and 4, the operational procedures during four distinct construction stages are dictated by the Final Judgment of the U.S. District Court - Southern District of Florida. This Judgment specifies discharge periods, flow rates, and salinity and temperature limits. In addition, the plant is directed to be in compliance with all existing state and Federal water quality standards. The draft statement, however, does not explicity recognize the potential water quality standard for thermal releases being proposed by the State of Florida. The effect that compliance with such standards would have on the plant design and operational procedures should be discussed.

Information presented in the AEC draft statement on plant operation does not consistently correspond with that previously furnished by Florida Power and Light to Federal agencies. For example, the multiple-canal cooling system when installed, will be capable of limited closed-cycle operation with the generating units operating at reduced capacity, permitting the plant to meet the requirements of the Final Judgment consent decree. The draft statement, however, does not adequately discuss the plans and operational procedures proposed by Florida Power and Light to enable the Turkey Point plant to meet these legal requirements. In addition, since situations necessitating operational changes will probably occur before the cooling canal system completed, the plans for assuring compliance with the consent decree during the interim periods, should be discussed. Further, the draft statement indicates that in order for the plant to operate at 100 % capacity and at all times satisfy the consent decree, several thousand acres of additional land will be required. Any such plans for expanding the 7000 acre cooling system presently under construction should be described in detail in the environmental impact statement.

The Final Judgment indicates that the court recognized the importance of protecting the shallow substrate that is exposed during low tide. It specifies that retaining and discharge structures be built that will guide the Card Sound discharge out through the shallow water to the 8 foot bathymetric contour and that the effluent be directed upwards at a velocity not to exceed 1.5 fps. Details on how the applicant will meet these requirements should be incorporated in the environmental statement.

Since there is a possibility of damage to the power plant and/or the cooling system from natural phenomena such as hurricanes or severe tropical storms, the final statement should consider the consequences of such occurences and estimate the amount of time that would be required for repairs.

Canals C-106 and C-107 and the Model Land Canal will be intersected by the cooling system. No information is presented, however, on the relocation of these canals or how the flow will be handled. The statement should include information on who is responsible for the relocatic how and where they will be relocated, and the relation of the new canal routes to the proposed interceptor ditch.

The Final Judgment directs that biocides such as chlorine, may not be introduced into cooling condenser water except in compliance with the specifications of the Florida Administrative Code and applicable laws and regulations of the State of Florida. The environmental impact statement should indicate these requirements and include a review and evaluation of the operational schedule that will be required by the state. In addition, the methods or techniques proposed by the applicant to reduce the effect of biocides on water quality such as applying chlorine to only one condenser at a time, should be outlined in the final statement.

The effects of plant operation on dissolved oxygen resources are not presented in the statement. The minor decreases in D.O. quoted in the environmental report supplement are in disagreement with results of an 18-month study conducted by M.S. Nugent and sponsored by the applicant. This study cites a decrease of about one mg/l as cooling water passes through the plant and down the effluent canal.

Alternative Cooling Methods

The two once-through alternatives -- Biscayne Bay intake with Card Sound discharge and Card Sound intake and discharge -- have been precluded by the consent decree and, hence, should not be considered as usable alternatives.

Florida Power and Light is obligated by the consent decree, however, to consider mechanical cooling devices. For example, cooling towers using brackish water should be explored. In this regard, it should be noted that recent data on tower drift characteristics indicate much less potential damage from salt drift onto the surrounding terrain than indicated by the statement. Also the comments in the statement concerning the frequency and persistence of a vapor plume seem to overestimate this effect. Such comments should be supported with factual information. In addition, the statement asserts that the predominant wind directions are toward Key Largo. To our knowledge, this is not the case. Should cooling towers prove feasible, many potential problems connected with the construction and use of the cooling channel system would be eliminated.

Biological Effects

The AEC environmental statement for the Turkey Point Plant does not adequately discuss the effect of the intake system on fish during the two interim operational periods. Since intake velocities will be high (2.4fps) with all four plant units operating, and fish escape slots may not be feasible, it is likely that fish kills from impingement on the protective screens and increased predation may be significant during the interim periods. The final statement should estimate the extent of fish mortalities that are likely to occur under various plant operational situations, environmental conditions in Biscayne Bay, and phases of the life cycle of the important fish species. Estimates of the fish kill should specify both total numbers and weight of each important species involved.

The environmental report supplement indicates that Florida Power and Light Company (FPL) is conducting studies on fish protective devices. The draft environmental statement, however, does not present any information as to the status or results, if any, of these studies. In addition, the Final Judgment states that FPL must install and maintain such protective devices "... as may be required by the Florida Department of Natural Resources", but no such requirements are cited in the draft statement.

The plant cooling system will entrain significant numbers of planktonic organisms from Biscayne Bay and Card Sound during the interim operational modes specified in the Final Judgment. The statement concludes, however, that the effects of the plant on planktonic organisms and planktonic life cycle stages of larger organisms will be ecologically negligible and that the loss of plankton by entrainment will have only a minor impact on Card Sound. Several studies reported by the National Marine Water Quality Laboratory (NMWQL) of EPA are used as references in arriving at these conclusions. In our opinion, the results of these studies have been misinterpreted. The impact statement fails to state that a 50% phytoplankton kill was found using chlorophyll a analysis and that the adenosine triphosphate (ATP) concentration corroborated this finding (within 2%). In addition, it was found that 73% mortalities occurred in zooplankton after passage through the cooling condensers and 85% were killed by the time cooling water reached the discharge point at the terminus of the Grand Canal. The total kill of one species of zooplankton over a two month period during the summer was estimated to be 6 to 7 tons. Further, zooplankton which were exposed to the warm discharge plume in the bay but were not, in fact, drawn through the cooling system, showed comparable mortalities. Thus, in our opinion, the conclusion made in the statement that the potential impact on plankton would not be appreciable, is not based on all the available information (for our estimate of damage see attachment A). Also, the statement indicates that "...there is no evidence that... the bay is being significantly depleted of plankton by the present operation of the plant." This statement requires substantiation. To our knowledge, no studies by EPA or any other research group have attempted to measure the degree of planktonic depletion in the Biscayne Bay Card Sound system. In fact, depletion of plankton is only one concern and may be of secondary importance to a power plant-induced selection in favor of undesirable, but more temperature resistant species such as the bluegreen algae. Such secondary effects have not been addressed in the draft statement.

The draft statement failed to note the role of the marine grass, *Thallassia*, and the macro algae as the major elements of productivity in the Bay-Sound system. The operational restrictions specified in the final judgment were in part dictated by the realization that these life forms are critical to the local environmental system and must be protected.

The Statement places considerable emphasis on the mangroves. The 7000 acre tract to be used for the recirculation cooling system is a peat-soil grass marsh with sparse stands of red, black and white mangroves, various grasses, and several types of trees. It is not a prime mangrove swamp. There are approximately 2,500 acres of mangrove to the east of the cooling system site, but they are estimated to contribute only marginally to the productivity of the estuary system. In addition, this mangrove fringe is deeded to the State of Florida to serve as a permanent protective barrier and will not be appreciably affected by the project.

The marsh area, where the cooling system is to be located, is dry during the winter months but is covered by fresh-to-brackish water at depths ranging from a few inches to one foot during the rainy season of the summer. It serves as a feeding habitat for wading birds, as does much of the similar terrain to the north and south of the immediate plant area. Construction of the cooling systems, consisting of numerous canals separated by long banks, will significantly alter the plant and animal environment at the site. For example, the high ground created by the excavation spoils and the new aquatic-terrestrial boundaries (biological edges) along the margins of the steep sided canals will modify the vegetative, bird, and small mammal habitat considerably. The draft statement does not discuss these aspects of the terrestrial habitat in the Turkey Point region.

It is essential to note that the flow of surface water over the marsh area and through the mangrove fringe has not existed for over 30 years because of drainage canals and roads that serve as diversion dikes. Consequently, fresh water falling on the marsh area tends to remain there until it sinks into the near-surface aquifer, evaporates, or is transpired by the vegetation. There is only a minor contribution of vegetative material to the bay-sound system; that occurs during return flow from storm and hurricane overwash.

The marsh represents an area of net carbon accumulation, as shown by the peat deposits, rather than a major source area for vegetative detritus to the bay-sound system. The nutrient cycle is largely self-contained in the marsh area and is not critical to the estuary system.

The proposed monitoring system, however, is not designed to determine the relations between the modified marsh area, the mangrove fringe, and the estuary system after the modifications created by the cooling canal complex are complete. The draft statement indicates that the monitoring system is inadequate for this purpose, but there is no indication of an AEC requirement that the applicant initiate adequate studies.

COST-BENEFIT

The environmental costs of operating the Turkey Point nuclear units, as presently designed, are not explored in sufficient depth in the environmental statement. Environmental impacts are listed in terms of temperature rise and radioactivity release, rather than effects on marine life and radiation exposure to population. For example, it is stated that after the cooling system is completed, damage to marine life is expected to be limited to only 10 acres in which there will be a rise of 3°. During interim operations the rise is expected to be greater than 4°F over 1500 acres of the bay. The statement, however, fails to relate these increases to specific environmental damage and to assess the significance of the effect. Increased temperature is not an environmental cost; effects on marine life are environmental costs. These marine life costs for interim operation should be stated in order to compare costs and benefits adequately. Without such an approach there cannot be a logical evaluation of the effectiveness of the plant components in reducing environmental impact.

The statement indicates that alternative actions result in "unknown" or "not different" effects. The basis for these statements should be incorporated. If an effect is unknown, it should be demonstrated to be insignificant or if it is "not different," an adequate basis of evaluation should be provided. Without this supporting evidence, we do not have a clear rationale for examining the alternatives.

A number of items with environmental consequence are missing in the cost-benefit discussion, e.g. environmental effects of airborne radiation waste, of waterborne radiation waste, and chemical emissions. If the environmental impacts from these are so small that they can be neglected, the statement should support this conclusion.

The statement about tax benefits in the summary section on cost-benefit analysis is not appropriate. Under the reasonable assumption that the power will be provided by some means (the analysis rejects the alternative that the projected power needs not be met) the tax revenues will exist in any case although they may not benefit the same segment of society.

From the point of view of the cost-benefit analysis, the discussion about sunk or unsalvageable cost serves only to confuse matters. The cost of a decision not to utilize the installed facilities will be appropriately reflected in the additional differential outlays necessary to obtain power generated by alternate facilities. Of importance for a specific action are those additional costs which must be incurred in order to achieve the stated objective.

The cost-benefit treatment of the natural area impacts does not deal adequately with the concept of cost. According to Table 21, the reference case would permanently affect 6,500 acres of natural area. To be consistent, the effects of the other alternatives, including leaving the land in its original state, should be similarly stated.

The costs assumed by AEC will only be realized if Florida Power and Light or some other owner of the 7,000 acre site guarantees that the land will be kept undeveloped. Otherwise, the natural area effects of the alternatives are those effects which will be associated with the most probable alternative use of the land as determined by the market and prevailing zoning and development restrictions. Should the most probable alternative use of the land be development for residential or industrial use, then the natural area effects may be greater than those of the reference case. Rational evaluation of all the alternatives demands that the probable ultimate disposition of the land under each alternatives be made explicit.

The value of the cost-benefit analysis would be enhanced if the assumptions with regard to the need for replacement power for this plant were made more explicit. The first and second year costs for replacement power of $25 million and $11 million respectively are major factors; and assumptions therefore are critical to an evaluation of the costs of delay.

One real economic cost of delaying commercial operation is the value of the electrical power that is not produced because of the unavailability of the capacity of Turkey Point units 3 and 4. The nuclear capacity at Turkey Point was planned to be used as baseload capacity. In addition, therefore, the costs of delay must include a consideration of the difference between the costs of producing 1520 MW of electricity at an 80 percent load factor by the nuclear plant and the other existing capacity in the FPL system. This difference probably would not be the 5 mills per kwh as assumed in the statement, but may be on the order of 1.5 to 2.0 mills per kwh. (According to 1969 operating data, total production expenses for the Ft. Meyers, Port Everglades, Riviera, Sanford, and Turkey Point Plants were 3.92, 3.50, 3.65, 4.61, and 3.34 mills per kwh.) If the variable cost of nuclear power is assumed to be 2 mills per kwh, the 5 mills per kwh difference appears to be high. Only at peak load would more costly alternative power sources have to be used. At other times, all power would be provided by the existing baseload units. The Table presented as attachment B provides additional support for this point.

The cost-benefit analysis prepared by the company and AEC assumes that "...the nuclear plants will be loaded preferentially to the fossil plants, since the incremental cost of power is less." This approach allows the utility to reduce considerably the opportunity cost of producing power. Apparently, by closing down the fossil units at Turkey Point, the utility will be able to operate Unit 3 at full capacity for the first year and both units 3 and 4 at full capacity after the second year. With a difference in variable costs of production between nuclear and fossil units of 5 mills per kwh, the above mode of operation results in power replacement costs or opportunity costs of $25 million for the first year and $11 million for the second year. The present value of these costs is $32 million. However, if the difference in variable costs of production is 2 mills per kwh rather than 5, the present value of the costs of such operations amounts to only $15 million. We maintain that the 2 mills per kwh difference is more realistic and, therefore, suggest that the power replacement costs in Table 21 be reduced accordingly.

Given the nature of the system, it is unreasonable to assume that all of the power that would otherwise have been provided by the nuclear units would have to be provided by the most inefficient units in the system. It is more reasonable to assume that the vast majority of the power will be provided at the weighted average cost of production in the system, or approximately 4.0 mills per kwh.

ADDITIONAL COMMENTS

During our review we noted that in certain instances the statement does not present sufficient information to substantiate the conclusions presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of the Turkey Point plant. The cumulative effect, however, could be significant. It would, therefore, be helpful in determining the impact of the plant if the following information were included in the final statement:

1. The statement does not include information about the disposal of non-radioactive solid waste, including debris and aquatic organisms from the traveling intake screens, collected during the routine operation of the plant. The disposal method (e.g., incineration, sanitary landfill) that will be used should be described.

2. A discrepancy is noted between page 68 (12 miles) and page 83 (25 miles) as to the location of the nearest dairy herd.

3. The population dose estimate should include the dose contribution from all sources including secondary effluent sources, such as auxiliary ventilation, containment purging, condenser air ejector, blowdown flash, blowdown, secondary system leakage and direct radiation.

Acreage Damage

The limiting discharge temperature during the initial period and the first and second interim periods is 95°F. Our estimate of acreage damage under these discharge conditions is shown below.

		Acres Damaged at 95°F and Discharge of			
Location	Extent of * Damage	3000 cfs	1500 cfs	2100 cfs	No Discharge
Biscayne Bay	Severe	400-600	100-200	300-500	
	Moderate	800-1000	300-500	600-800	
	Subtle	1000-1800	600-800	800-1200	
Location	Extent of Damage *		2750 cfs	2150 cfs	No Discharge
Card Sound	Severe		100-300	100-300	
	Moderate		300-600	200-500	
	Subtle		600-1000	500-800	
		Initial Period	First Interim	Second Interim	Final

* Extent of Damage

Severe Damage = 75-80% of the organisms are eliminated.
Moderate Damage = 50-60% of the organisms are eliminated.
Subtle Damage = 10% of the organisms are eliminated.

** Unless required under Paragraph V.

Operational Periods (as defined by the Final Judgment 9/10/71)

A. The "initial" period - September 10, 1971, until such time as the Card Sound Canal is completed (Paragraph IV, Secion 3). (The Card Sound Canal was completed in February, 1972.)

B. The "first interim" period - Following completion of the Card Sound Canal until October 1, 1973 (Paragraph IV, Section 4.)

C. The "second interim" period - October 1, 1973, until no later than September 10, 1976 (Paragraph IV, Section 4.)

D. The "final" period - commences following completion of the cooling system. (Paragraph IV, Preface.)

Attachment B

VARIABLE COSTS OF PRO...

Total Variable Costs [illegible] Production for FP&L Units Excluding Turkey Point Units 1 and 2 as of January 1972*

FP&L 1969	MW	Tot Prod Exp. Mills per KWH	Plant Factor
Cape Kennedy	[illegible]	3.52	–
Cutler	346	5.35	32%
Ft. Meyers	558	3.92	–
Lauderdale	212	4.44	39
Palatka	109	5.56	31
Port Everglades	1250	3.50	63
Riviera	740	3.65	51
Sanford	156	4.61	36
King Henry	72	7.03	26
TOTAL	4,3[illegible]		

Weighted average cost of

production = 3.95 mills/KWh

*Plans for additions to the system are as follows:

Year	Unit	Capacity
1972	Sanford #4	400 MW
1972	Lauderdale Gas Turbines	444 MW
1973	Sanford #5	400 MW
1974	Hutchinson Island	850 MW

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32201

50-250
50-251

SAJWE

31 March 1972

APPENDIX E - 11

APR 4 1972

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

Reference is made to your letter (undated) forwarding copies of the draft environmental statement on Turkey Point, Plant Units 3 and 4, for our review and comment. The statement has been reviewed as to its adequacy in accordance with the requirements contained in Appendix B to ER 1105-2-507, Corps of Engineers Regulations, dated 3 January 1972.

Based on our review of information and data presented in the statement the following comments are offered:

<u>Page 11</u> - The statement that - "The predominant mangrove swampland in the region . . . . . has very little direct commercial or recreational value" appears to be contradictory to that contained on page 19 relating to the importance of mangroves as . . . . . "one of the most important elements in the ecology of tropical and subtropical areas . ." and . . . "the beginning of all important marine food chains." Biological information and data presented in the statement on pages 22 and 23 would appear to support the fact that their contribution to the commercial and sport fishery of a marine area can be considerable. It is suggested these statements be reconsidered in the light of data presented.

<u>Page 47</u> - In the first paragraph describing the environmental impact of land use the EIS states that - "about 7,000 acres of natural swampland south of the plant will be altered in providing the channel cooling system . . . . ." However, we can find no discussion as to the anticipated degree of alteration and its concomitant impact on the productivity of Card Sound or Biscayne Bay. It would appear that some clarification may be necessary.

SAJWE 31 March 1972
Mr. Lester Rogers

Page 49 - In discussing the environmental impact of water use on plant operation and peak load conditions the EIS states that - "if the system is highly taxed it is likely that unfavorable conditions would become common." Some documentation or presentation of data, or an evaluation of the degree and duration of environmental stress to the various ecosystems that would be adversely impacted in this regard, appears warranted.

Page 50 - With further reference to the environmental impact of water use the report states - "that temperatures and salinity increases will exist along much of the Bay and Sound shorelines during most of the year cycle." Further discussion of the effects of those increases would be helpful, especially when considering an earlier statement (on page 24) that - "trawl samples collected around the rim of the Sound showed that most species occur in the shallow narrow band surrounding the basin."

Page 53 - In discussing the environmental impact of interim operating conditions it is stated that - "the bottom organisms in these (plume) zones will be exposed to the elevated temperature only half the time." The environmental impact of that condition would be clarified by additional discussion in the report. For example, if temperatures approach or exceed lethal limits only a small percent of the time during tidal flow in Biscayne Bay, the result could effect a major reduction in the number and kinds of organisms.

Pages 58 - 60 - The discussion of biological impacts relating to the loss of plankton organisms appears to be deficient in providing sufficiently detailed information for an adequate review of probable effects on phytoplankton or zooplankton in the Sound; although on page 60 it is stated that - "A major part of the plankton that enters the multi-channel cooling system from Card Sound will probably be killed . . . ."

Page 84 - In discussing adverse effects which cannot be avoided, the impact on rare and endangered species is indicated as an area requiring further assessment. Additional information as to when such impact and its scope would be evaluated appears necessary to qualify those effects.

Page 108 - The report states that - "Continuing monitoring and study programs are to be carried out to evaluate further the environmental impact of the proposed action." Problems as to the potential temperature rise in excess of consent decree limits are discussed rather briefly in the statement with the conclusion that there is a need for continuing

SAJWK
Mr. Lester Rogers

31 March 1972

research and field studies to permit optimal use of the plant while minimizing potential stresses on the adjacent ecological system. It is noted that those studies are postulated to require several years to complete before definitive results can be obtained. However, it is suggested that further discussion be included as to what actions would be taken as to plant operation and/or shutdown if and when such stresses became apparent during monitoring operations.

In summary, it would appear highly beneficial to include additional basic data in the statement to provide more conclusive evidence on which to fully evaluate the scope and nature of the impacts of the proposed action. The report admittedly states that - "additional studies are needed to more adequately define those effects." The summary of environmental impact and adverse effects, contained in paragraph 3 of the SUMMARY page prefacing the report, qualifies those effects as being minor in nature; however, the sparsity of data, at this time, would appear to preclude such a conclusion.

We appreciate the opportunity to comment on the statement and the extension of time granted to complete our review.

Sincerely yours,

James L. Garland
JAMES L. GARLAND
Chief, Engineering Division

STATE OF FLORIDA

Department of Administration

Bureau of Planning

725 SOUTH BRONOUGH

TALLAHASSEE

32304

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Reubin O'D. Askew
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L. K. Ireland, Jr.
SECRETARY OF ADMINISTRATION

Wallace W. Henderson
DIRECTOR OF PLANNING AND BUDGETING

Homer E. Still, Jr.
CHIEF
BUREAU OF PLANNING

APPENDIX E - 12

April 20, 1972

RECEIVED
APR 25 1972
U.S. ATOMIC ENERGY COMMISSION
Regulatory Mail Section

Mr. Lester Rogers, Director
Division of Radiological and Environmental
Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

The State Planning and Development Clearinghouse has reviewed the following draft environmental impact statements:

(1) Draft Detailed Statement on the Environmental Consideration by the Division of Reactor Licensing, U. S. Atomic Energy Commission, Related to the Proposed Operation of Turkey Point Units 3 & 4 by the Florida Power and Light Company. Issued December 23, 1970 SPDC Project No. 71-1071

(2) Draft Detailed Statement by the Division of Radiological and Environmental Protection, U. S. Atomic Energy Commission on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses to the Florida Power and Light Company for Turkey Point Plant Units 3 & 4, Docket Nos. 50-250 & 251 Dated February 9, 1972, and Florida Power and Light Company Turkey Point Plant Units No. 3 & 4, Environmental Report Supplement Dated November 8, 1971. SPDC Project No. 72-0799.

During the course of our review, we have referred the environmental impact statements to the following agencies, which we have identified as interested in the environmental effects of the project or in developing or enforcing standards relating to these effects: Department of Agriculture & Consumer Services; Board of Trustees of the Internal Improvement Trust Fund; Department of Community Affairs; Game and Fresh Water Fish Commission; Department of Health and Rehabilitative Services - Division of Health; Department of Natural Resources; Department of Commerce; Department of Pollution Control; Department of State - Division of Archives, History, and Records Management; Public Service Commission; Department of Legal Affairs; to the Metropolitan Dade County Planning Department; and to the Environmental Information Center through which we received comments by the Izaak Walton League of America and Mr. Ross McCluney of the Tropical Audubon Society.

Agencies were requested to review the statements and comment on the adequacy of treatment of environmental matters of their concern, additional alternatives which should be considered, and project modifications or special control measures to reduce or avoid adverse environmental effects.

2240

Mr. Lester Rogers
Page 2
April 20, 1972

Since the statements were received and, hence, sent to agencies for review on different dates, we received two sets of comments from some agencies. A summary of comments made on each statement is presented separately below. Review comments on statement (1) follow: The Board of Trustees of the Internal Improvement Trust Fund and the Department of Health and Rehabilitative Services - Division of Health offer no adverse comments. See attached letters. The Department of Natural Resources; Department of Pollution Control; Public Service Commission; Department of Legal Affairs; Metropolitan Dade County Planning Department and the Izaak Walton League of America offer comments on the statement and project which should be considered. See attached letters.

Review comments on statement (2), including the supplemental report, follow: The Department of Agriculture and Consumer Services; Public Service Commission; and the Department of Legal Affairs offer no adverse comments. See attached letters. The Board of Trustees of the Internal Improvement Trust Fund; Department of Health and Rehabilitative Services Division of Health; Department of Natural Resources; Metropolitan Dade County Planning Department; and Mr. Ross McCluney of the Tropical Audubon Society offer comments on the statement and project which should be considered. See attached letters.

No comments on these statements or the project were received from the Department of Commerce; Department of Community Affairs; and the Game and Fresh Water Fish Commission.

We find that this project will be in accord with state plans, projects, programs, and objectives provided: (1) the attached review comments are considered in the final environmental impact statement; and (2) the feasibility of incorporating into the project any modifications suggested by the review comments or resulting from a consideration the attached comments be addressed in the final environmental impact statement; and (3) with the understanding that the project must be certified and a permit issued by the Department of Pollution Control before operations begin.

In preparing the final statement, particular attention should be given to the comments of the Attorney General in revising the "need for power" section of the statement. This revision should delineate in operational terms the program to be undertaken by the Florida Power and Light Company to discourage or reduce low priority demands for power and cease to proceed on the faulty assumption that every demand for power must be granted as necessary to promote general welfare no matter how fundamental and basic or how whimsical, frivolous, or novel the intended power usage might be. The need or demand for power is not and does not have to be treated as though it were an uncontrollable factor. On the other hand the operation of power plants has to be looked at and treated for what it involves: the irreversible expenditure of energy fuels, the acceptance of thermal pollution from

Mr. Lester Rogers
Page 3
April 20, 1972

all energy released and not converted into electricity, and the acceptance of pollution from the by-products of the oxidation, fusion, or fission process involved. Heretofore, the demand for power has been considered the independent variable; the expenditure of energy resources has been considered the dependent variable; and the acceptance of the environmental effects has been considered a necessary consequence. What we are saying is that to promote the general welfare, it is imperative that a balance be sought; and that this balance can be achieved only if effective programs are developed to control growth in demands for power and to limit, reduce, or reject demands for power to be used for purposes which are not in the public interest.

Please append a copy of this letter, with attachments, to the final environmental impact statement submitted to the Council on Environmental Quality. This will assure the Council of our compliance with guidelines implementing the National Environmental Policy Act of 1969 (PL 91-190).

We request that the Atomic Energy Commission forward us one copy of the final environmental statement submitted to the Council on Environmental Quality and, in the letter of transmittal, refer to the SPDC numbers assigned these statements.

Sincerely yours,

Homer E. Still, Jr.

HOMER E. STILL, JR.
State Planning and Development
Clearinghouse

HESJr/was
Enclosures
cc: Lt. Governor Tom Adams
Honorable Doyle Conner
Mr. Randolph Hodges
Mr. Joel Kuperberg
Mr. Ross McCluney
Mr. William Partington
Mrs. M. Athalie Range
Mr. James Redford, Jr.
Mr. David H. Scott
Honorable Robert Shevin
Dr. Wade Stephens
Mr. H. E. Wallace
Mr. Reginald Walters
Mr. Jess Yarborough
Mr. Robert Williams
Mr. Kenneth Woodburn

E - 12 - 4

STATE PLANNING AND DEVELOPMEN
CLEARINGHOUSE

AUG 27 1971
RECEIVED

SPDC NO. 71-1071

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Joel Kuperberg, Executive Director
Board of Trustees of the Internal Improvement Trust Fund

RE: U. S. Atomic Energy Commission: DEIS on Turkey Point Units 3 & 4
by the Florida Power and Light Company. SPDC Project No. 71-1071

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Check (✓) for each item: Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:	✓	

This agency ☑ does wish ☐ does not wish to review the final environmental impact statement on this project.

Joel Kuperberg
(Name & title of authenticating official)

Enclosure(s) ☑ None
☐ Attached

E- 12 - 5

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Dr. Wade Stephens
Division of Health

RE: U. S. Atomic Energy Commission: DEIS on Turkey Point Units 3 & 4
by the Florida Power & Light Company. SPDC Project No. 71-1071

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 10 1971
RECEIVED
SPDC NO. 71-1071

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:		✓
6. We identify issues which require further discussion or resolution as shown:		✓

This agency ☒ does wish ☐ does not wish to review the final environmental impact statement on this project.

C. L. Nayfield MD

(Name & title of authenticating official)
C. L. Nayfield, M.D., Administrator
Radiological & Occupational Health Section

Enclosure(s) ☑ None ☐ Attached

E 12 - 6

State of Florida

REUBIN O'D. ASKEW
Governor
RICHARD (DICK) STONE
Secretary of State
ROBERT L. SHEVIN
Attorney General
FRED O. DICKINSON, JR.
Comptroller
THOMAS D. O'MALLEY
Treasurer
DOYLE CONNER
Commissioner of Agriculture
FLOYD T. CHRISTIAN
Commissioner of Education

DEPARTMENT OF NATURAL RESOURCES

RANDOLPH HODGES
Executive Director

LARSON BUILDING / TALLAHASSEE 32304 / TELEPHONE 224-7141

August 12, 1971

MEMORANDUM

TO: Mr. Homer E. Still, Jr.
State Planning and Development Clearinghouse

FROM: Randolph Hodges, Executive Director

SUBJECT: U. S. Atomic Energy Commission: Draft Environmental Impact Statement on Turkey Point Units 3 and 4 by the Florida Power and Light Company, SPDC Project No. 71-1071

Staff review of draft environmental consideration developed by Florida Power and Light Company concerning Turkey Point Units 3 and 4 indicates the following:

1. The statement does not adequately cover the adverse environmental effects on marine life that can be anticipated from operation of the proposed nuclear power plant. The statement minimizes environmental damage that has already occurred from the operation of the existing fossil fuel plant Units 1 and 2. A biological survey report prepared for Mr. F. D. R. Park, Water-Control Engineer, Public Works Department, Miami, Florida, concerning proposed intake and discharge canals for Florida Power and Light Company, Turkey Point, Biscayne Bay and Card Sound is attached for your information.

2. As is partially pointed out by the draft environmental statement, environmental damage has occurred off the existing discharge canal through the loss of submerged vegetation which is highly valuable as habitat to marine life. Some kills of marine life have occurred at this plant already, with the most recent involving about 2,000 fish.

3. Section 5.3.1 of the draft statement concerning intake structure design states that "Design of the condenser cooling water intake structure is similar to that of Units 1 and 2, with which Florida Power and Light has had considerable operating experience with no instances of significant numbers of fish or crabs being drawn into the intake. 'On the contrary,' states the applicant, 'large schools of fish are frequently seen in the intake avoiding the structure with great ease, and apparently thriving on food material being drawn into the area.' " Such statements as this indicate a complete lack of understanding concerning the problems of entrainment of marine organisms in power plant cooling water. Many marine animals of sport and commercial fishery importance occur in the plankton as eggs, yolk-sac larvae or small juveniles; these animals move with the currents and could not possibly avoid the intake structure. Recent laboratory studies have shown that eggs and larvae are very susceptible to temperature changes, and an increase of only a few degrees will retard or stop their development or result in death.

Since this proposed plant will circulate seven billion gallons of water per day of cooling, the destruction of planktonic marine animals in this volume of water will probably be highly significant

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Randolph Hodges, Executive Director
Department of Natural Resources

RE: U. S. Atomic Energy Commission: DEIS on Turkey Point Units 3 & 4 by the Florida Power and Light Company. SPDC Project No. 71-1071.

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Check (✓) for each item: Comment enclosed
1. Additional specific effects which should be assessed:		✓
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:		✓
6. We identify issues which require further discussion or resolution as shown:		✓

This agency ☐ does wish / ☐ does not wish to review the final environmental impact statement on this project.

[illegible] Admin. Asst.
(Name & title of authenticating official)

Enclosure(s) ☐ None
☐ Attached

STATE OF FLORIDA
DEPARTMENT OF
AIR & WATER POLLUTION CONTROL
SUITE 300, TALLAHASSEE BANK BUILDING
315 SOUTH CALHOUN STREET, TALLAHASSEE, FLORIDA 32301

VINCENT D PATTON
EXECUTIVE DIRECTOR

DAVID H. LEVIN
CHAIRMAN

August 13, 1971

Dade County, Turkey Point
Draft Environmental Impact
SPDC 71-1071

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 19 1971
RECEIVED
SPDC NO. 71-1071

Mr. Homer E. Still, Jr.
State Planning and Development Clearinghouse
Department of Administration
Bureau of Planning
725 S. Bronough Street
Tallahassee, Florida 32304

Dear Mr. Still:

The draft environmental impact statement for the Turkey Point Units 3 and 4 of the Florida Power and Light Company has been reviewed. This statement is based on the cooling water designs of about a year ago in which the water was to be discharged through a canal into Card Sound and Lower Biscayne Bay.

At present the cooling water system is the subject of consideration by the Federal environmental agencies and is under litigation in Federal court. The system which results from the settlement of this matter will probably be different from the one discussed in the statement. Further, the Air and Water Pollution Control Board has approved a Department proposal to study thermal effects of power generating facilities in Florida.

Based on the above circumstances and the yet unresolved effects of the cooling water system, the Department cannot give approval of the environmental impact statement.

Very truly yours,

Ronald P. Schoenrock

for David H. Scott, Acting Director
Division of Planning

DHS:sdt

cc: Mr. Donald G. Frier,
Bureau of Permitting

E - 12 - 10

FLORIDA PUBLIC SERVICE COMMISSION

COMMISSIONERS:
JESS YARBOROUGH, CHAIRMAN
WILLIAM T. MAYO
BILL BEVIS

7[illegible] SOUTH ADAMS STREET
TALLAHASSEE [illegible]
TELEPHONE 904 -- [illegible]-5622

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 5 1971
RECEIVED
S PDC NO. 71-1071

August 3, 1971

Mr. Homer E. Still, Jr.,
State Planning and Development Clearinghouse
725 South Bronough Street
Tallahassee, Florida 32304

Dear Mr. Still:

Thank you very much for your letter of July 26, 1971, requesting my comments on the environmental impact statement in reference to the Turkey Point Nuclear Power Plant located in Dade County.

I have followed very closely the progress of the Turkey Point Plant since 1965 and have reviewed several times the Company's plans for the protection of the environment. I have made on-site inspections of the facility and reviewed the plans with Florida Power & Light Company personnel. In my opinion, there will be at the worst, most minimum effects on the environment which will be greatly outweighed by the benefits of serving the public with adequate electric power.

With the controls and regulations of the U.S. Atomic Energy Commission, the Dade County Pollution Board, and the Florida Department of Air & Water Pollution Control - which is one of the best in the United States - I believe that the environment will be adequately protected.

If I can be of any further assistance or if there is any more information that you would like to have, please let me know.

Sincerely,

Jess Yarborough
Chairman

JY:di

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 5 1971
RECEIVED
SPDC NO. 71-1071

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Mr. Jess Yarborough, Chairman, Public Service Commission

RE: U. S. Atomic Energy Commission: DEIS on Turkey Point Units 3 & 4 by the Florida Power & Light Company. SPDC Project No. 71-1071

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Check (✓) for each item: Comment enclosed
1. Additional specific effects which should be assessed:	✓	✓
2. Additional alternatives which should be considered:	✓	✓
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	✓
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	✓
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	✓
6. We identify issues which require further discussion or resolution as shown:	✓	✓

This agency ☐ ~~does~~ wish / ☒ does not wish to review the final environmental impact statement on this project.

(Name & title of authenticating official)

Chairman Florida Public Service Commission

Enclosure(s) ☐ ~~None~~ ☒ Attached

DEIS 4/28/71

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 24 1971
RECEIVED
SPDC NO. 71-1071

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Honorable Robert L. Shevin
Attorney General

RE: U. S. Atomic Energy Commission: DEIS on Turkey Point Units 3 & 4 by the Florida Power and Light Company. SPDC Project No. 71-1071.

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item	
	None	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:		✓

This agency ☑ does wish / ☐ does not wish to review the final environmental impact statement on this project.

Robert L. Shevin Atty Gen.
(Name & title of authenticating official)

Enclosure(s) ☐ None
☑ Attached

E - 12 - 13

ROBERT L. SHEVIN
ATTORNEY GENERAL

STATE OF FLORIDA
DEPARTMENT OF LEGAL AFFAIRS
THE CAPITOL
TALLAHASSEE, FLORIDA 32304

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 24 1971
RECEIVED
SPDC NO. 71-1071

August 23, 1971

Mr. Homer E. Still, Jr.
State Planning and Development Clearinghouse
725 South Bronough Street
Tallahassee, Florida 32304

Dear Mr. Still:

After reviewing the attached draft detailed statement of the environmental considerations concerning the proposed operations of nuclear power plants at Turkey Point, I have the following comments:

I believe the material under Section 3.0, entitled Need for Power, should be re-evaluated. The question of whether or not the Company is creating a demand for electricity by advertising has not been considered. If a decision whether or not to grant operating licenses for these facilities is to be based partially upon the need for electricity, this question must be answered. If the Company is to maintain that it must begin operations to avoid brown outs or black outs, it must show that it is not contributing to such a crisis by advertising new and greater uses of electric power.

Secondly, Florida Power and Light Company's statement that there are no other power resources within or without the State of Florida that can be called upon must not go unchallenged. According to information available to this office from the Federal Power Commission, the Company is a member of what is known as the Florida Pool, which includes the Florida Power and Light Company, Florida Power Corporation, Tampa Electric Company, Orlando Utilities Commission, and the City of Jacksonville. Furthermore, Florida Power and Light is directly connected with the Florida Power Corporation, which is in turn interconnected with the Georgia Power Company.

These matters should be considered before granting operating permits, since the actual need for electricity is a major factor to be considered in the decision-making process.

Sincerely,

Robert L. Shevin

ROBERT L. SHEVIN
Attorney General

RLS/Hg

METROPOLITAN DADE COUNTY • FLORIDA

702 Justice Building
1351 N. W. 12 Street
Miami, Florida 33125

Telephone 377–0381

PLANNING DEPARTMENT

August 9, 1971

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 12 1971
RECEIVED
SPDC NO. 71-1071

Mr. Homer E. Still, Jr., Chief
Bureau of Planning
State Planning and Development
Clearinghouse
Florida Department of Administration
725 South Bronough
Tallahassee, Florida 32304

Dear Mr. Still:

Re: U.S. Atomic Energy Commission: Draft Environmental Impact Statement on Turkey Point Units 3 and 4 by the Florida Power and Light Company SPDC Project No. 71-1071.

The Metropolitan Dade County Planning Department, with the assistance of the Dade County Pollution Control Department, has reviewed the Draft Environmental Impact Statement on Turkey Point Units 3 and 4.

We have enclosed the comments of the Pollution Control Department, which deal with the thermal pollution aspects of the utilization and release of cooling water to Card Sound. It is their opinion that "the major problem that remains unknown is the possible long-term detrimental effect of the released cooling water" and that "there could be in time, a critical high water temperature affecting Card Sound, Barnes Sound, and South Biscayne Bay."

Although the Planning Department is not qualified to comment on the technical dispute concerning the effect of heated cooling water to Card Sound marine life, certain comments are in order regarding the content and rationale of the Draft Environmental Impact Statement. The page numbers accompanying the comments refer to pages in the Draft Environmental Impact Statement.

Pages 4-5: Need for Power. As a public utility, Florida Power and Light should be concerned with the lessening of demand for electricity as well as the supplying of power, as a means of adequately serving the public. Recent advertising of the company appears to recognize this, but much more could be done. For example, an advertising program could encourage lower electrical usage not only during peak times, but throughout the year.

Mr. Homer E. Still, Jr.
Page Two
August 9, 1971

Such a continuing program should stress the implications of increased power demands for the sensitive environment of South Florida: increased air and water pollution, increased thermal pollution, increased radiation levels, increased demand for land. Accompanying this program directed at individual consumers could be a counselling effort aimed at business, industry, and governmental users and the feasibility of changes in processes and policies resulting in lower power demands.

Changes in the rate structure, such as imposing a penalty on large users during critical periods, or at least eliminating lower rates for large-scale consumers, could further lessen the demand for power, and present an alternative to merely increasing capacity to meet demand trends.

Of course, the overriding factor in the increased demand for power is the population growth of Florida. Should the availability of natural resources, such as water and land, become more critical, it is possible that constraints on population and development would be imposed, thereby stabilizing the need for power.

Page 19: Regional Impact of the Plant. The plant site is not, and will not be, the "unspoiled wilderness" cited by the applicant in the last paragraph on the page. The plant itself is huge, with towering stacks for emissions from the two operating fossil fuel units. The plume from the stacks is visible for miles. The canals dug for intake of circulation and dilution water are at least 100 feet wide and the discharge channel under construction is proposed to be approximately 227 feet wide and 5.5 miles long. Quite obviously, the changes imposed on the previously unspoiled wilderness have been substantial. Nevertheless, Florida Power and Light has acted to maintain much of the site in its natural state. Their past actions in this regard are commendable, and current proposals, such as joint use of transmission rights-of-way, enhance the beneficial aspects of the plant.

Page 21: Alternatives to the Proposed Action. The fifth paragraph on the page should be amended. Currently scheduled design and construction of the plant, and current and projected demand requirements must not be the overriding criteria for cooling water discharge proposals. The long-term effect on Card Sound, Biscayne Bay, and the ambient environment must be the prime criterion for a decision.

Sincerely,

Charles R. Crumpton, Asst D

Reginald R. Walters, AIP
for Director

RRW:PK/kj
Enclosure

cc: Mr. Peter Baljet, Director, Pollution Control

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Reginald R. Walters, Executive Director
Metropolitan Dade County Planning Department

RE: U. S. Atomic Energy Commission: DEIS on Turkey Point Units 3 & 4 by the Florida Power & Light Company. SPDC Project No. 1071

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:		✓
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:		✓
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:		✓
6. We identify issues which require further discussion or resolution as shown:		✓

This agency ☑ does wish / ☐ does not wish to review the final environmental impact statement on this project.

Charles L. Crumpton, Asst. Dir.
(Name & title of authenticating official)

Enclosure(s) ☐ None
☑ Attached

MEMORANDUM E - 12 -17

1-17A

TO Paul Kelman, Principal Planner
D. C. Planning Department

DATE August 9, 1971

SUBJECT

FROM H. J. Schmitz, Chief
Evaluation & Planning Dept.
Pollution Control
H. J. Schmitz

ENVIRONMENTAL IMPACT OF THE NEW FLORIDA POWER & LIGHT PLANT

The environmental impact statement of December 23, 1970, by Florida Power & Light Company covers many possible environmental effects from the operation of the new nuclear plant.

Because of many unknown conditions and factors, the actual future impact of the full plant operation on the environment will not be known until after the plant is operated for some time. Since there is so much guess work involved to predict future conditions, it is important that all proposed temporary and permanent control measures as proposed by Florida Power & Light Co. for the different time periods of the operating schedules are conducted properly.

The major problem that remains unknown is the possible long term detrimental effect of the released cooling water to Card Sound and the other bodies of water the sound is connected with.

During the normal average tidal range of Card Sound, only approximately 15% of the sound waters are exchanged. Because of the few small channels connecting Card Sound with the Atlantic Ocean it can be assumed that most of the tidal water will come from and flow to the north (South Biscayne Bay) where part of it will be recycled as cooling water through the plant.

The total maximum discharged heated cooling water by the new canal into North Card Sound will be 10,625 cubic feet/second when the plant is in full operation; or 915,000,000 cubic feet per day, which represents approximately one-seventh of the total Card Sound water volume or theoretically the Card Sound water volume could be replaced every seven days by cooling water from the plant. Since the effluent from the canal empties in the northern waters of the sound, and there is no thorough mixing with all the sound water, this area of the sound will have the highest temperatures and because of its relatively short distance from the plant intake, may cause a recycling of part of the warmer water which again would result in higher plant effluent temperatures. In view of this and other factors, it is assumed that there could be in time, a critical high water temperature effecting Card Sound, Barnes Sound and South Biscayne Bay.

HJS:bw

Rec'd 8-11-71

E - 12 - 18

IZAAK WALTON LEAGUE OF AMERICA
MANGROVE CHAPTER
2829 BIRD AVENUE, MIAMI, FLORIDA 33133

August 9, 1971

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
AUG 11 1971
RECEIVED
SPDC NO. 71-1071

Mr. Homer Still, Jr.
Department of Administration
Bureau of Planning
725 S. Bronough
Tallahassee, Florida 32304

Dear Mr. Still:

I received a memo on the NEPA 102 statement from William Partington of the Environmental Information Center. I received it on the day -- August 9th -- the response was due. Although I realize that the Environmental Information Center may be the clearing house for such information, the Dade County Izaak Walton League is the major conservation factor in the Turkey Point controversy and should be notified. Therefore, I urge you to consider this response even though it is late.

Concerning 1.0, final paragraph, I do not consider this a fair statement since the controversy over this installation has been going on for 4 years, and, except for strikes, construction, has never been stopped.

In 5.2.2, fourth paragraph, you mention that water would be heated to a maximum of 15° f. above ambient Biscayne temperature. Elsewhere you mention that ambient temperatures are in the vicinity of 89° F. I would like to point out that the present oil-fired plants have discharged waters as high as 104° F., according to federal monitoring, and this represents 20% of the eventual cooling water flow. Obviously, talk of temperatures is meaningless unless we take into consideration B.T.U.'s.

Concerning 5.2.3, paragraph three. I think you will find that you are quoting the hired biologists of FP&L who have done little more than check in every 3 weeks. When you speak of true studies of the University of Miami, you dismiss them partially by saying they have not yet been completed. Little mention is made of the studies by EPA. I think you will find the area of destruction due to discharges into Biscayne Bay is closer to 650 acres. I would suggest that since November 1969, the date of your quote, a great deal of additional damage has been done, much of it irreversible.

Concerning 5.2.4, the difficulty for the statements under this section is that remedies are proposed after the fact. Also omitted is the hydrological study from the University of Miami's Marine Laboratory which predicts of the discharge waters from the Card Sound Canal will recirculate along the mainland shore into Biscayne Bay where they will be picked up again by the intake pipe. Consequently, the plant will suffer by taking in waters not sufficiently cooled. An investigation by you will show that this is the major reason for the Card Sound Canal; originally the canal to Biscayne Bay was to be the discharge for all four units. But recirculation caused the change of plans. Therefore, dismissing of one group of scientists by those hired by FP&L is scarcely an objective act.

I think that this is the major criticism of this report -- that is, whenever information adverse to the power company is produced at the University of Miami, outside consultants are hired by FP&L, and their word is taken. This is indefensible, and it only goes to show that if one scientist doesn't tell you what you want to hear, you can always find another who will tell you. I am afraid that this is the major criticism of these NEPA 102's. Almost inevitably they are a presentation of the applicant's point of view. I, therefore, suggest that your report is more like that of a Grand Jury where probably cause is ascertained by listening to only one side of the argument. We hope for better.

Sincerely yours

James F. Redford, Jr.

JFR:m

cc: William Partington

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Honorable Doyle Conner
Commissioner of Agriculture

RE: U. S. Atomic Energy Commission: Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses for Turkey Point, Units 3 & 4
SPDC Project No. 72-0799

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:	✓	

This agency ☒ does wish / ☐ does not wish to review the final environmental impact statement on this project.

John M. [signature]
(Name & title of authenticating official)

Enclosure(s) ☐ None
☐ Attached

DEIS 4/28/71

E - 12 - 21

FLORIDA PUBLIC SERVICE COMMISSION

COMMISSIONERS:
JESS YARBOROUGH, CHAIRMAN
WILLIAM T. MAYO
BILL BEVIS

700 SOUTH ADAMS STREET
TALLAHASSEE 32304
TELEPHONE 904 — 599-5622

March 13, 1972

STATE PLANNING AND DEVELOPMENT
CLEARING HOUSE
MAR 16 1972
RECEIVED
SPDC NO. 72-0799

Mr. Homer E. Still, Jr.
Chief, Bureau of Planning
Department of Administration
725 South Bronough
Tallahassee, Florida 32304

Dear Mr. Still:

Thank you for the recently received environmental reports regarding Florida Power and Light Company. This information is being forwarded to Mr. H. E. Janes, Director of the Commission's Engineering Department, for his attention.

Yours very truly,

T. Mabry Ervin

T. Mabry Ervin, Sr.
Executive Director

TME:ln
cc: Mr. H. E. Janes w/a

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
MAR 15 1972
RECEIVED
S PDC NO. 72-0799

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Mr. T. Mabry Ervin, Executive Director
Public Service Commission

RE: U. S. Atomic Energy Commission: Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses for Turkey Point, Units 3 & 4
SPDC Project No. 72-0799

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item	
	None	Comment enclosed
1. Additional specific effects which should be assessed:	✓	
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3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:	✓	

This agency ☐ does wish ☑ does not wish to review the final environmental impact statement on this project.

W. E. Jann

(Name & title of authenticating official)

Enclosure(s) ☑ None ☐ Attached

DETS 4/28/71

E 12 - 23

STATE PLANNING AND DEVELOPMENT CLEARINGHOUSE
JAN 12 1972
RECEIVED
SPDC NO. 72-0799

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Mr. Jess Yarborough, Chairman
Public Service Commission

Re: U. S. Atomic Energy Commission: Draft Environmental Impact Statement on Turkey Point Units 3 and 4 by the Florida Power and Light Company SPDC Project No. 71-1071.

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Check (✓) for each item: Comment enclosed
1. Additional specific effects which should be assessed:	✓	No Comments
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:	✓	

This agency ☐ ~~does~~ wish ☒ does not wish to review the final environmental impact statement on this project.

Jess Yarborough
(Name & title of authenticating official)

Enclosure(s) ☒ None ☐ Attached

DEIS 4/28/71

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
MAR 23 1972
RECEIVED
SPDC NO. 72-0799

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Honorable Robert L. Shevin
Attorney General

RE: U. S. Atomic Energy Commission: Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses for Turkey Point, Units 3 & 4
SPDC Project No. 72-0799

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

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5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:	✓	

This agency ☑ does wish / ☐ does not wish to review the final environmental impact statement on this project.

Robert L. Shevin
(Name & title of authenticating official)
Attorney General of Florida

Enclosure(s) ☐ None ☐ Attached

DEIS 4/28/71

E - 12 - 25

STATE OF FLORIDA
BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND
ELLIOT BUILDING — TALLAHASSEE, FLORIDA 32304

Joel Kuperberg
Executive Director

TELEPHONE 224-2101

March 13, 1972

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
MAR 16 1972
RECEIVED
SPDC NO. 72-0799

Mr. Homer E. Still, Jr.
State Planning and Development
Clearinghouse
725 South Bronough Street
Tallahassee, Florida 32304

Dear Mr. Still:

Flórida Power & Light Company
Turkey Point, Units 3 & 4
SPDC Project No. 72-0799

Your attention is called to our January 20 response to this project, a copy of which is attached. Our comment on this project remains the same.

Sincerely,

Joel Kuperberg
Executive Director

JK/xdb

Enclosure

E - 12 - 26

STATE OF FLORIDA

BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND

ELLIOT BUILDING — TALLAHASSEE, FLORIDA 32304

Joel Kuperberg
Executive Director

TELEPHONE 224-2101

January 20, 1972

STATE PLANNING AND DEVELOPMENT CLEARINGHOUSE
JAN 24 1972
RECEIVED
SPDC NO. ~~71-1071~~ 72-0799

Mr. Homer E. Still, Jr.
State Planning and Development
Clearinghouse
725 South Bronough Street
Tallahassee, Florida 32304

Dear Mr. Still:

Florida Power and Light Company
Turkey Point Plant
Units No. 3 and 4
Environmental Report Supplement
SPDC Project No. ~~71-1071~~ 72-0799

Your attention is called to Section 2.3.3.1.2 "Cooling Water Discharge 'Interim' Period."

"As required in the Final Judgement, the Florida Power and Light Company will provide for a minimum environmental impact by minimizing the discharge of heated water, to the extent possible, during the interim period. The minimization will be accomplished by a loading plan in which Turkey Point will not generate power above certain minimum values except after using other sources in the Florida Power and Light system and purchased power, if available. Application of the Turkey Point loading plan in 1972, for example, in conjunction with Biscayne Bay temperatures similar to those experienced in 1970, would result in discharge temperatures above 90°F only in the months of May through October. Discharge temperatures above 95° are not predicted for 1972 unless certain emergencies should occur requiring additional generation from Turkey Point." (Emphasis supplied)

Mr. Homer E. Still, Jr.
Page Two
January 20, 1972

These qualifications of the final judgement imply that emergency decisions can still be made by Florida Power and Light which might produce discharge above 95°F. We are opposed to discharge in excess of 95°F in light of present-day knowledge.

Sincerely,

Joel Kuperberg
Executive Director

JK/xmb

STATE PLANNING AND DEVELOPMENT CLEARINGHOUSE
FEB 2 1972
RECEIVED
SPDC NO. 72-0799

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Dr. Wade Stephens
Division of Health

Re: U. S. Atomic Energy Commission: Draft Environmental Impact Statement on Turkey Point Units 3 and 4 by the Florida Power and Light Company
SPDC Project No. 72-0799.

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item None	Comment enclosed
1. Additional specific effects which should be assessed:	X	
2. Additional alternatives which should be considered:	X	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	X	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	X	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	X	
6. We identify issues which require further discussion or resolution as shown:		X

This agency ☒ does wish / ☐ does not wish to review the final environmental impact statement on this project.

Dr. Wade Stephens, Administrator
(Name & title of authenticating official)

Enclosure(s) ☐ None
☒ Attached

DEIS 4/28/71

Re: U. S. Atomic Energy Commission: Draft Environmental Impact Statement on Turkey Point Units 3 and 4 by the Florida Power and Light Company SPDC Project No. ~~71-1971~~. 72-0799.

A review of 2.3.10 Transportation Transmission Lines and Accidents indicates that specific plans for shipment of waste and spent fuel accidents have not been presented.

This area in the report is one of concern due to the lack of information regarding shipments of rad waste. If an accident should occur the possibility of gross contamination of an area appears to be the result, since it is understood that many of the containers used for rad waste shipments are not designed for accident conditions. These kinds of shipments will begin to take place soon after the plant becomes operational.

Due to the press of time we are not able to put off requiring the company to furnish information to us. As indicated in the past all shipments to or from Turkey Point involving radioactive material is of concern to Dade County. Information that should be required from the Company is as follows:

1. Container design and criteria for all forms of rad waste products

   a. Solid waste
   b. Liquid waste
   c. Spent resin filters

2. Estimate of radioactivity per gram of waste material

3. Mode of anticipated transfer from Turkey Point to disposal.

4. Postulated accident analysis for accidents involving radioactive waste products other than spent fuel elements.

5. Postulated accident analysis for spent fuel elements in transport off-site.

J/g

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Mr. Randolph Hodges, Executive Director
Department of Natural Resources

Re: U. S. Atomic Energy Commission: Draft Environmental Impact Statement on Turkey Point Units 3 and 4 by the Florida Power and Light Company
SPDC Project No. ~~71-1071~~. 72-0799

STATE PLANNING AND DEVELOPMENT CLEARINGHOUSE
JAN 26 1972
RECEIVED 72-0799
SPDC NO. ~~71-1071~~

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Check (✓) for each item: Comment enclosed
1. Additional specific effects which should be assessed:	✓	
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:		✓

This agency ☑ does wish / ☐ does not wish to review the final environmental impact statement on this project.

James G. Smith Admin Ass't
(Name & title of authenticating official)
1-19-72

Enclosure(s) ☐ None
☑ Attached

DEIS 4/28/71

E - 12 - 31

State of Florida

DEPARTMENT OF NATURAL RESOURCES

RANDOLPH HODGES
Executive Director

LARSON BUILDING / TALLAHASSEE 32304 / TELEPHONE 224-7141

January 24, 1972

Comments on Item No. 6 - Issues which require further discussion or resolution - SPDC Project No. ~~71-1071~~. 72-0799

The recent supplement to the draft environmental impact statement pertaining to SPDC Project No. 71-1071 contains a wealth of information that was not included in the earlier statement. Accordingly, we have found it difficult to adequately evaluate this voluminous document in the short time allowed for such review.

In our review of the document we could find no reference to the dredging and filling of submerged lands lying below the mean high water line that will of necessity take place with the construction of the easternmost cooling canals. These submerged and inter-tidal lands are vegetated by red mangroves and a concerted effort should be made to save as much of the vegetated area as possible.

Alternatives to construction in this biologically productive area were not discussed. In our opinion, alternatives should be included. In particular, an alternative for realignment of the canals to avoid the lands lying below the mean high water line should be discussed, among others.

JGS:mw

E - 12 - 32

METROPOLITAN DADE COUNTY • FLORIDA

702 Justice Building
1351 N. W. 12 Street
Miami, Florida 33125

Telephone 377–0381

PLANNING DEPARTMENT

January 12, 1972

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
JAN 17 1972
RECEIVED 72-0799
SPDC NO. 71-1071

Mr. Homer E. Still, Jr.
Chief, Bureau of Planning
State Planning and Development
Clearinghouse
725 South Bronough
Tallahassee, Florida 32304

Dear Mr. Still:

On the basis of the letter we received from the Atomic Energy Commission accompanying the Florida Power and Light Company supplemental report, we do not see the need to comment on the report at this time, as requested in your letter of January 6, 1972 relative to State Planning and Development Clearinghouse Project No. ~~71-1071~~. 72-0799.

We would prefer to wait until the environmental impact statement is prepared by the Atomic Energy Commission and transmitted to us through your office. Since we have a copy of the Florida Power and Light Company supplemental report in our library for public access, we would require only those portions of the environmental impact statement prepared by the Atomic Energy Commission in order to review it properly.

Sincerely,

Reginald R. Walters

Reginald R. Walters, AIP
Director

RRW:PBK:rrd

E 12 - 33

METROPOLITAN DADE COUNTY • FLORIDA

702 Justice Building
1351 N. W. 12 Street
Miami, Florida 33125

Telephone 377–0381

PLANNING DEPARTMENT

March 8, 1972

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
MAR 10 1972
RECEIVED
SPDC NO. 72-0799

Mr. Homer E. Still, Jr., Chief
Bureau of Planning
State Planning and Development
Clearinghouse
Florida Department of Administration
725 South Bronough
Tallahassee, Florida 32304

Dear Mr. Still:

Re: U.S. Atomic Energy Commission: Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses to the Florida Power and Light Company for Turkey Point Plant Units 3 and 4.

The Metropolitan Dade County Planning Department has reviewed the Draft Detailed Environmental Statement on Turkey Point Plant Units 3 and 4.

We have no new comments on the statement but rather reaffirm past comments we have made concerning the Turkey Point Plant and cooling canal system. These past comments deal with the need for power, regional impact of the plant, alternatives to the proposed action, and multiple use of the cooling canal system. Copies of these past comments are attached.

Sincerely,

Reginald R. Walters

Reginald R. Walters, AIP
Director

RRW:PBK/kj
Enclosures

cc: United States Atomic Energy Commission, Washington, D.C. 20545
Attention: Director, Division of Radiological and Environmental Protection.

August 9, 1971

Mr. Homer E. Still, Jr., Chief
Bureau of Planning
State Planning and Development
Clearinghouse
Florida Department of Administration
725 South Bronough
Tallahassee, Florida 32304

Dear Mr. Still:

Re: U.S. Atomic Energy Commission: Draft Environmental Impact Statement on Turkey Point Units 3 and 4 by the Florida Power and Light Company SPDC Project No. 71-1071.

The Metropolitan Dade County Planning Department, with the assistance of the Dade County Pollution Control Department, has reviewed the Draft Environmental Impact Statement on Turkey Point Units 3 and 4.

We have enclosed the comments of the Pollution Control Department, which deal with the thermal pollution aspects of the utilization and release of cooling water to Card Sound. It is their opinion that "the major problem that remains unknown is the possible long-term detrimental effect of the released cooling water" and that "there could be in time, a critical high water temperature affecting Card Sound, Barnes Sound, and South Biscayne Bay."

Although the Planning Department is not qualified to comment on the technical dispute concerning the effect of heated cooling water to Card Sound marine life, certain comments are in order regarding the content and rationale of the Draft Environmental Impact Statement. The page numbers accompanying the comments refer to pages in the Draft Environmental Impact Statement.

Pages 4-5: Need for Power. As a public utility, Florida Power and Light should be concerned with the lessening of demand for electricity as well as the supplying of power, as a means of adequately serving the public. Recent advertising of the company appears to recognize this, but much more could be done. For example, an advertising program could encourage lower electrical usage not only during peak times, but throughout the year.

Mr. Homer E. Still, Jr.
Page Two
August 9, 1971

Such a continuing program should stress the implications of increased power demands for the sensitive environment of South Florida: increased air and water pollution, increased thermal pollution, increased radiation levels, increased demand for land. Accompanying this program directed at individual consumers could be a counselling effort aimed at business, industry, and governmental users and the feasibility of changes in processes and policies resulting in lower power demands.

Changes in the rate structure, such as imposing a penalty on large users during critical periods, or at least eliminating lower rates for large-scale consumers, could further lessen the demand for power, and present an alternative to merely increasing capacity to meet demand trends.

Of course, the overriding factor in the increased demand for power is the population growth of Florida. Should the availability of natural resources, such as water and land, become more critical, it is possible that constraints on population and development would be imposed, thereby stabilizing the need for power.

Page 19: Regional Impact of the Plant. The plant site is not, and will not be, the "unspoiled wilderness" cited by the applicant in the last paragraph on the page. The plant itself is huge, with towering stacks for emissions from the two operating fossil fuel units. The plume from the stacks is visible for miles. The canals dug for intake of circulation and dilution water are at least 100 feet wide and the discharge channel under construction is proposed to be approximately 227 feet wide and 5.5 miles long. Quite obviously, the changes imposed on the previously unspoiled wilderness have been substantial. Nevertheless, Florida Power and Light has acted to maintain much of the site in its natural state. Their past actions in this regard are commendable, and current proposals, such as joint use of transmission rights-of-way, enhance the beneficial aspects of the plant.

Page 21: Alternatives to the Proposed Action. The fifth paragraph on the page should be amended. Currently scheduled design and construction of the plant, and current and projected demand requirements must not be the overriding criteria for cooling water discharge proposals. The long-term effect on Card Sound, Biscayne Bay, and the ambient environment must be the prime criterion for a decision.

Sincerely,

Reginald R. Walters, AIP
Director

RRW:PK/hj
Enclosure

cc: Mr. Peter Baljet, Director, Pollution Control

MEMORANDUM

/.07-17 A

TO Paul Kelman, Principal Planner
D. C. Planning Department

DATE August 9, 1971

SUBJECT

FROM H. J. Schmitz, Chief
Evaluation & Planning Dept.
Pollution Control

ENVIRONMENTAL IMPACT OF THE NEW FLORIDA POWER & LIGHT PLANT

The environmental impact statement of December 23, 1970, by Florida Power & Light Company covers many possible environmental effects from the operation of the new nuclear plant.

Because of many unknown conditions and factors, the actual future impact of the full plant operation on the environment will not be known until after the plant is operated for some time. Since there is so much guess work involved to predict future conditions, it is important that all proposed temporary and permanent control measures as proposed by Florida Power & Light Co. for the different time periods of the operating schedules are conducted properly.

The major problem that remains unknown is the possible long term detrimental effect of the released cooling water to Card Sound and the other bodies of water the sound is connected with.

During the normal average tidal range of Card Sound, only approximately 15% of the sound waters are exchanged. Because of the few small channels connecting Card Sound with the Atlantic Ocean it can be assumed that most of the tidal water will come from and flow to the north (South Biscayne Bay) where part of it will be recycled as cooling water through the plant.

The total maximum discharged heated cooling water by the new canal into North Card Sound will be 10,625 cubic feet/second when the plant is in full operation; or 915,000,000 cubic feet per day, which represents approximately one-seventh of the total Card Sound water volume or theoretically the Card Sound water volume could be replaced every seven days by cooling water from the plant. Since the effluent from the canal empties in the northern waters of the sound, and there is no thorough mixing with all the sound water, this area of the sound will have the highest temperatures and because of its relatively short distance from the plant intake, may cause a recycling of part of the warmer water which again would result in higher plant effluent temperatures. In view of this and other factors, it is assumed that there could be in time, a critical high water temperature effecting Card Sound, Barnes Sound and South Biscayne Bay.

HJS:bw

METROPOLITAN DADE COUNTY PLANNING DEPARTMENT
RECOMMENDATION TO THE ZONING APPEALS BOARD

E - 12 - 37

TO: Members, Zoning Appeals Board

FROM: Reginald R. Walters, Director
Planning Department

DATE: November 1, 1971
REVISED RECOMMENDATION November 5, 197

SUBJECT: ZAB Hearing Item #71-11-50
Florida Power & Light Company
Section 27,28,28,32,33,34-57-40
4,5,7,8,16,17,18,19,20,21,28,29,30-58-40

REQUEST: Unusual Use to permit canal cooling systems excavations

RECOMMENDATION:

Approval. Purpose of the application is to provide a system for cooling water to be used by the power plant without returning it to South Biscayne Bay, where its "thermal pollution" could have detrimental effects on marine life and the delicate ecological balance of the estuarine environment. The proposed canal system has been approved by the Florida Pollution Control Board and seems the best answer as yet available to the dilemma of providing needed electric power with minimal damage to the natural environment.

Although we have serious concerns about the use of such a large area of the county for the proposed use, we appreciate the difficulties involved in finding a solution to cooling the effluent from the Turkey Point Plant.

Assuming that the alternative to returning heated water to the Bay provided by this canal network is the only feasible solution, we have conferred with representatives of Florida Power and Light Company regarding the multiple-use potential of the cooling canal system. They have assured us that consideration will be given to multiple-use of the Turkey Point site as feasible, given the primary purpose of the canal system as a cooling device and the rather immediate deadlines on system construction agreed to by the Company in compliance with Federal and State agencies' suggestions.

Approval should be subject to any requirements of Director of Public Works and all usual conditions required by Director of Building and Zoning applicable in this case.

RRW:CLC:PK:DC/gcw
cc - Mr. R. F. Cook, Director
Building and Zoning Department

STATE PLANNING AND DEVELOPMENT
CLEARINGHOUSE
APR 3 1972
RECEIVED
S P D C NO. 72-0799

To: Mr. Donald Albright
State Planning and Development Clearinghouse
702 South Duval
Tallahassee, Fla. 32304

FROM: Ross McCluney
Member of the Board
Tropical Audubon Society
6405 Santona St., Apt. 4
Coral Gables, Fla. 33146

RE: SPDC No. 72-0799
F.P.L. Turkey Point Units 3 + 4
Environmental Impact Statement

I have reviewed the above impact statement and my comments are enclosed.

Ross McCluney
28 March 1972

28 March 1972

STATE PLANNING AND DEVELOPMENT CLEARINGHOUSE
1972
RECEIVED
SPDC NO. 72-0799

TO: Homer E. Still, Jr., State Planning and Development Clearinghouse
725 South Bronough Street, Tallahassee, Florida 32304

FROM: Mr. Bill Partington, Director
Environmental Information Center

RE: U. S. Atomic Energy Commission: Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses for Turkey Point, Units 3 & 4
SPDC Project No. 72-0799

We have reviewed the above environmental impact statement and comment as to the adequacy of treatment of physical, ecological, and sociological effects of concern to us as shown below:

	Check (✓) for each item: None	Comment enclosed
1. Additional specific effects which should be assessed:		✓
2. Additional alternatives which should be considered:		✓
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid the irreversible or irretrievable commitment of resources:		✓
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution as shown:		✓

This agency ☐ does wish ☐ does not wish to review the final environmental impact statement on this project.

Ross McCluney
(Name & title of authenticating official)
Member of the Board
Tropical Audubon Society
800 Douglas Rd.
Coral Gables, Florida 33134

Enclosure(s) ☐ None ☐ Attached

COMMENTS ON THE ENVIRONMENTAL IMPACT STATEMENT CONCERNING TURKEY POINT ELECTRICAL GENERATING UNITS NO. 3 AND 4 OF THE FLORIDA POWER AND LIGHT COMPANY -- 28 March 1972

by Ross McCluney

ADDITIONAL SPECIFIC EFFECTS WHICH SHOULD BE ASSESSED

Interim Cooling Period

1) The effects of increasing siltation and water turbidity during once-through operations need to be treated in detail. This comment applies to the large volumes of water flowing through the cooling system on a daily basis, rather than to the effects of dredge and fill operations during construction.

2) The effects of the interruption of the overland and sub-surface flow of fresh water into Biscayne Bay and Card Sound need to be treated in detail. Some species are dependent upon gradual salinity gradients from fresh to sea water across a broad estuarine belt. The major aquatic species to a degree are abundant because they have free access to whatever proportions of the salt gradient they need at different times in their life cycles.

The effects on such species of the interruption of this fresh water flow by the plant and its cooling system should be treated in detail. If this overland flow is found to once have existed in quantities in the area but was eliminated by the works of man, even prior to F. P. L.'s arrival on the scene, the company should consider the possibility of at least artificially restoring this flow, if it is shown to be desirable to do so from an environmental standpoint.

3) As the cooling water from Biscayne Bay passes through units 3 and 4 it is subjected to low-level nuclear radiation. The time of exposure of the water is quite low and therefore is not expected to pick up significant radioactivity of its own. However, certain biological and mineral deposits tend to accumulate on the surfaces of the cooling tubes and are therefore subjected to longer radiation exposure times. This material eventually becomes detached from the tubes and can enter the Bay or Sound and might constitute another radiation pathway to man. The environmental effect of this pathway should be carefully considered.

Long-Range Cooling Period

1) Alteration of fresh-water overflow. Same as comments No. 2 above.

2) Although liquid radioactive wastes will be highly diluted when they are released to the cooling canals, the system is basically closed and the possibility exists that the level of radioactivity within the system might increase with time to a dangerous level. This possibility should be treated in detail.

ADDITIONAL CONTROL MEASURES WHICH SHOULD BE APPLIED TO REDUCE ENVIRONMENTAL EFFECTS

Long-Range Cooling Period

The Final Judgement in the U. S. District Court is contained in Appendix 6 of the Impact Statement. Since the procedures outlined in this judgement will be followed by the Company, it is appropriate to question possible adverse environmental effects of those procedures:

1) In paragraph IV, section 12, the words "...but at no power production penalty" should be stricken. Some power production penalty is acceptable if it significantly reduces environmental damage.

2) In an affadavit by Florida Power and Light Vice-President Robert J. Gardner it is stated that "the available senior executive of the comapny will make the determination of whether the health, safety or welfare of the public would be endangered" for the purposes of invoking the waiver provision of paragraph vi. After-the-fact review of his decision does not afford the same kind of environmental protection as before-the-fact review of the decision.

Some provision should be made for reviewing the decision of this official by the judge of the U. S. District Court for the Southern District of Florida or by an available member of the Florida Pollution Control Board before the decision is allowed to take effect.

3) According to the wording of paragraph VI any threatened brownout or blackout in any portion of Florida Power and Light's system would constitute an emergency of sufficient magnitude to justify the use of the provisions of paragraph VI. Furthermore, under the provisions of paragraph II, section (f), any county or municiple authorities may declare an emergency and thereby waive the agreement under paragraph VI. Frequent and unnecessary invoking of the waiver provisions, with possible adverse environmental impact, is thus permitted.

4) Due to evaporation, the salinity of water in the cooling system will be continually increasing. Provisions are made in the agreement for reducing this salinity by discharging some highly saline water and drawing in water of lower salinity from Card Sound. Due to the provisions of paragraph V, sections 5, 6, and 7, however, the amount and salinities of the discharge water are limited. It therefore appears possible that, due to engineering or other error, a condition might inadvertantly occur whereby the cooling water salinity might increase at a rate faster than it could legally be reduced by dilution and flushing subject to the above limits. The resulting salinity runaway of the cooling system would eventually threaten the continuing operation of the plant and would therefore constitute an emergency subject to the waiver provision of paragraph VI.

In such a circumstance, the company would be free to discharge unlimited amounts of highly saline water into the Sound at whatever temperature is permitted by local or state laws. Such an occurrence could be catastrophically and permanently damaging to the ecology of Card Sound and Lower Biscayne Bay and should be prevented at all costs. Limits should probably be placed on the salinity of the reservoir water itself, with emergency provisions for reducing the salinity without harm to the environment should the salinity limit ever be exceeded.

ADDITIONAL ALTERNATIVES WHICH SHOULD BE CONSIDERED

<u>Long-Range Cooling Period</u>

On page 2.5.4-7 it is stated that an additional

$8,700,000 cost disqualifies natural draft cooling towers as an alternative to a cooling reservoir system. This cannot be considered too great a price to pay for protecting many hundreds of acres of estuarine area which will be significantly altered by the proposed cooling reservoir system.

Furthermore, the use of a totally dry, forced draft cooling system should be considered in detail, as a possibly better alternative to both natural draft wet towers and the cooling reservoir system.

ISSUES REQUIRING FURTHER DISCUSSION OR RESOLUTION

Interim Cooling System

1) More detail should be given concerning possible adverse effects of alteration of natural waterflow patterns in the Bay and Card Sound.

2) The deleterious effects on phytoplankton due to short-term thermal shock during passage through the cooling system should be studied in much more detail.

3) The effects and possible alternatives to the use of chemical cleaners and biocides should be treated in much more detail.

Long-Range Cooling Period

1) Chemical cleaners and biocides. Same as item 3 above, with the need for a study of the possible increase in concentration of these substances in the recirculating system.

2) In Appendix 1 the discussion of methods of fuel introduction and shielding, spent fuel handling and disposal, operation of the coolant loops, pumps, and leakage control

systems are all treated too briefly. For example, specifically how is the reactor coolant purified, vented, and drained, and what are the environmental effects of these operations?

THE ASSUMPTION THAT CONTINUED GROWTH OF ELECTRIC POWER PRODUCTION IS NECESSARY

By the operation of its additional power generating facilities, Florida Power and Light Company will be providing more electricity than is needed by its customers. By so doing the movement of new residents into South Florida will be strongly encouraged. These residents will place new demands on the resources and environment of the area. The resulting increase in population will have severe and long-range environmental consequences.

In providing for an excess of electric power, F. P. and L. will be contributing to the environmental impact produced by the expanded population. A complete and thorough discussion of the impact of continued growth of electric power generation should be included in F. P. & L.'s final environmental impact statement. The company has a moral and a legal (through the National Environmental Policy Act of 1969) responsibility to define the long-range environmental consequences of continued growth in electric power generation.

Although the company may be legally prohibited from wilfully causing power shortages by an unfortunate rule of the Public Service Commission (see p. 2.5.1-3), the environmental impact of continued growth of electric power production should be fully discussed in any environmental impact statement which it prepares.

A more detailed discussion of the concept of limiting electric power production can be found on pages 12-19 of the enclosed paper titled: "Electrical Power Generation and the Environment."

Ross McClurney
6405 Santona St., Apt. 4
Coral Gables, Fla. 33146

E - 12 - 47

ELECTRICAL POWER GENERATION AND THE ENVIRONMENT

Ross McCluney

For

Tropical Audubon Society, Inc.
800 Douglas Road
Coral Gables, Florida 33134

ELECTRICAL POWER GENERATION AND THE ENVIRONMENT

by Ross McCluney

The earth receives a continuous flow of energy from the sun. A sizeable portion of this is reflected or otherwise re-radiated back into space. A small fraction of it is captured by the leaves of plants and stored as chemical energy. This chemically stored solar energy becomes the essential biological energy source for the entire animal kingdom. In particular, it supplies the energy required as food for the human population at an average rate of about 100 thermal watts per-capita.

During geologic history, a minute fraction of the organic matter of former plants and animals became buried in sedimentary sands, muds, and limes, under conditions of incomplete oxidation. This has become the source of our present supply of what are called the fossil fuels--coal, petroleum, and natural gas.

It has taken nature millions of years to accumulate energy in this form, but it is taking man only a few hundred to deplete them. Since these energy sources are being depleted much faster than they are being restored by natural processes, they are called non-renewable resources. Once taken, they are gone forever. With mankind's rapid population growth, and with the even more rapid growth in its demand for energy, these non-renewable natural resources are being depleted at ever increasing rates.

Fossil Fuel Depletion

Although we are not yet running out of such energy, we are being forced to use the resources that produce it faster than is probably healthy. Our supplies of fossil fuels are finite and will probably be consumed in two or three hundred years, probably much sooner. Petroleum, both because of its small initial supply and because of its more rapid rate of consumption, will probably last only another 70 to 80 years. In particular, the United States (except for Alaska) has just about reached its peak in crude-oil production and should reach its peak in the production of natural gas by about 1980. The date at which world production of petroleum will reach its maximum is estimated to be about the year 2000.

In view of the fact that 60 percent of the world's present production of energy for industrial purposes, and 67 percent of total energy production in the United States, is obtained from petroleum and natural gas, the imminent culmination and then decline in the annual supplies of these fuels pose problems of immediate and serious concern.

As the supplies of easy-to-get high-grade coal, oil, and natural gas begin to run out, we will be forced to go after the low-grade and harder to get deposits, and the prices for these resources will skyrocket. Indeed, this is happening now. Already we are being forced to consider more expensive mining techniques to permit utilization of the oil shales. We are being forced to get oil from expensive and hard to get at places such as the North Slope of Alaska. We are beginning to live beyond our means, "spending our capital," as Paul Ehrlich puts it, depleting what are essentially nonrenewable resources. Furthermore, the burning of fossil fuels for energy production is perhaps the most wasteful, least desirable use for these large organic molecules. Petroleum and coal have many other uses, uses that last and are not wasteful, such as for lubrication and in the production of plastics.

While it is true that there may exist still vaster, but as yet undiscovered, deposits of these vital natural resources, it would be folly for mankind to proceed on the assumption that they do exist. Furthermore, the environmental costs of extracting these resources are becoming greater and greater. Continued massive environmental damage will be the inevitable result of our growing, insatiable dependency on the energy supply accumulated for us by Mother Nature over millions of years.

Looking to the future, the energy needs of the United States and the world could conceivably be met for another century or so by coal alone. But coal is one of the worst sources of air pollution and its elimination would require the use of very costly and elaborate pollution control equipment. Strip mining for coal is one of the worst destroyers of our beautiful landscape. And when the coal is all gone dependence on other energy sources will be unavoidable.

Alternative Energy Sources

There are several possible alternative energy sources. Of these, large-scale power production directly from solar energy appears technologically unpromising.

The world's potential production of hydroelectric power is roughly equivalent to the amount of power now produced by the fossil fuels. However, most of this occurs in the industrially undeveloped areas of Africa, South America, and Southeast Asia, and could only be utilized by a parallel industrialization of these areas. Furthermore, hydro-electric power depends on dams, which under present conditions of technology are temporary structures. In a few hundred years, or less, their reservoirs fill with silt and become useless. Finally, there is an aesthetic question. Do we wish to impound and control all of the wild rivers of the earth?

Geothermal and tidal energy is now being exploited in a few suitable sites around the world but the ultimate amount of energy from these sources can never be very large.

This leaves us with nuclear energy as the only remaining source which is sufficiently large and practical to offer any hope of meeting future needs at either present or increasing rates of consumption. Of the possible sources of nuclear energy, that from fusion has not yet been achieved and may never be. Power from the fission of uranium-235 is an accomplished fact, and reactors using U-235 are rapidly being constructed. However, the supply of U-235 is such that serious shortages in the United States are expected before 1990. Fortunately, a newer kind of nuclear generator, called a breeder reactor, is available. The breeder reactor would convert more non fissionable uranium and thorium to plutonium than it would consume itself as fuel.

Nuclear Power

In the light of present technology, we are thus left with the development of these full-breeding nuclear reactors, capable of consuming all of natural uranium or of thorium, as our only adequate source of long-range industrial power. Although breeder reactors would effectively extend our fissionable fuel supply by a factor of approximately 400, they are not expected to become economically competitive with conventional reactors until the 1980's. Whenever they do, there is no guarantee that the cost of energy produced by this means will be significantly reduced any further, because of the probable high construction and maintenance costs of the power plants and the probable increase in the cost of ore that the breeders will convert to useable nuclear fuel.

A common misconception about nuclear power is that it can reduce our dependence upon fossil fuels to zero as soon as that becomes necessary or desirable. In fact, nuclear power plants produce electrical energy. Electrical energy constituted only 19 percent of the total energy consumed in the United States in 1960. The length of time that nuclear fuels can put off the depletion of fossil fuels depends on how much use of electrical energy can be increased. Because of our need to save petroleum for other, non-combustive users, we had better be getting along with the job of achieving this conversion. It will be an immense task. It will require a conversion from engines fueled by petroleum products to those fueled by electrical means or by electrically-derived energy sources, conversion from coal and oil to electrical heating (or heating more directly with the thermal wastes coming from the power plant), and conversion to electrically powered industries. All such conversions take time and will be extremely expensive, but they are necessary.

Thus it has become evident that nuclear energy is our only hope for substantially postponing the threatened depletion of our valuable petroleum and coal reserves, even if we were somehow able to restrict world population to its present level.

To quote Paul Ehrlich:

> It is clear that mankind, if it survives for another century or so, will witness drastic changes in the use of energy sources. It does not appear, however, that availability of energy itself will place a limit on population growth, although difficulties accompanying the transition from one source to another might well do so. The ultimate limits to the use of energy (assuming radioactive pollution and other safety problems associated with nuclear energy can be solved) come not from its shortage, but from the problem of dissipating the heat to which all useful energy is ultimately degraded.

Here lies the source of what is called the Nuclear dilemma. To continue our rapid expansion of energy consumption, we must undergo a massive conversion to almost total dependency on nuclear energy. This means that we will simply <u>have</u> to solve the problems of nuclear and thermal pollution and nuclear safety associated with nuclear power plants. Through better design of the power plant, or in some cases through a radical change in the way the fuels and by-products are treated, radioactive pollutants and wastes, and nuclear hazards, may be eliminated for all practical purposes. This will be incredibly expensive, but is a necessary consequence of unlimited growth in population and in energy use.

Thermal Pollution

Though it may be technically possible to eliminate problems with radiation safety and to eliminate non-thermal wastes, it is not possible to eliminate the thermal wastes coming from these plants. It is an inevitable consequence of any process (such as present-day-electrical power production) which converts heat into mechanical energy (the turning of wheels the running of electrical generators) that the conversion is not 100%. Thus some waste heat will always be produced. The best we can hope for is that the waste heat can be spread over a sufficiently large portion of the earth's atmosphere that it will cause little environmental damage.

The problems of adequately accomplishing this objective are quite large, but do not appear to be technologically insurmountable. The solutions will be costly and burdensome, but not impossible. A discussion of several alternative power plant cooling systems is contained in an Appendix to this paper.

The crux of the matter is that electrical power consumption in the United States is growing faster than the technology required to safely support it. Thus we are encountering numerous conflicts between the power industry and the environment all over the country. Even when the technology for safe and efficient dissipation of waste heat does exist, the power companies are frequently unwilling to pay the high costs to use it. In the end, the environment, and hence the general public, suffers.

The Role of the Conservationist

Since the environment has few powerful advocates either within the power companies or within the various levels of government, the general public, or more specifically conservation organizations, are being increasingly relied upon to raise their voices on behalf of the environment. Being composed mostly of laymen, with limited amounts of time to study the problems in detail, these groups are open to the criticism that they lack the knowledge and skills needed to make proper judgments about the extent of environmental protection to be expected from a proposed power plant cooling system. While this may be true, it must be recognized that even many of the scientists can't agree on the effectiveness and adequacy of proposed cooling systems. In such situations, the conservative watch-word would be: "don't build the plant" or "preserve the status-quo, and don't do anything that might cause serious damage." While some of the more radical conservationists might be saying such things, most are mainly concerned with insuring that sufficient environmental protection is built into the plants when they are constructed.

Until governmental institutions are changed sufficiently to provide the kind of interdisciplinary, across-departmental-boundaries, cooperation on environmental issues which is needed to properly defend the environment against the onslaught of the expanding electrical power companies, conservation organizations and other groups of private citizens will have to shoulder most of the burden of insuring adequate protection from the many hazards of nuclear power generation in the U. S.

Electrical Power Production in Florida

In Florida, the problem of electrical power production lies mainly in the facts that the state's inland lakes and rivers and coastal estuaries are quite susceptible to even moderate increases in temperature, especially during the summer months, and the more appropriate power plant locations on the off-shore islands have become quite scarce. By moving to "closed" cooling systems such as evaporation lakes, or (even better) cooling towers, the power companies could avoid some of their dependence on siting near the open ocean. But the power companies say that cooling towers are too expensive and not feasible in the Florida climate.

The adequacy of cooling lakes will be tested in the next few years by Florida Power and Light Company at its Turkey Point Plant. If this technique fails, the only alternative appears to be location of these power plants in regions more capable of handling thermal wastes, regions probably quite remote from Florida. This solution relies upon the further development of means of transporting electrical energy over great distances with relatively few losses along the way. Such systems are presently under development but will not be ready for full exploitation for several more years. In the meantime we will encounter more and more situations in which we will either have to curtail electrical power generation or accept inevitable large-scale environmental destruction.

If power company executives will be more willing to accept the higher costs of better cooling systems we may be able to avoid much of these unwanted and unnecessary conflicts between electrical power generation and the environment. In order to protect itself from the many potential dangers (both environmental and nuclear) of large-scale electrical power generation with nuclear reactors, the public will have to take an increasingly active part in the battle to get the power companies to spend the large amounts of money necessary to insure adequate protection.

A Broader View

Up to this point the general thrust of this paper has been that as our energy resources begin running out, and as electrical power demand continues to grow faster than the technology to support it, we will be faced with a series of powerful conflicts between power generation and the environment. We have said that if one is to accept the continuing expansion of electrical power generation, then one will either have to pay the high costs of protecting the environment or suffer tremendous and wholesale devastation of many of our most vital eco systems.

But there is another point which must be stressed. In a recent study of Florida Power Corporation's Anclote River power plant, it was pointed out that society has many diverse resource needs, such as water, power, food, and transportation. The Anclote study group emphasized that providing an abundance of one of these serves only to put great stress on all the others. An abundance of fresh water in a region, for example, encourages growth and severely taxes the power, schools, transportation, sewers, and other systems of the area. The conclusion is obvious. If it is desired to expand, say, the power generating capacity of the region, then provision must be made to also expand school facilities, water and sewer systems, transportation, housing, fire and police services, and in general all the other public facilities which are necessary to support the population. In all of this, great measures will have to be taken to insure only minimal damage to the environment. In short, what is needed is some form of regional planning in order to provide for parallel and concommitant growth of all of society's facilities.

Regional Planning

In order to be most effective and in order to produce minimal undesirable results, the planning should be done by an enlightened, interdisciplinary group of scientists, laymen, and planners and there should be adequate means for enforcing the provisions of the plan.

As the population and resource use in the region expands, the plan (if effective) will in principle provide for the natural and orderly growth of all of the community's facilities and will prevent the occurrence of serious shortages of any one of them. This growth process will continue until one of two things happens.

In the first, the region's ability to support one of the community services becomes depleted. For example, a point might be reached at which the supply of fresh water can no longer continue growing. All that can be taken from the region is being taken from the region. (We will assume for the purposes of this discussion that maximum reuse of the fresh water has already been achieved by the community).

In such a situation, continued growth of all the other community services will place gigantic stress on the deficient one. It is being pushed to the limit, and the people are clamoring for more. In such a case, if more is somehow given, it is at great economic cost and usually involves also significant environmental destruction.

The second thing that might happen with the uniform and parallel growth of a region's resources is that a point is reached at which continued "orderly" growth of all community services in the region could be accomplished but only at the expense of ever increasing levels of environmental damage and ecological disruption. The needed services, such as schools, transportation, housing, etc., are provided, but the environmental qualities of the region come to be seriously compromised.

Thus, clearly, in the community growth process, a point will be reached at which continued expansion of all of the community's resources requires extensive disruption of natural ecosystems and a loss of many of the amenities which make the region a desirable place to live.

Restriction Growth

At this point the growth must stop. For minimum economic, social, and other disruption, the conversion to a no-growth situation (on to a very slow growth situation) should be accomplished gradually, over a period of several years. This requires even more foresight and planning than was needed in the steady growth situation. The determination of the ultimate maximum population supportable by a region should be the first objective of the region's planning board. It is of the utmost priority, and without it the regional plan itself can only lead to environmental, social, and economic disaster for the region.

Once an approximate population limit has been established for the region, the problem becomes one of how best to achieve it. There are many methods for limiting the population of a region, most of which are extremely distasteful in that they restrict civil liberties, limit the freedom of choice, and burden the lower income groups more than others. A certain amount of increased regulation and loss of individual freedom is an inevitable result of growing population densities. But the restriction of this growth need not be excessively onerous, if carefully planned for.

Restricting Power Production

Howard T. Odum of the University of Florida suggests that the production of electrical and other forms of power is perhaps more fundamental than any of the other community resources and thus that by restricting its use, the use of all the other services will be similarly restricted. It takes power to run transportation systems, power to run water and sewer systems, power to manufacture goods, and power to provide housing. By providing for a gradual leveling off of power use, all of the community resources of the region can similarly be gradually stabilized simultaneously.

Professor Odum speaks of setting a maximum power-use-per-acre density limit for the region and points out that only through such controls can massive future disruption be avoided.

Power use controls, as a means for restricting population growth, have the advantage of avoiding many of the social, political, and moral difficulties associated with more direct population controls such as interstate immigration restrictions, governmentally enforced housing shortages, and involuntary sterilization programs.

While the concept of limiting power use to control population may appear to be strange and revolutionary, it has much merit and should be considered and discussed widely.

The interesting thing about this proposal, for South Florida, is that we may have an opportunity to indirectly test it out over the next few years. There are increasing indications that South Florida (and perhaps the whole state) may have already reached its maximum capacity for electrical power production. The inland lakes and estuaries cannot handle the thermal wastes coming from the larger and larger power plants planned for the future. Suitable sites on off-shore islands around the state are becoming scarcer and scarcer. The power companies tell us that cooling towers cannot be used in Florida due to climatic and other technological restrictions. Only artificial, man-made cooling ponds remain as a possible method for dispersing power plant waste heat in South Florida. If the Turkey Point plant of Florida Power and Light Company proves to be either ineffective or excessively damaging to the environment, then we may be forced to curtail electrical power generation and consumption in South Florida and at least a portion of the Odum method of restricting growth will have been instituted.

What is particularly unfortunate about this is that it would have occurred involuntarily, as a result of the lack of adequate past planning. No one likes to be restricted involuntarily. The restriction of power production in Florida, if it comes, will have happened accidentally, without benefit of proper planning and will therefore be very painful and disruptive.

Planning for the Future

The right to electrical power and other community services is not a God-given right. It is a privilege, earned by the labor and skill of past generations. The destruction of major ecosystems by the excessive growth of these services can have much more disasterous and longer lasting consequences than any shortages in electricity, transportation, or other facilities can have. The time has come for us to look to the future, to anticipate possible natural limitations on growth and to plan for them. To do otherwise will be folly and can result only in social, economic, and environmental chaos.

References

Odum, Howard T., Environment, Power, and Society, Wiley-Interscience, New York, 1971.

Ehrlich, Paul R. aand Anne H., Population, Resources, and Environment, W. H. Freeman & Co., San Francisco, 1970.

Conservation - 70's, Inc. and Florida Defenders of the Environment, "Interim Report to Florida Power Corporation on Anclote River, Florida, Power Plant." July 27, 1971, available from C - '70's, 319 S. Monroe, Tallahassee, Florida 32304.

Resources and Man by the Committee on Resources and Man of the Division of Earth Sciences of the National Academy of Sciences. W. H. Freeman & Company, San Francisco, 1969.

APPENDIX

MINIMIZING THE ENVIRONMENTAL EFFECTS OF WASTE HEAT PRODUCTION

If all the waste heat generated by man-made energy conversion processes were uniformly distributed throughout the atmosphere, its temperature would increase by a very small amount. The increase would be so slight that, at present rates of generation, no noticeable effect would be observed. No significant change in the earth's climate or life systems would occur.

Unfortunately, the waste heat which we are presently producing comes from relatively small, concentrated sources, and it is not uniformly distributed in the atmosphere. Furtheremore, the waste heat seldom (except in such cases as air-cooled automobile engines) enters the atmosphere directly. It is usually carried into the atmosphere by some body of water. When this intermediate body of water contains biological organisms susceptible to elevated temporatures, the waste heat is called thermal pollution.

It would appear, then, that the adverse effects of waste heat could best be minimized by discharging the heat as directly as possible into the atmosphere, bypassing biologically susceptible bodies of water, and rely upon the natural winds to spread it uniformly around the earth. But if this were done on a sufficiently large scale in a given region of the earth's surface, the climate of that region could conceivably be altered. Such effects would produce an ultimate limit to the amount of waste heat that could be produced in the region. Fortunately, there is little evidence that present levels of waste heat generation have any significant effect on local or regional weather patterns.

For large-scale operations the cheapest and most efficient method of waste heat disposal is usually chosen. Thus, historically, electrical power generating plants have discharged their waste heat directly into nearby bodies of water. In order to produce the least change in the temperature of the receiving waters with this method, the water should flow by the plant (or to and from it) with the greatest rate possible. The natural flow would therefore carry the heated water away with it and effectively distribute it over a large area. Through evaporation and conduction, the excess heat eventually finds its way into the atmosphere. When the amount of waste heat has been small and the rate of natural water flow has been large, this method of waste heat dispersal has been quite effective and has produced minimal environmental damage.

But electrical power plants are becoming larger and more numerous. In many cases, the amount of waste heat released is too large for receiving waters to support, and biological damage results. The problem is particularly severe where the rate of natural water flow (river current or tidal flushing) is small, and in southern, tropical, and semi-tropical, areas where the receiving waters may be rather warm to begin with.

In such situations, there are several possible solutions, which can be used. One would be to locate the plant near to a large body of water having a strong current. Water from this current could be drawn into the plant, heated, and then sent back into the current to be dispersed. The heated water would thereby be carried away and distributed over a very large area. Unfortunately, however, the water used in this process is likely to contain numerous tiny plants and animals (and some which are not so tiny) which are vital components of the stream's ecosystem. If the water is heated too much as it is passed through the plant's cooling tubes and if the pumps which force the water through them are not designed properly, many of these marine organisms will be destroyed by the temperature changes and the vigorous action of the pumps on their way through the system.

We can list several more desireable solutions, in order of increasing environmental protection (and unfortunately, expense). The first relys on the use of an artificial lake or cooling pond located adjacent to the plant, but isolated from all natural, biologically active bodies of water. Water from one end of the lake is drawn into the plant's cooling tubes, heated, and discharged at the other end of the pond. As the water travels across the lake it evaporates and heat energy is passed into the atmosphere. The efficiency of this process can be increased through the use of such things as powered spray modules to spray the water into the air and enhance evaporation. The efficiency of this method depends rather strongly on the temperature, humidity and wind velocity at the site.

The next solution seeks to reproduce the evaporating action occurring at the surface of the lake inside a structure called a wet cooling tower. Using forced ventilation in such a cooling tower, the same amount of cooling can be accomplished in a smaller space. If clean fresh water is used in this method, it should work quite well. But in many coastal power plant locations, fresh water is not available in sufficient quantities, and salt water must be used. Unfortunately, as the water evaporates in the tower, the salts are left behind and tend to accumulate. Furthermore, much salt is carried into the air and deposited on the land around the tower, degrading it.

An alternative to this method is the use of dry cooling towers. This technique is nearly identical in principle to the operation of the cooling system of a water-cooled automobile engine. Hot water from the power plant passes through a set of coils through which air is forced to blow. If the water is hotter than the air, then heat will flow directly from the water through the metal of the coils and into the air. Since the system is completely closed and no water evaporates, the problem of salt residues is eliminated and there is no need for make-up water. Environmentally this is probably the best of all the methods. Unfortunately it is probably the most expensive as well. And if the air temperature of the region is quite high then heat is transmitted into the air at a slower rate and the power plant's efficiency drops. It thus takes more fuel to produce the same amount of electricity. Fortunatel this effect is only temporary, being confined to the hottest 2 or 3 hours of the day during the hottest portion of the summer The overall effect on power plant operation should be slight.

STATE OF FLORIDA

DEPARTMENT OF POLLUTION CONTROL

SUITE 300, TALLAHASSEE BANK BUILDING
315 SOUTH CALHOUN STREET, TALLAHASSEE, FLORIDA 32301

VINCENT D. PATTON
EXECUTIVE DIRECTOR

DAVID H. LEVIN
CHAIRMAN

April 26, 1972

Appendix E - 13

RECEIVED MAY 2 1972 U.S. ATOMIC ENERGY COMMISSION Mail Section

Mr. Lester Rogers, Director
Division Radiological & Environmental Protection
Atomic Energy Commission
Washington, D. C.

ATTENTION: Mr. Gene Blanc

SUBJECT: Docket Numbers 50-250 and 50-251

Dear Mr. Rogers:

In response to your request of March 22, 1972, this office has reviewed the R. E. P. Draft Detailed Statement dated February, 1972, for units three and four of the Florida Power and Light Company, Turkey Point Plant. We agree with the conclusions reached in the areas of this agency's responsibility, and offer no further comment or objection.

Sincerely,

W. E. Linne

W. E. Linne, Acting Chief
Bureau of Permitting

WEL/cb

cc: V. D. Patton
C. G. Mauriello

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

50-250
50-251

APPENDIX E - 14

MAY 1 1972

Dear Mr. Muntzing:

This is in response to Mr. Rogers' letter of February 10, 1972, requesting our comments on the Atomic Energy Commission's draft detailed statement, dated February 1972, on environmental considerations for Turkey Point, Units 3 and 4, Dade County, Florida.

General
We think that this statement could be strengthened in many respects. It has many unsupported conclusions and deficiencies in information. This lack of data makes it impossible to conclude that the proposed system will offer adequate environmental protection, or to adequately assess the environmental impacts. Our suggestions are that this lack of information, as pointed out in many cases by the AEC, be furnished by the applicant and included in the final environmental statement. In addition we request that all maps show the boundary of Biscayne National Monument. The following comments refer to specific sections of the statement.

Introduction
We suggest that you summarize the consent decree in the introduction and include the decree in its entirety as an appendix to the environmental statement.

The reference to the experience of several extensive power failures should be expanded to indicate whether these were in fact due to the lack of generating capacity or to distribution systems. It appears that inadequate attention has been directed to sufficient interties within and without the system.

According to the first paragraph of page 5, alternative sites in western Dade County were undesirable due to the absence of navigable waterways. The need for such navigable waterways should be explained.

RECEIVED
MAY 2 1972
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

Regional Demography and Land Use

The statement gives the principal value of the mangrove swampland as the role it plays in the biologic life cycle of some terrestrial and aquatic species and its use as a wilderness area. We think the statement should also indicate that the mangroves form the basis for extensive commercial and recreational fishing values and are important in suppression of flood and hurricane tides. The biological and esthetic importance of mangroves has been recognized by the establishment of the Biscayne National Monument.

The statement notes that this land can be converted into productive cropland. This may be true of swampland in general, but it is not true of the specific site in question because it lies seaward of the salinity barrier (Levee 31), and much of it is in the intertidal zone.

Historic Significance

The statement should indicate that the presence or absence of archeological and historic values and any evaluations of their significance, are based on factual, professional knowledge. The environmental statement should also indicate consultation with both the National Register of Historic Places and the State Liaison Officer for Historic Preservation (Director, Division of Archives, History, and Records Management, Department of State, 401 East Gaines Street, Tallahassee, Florida 32304) in the determination whether or not the project adversely affects significant historic values.

Environmental Features

We think that the statement in the last paragraph on page 17 regarding the relative biological productivity of Card Sound should be qualified. The findings of other more intensive and recent studies, such as reference (27) by the same co-author given on page 25, refute it. Present scientific investigation in Card Sound will undoubtedly raise the number of species listed.

Pages 16 and 17 state that temperatures in Biscayne Bay and Card Sound range from 59° to 96° F. This is misleading because temperatures near these extremes occur only in very shallow areas. Natural water temperatures rarely exceed 90° F.

Effluent System - Heat

Further reference to the consent decree would be particularly valuable in this section. It would lay the groundwork for the subsequent discussion of the various cooling systems.

It was recognized during the decree's negotiation that environmental damage would result from the use of the canal system and the language of the decree requires investigations of mechanical cooling devices and other sources of water. Thus, approval of the canal system is provisional, since other systems or water sources may prove to have less adverse environmental impacts. In its treatment of the canal system, the statement should remain open to the possibilities of using the results of the studies required by the decree to further improve the cooling system.

The velocity of water in the intake channel is not given nor the amount of hypochlorite or chlorine used. These data are needed.

Substitute "exposure" for "immersion" in the third paragraph of page 31.

Effluent Systems - Radioactive Wastes

The statement mentions on page 37 that the significant radioactive constituents of gaseous wastes are krypton-85 and xenon-133. It gives the half-life of xenon-133 as relatively short but does not specify this time requirement. The statement should note the half-life of krypton-85 or the adequacy of the 45-day storage period for decay.

The final statement should include the location of the disposal site and method of disposal for solid radioactive wastes.

The fourth paragraph on page 38 indicates that 7,650 curies of tritium per year would be discharged in liquid releases. This number does not agree with the corresponding values listed in Table 6.

Impacts on Land, Water, and Human Resources

The first paragraph of page 45 indicates that a major environmental impact on the indigeneous plants and animals would result from the cooling system dredging operation. We suggest that a quantitative estimate be made of this impact. This is particularly meaningful since there is consideration for expanding the canal system to several thousand more acres of marshland in order to operate the four units at higher plant factors.

Land Use

We believe that the applicant should not delay starting a program to establish vegetation on the spoil areas between the cooling canals. Delay in starting such a program could result in not only extending a poor esthetic situation but would also continue to deprive Card Sound of plant nutrients. The Florida Department of Natural Resources should be consulted in the development of an effective vegetation program for the approximately 3,000 acres between the cooling canals. Plans for the program should be included in the final environmental statement.

Water Use

The prediction of capacity limitations resulting from effluent temperature requirements of the consent decree presented in Tables 9 and 10 appears to be contradictory. We suggest that only one of these tables be presented in the final environmental statement or that sufficient bases be given to show why the predictions differ.

It is apparent that both the AEC and the applicant feel that much of the time the selected cooling system will not adequately cool the effluent to meet temperature requirements imposed by the consent decree. Because the statement advances this system as the selected alternative, it follows that the statement should also describe how the applicant intends to meet the conditions of the consent decree. To do nothing is to suggest that the applicant is going to request the Court to determine that these extensive periods when the temperature limitations are predicted to be exceeded are "emergencies."

The probable accumulation of higher salinity water at 2-3° F elevated temperatures on the bottom of Card Sound is recognized on page 50. A mitigation solution is proposed which, according to the statement, would be in conflict with the consent decree. However, the decree recognized this problem in Section IV, 11 and 12, by requiring studies of alternative sources of make-up water and the use of mechanical cooling devices. The decree requires that these studies shall be directed toward the determination of the feasibility, practicability, and acceptability of utilizing such alternative sources of water and cooling methods as substitutes or supplements for withdrawals of make-up water from Card Sound.

Although a section on environmental monitoring is presented on page 81, the relationship between the plant factor, water use, and consent decree limitations indicates that specific reference to such monitoring is needed in this section. This is particularly appropriate because, according to Table 10, the applicant expects that the four units of the plant can operate at only 22 - 36% of full capacity during the three winter months, during which the peak load occurs, in order to stay within the limitations of the decree.

The discussion of the permeability of soils on page 49 indicates the flow westward beyond Levee 31 would be 600 to 800 cfs out of the system. This flow appears to be high. Also, it is not shown why the seepage flow to the west is higher than that to the east, which is given as 50 to 200 cfs.

Calculations by this Department show that the area within the 1° isotherm is about twice that shown in Table 11, page 53.

Biological Impact

No mention is made of the effects of plant operation on waterfowl and shore and wading birds. We believe that the 7,000 acres involved in the cooling canal system should be acknowledged as a habitat loss for, if revegetation of the muck spoil banks occurs, it will probably not be the present intertidal types used by these birds.

It is stated on page 60 that there is no evidence that the Bay is being significantly depleted of plankton by the present operation of the plant. This should be qualified since there have been no studies designed to investigate this specific point.

When the present nutrient contribution from the 7,000-acre cooling canal area is reduced or eliminated, reduction in primary productivity of south Biscayne Bay and Card Sound may result. Mention should also be made in this section of the possible use of several thousand acres of additional land which may be required if the four units are operated at 100% plant factor and within the limitations of the consent decree. We think that possible environmental effects should be studied before a decision is made to use more land for waste heat dissipation.

The possibility of calcium carbonate being dissolved from the underlying limestone of the cooling canals and the effects on the aquatic life of Card Sound and Biscayne Bay should be evaluated in the final statement.

Page 59 mentions the results of studies of the National Marine Water Quality Laboratory of the Environmental Protection Agency. The indication "that phytoplankton cells had been damaged" is an understatement of that report's conclusion, for, in fact, the damage is severe. It is our understanding that a 50% phytoplankton kill was found using chlorophyl a analysis and corroborated by ATP analysis.

We suggest that the last sentence of the third paragraph on page 59 be corrected to indicate that the percent mortalities of zooplankton which were entrained in the plume without passing through the plant were identical to mortalities of zooplankton passing through the plant.

A quantitative evaluation of the biological impacts resulting from fish being impinged on the traveling intake screens and subjected to sudden changes in temperature, flow, and salinity under emergency conditions and on fish living in the canals or near the canal outfall should be given.

The third paragraph on page 56 should also state the probable effects of radiation, heat, chemicals, and toxins on shore birds and waterfowl which may be attracted to the canals.

Substitute "less damaging" for "more favorable" in the second paragraph of page 59 and substitute "but allow some recovery" for "but result in increased numbers" in the third paragraph of page 62.

Accidents

Section V, Environmental Impacts of Plant Operation, gives an adequate evaluation of impacts resulting from postulated accidents through Class 8 for air borne emissions. However, the environmental effects of releases to water is lacking. Some of the accidents described in Table 14 could result in releases to the Bay and should be evaluated in detail.

We also think that Class 9 accidents resulting in both water and air releases should be described and the impact on human life and the remaining environment discussed as long as there is any possibility of occurrence. The consequences of an accident of this severity should be weighed.

Environmental Monitoring and Research Program
The statement points out the need for quantitative scientific information on the mangrove salt-marsh section due to the recent decision to install a multichannel recirculating cooling-water system instead of the earlier proposed once-through system. It is not clear from the statement that this will be an AEC requirement. The needed investigations listed on page 82 appear to be of great importance to the terrestrial life in the area affected; accordingly, we suggest that the AEC require the applicant to perform these studies.

Adverse Effects Which Cannot Be Avoided
The mention of the possible need for several thousand acres of land in addition to the 7,000 acres presently planned reinforces the need for further consideration of alternative cooling systems or modifications to the operation of the proposed system which will enable the applicant to meet the conditions of the consent decree. The possible need for "several thousand acres of additional land for cooling canals" has not been shown. Its use would entail further habitat destruction and reduction of nutrients to the Bay. We believe that the success of the system is not a function of size alone but of design including the intake and discharge systems.

Even if a viable mangrove fringe develops on the canal banks, and if it is not periodically removed to facilitate water flow, the statement should recognize that there will still be a substantial loss of nutrients to Card Sound.

Underflow to the bays will be increased by the operation of the cooling channel system. The statement notes on page 85 that the temperature and salinity of the groundwater will increase and the section on radiological impact infers that radioactivity in the groundwater will also increase. Although the statement indicates that the effects of these contaminated underflows are unknown at the present time, some estimate of the magnitude of such temperature, salinity, and radiological increases should be included in the final environmental statement.

We recognize that the fossil-fueled plant was in operation and the nuclear plant was under construction prior to establishment of the Biscayne National Monument. However, the visual impact of the plant on visitors to the Monument should be recognized in the report. The Monument's value as a wilderness area was recognized on page 11.

Delete "(if any)" in the last paragraph of page 84.

Short-Term Uses and Long-Term Productivity
The environmental statement implies that there will be long-term effects on terrestrial productivity but short-term effects on marine life of Biscayne Bay and Card Sound. Since their productivity depends on the land area for nutrients, the effects on the aquatic life will continue as long as there are effects on the land area.

We do not agree with your line of reasoning that argues that, because the 30 to 40-year life of the plant is considered a short-term use, the land associated with the plant can be considered the same. In addition, you speculate that the site may be used for the generation of electricity for some time after the original plant is decommissioned. We believe that you should readily acknowledge the possibility of this occurrence and that you should also recognize that the plant may have significant long-term effects on future land-use patterns in the nearby area.

Irreversible and Irretrievable Commitments of Resources
This section should describe the reduction in production of fish and wildlife resources that would occur due to habitat destruction entailed in construction and operation of the plant and cooling canals.

Moreover, any major land-use changes, either directly or indirectly caused by the plant, are for all intents and purposes irreversible commitments of resources.

Alternatives
We feel that the discussion of alternatives to the proposed action should be expanded to consider additional alternatives. The section should be recast to provide environmental impact assessments rather than economic justifications in support of the proposal. Throughout the section, alternative sites, alternative fuels, and abandonment of the project are rejected on the grounds that they result in the non-use and waste of already constructed capital facilities, raise consumer costs, contribute to local unemployment and tax losses, and would fail to satisfy projected energy demands.

Although beneficial and adverse economic consequences cannot be ignored in evaluating a proposal, they should not be the controlling factor in an environmental statement. In the Calvert Cliffs decision, the Court recognized that a thorough consideration of all reasonable alternatives to the proposal, including those that necessarily involve increased costs or economic waste, should be considered.

The consent decree orders studies of the feasibility of using brackish groundwater and/or canal water as a substitute or supplement for make-up water from Card Sound to reduce adverse environmental effects. Investigations of mechanical cooling devices such as powered spray modules and other reasonable concepts are also ordered. These, with the exception of the use of canal water in conjunction with cooling towers, are not discussed. In view of references to the probability that the proposed system will not meet the temperature and salinity requirements of the consent decree, discussion of these investigations as possible modifications to the proposed plan should be included.

In the discussion of salt drift on page 100, 3 to 10 square miles are indicated as being affected. It should be pointed out that during a large portion of the time this salt drift would fall into the bays and in the swamp within the intertidal zone where its environmental effects would be less severe. We note that this impact is significantly less than that resulting from the loss of 11 square miles for the canal cooling system.

The alternative of using brackish water in a closed-cycle cooling system referred to in the statement deserves further discussion. One possible source of this water is the Floridan aquifer; an analysis of the quantity and quality of water available at the site from this source should be included in the statement.

We have confirmed, by approximation, the quantities of waste products which could be expected from the operation of equivalent size coal-fired and oil-fired powerplants given in Table 16. In addition, we found that these probable emissions of SO_2, NO_x, and particulates for both oil and coal firing meet the specifications of the December 23, 1971, Environmental Protection Agency's "Standards of Performance for New Stationary Sources."

The 14,000 tons of coal indicated in the last paragraph on page 90 should be corrected to read "14,000 metric tons." This number of short tons at the reported 10,000 Btu/lb is not capable of providing enough energy to power a 1,520 MW plant. Also, there is a minor discrepancy in the daily volume of fuel oil reported to be necessary for the 1,520 MW oil-fired powerplant. This volume is given as 50,000 barrels on page 90 and 51,500 on page 91.

Cost-Benefit Analysis
According to the first paragraph on page 89, the plant will increase tax revenues to all levels of government almost $40 million annually by 1975. We suggest that this benefit be offset by the costs of providing additional required services.

We think that the Cost-Benefit Summary given in Table 21 is inadequate due to the lack of sufficient quantification of environmental impacts.

Recommendations
The AEC license should be conditioned to require the applicant to comply with the consent decree. Moreover, the applicant should be required to consider all other alternative cooling methods prior to building the large canal system.

According to page 47, the raised area between the cooling channels may permit some agricultural, commercial, and residential development. We request that the applicant not be permitted to develop this area for such purposes. This land should be returned to a condition as close to the natural conditions as feasible with the possible exception of recreational development such as hiking trails.

It is stated on page 101 that the AEC assumes that the nuclear units will be loaded preferentially to the fossil plants, since the incremental cost of power is less. It appears from information contained in the environmental statement that the economic cost of the nuclear plant is less than the alternative fossil-fueled plant; however, when environmental effects are included, the total incremental costs may be less for the fossil-fueled units since they would discharge about 30% less waste heat to the cooling water per unit of generation. We recommend that the AEC require the applicant to make a determination of the difference in environmental impacts between the nuclear and fossil-fueled units and to include this factor in deciding which units should be loaded first.

We hope these comments will be useful to you in the preparatior of the final environmental statement.

Sincerely yours,

H. S. Lyon

Deputy Assistant Secretary of the Interior

Mr. L. Manning Muntzing
Director of Regulation
Atomic Energy Commission
Washington, D. C. 20545

50-250-251

ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APPENDIX E - 15

May 1, 1972

Mr. A. Giambusso
Deputy Director
Division of Radiological and
Environmental Protection
Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Giambusso:

As indicated in the attached memorandum, our Region IV office felt that additional information is needed on air quality. If this can be addressed in the final statement, I would be grateful.

Sincerely,

Bill

William Holmberg, Director
Federal Agency Liaison Staff
Office of Federal Activities

Enclosure

ENVIRONMENTAL PROTECTION AGENCY
REGION IV
1421 Peachtree Street, N. E.
Atlanta, Georgia 30309

MEMORANDUM

DATE : April 26, 1972

FROM: : Regional Administrator

SUBJECT: Draft Environmental Impact Statement - - -
TURKEY POINT NUCLEAR POWER PLANT, Units 3 and 4, near Miami, Florida.

TO : Sheldon Meyers
Director, Office of Federal Activities
Environmental Protection Agency
Washington, D. C. 20460

In reviewing the EPA official comments directed to the USAEC under date of March 24, 1972, by Robert W. Fri, I find that the clarifications regarding air quality protection included in the Region IV coordinated comments submitted on March 1, to the Office of Radiation Programs, have been ignored. Those comments are quoted below:

> "No mention is made of the impact of construction and operation of the plant on air quality. We cannot assume that there will be no effects on air quality (such as emissions from standby, utility, or peaking boilers); therefore, it is suggested that the Final Statement include assurances that air pollution effects of the plant have been considered."

It is my opinion that this is of significant importance to be included in our Agency's coordinated comments to the USAEC.

Jack E. Ravan

Jack E. Ravan

C O P Y

APPENDIX F

April 13, 1972

Mr. Homer E. Still, Jr.
State Planning and Development
Clearinghouse
725 South Bronough
Tallahassee, Florida 32304

Re: Environmental Considerations
Units 3 & 4 - SPDC Project
No. 72-0799

Dear Homer:

The draft environmental considerations related to the proposed issuance of operating licenses for Turkey Point, Units 3 & 4, SPDC Project No. 72-0799, have been reviewed by this agency. This project does not appear to threaten any known archaeological or historical sites of significance. The area does not include sites currently listed on the National Register of Historic Places or any sites currently under nomination to the National Register. The Turkey Point area should have received extensive archaeological survey prior to construction activity; however, the draft statement indicates 90% construction completion. Any comment concerning site destruction would have been academic at best.

Sincerely,

Robert Williams
Director, Division of
Archives, History and Records Management
Florida Department of State

RW:Mpmo