NUREG-0842

Draft Environmental Statement

related to the operation of St. Lucie Plant, Unit No. 2

Docket No. 50-389

Florida Power and Light Company
Orlando Utilities Commission of the City of Orlando, Florida

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

October 1981

SUMMARY AND CONCLUSIONS

This Draft Environmental Statement, related to the Operating Phase, was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff). Sections related to the aquatic environment were prepared in cooperation with the U.S. Environmental Protection Agency, Region IV.

1. This action is administrative.

2. The proposed action is the issuance of an operating license to the Florida Power and Light Company (the applicant) for the startup and operation of the St. Lucie Plant Unit No. 2 (St. Lucie 2), Docket No. 50-389, located on Hutchinson Island which is a barrier island on the east coast of Florida approximately midway between the cities of Fort Pierce and Stuart.

   St. Lucie 2 will employ a pressurized-water reactor to produce 2560 megawatts thermal (MWt). A steam turbine-generator will use this heat to provide 850 megawatts electric (MWe) gross. The maximum design thermal output is 2700 MWt. The exhaust steam will be condensed by a once-through flow of water taken from and returned to the Atlantic Ocean.

3. The evaluation in this statement represents the second assessment of the environmental impact associated with St. Lucie 2, pursuant to the guidelines of the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 of the Commission's Regulations. After receipt of an application in 1973 to construct St. Lucie 2, the staff carried out a review of impact that would occur during its construction and operation. This evaluation was issued as a Final Environmental Statement, related to the construction phase, in May 1974. After this environmental review, a safety review, an evaluation by the Advisory Committee on Reactor Safeguards, and public hearings in Stuart, Florida, the U.S. Nuclear Regulatory Commission, issued a permit in May 1977 for the construction of St. Lucie 2. As of August, 1981 the construction of St. Lucie 2 was about 80% complete. With a proposed fuel-loading date of October 1982, the applicant has applied for a license to operate St. Lucie 2 and has submitted (March 1980) the required safety (FSAR)[1] and environmental (ER-OL)[2] reports in support of the application. The staff has reviewed the activities associated with the proposed operation of St. Lucie 2 and the potential environmental impacts from operation, both beneficial and adverse are summarized as follows:

   a. St. Lucie 2 is being constructed south of, and on the the same site as, St. Lucie 1, an operating nuclear power plant of equivalent design. The site consists of 1132 acres which are owned by Florida Power and Light Company. The environmental impact on the site occurred with the construction of St. Lucie 1. There were no offsite transmission lines built specifically for St. Lucie 2. (Section 4.2.8)

   b. Controlled and treated releases of heat, chemical wastes, and sanitary wastes into the Atlantic Ocean will be rapidly assimilated; thus adverse impacts on water use and aquatic biota will be absent or negligible. (Secs. 5.3 and 5.6)

c. No measurable radiological impact on man or biota is expected to result from routine operation. The risk associated with accidental radiation is very low. (Sec. 5.10)

d. No adverse impacts on the terrestrial environment of the project area will occur due to St. Lucie 2 operation. (Sec. 5.5)

e. Heated water will slightly increase the water temperature of the Atlantic Ocean in the vicinity of the discharge, but the effects on marine biota will be minimal. (Secs. 4.2.4 and 5.6.4)

f. Chemical releases to the Atlantic Ocean are not expected to exceed water-quality criteria levels, and will not adversely impact marine biota. (Sec. 5.6.5)

g. The design of the discharge structure has been modified since the CP review. The redesign results in lesser impact to marine biota. (Secs. 4.2.4 and 5.6)

h. A reassessment of the socioeconomic impacts of the operation of St. Lucie 2 indicates that no significant change from the impacts already experienced from the operation of St. Lucie 1 and the construction of St. Lucie 2 will occur. (Sec. 5.9)

i. The staff has reassessed the need for the facility and concluded that operation of St. Lucie 2 is warranted. (Chap. 2)

4. This Draft Environmental Statement was made available to the agencies specified in Chapter 8 and to the public.

5. On the basis of the analysis and evaluation set forth in this statement, and after weighing the environmental, economic, technical, and other benefits against the environmental and economic costs, and after considering available alternatives at the operating license stage, it is concluded that the action called for under NEPA and 10 CFR Part 51 is the issuance of an operating license for St. Lucie Plant, Unit No. 2, subject to the following conditions for the protection of the environment:

   a. Before engaging in additional construction or operational activities that may result in a significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this statement, the applicant shall provide written notification to, and obtain prior written approval from, the Director of the Office of Nuclear Reactor Regulation.

   b. The applicant shall carry out the environmental (thermal, meteorological, chemical, radiological, and ecological) monitoring programs outlined in this statement as modified and approved by the staff and implemented in the environmental protection plan incorporated in the operating license for the St. Lucie Plant, Unit No. 2. (Chap. 5)

   c. If harmful effects or evidence of irreversible damage are detected during the operating life of the station, the applicant shall immediately provide the staff with an analysis of the problem and a proposed course of action to alleviate it.

References for Summary and Conclusions

1. Florida Power and Light Company, St. Lucie Plant, Unit No. 2, Final Safety Analysis Report, Docket No. 50-389, 1980.

2. Florida Power and Light Company, St. Lucie Plant, Unit No. 2, Environmental Report, Operating License Stage, Docket No. 50-389, 1980.

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FOREWORD

This Draft Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff) in accordance with the Commission's Regulations, set forth in 10 CFR Part 51, which implement the requirements of the National Environmental Policy Act of 1969 (NEPA). Sections related to the aquatic environment were prepared in cooperation with the U.S. Environmental Protection Agency, Region IV. This statement reviews the impact of operation of the St. Lucie Plant, Unit 2. Assessments that are found in this statement supplement those described in the Final Environmental Statement (FES-CP) that was issued in May 1974 in support of issuance of a construction permit for the unit.

The information to be found in the various sections of this statement updates the FES-CP in four ways: (1) by evaluating changes to facility design and operation that will result in different environmental effects of operation (including those which would enhance as well as degrade the environment) than those projected during the preconstruction review; (2) by reporting the results of relevant new information that has become available subsequent to the issuance of the FES-CP; (3) by factoring into the statement new environmental policies and statutes that have a bearing on the licensing action; and (4) by identifying unresolved environmental issues or surveillance needs which are to be resolved by means of license conditions. (No unresolved environmental issues or surveillance needs have been identified in this statement for St. Lucie 2).

The staff recognized the difficulty a reader may encounter in trying to establish the conformance of this review with the requirements of the National Environmental Policy Act with only "updating information." Consequently, a copy of the FES-CP is attached to this Draft Environmental Statement as Appendix B. Introductory résumés in appropriate sections of this statement will summarize both the extent of "updating" and the degree to which the staff considers the subject to be adequately reviewed.

Copies of this Statement are available for inspection at the Commission's Public Document Room, 1717 H Street, NW, Washington, D.C. 20555, and at the Indian River Community College Library, 3209 Virginia Avenue, Ft. Pierce, Florida. Single copies of this Statement may be obtained by writing to the:

> Division of Technical Information and Document Control, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555

Victor Nerses is the NRC Project Manager for St. Lucie Plant Unit 2. He may be reached at the address shown above or by telephone (301) 492-7318.

Comments on this Draft statement are invited. They should be addressed to the Director, Division of Licensing.

1 INTRODUCTION

1.1 Résumé

The proposed action is the issuance of an operating license to the Florida Power and Light Company (FP&L or the applicant) for the startup and operation of St. Lucie Plant, Unit No. 2 (St. Lucie 2), Docket No. STN 50-389. St. Lucie 2 is located on a 1132 acre site on Hutchinson Island, St. Lucie County, approximately midway between the cities of Fort Pierce and Stuart on the east coast of Florida. It is approximately 120 mi north of Miami and 225 mi south of Jacksonville. St. Lucie 2 will employ a pressurized water reactor manufactured by Combustion-Engineering and will have a gross electrical capacity of approximately 850 MWe and a thermal power rating of 2560 MWt.

St. Lucie 2 is being constructed south of, and on the same site as, St. Lucie 1 which is an operating nuclear power plant. St. Lucie 2 shares certain facilities, including intake and discharge cooling canals and transmission lines, with St. Lucie 1. Condenser cooling will be accomplished through a once-through cooling system using water from the Atlantic Ocean.

1.2 Administrative History

This operating license review is the second assessment of the environmental impact associated with St. Lucie 2. After receiving an application, in April 1973, to construct St. Lucie 2, the staff reviewed the environmental impacts that would occur during its construction and operation. This evaluation was issued as a Final Environmental Statement (FES-CP) in May 1974. As a result of that environmental review, a safety review, an evaluation by the Advisory Committee on Reactor Safeguards (ACRS), and public hearing before an Atomic Safety and Licensing Board (ASLB) in Stuart, Florida, the NRC issued a permit in May 2, 1977 for the construction of St. Lucie 2 (CPPR-144). In March 24, 1980 the applicant submitted an application, including a Final Safety Analysis Report (FSAR) and an Environmental Report (ER-OL), requesting an operating license for St. Lucie 2. These documents were docketed on February 17, 1981 and the operational safety and environmental reviews were initiated by the staff.

As of August, 1981 construction of St. Lucie 2 was approximately 80% complete with the reactor expected to be ready for fuel loading in October 1982.

1.3 Permits and Licenses

The status of permits and licenses which are required for the operation of St. Lucie 2 is provided in Table 1.1. The staff has reviewed this listing and is not aware of any potential non-NRC licensing difficulties that would delay or preclude the proposed operation of St. Lucie 2. The Clean Water Act 401 certification by the State of Florida and the National Pollutant Discharge Elimination System (NPDES) Permit (required by Section 402 of the Clean Water Act) issued by the the Environmental Protection Agency (EPA) are prerequisites for the issuance of an operating license by the NRC.

EPA, Region IV issued a Public Notice of proposed issuance of a NPDES Permit and Consideration of State certification of the NPDES Permit on or about October 15, 1981. Comments on the draft NPDES Permit, including the nonradiological aquatic monitoring program, should be addressed directly to:

U.S. Environmental Protection Agency
Region IV, Consolidated Permits Branch.
345 Courtland Street, N.E.
Atlanta, Georgia 30365
ATTN: Ms. Earline Hanson
NPDES No. FL0002208

Ms. Hanson may be reached at (404) 881-4201

The draft NPDES Permit and proposed monitoring programs are reproduced in Appendix C of this Draft Environmental Statement. In addition, the applicant must obtain State approval of the facility in the form of a site certification. A petition was filed by the applicant on September 1, 1981 to amend the current State site certification for St. Lucie 2.

Table 1.1

LICENSES, PERMITS AND OTHER APPROVALS REQUIRED FOR ST LUCIE 2

Agency	Authority Required	Impact	Status or Authority	Status
U.S. Nuclear Regulatory Commission	Limited work authorization	Air, Land, Water	68 Stat. 919; 10 CFR 50	LWA received - 3/75
	Construction permit	Air, Land, Water	68 Stat. 919; 10CFR50	Permit received - 5/77
	Operating License	Air, Land, Water	68 Stat. 919; 10CFR50	Application submitted - 3/80
	Special Nuclear Mat'l	Air, Land, Water	68 Stat. 919; 10CFR70	Application to be submitted - 2/82
	Source Nuclear Mat'l License	Air, Land, Water	68 Stat. 919; 10CFR40	Application to be submitted - 2/82
	By-product Nuclear Mat'l License	Air, Land, Water	68 Stat. 919; 10CFR30	Application to be submitted - 2/82
U.S. Environmental Protection Agency	National Pollutant Discharge Elimination System Permit	Water	P L 92-500 Section 402	Application submitted - 4/81. Draft NPDES Permit included in this document as Appendix C.
	Approval of State Certification of Compliance with Effluent Limitations	Water	P L 92-500 Section 401	The final NPDES Permit will be submitted by EPA to the State for certification.
U.S. Army Crops of Engineers	Permit for Dredge - Fill for Discharge Pipeline	Water	River and Harbors Act Section 10 33CFR209	Application submitted - 7/79
U.S. Coast Guard	Permit to Establish	Water	80 Stat. 932; 14CFR77	Permit requested - 1/80
Advisory Council on Historic Preservation	Determination that Site does not Infringe on Federal Landmarks	Land	Historic Preservation Act of 1966	See Section 2.6 of this Document
	Determination that Site is not Archeologically Significant	Land	Archeological Conservation Act of 1974	See Section 2.6 of this Document
National Marine Fisheries Service/ Fish & Wildlife Service	Collection of Threatened and Endangered Species of Sea Turtles	Water	Endangered Species Act of 1973	Permit obtained - 6/79

Table 1.1 (continued)

LICENSES, PERMITS AND OTHER APPROVALS REQUIRED FOR ST LUCIE 2

Agency	Authority Required	Impact	Status or Authority	Status
Florida Dept of Natural Resources	Beaches and Shores	Land	Chapter 161 Florida Statutes	Not required
	Biological Survey	Water	Chapter 253 Florida Statutes	Not required
Florida State Planning Board	Certification of Site Suitability	Water, Land, Air	Power Plant Siting Act of 1972; Sections 403.501 et. seq.	Certification obtained 5/76, modified - 4/80. FP&L filed a petition for amendment on September 1, 1981.
State of Florida Trustees of the Internal Improvement Fund	Construction of Discharge Line	Water	Chapter 253 Florida Statues	Permit applied for 8/79
Florida Dept of Environmental Regulation	Variance from State Water Quality Standards	Water	Ch 17-3, Florida Administrative Code	Being developed under Power Plant Siting Act
	State Certification that Discharge Complies with Sections 301, 302, 306, and 307 of P L 92-500	Water	P L 92-500 Sect. 401	Certification will be developed following State review of the final NPDES Permit.
	Certification to Construct and Operate Pollution Control Device	Land, Water	Power Plant Siting Act of 1972	Certification obtained 5/76
Federal Aviation Agency	Air Navigation Approval	Air	80 Stat. 932; 14CFR77	Permit requested 12/79

Source: FSAR, Table 12.0-1

2 PURPOSE OF AND NEED FOR ACTION

2.1 Résumé

When the Final Environmental Statement-Construction Permit (FES-CP) was issued in May, 1974, the staff concluded that St. Lucie 2 should be allowed to operate to ensure the reliability of service on the FP&L system. At that time, St. Lucie 2 was scheduled to begin commercial operation in December 1979. This online date was predicated on an expected growth rate in summer peak load demand in the FP&L service area of about 11.4% a year from 1973 to 1980. However, the actual growth rate from 1973 to 1980 was only about 4.9% a year. This decline in the expected growth rate of electricity demand is not unique to the FP&L service area; rather, it is representative of a national trend, attributable in part to higher prices for electricity, conservation, and an overall slowdown in economic growth. One response by utilities has been to adjust the projected expansion of capacity by delaying planned additions to their systems. It is in this context that the applicant has delayed the commercial availability of St. Lucie 2. Current scheduling calls for St. Lucie 2 to begin commercial operation in May 1983.

In this statement the staff evaluates the purpose and need for St. Lucie 2 in the context of (1) overall system production costs for generating electricity; (2) availability of alternative fuels; and (3) reliability of the power supply for the FP&L System. The conclusions drawn from this review will be factored into the staff's decision regarding the issuance of an operating license to St. Lucie 2.

2.2 Production Costs

St. Lucie 2 was constructed to provide an economical source of baseload energy. Because substantial capital as well as environmental costs associated with construction have already been incurred, the only economic factors that are relevant for consideration now are fuel costs and operation and maintenance (O&M) costs, because these expenses will be affected by whether the unit operates or not. A comparison of system production costs with and without St. Lucie 2 available to the system shows strong economic justification for operation of the facility.

The FP&L system is currently heavily dependent on fossil fuels for generating electricity for its customers. In 1979 and 1980, slightly more than 50% of FP&L's electrical energy was generated by oil. Other major energy sources relied upon by FP&L in 1979 and 1980 include nuclear (~25%), natural gas (~20%), and outside purchases (~5%).[1] The system's dependence on oil is even more pronounced when viewed in the context of FP&L's system capacity. For example, in 1980 slightly more than 60% of FP&L's capacity was oil fired and although significant additions to capacity are planned throughout the 1980's, FP&L's 1989 system capacity will still be about 50% oil fired.[2] Because of FP&L's current and future strong dependence on oil-fired capacity, the staff has concluded that the replacement for any energy not produced by St. Lucie 2 would have to come predominantly from oil-fired generation. This conclusion is consistent with the applicant's own assessment of the source of replacement energy should St. Lucie 2 not be allowed to operate.

St. Lucie 2 is an 802 MWe (net) unit which according to the applicant is expected to operate at an annual capacity factor of 72 percent. On an annual basis, the unit would thus produce about 5 billion kWh. The applicant has estimated that if St. Lucie 2 were not permitted to operate, all of this energy would have to be provided by oil-fired capacity. FP&L also estimates an average plant heat rate for its oil-fired capacity of 10,000 BTU per kWh and 8 percent per year escalation on the price of oil. This escalation rate is applied to a 1981 base price of $36.00 per barrel. These parameters result in a fuel cost for replacement energy of about $363 million during the proposed initial year of full operation of St. Lucie 2 (1984).[3]

The staff has evaluated the replacement energy cost of St. Lucie 2 and concludes that substantial dollar savings will be realized with its operation, despite the fact that the staff views the dollar savings reported by the applicant as being on the high side. First, production cost savings are computed by taking the difference in operating cost between the source of replacement energy and the nuclear unit. The applicant's analysis estimates the cost of replacement fuel but fails to deduct the savings in nuclear fuel resulting from that increased reliance on oil. Assuming a 1984 nuclear fuel cost of 10 mills/kwh the dollar savings should be about $50 million less than that estimated by the applicant. Second, given the operating experience with nuclear plants in general, the staff believes that the applicant's capacity factor assumption for St. Lucie 2 during its initial years of operation is optimistically high. If a lower capacity factor were assumed, on the order of 50% to 55%, the applicant's estimate would be reduced by about 25% to 30%. Taking both factors into consideration, the staff estimates fuel cost savings, during the initial year of operation of St. Lucie 2, on the order of $225 million.

A production-cost analysis should also include the differential in variable O&M costs between St. Lucie 2 and the units which would provide the replacement energy. However, these cost items are quite small in relation to the fuel-cost differential and would not alter the ultimate cost differential to any meaningful degree.

In addition, a decision to operate St. Lucie 2 will necessitate a decommissioning expense once the unit is retired from service. In Section 8.5 of the FES-CP, the staff discusses the different decommissioning methods available. For a large PWR unit (such as St. Lucie 2) the decommissioning cost is estimated to range from $21 million to $43 million (in 1978 dollars).[4]

In conclusion, savings associated with the operation of St. Lucie 2 are substantial although less than that estimated by the applicant. The results would not be significantly altered if the demand for electricity grows at a lower rate than assumed, because FP&L's marginal energy source would continue to be oil. Savings were only estimated for the initial year of operation; in actuality, fuel-cost savings would continue as long as St. Lucie 2 is capable of operating and the marginal cost of replacement energy exceeds that of St. Lucie 2.

The operation of St. Lucie 2 also will result in environmental impacts and risk. These have been evaluated by the staff, and the findings are presented in Chapters 4 and 5 of this report. These impacts are viewed as negligible to acceptable.

2.3 Diversity of Supply

It is to the advantage of a public utility to have diverse sources of power available. Any number of problems could arise regarding the availability of fuel to generate electricity. If imported oil were not available, if further limits were placed on the use of natural gas as a boiler fuel, or if shortages of enrichment facilities were to develop, too much reliance on one or two fuels, especially for baseload operation, could necessitate cutbacks in power to the power-supply grid. Currently, slightly more than 80 percent of FP&L's generating capacity comes from natural gas or oil.[5] With St. Lucie 2 in operation, FP&L would be better prepared to meet unexpected changes in the supply of these fossil fuels. The fact that operation of St. Lucie 2 will improve the diversity of fuel supply for the service area is further justification for operation of the facility.

2.4 Reliability of Analysis

FP&L's current official projections for its system call for average annual rates of increase of about 4.3 percent for peak-load demand and 3.6 percent for net-energy-for-area load for the period 1978 to 1988.[6]

Table 2.1 shows FP&L's reserve margins with and without St. Lucie 2 in operation for 1983 through 1988. The peak-load-responsibility values reported here reflect FP&L's official forecast for the summer system-maximum hourly load including interruptible loads. System capacity reflects summer ratings for all capacity owned by FP&L.

Table 2.1 FP&L's Projections of Summer Peak Loads, Capacity, and Reserves, 1983-1988*

		Capacity (MWe)		Reserve margin (%)	
	Peak load (MWe)	With St. Lucie 2	Without St. Lucie 2	With St. Lucie 2	Without St. Lucie 2
1983	10,715	13294	12547	24.1	17.1
1984	11,105	13294	12547	19.7	13.0
1985	11,495	13994	13247	21.7	15.2
1986	11,885	13994	13247	17.7	11.5
1987	12,275	14994	14247	22.2	16.1
1988	12,670	14994	14247	18.3	12.4

*Assumes St. Lucie 2 is available for operation by the summer of 1983.
Source: ER-OL Table 1.1-9.

For capacity expansion planning purposes, FP&L considers reserve margins of 20 to 25 percent an acceptable range to insure an adequate and reliable system for its customers.[7] This standard is consistent with the 15- to 25-percent reserve margin guideline of the Federal Energy Regulatory Commission. Thus, based on FP&L's current load forecast and capacity plans (as shown in Table 2.1), if St. Lucie 2 is not added within the proposed time frame, FP&L's reserve margins will be inadequate.

The staff concurs with FP&L's finding that St. Lucie 2 will probably be needed to maintain minimum-reliability levels. A state-level econometric forecasting model has been developed for NRC by the Oak Ridge National Laboratory (ORNL).[8] This model suggests that the growth in kWh sales in the State of Florida between 1980 and 1990 will approximate 5 percent per year. Assuming equivalency in the growth of electric energy sales and peak load growth (i.e., a constant system load factor) the staff's analysis results in higher projections of peak load demand and lower reserves than those estimated by the applicant. Thus, if a 20 to 25 percent reserve margin is needed for reliability purposes, the staff's analysis supports the need for this unit.

2.5 Conclusions

The results of the staff's assessment of purpose and need support a decision to issue the operating license for St. Lucie 2 in the time frame proposed by the applicant. The fact of overriding importance is that the timely addition of this unit on the FP&L's system is expected to result in significant savings in system production costs. Furthermore, the operation of this unit will decrease FP&L's dependence on fuel supplies of uncertain availability and will increase system reliability.

The operation of this unit will result in environmental costs and limited risk. However, these issues have been addressed in this statement, and the staff has found the costs and risk to range from negligible to acceptable. Moreover, if St. Lucie 2 does not operate, replacement energy will have to be generated. This increased use of other power generation facilities would have their associated environmental costs and risks. Finally, although decommissioning is identified as an incremental cost of operating St. Lucie 2, it should be noted that this cost represents less than 25 percent of the projected production-cost savings resulting from St. Lucie 2 operation for a single year.

2.6 References

1. Florida Power and Light Company, St. Lucie Plant Unit No. 2, Environmental Report Operating License Stage, Docket No. 50-389, 1980, (ER-OL), Response to NRC Question 4, Amendment 1, April 1981.

2. Ibid., Table 1.1-4.

3. Ibid., Response to NRC Question 9, Amendment 1, April 1981.

4. U.S. Nuclear Regulatory Commission, "Draft Environmental Impact Statement on Decommissioning of Nuclear Facilities," NUREG-0586, January 1981.

5. Op. Cit., ER-OL, Table 1.1-4.

6. Ibid., Table 1.1-9.

7. Ibid., Response to NRC Question 3, Amendment 1, April 1981.

8. U.S. Nuclear Regulatory Commission, "The ORNL State-Level Electricity Demand Forecasting Model," NUREG/CR-1295, July 1980.

3 ALTERNATIVES TO THE PROPOSED ACTION

3.1 Résumé

During the Construction Permit (CP) stage of the licensing process, the staff analyzed alternative sites, alternative plant designs, and alternative sources of generation, including the alternative of not adding new production capacity. The staff concluded based on its analysis of these alternatives, as well as on a cost benefit analysis, that additional capacity was needed, that nuclear would be an environmentally acceptable means of providing the capacity, and that St. Lucie 2, at a specified site, and of a specified design, was acceptable from an environmental perspective. Since that time the unit has been substantially constructed. The economic and environmental costs associated with the construction of the unit that have been incurred must be viewed as "sunk costs" in any prospective assessment.

3.2 Alternatives

Absent the discovery of a compelling safety or environmental concern which was not evident during the construction permit review, consideration of different sites, dramatic plant modifications, or the construction of new and different energy sources as alternatives to the existing nuclear facility is not warranted at the OL stage. No such compelling consideration has emerged.

The environmental costs associated with any of these alternatives which were considered and foreclosed at the CP review stage would now be prohibitive when compared to the incremental costs of operating the completed St. Lucie 2. These alternatives would require significant environmental and capital commitments, in addition to their costs of operation. Further, the delays caused by any proposed change in plans would necessitate an assessment of the cost of providing the energy that could have been produced by St. Lucie 2 versus the cost of energy from replacement energy sources during the delay period.

Therefore, it is the staff's view that at this time, the only alternative to operation of St. Lucie 2 is to deny its operation. Absent any significant environmental or safety objection, the decision is an economic one. If operation is denied, the most conservative assumption (i.e., least costly) is that existing capacity on the applicant's system is available to replace the energy that could have been provided by St. Lucie 2. If, under this scenario, it can be demonstrated that significant production cost savings are available from operation vis-a-vis non-operation, then the operating alternative is preferable. The staff has evaluated this cost differential in Section 2.2 of this statement and finds that savings on the order of $225 million would be realized during the proposed initial year of operation of St. Lucie 2. Comparable savings would be expected for subsequent years.

Thus, the only feasible alternative to operation has been evaluated, and operation of St. Lucie 2 has been determined to be the preferred alternative.

4 AFFECTED ENVIRONMENT

4.1 Résumé

The following sections provide a description of the facility and the related environment only with respect to those areas where additional information or changes have occurred since the FES-CP review.

4.2 Facility Description

4.2.1 External Appearance, Plant Layout, and Land Use

A general description of the external appearance, land use, and plant layout is provided in Chapters 2 and 3 of the FES-CP. Since the FES-CP was written, some minor changes have occurred in these areas. The terminal end of the discharge canal headwall has been extended to the south to handle the altered design of the discharge line for St. Lucie 2.[1] The discharge pipeline for Unit 2 has a 4.9-m (16-ft) inside diameter changed from the 3.7-m (12-ft) diameter pipeline described in the FES-CP. The original headwall was constructed to accommodate the 3.7-m (12-ft) pipe. A detailed description of the effects of these changes may be found in Section 4.2.4, Discharge System. Also, an additional plant access road was constructed over 61 m (200 feet) north of the discharge canal access on State Road A1A. A general plant layout is presented in Figure 4.1.

4.2.2 Plant Water Use

The sources of water for Unit 2 usage remain as described in the FES-CP. Potable water and water for other uses requiring low salinity is provided by the Fort Pierce Municipal Water Supply System. Cooling water is obtained from the Atlantic Ocean. There is an intake on Big Mud Creek to be used only for safe shutdown of the plant under emergency conditions. Estimates of water use rates within the plant have been revised but changes since the FES-CP review are small. Estimated average usage from the Fort Pierce water system is now 9.6ℓ/sec (152 gpm), reduced from 13.2 ℓ/sec (210 gpm) at the FES-CP review, and usage of ocean water is now estimated to be about 32.5 m^3/sec (520,000 gpm), an increase from 27.1 m^3/sec (430,000 gpm) at the FES-CP review.

4.2.3 Intake System

The circulating water ocean intake structures, installed during the construction of St. Lucie 1, have not been modified substantially since the St. Lucie 2 FES-CP review.

The emergency water intake structure, which the applicant has constructed, is different in design and operation from that evaluated in the FES-CP. The emergency water intake structure allows water to flow from Big Mud Creek, an arm of the Indian River, into the cooling intake canal. In the event that insufficient flow is available for the shutdown of the station, two 1.4 m (54 in) pipe/valve assemblies on the intake structure are opened and water is allowed to flow from Big Mud Creek to the intake canal. The flow rate into the intake canal is dependent on the head differential between the canal and the creek.[2]

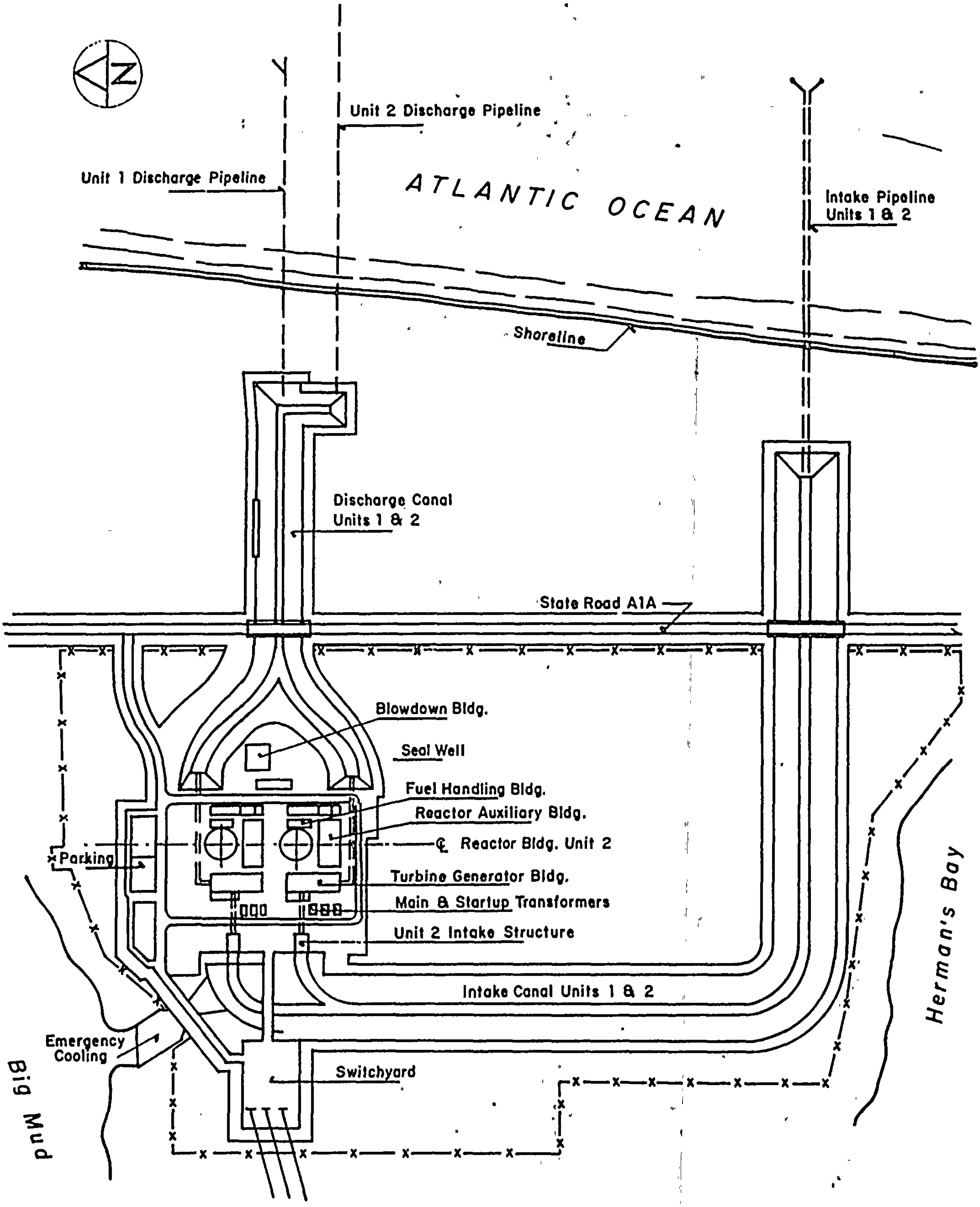

Figure 4.1 General Plant Layout

To assure that the emergency system remains operational, the system is tested semi-annually. The test consists of opening and closing each valve in each 1.4 m (54 in) diameter pipe for a period of less than one minute. Depending on the head differential between the canal and the creek, about 380 m^3 (100,000 gal) per valve per test would flow from Big Mud Creek to the intake canal. Yearly estimated flows due to testing from Big Mud Creek to the intake canal are estimated to be less than 1900 m^3 (500,000 gal).[2]

The FES-CP evaluated the water flow from the creek to the canal through pneumatic control plugs rather than remotely operated valves. Semi-annual testing of the earlier design that used nine pneumatic plugs would have resulted in the flow of approximately 15,000 m^3 ($4x10^6$ gal) of water from the creek into the canal.

The new design using the two 1.4 m (54 in) diameter pipes and remotely operated valves results in an approximately 8-fold reduction in the annual flow of water from the creek to the canal during reliability testing.

4.2.4 Discharge System

The St. Lucie discharge system is composed of a 671 m (2200 ft) long discharge canal that terminates at two headwall structures east of State Road A1A. Each headwall structure is connected to an ocean discharge pipeline. The discharge canal constructed prior to the operation of St. Lucie 1 has not been substantively modified since the preparation of the St. Lucie 2 FES-CP. However, the second headwall structure and discharge pipeline which the applicant is constructing for St. Lucie 2 operation is different from that evaluated in the FES-CP. The diameter has been increased, the spacing between adjacent ports has been increased, additional ports are provided, and the ports have been turned to discharge at an angle away from shore rather than parallel to shore.

To accommodate the redesigned St. Lucie 2 discharge pipeline a new pipeline headwall had to be constructed off the discharge canal. The headwall and associated enlargement of the discharge canal are located immediately to the south of the original and functioning pipeline (see Figure 4.2).

At the time of the FES-CP review the discharge pipeline designed to handle the additional canal flow from St. Lucie 2 operation was a 3.7 m (12 ft) diameter multiport diffuser line extending about 853 m (2800 ft) offshore with each of the 48 ports oriented to discharge horizontally. The partially constructed discharge pipeline, emanating from the newly constructed headwall, will extend from the headwall into the ocean about 1029 m (3375 ft). It has a 4.9 m (16 ft) inside diameter and is buried about 1.5 m (5 ft) below the ocean floor. The last 432 m (1416 ft) of the buried pipeline will be the diffuser section (See Figure 4.3).

The multiport diffuser consists of 58 ports, each port located 7.3 m (24 ft) between centers, is 40.6 cm (16 in) in diameter. Each port is mounted on a 4.3 m (14 ft) high riser with a 1.2 m (4 ft) inside diameter. To minimize plume interference as well as reentrainment in the intake, the ports are oriented in an offshore direction at a horizontal angle alternating 25 degrees left and right from the long axis of the diffuser. Therefore, ports discharging water to the same side of the diffuser are 14.6 m apart and direct the jet flow away

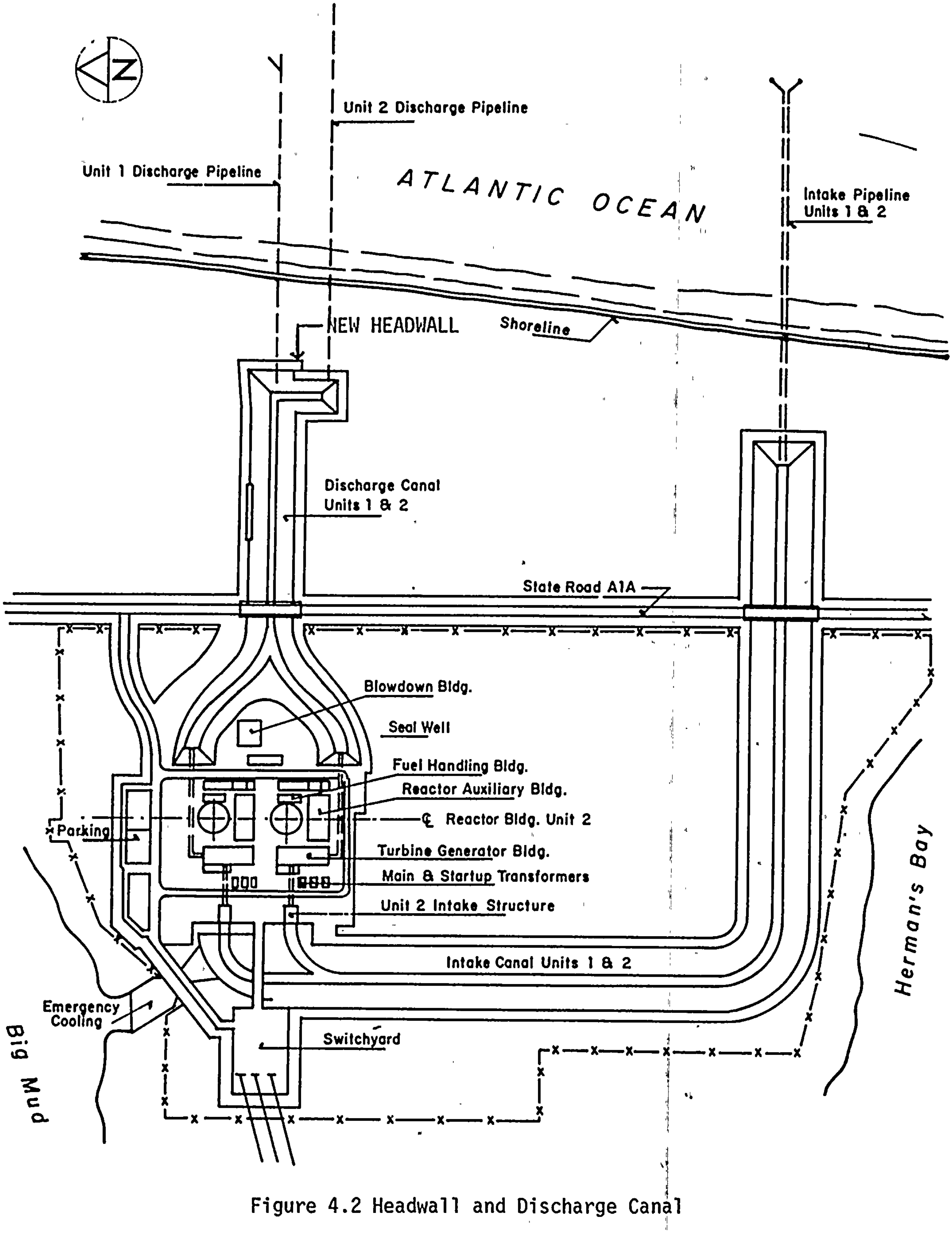

Figure 4.2 Headwall and Discharge Canal

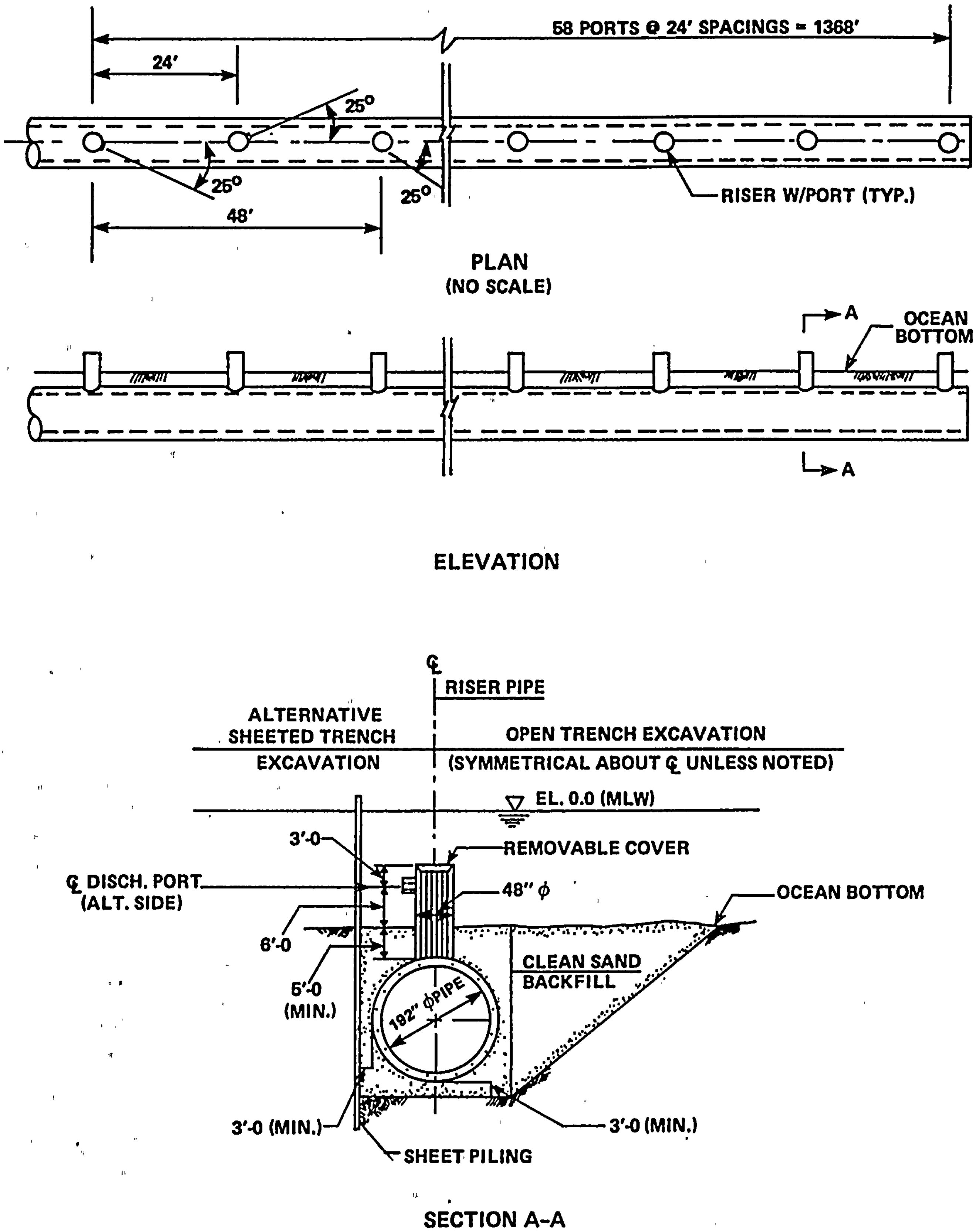

Figure 4.3 Discharge Pipeline Diffuser Section

from shore. Jet velocity of the discharge water at each port will average about 4 m/sec (13 ft/sec). The velocity of water inside the discharge pipeline will average about 1.7 m/sec (5.7 ft/sec).

To control fouling in the discharge pipeline the inside of each port riser is lined with an anti-fouling compound called bis-(n-tributyllin) oxide (TBTO) in a neoprene rubber base. This lining is 1.3 cm (0.5 inch) thick with a 5% concentration of TBTO. The anti-fouling property of this system is due to the continuous slow release of TBTO from the rubber. Estimates[3] of continuous release rates based on the total surface area of TBTO impregnated rubber. The release rate ranges from an initial rate of 0.24 lbs/day to an ultimate rate of 0.11 lbs/day. At a discharge flow rate of 32.5 m^3/sec (515,000 gpm) this corresponds to 0.039 ppb the first year of operation and to an average of 0.018 ppb during the later years of operation. TBTO is currently registered with the USEPA for use as an anti-foulant.

When either St. Lucie 1 or 2 is out of service the Y-port diffuser is to be closed and all flow will be diverted through the multi-port diffuser. With both units in service the relative distribution of flow between the two outfalls will vary with the Plant flow and perhaps with tidal and ocean current conditions. Nominally each discharge structure is designed for 33m^3/sec (1160 cfs) corresponding to the rated circulating plus intake cooling water flow of each unit.

4.2.5 Radioactive Waste Treatment System (NPDES 004*)

10 CFR 50.34a requires an applicant for a license to operate a nuclear power reactor to include a description of the design of equipment to be installed for keeping levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable (ALARA). The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology and the economics of improvement in relation to benefits to the public health and safety and other societal and socioeconomic considerations and in relation to the utilization of atomic energy in the public interest. Appendix I to 10 CFR Part 50 provides numerical guidance on design objectives for light-water-cooled nuclear power reactors to meet the requirements that radioactive materials in effluents released to unrestricted areas be kept as low as is reasonably achievable.

To meet the requirements of 10 CFR 50.34a, the applicant has provided final designs of radwaste systems and effluent control measures for keeping levels of radioactive materials in effluents to unrestricted areas within the design objectives of Appendix I to 10 CFR Part 50. The applicant has performed a cost-benefit analysis as required by Section II.D of Appendix I for St. Lucie 2, to show conformance with Appendix I to 10 CFR Part 50. The staff, however, elected to evaluate the final designs of radwaste systems and effluent control measures based on the requirements of the Annex to Appendix I, dated September 4, 1975, since (1) the applicant previously elected, on June 1, 1976, to show conformance with the Annex rather than a cost-benefit analysis for St. Lucie 1, which has operated since 1976; and (2) the evaluation of the system's ability to meet

*NPDES number refers to the outfall serial number designated in the draft NPDES Permit included in Appendix C.

the requirements of the Annex is more conservative than that of Section II.D of Appendix I. In addition, the applicant has provided an estimate of the quantity of each principal radionuclide expected to be released annually to unrestricted areas in liquid and gaseous effluents produced during normal operation, including anticipated operational occurrences.

The staff's detailed evaluation of the liquid and gaseous radwaste systems and the capability of these systems to meet the requirements of Appendix I will be presented in Chapter 11 of the safety evaluation report issued in October 1981. The quantities of radioactive material calculated by the staff to be released from the plant are presented in Section 5.10 of this environmental statement, along with the calculated doses to individuals and to the population that will result from these effluent quantities. The staff's evaluation concludes that the final designs of radwaste systems and effluent control measures are capable of meeting the design objectives of Appendix I to 10 CFR Part 50, such that radioactive materials in effluents released to unrestricted areas can be kept as low as reasonably achievable.

At the time of issuance of the operating license, the applicant will be required to submit technical specifications that will establish release rates for radioactive material in liquid and gaseous effluents. These specifications will also provide for the routine monitoring and measurement of all principal release points to assure that the facility operation is in conformance with the requirements of Appendix I to 10 CFR Part 50.

4.2.6 Cooling Water Discharge (NPDES 001 and 008)

Because the design of the cooling system discharge structure has been changed since the FES-CP, the potential for environmental impact has been reconsidered. Additionally, although the performance of the turbines and condensers have not necessarily changed, a wider range of conditions has been considered in assessing impact. This information provides the basis for the new review.

The Circulating Water System (CWS) which cools the condensers is designed for a calculated maximum heat rejection rate of 6.51×10^{12} J/hr (6.17×10^{9} Btu/hr). At this rate the maximum temperature rise of the circulating water through the condenser is about 14°C (25°F) at a circulating water flow of 30.9 m^3/sec (490,600 gpm).[4]

With one of the four St. Lucie 2 circulating water pumps out of use for servicing, cooling water flow would be reduced to a nominal rate of 24.9 m^3/sec (394,600 gpm) and the maximum condenser temperature rise would be about 17.2°C (31°F). Servicing will be scheduled to coincide with unit outage. However, the higher temperature condition is examined to determine impact during unplanned pump failure. With both nuclear units operating at capacity, failure of a single circulating pump would leave seven pumps in service with a Plant temperature rise of 15.6°C (28°F).

The Intake Cooling Water System (ICWS) for St. Lucie 2 uses ocean water at a flow rate of 1.8 m^3/sec (29,000 gpm), principally to cool equipment, and has an average temperature rise of about 10.6°C (19°F). When combined with the full water flow of St. Lucie 1 the total heat rejection rate is about 6.8×10^{12} J/hr (6.4×10^{9} Btu/hr) and the net temperature rise is 13.7°C (24.6°F) with all pumps operating.

Since the discharge canal will carry the combined St. Lucie 1 and 2 flows as well as the discharges from the Intake Cooling Water Systems, the temperature differential between the ocean intake and the ocean discharge will depend on the status of operation of both units.

To assure that impacts would be acceptable while operating with circulating pump outages and to assure compliance with State of Florida regulations governing temperature in the ocean near the power plant discharge during such conditions, FP&L looked at hypotheitcal worst case conditions for temperature studies. They examined the situations which would exist with all eight station CWS pumps operating with temperature rises of 15.6°C (28°F) and 17.8°C (32°F). The application to EPA in the NPDES Permit and the petition to the State for certification requested approval of continuous operation with a temperature rise of 16.7°C (30°F) and intermittent rises as high as 17.8°C (32°F).

4.2.7 Non-Radioactive Waste Discharge Systems (NPDES 001, 002, 003, 005, 006 007, and 008)

Since the FES-CP review, some changes have been made in plans for usage of chemicals. FP&L has described[5] the on-site hypochlorite generation system and associated waste streams and have given additional detail on usage of chemicals for Corrosion Control Systems.[5] The hypochlorite generation system will produce the sodium hypochlorite for condenser defouling. Although condenser defouling was discussed at the time of the FES-CP review, on-site generation of hypochlorite was not. Wastes from periodic cleaning of hypochlorite generator assemblies will be disposed of offsite by a licensed contractor. The draft NPDES permit limits the discharge of total residual oxidants (TRO), which would include total residual chlorine, to 0.1 mg/ℓ as an instantaneous maximum value (outfall serial numbers 001 and 008). FP&L has applied to EPA for authorization to chlorinate the auxiliary cooling water systems continuously. Discharge from these systems is regulated by NPDES 001 and 008. TRO must be maintained at concentration below 0.02 mg/l during periods when circulating water systems are being chlorinated.

Discharges of water treatment plant waste (demineralizer regeneration wastes, etc.) normally are directed to the evaporation/percolation ponds. However, on occasion, direct discharge to the intake canal from the neutralization basin (NPDES 002) may occur.

Immediately preceding St. Lucie 2 operations some of the components (including piping and various portions of the steam system) may be cleaned and/or flushed with alkaline detergents and/or acid cleaning solutions. These "metal cleaning" wastes will be discharged to the evaporation/percolation ponds or to the plant discharge canal (NPDES 003) after treatment.

Prior to completion of construction, dewatering wastes continue to be discharged (NPDES 005) to the intake or discharge canals or the evaporation/ percolation ponds.

Condensers are tubed with titanium, a highly corrosion-resistant metal, and have tube sheets fabricated of a copper alloy. Appearance of titanium in the cooling water will be almost non-existent and copper corrosion should produce a concentration of less than 0.02 μg/l.[6]

FP&L has installed an extended-aeration wastewater treatment plant to treat the sanitary wastes from both units. Chlorinated effluent (NPDES 006) will enter the cooling water intake canal where it will be further diluted. This is in lieu of the septic tank and tile field planned at the time of the FES-CP review. The new system avoids the potential problem of clogging of leaching fields identified in Section 3.7 of the FES-CP and should preclude the need for later tying into municipal treatment facilities.

Additions of hydrazine, cyclohexylamine, and phosphates for corrosion control will leave the system with steam generator blowdown (NPDES 007), which passes through filters and demineralizers prior to any discharge. Releases will be infrequent and at low concentration. Potassium chromate will be used in completely closed cooling systems. Only leakage from these closed systems will be directed to the evaporation/percolation ponds. The ER-OL includes additional data on planned chemical usage and on chemical and biocide waste discharges.[7]

No point source discharge to waters of the United States will occur from the evaporation/percolation ponds.

4.2.8 Power Transmission System

During construction of St. Lucie 1 the applicant installed a three-circuit, 240 kV transmission system which is capable of carrying the full output of St. Lucie 1 and 2 with one circuit as a spare. Therefore, there are no differences from the FES-CP.

4.3 Project Related Environmental Descriptions

4.3.1 Community Characteristics

The general socioeconomic characteristics of the region, including demography and land use, are described in Section 2.2 of the FES-CP. As that source indicates, the plant is located on 1132 acres in the middle of Hutchinson Island and is roughly equidistant from the cities of Fort Pierce and Stuart. The island is in both St. Lucie and Martin Counties. St. Lucie County covers approximately the northern two-thirds of the island with Martin County covering the remainder.

The entire area is experiencing great population growth which is expected to continue until a limit is met whether due to physical constraints such as traffic congestion and the availability of potable water or due to zoning restrictions. The projected growth has caused the Treasure Coast Planning Council to question the future availability of public facilities on the island.

With respect to zoning, Martin County is more restrictive in limiting the height of buildings and the density of residential units per acre than St. Lucie County. Martin County's area plan for Hutchinson Island restricts height to four stories and allows for a maximum of up to twelve units/a for planned unit developments. Because of a limit on the total number of units on the island in Martin County, the average density is about 7.5 units/a.[8] St. Lucie County has no height restrictions, allows up to 18 units/a but has primarily 5 and 11 unit/a density zones.[9]

Traffic congestion presents another possible constraint to population growth on the island. There are presently three bridges from the mainland to Hutchinson Island. One is in Fort Pierce while the Jensen Beach Bridge and Stuart Causeway are in the Martin County portion of the island. Because of the rapid growth on the island, especially in St. Lucie County and the resulting traffic flow to the mainland in Martin County, the Treasure Coast Planning Council is undertaking a traffic study of the three bridges and State Road A1A. State Road A1A is the only highway running the length of the island.[10]

The traffic study which is estimated to be completed by November, 1981 will be used to determine if a new development in St. Lucie County will warrant a Development Regional Impact Study. One of the possible results of the impact study could be a more restrictive density for that development.

Possible evacuation of the island due to an accident at the plant is a concern because of traffic congestion. Great concern also exists, however, because of evacuation due to hurricanes.[11]

The constraint to population growth due to the limited supply of potable water is discussed in the FES-CP Section 2.2. Since then, there have been plans to expand the water supply on Hutchinson Island. The Fort Pierce Utilities Authority (FPUA) plans to construct a 41 cm (16 in) water main to a point approximately 5.6 km (3.5 mi) south of St. Lucie 2. This water main is being installed to serve Island Dunes, a 572 unit high rise development which is scheduled for completion by 1988. The FPUA water main serving Island Dunes is in addition to the 30.5 cm (12 in) FPUA main already serving Hutchinson Island between St. Lucie 2 and the southern boundary of St. Lucie County.

Other plans to expand the water supply on Hutchinson Island involve the construction of deep wells to the Floridan Aquifer. These wells employ a desalinization process called "reverse osmosis". They are being constructed by developers not served by public water supplies. On Hutchinson Island, all planned developments, except for Island Dunes and those projects within the City of Fort Pierce, will be providing their own potable water with the reverse osmosis process. As a result, desalinization by this process means potable water will be less of a constraint to the island's development than previously thought. This desalinization process is encouraged by the South Florida Water Management District.[12]

The population growth in the five mile area around the Plant was much greater than previously anticipated. The FES-CP (Section 2.2) projected a 1980 population within 8 km (5 mi) of the Plant of 1620. FP&L now estimates the 1981 population of that area to be 10,336.[13] The resident population within 8 km (5 mi) of the Plant is estimated to reach 94,180 in the year 2030.

This growth is reflected in Tables 4.1 and 4.2 which list new developments within 8 km (5 mi) of St. Lucie 2 for the periods 1978 through May of 1981 and 1981 through 1990.

This area is also growing at a rate greater than anticipated beyond the 8 km (5 mi) radius. The 80 km (50 mi) radius around the plant contained 573,048 people in 1981. The estimated populations for 2000 and 2030 are 1,006,452 and 1,710,139 respectively. The FES-CP projected a 2000 population of over 470,000 only.

TABLE 4.1

NEW DEVELOPMENTS WITHIN 8 km (5 mi) OF ST. LUCIE 2
BETWEEN 1978-1981 (AS OF MAY, 1981)

On Hutchinson Island:	Location by Annular Sector	Total Number of Units	Completion Date
Sand Dollar Villas	SE 1-2 SSE 1-2	203	1981
Ocean Towers	SSE 4-5	158	1981
Island Village	SSE 4-5	32	1981
Sheraton Condo (Formerly Sheraton Motel)	SSE 4-5	84	1978
Oceana	SSE 4-5	286	1981
Mainland:			
Golf Village	SW 3-4 4-5	617	1980
Midport	SSW 4-5 SW 4-5	375	1981

Source: ER-OL, Response to NRC Question 310.8.

TABLE 4.2

FUTURE DEVELOPMENT WITHIN 8 km (5 mi) OF ST. LUCIE 2,
1981 to FUTURE

On Hutchinson Island:	Location by Annular Sector	Total Number of Units	Completion Date
Sand Dollar Villas	SE 1-2 and SSE 1-2	162 144	1983 1986
Island Dunes	SSE 3-4	108 540	1982 1987 or 1988
Island Village	SSE 4-5	102	1982
Islandia	SSE 4-5	388 184	1983 1986
Mainland:			
Saddle Club	WNW 4-5 NW 4-5	700 (Note: only 413 units are estimated to be in the five mile area.)	1985
The Grove	W 4-5	576	Before 1990
Savannah Club	SW 2-3 SW 3-4 SW 4-5 WSW 2-3 WSW 3-4 WSW 4-5	2560	Before 1990
Midport (Part of Port St. Lucie)	SSW 3-4	426	End of 1981
	SSW 4-5	380	1983
	SW 3-4 SW 4-5	976	1990

Source: ER-OL, Response to NRC Question 310.8

The entire area is a popular one for tourists and seasonal visitors. The applicant has estimated the number of tourists and seasonal visitors to the area using data from the State of Florida Division of Tourism. The applicant made projections through 1985 using a year's growth rate of 8% based upon a 1977 to 1978 comparison. The State had done the same. The applicant then used the annual growth rate from the year 1970-1978, 2.1%, to project for 1985 to 2030.[14] The staff feels that a projected growth rate based upon more than one year's worth of data would have better served the purpose for the projections through 1985. The State has since revised their projections through 1985 to about a 5% growth rate.[15]

For the five mile area around the Plant, the applicant estimates a peak daily tourist and seasonal visitor total of 4412 for 1981 and a projection of 40,259 for the year 2030. The 48 km (30 mi) totals are 54,680 and 196,758 for the same years.[13]

The population growth in the area has greatly exceeded the projections of the FES-CP. This growth does not show any signs of slackening until one of the previously mentioned constraints is met.

4.3.2 Water Quality

The FES-CP review was based on about two years of water quality studies in the immediate site vicinity. FP&L has continued to collect water quality data in conjunction with St. Lucie 1 operation. These St. Lucie 1 studies provide additional data on temperature and nutrient content.

The basic understanding of coastal water quality remains as described at the FES-CP review. With the longer period covered by the availability of local data, the ranges of values of most parameters have been extended. For example, at the time of the FES-CP review data showed the range of ocean surface temperature near the site to be 15°C to 30°C (59°F to 86°F). The longer sampling interval shows the range to be 15°C to 32°C (59°F to 90°F).

Nutrient levels during the post FES-CP sampling period remained low and within the range expected. The "seasonal" peak in phosphorous reported in the FES-CP review has not recurred. The peak had been attributed to upwelling of the nutrient rich water from greater depths. Temporal variations in the subsequent data have been attributed to tidal exchange with the richer Indian River estuary.

Dissolved oxygen levels continue to be low in mid summer although values in recent years did not drop for extended periods to the 1972 low discussed in Section 2.5 of the FES-CP.

4.3.3 Surface Water Hydrology

The surface water descriptions presented in Section 2.5 of the FES-CP are still valid. Bathymetric and tidal data have been collected subsequent to the FES-CP. In addition, Section 5.3.3 contains a discussion of the hydrologic effect of alterations in the floodplain as required by Executive Order 11988 - Floodplain Management.

The St. Lucie site, located on Hutchinson Island, is bordered on the east by the Atlantic Ocean which will be used for waste heat dissipation. The Atlantic Ocean will also receive treated liquid effluents during normal plant operation. Hutchinson Island is separated from the mainland by the Indian River, a shallow, tidally influenced lagoon. To the north of the site lies Big Mud Creek, an inlet off the Indian River. Big Mud Creek is not a flowing stream but does receive surface and subsurface runoff resulting from precipitation on Hutchinson Island. Big Mud Creek serves as a source of emergency cooling water for both St. Lucie 1 and 2. Average annual precipitation at the site is 157 cms (62 in.). Surface runoff, however, is very small at the site because of high soil permeability and evapotranspiration. There are no freshwater streams in the vicinity of the site.

The nearshore bottom of the Atlantic Ocean off the site slopes at a one on 80 gradient to about -10.7 m (-35 ft) MLW. The ocean bottom maintains this depth for about 800 m (0.5 m) before rising to Pierce Shoal at about -6.4 m (-21 ft) MLW. A slight trough 8 km (5 mi) wide and approximately 15 m (50 ft) deep separates Pierce Shoal from the northward extension of St. Lucie Shoal. The ocean bottom then slopes at a gradient of approximately one in 600 for 19 km (12 mi) across the continental shelf, to a depth of 36 m (120 ft). The slope then increases, resulting in a depth of 183 m (600 ft) approximately 29 km (18 mi) east of the Plant site.

A tide monitoring program undertaken by the applicant from May 1976 to May 1977 showed a mean tidal range of 1 m (3.28 ft). This compares favorably with mean tidal ranges determined from established tide gauges at Miami 0.76 m (2.3 ft), Palm Beach 0.85 m (2.6 ft), and Vero Beach 1.04 m (3.1 ft).

Currents in the nearshore region of the site are affected primarily by winds and tides. The Florida Current, a part of the Gulf stream system, is found farther offshore, beyond the 91 m (300 ft) contour. Ocean currents near the St. Lucie 1 discharge were measured by Continental Shelf Associates (CSA), Tequesta, Florida, from November 1973 through May 1975. Average current speed was found to be 22.5 cm/s (0.74 ft/sec) near the surface and 1.64 cm/s (0.54 ft/sec) near the bottom. The prevailing surface current direction is alongshore from the north and occurs about 49% of the time. FLow from the south occurs about 23% of the time. Current speeds were found to range from near zero to 48.8 cm/s (1.6 ft/s). Frequency distributions by month for surface and bottom current directions and speed are provided in the applicant's ER-OL.[16]

Sea water temperatures on the Atlantic Ocean offshore of the site were found to range from about 15°C (59°F) to 32°C (90°F) between 1971 and 1978. The mean temperature for all stations and depths monitored during the period was 25°C (77°F). The average salinity of the Atlantic Ocean off Hutchinson Island is about 35.5 parts per thousand (ppt). A range of 33.0 ppt to 38.5 ppt has been reported with most values between 34.0 ppt and 36.0 ppt. Salinity is generally lowest during fall and winter and increases to a maximum during the summer.

4.3.4 <u>Groundwater Hydrology</u>

Underlying the one to two meters (3 to 6 ft) of surface organic material on Hutchinson Island is the Anastasia Formation. The Anastasia Formation is an unconfined water table aquifer consisting of grey slightly silty fine to medium sand with varying amounts of fragmented shells. The Anastasia Formation extends to a depth of about -41 m (-135 ft) MSL to -47 m (-155 ft) MSL. Below the Anastasia Formation lies the Hawthorne formation. The upper 30 meters of the Hawthorne formation at the site consists of a slightly clayey and silty very fine sand. Below this zone and extending to about -122 m (-400 ft) MSL are sandy clayey silts which form an aquiclude for the underlying Floridian artesian aquifer. The Floridian aquifer, which lies about 210 m below the land surface in St. Lucie County, underlies all of Florida and southern Georgia. The Floridian aquifer is a highly porous limestone formation with an estimated artesian head at the site of 10.7 m (35 ft) MSL. The thickness of the Floridian aquifer at the site is unknown; however, artesian wells up to about 370 m in depth have been drilled in St. Lucie County.

The groundwater table at the site occurs near or at the natural ground surface and reflects tidal variations near the Atlantic shore. Field and laboratory tests show the permeability of the near surface material to be between 10^{-2} to 10^{-5} cm/s.

4.3.5 <u>Water Use</u>

There are no potable water intakes in surface water bodies that potentially may be affected by the plant. Recreational uses of the Atlantic Ocean within 80 km (50 mi) of the St. Lucie Plant include beach activities, saltwater fishing, boating and surfing. The present and projected future participation rates of recreational water use are provided in the applicant's ER-OL.

A well survey conducted by the applicant for issuance of the Construction Permit indicated that there were no potable water wells on Hutchinson Island. An October 1979 survey conducted by the applicant indicated that there are now two wells located approximately 9 km (5-1/2 mi) south of the plant on State Road A1A presently being used as a source of potable drinking water. The survey also determined that condominium developments were planned in an area extending from 1.5 to 6.5 km south of the site. The applicant has indicated that these developments may drill deep wells and use a reverse osmosis system for water supply.

4.3.6 <u>Meteorology and Air Quality</u>

The discussion of the general climatology of the site and vicinity contained in the FES-CP remains unchanged. Climatological statistics for average temperature and precipitation in the area have changed only slightly since issuance of the FES-CP. However, information about the frequencies of thunderstorms, tornadoes, waterspouts, and hurricanes has changed. A recent study by the National Climatic Center[17] indicates that about 100 thunderstorms occur each year in the vicinity of the St. Lucie site. Tornadoes in Florida are most likely in spring and summer. The applicant has examined tornado occurrences in the area for several different periods of record and concluded that the number of reported tornadoes in Florida is highest for the period 1968-1980, almost double the average reported for the period 1955-1967. Using the higher frequency of tornado occurrences, the applicant has computed a recurrence interval of 275 years for a tornado at the Plant site. Waterspouts are quite common along the east coast of Florida, with 196 waterspouts reported within 40 km (25 mi) of the shore along 332 km (200 mi) of the coast centered at St. Lucie in the period 1952-1980. Tropical cyclones (classified as tropical depressions, tropical storms, and hurricanes) affect the Florida penninsula on the average of about once per year. The applicant has determined that 95 tropical cyclones (16 tropical depressions, 40 tropical storms, and 39 hurricanes) have affected the Florida penninsula within 161 km (100 mi) of the St. Lucie site in the period 1899-1980. Tropical cyclones are most likely in August, September, and October.

Since issuance of the FES-CP, several additional years of onsite meteorological data have been collected at the plant site. However, the onsite meteorological measurements program has also changed since issuance of the FES-CP. The best available period of record for onsite meteorological data at this time is January 1977 - December 1978. Prevailing winds at St. Lucie are southeasterly, with winds from the east-southeast, southeast, and south-southeast occurring between 25% and 30% of the time at the site; however, from November through February, northwesterly winds prevail. The average wind speed at St. Lucie is about 3.1 m/s (7 mph). Calm conditions occur about 0.5% of the time. Neutral (Pasquill type "D") and slightly stable (Pasquill type "E") conditions, as defined by vertical temperature gradient, occur between two-thirds and three-quarters of the time. Moderately stable (Pasquill type "F") and extremely stable (Pasquill type "G") conditions occur relatively infrequently, totalling only about 5% for the period January 1977 - December 1978.

As indicated above, several changes have been made to the preoperational onsite meteorological measurements program described in Section 6.1.3 of the FES-CP. The current meteorological program consists of a 60.6m (199 ft) tower located about 730m (2400 ft) north of the reactor complex, with the following measurements: wind speed and wind direction at the 10m (32.8 ft) and 57.9m (190 ft) levels; temperature gradient between the 10m and 57.9m levels and between the 10m and 33.5m (110 ft) levels; drybulb temperature at 10m, 33.5m, and 57.9m; and dewpoint temperature at the 10m level. Precipitation is measured by a tipping bucket rain gauge located near the tower. The wind speed and direction sensors have been upgraded since issuance of the FES-CP to conform to the guidance of Regulatory Guide 1.23 with respect to starting thresholds. The entire onsite meteorological measurement program now conforms to the guidance of Regulatory Guide 1.23. The operational phase of the onsite meteorological measurements program will be essentially the same as the current program.

4.3.7 Terrestrial Ecology

4.3.7.1 General

The only change occurring since the FES-CP is the elimination of approximately three acres of vegetation, primarily red mangrove and less that one acre of saw palmetto and Australian pine at the eastern end of the discharge canal. This action is necessary for the construction of a second headwall and second discharge pipeline which will form part of the St. Lucie 2 once-through cooling system. While this construction involves excavating through the dune appropriate precautions will be taken to restrict activity to less than 30 m (100 ft) in width. Once the structures are in place the dune will be restored to its original contour and revegetated with native dune - stabilizing species. Therefore, this activity will have limited effect for a short period of time on the terrestrial ecology of the site.

4.3.7.2 Prime Agricultural Land

There is no prime or unique agricultural land onsite.

4.3.8 Aquatic Ecology

4.3.8.1 Indian River and Big Mud Creek

Indian River is a shallow bay lying to the west of Hutchinson Island. It is approximately 2.4 km (1.5 mi) wide in the vicinity of the station. Big Mud Creek was a shallow (less than 1 m (3 ft) deep) arm of Indian River that extends nearly across Hutchinson Island immediately north of the Plant and serves as the source of emergency cooling water. The creek was dredged for barge access and fill material during station construction. Between Herman Bay Point and State Road A1A the creek was dredged to a depth of approximately minus 14 m (45 ft) MLW.[2] A channel connecting Big Mud Creek and the Intracoastal Waterway in Indian River was dredged to minus 3.7 m (12 ft) MLW.

The FES-CP briefly discusses the biological characteristics of Indian River and Big Mud Creek. Since issuance of the FES-CP additional information characterizing these two waterbodies has been collected.[2,18,19,20,21]

Gilmore[21] provided a qualitative analysis of the ichthyofauna of the southern portion of the Indian River Lagoon and described it as exceptionally speciose and probably the most diverse estuarine fish fauna in North America with over 300 species known. During the 1974-75 study over 1 million fish were captured in monthly seine hauls at seven stations in Indian River Lagoon (a total of 16 collections). Approximately 50% of all species of fish were captured from Big Mud Creek, one of the seven stations. About 46% of the fish were taken from Big Mud Creek were from species of commercial or recreational value. The Big Mud Creek sampling station had a sea grass bed at the eastern end of Big Mud Creek near State Road A1A crossing. The large populations encountered by Gilmore[18] probably was due to the scarcity of other sea grass beds in Big Mud Creek since the dredging of the waterbody during station construction. Chlorophyll, phytoplankton, and zooplankton sampling indicated that this sampling station was not exceptionally productive even though there was a great abundance of planktivorous fishes. Gilmore[18] surmises that since more of Big Mud Creek has been dredged to depths below 10 m (33 ft) only a single shallow sea-grass bed is presently available for schooling planktivorous fishes to avoid predators during diurnal periods. During nocturnal periods these fishes graze on zooplankters found in the deeper open waters of the creek.

Poolt[20] commented on the diversity of crustaceans collected from the Indian River at Big Mud Creek. A total of 24 species of decapod and 1 species of stomatopod crustaceans were collected during a 1972-74 survey.

4.3.8.2 Atlantic Ocean

The FES-CP describes the various communities inhabiting the Atlantic Ocean immediately offshore of the St. Lucie Plant. This description is based on data available prior to St. Lucie 1 startup in 1976. As part of the operating license for St. Lucie 1 the applicant has conducted a biological monitoring program, begun in December 1975, which included sampling offshore in the vicinity of the Plant. The results of this monitoring program are summarized yearly and presented in the annual non-radiological environmental monitoring reports, the most recent is for calendar year 1980.[22] In 1980 offshore sampling was conducted for aquatic macrophytes, zooplankton, phytoplankton, macroinvertebrates, fish, and shellfish.

4.3.8.2.1 Benthic Macrophytes

The occurrence of benthic macrophytes in the vicinity of the Plant is limited principally by the lack of suitable substrate for macrophyte attachment. Benthic macrophytes are generally fragments of small specimens attached to shell and rock. Algal diversity and abundance at six sampling stations increases in the summer and autumn. This increase is primarily caused by drift algae although the number of attached species also increases. Drift algae tends to accumulate at the discharge and control stations both with sand bottoms and inshore. These two stations had the highest species diversity. Attached algae were dominant at the remaining more offshore stations where the shell and shell fragment bottom offered some surface area for algal attachment. No effect of St. Lucie 1 operation to the benthic macrophyte community was observed.

4.3.8.2.2 Phytoplankton

Seasonal variation of phytoplankton density and chlorophyll α offshore of the Plant over the past five years was generally bimodal with peaks in the fall and early spring. Generally densities in the intake and discharge canals and at the offshore discharge and control stations were generally higher than at the remaining four offshore stations. The discharge and control stations are the most inshore of the six offshore stations. The only probable offshore impact of Plant operation is phytoplankton enrichment at the discharge station; however, high densities of organisms and chlorophyll α at the control station may indicate that a nearshore influence rather than plant operation may be responsible for the higher phytoplankton standing crop.

4.3.8.2.3 Zooplankton

Peak zooplankton densities occurred generally during the summer months, with variable winter and spring production periods. Densities between stations were highly variable. A comparison of baseline and St. Lucie 1 operational studies showed no discernible trends. Mean zooplankton densities and biomass were generally higher at the discharge sampling station than at other offshore stations. This higher number of organisms is probably related to nearshore influences rather than Plant operation. No effect of St. Lucie 1 operation, other than possible zooplankton enrichment due to a higher phytoplankton standing crop was observed.

4.3.8.2.4 Benthic Macroinvertebrates

Benthic data have been collected from five to six permanent offshore stations during the preceeding 5 years. Sediment composition at the discharge station has remained essentially unchanged since prior to St. Lucie 1 startup. Benthic grab data typically show extensive seasonal variation. Within the last two years both the discharge and the southern control station have experienced increases in molluscs and echinoderm. Recently increases occurred in the number of taxa and number of individuals collected between 1979 and 1980. These increases tended to counteract the decreases noted between 1978 and 1979. All observed fluctuations are attributed to long-term variability of the community and are probably not attributable to St. Lucie 1 operation.

4.3.8.2.5 Fish and Shellfish

In 1980 sampling of fish and shellfish was conducted using gill nets, trawling and beach seines. Five years of gillnetting and trawling in the Atlantic immediately offshore of the station established that greater numbers (~65% of the total catch) of fish captured were from the discharge and control stations. These two stations were the most inshore of the six stations sampled. This difference was attributed to the highly motile schooling nature of several of the species and the inshore preference of forage species. The bottom relief, warmer water and turbulence associated with the St. Lucie 1 discharge may also attract forage fish and their predators.

Beach seining established that the largest percentage of the total catch was found north of the Plant.

Ichthyoplankton was generally abundant during the spring and summer of each year. The most common larval fishes were herrings and anchovies. Differences in ichthyoplankton densities between the various offshore stations was attributed to natural year-to-year and seasonal variations rather than Plant operation.

4.3.9 Threatened and Endangered Species

Five species of marine turtles, Federally listed as threatened or endangered are known to be at the site (see Section 5.7). All five species have been taken from the intake canal (see Section 5.6.1). Three species have been taken from the intake. Three species are known to nest on the beaches of Hutchinson Island. Based on information presented by NMFS, Hutchinson Island may be one of the largest marine turtle rookeries in the U.S.[23] Censusing marine turtle nesting on the beaches of Hutchinson Island was conducted in 1971[24], 1973[25], 1975, 1977, and 1979.[26,27]

The total estimated number of loggerhead nests on Hutchinson Island ranged from 2872 in 1977 to 4813 in 1975.[28] Since 1973 there has been an overall increase in the ratio of unsuccessful to successful loggerhead nesting crawls in which eggs are deposited.[27]

Compared to loggerhead turtles, green turtle nesting is uncommon on Hutchinson Island. The number of nests observed in the beach nesting survey ranged from five in 1977 to 43 in 1975.[27] Assuming a two to three year breeding interval of 8-15 female green turtles nesting on Hutchinson Island, this represents a major portion of the Florida population of nesting adults.

Leatherback turtles nest only incidently in Florida. The Hutchinson Island surveys have identified no more than six nests per year.

The ER-OL[29] confirms that the Brown pelican (Pelecanus occidentalis) is a common permanent resident and that Bald eagles (Haliaeetus leucocephalus) are occasionally seen during the fall, winter and spring on Hutchinson Island. Neither species was seen onsite during the staff's site visit February 17 and 18, 1981. Brown pelicans were seen about 10 miles south of the site on Hutchinson Island.

The ER-OL stage also lists the Pergrine falcon (<u>Falco peregrinus</u>) as an occasional visitor during fall, winter and spring.[30]

The Florida Game and Fresh Water Fish Commission lists both the Brown pelican and Bald eagle as threatened and list the Peregrine falcon as endangered. In addition, they list the Wood Stork (<u>Mycteria americana</u>) as endangered and the following species as "species of special concern":

Little blue heron (<u>Florida caerulea</u>)
Snowy egret (<u>Egretta thula</u>)
Reddish egret (<u>Dichromanassa rufescens</u>)
Louisiana heron (<u>Hydranassa tricolor</u>)

All five species have been observed on Hutchinson Island[30] and they all nest in mangroves.

Florida also has a Preservation of Native Flora Act. A number of species listed in this act grow on the St. Lucie Plant site. However, the Act is only concerned with removal of terrestrial plants.

4.3.10 Historical and Archeological Sites

There has been no change in the description of the historic and archeological sites discussed in Section 2.3 of the FES-CP.

4.4 References

1. Op. Cit., ER-OL, Section 3.4.2.3.

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3. Uhrig, Robert E. 1981. Letter to Darrell G. Eisenhut, U.S. Nuclear Regulatory Commission, Washington, D.C., from Robert E. Uhrig, Florida Power and Light Company, Miami, FL, August 11, 1981.

4. Op. Cit., ER-OL, page 3.4-1.

5. Ibid., page 3.6-1.

6. Ibid., page 3.6-4.

7. Ibid., Tables 3.6-2 and 5.6-1.

8. Personal Communication, Martin County Planning Department, Stuart, Florida, February and May, 1981.

9. Personal Communication, St. Lucie County Planning Department Board, Fort Pierce, Florida, February, 1981.

10. Personal Communication, Treasure Coast Planning Council, Stuart, Florida, May 1981.

11. Ibid., February 1981.

12. Op. Cit., ER-OL, Response to NRC Question 310.7.

13. Ibid., Response to NRC Question 310.8.

14. Ibid., Response to NRC Question 310.10.

15. State of Florida, 1979 Florida Tourist Study, Division of Tourism, Tallahassee, Florida, 1980.

16. Op. Cit., ER-OL, Table 2.4.1 thru 2.4.4.

17. M. J. Changery, "National Thunderstorm Frequencies for the Contiguous United States." To be published as NUREG/CR-2252.

18. Gilmore, R. Grant, Jr., 1981. Letter to Michael T. Masnik, U.S. Nuclear Regulatory Commission, Washington, D.C., from R. Grant Gilmore, Harbor Branch Foundation, Inc., Fort Pierce, FL, dated February 26, 1981.

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22. Florida Power and Light Company. 1981. Annual Non-Radiological Environmental Monitoring Report 1980. Vol. 1-2, prepared by Applied Biology, Inc., Atlanta, GA.

23. National Marine Fisheries Service, 1976, "Listing and protecting green sea turtle (Chelonia mydas), loggerhead sea turtle (Caretta caretta), Pacific ridley sea turtle (Lepidochelys olivacea) as threatened species under the Endangered Species Act of 1973," FEIS, NMFS, Dept. of Commerce, Washington, D.C., 114 pp.

24. Gallagher, Robert M., et al., 1972, "Marine turtle nesting on Hutchinson Island, Florida, in 1971," Fla. Dept. of Nat. Res., Sp. Sci. Rpt. No. 37.

25. Worth, Dewey F. and Jonathan B. Smith, 1976, "Marine turtle nesting on Hutchinson Island, Florida, in 1973, Fla. Dept. of Nat. Res., Mar. Sci. Lab., Fla. Mar. Res. Pub. No. 18.

26. Florida Power and Light Company, 1978, "Ecological Monitoring at the Florida Power and Light Company., St. Lucie Plant - Annual Report 1977, Vol. 1, prepard by Applied Biology, Inc., Atlanta, GA.

27. Florida Power and Light Company. 1980. "Annual Non-Radiological Environmental Monitoring Report, 1979, Vol. 1-3," prepared by Applied Biology, Inc., Atlanta, GA.

28. Op. Cit., ER-OL.

29. Ibid., ER-OL, Table 2.2-7.

30. Ibid., ER-OL, Table 2.2-6.

5 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

5.1 Résumé

The following sections discuss and evaluate the environmental consequences and mitigating actions for those areas where additional information or changes have occurred since the FES-CP review. Where there is no new information or change, no discussion is provided.

Operational monitoring programs are to be conducted in accordance with the Environmental Protection Plan (EPP) to be issued as a part of the Operating License by the NRC. The EPP will require the applicants, as licensees, to (1) notify the NRC if changes in station design or operation occur or if tests or experiments affecting the environment are performed, providing that such changes, tests, or experiments involve an unreviewed environmental question; (2) maintan specific environmentally related records; (3) report violations of, and reports arising from, the NPDES permit or State certification pursuant to Section 401 of the Clean Water Act; and (4) report unusual or important environmental events.

5.2 Land-Use Impacts

Section 5.1 of the FES-CP explains that these impacts occurred with the installation and operation of St. Lucie 1. There are no significant land-use impacts associated with the operation of St. Lucie 2.

5.3 Water Use and Hydrological Impacts

5.3.1 Surface Water Use

The average estimated water use by St. Lucie 2 is 32.74×10^6 l/s (1158 cfs) and the maximum estimated water use is 33.33×10^6 l/s (1177 cfs). Almost all of this water will be withdrawn from the Atlantic Ocean and will be used for the circulating water system and the intake cooling water system after which it will be returned to the Atlantic Ocean through the discharge canal. An average of 9.6 l/s (152 gpm) of fresh water will be supplied by the Fort Pierce Municipal Water Supply System and will be used for the water treatment system, potable and sanitary water system, and other miscellaneous uses. Most of this water will be ultimately discharged to the Atlantic Ocean after treatment.

In that the St. Lucie 2 withdraws its major water requirement from the Atlantic Ocean and discharges waste heat and treated effluents into the same water body, there are no potable water supplies that can be affected by the operation of St. Lucie 2. The amount of water supplied by the Fort Pierce Municipal Water Supply System is too small to have any significant impact on water availability in the site area throughout the operating life of the plant.

Use of ocean water at St. Lucie 2 will not preempt other water uses by man.

5.3.2 Groundwater Use

There will be no groundwater used by St. Lucie 2 during operation or any discharge of effluents into the groundwater environment.

5.3.3 Floodplain Aspects of the Site

Development of the St. Lucie site was essentially completed before St. Lucie 1 became operational in 1976. Executive Order 11988, Floodplain Management, was signed in May 1977. It is, therefore, our conclusion that consideration of alternative locations for those structures located on the preconstruction 100 year floodplain is neither required nor practicable.

Hutchinson Island, where the St. Lucie Plant is sited, is a coastal barrier island fronting the Atlantic Ocean between Stuart and Fort Pierce, Florida. It is separated from the Florida mainland by a tidal lagoon, the Indian River. The 37 km (23 mi) long island is bounded to the north by Fort Pierce Inlet and to the south by St. Lucie Inlet. On the Atlantic side of the island the beach front is backed by a barrier dune which extends between the two inlets. The preconstruction elevation of the site area varied between elevation 0.6 and 1.6 m (2 and 5 ft.) MSL.

The 100-year preconstruction flood level established by the Federal Insurance Administration (FIA) in a preliminary study is 2.1 m (7 ft) MSL for both the Indian River and the Atlantic Ocean. The seismic Category I landfill upon which the Plant island is located is at least 4.9 m (16 ft) above mean sea level. Plant grade for St. Lucie 2 is established at about 5.2 m (17 ft) MSL which is above the level of the Probable Maximum Hurricane Surge (a more extreme event than the 100-year flood). The location of the plant relative to the 100-year floodplain is shown in Figure 5.1.

The applicant estimated the impact on the 100-year flood level in the Indian River due to St. Lucie 2 construction by assuming that the rise in water level in the Indian River during the flood would be equal to the volume of the flood displaced by the construction landfill. This rise was determined to be 3.7 cm (1.5 in). The hydrological impact is, therefore, considered to be negligible.

5.4 Air Quality Impacts

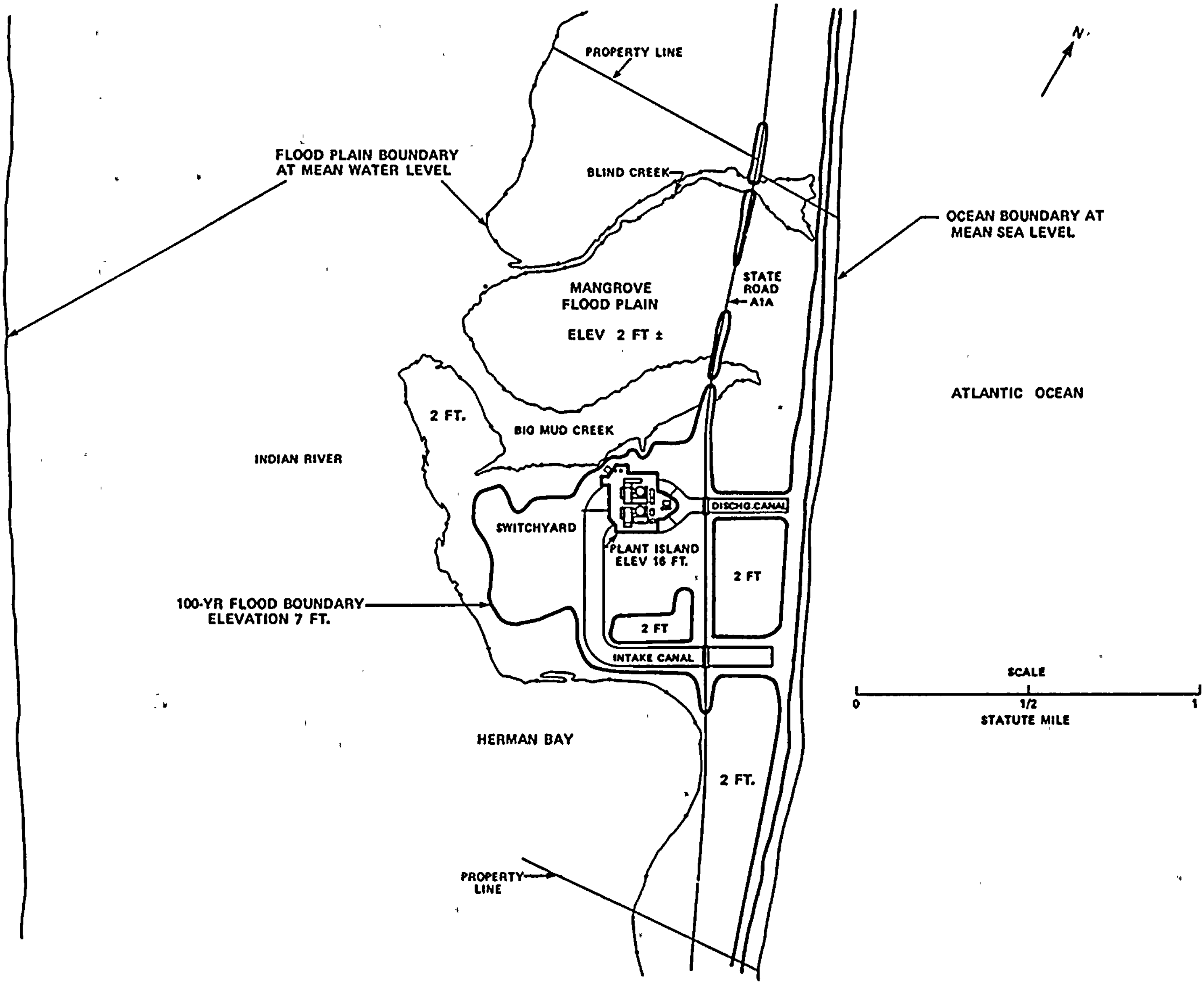
As stated in Section 5.7 of the FES-CP, nonradioactive atmospheric pollutants (such as those indicated in Table 3.6 of the FES-CP) produced by operation of the diesel generators for emergency power should not have a significant impact on air quality in the vicinity of the plant.

5.5 Terrestrial Ecology Impacts

Throughout the construction of St. Lucie 2 the architect engineer contractor has had an environmental engineer onsite. This individual was on the resident construction engineer's staff and implemented the environmental protection program. His daily log was inspected during the staff's site visit.

Once construction is completed and the disturbed areas not needed for operation (e.g., laydown, the area disturbed for the new discharge pipeline, etc.) are landscaped there should be no significant impacts to the terrestrial environment.

Figure 5.1



Floodplain

5.5.1 Transmission Lines

The staff has reviewed sources of environmental impact which could be associated with the operation of transmission lines.

The staff has found no convincing or compelling argument to date to prohibit the operation of 500 kV lines. Therefore, St. Lucie's 240 kV lines should pose no problems. The applicant does not use herbicides in maintaining its transmission corridor rights-of-way.

5.5.2 Terrestrial Monitoring

No specific monitoring program associated with the terrestrial biota is deemed necessary. Monitoring of turtle nesting impacts are treated under the aquatic section.

Reporting of unusual or important environmental events will be specified in the Environmental Protection Plan.

5.6 Aquatic Ecology Impacts

Operation of St. Lucie 2 will result in an approximate doubling of intake flow to 66 m^3/sec. (2,320 ft^3/sec). Organisms unable to resist this flow will be entrained into the offshore intake structures and pass through the intake pipes in to the intake canal. Because of the high flow rates through the velocity caps and intake pipes escape by aquatic organisms from the intake canal is impossible except during station shutdown. Ultimately these organisms will be (1) impinged on either the block net at the State Road A1A bridge or the plant intake traveling screens, (2) entrained through the plant service or circulating water systems, (3) die, (4) be removed, or (5) escape back through the intake pipe if both units stop pumping.

Semi-annual testing of the emergency water intake structure will result in the impingement and entrainment of some Indian River - Big Mud Creek organisms. The effect of this loss on the fish and shellfish communities of Indian River and Big Mud Creek was evaluated and found acceptable in the FES-CP. The emergency water intake structure has been significantly redesigned (see Section 4.2.3). The new design results in an approximately 8-fold reduction in the water usage from the creek to the canal during reliability testing therefore no detectable impact to organisms inhabitating Big Mud Creek is anticipated.

5.6.1 Entrapment

The potential impact on populations of marine organisms due to entrapment in the Plant canal system was evaluated in the FES-CP. It was concluded that with an adequate velocity at the intake structure, the numbers of organisms entrained through the intake pipes were expected to be small and the effect of entrapment minor. The FES-CP recommended a monitoring program to determine the actual numbers of organisms entrapped.

Monthly gill net collections were taken in the intake canal since St. Lucie 1 began operation in 1976. The 61 m x 3 m (200 ft x 10 ft) gill nets (76 mm (3 in.)

stretch mesh) was fished two consecutive 24-hour periods each month. After each 24-hour period, organisms were removed from the nets and identified. A wide variety of species are taken including lobsters, crabs, sharks, rays, drums, jacks, and grunts. The most commonly collected organisms over the past 5 years are grunt, drum, snapper, jack, porgy, mullet, and searobin. When the number of fish and shellfish taken in the intake canal are compared to the number taken from offshore stations the number entrapped in the intake canal was low. Very few sport and commercial migratory species of fish have been taken in the canal gill netting effort over the past 5 years. Detailed results of these gill net collections are presented in the recent annual operating reports.[1,1a]

Since operation of St. Lucie 1 commenced in March 1976 sea turtles have been observed in the intake canal. A total of five different species, Chelonia mydas, the green turtle, Caretta caretta, the loggerhead turtle, Dermochelys coriacea, the leatherback, Lepidochelys kempi, Kemp's Atlantic ridley, and Erethmochelys imbricata the Hawksbill have been collected. The applicant has instituted a turtle recovery program in which sea turtles are denied access to the intake canal downstream of State Road A1A bridge through the use of a block net, are captured using a gill or tangle net and are identified, measured, condition recorded, tagged, and, released alive to the Atlantic Ocean south of the intake structure. Between 1976 and March of 1981[2] a total of 342 loggerheads, almost all juveniles, 48 green turtles, all juveniles, 6 leatherbacks, all adults, one Kemp's Atlantic ridley, and 1 hawksbill have been collected in the intake canal. The mortality rates for the species taken in the net have been 9.2% for loggerheads, and 14.6% for green turtles. No mortality was observed in the captured leatherbacks, hawksbill, or ridley. The staff has performed an assessment of the potential impact of two unit operation on the different species of sea turtles and has concluded that operation of St. Lucie 2 will not impact the habitat or continued existence of any species.

5.6.2 Impingement

The intake canal block net located at State Road A1A bridge is designed to exclude marine turtles from the remainder of the canal and plant intake structure. The block net is constructed of 1.3 cm (.5 in) × 15 cm (6 in) polyline square mesh and will only exclude larger organisms. Organisms small enough to pass through the block net will ultimately be swept down the canal to the plant intake structure. Due to the flows involved and the irregularity of the bottom some larger organisms occasionally avoid the block net and move downstream towards the plant. Mortality associated with this net is probably almost non-existent due to the large mesh size and the low canal flow rates of 27 cm/sec (.9 ft/sec) to 33.5 cm/sec (1.1 ft/sec). Because of the mesh size only large organisms would be expected to be impinged, however, these organisms are generally strong swimmers and would be able to escape a current of this magnitude.

Impingement of organisms on the traveling intake screens was discussed in the FES-CP. It was concluded that impingement losses were expected to be of minor significance. Since issuance of the FES-CP, St. Lucie 1 commenced operation. As part of the St. Lucie 1 operating license the utility was required to monitor impingement. Between 1976 and 1978 24-hour impingement samples were taken at the St. Lucie 1 intake screen during 226 days. The mean numbers of finfish and shellfish collected per 24-hour period were 222 and 82 respectively. The mean weights per 24-hour period were 1.7 kg (3.7 lbs) and .5 kg (1.1 lbs). Principal species impinged at the St. Lucie 1 intake were anchovy, grunt, jack, croaker, mojarra, shrimp, and blue crab. The majority of organisms were small with over 80% of the impinged fish less than or equal to 8 cm (3 in) in length, and almost 100% of the impinged shrimp 4 cm (1.6 in) or less in length. Assuming continuous St. Lucie 2 operation, the applicant has estimated that impingement rates (number per year) varied during the years of study from approximately 34,000 (1978) to 131,000 (1976) finfish and from 26,000 (1976) to 37,000 (1978) for shellfish.[3]

On January 24, 1979 the NRC issued an amendment to the St. Lucie 1 Operating License[4] that deleted the requirement for impingement monitoring. The environmental impact appraisal which accompanied the amendment concluded that impingement losses due to the operation of St. Lucie 1 represent a very insignificant portion of the numbers of fishes in the site vicinity and a very small portion of the numbers of shrimp commercially caught off Florida's east coast.

Operation of St. Lucie 2 is expected to increase the station impingement rate. The magnitude of this increase is unknown. Doubling the volume of water flowing through the velocity caps and intake pipes due to two unit operation will result in a doubling of the intake velocity. As the intake velocity increases the probability of a fish being entrained in the flow will also increase. Increasing the flow velocity, however, will not increase the probability of a fish or shellfish encountering the velocity cap. Therefore, impingement is expected to increase but probably will be less than twice the annual impingement estimates calculated from the three years of St. Lucie 1 data. A doubling of the total weight of the mean annual impingement estimate for St. Lucie 1 is less than 0.04% and .005% of the commercial fish and shellfish landed in either St. Lucie or Martin Counties.

It is concluded that operation of St. Lucie 2 will increase the impingement rate of fish and shellfish. The rate of impingement is expected to be less than double the rate observed with one unit operation. When compared to the local commercial fishery landings even a five fold increase would be considered insignificant.

5.6.3 Entrainment

The impact of entrainment on the phytoplankton, zooplankton, and ichthyoplankton into the plant circulating water system was evaluated in the FES-CP. It was concluded that there would be no measurable effect on the ecosystem of the adjacent oceanic waters. Since issuance of the FES-CP the applicant has conducted monitoring programs to assess the losses to the phytoplankton, zooplankton, and ichthyoplankton communities due to the operation of St. Lucie 1. The results of this monitoring program are summarized in Section 4.3.8 and indicate slightly higher levels of zooplankton and phytoplankton in the vicinity of the discharge and that these elevated levels may be due to station operation. Based on the result of the monitoring programs for St. Lucie 1 and the staff's experience in evaluating operating data at other coastal facilities it is concluded that operation of St. Lucie 2 will have no detrimental impact on the phytoplankton and zooplankton communities. Two unit operation may increase further the local inshore populations of these two communities due to increases in the canal standing crop of certain taxa.

The applicant since 1976 has collected ichthyoplankton samples from 6 offshore stations and one station in each the intake and discharge canal as part of the monitoring requirements for St. Lucie 1. Using the results of five years of sampling and a method of analysis presented in Goodyear[5] the percent entrainment of eggs and larvae drifting past the stations has been estimated. Assuming two unit operation and 100% mortality due to plant passage it is estimated that between .3% and .6% ($\bar{x}$ = .4%) of the eggs and larvae moving past the station would be entrained. Under the most conservative conditions a maximum of less than 4% of the eggs and larvae passing the site could be entrained. Based on above estimated percent loss no significant impact by entrainment to the local fisheries is expected due to operation of St. Lucie 2.

5.6.4 Environmental Effects of Discharge of Cooling Water

As a result of redesigning the additional cooling water discharge system provided to accommodate operation of St. Lucie 2, the thermal plume will be different from that described in the FES-CP. FP&L has employed both physical and mathematical models in the analysis of dispersion of the heated discharge. FP&L has also made use of St. Lucie 1 plume data in the updated modelling effort. The staff has evaluated the applicants approach and information and finds it generally reasonable.

The new analyses address two-unit operation as well as operation of the new discharge system alone. Since the two units share the 671 m (2200 ft) long discharge canal, the effluents from the two units are mixed and the flow through the "Unit 2 diffuser" need not be that originating in St. Lucie 2. The actual distribution of flow between the two discharge systems will be dependent on a number of hydraulic factors[6] with the fraction of the station flow passing through either structure being less than or greater than half the total flow. The range of flow distributions studied demonstrates that for a given Plant temperature rise the ocean surface temperature rise becomes higher with lower flow rate through the diffuser[7]. Thus, the worst case condition with respect to the maximum ocean temperature produced by the discharge would occur with only one unit in service but both discharge systems open. The applicant did not specifically model this situation. However, the State certification prohibits extended operation in this mode.

Except under the hypothetical stagnant ocean conditions, the modelling of the discharges showed no interference of the plumes from the two discharges. Some interference at distances beyond modelling limits is still conceivable but not significant due to the low temperatures involved. For most ocean current and plant operating conditions, the plume area with both units in operation and both discharges in use was equal to the sum of the individual St. Lucie 1 and 2 plume areas. Thus, much of the interference of the plumes noted at the time of the FES-CP review was eliminated by the change in the design of the new discharge. For stagnant ocean conditions which would exist only briefly during intertidal periods in the absence of wind driven currrents, the combined plume within the 1.1°C (2°F) isotherm could be as much as 25% larger than the sum of the individual plumes under the conservative assumptions of the modelling studies.

Actual maximum plume area is predicted by the applicant's models to occur with southward current conditions and with reduced flow through the diffusers. For example, with discharge flow reduced to 23.7 m^3/s (836 cfs), but with a Plant temperature rise of 17.8°C (32°F), the 1.1°C (2°F) isotherm encloses an area of 390 x 10^3 m^2 (963 acres).

Table 5.1 presents typical predicted St. Lucie 2 plume characteristics for cooling system operation with the three current conditions. The model results indicate that the northward current, which prevails, produces the smallest heated plume. The model shows, as expected, that the highest surface temperature occurs under stagnant conditions but surprisingly that the greatest area covered with warmed water would exist under the southward wind conditions. Plume characteristics for other conditions of cooling system operation are provided in the ER-OL.[8]

The regulations of the State of Florida Department of Environmental Regulation governing discharge of heated water as applicable to St. Lucie 2 prescribe that heated water may be discharged with a temperature at the point of discharge up to 9.4°C (17°F) above ambient as long as the surface water temperature is not raised above 36.1°C (97°F). The rules further provide that the Department may, upon application, establish a zone of mixing within the receiving waterbody beyond which the limits shall apply. FP&L has petitioned for a variance from the State specifying a mixing zone since the temperature rise exceeds 9.4°C (17°F). The state has reviewed the FP&L petition and has tentatively defined the mixing zone limitation as follows: "The heated water discharged from the multiport diffuser shall not exceed 9.4°C (17°F) above ambient outside of a thermal mixing zone of 13,000 m^3 (10.7 acre-ft). The mixing zone shall be bounded by an area 422m (1385 ft) long extending seaward from the most landward discharge port, 6.4m (21.0 ft) to either side of the discharge pipe axis, and 2.4m (8.0 ft) in height above the bottom of the discharge ports." The proposed State requirements are included in Appendix C.

Based on St. Lucie 2 modelling it would appear that a variance will not be needed for the 36.1°C (97°F) limitation on surface temperature. Maximum ambient surface temperature at the site is less than 32.2°C (90°F) and surface temperature rise of the new diffuser was generally less than 2.8°C (5°F) in the modelling results. The State requirements for the variance will be spelled out in the site certification issued under the Power Plant Siting Program and will be included in the State 401 Certification of the NPDES Permit.

Table 5.1 Typical Plume Characteristics for St. Lucie 2 as Predicted by FP&L Model Studies

Ocean Current	Max Surface Temp Rise °C (°F)	Surface Area Within 2°F Isotherm 10^3 m^2 (Acres)	Plume Volume Within Isotherm 1.1°C (2°F) 10^3 m^3 (A-ft)	Plume Volume Within Isotherm 2.8°C (5°F) m^3 (A-ft)	Travel Time Through Plume to Isotherm 1.1°C (2°F) Min	Travel Time Through Plume to Isotherm 2.8°C (5°F) Min
Northward	1.2 (2.1)	113 (28)	105 (85)	0.62 (0.5)	28	8
Southward	1.3 (2.3)	708 (175)	210 (170)	0.74 (0.6)	56	9
Stagnant	1.9 (3.5)	696 (172)	387 (314)	1.73 (1.4)	42	14

Source: Section 5.1 of the ER-OL from Test No.5. Flow = 1145 cfs and condenser temperature rise = 28°F.

The thermal plume from the St. Lucie 2 discharge pipeline will rise rapidly from the discharge ports resulting in little plume contact with, or scouring of, the bottom. The impact of the plume on benthos is expected to be insignificant even in the immediate vicinity of the discharge pipeline.

Planktonic species in the vicinity of the discharge pipeline will be entrained in the plume. The high regeneration rates of phytoplankton and zooplankton will offset any significant losses due to plume entrainment. Furthermore, the results of operational monitoring programs for St. Lucie 1 indicate there has been, in the past, enrichment of phytoplankton and zooplankton in the vicinity of the St. Lucie 1 discharge. Ichthyoplankton entrained in the discharge plume will sustain some mortality. Observed thermal tolerances of ichthyoplankton species known to occur off Hutchinson Island are quite variable. Little is known on the effect of short-term thermal excursions typically encountered by eggs and larvae during plume entrainment. Some ichthyoplankton mortality will occur as a result of plume entrainment. This loss is expected to be significantly less than that due to Plant entrainment and probably would not be significant in relation to mortality from other causes. Since under the most conservative conditions less than 4% of the eggs and larvae passing the site will be entrained (see Section 5.6.3) and since only a fraction of these will suffer plume entrainment related mortality, no detectable impact is predicted.

Adult fish are not expected to be adversely affected by the thermal plume. Adult fish actively avoid areas where water temperatures reach lethal levels.

The peak period of turtle nesting appears to be related to ocean temperature. The results of beach nesting censuses since commencement of St. Lucie 1 operation have not provided evidence that higher temperatures due to the presence offshore of the discharge plume have caused premature nesting in the vicinity of the site. Due to the small size of the plume and the rapidity with which turtles could move through it, premature nesting of marine turtles due to simultaneous two unit operation is not predicted. Furthermore, the beach nesting censuses also indicate that marine turtles do not avoid nesting on beaches bordering the plume.

In 1977 FP&L contracted a study[9] to determine the influence of water temperature on hatchling marine turtles. The LT_{50} for loggerhead hatchlings was found to be 37.4°C (99°F) which is considerably higher than the maximum surface temperatures expected due to plant operation. Temperatures of 33.3°C (91°F) produced a reduction in swimming speed and an impairment of orientation to brightness cues. Temperatures of 30°C were high enough to produce significantly reduced swimming speeds. Temperatures below 30°C (86°F) seem to have a negligible effect on hatchling loggerhead turtles. The response of green turtle hatchlings to elevated temperatures is thought to be similar to that of the loggerhead.

Since the maximum surface plume discharge temperature during the period of maximum hatchling emergence of July through September will only infrequently exeed 32°C (90°F) few hatchlings will be exposed to surface temperatures greater than 30°C (86°F). Mortality due to high water temperatures is not expected to occur. Mortality to hatchlings due to disorientation and increased predation will be minor since (1) the normal plume direction is northerly which results in the smallest plume dimensions, (2) hatchlings that enter the plume and exhibit reduced swimming speeds will be entrained in the plume and be rapidly moved into cooler water and (3) access to the hottest portion of the plume, which is at the diffuser ports, will be denied due to the surface orientation of the hatchlings.

The potential for gas bubble disease killing a significant number of fish in the area of the discharge pipeline is minimal. The use of the multiport jet diffuser promotes rapid mixing of the discharge and the high velocity of the existing water discourages fish from remaining in the plume for any significant period of time.

The staff's assessment of the potential for cold shock to marine organisms, presented in the FES-CP remains valid and predicts no significant mortality.

5.6.5 Effects of Chemical Discharges

Usage of chemicals at this Plant is updated in Section 4.2.7 and NPDES permit limitations are presented there. The FES-CP review expressed concern over the potential impact of residual chlorine. Currently, FP&L is constrained by the NPDES Permit to a maximum total residual oxidant (TRO) concentration of 0.1 mg/l at the end of the discharge canal, during intermittent condenser chlorination. Experience with operation of St. Lucie 1 under this constraint has been that actual TRO concentration is generally less than 0.05 mg/l at the end of the discharge canal.[10,11] When St. Lucie 2 begins operation, concentration will be further reduced by dilution and chemical reaction. Impact to organisms will be limited to partial loss of those entrained and passed through the cooling system during chlorination. This effect will be small.

The use of titanium condenser tubes in lieu of the copper alloy tubes evaluated at the FES-CP stage of licensing will avoid to a great extent the potential stress of the copper to organisms passed through the condensers.

The organic tin compound which lines the new diffuser (See Section 4.2.4) to prevent the growth of marine organisms within its ports is toxic by design. FP&L has provided data which show the compound to have toxic effects at concentrations as low as 0.2 ppb for prolonged exposure. It will leach from the surface at a low rate but the continual discharge of cooling water through the diffuser will result in concentrations in the discharge much lower than those toxic levels. Extended periods without flow through the diffuser, if occurring during stagnant ocean current conditions, could allow accumulation of the substance to toxic concentrations near the diffuser with the potential of some damage to aquatic organisms. However, the applicant will use the diffuser rather than the Y port discharge during extended single unit outages. During extended periods with no flow through the Plant small, local impacts could occur.

During the period of operation of St. Lucie 1, sampling of aquatic biota has not revealed any damaged biota indicative of chemical stresses.

The discharges of liquid wastes are regulated through the NPDES Permit. A draft of the permit is included in this DES in Appendix C.

5.6.6 Aquatic Monitoring

The applicant's preoperational monitoring program to measure physical, chemical, and ecological parameters of surface waters is presented in Chapter 6 of the FES-CP. As a condition of the St. Lucie 1 operating license the applicant has conducted a non-radiological environmental monitoring program. The results of the program are summarized in Section 4.3.8. Detailed accounts are presented in the more recent annual non-radiological environmental monitoring reports prepared by the applicant.[12,13]

Nonradiological aquatic monitoring programs for both St. Lucie 1 and 2 will be conducted in accordance with the NPDES permit issued by USEPA Region IV and the certifications issued by the State of Florida. The current proposed aquatic monitoring program required by the NPDES Permit is included in Appendix C.

5.7 Threatened and Endangered Species

Section 2.7.2.2.7 of the FES-CP discussed the probability of any Federally recognized rare or endangered species being found on the St. Lucie site. Since 1973, the U.S. Fish and Wildlife Service has dropped the "rare" category and now classifies species either "endangered" or "threatened." The FES-CP did not identify any significant impacts to the populations of the identified species.

In compliance with Section 7 of the 1978 amendments to the Endangered Species Act, the NRC requested from the U.S. Fish and Wildlife Service (FWS) and the U.S. National Marine Fisheries Service (NMFS) a list of those Federally recognized threatened and endangered species, both listed and proposed to be listed, and designated critical habitat which might be affected by the licensing of St. Lucie 2.[14,15] The FWS and NMFS response[16,17] listed the West Indian manatee (*Trichechus manatus*), brown pelican (*Pelecanus occidentalis*), bald eagle (*Haliaeetus leucocephalus*), american alligator (*Alligator mississippiensis*), loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), Kemp's Atlantic ridley turtle (*Lepidochelys kempi*), and the leatherback turtle (*Dermochelys coriacea*). The FWS also requested under provision of the Endangered Species Act, that the NRC perform a biological assessment for each of the listed species. The assessment has been performed and the results have been transmitted to the FWS and NMFS for review.

Based principally on the results of the St. Lucie 1 monitoring program the assessment concluded that no significant impact to the local populations of any of these species is expected. Some mortality to sea turtles, specifically the loggerhead and green turtles is expected (see Section 5.6). The staff considers this impact to be acceptable.

Continued efforts on the part of the applicant to monitor nesting on Hutchinson Island and to release turtles entrapped in the intake canal will serve to monitor the plant impact on the population. Based on the results of FWS an NMFS review of the assessment, additional requirements may be imposed on the applicant.

5.8 Historic and Archeological Site Impacts

Operation of the Plant will not result in any significant impact on historic and archeological sites in the area. The State Historic Preservation Officer has stated: "the proposed project will have no effect on any sites listed, or eligible for listing, in the National Register of Historic Places, or otherwise of National, State, or local significance." (See Appendix D.)

5.9 Socioeconomic Impacts

Socioeconomic impacts of station operation on the community are discussed in Sections 5.6 and 8.2 of the FES-CP. The primary impacts are benefits from increased local tax revenues, employment, and local purchases.

When St. Lucie 2 is placed in service, FP&L will be paying both real and personal property taxes on the unit. Based upon projected taxable value and millage rates, and the current Florida laws, the estimated tax yield from St. Lucie 2 for the first year in service will be 5.5 million in 1981 dollars.

St. Lucie 2 will be depreciated (straight-line) at a rate of approximately four percent per year for property tax purposes. New additions will be added to the tax base as they are completed. The additions, unless substantial, tend to offset depreciation to the extent that the 5.5 million annual projection should be forecast through 1988.

The actual amount of taxes paid will be based on the millage rates as authorized by law during the years St. Lucie 2 is energized for commercial use, and the valuation established following project completion. For these reasons, the actual taxes received by the county may be either less than or greater than the amount indicated above.

The authorized 1981 tax revenues for St. Lucie County are $27,885,000.

Based on these values, the taxes collected attributable to St. Lucie 2 amount to 19.7 percent of the taxes collected by St. Lucie County.[18]

The estimated average number of workers required for the operation of St. Lucie 2 and their average annual payroll in 1981 dollars follows[19]:

	Workers	Payroll
FP&L employees	150	$3.78 million
Backfit (permanently contracted)	134	4.05 million
Backfit (temporarily contracted)	700*	6.00 million*

*Not annual data, contracted refueling periods only; once every 18 months for an 8 to 10 week period.

These additional workers required for the operation of St. Lucie 2 are not expected to be a significant impact upon the community. As explained in the FES-CP (Section 4.4) St. Lucie 1's construction work force created no special burden on the local schools and other facilities and services. The FES-CP (Section 5.6) also indicates that the operating personnel would reside primarily in Stuart and Fort Pierce which handled the largest part of the construction worker force.

FP&L operates a central stores department for its various facilities which precludes the need for local purchases. The department makes bulk centralized purchases that are needed at each site in order to economize on large quantity purchases.

Based on FP&L's experience from the operation of St. Lucie 1, it is estimated that the annual local (i.e., St. Lucie and Martin counties) purchases will be about $750,000[20] in 1981 dollars.

5.10 Radiological Impacts

5.10.1 Regulatory Requirements

Nuclear power reactors in the United States must comply with certain regulatory requirements in order to operate. The permissible levels of radiation in unrestricted areas and of radioactivity in effluents to unrestricted areas are recorded in 10 CFR Part 20, Standards for Protection Against Radiation.[21] These regulations specify limits on levels of radiation and limits on concentrations of radionuclides in the Station's effluent releases to the air and water (above natural background), under which the reactor must operate. These regulations state that no member of the general public in unrestricted areas shall receive a radiation dose, due to Station operation, of more than 0.5 rems in one calendar year, or if an individual were continously present in an area, 2 mrems in any one hour or 100 mrems in any seven consecutive days to the total body. These radiation-dose limits are established to be consistent with considerations of the health and safety of the public.

In addition to the Radiation Protection Standards of 10 CFR Part 20, there are recorded in 10 CFR 50.36a[22] license requirements that are to be imposed on licensees in the form of Technical Specifications on Effluents from Nuclear Power Reactors to keep releases of radioactive materials to unrestricted areas during normal operations, including expected operational occurrences, as low as is reasonably achievable (ALARA). Appendix I of 10 CFR Part 50 provides numerical guidance on dose-design objectives for LWRs to meet this ALARA requirement. Applicants for permits to construct and licenses to operate an LWR shall provide reasonable assurance that the following calculated dose-design objectives will be met for all unrestricted areas: 3 mrems/yr to the total body or 10 mrems/yr to any organ from all pathways of exposure from liquid effluents; 10 mrads/yr gamma radiation or 20 mrads/yr beta radiation air dose from gaseous effluents near ground level--and/or 5 mrems/yr to the total body or 15 mrems/yr to the skin from gaseous effluents; and 15 mrems/yr to any organ from all pathways of exposure from airborne effluents that include the radioiodines, carbon-14, tritium, and the particulates.

Experience with the design, construction and operation of nuclear power reactors indicates that compliance with these design objectives will keep average annual releases of radioactive material in effluents at small percentages of the limits specified in 10 CFR Part 20, and in fact, will result in doses generally below the dose-design objective values of Appendix I. At the same time, the licensee is permitted the flexibility of operation, compatible with considerations of health and safety, to assure that the public is provided a dependable source of power even under unusual operating conditions which may temporarily result in releases higher than such small percentages, but still well within the limits specified in 10 CFR Part 20.

In addition to the impact created by Station radioactive effluents as discussed above, within the NRC policy and procedures for environmental protection described in 10 CFR Part 51 there are generic treatments of environmental effects of all aspects of the Uranium Fuel Cycle. These environmental data have been summarized in Table S-3 of the generic study and are discussed later in this Statement in Section 5.11. In the same manner the environmental impact of transportation of fuel and waste to and from an LWR is summarized in Table 5.3 of Section 5.10.1.1.2.

Recently an additional operational requirement for Uranium-Fuel-Cycle Facilities including nuclear power plants has been established by the EPA in 40 CFR Part 190.[23] This regulation limits annual doses (excluding radon and its daughters) for members of the public to 25 mrems, total body; 75 mrems, thyroid; and 25 mrems, other organs from all fuel-cycle facility contributions that may impact a specific individual in the public.

5.10.2 Operational Overview

During normal operations of St. Lucie 2, small quantities of radioactivity (fission and activation products) will be released to the environment. As required by NEPA, the staff has determined the dose estimated to members of the public outside of the plant boundaries due to the radiation from these radioisotope releases and relative to natural background radiation dose levels.

These Plant-generated environmental dose levels are estimated to be very small due to Plant design and the development of a program which will be implemented at the Plant to contain and control all radioactive emissions and effluents. As mentioned above, highly efficient radioactive-waste management systems are incorporated into the design and are specified in detail in the Technical Specifications for the Plant. The effectiveness of these systems will be measured by process and effluent radiological monitoring systems that permanently record the amounts of radioactive constitutents remaining in the various airborne and waterborne process and effluent streams. The amounts of radioactivity released through vents and discharge points to be further dispersed and diluted to points outside the Plant boundaries are to be recorded and published semiannually in the Radioactive Effluent Release Reports of each unit.

The small amounts of airborne effluents that are released will diffuse in the atmosphere in a fashion determined by the meteorological conditions existing at the time of release and are generally much dispersed and diluted by the time they reach unrestricted areas that are open to the public. Similarly, the small amounts of waterborne effluents released will be diluted with Plant waste water and then further diluted as they mix with the Atlantic Ocean beyond the Plant boundaries.

Radioisotopes in the Plant's effluents that enter unrestricted areas will produce doses through their radiations to members of the general public similar to the doses from background radiations (i.e., cosmic, terrestrial and internal radiations), which also include radiation from nuclear weapons fallout. These radiation doses can be calculated for the many potential radiological exposure pathways specific to the environment around the Plant, such as direct radiation doses from the gaseous plume or liquid effluent stream outside of the Plant boundaries, or internal radiation dose commitments from radioactive contaminants that might have been deposited on vegetation, or in meat and fish products eaten by people, or that might be present in drinking water outside the plant, or incorporated into milk from cows at nearby farms.

These doses, calculated for the "maximally exposed" individual (i.e., the hypothetical individual potentially subject to maximum exposure), form the basis of the staff's evaluation of impacts. Actually, these estimates are for a fictitious person because assumptions are made that tend to overestimate the dose that would accrue to members of the public outside the Plant boundaries. For example, if this "maximally exposed" individual were to receive the total body dose calculated at the Plant boundary due to external exposure to the gaseous plume, he/she is assumed to be physically exposed to gamma radiation at that boundary for 70% of the year, an unlikely occurrence.

Site specific values for the various parameters involved in each dose pathway are used in the calculations. These include calculated or observed values for the amounts of radioisotopes released in the gaseous and liquid effluents, meteorological information (e.g., wind speed and direction) specific to the site topography and effluent release points, and hydrological information pertaining to dilution of the liquid effluents as they are discharged.

An annual land census, to be required by the Radiological Technical Specifications of the operating license, will require that as use of the land surrounding the site boundary changes, revised calculations be made to ensure that this dose estimate for gaseous effluents always represents the highest dose for any individual member of the public for each applicable foodchain pathway. The estimate considers, for example, where people live, where vegetable gardens are located, and where cows are pastured.

For St. Lucie 2, in addition to the direct effluent monitoring, measurements will be made on a number of types of samples from the surrounding area to determine the possible presence of radioactive contaminants which, for example, might be deposited on vegetation, or be present in drinking water outside the plant, or incorporated into cow's milk from nearby farms.

5.10.3 Radiological Impacts from Routine Operations

5.10.3.1 Radiation Exposure Pathways: Dose Commitments

There are many environmental pathways through which persons may be exposed to radiation originating in a nuclear power reactor. All of the potentially meaningful exposure pathways are shown schematically in Figure 5.2. When an individual is exposed through one of these pathways, the dose is determined in part by the amount of time the person is in the vicinity of the source, or the amount of time the radioactivity is retained in the body. The actual effect of the radiation or radioactivity is determined by calculating the dose commitment. This dose commitment represents the total dose that would be received over a 50-yr period, following the intake of radioactivity for 1 yr under the conditions existing 15 yrs after the Plant begins operation (i.e., the mid-point of Plant operation). However, with few exceptions, most of the internal dose commitment for each nuclide is given during the first few years after exposure due to turnover of the nuclide by physiological processes and radioactive decay.

There are a number of possible exposure pathways to man that can be studied to determine whether the routine releases at the St. Lucie site are likely to have any significant impact on members of the general public living and working outside of the site boundaries, and whether the releases will in fact meet regulatory requirements. A detailed listing of these possibilities would include external radiation exposure from the gaseous effluents, inhalation of iodines and particulate contaminants in the air, drinking milk from a cow or eating meat from an animal that feeds on open pasture near the site on which iodines or particulates may have deposited, eating vegetables from a garden near the site that may be contaminated by similar deposits, and drinking water or eating fish caught near the point of discharge of liquid effluents.

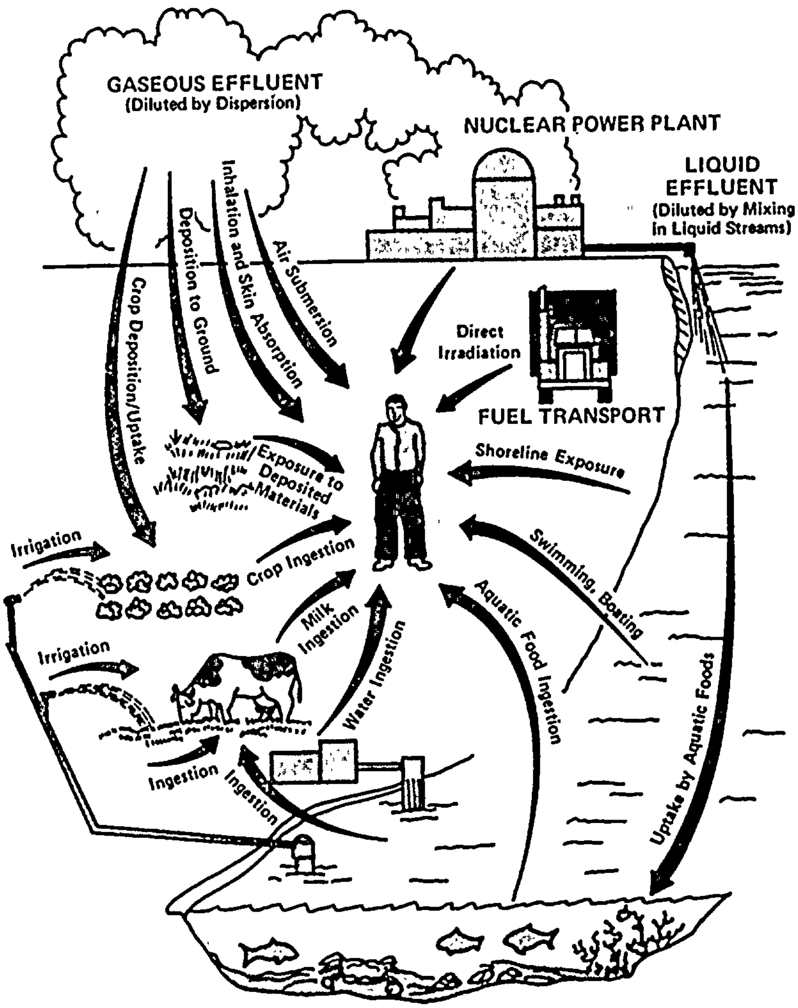


Figure 5.2 Potentially Meaningful Exposure Pathways to Individuals

Other less significant pathways include: external irradiation from radionuclides deposited on the ground surface, shoreline, boating and swimming activities near the ocean, lakes or streams that may be contaminated by effluents, and direct radiation from within the Plant itself. Note that for the St. Lucie site there is no drinking water pathway of concern since the liquid effluents are discharged into the Atlantic Ocean.

Calculations of the effects for most pathways are limited to a radius of 80 km (50 mi). This limitation is based on several facts. Experience has shown that all significant dose commitments (>0.1 mrems/yr) for radioactive effluents are accounted for within a radius of 80 km (50 mi) from the Plant. Beyond this distance the doses to individuals are smaller than 0.1 mrems/yr, which is far below natural-background doses, and the doses are subject to substantial uncertainty because of limitations of predictive mathematical models.

The staff has made a detailed study of all of the above significant pathways and has evaluated the radiation-dose commitments both to the plant workers and the general public for these pathways resulting from routine operation of the Plant. A discussion of these evaluations follows.

5.10.3.1.1 <u>Occupational Radiation Exposure for PWRs</u>

Most of the dose to nuclear plant workers results from external exposure to radiation from radioactive materials outside of the body rather than from internal exposure from inhaled or ingested radioactive materials. Experience shows that the dose to nuclear plant workers varies from reactor to reactor and from year to year. For environmental-impact purposes, it can be projected by using the experience to date with modern PWRs. Recently licensed 1000-MWe PWRs are operated in accordance with the post-1975 regulatory requirements and guidance that place increased emphasis on maintaining occupational exposure at nuclear power plants ALARA. These requirements and guidance are outlined primarily in 10 CFR Part 20,[21] Standard Review Plan Chapter 12,[24] and Regulatory Guide 8.8.[25]

The applicant's proposed implementation of these requirements and guidelines is reviewed by the staff during the licensing process, and the results of that review are reported in the staff's Safety Evaluation Reports. The license is granted only after the review indicates that an ALARA program can be implemented. In addition, regular reviews of operating plants are performed to determine whether the ALARA requirements are being met.

Average collective occupational dose information for 239 PWR reactor years of operation is available for those plants operating between 1974 and 1980. (The year 1974 was chosen as a starting date because the dose data for years prior to 1974 are primarily from reactors with average rated capacities below 500 MWe.) These data indicate that the average reactor annual dose at PWRs has been about 440 person-rems, with some plants experiencing an average plant lifetime annual dose to date as high as 1300 person-rems.[26] These dose averages are based on widely varying yearly doses at PWRs. For example, for the period mentioned above, annual collective doses for PWRs have ranged from 18 to 5262 person-rems per reactor. However, the average annual dose per nuclear plant worker of about 0.8 rems[27] has not varied significantly during this period. The worker dose limit, established by 10 CFR Part 20, is 3 rems/ quarter (if the average dose over the worker lifetime is being controlled to 5 rems/yr) or 1.25 rems/quarter if it is not.

The wide range of annual collective doses experienced at U.S. PWRs results from a number of factors such as the amount of required maintenance, and the amount of reactor operations and in-plant surveillance. Because these factors can vary widely and unpredictably, it is impossible to determine in advance a specific year-to-year annual occupational radiation dose for a particular plant over its operating lifetime. The need for high doses can occur, even at plants with radiation protection programs designed to ensure that occupational radiation doses will be kept ALARA.

In recognition of the factors mentioned above, staff occupational dose estimates for environmental impact purposes for St. Lucie 2 are based on the assumption that the Plant will experience the annual average occupational dose for PWRs to date. Thus the staff has projected that the occupational doses for each unit at St. Lucie will be 440 person-rems but could average as much as 3 to 4 times this value over the life of the plant.

The average annual dose of about 0.8 rem per nuclear plant worker at operating BWRs and PWRs has been well within the limits of 10 CFR Part 20. However, for impact evaluation, the staff has estimated the risk to nuclear power plant workers and compared it in Table 5.3 below to risks that are published for other occupations. Based on these comparisons, the staff concludes that the risk to nuclear plant workers from Plant operation is comparable to the risks associated with other occupations.

5.10.3.1.2 Public Radiation Exposure

- Transportation of Radioactive Materials

The transportation of "cold" (unirradiated) nuclear fuel to the reactor, of spent irradiated fuel from the reactor to a fuel reprocessing plant, and of solid radioactive wastes from the reactor to waste burial grounds is considered in 10 CFR 51.20.[28] The contribution of the environmental effects of such transportation to the environmental costs of licensing the nuclear power reactor is set forth in Summary Table S-4 from 10 CFR 51.20, reproduced herein as Table 5.4. The cumulative dose to the exposed population as summarized in Table 5.4 is very small when compared to the annual dose of about 61,000 person-rems to this same population or 26,000,000 person-rems to the U.S. population from background radiation.

- Direct Radiation for PWRs

Radiation fields are produced around nuclear plants as a result of radioactivity within the reactor and its associated components, as well as a result of radioactive-effluent releases. Direct radiation from sources within the plant are due primarily to nitrogen-16, a radionuclide produced in the reactor core. Because the primary coolant of a PWR is contained in a heavily shielded area, dose rates in the vicinity of PWRs are generally undetectable (less than 5 mrems/yr).

Low-level radioactivity storage containers outside the plant are estimated to make a dose contribution at the site boundary of less than 1% of that due to the direct radiation from the plant.

Table 5.3 Incidence of Job-Related Fatalities

Occupational Group	Fatality Incidence Rates (premature deaths per 10^5 person-years)
Underground metal miners[a]	~1300
Uranium miners[a]	420
Smelter workers[a]	190
Mining[b]	61
Agriculture, forestry, and fisheries[b]	35
Contract construction[b]	33
Transportation and public utilities	24
Nuclear-plant worker[c]	23
Manufacturing[b]	7
Wholesale and retail trade[b]	6
Finance, insurance, and real estate[b]	3
Services[b]	3
Total private sector[b]	10

[a]The President's Report on Occupational Safety and Health, "Report on Occupational Safety and Health by the U.S. Department of Health, Education, and Welfare," E. L. Richardson, Secretary, May 1972.

[b]U.S. Bureau of Labor Statistics, "Occupational Injuries and Illness in the United States by Industry, 1975," Bulletin 1981, 1978.

[c]The nuclear-plant workers' risk is equal to the sum of the radiation-related risk and the nonradiation-related risk. The occupational risk associated with the industry-wide average radiation dose of 0.8 rem is about 11 potential premature deaths per 10^5 person-years due to cancer (using the same risk estimators as used in Appendix C, "Impact of the Uranium Fuel Cycle"). The average nonradiation-related risk for seven U.S. electrical utilities over the period 1970-1979 is about 12 actual premature deaths per 10^5 person-years as shown in Figure 5 of the paper by R. Wilson and E. S. Koehl, "Occupational Risks of Ontario Hydro's Atomic Radiation Workers in Perspective," presented at Nuclear Radiation Risks, A Utility-Medical Dialogue, sponsored by the International Institute of Safety and Health in Washington, D.C., September 22-23, 1980. (Note that the estimate of 11 radiation-related premature cancer deaths is potential rather than actual.)

• Radioactive Effluent Releases: Air and Water

As pointed out in an earlier section, all effluents from the Plant will be subject to extensive decontamination, but small controlled quantities of radioactive effluents will be released to the atmosphere and to the hydrosphere during normal operations. Estimates of site-specific radioisotope release values have been developed on the basis of the descriptions of operational and radwaste systems in the applicant's ER and FSAR and by using the calculational model and parameters developed by the staff.[29] These have been supplemented by extensive use of the applicant's site and environmental data in the ER and in subsequent answers to staff questions, and should be studied to obtain an understanding of airborne and waterborne releases from the Plant.

These radioactive effluents are then diluted by the air and water into which they are released before they reach areas accessible to the general public.

Radioactive effluents can be divided into several groups. Among the airborne effluents the radioisotopes of the noble gases--krypton, xenon, and argon--do not deposit on the ground nor are they absorbed and accumulated within living organisms; therefore, the noble gas effluents act primarily as a source of direct external radiation emanating from the effluent plume. Dose calculations are performed for the site boundary where the highest external-radiation doses to a member of the general public as a result of gaseous effluents have been estimated to occur; these include the total body and skin doses as well as the annual beta and gamma air doses from the plume at that boundary location.

Another group of airborne radioactive effluents--the radioiodines, carbon-14, and tritium--are also gaseous but tend to be deposited on the ground and/or absorbed into the body during inhalation. For this class of effluents, estimates of direct external-radiation doses from deposits on the ground, and of internal radiation doses to total body, thyroid, bone, and other organs from inhalation and from vegetable, milk, and meat consumption are made. Concentrations of iodine in the thyroid and of carbon-14 in bone are of particular significance here.

A third group of airborne effluents, consisting of particulates that remain after filtration of airborne effluents in the plant prior to release, includes fission products such as cesium and barium and corrosion activition products such as cobalt and chromium. The calculational model determines the direct external radiation dose and the internal radiation doses for these contaminants through the same pathways as described above for the radioiodines, carbon-14, and tritium. Doses from the particulates are combined with those of the radioiodines, carbon-14, and tritium for comparison to the design objectives set forth in of Appendix I to 10 CFR Part 50.

The waterborne radioactive effluent constituents could include fission products such as nuclides of strontium and iodine; activation products, such as nuclides of sodium and manganese; and tritium as tritiated water. Calculations estimate the internal doses (if any) from fish consumption, from water ingestion (as drinking water), and from eating of meat or vegetables raised near the site on irrigation water, as well as any direct external radiation from recreational use of the water near the point of discharge.

Table 5.4 (Summary Table S-4) Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor[1]

SUMMARY TABLE S-4—ENVIRONMENTAL IMPACT OF TRANSPORTATION OF FUEL AND WASTE TO AND FROM ONE LIGHT-WATER-COOLED NUCLEAR POWER REACTOR [1]

NORMAL CONDITIONS OF TRANSPORT

	Environmental impact
Heat (per irradiated fuel cask in transit)	250,000 Btu/hr.
Weight (governed by Federal or State restrictions)	73,000 lbs. per truck; 100 tons per cask per rail car.
Traffic density:	
Truck	Less than 1 per day.
Rail	Less than 3 per month.

Exposed population	Estimated number of persons exposed	Range of doses to exposed individuals [2] (per reactor year)	Cumulative dose to exposed population (per reactor year) [3]
Transportation workers	200	0.01 to 300 millirem	4 man-rem.
General public:			
Onlookers	1,100	0.003 to 1.3 millirem	3 man-rem.
Along Route	600,000	0.0001 to 0.06 millirem	

ACCIDENTS IN TRANSPORT

	Environmental risk
Radiological effects	Small [4].
Common (nonradiological) causes	1 fatal injury in 100 reactor years; 1 nonfatal injury in 10 reactor years; $475 property damage per reactor year.

[1] Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972, and Supp. I, NUREG-75/038 April 1975. Both documents are available for inspection and copying at the Commission's Public Document Room, 1717 H St. NW., Washington, D.C., and may be obtained from National Technical Information Service, Springfield, Va. 22161. WASH-1238 is available from NTIS at a cost of $5.45 (microfiche, $2.25) and NUREG-75/038 is available at a cost of $3.25 (microfiche, $2.25).

[2] The Federal Radiation Council has recommended that the radiation doses from all sources of radiation other than natural background and medical exposures should be limited to 5,000 millirem per year for individuals as a result of occupational exposure and should be limited to 500 millirem per year for individuals in the general population. The dose to individuals due to average natural background radiation is about 130 millirem per year.

[3] Man-rem is an expression for the summation of whole body doses to individuals in a group. Thus, if each member of a population group of 1,000 people were to receive a dose of 0.001 rem (1 millirem), or if 2 people were to receive a dose of 0.5 rem (500 millirem) each, the total man-rem dose in each case would be 1 man-rem.

[4] Although the environmental risk of radiological effects stemming from transportation accidents is currently incapable of being numerically quantified, the risk remains small regardless of whether it is being applied to a single reactor or a multireactor site.

The release values for each group of effluents, along with site-specific meteorological and hydrological data, serve as input to computerized radiation-dose models that estimate the maximum radiation dose that would be received outside the facility via a number of pathways for individual members of the public, and for the general public as a whole. These models and the radiation dose calculations are discussed in Regulatory Guide 1.109[30] and in Appendix F of this Statement.

Examples of site-specific dose assessment calculations and discussions of parameters involved are given in Appendix F. Doses from all airborne effluents except the noble gases are calculated for the location (e.g., site boundary, garden, residence, milk cow, meat animal) where the highest radiation dose to a member of the public from all applicable pathways has been established. Only those pathways associated with airborne effluents that are known to exist at a single location are combined to calculate the total maximum exposure to an exposed individual. Pathway doses associated with liquid effluents are combined without regard to any single location, but they are assumed to be associated with maximum exposure of an individual through other than gaseous-effluent pathways.

5.10.3.2 Radiological Impact on Humans

Although the doses calculated in Appendix F are based on radioactive-waste treatment system capability, the actual radiological impact associated with the operation of the Plant will depend, in part, on the manner in which the radioactive waste treatment system is operated. Based on its evaluation of the potential performance of the ventilation and radwaste treatment systems, the staff has concluded that the systems as now proposed are capable of controlling effluent releases to meet the dose-design objectives of Appendix I to 10 CFR Part 50.[22]

The Plant's operation will be governed by operating license Technical Specifications which will be based on the dose-design objectives of Appendix I to 10 CFR Part 50.[22] Since these design-objective values were chosen to permit flexibility of operation while still ensuring that Plant operations are ALARA, the actual radiological impact of Plant operation may result in doses close to the dose-design objectives. Even if this situation exists, the individual doses for the member of the public subject to maximum exposure will still be very small when compared to natural background doses (~100 mrems/yr) or the dose limits specified in 10 CFR Part 20 (500 mrems/yr - total body). As a result, the staff concluded that there will be no measurable radiological impact on any member of the public from routine operation of the Plant.

Operating standards of 40 CFR Part 190, the Environmental Protection Agency's Environmental Radiation Protection Standards for Nuclear Power Operations,[23] specify that the annual dose equivalent must not exceed 25 mrems to the whole body, 75 mrems to the thyroid, and 25 mrems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials (radon and its daughters excepted) to the general environment from all uranium-fuel-cycle operations and radiation from these operations that can be expected to affect a given individual. The staff concluded that under normal operations the St. Lucie site is capable of operating within these standards.

The radiological doses and dose commitments resulting from a nuclear power plant are well known and documented. Accurate measurements of radiation and radioactive contaminants can be made with very high sensitivity so that much smaller amounts of radioisotopes can be recorded than can be associated with any possible observable ill effects. Furthermore, the effects of radiation on living systems have for decades been subject to intensive investigation and consideration by individual scientists as well as by select committees, occasionally constituted to objectively and independently assess radiation dose effects. Although, as in the case of chemical contaminants, there is debate about the exact extent of the effects of very low levels of radiation that result from nuclear power plant effluents, upper bound limits of deleterious effects are well established and amenable to standard methods of risk analysis. Thus the risks to the maximally exposed member of the public outside of the site boundaries can be readily quantified. Further, the impacts on, and risks to, the total population outside of the boundaries can also be readily calculated and recorded.

5.10.3.3 Radiological Impacts on Biota Other Than Humans

Depending on the pathway and radiation source, terrestrial and aquatic biota will receive doses that are approximately the same or somewhat higher than humans receive. Although guidelines have not been established for acceptable limits for radiation exposure to species other than human, it is generally agreed that the limits established for humans are conservative for other species. Experience has shown that it is the maintenance of population stability that is crucial to the survival of a species, and species in most ecosystems suffer rather high mortality rates from natural causes.

Although the existence of extremely radiosensitive biota is possible and increased radiosensitivity in organisms may result from environmental interactions with other stresses (for example, heat or biocides), no biota have yet been discovered that show a sensitivity (in terms of increased morbidity or mortality) to radiation exposures as low as those expected in the area surrounding the Plant. Furthermore, at all nuclear plants for which radiation exposure to biota other than humans has been analyzed,[31] there have been no cases of exposure that can be considered significant in terms of harm to the species, or that approach the limits for exposure to members of the public that are permitted by 10 CFR Part 20.[21] Inasmuch as the 1972 BEIR Report[32] concluded that evidence to date indicated no other living organisms are very much more radiosensitive than humans, no measurable radiological impact on populations of biota is expected as a result of the routine operation of this Plant.

5.10.3.4 Radiological Monitoring

Radiological environmental monitoring programs are established to provide data on measurable levels of radiation and radioactive materials in the site environs. Such monitoring programs are conducted to verify the effectiveness of in-plant systems used to control the release of radioactive materials and to ensure that unanticipated buildups of radioactivity will not occur in the environment. Secondarily, the monitoring programs could identify the highly unlikely existence of unmonitored releases of radioactivity. An annual surveillance (Land Census) program will be established to identify changes in the use of unrestricted areas to provide a basis for modifications of the monitoring programs.

These programs are discussed in greater detail in NRC Regulatory Guide 4.1, Rev. 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants,"[33] and the Radiological Assessment Branch Technical Position, Rev. 1, November 1979, "An Acceptable Radiological Environmental Monitoring Program."[34]

5.10.3.4.1 Preoperational

The preoperational phase of the monitoring program should provide for the measurement of background levels of radioactivity and radiation and their variations along the anticipated important pathways in the areas surrounding the Plant, the training of personnel and the evaluation of procedures, equipment and techniques. The St. Lucie 2 preoperational program is the ongoing monitoring program for St. Lucie 1. This ongoing program is described in detail in the St Lucie 1 Environmental Technical Specifications and summarized in Table 5.5.

5.10.3.4.2 Operational

The operational, offsite radiological-monitoring program is conducted to measure radiation levels and radioactivity in Plant environs. It assists and provides backup support to the effluent-monitoring program as recommended in NRC Regulatory Guide 1.21, "Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants."[35]

The applicant states that the operational program will in essence be a continuation of the preoperational program described above with some periodic adjustment of sampling frequencies in expected critical exposure pathways--such as increasing milk sampling frequency and deletion of fruit, vegetable, soil, and gamma radiation survey samples. The proposed operational program will be reviewed prior to Plant operation. Modification will be based upon anomalies and/or exposure pathway variations observed during the preoperational program.

The final operational-monitoring program proposed by the applicant will be reviewed in detail by the staff, and the specifics of the required monitoring program will be incorporated into the Operating License Radiological Technical Specifications.

5.10.4 Environmental Impact of Postulated Accidents

5.10.4.1 Plant Accidents

The staff has considered the potential radiological impacts on the environment of possible accidents at the St. Lucie 2 in accordance with a Statement of Interim Policy published by the Nuclear Regulatory Commission on June 13, 1980.[36] The following discussion reflects these considerations and conclusions.

The first section deals with general characteristics of nuclear power plant accidents including a brief summary of safety measures to minimize the probability of their occurrence and to mitigate their consequences if they should occur. Also described are the important properties of radioactive materials and the pathways by which they could be transported to become environmental hazards. Potential adverse health effects and impacts on society associated with actions to avoid such health effects are also identified.

TABLE 5.5

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

ST. LUCIE PLANT

Exposure Pathway and/or Sample	Criteria and Sampling Locations	Collection Frequency	Type and Frequency of Analysis
1. AIR			
1.1 Particulate and Iodine	Comparison on-site versus off-site & reference locations: 3 locations on-site, north, east, & southewast of the plant: 5 locations off-site within a radius of 10 miles of plant: and 1 control location:	Weekly	Gross Beta Gamma spectral analysis of monthly composite Radioactive Iodine
1.2 Direct Radiation	Comparison of on-site versus off-site & reference locations: 3 locations on-site, north, east, & southeast of the plant: 5 locations off-site within a radius of 10 miles of plant: and 1 control location:	Quarterly	Determine direct radiation exposure by TLD readout (mean of 2 TLDs)
2. WATER			
2.1 Surface Water			
2.1.1 Discharge Canal	1 location, west of AIA:	Monthly	Gamma spectral analysis Tritium (Quarterly Composite) Sr-89 & 90 (Quarterly Composite)
2.1.2 Ocean	2 locations: (Control)	Monthly	Gamma spectral analysis Tritium (Quarterly Composite) Sr-89 & 90 (Quarterly Composite)

TABLE 5.5 (Continued)

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

ST. LUCIE PLANT

Exposure Pathway and/or Sample	Criteria and Sampling Locations	Collection Frequency	Type and Frequency of Analysis
2. WATER (cont'd)			
2.1.3 Estuarine	1 location: Big Mud Creek:	Quarterly	Gamma spectral analysis Tritium
2.2 Ground Water (well)	1 location, Residence, 7609 Indian River Drive:	Semi-annually	Gamma Spectral Analysis Gross Beta Tritium
2.3 Potable Water (wells)	1 location, City of Ft. Pierce, drinking water supply, 1 location, City of Stuart, drinking water supply, 1 location, Port St. Lucie, drinking water supply,	Quarterly	Gamma spectral analysis Gross Beta Tritium
3. BOTTOM SEDIMENT			
3.1 Discharge Canal	1 location, west of AIA:	Semi-annually	Gamma spectral analysis Sr-90
3.2 Ocean	1 location, beach west of dicharge structure: 1 location, offshore, 1 mile north of discharges: 1 location, offshore, 1 mile south of discharge: 1 location, offshore, Vero Beach: (Control)	Semi-annually	Gamma spectral analysis Sr-90
3.3 Beach (sand)	1 location, east of Blind Creek, 1 mile north of discharge: 1 location, near intake, 1 mile south of discharge: 1 location, Vero Beach: (Control)	Semi-annually	Gamma spectral analysis Sr-90

TABLE 5.5 (Continued)

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

ST. LUCIE PLANT

Exposure Pathway and/or Sample	Criteria and Sampling Locations	Collection Frequency	Type and Frequency of Analysis
3. BOTTOM SEDIMENT (cont'd)			
3.4 Estuarine	1 location, Big Mud Creek:	Semi-annually	Gamma spectral analysis
4. AQUATIC BIOTA			
4.1 Crustacea (Lobster or crab or shrimp)	1 location, vicinity of discharge structure: 1 location, Vero Beach: (Control)	Semi-annually	Gamma spectral analysis
4.2 Fish			
4.2.1 Carnivores	1 location, vicinity of discharge structure: 1 location, Vero Beach: (Control)	Semi-annually	Gamma spectral analysis Sr-89 & 90
4.2.2 Herbivores	1 location, vicinity of discharge structure: 1 location, Vero Beach: (Control)	Semi-annually	Gamma spectral analysis Sr -89 & 90
5. TERRESTRIAL			
5.1 Milk	1 location within 15 miles radius of plant and in the prevailing wind direction from the plant:	Semi-monthly	Gamma spectral analysis Sr-89 & 90 I-131
	1 location, 53.2 mi south of the plant, Palm Beach County (Control)	Monthly	Gamma spectral analysis Sr-89 & 90 I-131
	Dairy herd census	Semi-annually	

TABLE 5.5 (Continued)

OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

ST. LUCIE PLANT

Exposure Pathway and/or Sample	Criteria and Sampling Locations	Collection Frequency	Type and Frequency of Analysis
5. TERRESTRIAL (cont'd)			
5.2 Biota			
5.2.1 Food Crop (Citrus)	6 locations,	Harvest Time	Gamma spectral analysis Sr-89 & 90
	1 location, Vero Beach: (Control)	Harvest Time	Gamma spectral analysis Sr-89 & 90
5.2.2 Food Crop (edible Leafy) vegetation)	1 location as determined by garden census (Specification 3.2.d)	Harvest Time	Gamma spectral analysis I-131
5.3 Soil	5 locations within a 25 mile radius of plant: 1 location, Vero Beach: (Control)	Once per 3-year period	Gamma spectral analysis Sr-90

Next, actual experience with nuclear power plant accidents and their observed health effects and other societal impacts are described. This is followed by a summary review of safety features of St. Lucie 2 and of the site that act to mitigate the consequences of accidents.

The results of calculations of the potential consequences of accidents that have been postulated in the design basis are then given. Also described are the results of calculations for the St. Lucie 2 site using probabilistic methods to estimate the possible impacts and the risks associated with severe accident sequences of exceedingly low probability of occurrence.

5.10.4.1.1 <u>General Characteristics of Accidents</u>

The term "accident," as used in this section, refers to any unintentional event not addressed in Section 5.10.3 that results in a release of radioactive materials into the environment. The predominant focus, therefore, is on events that can lead to releases substantially in excess of permissible limits for normal operation. Such limits are specified in the Commission's Regulations in 10 CFR Part 20[21] and 10 CFR Part 50, Appendix I.[22]

There are several features which combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation comprising the first line of defense are to a very large extent devoted to the prevention of the release of these radioactive materials from their normal places of confinement within the plant. There are also a number of additional lines of defenses that are designed to mitigate the consequences of failures in the first line. Descriptions of these features for the Station may be found in the Final Safety Analysis Report,[37] and in the staff's forthcoming Safety Evaluation Report. The most important mitigative features are described in Section 5.10.4.1.3 below.

These safety features are designed taking into consideration the specific locations of radioactive materials within the Plant, their amounts, their nuclear, physical, and chemical properties, and their relative tendency to be transported into, and for creating biological hazards in, the environment.

5.10.4.1.1.1 <u>Fission Product Characteristics</u>

By far the largest inventory of radioactive material in a nuclear power plant is produced by the uranium oxide fuel fission process and is contained in the fuel rods. During periodic refueling shutdowns, the assemblies containing these fuel rods are transferred to a spent fuel storage pool so that the second largest inventory of radioactive material is located in this storage pool. Much smaller inventories of radioactive materials are also normally present in the water that circulates in the reactor coolant system and in the systems used to process gaseous and liquid radioactive wastes.

These radioactive materials exist in a variety of physical and chemical forms. Their potential for dispersion into the environment is dependent not only on mechanical forces that might physically transport them, but also upon their inherent properties, particularly their volatility. The majority of these materials exist as nonvolatile solids over a wide range of temperatures. Some, however, are relatively volatile solids and a few are gaseous in nature. These characteristics have a significant bearing upon the assessment of the environmental radiological impact of accidents.

The gaseous materials include radioactive forms of the chemically inert noble gases krypton and xenon. These have the highest potential for release into the atmosphere. If a reactor accident were to occur involving rupture or other failure of the fuel rod cladding, the release of substantial quantities of these radioactive gases from the affected fuel rods is a virtual certainty. Such accidents are considered to have very low frequency but are credible events (see Section 5.10.4.1.2). It is for this reason that each nuclear power plant is analyzed for a hypothetical design basis accident that postulates the release of the entire contained inventory of radioactive noble gases from the fuel into the containment structure. If released to the environment beyond the containment structure as a possible result of failure of safety features, the hazard to individuals from these noble gases would arise predominantly through the external gamma radiation from the airborne plume. The reactor containment structure is designed to minimize this type of release.

Radioactive isotopes of iodine are formed in substantial quantities in the fuel by the fission process and, in some chemical forms, may be quite volatile. For this reason, they have traditionally been regarded as having a relatively high potential for release from the fuel. The chemical forms in which the fission product radioiodines are found are generally solids at room temperature, and have a strong tendency to condense (or "plate out") upon cooler surfaces. In addition, most of the iodine compounds are quite soluble in, or chemically reactive with, water. Although these properties do not inhibit the release of radioiodines from degraded fuel rods, they do act to mitigate the release from containment structures that have large internal surface areas and that contain large quantities of water as a result of an accident. The same properties affect the behavior of radioiodines that may escape from the containment into the atmosphere. Thus, if rainfall occurs during a release, or if there is moisture on exposed surfaces, e.g., dew, the radioiodines will show a strong tendency to be absorbed by the moisture. Because of radioiodine's relatively high solubility and distinct radiological hazard, its potential for release to the atmosphere has also been reduced by the use of special containment spray systems which act to absorb airborne iodines. If released to the environment, the principal radiological hazard associated with the radioiodines is ingestion into the human body and subsequent concentration in the thyroid gland.

Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities, and therefore, by comparison with the noble gases and iodine, a much smaller tendency to escape from degraded fuel rods unless the temperature of the fuel becomes abnormally high. If such materials escape by volatilization from the fuel, they tend to condense quite rapidly to solid form again when transported to a lower temperature region and/or dissolve in water when present. The former mechanism can have the result of producing some solid particles of sufficiently small size to be carried some distance by a moving stream of gas or air. If such particulate materials are dispersed into the atmosphere as a result of failure of the containment barrier, they will tend to be carried downwind and deposit on surface features by gravitational settling or by precipitation (fallout), where they will become "contamination" hazards in the environment.

All radioactive isotopes exhibit the property of radioactive decay with characteristic half-lives ranging from fractions of a second to many days or years. Many of them decay through a sequence or chain of decay processes and all eventually become stable (nonradioactive) isotopes. The radiation emitted during these decay processes is the reason that they are hazardous materials.

5.10.4.1.1.2 Exposure Pathways.

The radiation exposure (hazard) to individuals is determined by their proximity to the radioactive material, the duration of exposure, and factors that act to shield the individual from the radiation. Pathways for the transport of radiation and radioactive materials that lead to radiation exposure hazards to humans are generally the same for accidental as for "normal" releases. These are depicted in Figure 5.2. There are two additional possible pathways that could be significant for accident releases that are not shown in Figure 5.2. One of these is the fallout onto open bodies of water of radioactivity initially carried in the air. The second would be unique to an accident that results in temperatures inside the reactor core sufficiently high to cause melting and subsequent penetration of the basemat underlying the reactor by the molten core debris. This creates the potential for the release of radioactive material into the hydrosphere through contact with groundwater. These pathways may lead to external exposure to radiation, and to internal exposures if radioactivity is inhaled, or ingested from contaminated food or water.

It is characteristic of these pathways that during the transport of radioactive material by wind or by water, the material tends to spread and disperse, like a plume of smoke from a smokestack, becoming less concentrated in larger volumes of air or water. The result of these natural processes is to lessen the intensity of exposure to individuals downwind or downstream of the point of release, but they also tend to increase the number who may be exposed. For a release into the atmosphere, the degree to which dispersion reduces the concentration in the plume at any downwind point is governed by the turbulence characteristics of the atmosphere which vary considerably with time and from place to place. This fact, taken in conjunction with the variability of wind direction and the presence or absence of precipitation, means that accident consequences are very much dependent upon the weather conditions existing during the accident.

5.10.4.1.1.3 Health Effects

The cause and effect relationships between radiation exposure and adverse health effects are quite complex[38,39] but they have been more exhaustively studied than for any other environmental contaminant.

Whole-body radiation exposure resulting in a dose greater than about 10 rem for a few persons and about 25 rem for nearly all people over a short period of time (hours) is necessary before any physiological effects to an individual are clinically detectable. Doses of about 10 to 20 times larger than the latter dose, also received over a relatively short period of time (hours to a few days), can be expected to cause some fatalities. At the severe, but extremely low probability end of the accident spectrum, exposures of these magnitudes are theoretically possible for persons in the close proximity of such accidents if measures are not or cannot be taken to provide protection, e.g., by sheltering or evacuation.

Lower levels of exposures may also constitute a health risk, but the ability to define a direct cause and effect relationship between a known exposure to radiation and any given health effect is difficult given the backdrop of the many other possible reasons why a particular effect is observed in a specific individual. For this reason, it is necessary to assess such effects on a statistical basis. Such effects include cancer and genetic changes in future generations after exposure of a prospective parent. Cancer in the exposed population may begin to develop only after a lapse of 2 to 15 years (latent period) from the time of exposure and then continue over a period of about 30 years (plateau period). However, in the case of exposure of fetuses (in utero), cancer may begin to develop at birth (no latent period) and end at age 10 (i.e., the plateau period is 10 years). The health consequences model currently being used is based on the 1972 BEIR Report of the National Academy of Sciences.[32]

Most authorities are in agreement that a reasonable and probably conservative estimate of the statistical relationship between low levels of radiation exposure to a large number of people is within the range of about 10 to 500 potential cancer deaths (although zero is not excluded by the data) per million person-rem. The range comes from the latest NAS BEIR III Report (1980)[40] which also indicates a probable value of about 150. This value is virtually identical to the value of about 140 used in the current NRC health effects models. In addition, approximately 220 genetic changes per million person-rem would be projected by BEIR III over succeeding generations. That also compares well with the value of about 260 per million person-rem currently used by the staff.

5.10.4.1.1.4 Health Effects Avoidance

Radiation hazards in the environment tend to disappear by the natural process of radioactive decay. Where the decay process is a slow one, however, and where the material becomes relatively fixed in its location as an environmental contaminant (e.g., in soil), the hazard can continue to exist for a relatively long period of time--months, years, or even decades. Thus, a possible consequential environmental societal impact of severe accidents is the avoidance of the health hazard rather than the health hazard itself, by restrictions on the use of the contaminated property or contaminated foodstuffs, milk, and drinking water. The potential economic impacts that this can cause are discussed below.

5.10.4.1.2 Accident Experience and Observed Impacts

The evidence of accident frequency and impacts in the past is a useful indicator of future probabilities and impacts. As of mid-1981, there were 73 commercial nuclear power reactor units licensed for operation in the United States at 51 sites with power generating capacities ranging from 50 to 1130 MWe. The combined experience with the 73 operating units represents approximately 500 reactor years of operation over an elapsed time of about 20 years. Accidents have occurred at several of these facilities.[41,42] Some of these have resulted in releases of radioactive material to the environment, ranging from very small fractions of a curie to a few million curies. None is known to have caused any radiation injury or fatality to any member of the public, nor any significant individual or collective public radiation exposure, nor any significant contamination of the environment. This experience base is not large enough to permit a reliable quantitative statistical inference. It does, however, suggest that significant environmental impacts due to accidents are very unlikely to occur over time periods of a few decades.

Melting or severe degradation of reactor fuel has occurred in only one of these 73 operating units, during the accident at Three Mile Island - Unit 2 (TMI-2) on March 28, 1979. In addition to the release of a few million curies of xenon-133, it has been estimated that approximately 15 curies of radioiodine was also released to the environment at TMI-2.[43] This amount represents an extremely minute fraction of the total radioiodine inventory present in the reactor at the time of the accident. No other radioactive fission products were released in measurable quantity.

It has been estimated that the maximum cumulative offsite radiation dose to an individual was less than 100 millirem.[43,44] The total population exposure has been estimated to be in the range from about 1000 to 3000 person-rem. This exposure could produce between none and one additional fatal cancer over the lifetime of the population. The same population receives each year from natural background radiation about 240,000 person-rem and approximately a half-million cancers are expected to develop in this group over its lifetime,[43,44] primarily from causes other than radiation. Trace quantities (barely above the limit of detectability) of radioiodine were found in a few samples of milk produced in the area. No other food or water supplies were affected.

Accidents at commercial nuclear power plants have also caused occupational injuries and a few fatalities but none attributed to radiation exposure. Individual worker exposures have ranged up to about 4 rem as a direct consequence of accidents, but the collective worker exposure levels (person-rem) are a small fraction of the exposures experienced during normal routine operations that average about 500 person-rem per reactor year.

Accidents have also occurred at other nuclear reactor facilities in the United States and in other countries.[41] Due to inherent differences in design, construction, operation, and purpose of most of these other facilities, their accident record has only indirect relevance to current nuclear power plants. Melting of reactor fuel occurred in at least seven of these accidents, including the one in 1966 at the Enrico Fermi Atomic Power Plant Unit 1. This was a sodium-cooled fast breeder demonstration reactor designed to generate 61 MWe. The damages were repaired and the reactor reached full power four years following the accident. It operated successfully and completed its mission in 1973. This accident did not release any radioactivity to the environment.

A reactor accident in 1957 at Windscale, England released a significant quantity of radioiodine, approximately 20,000 curies, to the environment. This reactor, which was not operated to generate electricity, used air rather than water to cool the uranium fuel. During a special operation to heat the large amount of graphite in this reactor, the fuel overheated and radioiodine and noble gases were released directly to the atmosphere from a 123 m (405 ft) stack. Milk produced in a 512-km^2 (200-mi^2) area around the facility was impounded for up to 44 days. This kind of accident cannot occur in a reactor like St. Lucie 2, however, because of its water-cooled design.

5.10.4.1.3 <u>Mitigation of Accident Consequences</u>

The principal design features of St. Lucie 2 are presented in the following section.

5.10.4.1.3.1 <u>Design Features</u>

St. Lucie 2 contains features designed to prevent accidental release of radioactive fission products from the fuel and to lessen the consequences should such a release occur. Many of the design and operating specifications of these features are derived from the analysis of postulated events known as design basis accidents. These accident preventive and mitigative features are collectively referred to as engineered safety features (ESF). The possibilities or probabilities of failure of these systems is incorporated in the assessments discussed in Section 5.7.

The Reactor Building, which is a dual containment design comprising a steel containment vessel surrounded by an annular space and enclosed by a reinforced concrete shield building, is a passive mitigation system which is designed to minimize accidental radioactivity releases to the environment. Safety injection systems are incorporated to provide cooling water to the reactor core during an accident to prevent or minimize fuel damage. Cooling fans provide heat removal capability inside the containment following steam release in accidents and help to prevent containment failure due to overpressure. Similarly, the containment spray system is designed to spray cool water into the containment atmosphere. The spray water also contains an additive (hydrazine) which will chemically react with any airborne radioiodine to remove it from the containment atmosphere and prevent its release to the environment.

All the mechanical systems mentioned above are supplied with emergency power from onsite diesel generators in the event that normal offsite station power is interrupted.

The fuel handling building also has accident mitigating provisions. On a high radiation signal in the fuel building, discharge from the fuel building ventilation system is automatically switched to the safety grade shield building ventilation filter system.

There are features of the plant that are necessary for its power generation function that can also play a role in mitigating certain accident consequences. For example, the main condenser, although not classified as an ESF, can act to mitigate the consequences of accidents involving leakage from the primary to the secondary side of the steam generators (such as steam generator-tube ruptures). If normal offsite power is maintained, the ability of the plant to send contaminated steam to the condenser instead of releasing it through the safety valves or atmospheric dump valves can signficantly reduce the amount of radioactivity released to the environment. In this case, the fission product removal capability of the normal operating off-gas treatment system would come into play.

Much more extensive discussions of the safety features and characteristics of St. Lucie 2 may be found in the applicant's Final Safety Analysis Report.[37] The staff evaluation of these features will be addressed in its Safety Evaluation Report. In addition, the implementation of the lessons learned from the TMI-2 accident, in the form of improvements in design, and procedures and operator training, will significantly reduce the likelihood of a degraded core accident which could result in large release of fission products to the containment. Specifically, the applicant will be required to meet those TMI-related requirements specified in NUREG-0737. As noted in Section 5.10.4.1.4, no credit has been taken for these actions and improvements in discussing the radiological risk of accidents.

5.10.4.1.3.2 Site Features

The NRC's reactor site criteria, 10 CFR Part 100, require that the site for every power reactor have certain characteristics that tend to reduce the risk and potential impact of accidents. The discussion that follows briefly describes the St. Lucie site characteristics and how they meet these requirements.

First, the site has an exclusion area, as required by 10 CFR Part 100. The exclusion area, located within the 1132 acre site owned by the FP&L, is a circular area with a 1554 meters (5100 ft.) radius centered on the St. Lucie 2 containment building. There are no residents within the exclusion area. The applicant owns all surface and mineral rights in the land portions of the exclusion area, and has the authority, required by 10 CFR Part 100, to determine all activities in this area. The exclusion area extends eastward into the Atlantic Ocean as well as westward into the Indian River, so that these waterways, as well as State Road A1A, traverse the exclusion area. Activities unrelated to Plant operation that occur within the exclusion area include traffic on State Road A1A, and water related activities on the Indian River and Atlantic Ocean. In case of an emergency, formal arrangements have been made with Federal, State, and local officials, to control the traffic and other activity on the highway, waterways, and beach traversing the exclusion area.

Second, beyond and surrounding the exclusion area is a low population zone (LPZ), also required by 10 CFR Part 100. The LPZ for St. Lucie 2 is a circular area with a 1.609 km (1 mi) radius, measured from the center of the St. Lucie 2 containment building. Within this zone, the applicant must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents in the event of a serious accident. All land within the LPZ is owned by the applicant (this is <u>not</u> required by 10 CFR Part 100), and only structures related to the operation of the Plant are within this area. There are no other facilities, institutions or residences in the LPZ now, or planned for the future. Transients occasionally use the beach seaward of the mean highwater line. The over-water portions of the LPZ are under the jurisdictional control of State and local government agencies. In case of a radiological emergency, the applicants have made arrangements to carry out protective actions, including evacuation of personnel in the vicinity of the Plant. For further details, see Section 5.10.4.1.3.3 on Emergency Preparedness.

Third, 10 CFR Part 100 also requires that the distance from the reactor to the nearest boundary of a densely populated area containing more than about 25,000 residents be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. Since accidents of greater potential hazards than those commonly postulated as representing an upper limit are conceivable, although highly improbable, it was considered desirable to add the population center distance requirement in 10 CFR Part 100 to provide for protection against excessive exposure doses to people in large centers. The city of Port St. Lucie (with a 1980 population of 14,751 persons) with its closest boundary about 8 km (5 mi) southwest of the site, has been designated as the nearest population center. The population center distance is at least one and one-third times the LPZ outer radius. The major city within 80 km (50 mi) of the St. Lucie site is the urbanized area of West Palm Beach, Florida, located about 55 km (34 mi) south, with a 1978 population of 483,000. Current population density within 48 km (30 mi) of the site is about 105 persons per square mile and is projected to reach about 265 persons per square mile during the life of the plant.

The safety evaluation of the St. Lucie site has also included a review of potential external hazards, i.e., activities offsite that might adversely affect the operation of the Plant and cause an accident. This review encompassed nearby industrial, transportation, and military facilities that might create explosive, missile, toxic gas or similar hazards. The risk to the St. Lucie facility from such hazards has been found to be negligibly small. A more detailed discussion of the compliance with the Commission's siting criteria and the consideration of external hazards is given in the staff's Safety Evaluation Report.

5.10.4.1.3.3 Emergency Preparedness

Emergency preparedness plans including protective action measures for the Plant and environs are in an advanced, but not yet fully completed stage. In accordance with the provisions of 10 CFR 50.47, effective November 3, 1980, no operating license will be issued to a nuclear facility applicant unless a finding is made by the staff that the state of onsite and offsite emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Among the standards that must be met by these plans are provisions for two Emergency Planning Zones (EPZ). A plume exposure pathway EPZ of about 16 km (10 mi) in radius and an ingestion exposure pathway EPZ of about 80 km (50 mi) in radius are required. Other standards include appropriate ranges of protective actions for each of these zones, provisions for dissemination to the public of basic emergency planning information, provisions for rapid notification of the public during a serious reactor emergency, and methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences in the EPZs of a radiological emergency condition.

Staff findings will be based upon a review of the Federal Emergency Management Agency (FEMA) findings and determinations as to whether State and local government emergency plans are adequate and capable of being implemented, and on the staff assessment as to whether the applicants' onsite plans are adequate and capable of being implemented. Staff findings will be reported in its Safety Evaluation Report. Although the presence of adequate and tested emergency plans cannot prevent the occurrence of an accident, it is the judgment of the staff that such plans can and will substantially mitigate the consequences to the public if an accident should occur.

5.10.4.1.4 Accident Risk and Impact Assessment

5.10.4.1.4.1 Design Basis Accidents

As a means of ensuring that certain features of St. Lucie 2 meet acceptable design and performance criteria, the applicant and the staff have analyzed the potential consequences of a number of postulated accidents. Some of these could lead to significant releases of radioactive materials to the environment, and calculations have been performed to estimate the potential radiological consequences to persons offsite. For each postulated initiating event, the potential radiological consequences cover a considerable range of values depending upon how the accident develops and the relevant conditions, including wind direction and weather, prevalent during the accident.

In the safety analysis of St. Lucie 2, three categories of accidents have been considered. These categories are based upon their probability of occurrence and include (a) incidents of moderate frequency, i.e., events that can reasonably be expected to occur during any year of operation, (b) infrequent accidents, i.e., events that might occur once during the lifetime of the plant, and (c) limiting faults, i.e., accidents not expected to occur but that have the potential for significant releases of radioactivity. The radiological consequences of incidents in the first category, also called anticipated operational occurrences, are discussed in Section 5.10.3. Some of the initiating events postulated in the second and third categories for St. Lucie 2 are shown in Table 5.6. These are designated design basis accidents because specific design and operating features, as described above in Section 5.10.4.1.3.1, are provided to limit their potential radiological consequences. Approximate radiation doses that might be received by a person at the nearest site boundary (1550 meters (5100 ft) from the plant) are also shown in Table 5.5, along with a characterization of the time duration of the releases. The results shown in the Table reflect the expectation that ESF and other operating features would function as intended.

Table 5.6 Approximate Doses from Selected Design Basis Accidents

	Duration of Release**	2 hour doses at 1550 meters* Whole Body (rem)
Infrequent accidents:		
Release of liquid waste storage	<2 hours	0.001
Steam Generator Tube Rupture	<2 hours	0.01
Fuel handling accident	<2 hours	0.025
Limiting faults:		
Main steam line break	<2 hours	<0.0005
Control rod ejection	hours-days	<0.0015
Large-break LOCA	hours-days	0.014

*The nearest site (or exclusion area) boundary.

**< means "less than".

Source: FES-CP.

An important consequence of this expectation is that the radioactive releases considered are limited to noble gases and radioiodines and that any other radioactive materials, e.g., in particulate form, are not expected to be released. The results are also quasi-probabilistic in nature in the sense that the meteorological dispersion conditions are taken to be neither the best nor the worst for the site, but rather at an average value determined by actual site measurements. In order to contrast the results of these calculations with those using more pessimistic, or conservative, assumptions described below, the doses shown in Table 5.6 are sometimes referred to as "realistic" doses.

The staff has also carried out calculations to estimate the potential upper bounds for individual exposures from the same initiating accidents in Table 5.6 for the purpose of implementing the provisions of 10 CFR Part 100, "Reactor Site Criteria." For these calculations, much more pessimistic (conservative or worst case) assumptions are made as to the course taken by the accidents and the prevailing conditions. These assumptions include much larger amounts of radioactive material released by the initiating events, additional single failures in equipment, operation of ESF's in a degraded mode,* and very poor meteorological dispersion conditions.

The results of these conservative calculations show that, for these events, the limiting whole-body exposures are not expected to exceed 2.5 rem to any individual at the site boundary. They also show that radioiodine releases have the potential for offsite exposures ranging up to about 65 rem to the thyroid. For such an exposure to occur, an individual would have to be located at a point on the site boundary where the radioiodine concentration in the plume has its highest value and inhale at a breathing rate characteristic of a person jogging, for a period of two hours. The health risk to an individual receiving such a thyroid exposure is the potential appearance of benign or malignant thyroid nodules in about 2 out of 100 cases, and the development of a fatal cancer in about 1 out of 1000 cases.

None of the calculations of the impacts of design basis accidents described in this section takes into consideration possible reductions in individual or population exposures as a result of taking any protective actions.

5.10.4.1.4.2 Probabilistic Assessment of Severe Accidents

In this and the following three sections, the probabilities and consequences of accidents of greater severity than the design basis accidents identified above in Section 5.10.4.1.4.1 are evaluated. As a class, they are considered less likely to occur, but their environmental consequences could be more severe. These more severe accidents, frequently called Class 9 accidents, are different from design basis accidents in two primary respects: they involve substantial physical deterioration of the fuel in the reactor core, including overheating to the point of melting, and they involve deterioration of the capability of the containment structure to perform its intended function of limiting the release of radioactive materials to the environment.

The assessment methodology employed is that described in the Reactor Safety Study (RSS) which was published in 1975.[45]** In 1980, the sets of accident

*The containment system, however, is assumed to prevent leakage in excess of that which can be demonstrated by testing, as provided in 10 CFR 100.11(a).
**Because this report has been the subject of considerable controversy, a discussion of the uncertainties surrounding it is provided in Section 5.10.4.1.4.7.

sequences that were found in the RSS to be the dominant contributors to the risk in the prototype PWR (Surry Unit 1) were updated[46] ("rebaselined"). The rebaselining was done largely to incorporate peer group comments[47] and better data and analytical techniques resulting from research and development after the publication of the RSS. Entailed in the rebasing effort was the evaluation of individual dominant accident sequences as they are understood to evolve. The earlier technique of grouping a number of accident sequences into the encompassing Release Categories as was done in the RSS has been largely eliminated.

St. Lucie 2 is a Combustion Engineering-designed pressurized water reactor having similar design and operating characteristics to the RSS prototype PWR. Therefore, the present assessment for St. Lucie 2 has used as its starting point the rebaselined accident sequences and sequence groups referred to above, and more fully described in Appendix G. Characteristics of the sequences (and release categories) used (all of which involve partial to complete melting of the reactor core) are shown in Table 5.7. Sequences initiated by natural phenomena such as tornadoes, floods, or seismic events and those that could be initiated by deliberate acts of sabotage are not included in these event sequences. The radiological consequences of such events would not be different in kind from those which have been treated. Moreover, it is the staff's judgment, based on design requirements of 10 CFR Part 50, Appendix A, relating to effects of natural phenomena, and safeguards requirements of 10 CFR Part 73, that these events do not contribute significantly to risk.

Calculated probability per reactor year associated with each accident sequence (or release category) used is shown in the second column in Table 5.7. As in the RSS there are substantial uncertainties in these probabilities. This is due, in part, to difficulties associated with the quantification of human error and to inadequacies in the data base on failure rates of individual plant components that were used to calculate the probabilities.[47] (See Section 5.10.4.1.4.7 below.) The probabilities of accident sequences from Surry Unit 1 (the prototype PWR) were used to give a perspective of the societal risk of St. Lucie 2 because, although the probabilities of particular accident sequences may be substantially different for St. Lucie 2, the overall effect of all sequences taken together is likely to be within the uncertainties (see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates).

The magnitudes (curies) of radioactivity releases for each category are obtained by multiplying the release fractions shown in Table 5.7 by the amounts that would be present in the core at the time of the hypothetical accident. These are shown in Table 5.8 for St. Lucie 2 at a core thermal power level of 2754 megawatts.

The potential radiological consequences of these releases have been calculated by the consequence model used in the RSS[48] and adapted to apply to a specific site. The essential elements are shown in schematic form in Figure 5.3. Environmental parameters specific to the St. Lucie site have been used and include the following:

Meteorological data for the site representing a full year of consecutive hourly measurements and seasonal variations.

Table 5.7 Summary of Atmospheric Releases in Hypothetical Accident Sequences in a PWR (Rebaselined)

Accident Sequence or Sequence Group[b]	Probability per reactor-yr	Fraction of Core Inventory Released[a]						
		Xe-Kr	I	Cs-Rb	Te-Sb	Ba-Sr	Ru[c]	La[d]
Event V	2.0×10^{-6}	1.0	0.64	0.82	0.41	0.1	0.04	0.006
TMLB'	3.0×10^{-6}	1.0	0.31	0.39	0.15	0.044	0.018	0.002
PWR 3	3.0×10^{-6}	0.8	0.2	0.2	0.3	0.02	0.03	0.003
PWR 7	4.0×10^{-5}	6×10^{-3}	2×10^{-5}	1×10^{-5}	2×10^{-5}	1×10^{-6}	1×10^{-6}	2×10^{-7}

(a) Background on the isotope groups and release mechanisms is presented in Appendix VII, WASH-1400 (Ref. 45).
(b) See Appendix G for description of the accident sequences and release categories.
(c) Includes Ru, Rh, Co, Mo, Tc.
(d) Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, Cm.

NOTE: Please refer to Section 5.10.4.1.4.7 for a discussion of uncertainties in risk estimates.

Table 5.8 Activity of Radionuclides in the St. Lucie 2 Core at 2754 MWt

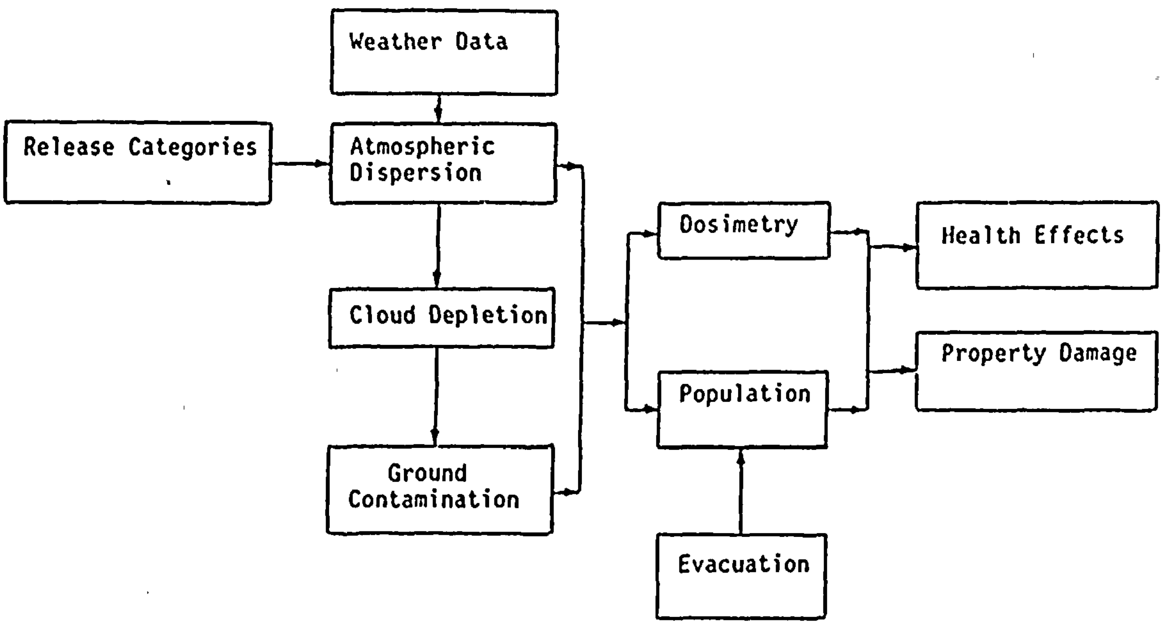
Group/Radionuclide	Radioactive Inventory (millions of curies)	Half-life (days)
A. NOBLE GASES		
Krypton-85	0.48	3,950
Krypton-85m	21	0.183
Krypton-87	40	0.0528
Krypton-88	59	0.117
Xenon-133	150	5.28
Xenon-135	29	0.384
B. IODINES		
Iodine-131	73	8.05
Iodine-132	100	0.0958
Iodine-133	150	0.875
Iodine-134	160	0.0366
Iodine-135	130	0.280
C. ALKALI METALS		
Rubidium-86	0.022	18.7
Cesium-134	6.5	750
Cesium-136	2.6	13.0
Cesium-137	4.0	11,000
D. TELLURIUM-ANTIMONY		
Tellurium-127	5.1	0.391
Tellurium-127m	0.95	109
Tellurium-129	27	0.048
Tellurium-129m	4.6	34.0
Tellurium-131m	11	1.25
Tellurium-132	100	3.25
Antimony-127	5.3	3.88
Antimony-129	28	0.179
E. AKALINE EARTHS		
Strontium-89	81	52.1
Strontium-90	3.2	11,030
Strontium-91	95	0.403
Barium-140	140	12.8
F. COBALT AND NOBLE METALS		
Cobalt-58	0.67	71.0
Cobalt-60	0.25	1,920
Molybdenum-99	140	2.8
Technetium-99m	120	0.25

Table 5.8 (Cont.)

Group/Radionuclide	Radioactive Inventory (millions of curies)	Half-life (days)
F. COBALT AND NOBLE METALS (cont'd.)		
Ruthenium-103	95	39.5
Ruthenium-105	62	0.185
Ruthenium-106	22	366
Rhodium-105	42	1.50
G. RARE EARTHS, REFRACTORY OXIDES AND TRANSURANICS		
Yttrium-90	3.4	2.67
Yttrium-91	100	59.0
Zirconium-95	130	65.2
Zirconium-97	130	0.71
Niobium-95	130	35.0
Lanthanum-140	140	1.67
Cerium-141	130	32.3
Cerium-143	110	1.38
Cerium-144	73	284
Praseodymium-143	110	13.7
Neodymium-147	52	11.1
Neptunium-239	1400	2.35
Plutonium-238	0.049	32,500
Plutonium-239	0.018	8.9×10^6
Plutonium-240	0.018	2.4×10^6
Plutonium-241	2.9	5,350
Americium-241	0.0015	1.5×10^5
Curium-242	0.43	163
Curium-244	0.020	6,630

NOTE: The above grouping of radionuclides corresponds to that in Table 5.6.

Figure 5.3



Schematic Outline of Consequence Model.

- Projected population for the year 2000 extending throughout regions of 80 and 560 km (50 and 350 mi) radius from the site, including estimates of the population of off-shore islands such as Cuba, Grand Bahama Island, and many others.

- The habitable land fraction within the 560 km (350 mi) radius.

- Land use statistics, on a state-wide basis, including farm land values, farm product values including dairy production, and growing season information, for the State of Florida and each surrounding State within the 560 km (350 mi) region. The off-shore islands were assumed to have land use statistics comparable to Florida.

To obtain a probability distribution of consequences the calculations are performed assuming the occurrence of each accident release sequence at each of 91 different "start" times throughout a one-year period. Each calculation utilizes the site specific hourly meteorological data and seasonal information for the time period following each "start" time. The consequence model also contains provisions for incorporating the consequence reduction benefits of evacuation and other protective actions. Early evacuation of people would considerably reduce the exposure from the radioactive cloud and from the contaminated ground in the wake of the cloud passage. The evacuation model used (see Appendix H) has been revised from that used in the RSS for better site-specific application. The quantitative characteristics of the evacuation model used for the St. Lucie site are best estimate values made by the staff and based upon evacuation time estimates prepared by the applicant. Actual evacuation effectiveness could be greater or less than that characterized but would not be expected to be much less, even under adverse conditions.

The other protective actions include: (a) either complete denial of use (interdiction), or permitting use only at a sufficiently later time after appropriate decontamination of food stuffs such as crops and milk, (b) decontamination of severely contaminated environment (land and property) when it is considered to be economically feasible to lower the levels of contamination to protective action guide (PAG) levels, and (c) denial of use (interdiction) of severely contaminated land and property for varying periods of time until the contamination levels reduce to such values by radioactive decay and weathering so that land and property can be economically decontaminated as in (b) above. These actions would reduce the radiological exposure to the people from immediate and/or subsequent use of or living in the contaminated environment.

Early evacuation in the plume exposure pathway EPZ and the other protective actions mentioned above are considered appropriate sequels to serious nuclear reactor accidents at this site involving significant release of radioactivity to the atmosphere. Therefore, the dose consequence results shown for these more severe accidents at St. Lucie 2 include the benefits of these protective actions.

There are also uncertainties in the estimates of consequences, and the error bounds may be as large as they are for the probabilities. It is the judgment of the staff, however, that it is more likely that the calculated results are overestimates of consequences rather than underestimates.

The results of the calculations using this consequence model are radiological doses to individuals and to populations, health effects that might result from these exposures, costs of implementing protective actions, and costs associated with property damage by radioactive contamination.

5.10.4.1.4.3 Dose and Health Impacts of Atmospheric Releases

The results of the calculations of dose and health impacts performed for the St.Lucie 2 facility and site are presented in the form of probability distributions in Figures 5.4 through 5.7 and are included in the impact Summary Table 5.9. All of the accident sequences shown in Table 5.6 contribute to the results. The consequences from each sequence of group of sequences is weighted by its associated probability.

Figure 5.4 shows probability distribution curves for the number of persons who might receive whole body doses equal to or greater than 200 rem and 25 rem, and thyroid doses equal to or greater than 300 rem from early exposure,* all on a per-reactor-year basis. A 200 rem whole body dose corresponds approximately to a threshold value for which hospitalization would be indicated for the treatment of radiation injury. A 25 rem whole body dose (which has been identified earlier as the lower limit for clinically observable physiological effects in nearly all people) and 300 rem thyroid dose are guideline values applied to reactor siting in 10 CFR Part 100.

The Figure shows that there are less than 6 chances in 1,000,000 per year (a 6×10^{-6} probability) that hundreds of persons may receive doses equal to or greater than any of these doses specified.

The chances of very large numbers of persons (thousands) being exposed at the threshold value or guideline dose levels are seen to be considerably smaller. For example, the chances are about 1 in 100,000,000 (a 10^{-8} probability) that 15,000 or more people might receive whole-body doses of 200 rem or greater. It should be noted that a very low probability, such as 10^{-8} per reactor-year, is associated with a large release of radioactive material at a time when there are very infrequent weather conditions that tend to maximize total exposure. A majority of the exposures reflected in this figure would be expected to occur to persons within a 40 km (25 mi) radius of the plant. Virtually all exposures would occur with a 160 km (100 mi) radius.

Figure 5.5 shows the probability distribution for the total population exposure in person-rem, i.e., the probability per reactor-year that the total population

*Early exposure to an individual includes external doses from the radioactive cloud and the contaminated ground, and the dose from internally deposited radionuclides from inhalation of contaminated air during the cloud passage. Other pathways of exposure are excluded.

PROBABILITY DISTRIBUTIONS OF INDIVIDUAL DOSE IMPACTS

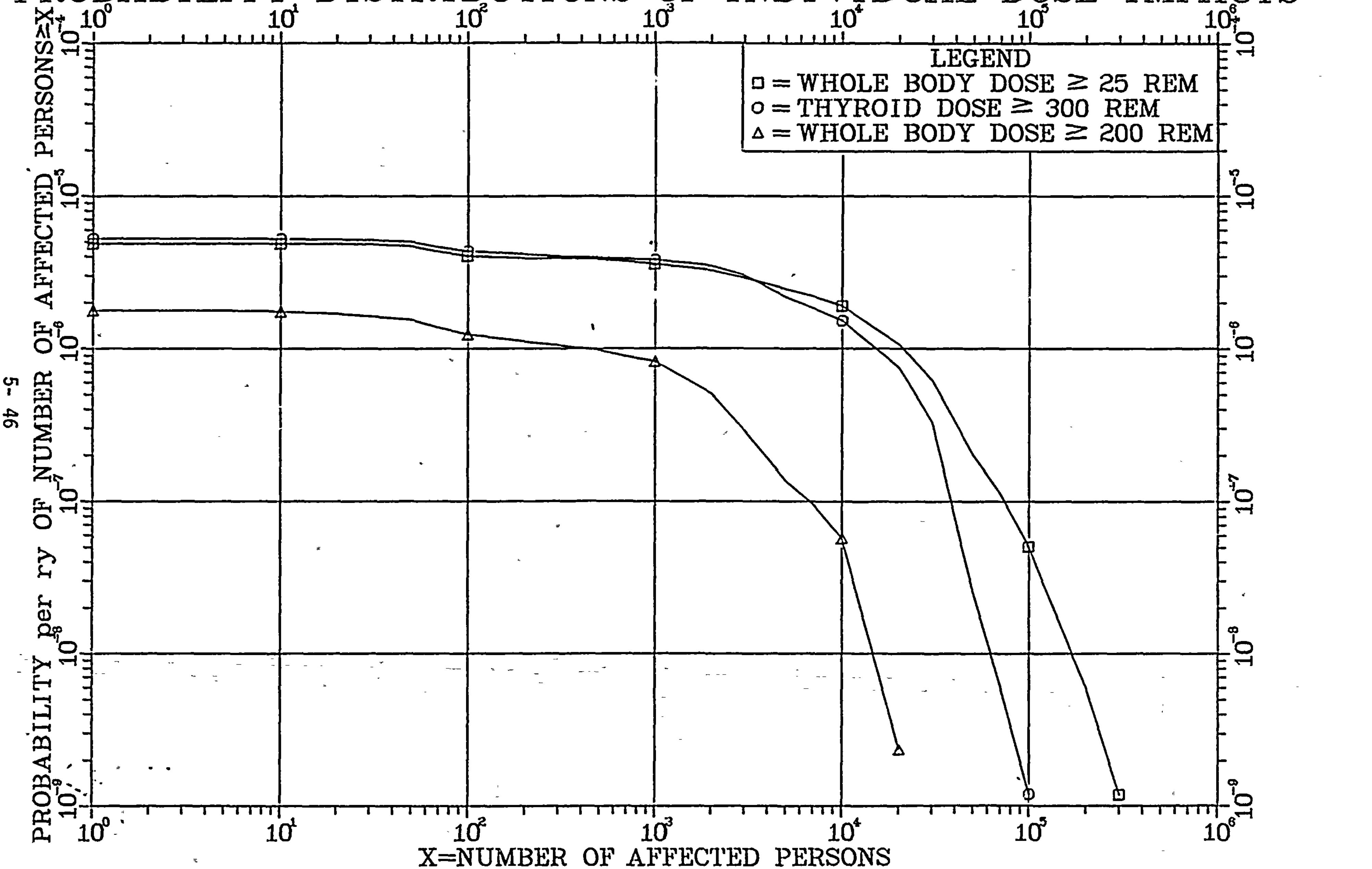


Figure 5.4

Note: Please see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates.

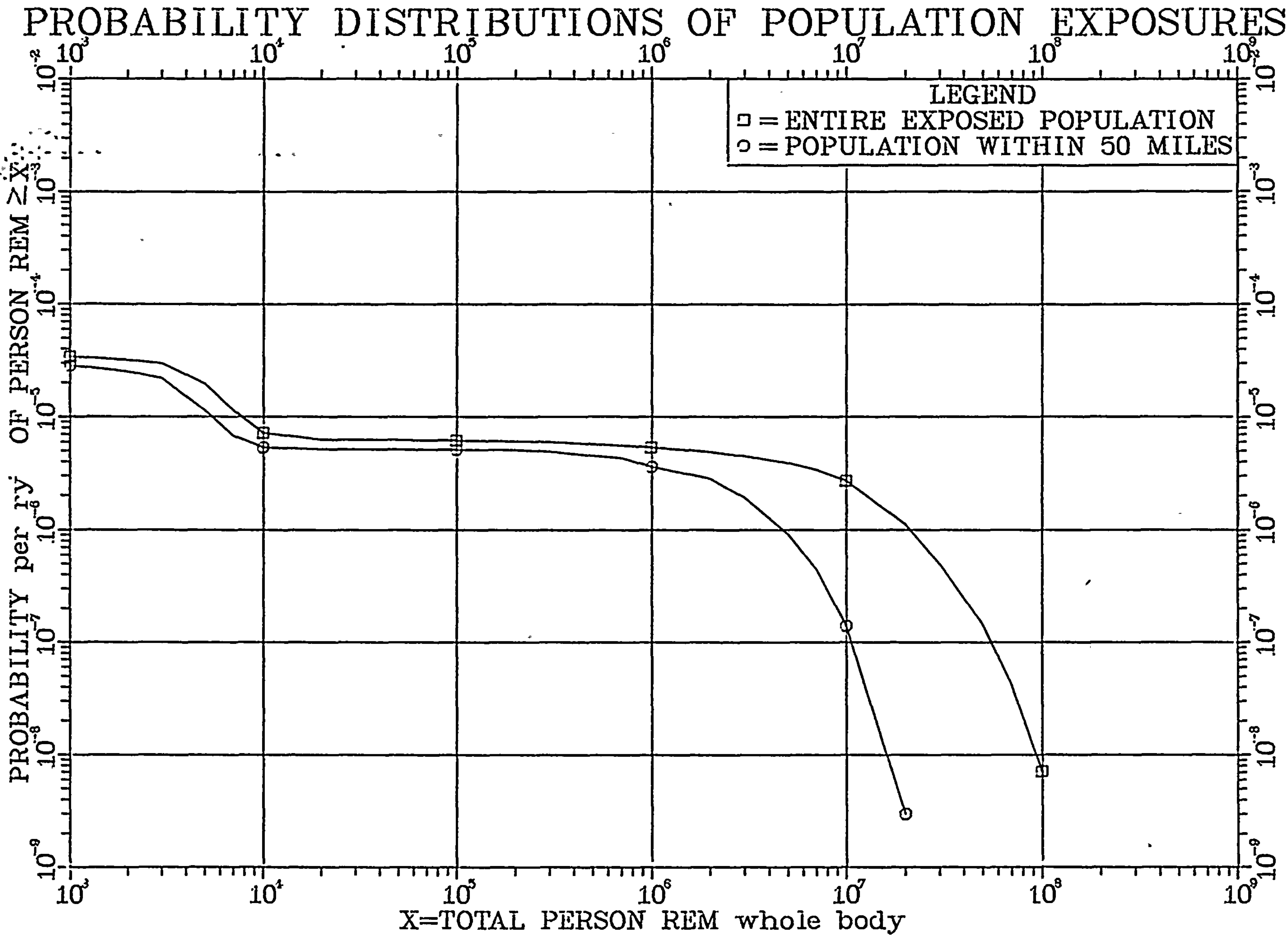


Figure 5.5

Note: Please see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates.

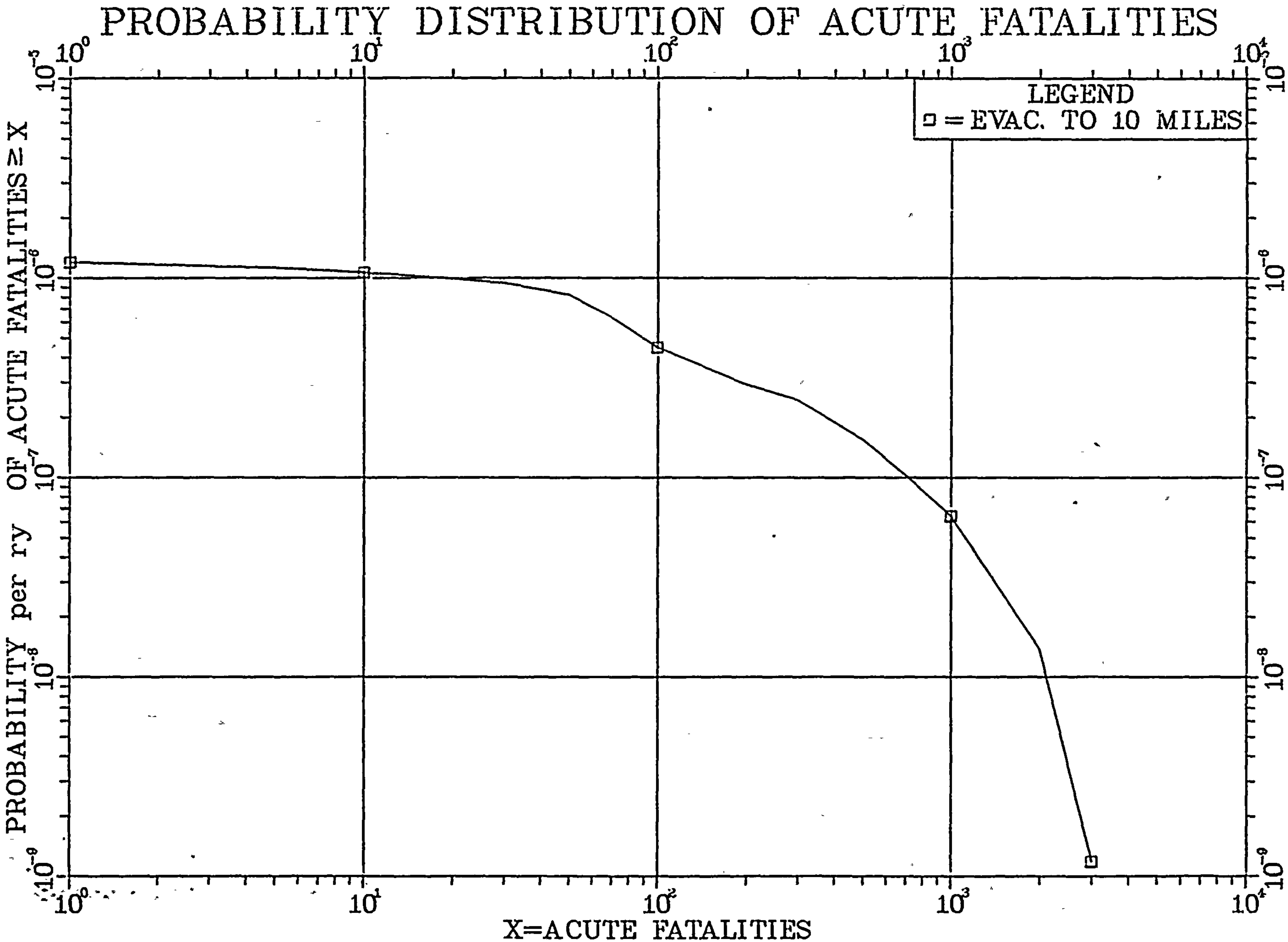


Figure 5.6

Note: Please see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates.

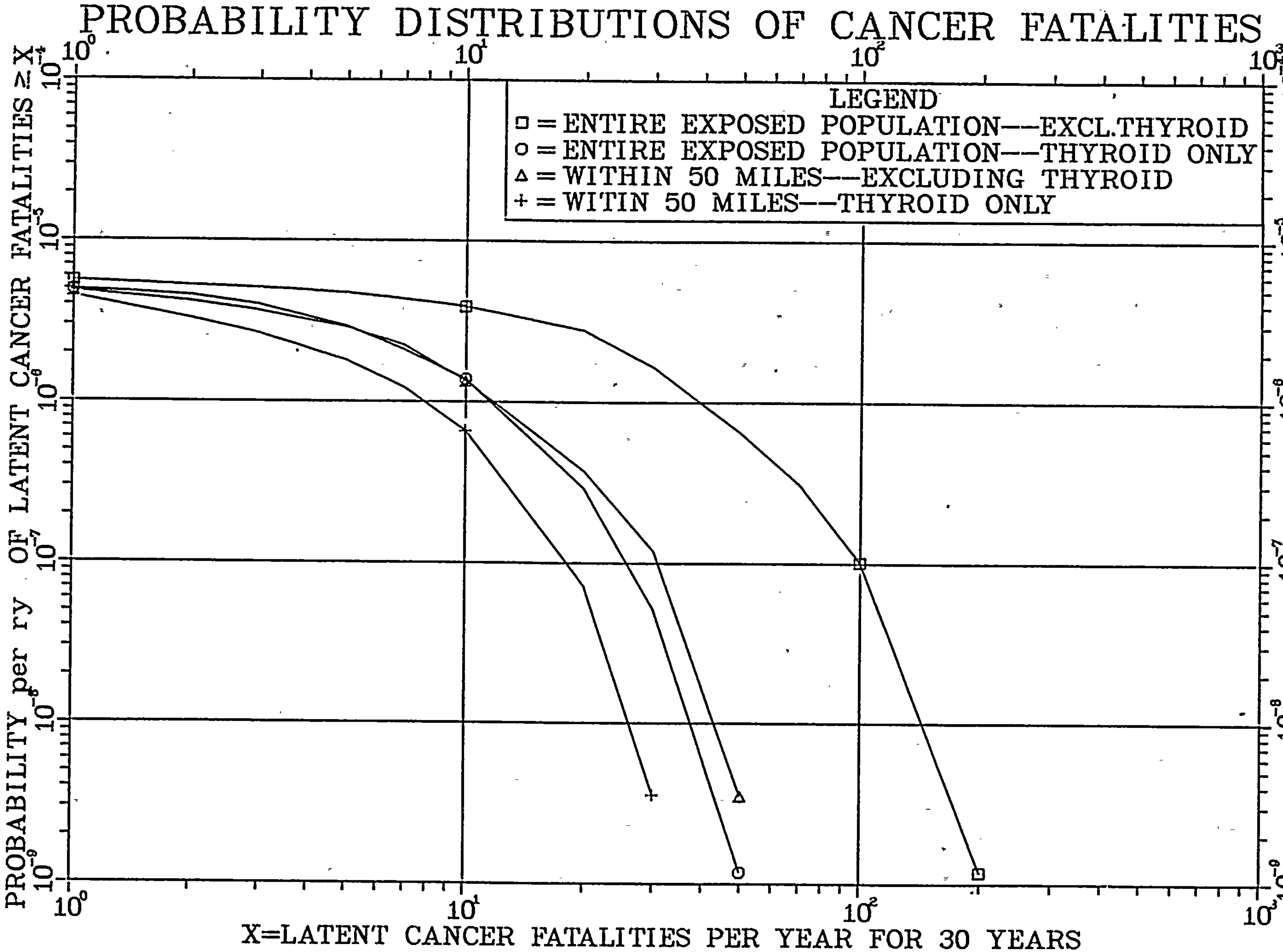


Figure 5.7

Note: Please see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates.

Table 5-9

Summary of Environmental Impacts and Probabilities

Probability of Impact Per Reactor-Year	Persons Exposed over 200 rem	Persons Exposed over 25 rem	Acute Fatalities	Population Exposure Millions of person-rem 50 mi/Total	Latent* Cancers 50 mi/ Total	Cost of Offsite Mitigating Actions Millions of Dollars
10^{-4}	0	0	0	0/0	0/0	0
10^{-5}	0	0	0	0.0056/0.008	0/0	22
5×10^{-6}	0	30	0	0.3/1.9	50/120	100
10^{-6}	400	21,000	19	4.7/21	580/1500	800
10^{-7}	6,800	72,000	700	11/55	1500/3800	1900
10^{-8}	15,000	180,000	2,100	17/92	2000/5300	3200
Related Figure	5.3	5.3	5.5	5.4	5.6	5.7

*Includes cancers of all organs. Thirty times the values shown in the Figure 5.6 are shown in this column reflecting the thirty-year period over which cancers might occur. Genetic effects might be approximately twice the number of latent cancers.

NOTE: Please refer to Section 5.10.4.1.4.7 for a discussion of uncertainties in risk estimates.

exposure will equal or exceed the values given. Much of the population exposure would occur within 80 km (50 mi) but the more severe releases would result in exposure to persons beyond the 80 km (50 mi) range as shown.

For perspective, population doses shown in Figure 5.5 may be compared with the annual average dose to the population within 80 km (50 mi) of the St. Lucie site due to natural background radiation of 100,000 person-rem, and to the anticipated annual population dose to the general public from normal Plant operation of 3.5 person-rem (excluding plant workers).

Figure 5.6 shows the probability distribution for acute fatalities, representing radiation injuries that would produce fatalities within about one year after exposure. Virtually all of the acute fatalities would be expected to occur within a 20 km (12.5 mi) radius. The results of the calculations shown in this figure and in Table 5.9 reflect the effect of evacuation within the 16 km (10 mi) plume exposure pathway EPZ only. For the very low probability accidents having the potential for causing radiation exposure above the threshold for acute fatality at distances beyond 16 km (10 mi), it would be realistic to expect that authorities would evacuate persons at all distances at which such exposures might occur. Acute fatality consequences would therefore reasonably be expected to be less than the numbers shown.

Figure 5.7 represents the statistical relationship between population exposure and the induction of fatal latent cancers--that is, those cancers that might appear over a period of many years following exposure. The impacts on the total population and the population within 80 km (50 mi) are shown separately. The fatal latent cancers have been subdivided into those attributable to exposures of the thyroid and to those attributable to exposures of all other organs.

5.10.4.1.4.4 Economic and Societal Impacts

As noted in Section 5.10.4.1.1, the various measures for avoidance of adverse health effects including those due to residual radioactive contamination in the environment are possible consequential impacts of severe accidents. Calculations of the probabilities and magnitudes of such impacts for St. Lucie 2 and environs have also been made. Unlike the radiation exposure and adverse health effect impacts discussed above, impacts associated with adverse health effects avoidance are more readily transformed into economic impacts.

The results are shown as the probability distribution for costs of offsite mitigating actions in Figure 5.8 and are included in the impact Summary Table 5.8. The factors contributing to these estimated costs include the following:

- Evacuation costs
- Value of crops contaminated and condemned
- Value of milk contaminated and condemned
- Costs of decontamination of property where practical
- Indirect costs due to loss of use of property and incomes derived therefrom.

The last named costs would derive from the necessity for interdiction to prevent the use of property until it is either free of contamination or can be economically decontaminated.

Figure 5.8 shows that at the extreme end of the accident spectrum these costs could exceed billions of dollars but that the probability that this would occur is exceedingly small, less than one chance in one million per year.

Additional economic impacts that can be monetized include costs of decontamination of the facility itself and the costs of replacement power. Probability distributions for these impacts have not been calculated, but they are included in the discussion of risk considerations in Section 5.10.4.1.4.6 below.

5.10.4.1.4.5 Releases to Groundwater

A pathway for public radiation exposure and environmental contamination that would be unique for severe reactor accidents was identified in Section 5.10.4.1.1 above. Consideration has been given to the potential environmental impact of this pathway for the St. Lucie Plant. The principal contributors to the risk are the core melt accidents associated with the PWR-1 through 7 release categories. The penetration of the basemat of the containment building can release molten core debris to the geologic strata beneath the Plant. Soluble radionuclides in this debris can be leached and transported with groundwater to downgradient domestic wells used for drinking or to surface water bodies used for aquatic food and recreation. In pressurized water reactors, such as the St. Lucie Plant, there is an additional opportunity for groundwater contamination due to the release of contaminated sump water to the ground through a breach in the containment.

An analysis of the potential consequences of a liquid pathway release of radioactivity for generic sites was presented in the "Liquid Pathway Generic Study" (LPGS).[49] The LPGS compared the risk of accidents involving the liquid pathway (drinking water, irrigation, aquatic food, swimming and shoreline usage) for four conventional, generic land-based nuclear plants and a floating nuclear plant, for which the nuclear reactors would be mounted on a barge and moored in a water body. Parameters for the land-based sites were chosen to represent averages for a wide range of real sites and are thus "typical," but represented no real site in particular.

The discussion in this section is an analysis to determine whether or not the St. Lucie site liquid pathway consequences would be uniquely severe when compared to land-based sites considered in the LPGS. The method consists of a direct scaling of the LPGS population doses based on the relative values of key parameters characterizing the LPGS "ocean" site and the St. Lucie site. The parameters which were evaluated included amounts of radioactive materials entering the ground, groundwater travel time, sorption on geologic media, surface water transport, aquatic food consumption, and shoreline usage.

Doses to individuals and populations were calculated in the LPGS without consideration of interdiction methods such as isolating the contaminated groundwater or denying use of the water. In the event of surface water contamination, commercial and sports fishing, as well as many other water-related

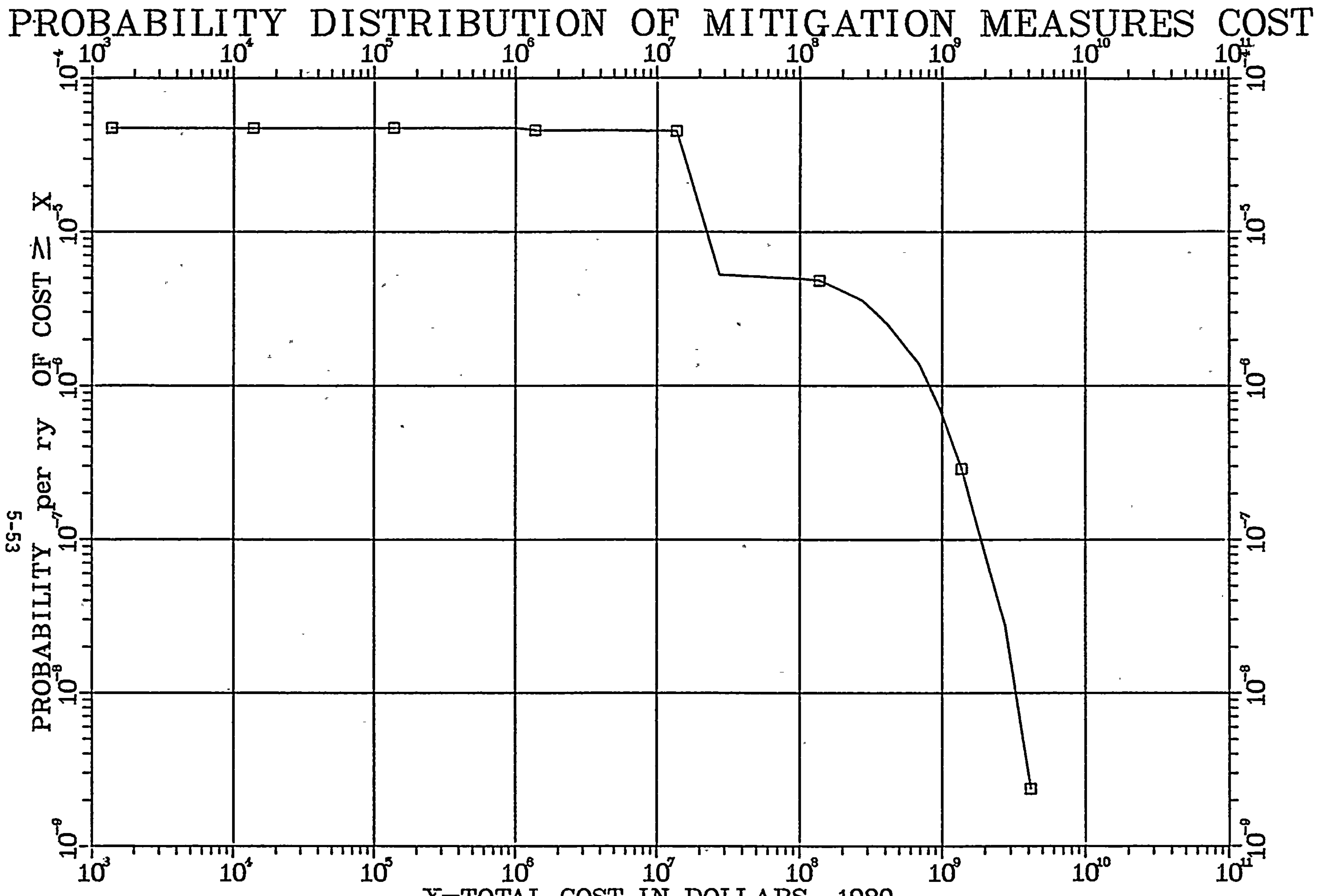


Figure 5.8

Note: Please see section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates activities, would be restricted. The consequences would therefore be largely economic or social, rather than radiological. In any event, the individual and population doses for the liquid pathway range from fractions to very small fractions of those that can arise from the airborne pathways.

The St. Lucie site is located on Hutchinson Island, which is a typical east coast barrier island in southern Florida. The site is bordered by the Indian River (an estuarine bay) on the southwest, the Atlantic Ocean on the northeast and Big Mud Creek (a backwater off the Indian River) on the northwest. Groundwater flows in several layers under the site, but the only flows which concern the liquid pathway analysis are in the unconsolidated sand and silt water table aquifer of the Anastasia formation.

The Anastasia formation is roughly 50 meters (150 feet) thick at the site. Ground water flows in this formation are generally toward the Atlantic Ocean, caused by recharge from precipitation on the mainland. The Indian River comes between Hutchinson Island and the mainland, but is too shallow to intercept the major portion of ground water flow toward the ocean. Piezometers located on Hutchinson Island generally show a slight gradient of 0.00016 toward the ocean.[37] Using the applicant's site parameters shown in Table 5.9, the staff calculated a ground water travel time of 1180 years to the Atlantic Ocean. This compares to a ground water travel time of 0.61 years used in the LPGS ocean-based case,[49] which would clearly demonstrate the superiority of the St. Lucie site for the liquid pathway contribution to risk if it could be determined that this is the only pathway for contaminants released to groundwater to reach the surface water.

There exists, however, the possibility of an alternative pathway for contamination of surface water via groundwater travel to Big Mud Creek. The placement of piezometers on Hutchinson Island is not adequate to show the existence of a gradient toward Big Mud Creek, which is the closest body of surface water. A phenomenon on many islands is the presence of a fresh water lens in the water table which floats over salt water. The lens is supported by the infiltration of fresh water from precipitation. It is thickest in the middle of the island and thinnest at the coasts. It is the possibility of a gradient in the fresh water lens towards Big Mud Creek that is of concern here.

The staff analyzed the transport of radioactively contaminated water released to the postulated fresh water lens using an analytical method based on the Ghyben-Hertzberg approximation for fresh water lenses.[50] The estimated minimum travel time for groundwater to reach Big Mud Creek is 29 years.

For groundwater travel times on the order of years, the staff has shown[49] that the only significant radionuclide contributors to the liquid pathway population dose from an assumed core melt accident would be Sr90 and Cs137. These two nuclides interact chemically with most geologic media and thus travel more slowly than the groundwater. Conservative values of the retardation factors, which reflect the effects of sorption of the radionuclides on geologic materials, were estimated by the applicant to be 9.5 for Sr and 86 for Cs. The staff considers these values to be conservative, and consistent with ranges of retardation factors displayed by geologic materials similar to those found under the site.[51] Using these values the staff estimates that the mean groundwater transport time from the reactor buildings to Big Mud Creek would be 278 years

Table 5.10 - Comparison of St. Lucie and LPGS Land Based Ocean Site Liquid Pathway Consequences

Parameter		LPGS	St. Lucie-Groundwater Flow to Atlantic Ocean	St. Lucie-Groundwater Flow to Big Mud Creek
Groundwater Velocity		2m/day (6.7 ft/day)	0.00173 m/day (0.00568 ft/day)	N/A
Distance to Surface Water		460m (1500 ft)	745m (2444 ft)	218m (700 ft)
Effective Porosity		0.2	0.4	0.4
Permeability		N/A	5×10^{-3} cm/sec (5173 ft/yr)	5×10^{-3} cm/sec
Groundwater Travel Time (years)		0.61	1180	29
Retardation Coefficients	Sr	9.2	9.5	9.5
	Cs	83	86	86
Radionuclide Travel Time (years)	Sr	5.7	11,000	278
	Cs	51	100,000	2520
Fraction Reaching surface water	Sr-90	0.87	~0	0.0013
	Cs-137	0.31	~0	6.3×10^{-26}
Total finfish & shellfish annual harvest within 80 km		1.9×10^{6} Kg (2.1×10^{3} tons)	2.6×10^{7} Kg (2.9×10^{4} tons)	2.6×10^{7} Kg
Population dose relative to LPGS-aquatic				
food		1.0	~0	0.0078
shoreline		1.0	~0	~0

for Sr-90 and 2520 years for Cs-137. Groundwater travel times to the Atlantic Ocean would be much longer, about 11,000 years for Sr-90 and 100,000 years for Cs-137.

When these travel times are compared to the 5.7 years for Sr-90 and 51 years for Cs-137 used in the LPGS land-based ocean site case, the relatively larger travel times for the St. Lucie site would allow a much smaller fraction of the released radioactivity to escape to the surface water. This reduction would be about a factor of 775 for Sr-90 in the pathway to Big Mud Creek. Virtually all of the Cs-137 would have decayed before reaching surface water via either pathways as would the Sr-90 for the pathway to the Atlantic Ocean.

Contaminated water reaching Big Mud Creek would subsequently be transported into the Indian River and then carried to the Atlantic Ocean. The two potential liquid exposure pathways for the site are aquatic food consumption and direct shoreline exposure.

The applicant estimated the commercial and recreational finfish and shellfish harvests within 80 km (50 mi) of the St. Lucie site to be about 2.6×10^7 Kg/yr (2.9×10^4 tons/yr).[52] This value includes all brackish inland waterways. The staff considers these values for the amount of affected seafood harvest to be conservative for the reason that much of these waters would be unaffected by the assumed releases from the Plant. The LPGS evaluation considered only the recreational and commercial fishing offshore, which is taken to be about 1.9×10^6 Kg/yr (2100 tons/yr). Therefore, the St. Lucie catch is taken to be a factor of about 14 times greater than the LPGS catch.

Approximately 62 percent of the population dose from aquatic food consumption calculated in the LPGS was due to Cs-137 and approximately 38 percent was due to Sr-90. The only significant radionuclide which could enter the ocean from the liquid pathway in the St. Lucie case is Sr-90 via the Big Mud Creek pathway. The staff has conservatively estimated, therefore, that the uninterdicted population dose in the St. Lucie case would be at least a factor 930 smaller than the LPGS case for seafood consumption.

Nearly all of the direct shoreline exposure in the LPGS case was determined to be caused by Cs-137. Since virtually all of the Cs-137 would decay before reaching the ocean, the direct exposure pathway can be eliminated from further consideration. Results of these analyses are summarized in Table 5.9. The St. Lucie liquid pathway contribution to population dose has, therefore, been demonstrated to be smaller than that predicted for the LPGS land based ocean site, which represents a "typical" ocean site. Thus the St. Lucie site is not unique in its liquid pathway contribution to risk.

There are measures which could be taken to minimize the impact of the liquid pathway. The staff estimated that the minimum groundwater travel time from the St. Lucie site to Big Mud Creek would be at least 29 years. In addition, the holdup of important radionuclides would provide additional time to utilize engineering measures such as slurry walls and well point dewatering to isolate the radioactive contaminants at the source.[53]

5.10.4.1.4.6 Risk Considerations

The foregoing discussions have dealt separately with the probabilities and consequences of accidents. These two factors are combined to obtain average measures of environmental risk of accidents. Such averages can be particularly instructive as an aid to the comparison of radiological risks associated with accident releases and with normal operational releases.

A common way in which this combination of factors is used to estimate risk is to multiply the probabilities by the consequences. The estimate is then expressed numerically as consequences expected per unit of time. By use of such a quantification of risk the staff does not mean to assert that there is universal agreement that people's attitudes about risk, or what constitutes an acceptable risk, should be governed solely by such a measure. Nevertheless, we believe that it can be a contributing, but not necessarily decisive, factor in making a risk judgment.

Table 5.10 shows average annual values of risk for the St. Lucie 2 reactor, associated with population dose, acute fatalities, latent fatalities, and costs for evacuation, other protective actions, and decontamination. These average values are obtained by multiplying the probabilities by the consequences, and summing these products over the entire range of consequence distribution. Since the probabilities are on a per reactor-year basis, the average risks shown are also on a per reactor-year basis.

The population exposure may be compared with those for normal operation releases shown in Appendix F, Table F.5. The population exposure risk within 80 km (50 mi) due to accidents is about 15 person-rem, higher than the average annual dose of 3.5 person-rem due to normal operations. The two figures are roughly comparable, however, considering the uncertainties involved.

There are no acute fatality or economic risks associated with protective actions and decontamination for normal releases; therefore, these risks are unique for accidents. For perspective and understanding of the meaning of the acute fatality accident risk estimate of 0.0003 per year, the staff notes that the population at risk is mostly within about 16 km (10 mi) of the plant (about 117,000 persons in the year 2000). The risk of accidental fatalities per year for a population of this size, based upon overall averages for the United States, are approximately 26 for motor vehicle accidents, 9 from falls, 4 from drowning, 3 from burns, and 1 from firearms.[54]

The economic risk associated with protective actions and decontamination could be compared with property damage costs associated with alternative energy generation technologies. The use of fossil fuels, coal or oil, for example, would emit substantial quantities of sulfur dioxide and nitrogen oxides into the atmosphere, and, among other things, lead to environmental and ecological damage through the phenomenon of acid rain.[55] This effect has not, however, been sufficiently quantified to draw a useful comparison at this time.

Figure 5.9 shows the calculated risk expressed as whole-body dose to an individual from early exposure as a function of the distance from the Plant within the plume exposure pathway EPZ. The values are on a per reactor-year basis and all accident sequences and sequence groups in Table 5.6 contributed to the dose, weighted by their associated probabilities.

Table 5.11 Average Values of Environmental Risks Due to Accidents, per Reactor-Year

Population exposure	
person-rem within 80 km (50 mi)	15
person-rem total	70
Acute fatalities	0.0003
Latent cancer fatalities	
all organs excluding thyroid	0.004
thyroid only	0.0012
Cost of protective actions and decontamination	$3,500

NOTE: See Section 5.10.4.1.4.7 for discussions of uncertainties in risk estimates.

Evacuation and other protective actions reduce the risks to an individual of acute and latent cancer fatalities. Figures 5.10 and 5.11 show curves of constant risk, as a function of distance, per reactor-year, to an individual living in the St. Lucie 2 plume exposure pathway EPZ, of acute death and death from latent cancer, respectively, due to potential accidents in the reactor. Directional variation of these curves reflect the variation in the average fraction of the year the wind would be blowing into different directions from the Plant. For comparison the following risks of fatality per year to an individual living in the U.S. may be noted;[54] automobile accident 2.2×10^{-4}, falls 7.7×10^{-5}, drowning 3.1×10^{-5}, burning 2.9×10^{-5}, and firearms 1.2×10^{-5}.

There are other economic impacts and risks that can be assigned a monetary value that are not included in the cost calculations discussed in Section 5.10.4.1.4.4. These are accident impacts on the facility itself that result in added costs to the public, i.e., ratepayers, taxpayers and/or shareholders. These costs would be associated with decontamination, repair or replacement of the facility, and for replacement power.

No detailed methodology has been developed for estimating the contributions of an accident to the economic risks to the licensee for decontamination and restoration of the plant. Experience with such costs is currently being accumulated as a result of the Three Mile Island accident. If an accident occurred during the first year of St. Lucie 2 (1984) operation, the economic penalty associated with the initial year of the unit's operation is estimated at $1.0 billion for decontamination and $600 million for restoration, including replacement of the damaged nuclear fuel. The staff considers the estimate as conservative (high) in that the total costs are assumed to occur during the

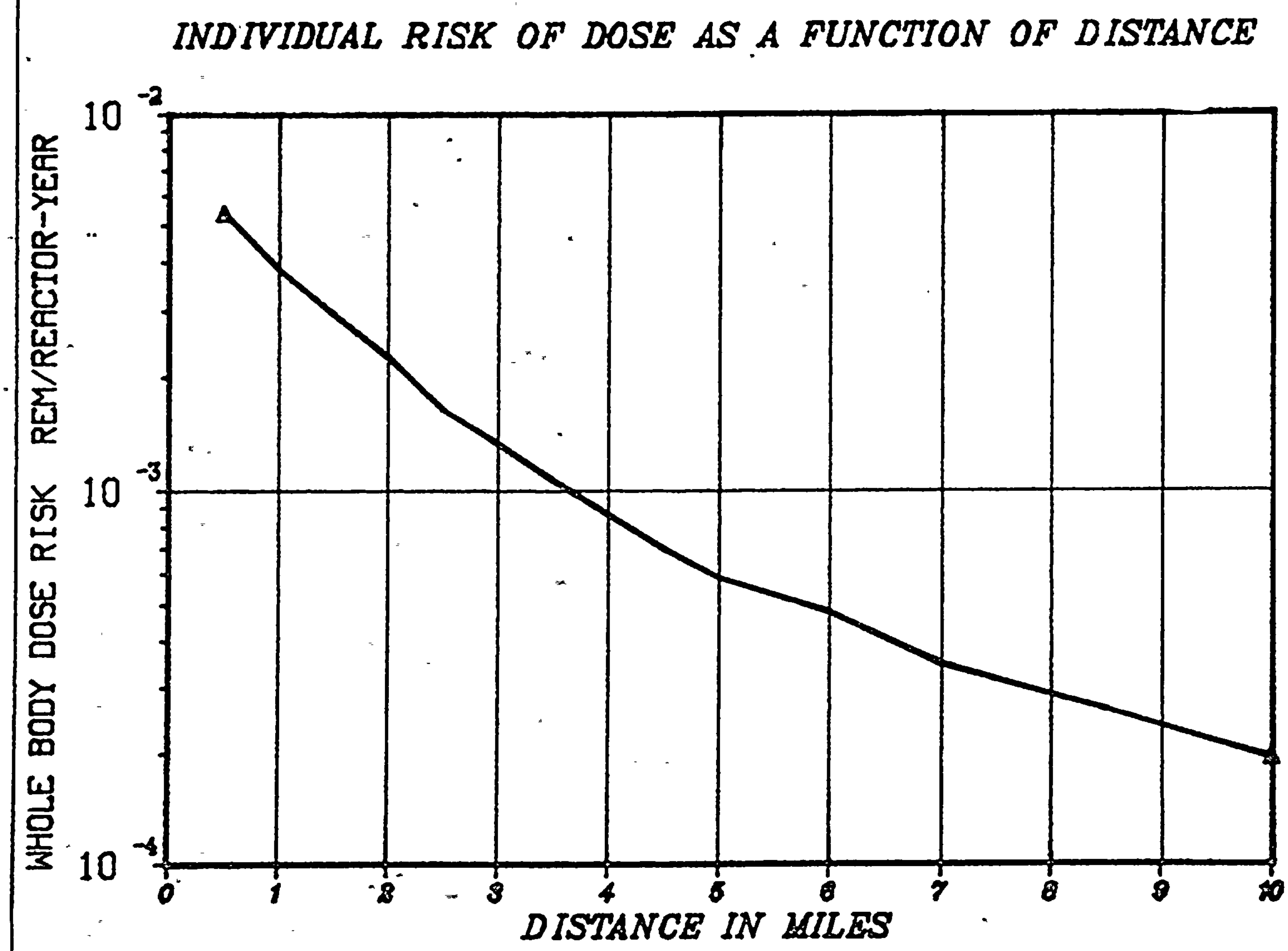


Figure 5.9

Note: Please see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates.

Figure 5.10
Isopleths of Risk of Acute Fatality per Reactor Year to an Individual
Note: Please see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates.

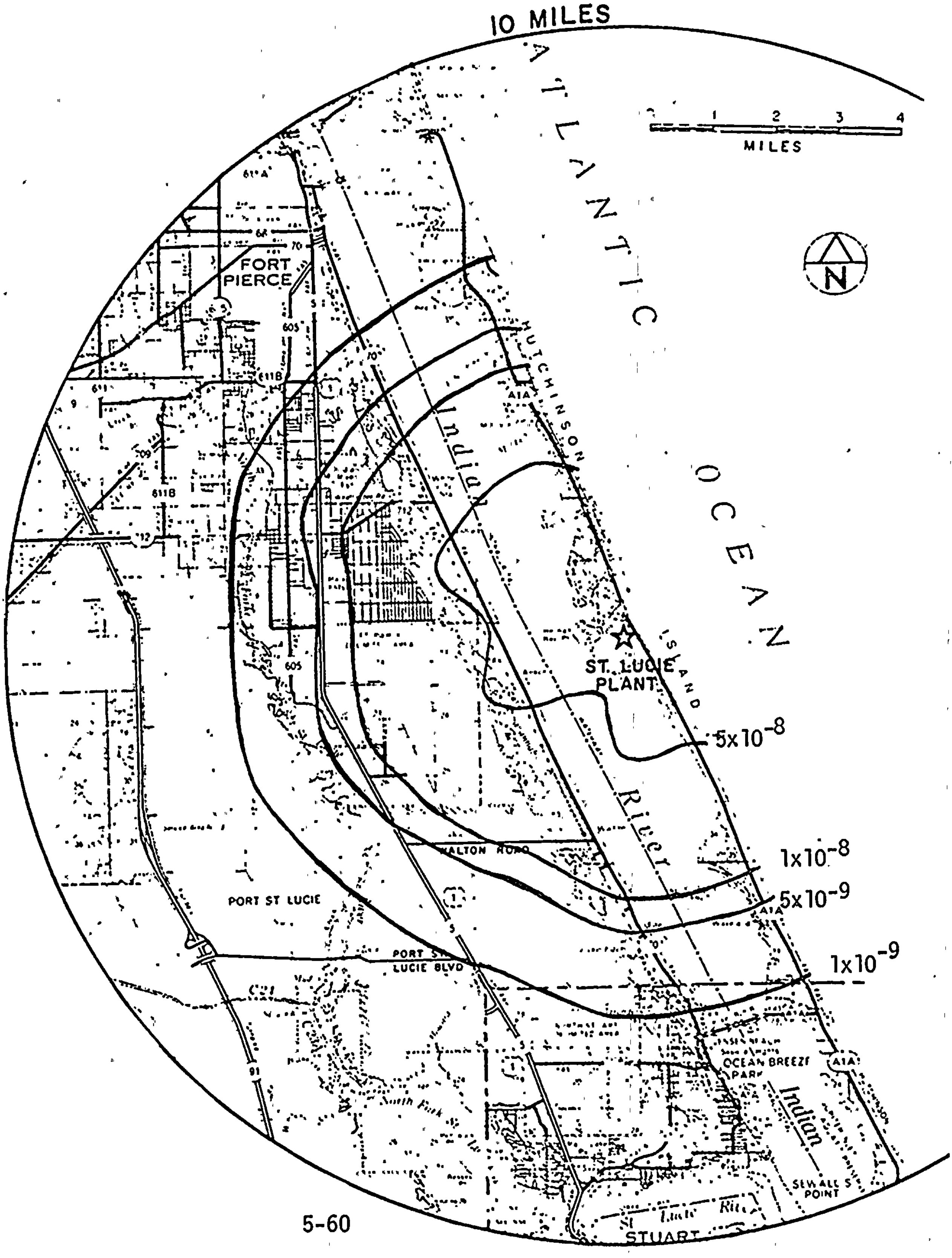
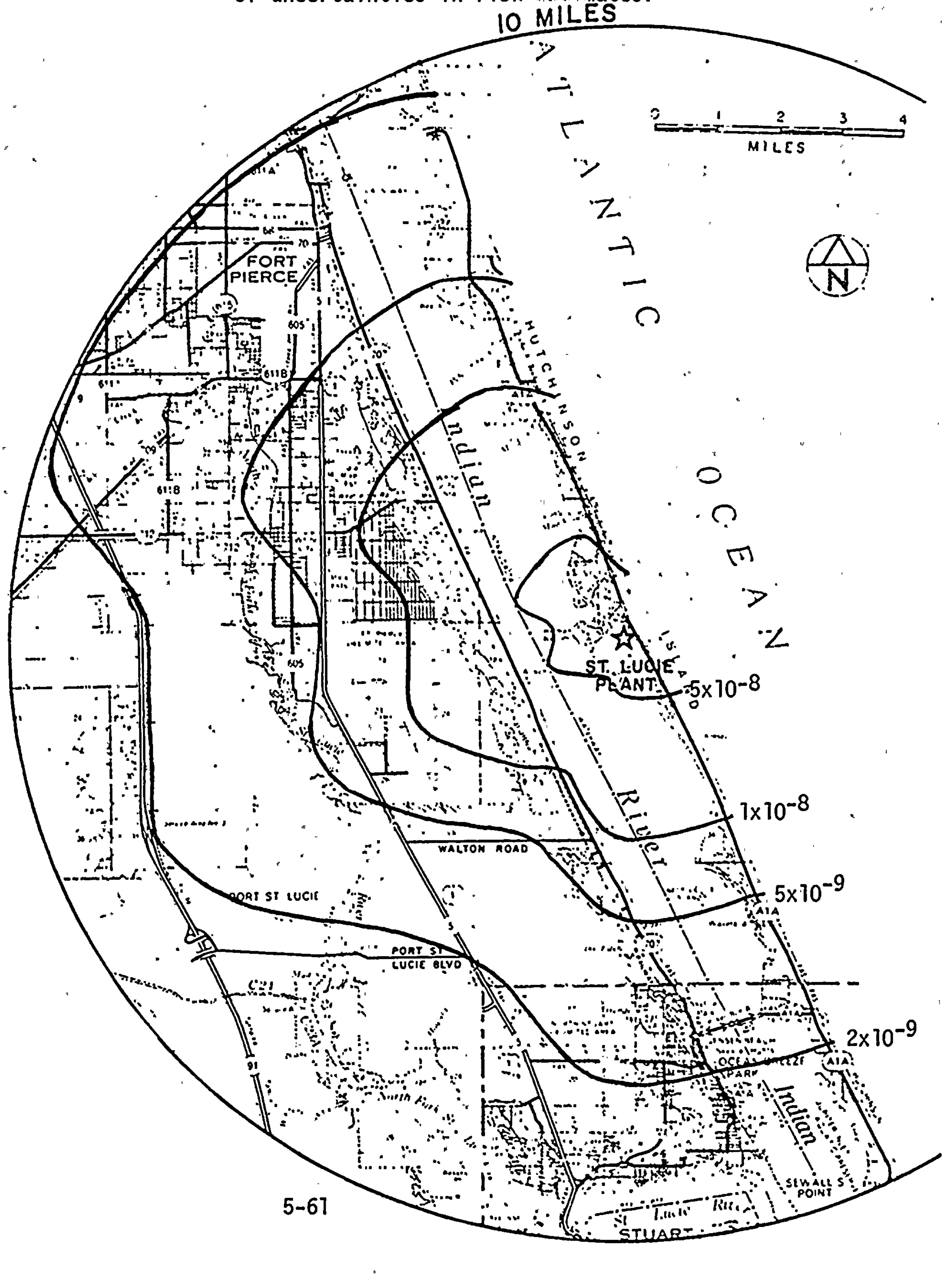


Figure 5.11
Isopleths of Risk of Latent Cancer Fatality per Reactor Year to an Individual
Note: Please see Section 5.10.4.1.4.7 for discussion of uncertainties in risk estimates.



first year of the accident whereas in reality the costs would be spread over several years thereafter. Although insurance would cover $300 million of the $1600 million, the insurance is not credited against the $1600 million because the $300 million times the risk probability should theoretically balance the insurance premium. In addition, the staff estimates additional fuel costs of $225 million (1984 dollars) for replacement power during each year the unit is being restored. This estimate assumes that the energy that would have been forthcoming from St. Lucie 2 (assuming 60% capacity factor) will be replaced primarily by oil-fired generation. Assuming $225 million per year for replacement power costs and inoperation of St. Lucie 2 for 8 years, the total additional replacement power costs in 1984 dollars would be approximately $1.8 billion.

If the probability of sustaining a total loss of the original unit is taken as the sum of the occurrence of a core melt accident (the sum of the probabilities for the categories in Table 5.7), then the probability of a disabling accident happening during each year of the units service life is 4.8×10^{-5}. Multiplying the previously estimated cost of $3.4 billion for an accident to St. Lucie 2 during the initial year of its operation by the above 4.8×10^{-5} probability results in an economic risk of approximately $165,000 applicable to St. Lucie 2 during its first year of operation. This is also approximately the economic risk during the second and each subsequent year of its operation. Although nuclear units depreciate in value and may operate at reduced capacity factors such that the economic consequences due to an accident become less as the units become older, this is offset by higher costs of decontamination and restoration of the unit in the later years due to inflation.

5.10.4.1.4.7 <u>Uncertainties</u>

The foregoing probabilistic and risk assessment discussion has been based upon the methodology presented in the Reactor Safety Study (RSS) which was published in 1975.

In July 1977, the NRC organized an Independent Risk Assessment Review Group to (1) clarify the achievements and limitations of the Reactor Safety Study Group, (2) assess the peer comments thereon and the responses to the comments, (3) study the current state of such risk assessment methodology, and (4) recommend to the Commission how and whether such methodology can be used in the regulatory and licensing process. The results of this study were issued September 1978.[47] This report, called the Lewis Report, contains several findings and recommendations concerning the RSS. Some of the more significant findings are summarized below.

- A number of sources of both conservatism and nonconservatism in the probability calculations in RSS were found, which were very difficult to balance. The Review Group was unable to determine whether the overall probability of a core melt given in the RSS was high or low, but they did conclude that the error bands were understated.

- The methodology, which was an important advance over earlier methodologies that had been applied to reactor risk, was sound.

- It is very difficult to follow the detailed thread of calculations through the RSS. In particular, the Executive Summary is a poor description of the contents of the report, should not be used as such, and has lent itself to misuse in the discussion of reactor risk.

On January 19, 1979, the Commission issued a statement of policy concerning the RSS and the Review Group Report. The Commission accepted the findings of the Review Group.

The accident at Three Mile Island occurred in March 1979 at a time when the accumulated experience record was about 400 reactor years. It is of interest to note that this was within the range of frequencies estimated by the RSS for an accident of this severity.[56] It should also be noted that the Three Mile Island accident has resulted in a very comprehensive evaluation of reactor accidents like that one, by a significant number of investigative groups both within NRC and outside of it. Actions to improve the safety of nuclear power plants have come out of these investigations, including those from the President's Commission on the Accident at Three Mile Island, and staff investigations and task forces. A comprehensive "NRC Action Plan Developed as a Result of the TMI-2 Accident," NUREG-0660, Vol. I, May 1980 collects the various recommendations of these groups and describes them under the subject areas of: Operational Safety; Siting and Design; Emergency Preparedness and Radiation Effects; Practices and Procedures; and NRC Policy, Organization and Management. The action plan presents a sequence of actions, some already taken, that will result in a gradually increasing improvement in safety as individual actions are completed. St. Lucie 2 is receiving and will receive the benefit of these actions. The improvement in safety from these actions has not been quantified, however, and the radiological risk of accidents discussed in this chapter does not reflect these improvements.

Subsequent to the preparation of this section of the Draft Environmental Statement by the staff, the applicant has submitted (Reference 2) revised estimates of population, based on 1980 census data, and reviewed estimates of population growth within 50 miles of the St. Lucie site over the projected life span of the plant. These projections reflect a large growth rate of population, particularly within 10 miles of the plant, than those used in the consequence calculations presented herein. These projections are currently under review by the staff and if corrections are necessary, revisions will be reflected in the FES. The principal effect of these revised projections would be expected to show higher risks of acute fatalities, but still well within the range of risks that have been estimated for existing operating plants.

5.10.4.2 <u>Conclusions</u>

The foregoing sections consider the potential environmental impacts from accidents at St. Lucie 2. These have covered a broad spectrum of possible accidental releases of radioactive materials into the environment by atmospheric and groundwater pathways. Included in the considerations are postulated design basis accidents and more severe accident sequences that lead to a severely damaged reactor core or core melt.

The environmental impacts that have been considered include potential radiation exposures to individuals and to the population as a whole, the risk of near- and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment. These impacts could be severe, but the likelihood of their occurrence is judged to be small. This conclusion is based on (a) the fact that considerable experience has been gained with the operation of similar facilities without significant degradation of the environment; and (b) a probabilistic assessment of the risk based upon the methodology developed in the Reactor Safety Study. The overall assessment of environmental risk of accidents, assuming protective action, shows that it is somewhat higher, but comparable to, the risk for normal operational releases, although accidents have a potential for acute fatalities and economic costs that cannot arise from normal operations. The risk of acute fatalities from potential accidents at the site are small in comparison with the risk of acute fatalities from other human activities in a comparably sized population.

The staff has concluded that there are no special or unique features about the St. Lucie 2 site and environs that would warrant additional mitigation features for St. Lucie 2.

5.11 Impacts from the Uranium Fuel Cycle

The Uranium Fuel Cycle rule, 10 CFR 51.20 (44 FR 45362), reflects the latest information relative to the reprocessing of spent fuel and to radioactive waste management as discussed in NUREG-0116, Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle,[57] and NUREG-0216,[58] which presents staff responses to comments on NUREG-0116. The rule also considers other environmental factors of the uranium fuel cycle, including aspects of mining and milling, isotopic enrichment, fuel fabrication, and management of low- and high-level wastes. These are described in the AEC report WASH-1248, Environmental Survey of the Uranium Fuel Cycle.[59] The Commission also directed that an explanatory narrative be developed that would convey in understandable terms the significance of releases in the table. The narrative was also to address such important fuel cycle impacts as environmental dose commitments and health effects, socioeconomic impacts and cumulative impacts, where these are appropriate for generic treatment. This explanatory narrative was published in the Federal Register on March 4,1981 (46 FR 15154-15175). Appendix I to this Statement contains a number of sections that address those impacts of the fuel cycle that reasonably appear to have significance for individual reactor licensing sufficient to warrant attention for NEPA purposes.

Table S-3 of the final rule is reproduced in its entirety as Table 5.12 herein. Specific categories of natural resource use included in the Table relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high- and low-level wastes, and radiation doses from transportation and occupational exposures. The contributions in the table for reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle); that is, the cycle that results in the greater impact is used.

Appendix I of this Draft Environment Statement contains a description of the environmental impact assessment of the uranium fuel cycle as related to the operation of the St. Lucie Plant. The environmental impacts are based on the values given in Table S-3 (Table 5.12), and on an analysis of the radiological impact from radon-222 and technetium-99 releases. The staff has determined that the environmental impact of the Plant on the U.S. population from radioactive gaseous and liquid releases (including radon and technetium) due to the uranium fuel cycle is insignificant when compared with the impact of natural background radiation. In addition, the nonradiological impacts of the uranium fuel cycle have been found to be acceptable.

Table 5.12 (Table S-3) Uranium-Fuel-Cycle Environmental Data[1]

Table S-3.—*Table of Uranium Fuel Cycle Environmental Data*[1]

[Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116]]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
NATURAL RESOURCES USE		
Land (acres):		
Temporarily committed[2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
EFFLUENTS—CHEMICAL (MT)		
Gases (including entrainment):[3]		
SO_x	4,400	
NO_x[4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health
HCl	.014	
Liquids		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs, NO_3—20 cfs, Fluoride—70 cfs
NO_3	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment
Solids	91,000	Principally from mills—no significant effluents to environment

Table 5.12

Table S-3.—*Table of Uranium Fuel Cycle Environmental Data*[1]—*Continued*

[Normalized to model LWR annual fuel requirement (WASH-1248) or reference reactor year (NUREG-0116)]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
EFFLUENTS—RADIOLOGICAL (CURIES)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226	.0034	From UF_6 production.
Th-230	.0015	
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3 The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

5.12 Decommissioning

Decommissioning of a nuclear power reactor does not usually involve environmental impacts which are unique to a specific project. The technology for decommissioning nuclear facilities is well in hand, and, while technical improvements in decommissioning techniques are to be expected, at the present time decommissioning can be performed safely and at reasonable cost. Radiation doses to the public as a result of decommissioning activities should be very small and would primarily come from the transportation of decommissioning waste to waste burial grounds. Radiation doses to decommissioning workers should be a small fraction of the worker exposure over the operating lifetime of the facility; these doses usually will be well within the occupational exposure limits imposed by regulatory requirements. Decommissioning costs for reactors are a small fraction of the present worth commissioning costs. A full analysis of decommissioning is available in NUREG-0586, "Draft Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," U.S. Nuclear Regulatory Commission, January 1981.

5.13 Emergency Planning Impacts

5.13.1 Impact from Siren Alert System

FP&L is currently developing its Emergency Plan for the Plant in accordance with 10 CFR Part 50, as well as the recommended criteria contained in NUREG-0654. The staff believes the only noteworthy potential source of impact on the public from emergency planning would be associated with a siren alert system. A complete cycle test will be required annually. The test requirements and alarm noise levels are consistent with those used for existing alert systems; therefore, the staff concludes that the noise impacts associated with a siren alert system will be infrequent and insignificant.

5.13.2 Emergency Operations Facility

An Emergency Operations Facility (EOF) will be constructed to conform to the requirements of 10 CFR Part 50, as amended to meet the recommended criteria contained in NUREG-0696. The staff believes that this can be done in a manner that will not significantly disturb the area and without imposing an unacceptable environmental impact on the affected area.

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6 EVALUATION OF THE PROPOSED ACTION

6.1 Unavoidable Adverse Impacts

The staff has reassessed the physical, social, biological, and economic impacts that can be attributed to the operation of St. Lucie 2. For the most part, these impacts are as stated in Chapter 5 of the FES-CP. Actions taken by the applicant since the FES-CP stage have resulted in adequately mitigating the operating impacts.

6.2 Irreversible and Irretrievable Commitments of Resources

All of the significant resource commitments were identified at the time of the CP review and are discussed in Chapter 8 of the FES-CP. The staff's assessment has not changed except that the continuing escalation of costs has increased the dollar values of the materials used for constructing and fueling St. Lucie 2.

6.3 Relationship Between Short-Term Uses and Long-Term Productivity

There have been no significant changes in the staff's evaluation for the Plant since the CP review as discussed in Chapter 8 of the FES-CP.

6.4 Benefit-Cost Summary

6.4.1 Summary

Sections below summarize the economic, environmental, and socioeconomic benefits and costs which are associated with the operation of St. Lucie 2. The benefits and costs are shown in Table 6.1.

6.4.2 Benefits

The direct benefits to be derived from the operation of St. Lucie 2 include approximately 4.2 billion kWh of electrical energy which the unit will be able to produce annually (this projection assumes that St. Lucie 2 will operate at an average 60 percent capacity factor). The benefits also include improved reliability due to the addition of 802 MWe of generating capacity, as well as the saving of approximately $225 million in production costs per year. FP&L's plan to sell 168 MWe of St. Lucie 2 will reduce these direct benefits to the FP&L system by about 20 percent but the total benefits will be retained within a regional context.

6.4.3 Economic Costs

The economic costs associated with St. Lucie 2 operation include fuel and operation and maintenance costs. For the first year of operation, fuel and O&M are estimated at 10 mills/kWh and 4 mills/kWh, respectively. The cost of decommissioning is a small additional cost of operation. The staff's estimate for decommissioning St. Lucie 2 ranges from about $21 million to $43 million in 1978 dollars.

Table 6.1 Benefit-Cost summary

Primary Impact and Effect on Population or Resources[1]	Magnitude or Reference[2]	Staff Assesment of Benefit or Cost[3]
Direct benefits		
Energy (2.2 and 6.4.2)	4,200 kWh/yr x 10^6	
Capacity (2.4)	802 kW x 10^3	
Reduced generating costs (2.2)	225 million $/yr	Large
Improved diversity of supply (2.3)		Small
Improved system reliability (2.4)		Small
Indirect Benefits		
Local Taxes (Ad Valorem) (5.9)	5.5 million $/yr	Large
Annual employment (5.9)	280 persons	Small
Annual payroll (5.9)	7.8 million $/yr	Moderate
Annual local purchases (5.9)	$750,000/yr	Small
Economic costs of operating		
Fuel (2.2 and 6.4.3)	10 mills/kWh (initial year of operation)	Small
O & M (6.4.3)	4 mills/kWh (initial year of operation)	Small
Decommissioning (2.2 and 5.11)	21-43 million 1978 $	Small
Environmental Costs		
1. Resources Committed		
a. Land (FES-CP 2.1)	458 ha	Small
b. Water (5.3.1)	9.6 ℓ/s	None
2. Damages Suffered by Other Water Users Because of		
a. Surface Water Consumption (5.3.1)		None
b. Surface Water Contamination (5.3.1)		None
c. Ground Water Consumption (5.3.2)		None
d. Ground Water Contamination (5.3.2)		None

Table 6.1 (continued)

Primary Impact and Effect on Population or Resources[1]	Magnitude or Reference[2]	Staff Assesment of Benefit or Cost[3]
3. Damage to Aquatic Biota Due to		Small
a. Intake Losses (5.6)		
b. Surface Water Discharges - Heat (5.6.4)	6.5×10^{12} J/hr	Small
c. Surface Water Discharges - Chemical (5.6.5)		None
4. Damage to Terrestrial Resources (5.5)		None
5. Human Health Effects (Non-radiological) Due to Air Quality Changes (5.4)		None
6. Human Health Effects (Radiological) Due to		
a. Effects of Reactor Operation on General Population (5.10)		Small
b. Effects of Reactor Operation on Workers at Site (5.10.3.1.1)		Small
c. Effects of Balance of Fuel Cycle (5.10.3.1.2)		Small
d. Accident Risk (5.10.4)		*
7. Societal Costs in Terms of		
a. Historic and Archeological Resources (5.8)		Small
b. Visual Intrusion (5.9)		Small
c. Increased Traffic (5.9)		Small
d. Increased demands on Public Facilities and Services (5.9)		Small
e. Increased demands on Private Facilities and Services (5.9)		Small

*The impact of an accident could possibly be large, while the risk of an accident is small.

Table 6.1 (continued)

Notes:

1. References in parentheses indicate EIS section where evaluation appears.

2. For those factors which are not quantifiable, see text section.

3. Subjective measure of costs and benefits are assigned by reviewers, where quantification is not possible: Small - impacts which, in the reviewers' judgement, are of such minor nature, based on currently available information, that they do not warrant detailed investigations or considerations of mitigative actions; Moderate - impacts which, in the reviewers' judgement, are likely to be clearly evident (Mitigation alternatives are usually considered for moderate impacts.); Large - impacts which, in the reviewers' judgement, represent either a severe penalty or a major benefit. Acceptance requires that large negative impacts should be more than offset by other overriding project considerations.

6.4.4 Socioeconomic Costs

No significant socioeconomic costs are expected from either the operation of St. Lucie 2 or from the number of employees and their families living in the area.

6.4.5 Environmental Costs

The environmental costs were previously evaluted in the FES-CP and have not adversely changed.

No significant environmental costs are expected from the operation of St. Lucie 2, including considerations of the uranium fuel cycle and accidents.

6.4.6 Conclusions

As a result of the analysis and review of potential environmental, technical, economic, and social impacts, the staff has prepared an updated forecast of the effects of the operation of St. Lucie 2. No new information has been obtained that alters the overall balancing of the benefits of operation versus the environmental costs. The staff has determined that St. Lucie 2 can be operated with minimal environmental impact.

7 LIST OF CONTRIBUTORS

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Rex Wescott, Hydrology/Accident Analysis

8 AGENCIES AND ORGANIZATIONS TO WHICH COPIES OF THIS DRAFT ENVIRONMENTAL STATEMENT WERE SENT

Copies of this document were sent to the following on initial distribution:

U. S. Department of Agriculture
U. S. Department of the Army, Corps of Engineers
U. S. Department of Commerce
U. S. Department of Energy
U. S. Department of Health and Human Services
U. S. Department of Housing and Urban Development
U. S. Department of the Interior
U. S. Department of Transportation
U. S. Environmental Protection Agency
Advisory Council on Historic Preservation
Federal Emergency Management Agency
State of Florida, Bureau of Intergovernmental Relations
State of Florida, Department of Environmental Regulation
State Historic Preservation Office
Treasure Coast Regional Planning Council
Martin County Planning Department
St. Lucie County, County Administrator

9 STAFF RESPONSES TO COMMENTS

This chapter is reserved for staff responses to comments on this Draft Environmental Statement; such comments and responses will be considered in the Final Environmental Statement.

APPENDIX A

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

APPENDIX B

FINAL ENVIRONMENTAL STATEMENT RELATED TO CONSTRUCTION OF ST. LUCIE PLANT UNIT 2

Final

environmental statement

related to construction of

ST. LUCIE PLANT UNIT 2

FLORIDA POWER AND LIGHT COMPANY

DOCKET NO. 50-389

MAY 1974

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 a construction permit to the Florida Power and Light Company (the applicant) for constructing St. Lucie Plant Unit No. 2, a nuclear power reactor located on Hutchinson Island on the east coast of Florida approximately midway between the cities of Fort Pierce and Stuart (Docket No. 50-389).

   Unit 2 is proposed as a nuclear pressurized water type plant with a thermal power rating of 2560 megawatts (MWt) and a gross electrical power output of 850 MWe and a net output of 810 MWe. A design power level of 2700 MWt is anticipated at some future date and is considered in the assessments contained in this statement. Exhaust steam from the plant will be cooled by water pumped from and discharged back to the Atlantic Ocean.

   At the present time there is one other nuclear power plant being built on the site (Unit No. 1) which is similar in design and electrical power generation capacity to Unit 2. The two units will share certain facilities including the intake and discharge cooling canal system and the three-circuit transmission system. Unit 1 is scheduled to start producing power commercially in December 1975.

3. Summary of environmental impact and adverse effects:

   - About 300 acres of the 1132-acre site have been converted to cooling canals and a landscaped fill area for Unit 1. The filled area was predominately mangrove swamp, containing many dead trees as a result of earlier flooding for mosquito control. No additional acreage will be converted for Unit 2 (Section 4.1).

   - Some fish and planktonic organisms will be entrained in the Atlantic Ocean intake system. Fish will be trapped in the intake canal with no mechanism for return to the ocean. Most planktonic organisms will be eventually killed by thermal shock as they pass through the condenser. However, the numbers will be small and the impact on the ecosystem is expected to be minor (Section 5.5.2).

   - The maximum ocean surface temperature rise at the Atlantic Ocean discharge should be about 1.5°F. The area of the 1°F isotherm should be extended from an estimated 2860 acres with only Unit 1 operating to 3372 acres with the addition of Unit 2. It was estimated there could conceivably be some thermal effects from Unit 1 operation on the mating habits of turtles in the plume zone and on the activity of turtle hatchlings as they leave their beach nests. Effects on other marine life were expected to be minimal. The addition of Unit 2 should have no significant additional effects due to the lower maximum surface temperature associated with the multiport discharge line (Section 5.5.2.6).

- Plant lighting may cause turtle hatchling misorientation leading to increased mortality. However, most of the lighting was required for Unit 1 and plantings of Australian pine or other suitable plants behind the dune line were required to shield the beach and dune areas from this lighting. With these plantings, the additional lighting required for Unit 2 should have no significant additional effect on turtle misorientation (Sections 4.3.1 and 5.5.1).

- Equipment lighting during construction could cause misorientation of birds during storm fronts, with death from exhaustion or hitting tall structures. As was done during Unit 1 construction, non-essential lighting will be turned off during such periods, and with this action no significant bird kills are anticipated. No significant effect of operational lighting of Unit 2 is anticipated since little additional lighting is required for Unit 2 (Sections 4.3.1 and 5.5.1).

- Improper storage and disposal of edible refuse by the construction and operating work forces for Unit 2 could lead to increased raccoon populations with a corresponding increase in turtle hatchling predation. However, refuse control measures are planned and the impact is expected to be minor (Sections 4.3.1 and 5.5.1).

- The ocean beach dune will have to be recut to install the discharge line for Unit 2. The dune is the primary barrier against severe wave action cutting the island in two during a storm. The applicant plans a construction procedure to minimize the potential for wave damage. (Section 4.1)

- Beach construction activities for the Unit 2 discharge line will probably affect turtle nesting in the immediate construction area during one nesting season. Short-term preventive measures are planned and no long-term effects from construction are expected (Section 4.3.1).

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- Approximately 4.3 acres of the ocean bottom will be dredged to install the discharge line. Benthic organisms in this area will be killed. However, the number lost is a very small portion of the total population in the area and repopulation is expected within one year. Consequently the impact should be minor and short term (Section 4.3.2).

- The risk associated with accidental radiation exposure is very low (Section 7).

- No significant environmental impacts are anticipated from normal operational releases of radioactive materials. The estimated total body dose from gaseous and liquid effluents to the 1980 population within 50 miles from operation of Unit 2 is 0.4 man-rem/yr. The dose to the general population from shipments of spent fuel and waste amount to 7 man-rem/yr. These doses are less than the normal fluctuations in the 54,000 man-rem/yr background dose this population would receive (Section 5.4.7).

- The entire plant cannot be hidden from view in the flat, generally low growth terrain of Hutchinson Island. However, since natural plantings screen the plant from most of the ocean beach and the nearest mainland residential area is about 1.5 miles away, the impact of Unit 1 was considered minimal. The addition of Unit 2 should result in only a very minor increase in the overall visual impact of the plant (Section 5.1).

4. Principal alternatives considered:

   - A decision <u>not</u> to provide the power to be supplied by Unit 2,
   - Construction of an equivalent capacity nuclear plant at another site,
   - Use of alternative fuels (fossil or hydroelectric),
   - Modification of the proposed condenser cooling system to utilize:
     - a cooling pond
     - a spray pond
     - dry cooling towers
     - mechanical draft, saltwater cooling towers
     - natural draft, saltwater cooling towers
     - dilution of the discharge water,

- Alternative sanitary systems
  - extended aeration
  - installation of a sewage line to Fort Pierce,
- Alternative biocide systems
  - mechanical cleaning
  - ozonization,
- Alternative chemical treatment systems
  - crystallization of wastes
  - reverse osmosis of supply water,
- Alternative transportation procedures.

5. The following Federal, State and local agencies were asked to comment on the Draft Environmental Statement:

- Advisory Council on Historic Preservation
- Department of Agriculture
- Department of the Army, Corps of Engineers
- Department of Commerce
- Department of Health, Education and Welfare
- Department of Housing and Urban Development
- Department of the Interior
- Department of Transportation
- Environmental Protection Agency
- Federal Energy Office
- Federal Power Commission
- Florida Department of Pollution Control
- Florida Department of Natural Resources
- Office of the Governor, State of Florida
- Florida Division of Health
- Florida Public Service Commission
- County Administrator, St. Lucie County

The following Federal, State and local agencies submitted comments on the Draft Environmental Statement which was issued on February 8, 1974.

- Advisory Council on Historic Preservation
- Department of Agriculture
- Department of Commerce
- Department of Health, Education and Welfare

- Department of the Interior
- Department of Transportation
- Environmental Protection Agency
- Federal Power Commission
- Florida State Department of Administration
- Florida State Department of Pollution Control
- Florida State Department of Natural Resources
- Florida Public Service Commission
- County Administrator, St. Lucie County

In addition, comments on the Draft Environmental Statement were received from Florida Power and Light Company.

The texts of these comments are appended to this Final Environmental Statement.

6. This Final Environmental Statement was made available to the public, to the Council on Environmental Quality, and to the other specified agencies in May 1974.

7. On the basis of the analysis and evaluation set forth in this statement, after weighing the environmental, economic, technical and other benefits of the St. Lucie Plant Unit No. 2 against environmental and other costs and considering available alternatives, it is concluded that the action called for, under the National Environmental Policy Act of 1969 (NEPA) and Appendix D to 10 CFR Part 50, is the issuance of a construction permit for St. Lucie Plant Unit No. 2 subject to the following conditions for protection of the environment:

   a. If any portion of the light screen of Australian pine or other suitable plants installed behind the beach dune for Unit 1 is disturbed for Unit 2 construction, the applicant will replace these plantings at the earliest feasible time. Furthermore, the applicant will shield plant lighting added for Unit 2 to minimize sky shine.

   b. In restoring the ocean dune to its original condition after installation of the Unit 2 discharge line, the applicant will replant the dune at the earliest feasible time with dune stabilizing plants indigeneous to the area (Section 4.1). These plantings will be <u>in addition to</u> the applicant's commitment to replant the Australian pine or other suitable plants light screen if disturbed.

   c. The applicant shall take the necessary mitigating action, including those summarized in Section 4.5 of this Environmental Statement, during construction of the plant to avoid unnecessary adverse environmental impacts from construction activities.

d. A control program shall be established by the applicant to provide for a periodic review of all construction activities to assure those activities conform to the environmental conditions set forth in the construction permit.

e. Before engaging in a construction activity which may result in a significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this Environmental Statement, the applicant shall provide written notification to the Director of Licensing, U.S. Atomic Energy Commission.

f. If unexpected harmful effects or evidence of irreversible damage are detected during facility construction, the applicant shall provide to the staff an acceptable analysis of the problem and a plan of action to eliminate or significantly reduce the harmful effects or damage.

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FOREWORD

This environmental statement was prepared by the U.S. Atomic Energy Commission, Directorate of Licensing (the staff) in accordance with the Commission's regulation, 10 CFR 50, Appendix D, which implements the requirements of the National Environmental Policy Act of 1969 (NEPA). New proposed regulations have been published (38 FED REG 30203, Nov. 1, 1973) as Part 51 of 10 CFR, which would replace Appendix D to Part 50.

The NEPA states, among other things, that it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice.
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the NEPA calls for preparation of 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.

An environmental report accompanies each application for a construction permit or a full-power operating license. A public announcement of the availability of the report is made. Any comments by interested persons on the report are considered by the staff. In conducting the required NEPA review, the staff meets with the applicant to discuss items of information in the environmental report, to seek new information from the applicant that might be needed for an adequate assessment, and generally to ensure that the staff has a thorough understanding of the proposed project. In addition, the staff seeks information from other sources that will assist in the evaluation and visits and inspects the project site and surrounding vicinity. Members of the staff may meet with State and local officials who are charged with protecting State and local interests. On the basis of all the foregoing and other such activities or inquiries as are deemed useful and appropriate, the staff makes an independent assessment of the considerations specified in Section 102(2)(C) of the NEPA and Appendix D of 10 CFR 50.

This evaluation leads to the publication of a draft environmental statement, prepared by the Directorate of Licensing, which is then circulated to Federal, State and local governmental agencies for comment. A summary notice is published in the Federal Register of the availability of the applicant's environmental report and the draft environmental statement. Interested persons are requested to comment on the proposed action and the draft statement.

After receipt and consideration of comments on the draft statement, the staff prepares a final environmental statement, which includes a discussion of questions and objections raised by the comments and the disposition thereof; a final cost-benefit analysis, which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects with the environmental, economic, technical, and other benefits of the facility; and a conclusion as to whether — after the environmental, economic, technical, and other benefits are weighed against environmental costs and after available alternatives have been considered -- the action called for, with respect to environmental issues, is the issuance or denial of the proposed permit or license or its appropriate conditioning to protect environmental values. This final environmental statement and the safety evaluation report prepared by the staff are submitted to the Atomic Safety and Licensing Board for its consideration in reaching a decision on the application.

Single copies of this statement may be obtained by writing the Deputy Director for Reactor Projects, Directorate of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545. Mr. F. A. St.Mary is the AEC Environmental Project Manager for this statement. (301-443-6990).

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1. INTRODUCTION

1.1 The Proposed Project

The proposed project is the St. Lucie Plant Unit No. 2, a nuclear pressurized water type plant, with a gross electrical power output of 850 MW and a thermal power rating of 2560 MW. The unit will be constructed on Hutchinson Island, approximately midway between the cities of Fort Pierce and Stuart on the east coast of Florida.

One other nuclear plant is currently being constructed on the same site, St. Lucie Plant Unit No. 1, which is similar in design and power output to Unit No. 2. The two units will share certain facilities including the intake and discharge cooling water canals and the three-circuit transmission system.

Unit No. 1 is scheduled for commercial power operation in December 1975; Unit No. 2 commercial power operation is scheduled for December 1979.

1.2 Status of Reviews and Approvals

The applicant applied for a construction permit for Unit No. 2 from the Atomic Energy Commission in April 1973. An environmental report was submitted to the AEC in August 1973.

The applicant states the following major licenses or permits will be required:[1]

Permit or License	Statutory Authority or Issuing Agency	Status
Plant Construction Permit	Atomic Energy Act of 1954 as amended, and Code of Federal Regulations, Title 10, Parts 20, 50, 100	Application Filed April 1973
General Plant Construction	Board of County Commissioners Building and Zoning Dept. St. Lucie County, Florida	Issued October 6, 1971
Construction of Atlantic Ocean Discharge Line	U.S. Army Corps of Engineers; Section 10 Act of Congress March 3, 1899 (33USC403)	Future
Construction of Atlantic Ocean Discharge Line	St. Lucie County Board of Commissioners	Future
Discharge Permit	Environmental Protection Agency; Federal Water Quality Act as amended	Future
Certification	Fla. Dept. of Pollution Control; Section 401 EPA Water Quality Amendment of 1972 to 1970 Water Quality Act, Power Plant Siting Act Sections 403.501 and 403.516	Application Filed
Reactor Building Lighting	Federal Aviation Agency	Future

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Permit or License	Statutory Authority or Issuing Agency	Status
Plant Operating License	AEC-Title 10 CFR Parts 20, 50 100	Future
Possession and Use of Special Nuclear Materials	U.S. AEC Title 10 CFR Parts 30, 40	Future
Possession and Use of Nuclear Fuel	U.S. AEC Title 10 CFR Part 70	Future

REFERENCES

1. Florida Power and Light Company, St. Lucie Plant Unit No. 2, Environmental Report, Section 12, August 10, 1973.

2. THE SITE

2.1 Plant Location

The plant is located on Hutchinson Island in St. Lucie County about halfway between the cities of Fort Pierce and Stuart on the east coast of Florida (see Figure 2.1). The site is approximately 120 highway miles north of Miami, 225 miles south of Jacksonville and 150 miles east of Tampa. Lake Okeechobee is approximately 30 miles to the southwest.

The portion of Hutchinson Island on which the plant is located is approximately 22 miles long by 1 mile wide at its maximum width. This portion of the island extends from Fort Pierce Inlet, at the city of Fort Pierce, south to Sewalls'Point near the city of Stuart. The Atlantic Ocean lies to the east and the Indian River separates the island from the mainland to the west. Indian River is not a river in the usual sense. It is a long, thin, tidal lagoon stretching down the southeastern coast of Florida between the mainland and a series of off-shore islands. The river is approximately 7200 ft wide at the plant site.

As shown in Figure 2.2, Hutchinson Island is generally flat. Much of it consists of swamp covered with dense vegetation characteristic of Florida coastal mangrove swamps. Many of the black mangroves were killed when parts of the island were flooded for mosquito control in the 1930's and 1940's. Red mangroves are taking their place in some areas. From the ocean shore the land rises slightly to a dune or ridge approximately 15 ft above mean low water.

The plant is located on 1132 acres near the midpoint of the island. As shown in Figures 2.3 and 2.4, the plant occupies approximately 300 acres adjacent to Big Mud Creek, an inlet off the Indian River, and across State Road A-1-A from the ocean shore. The remaining approximately 830 acres of the plant site will be left essentially as it was at the time of acquisition in 1968, subject to disturbance only if other power plants are built on the site.

2.2 Regional Demography, Land and Water Use

As shown in Figure 2.1, Hutchinson Island forms the eastern boundary of St. Lucie County. This 588-square-mile county is flat and low, with the western three-fifths being covered by St. Johns Marsh to the north and Allapattah Flats to the south. The remaining portion near the coast is flatwoods country used extensively to raise cattle and citrus fruit. Two-thirds of the land area of the county is devoted to agriculture: 41% pasture, 23% citrus and 1% vegetables. Tomatoes comprise 99% of the vegetable crop.

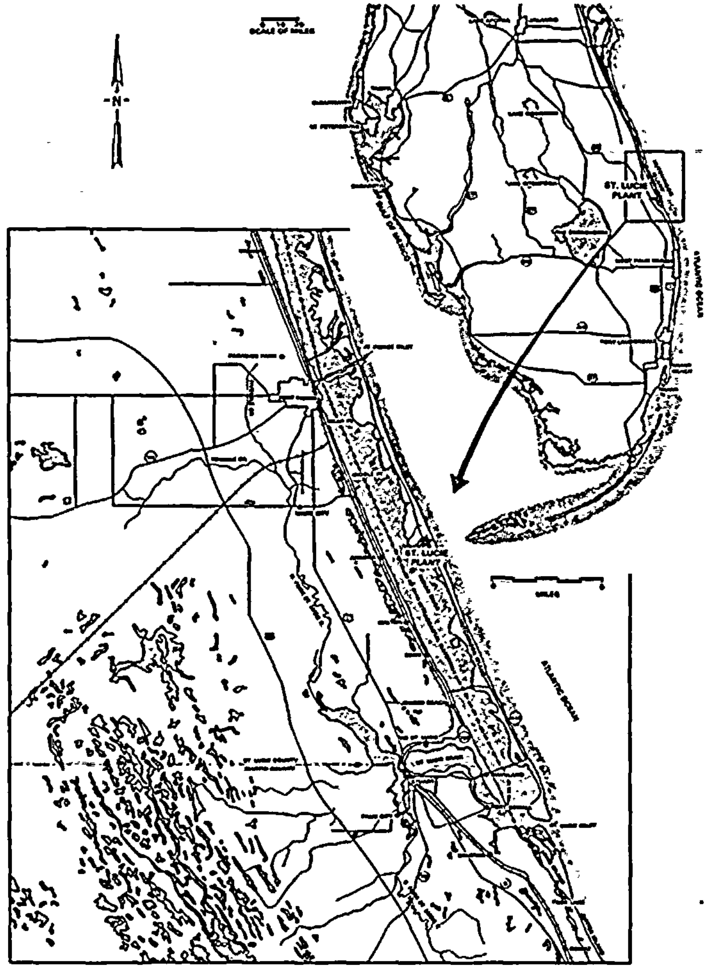

FIGURE 2.1 SITE LOCATION MAP

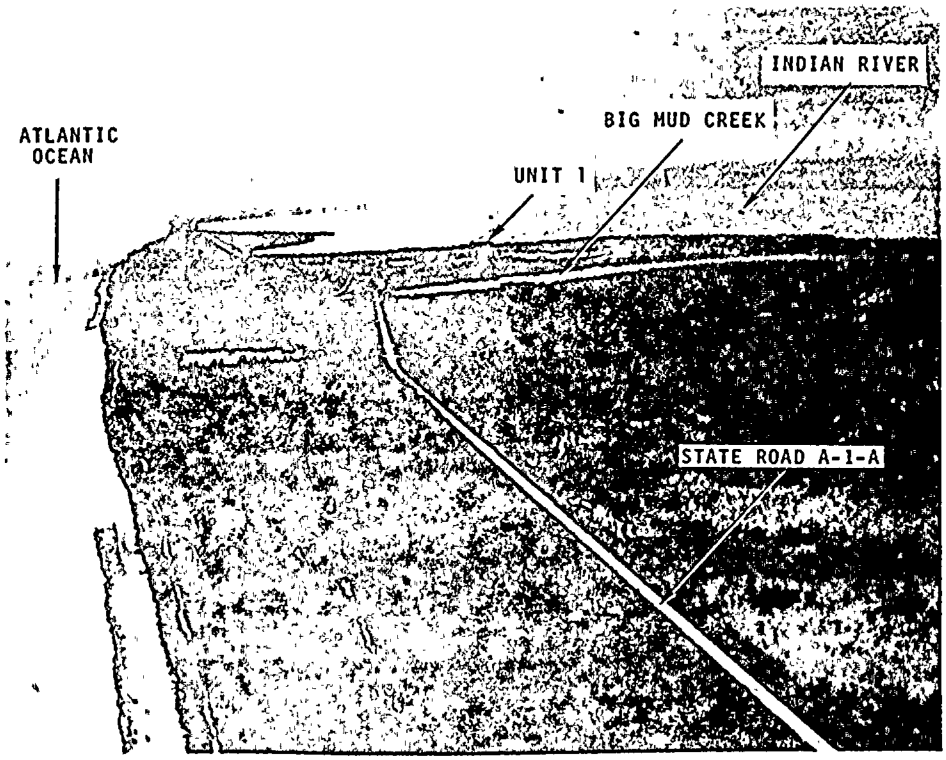

FIGURE 2.2 ST. LUCIE PLANT LOOKING SOUTH

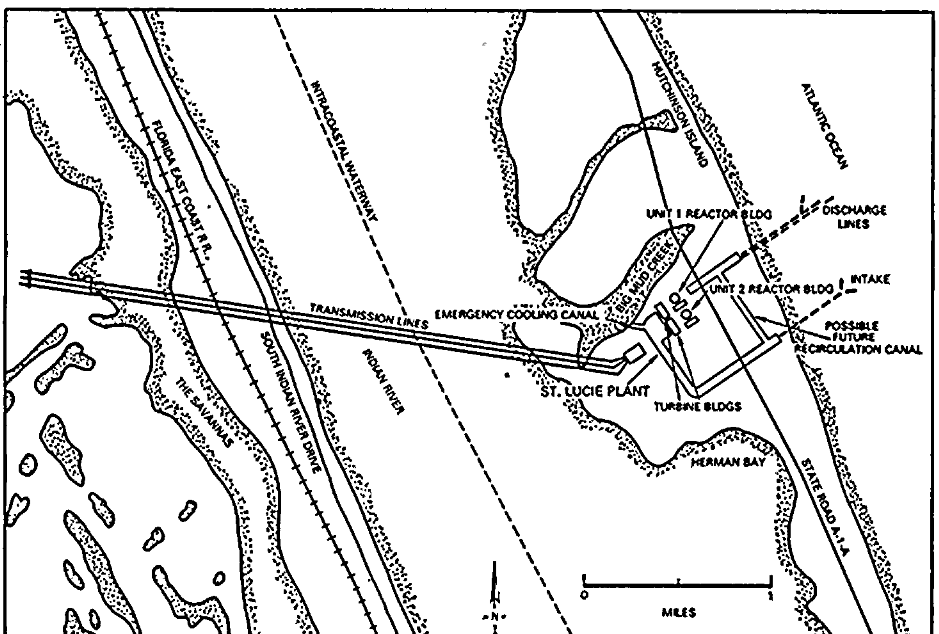

FIGURE 2.3 SITE PLOT PLAN

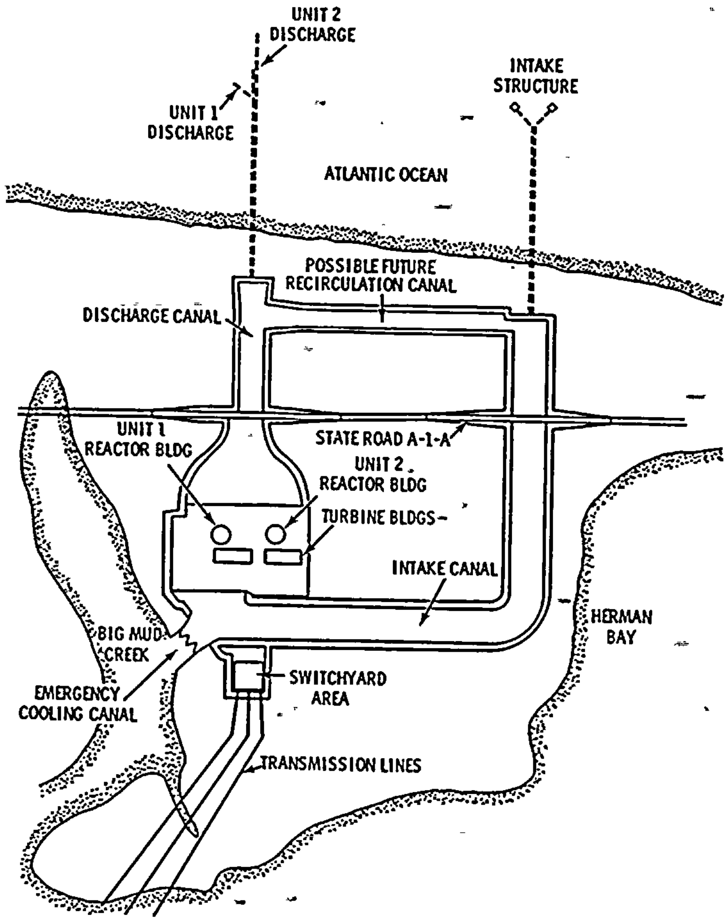

FIGURE 2.4 PLANT PLOT PLAN

South of St. Lucie County lies Martin County; the county boundary on Hutchinson Island is approximately 7.5 miles south of the plant. This 559-square-mile county is also flat and low with large patches of flat-woods in the western third of the county. Approximately 50% of the land area is devoted to agriculture: 35% pasture, 14% citrus and 0.7% vegetable. Most of the agricultural activities are west of the Sunshine State Parkway (US 95).

Both counties are sparsely populated now, with most of the population concentrated along the coastline. In 1970 the population within a 5-mile radius of the site was 1165. Within a 10-mile radius the population was 46,505 and within 50 miles it was 301,155. By 1980, when Unit 2 is scheduled to be in operation, the population within 5 miles is estimated to be 1620, within 10 miles - 61,000, and within 50 miles is estimated to be over 446,000. By the year 2000 the population within 50 miles should exceed 740,000. A detailed breakdown of current and projected future population around the plant is shown in Figures 2.5, 2.6 and 2.7.

Currently population near the plant is concentrated around two cities, Fort Pierce and Stuart. Fort Pierce, the largest city and county seat of St. Lucie County, is located approximately 8 miles north of the plant. Stuart, the largest city and county seat of Martin County is located across from the southern end of Hutchinson Island. Recent census figures for these counties are:[1]

	1970	1960	% Change
St. Lucie County Total	50,836	39,294	29.4
Fort Pierce division	29,721	25,256	17.7
Fort Pierce city	29,721	25,256	17.7
Fort Pierce North division	7,340	5,776	27.1
Fort Pierce northwest	3,269	1,417	130.7
St. Lucie village	428	—	—
Fort Pierce South division	10,964	6,415	70.9
Port St. Lucie city	330	—	—
West St. Lucie division	2,811	1,847	52.2
Martin County Total	28,035	16,932	65.6
Hobe Sound division	7,751	4,001	93.7
Hobe Sound	2,029	--	--
Jupiter Island town	295	114	158.8
Salerno	1,161	—	--
Indiantown division	4,446	2,652	67.6
Indiantown	2,283	1,411	61.8
Stuart division	15,838	10,279	54.1
Ocean Breeze town	714	--	--
Sewalls Point town	298	151	97.4
Stuart city	4,820	4,791	0.6

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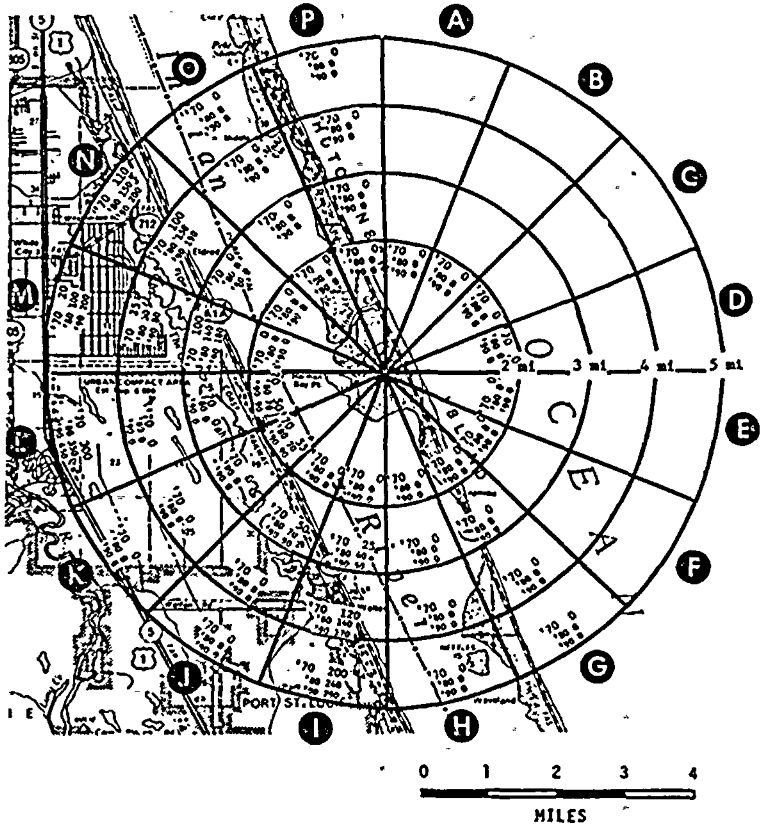

FIGURE 2.5 POPULATION DENSITY CHART, 5-MILE RADIUS

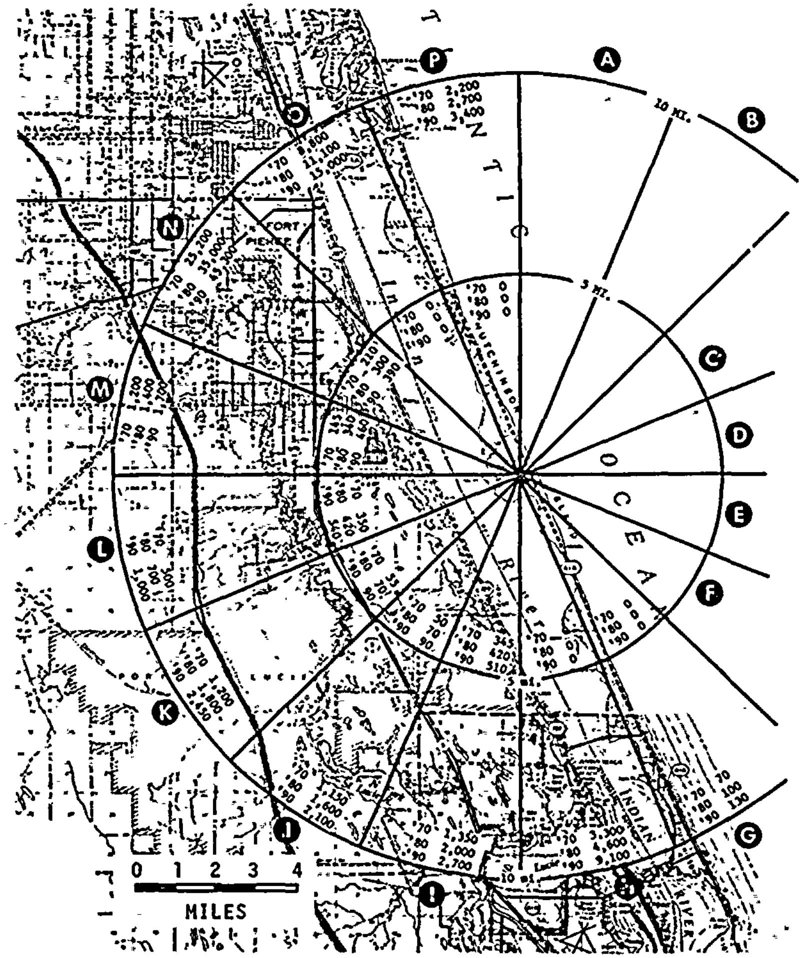

FIGURE 2.6 POPULATION DENSITY CHART, 10-MILE RADIUS

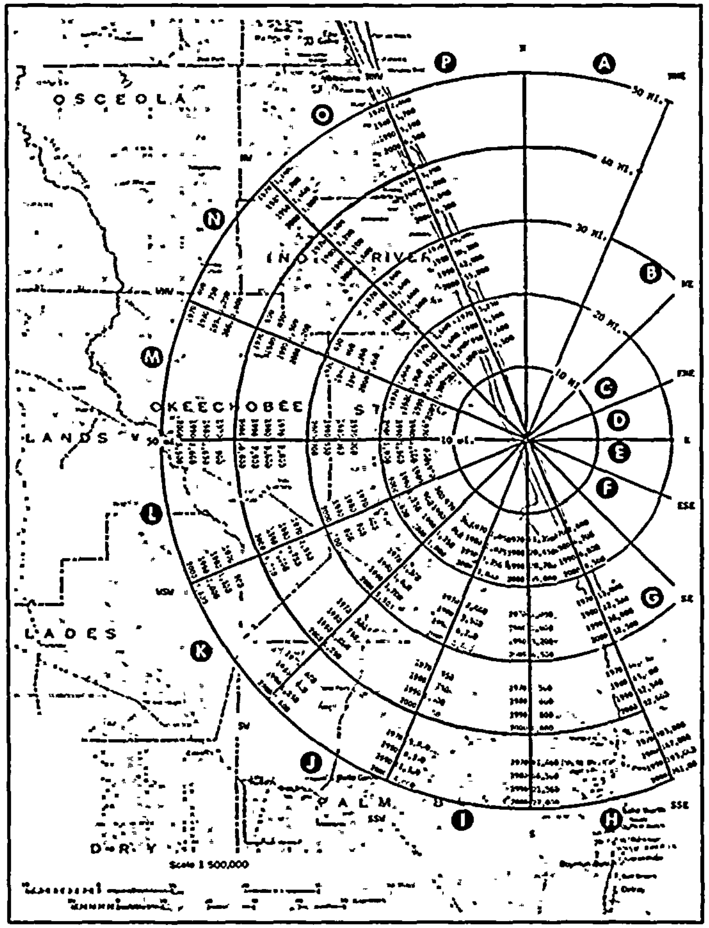

FIGURE 2.7 POPULATION DENSITY CHART 50-MILE RADIUS

Hutchinson Island has been sparsely populated due mainly to a lack of fresh water. No freshwater wells have been successful. A pipeline from Stuart to the south end of the island has allowed some limited development mainly related to tourism. At the north end, a pipeline has permitted development with the city limits of Fort Pierce. A 12-in. water line has been extended at the applicant's expense from Fort Pierce down the island to serve the plant. Others may tie into the line by paying a prorated share of the cost, although the applicant has reserved two-thirds of the line capacity (1800 gpm total capacity) for plant use.[2] The line has been extended south from the plant approximately 5 miles by developers to serve resort and trailer park/campground developments in that area.

As of November 1973, most of the actual or planned developments on the island were tourism related. Much of the island adjacent to the ocean beach, including the areas on either side of the plant site was zoned R-4 (see Figure 2.8). This zoning permits apartment and condominium construction with a density of 18 units/acre or hotels and motels with a density of 36 units/acre. A Sheraton Motor Inn is open approximately 5 miles south of the plant (see Figure 2.9), a Holiday Inn is almost completed and a Ramada Inn is under construction for the same vicinity. A major trailer park/campground is in operation about 5 miles south of the plant, partially on the Indian River side of Hutchinson Island and partially on Nettles Island. Development plans have been submitted for other (mainly condominium-type) developments nearer the plant.

Across Indian River there is a narrow strip of primarily residential development extending from Stuart north to Fort Pierce. This development is bounded by Indian River on the east and the Savannas, a swampy area up to one-half mile wide in places, on the west. The Florida East Coast Railroad line borders the Savannas and South Indian River Drive borders Indian River, with the residential development between (see Figure 2.10). The area immediately across from the applicant's plant is residential. However, there were efforts underway in September 1973 to get approval for a large condominium development on South Indian River Drive across from Herman Bay just south of the plant.

Major recreational activities in the vicinity of the plant include boating and fishing (particularly in Indian River), swimming, picnicking, camping and limited duck hunting in season. The applicant estimates about 15,000 boats per year traverse Indian River near the plant site.[3] Stuart is considered a major boating and fishing resort area and some sport fishing boats also operate from Fort Pierce.

The Savannas Recreation Area, located approximately 5 miles WNW of the plant (see Figure 2.9) is the largest center of recreational activities near the plant. Approximately 440 visitors per day and 25 campers per night are estimated to use this facility (Ref. 4, p. 2.2-3). On Hutchinson Island small public beaches and parks are located about 5 miles north and 7 miles south of the plant. Public beaches and parks are also located in Fort Pierce at the north end of the island.

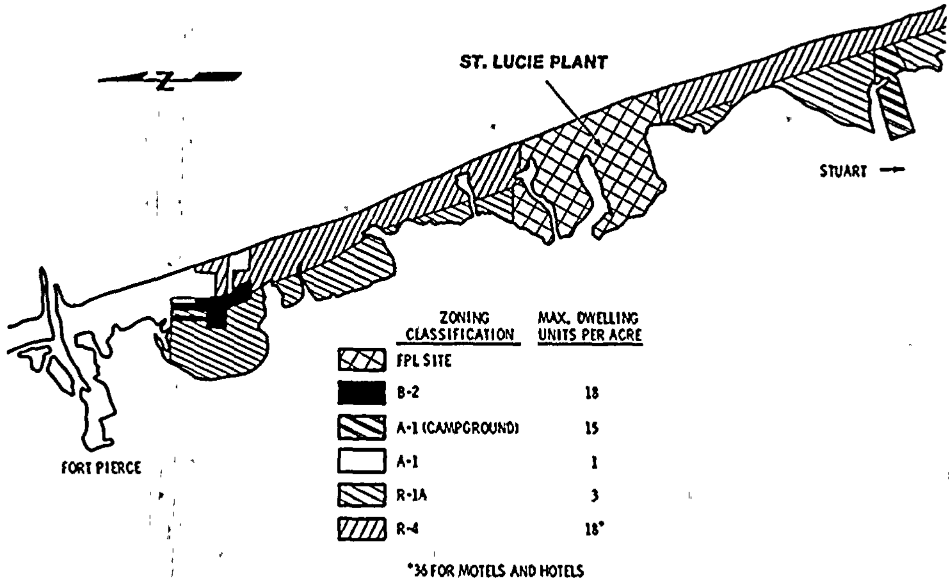

FIGURE 2.8 HUTCHINSON ISLAND ZONING MAP

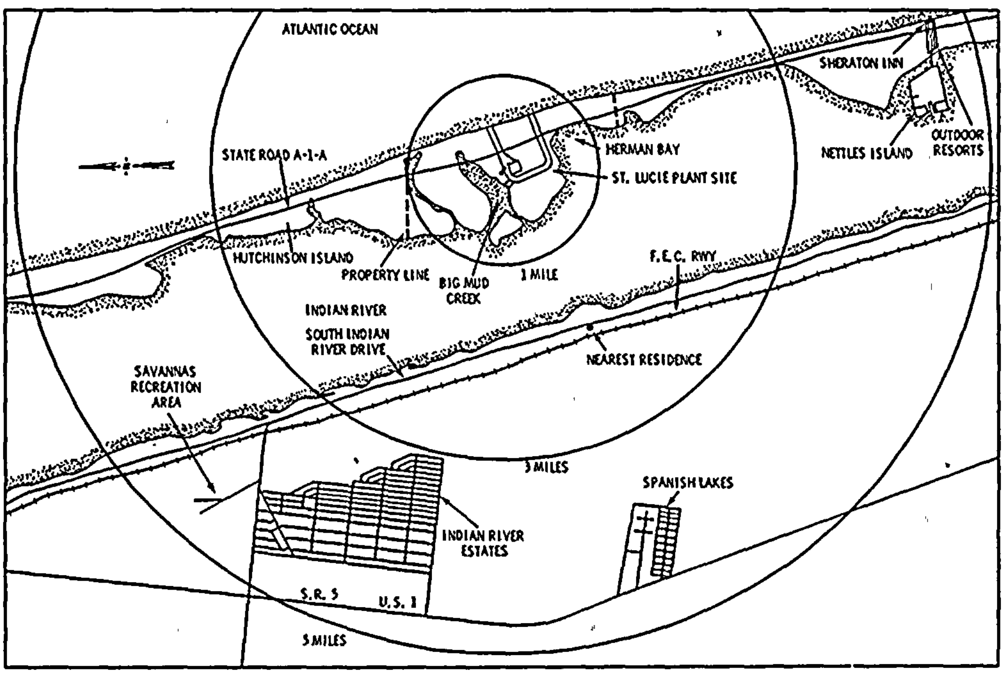

FIGURE 2.9 UNIT 2 LOCATION, 5-MILE RADIUS

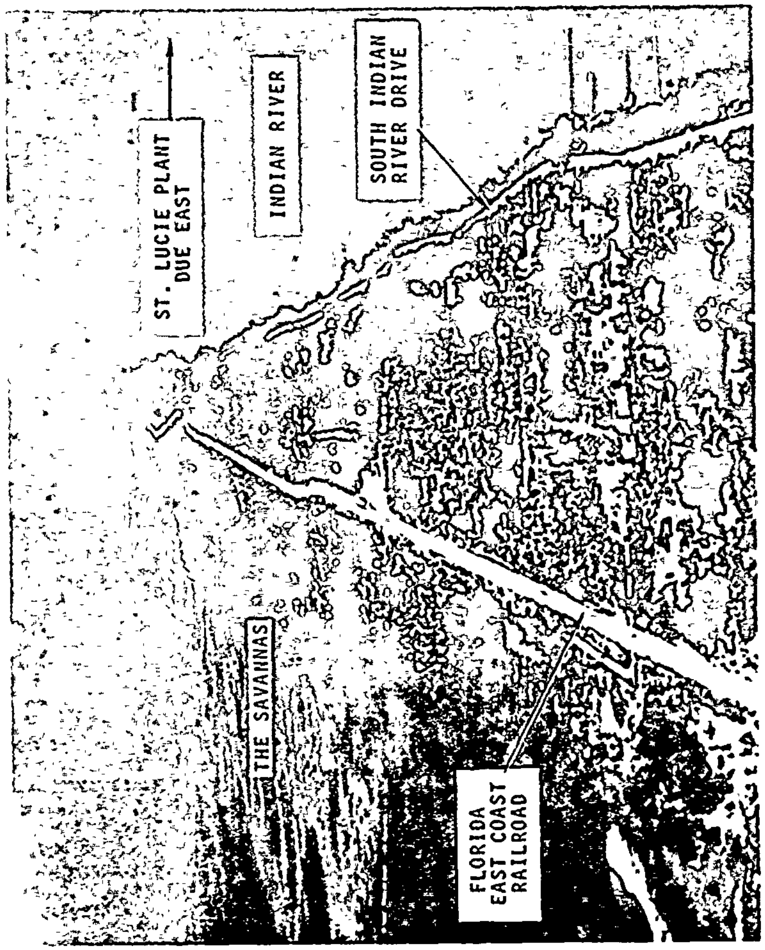

FIGURE 2.10 WEST SHORE OF INDIAN RIVER LOOKING NORTH

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2.3 Historic and Archeological Sites and Natural Landmarks

The National Register of Historic Places[5] lists no historic places on or near the plant site or Hutchinson Island. The nearest places listed are the Pelican Island National Wildlife Refuge and the site of Salvors Camp for Spanish Wrecks, both near the town of Sebastian approximately 40 miles north of the plant. The Okeechobee Battlefield is located about the same distance west of the plant, near the town of Okeechobee.

The State of Florida, Board of Archives and History states "no historical damage will be done by this project."[6] They further indicate there are unexplored middens and mounds, but these are mainly located on or near the north end of the Florida Power and Light Company property (that part of the site to be left in its natural state).

The State also surveyed the transmission line right-of-way and concluded "this project will not affect any archeological or historical sites."[7]

As the site has previously been surveyed for Unit 1 and essentially all of the land clearing for both units was accomplished during the construction of Unit 1 there is virtually no potential for discovery of objects of historical, archeological, architectural, or cultural significance during construction of Unit 2.

2.4 Geology and Seismology (Ref. 8, pp. 6-7; Ref. 4, pp. 2.4-1 to 2.4-4)

The general topography of Hutchinson Island is of the bar and swale type. The area of the site is predominantly flat and water covered with dense vegetation typical of coastal mangrove swamps. Beneath the land surface there is a peat layer 4 to 6 ft thick. Below this layer is the Anastasia formation, a sedimentary rock formation composed of clay lenses, sandy limestone, and silty fine-to-medium sand with fragmented shells. This highly permeable stratum extends 35 to 90 ft below sea level. Underlying this stratum there is semipermeable zone, Hawthorne formation, consisting of slightly clayey and very fine silt which extends 600 ft below sea level. In preparing the site, the applicant has raised the plant area by filling and compacting to about 18 ft above mean sea level.

Earthquakes observed in Florida have been infrequent, of low to moderate intensity, and with epicenters far removed from the site. The one area of observed earthquake concentration, Green Cove Springs, is more than 180 miles from the site and about 25 miles south of Jacksonville, Florida. Other earthquakes within the state have been scattered. There is no evidence any are related to known structural features. The strongest earthquake felt in the state was centered far to the north, at Charleston, South Carolina. There is no evidence of any structural features which might project the effects of such an earthquake toward this site at some later time.

2.5 Surface and Ground Waters

Subsurface flows at the site are predominantly from west to east toward the Atlantic Ocean. Groundwater at the site occurs very near or above the ground surface with a maximum distance of 18 ft below the land surface. Average annual precipitation is about 62 in. Surface runoff at the site is very small because of high soil permeability and evaporation. Seepage rates are very high: approximately 15,000 ft/yr due to the high transmissibility (approximately 20,000 gal/day-ft) of the earth material.

Currently, there are no freshwater supplies on Hutchinson Island; many attempts to develop wells have proved unsuccessful and freshwater must be brought in from the mainland by pipelines. The surface hydrologic boundaries of the site are the Atlantic Ocean to the east and Indian River to the west.

Indian River is a long, thin, shallow, tidally influenced lagoon which separates the island from the mainland. Tidal flows enter and leave through Fort Pierce Inlet, 8 miles north of the site, and St. Lucie Inlet, 14 miles to the south, near Stuart. The lagoon is a brackish body of water which is supplied by subsurface return flows, mainland runoff, small stream inflows and tidal exchange. The tidal range in Indian River is approximately 0.5 ft. The shallow depth of the lagoon, approximately 5 to 10 ft, in conjunction with the tidal exchanges prevents any significant thermal stratification. Average salinity varies seasonally from about 32 parts per thousand (ppt) to 15 ppt (Ref. 9, p. 3); these large variations in salinity appear to occur from dilution with freshwater runoff or reconcentration due to evaporation.

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The coastal waters offshore of Hutchinson Island respond to a large field of motion including possible variations in the Florida Current and Gulf Stream. Preliminary data[10] indicate the currents are generally oriented parallel to the shoreline. Longshore currents predominately run south at about 0.6 ft per second (fps); however, during periods of direction reversal a northerly current flows at about 0.2 fps. The maximum south and north currents are 1.3 fps and 0.7 fps, respectively.

Ocean water temperatures, recorded from August 1970 through March 1972, at the proposed condenser cooling discharge point, show a maximum of 86°F and a minimum of 61°F.[11] Highs occurred during September and October and lows during January, February and March. Normally, surface and bottom temperatures closely parallel each other indicating lack of a pronounced thermocline (Ref. 8, p. 27, 29). However, temperature decreases have been noted in mid-summer probably due to upwelling (Ref. 4, p. 2.7-9). Salinity was reported to range from 33 to 36 ppt at the eight stations sampled in September and November 1971.[12] In July 1970, no halocline was observed offshore and salinity was reported to be 36.8 ppt.[9] Dissolved oxygen decreased during the mid-summer period to 3.2 ppm compared with 5 to 7 ppm during other seasons (Ref. 4, p. 2.7.8).

Nutrient levels (phosphate, nitrate, nitrite, ammonia, and silicate) are measured monthly and are available from February 1972 to March 1973 at

surface and bottom for five stations offshore. The mean levels for each sampling day are plotted on Figures 2.11 through 2.15 (Ref. 4, p. 2.7.8, 2.7.9).

Phosphate-phosphorous levels indicate a major peak in December with significant peaks in July and October. They range over an order of magnitude, from less than 0.05 ppm to nearly 10 ppm. The peak in July provides additional evidence of upwelling. These values are very high compared with typical oceanic levels.[13] Nitrate-nitrogen also peaks in December with a slight peak in July; it ranges from about 0.002 to 0.0075 ppm. Similarly, nitrite-nitrogen has a peak in December but reaches a minimum in July. It ranges from zero to about 0.001 ppm, which like the nitrate levels is quite low for oceanic waters.[13] Ammonium-nitrogen levels were very high in February 1972, but are reported to be quite low since then. Silicate-silicon values show a wide month-to-month fluctuation, but are within the mid-range of typical oceanic levels.[13] The December maxima in nutrient levels may result from decomposition of the organisms in the fall bloom.

Proposed State of Florida water quality standards (Ref. 14, p. 11) classify the adjacent Atlantic waters as Class III waters (i.e. suitable for recreation, propagation and management of fish and wildlife). Rules of the Department of Pollution Control (Ref. 14, p. 8-8A) provide that:

> The criteria of water quality hereafter provided will be applied only after reasonable opportunity for mixture of wastes with receiving waters has been afforded; the reasonableness of the opportunity for mixture of wastes and receiving water shall be determined on the basis of the physical characteristics of the receiving waters... All discharges or proposed discharges of heated water into receiving bodies of water which are controlled by the state shall be subjected to a thorough study to assess the consequences of the discharge upon the environment...

Further specifications of water quality parameters are shown in Table 2.1 and 2.2.

In addition, the current National Pollutant Discharge Elimination System (NPDES) permit issued by the U.S. Environmental Protection Agency[15] for the St. Lucie Plant requires:

> The discharge into the Atlantic Ocean shall not cause a temperature rise in excess of 0.8°C (1.5°F) above ambient surface temperature outside a 162 Hectares (400 acre) zone of mixing during the months of June through September, nor a 2.2°C (4°F) rise during the remaining months. In addition, the surface temperature conditions within the zone of mixing will not extend a rise of 3.1°C (5.5°F) over ambient temperature nor a maximum temperature of 33.9°C (93°F) as an

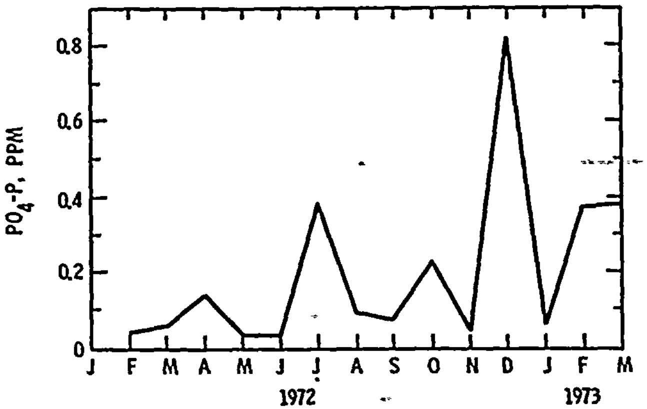

FIGURE 2.11 OCEAN PHOSPHATE LEVELS AT HUTCHINSON ISLAND (MEANS OF 5 STATIONS)

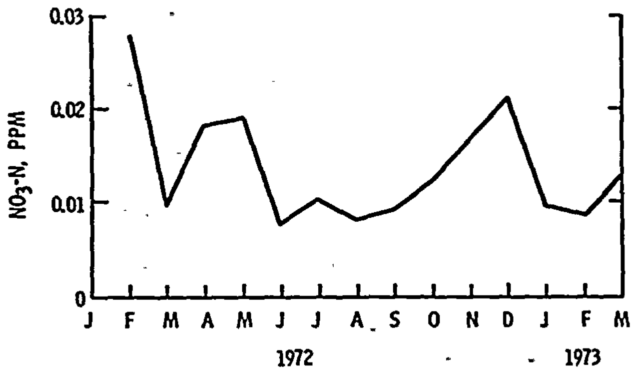

FIGURE 2.12 OCEAN NITRATE LEVELS AT HUTCHINSON ISLAND (MEANS OF 5 STATIONS)

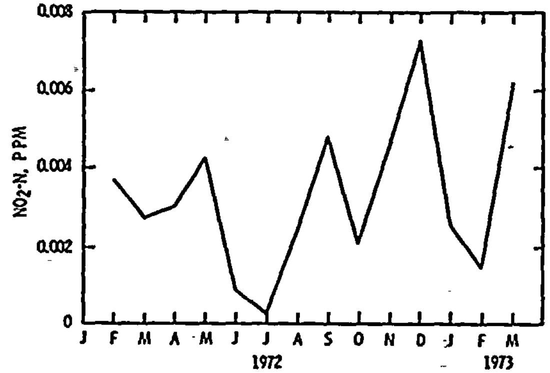

FIGURE 2.13 OCEAN NITRITE LEVELS AT HUTCHINSON ISLAND (MEANS OF 5 STATIONS)

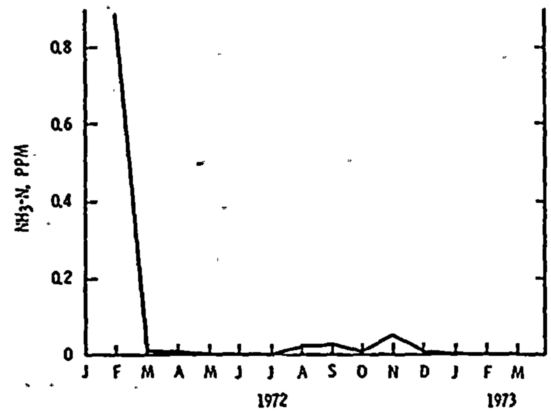

FIGURE 2.14 OCEAN AMMONIA LEVELS AT HUTCHINSON ISLAND (MEANS OF 5 STATIONS)

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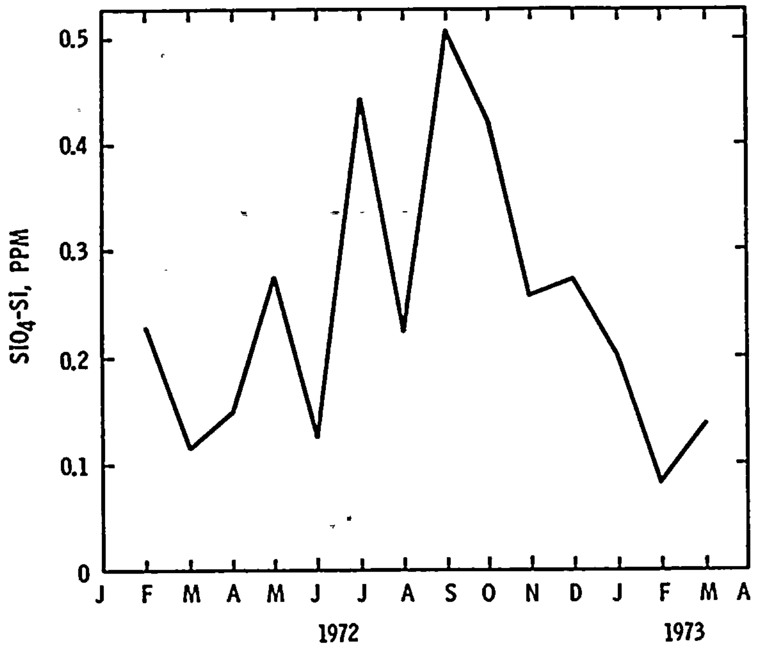

FIGURE 2.15 OCEAN SILICATE LEVELS AT HUTCHINSON ISLAND (MEANS OF 5 STATIONS)

TABLE 2.1

STATE OF FLORIDA
WATER QUALITY DESCRIPTION FOR CLASS III WATERS

Natural waters suitable for recreation, propagation and management of fish and wildlife.

1. Sewage, Industrial Wastes	Shall be effectively treated by the latest modern technological advances as approved by the regulatory agency.
2. pH	Not to vary more than one (1.0) unit above or below normal pH of the waters; lower value not less than six (6.0) and upper value not more than eight and one-half (8.5).
3. Dissolved Oxygen	Not artificially depressed below four (4.0) ppm.
4. Bacteriological	Coliform group not to exceed 1,000/100 ml as a monthly average; nor exceed the number in more than 20% of the samples examined during any month; nor exceed 2400/100 ml on any day.
5. Toxic Substances	None in concentrations or combinations which are toxic or harmful to humans, animals or aquatic life.
6. Deleterious Substances	None to such a degree as to create a nuisance.
7. Turbidity	Not to exceed fifty (50.0) Jackson units.

TABLE 2.2

STATE OF FLORIDA
WATER TEMPERATURE STANDARDS

Zone	Streams	Lakes	Coastal June-September	Coastal October-May	Open
Peninsular Florida	90°F Max AM +5°F	90°F Max AM +3°F	92°F Max AM +2°F	90°F Max AM +4°F	97°F Max AM +17°F
Northern Florida	92°F Max AM +5°F	92°F Max AM +3°F	92°F Max AM +2°F	90°F Max AM +4°F	97°F Max AM +17°F

AM - Ambient

Peninsular Florida - South of Lat. 30°N excluding Gulf and Franklin Counties.

Northern Florida - North of Lat. 30°N including Gulf and Franklin Counties.

TABLE 2.3

NPDES EFFLUENT LIMITATIONS

1.	Flow	1180 cfs
2.	pH	6.0 - 9.0
3.	Total Chlorine Residual	Not to exceed 0.1 ppm
4.	Intake Velocity	Not to exceed 1.0 fps

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instantaneous maximum at any point. Thermal defouling of the intake pipeline is authorized subject to (1) a maximum release temperature limitation of 48.9°C (120°F), (2) a maximum surface temperature rise limitation of 1.1°C (2°F), (3) conditions necessary to assure that discharge limits for aerial 001 are not exceeded due to recirculation, and (4) minimization of frequency of defouling and periods of cleaning consistent with required defouling results...

Other NPDES effuent limitations are listed in Table 2.3. The NPDES permit also provides for temperature, chemical and biological monitoring requirements.

2.6 Meteorology

The meteorology at the site is dominated by the presence of the Azores Bermuda high pressure system which results in a subtropical marine type climate for the Florida east coast. The summers are warm with abundant rainfall while the winters are mild and dry. Only occasionally during the winter is the area subjected to an outbreak of cold continental air. Severe weather at the site comes in the form of thunderstorms, tornadoes, and hurricanes.

Based on climatological data from West Palm Beach from 1931 to 1960, the normal monthly temperatures range from 66.9°F in January to 83.0°F in August. The highest reported remperature in the West Palm Beach locality was 101°F in July 1942, while the lowest was 29°F in January 1970. On the average, the maximum temperature at West Palm Beach is above 90°F 53 days/yr, while the minimum temperature is below 32°F only one day/yr.[16] Data collected at Fort Pierce from 1904 to 1960, shows mean average daily temperatures range from 64.7°F in January to 81.8°F in August with an annual average of 73.7°F (Ref. 4, p. 2.6-7).

Precipitation at the site is unevenly distributed during the year. West Palm Beach data from 1931 to 1960 reveals the normal precipitation total is 61.7 in. of rain/yr, while February has the lowest with 2.35 in. of rain/month. On the average, precipitation at West Palm Beach is 0.01 in. or more 131 days/yr.[16]

Based on West Palm Beach data from 1964 to 1971 the annual average relative humidity is 72% and the annual average humidities for the hours 1 a.m., 7 a.m., 1 p.m. and 7 p.m. are 80, 82, 60 and 72%, respectively.[16]

Heavy fog occurs on the average only eight days/yr (Ref. 4, p. 2.6-2, Ref. 16). Climatological statistics for temperature, precipitation, thunderstorms, winds, and humidity are listed in Table 2.4.

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TABLE 2.4

CLIMATOLOGICAL SUMMARY, WEST PALM BEACH, FLORIDA

	Mean Temperatures (°F) Daily Max. (1931-1960)	Mean Temperatures (°F) Daily Min. (1931-1960)	Mean Precipitation (in.) (1931-1960)	Thunderstorms Days of Occurrence (1931-1967)	Winds Prevailing Direction (1931-1963)	Winds Mean Speed (mph) (1931-1963)	Winds Calms (%) (1956-1960)	Mean Humidity (%) (1956-1960)
Jan	76	58	2.48	1	NW	9.9	5.9	74
Feb	77	59	2.35	1	SE	10.4	2.7	73
Mar	79	61	3.44	2	SE	10.7	3.4	71
Apr	82	65	4.34	4	E	10.8	2.7	71
May	86	69	5.11	7	ESE	9.4	7.2	74
Jun	89	73	7.53	13	ESE	8.0	10.0	76
Jul	91	74	6.66	16	ESE	7.5	12.0	76
Aug	91	75	6.74	17	ESE	7.4	13.0	77
Sep	90	75	9.66	11	ENE	7.9	9.1	80
Oct	85	71	7.96	5	ENE	9.9	10.7	75
Nov	80	65	2.86	1	ENE	9.9	3.2	74
Dec	77	59	2.57	1	NNW	9.8	3.2	72
Year	84	67	61.70	79	ESE	9.4	7.0	74

Extremes

Temperature:	Maximum 101°F,	Minimum 30°F	
Precipitation:	Maximum Monthly	24.86 in.	
	Minimum Monthly	0.04 in.	
	Maximum 24-hr	15.23 in.	
	Maximum Hourly	6.00 in.	
	Maximum Annual (1939-1967)		108.64 in.
	Minimum Annual (1939-1967)		37.31 in.
Wind:	Maximum 86 mph		
	Maximum Estimated 140 mph		

Potentially destructive winds at the site are associated with thunderstorms, hurricanes and tornadoes. From data recorded at West Palm Beach from 1943-1971, on an annual average there are 78 days during which thunderstorms are observed. July and August have the largest mean number of thunderstorms with 16.[16] From 1955-1967 the mean annual tornado frequency was 2.5 for the 1° latitude-longitude square containing the site. Thus, the probability of a tornado actually striking the 1 degree square area containing the site is 1.9×10^{-3}, while the recurrence interval is 541 years. Tornadoes are most common from May through October. Hurricane occurrence in Florida for the period 1885 to 1958 was reported to be 1.6/yr with a range of 0 to 5 in individual years. The probability of hurricane force winds at the plant site is estimated to be one in 15 years. Hurricanes occur during June to November (Ref. 17, p. II-11).

The monsoonal nature of the general circulation in the area together with the proximity of the site to the ocean results in a high percentage of easterly component (onshore) winds. Wind data obtained at the site during the period March 1, 1971, to February 29, 1972, indicate onshore winds occurred about 60% of the time with a mean wind speed of 9 mph while offshore winds occurred about 35% of the time with a mean wind speed of 8 mph. Calms occurred about 5% of the time.[18]

Diffusion characteristics of the site are generally favorable. The warm waters of the adjacent Gulf Stream current, located a few miles offshore, tend to inhibit the formation of strong persistent low level inversions while instability during the day is aided by the strong insolation. Based on data taken at the site from March 1, 1971, through December 31, 1972, unstable, neutral, stable, and very stable conditions occur about 29, 27, 34 and 9% of the time, respectively, with corresponding mean wind speeds of 8.2, 8.6, 6.2 and 3 mph (Ref. 4, pp. 2.6-46 to 2.6-49).

A meteorological monitoring program was begun at the site in March 1971. Meteorological data acquisition during the preoperational and operational program is described in Section 6.

2.7 Ecology

2.7.1 Terrestrial

Hutchinson Island is typical of the offshore sandbars which line the southern U.S. Atlantic coastline. It is made up of an eastern sandbar which rises to about 15 ft and a swale on the inland side which extends about a mile westward at the site of the reactor which is the widest place on the island. This divides the habitats into a beach-dune eastern zone and a western swale primarily occupied by mangrove swamps.

The mangrove swamps were initially maintained by tidal and occasional storm driven incursions of seawater as well as by rain. In the lower

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zones along Indian River and Big Mud and Blind Creeks, the red mangrove, Rhizophora mangle, predominated while the larger black mangrove, Avicennia nitida, and the smaller white mangrove, Raguncularia racemosa, were established on higher ground less frequently and less deeply flooded. Typically, in such an environment, button wood, Conocarpus, would be expected along the higher edges of such mangrove swamps but there is no evidence at this time of its presence. These mangrove swamps are noteworthy for their high productivity with leaf fall leading to a basal mangrove peat which provides the energy source to support a rich population of zooplankton, insects, snails, fiddler crabs and minnows, which in turn support large populations of fish, reptiles, birds and mammals.

Much of this natural community was destroyed in the 1930's and 40's when a mosquito control program was initiated under the W.P.A. The mosquito control program was predicated on the fact that mosquitos do not breed successfully in saline water. Thus the mangrove swamps were trenched, diked and flooded with seawater which remained stagnant at a relatively fixed level. Since the mangrove roots obtain their oxygen supply through specialized breathing pores within the tidal zone, such flooding caused the death of large numbers of trees, principally the black mangroves, and drastically reduced the productivity of the area.

Essentially all of the land now being occupied by the plant had been so affected and much of the remaining swale area owned by the applicant continues to be maintained in the flooded state by the mosquito control district. The extensive fill of approximately 200 acres for Unit 1 changed one of these diked areas from its status as an artificial impoundment to that of an artificial knoll. It is doubtful this newly raised ground will provide much new habitat for native life since it will be intensively used.

The applicant has left a canal surrounding the Indian River side of the site so that a band of mangroves shields the new fill from Indian River. This canal has been shortened by nearly 500 ft relative to the initial plan (Ref. 17, p. IV-4) to provide for an emergency cooling water intake to Unit 1 from Big Mud Creek. While this has decreased the screen of trees which limited visibility of the plant from Indian River, loss of this portion of the perimeter canal has little significance to the biota.

The sandbar immediately behind the ocean beach rises to about 15 ft and has typical small dunes stabilized in large part by a profusion of plants such as: sea oats, Uniola paniculata, sea grape, Coccoloba uvifera; dune cordgrass, Spartina patens; sea purslane, Sesuvium portulacastrum; bay cedar, Suriana maritima; and several other grasses, succulents, and woody species. In the more open and higher areas, immediately behind the dunes, Yucca, saw palmetto, and cactus abound along with many other plants. Where the Australian pine has established itself, few understory plants survive the dense shade and needle fall.

Hutchinson Island is estimated to represent 0.1% of the world shore line suitable for nesting of sea turtles (Ref. 4, p. 2.7-5). Three one mile segments of the island's beach were censused in 1967[19] and a similar more extensive census was made in 1971.[20] Although the areas studied were not identical, sampling sites can be related between the two studies and it appears the nesting frequency did not materially change in the four years.

It also appears principal raccoon predation has shifted from mid island in 1967 to a more distributed pattern in 1971 with the rate remaining between 25 and 30% of nests. In the 1967 census, one nest was presumed to be that of a green turtle (chelonia mydas) while in 1971 22 nests were observed. Based on multiple nesting returns, these are estimated to represent only nine female turtles. Six leatherback (Dermochelys coriacea) nests were also found. A predation rate of 28% by raccoons was observed for the loggerhead nests.

Some losses to birds also occur on land as newly hatched turtles move from their nests to the ocean. However, this movement typically occurs at night due to a temperature response which inhibits hatchling emergence at temperatures above 83°F,[21] and bird predation is minimized. At the present time the green seaturtle is considered either marginal or is included on most lists of endangered species, primarily due to overexploitation by man for food. During their nesting season the turtles are protected by Florida game laws.

The applicant has provided a list of plants, animals and birds of the area (Ref. 4, pp. 2.7-15 to 2.7-22) as well as data on turtle nestings. Nearly 160 species of birds are either resident or visitors to the island with water birds being the most common. Visitors listed as rare or endangered include the American peregrine falcon and southern bald eagle which are frequent visitors and the Florida great white heron and short tailed hawk, which are rare visitors to the island. While Section 2.73 of the Environmental Report lists several species of "rare or endangered" animals, which may visit or be resident on Hutchinson Island, the applicant has found no evidence that they reside on the site.

Among nearly 40 mammals reported for the island, the raccoon, opossum and beach mouse appear to be the most abundant. The rare or endangered Florida manatee and Florida panther may also occasionally visit the vicinity of the island.

There is no evidence that hunting is a significant feature on the island, though some duck hunting along Indian River is reported and hunting for small mammals may be assumed. Such hunting should decrease on the island as more of it is developed.

2.7.2 Aquatic

2.7.2.1 Indian River

Indian River is a shallow body of oceanic water lying to the west of Hutchinson Island. It is approximately 1.5 miles wide in the vicinity of the plant site. Running north-south down the river is the Intracoastal Waterway, a navigation channel dredged to a depth of 6 to 12 ft (Ref. 9, p. 7). Big Mud Creek was a shallow (less than 3-ft deep) arm of Indian River which extends nearly across Hutchinson Island immediately north of the plant location. A channel 55-ft deep was dredged during construction of Unit 1 for barge access and fill material. Mangrove communities encroach on both Indian River and Big Mud Creek from the Hutchinson Island shoreline.

Tidal exchange in Indian River is minimal due to small diurnal range (1 ft) (Ref. 9, p. 7) and the constricted entrances to the river as well as its shallow nature. The plant site and Big Mud Creek are midway between the channels at either end of the island and therefore in the region of least tidal exchange. No major streams enter Indian River in the area and freshwater runoff is primarily associated with seasonal heavy rainfall. Thus, the salinity of the river varies greatly over short periods of time and species present must be relatively euryhaline.[22]

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The waters of Indian River are reported to be a nursery ground with dense stands of manatee grass (Syringodium filiforme).[22] The grass provides protection for eggs and larvae of fish species as well as invertebrates. On its leaves grow diatoms (Ref. 8 pp. 38-39) and algae which serve as food for the developing larvae. Likewise, the mangrove communities provide protection for aquatic fauna and serve as additional nursery grounds. A large benthic community which includes shellfish, tube worms and crustaceans is also present (Ref. 22, p. 2.7-6). Some shellfishing took place in the river until 1970 when the Florida Health Board closed the waters due to pollution from sewage. This pollution load is particularly heavy during the winter, when pleasure craft are abundant in the waterway, and following heavy rains when septic tank drainage is high from the residential areas along the west bank of the river (Ref. 8, pp. 38-39).

Indian River supports both sport and commercial fisheries. In 1970, 23% of the value of commercial landings in St. Lucie County consisted of fish taken in Indian River waters, primarily black mullet (Mugil cephalus) and silver mullet (M. curema) (Ref. 8, p. 18). Popular sport species include spotted sea trout (Cynoscion nubulosus), snook (Centropomidae), sheepshead (Archosargus probatocephalus), and mangrove snapper (Lutajanus griscus) (Ref. 4, p. 2.7-7).

Prior to commencement of Unit 1 construction, Big Mud Creek had a high biochemical oxygen demand (BOD) associated with an accumulation of decomposing organic sedimentary debris. Plankton tows in Big Mud Creek yielded very few organisms (Ref. 4, p. 2.7-7). Dredging the barge access channel removed much of the BOD and fishes have been recently observed in these waters.

2.7.2.2 Atlantic Ocean

The Atlantic Ocean lies to the east of Hutchinson Island. The bottom topography gently slopes to a depth of 40 ft, then rises to 21 ft at Pierce Shoal approximately 1 mile offshore. Diving surveys indicate the bottom sediment is coarse sand and contains shell fragments. No outcroppings, reefs, or grasses were reported within 6 miles of the site. The benthos is diverse, but does not include a significant number of commercially valuable species.

Ocean waters adjacent to Hutchinson Island appear to be low in nutrients, except phosphates, with evidence of some upwelling occurring in midsummer. Phytoplankton standing crop and production are average for coastal waters, and show peaks in winter and again in autumn. Zooplankton biomass is low and shows excellent diversity. Invertebrate larvae are common, but fish eggs and larvae are scarce in the plankton. Populations of fishes appear to be small with the exception of the surf zone where migrating schools of anchovy are common but transient members of the community. In general, the area appears healthy with good diversity and average productivity. The oceanic ecosystem is further discussed in the following sections. Biological monitoring sites are shown on Figure 2.16.

2.7.2.2.1 Phytoplankton

Phytoplankton have been sampled offshore at five stations every second month beginning in September 1971 to September 1972 and monthly thereafter. Through April 1973, cell counts/liter ranged from 1 to 30,000, with blooms apparent in the autumn, January 1973, and in February-March, 1972 (Ref. 4, p. 2.7-10). Variance among stations at a given sampling time was less than an order of magnitude except in September 1971 and April 1973, when Station I (nearest shore) was lower than the other locations. Numbers were lowest in July 1972, coinciding with the upwelling described in Section 2.5. Cell counts are plotted in the applicant's Environmental Report (Ref. 4, Figures 2.7-13 to 2.7-17). Monthly chlorophyll a measurements are plotted in Figure 2.17. Chlorophyll a values range from 0.08 to 7.70 mg/m^3 and also indicate a decrease in midsummer with a winter and an autumn bloom (Ref. 4, p. 2.7-11).

Primary productivity has been calculated from chlorophyll a, mean monthly solar radiation, and the light extinction coefficient at each of the stations monthly, since July 1972. Data through April 1973 indicate a range of 0.14 to 0.53 $gC/m^2/day$, with the peak values in September and

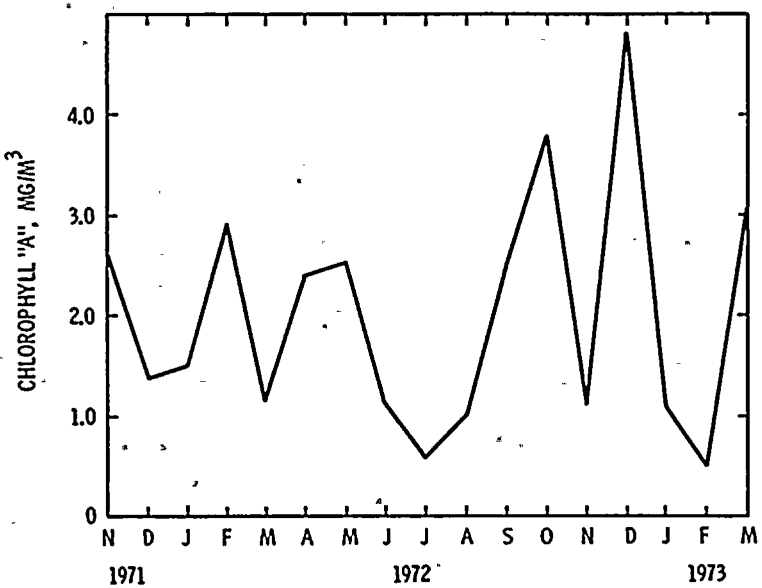

FIGURE 2.16 CHLOROPHYLL a LEVELS AT HUTCHINSON ISLAND

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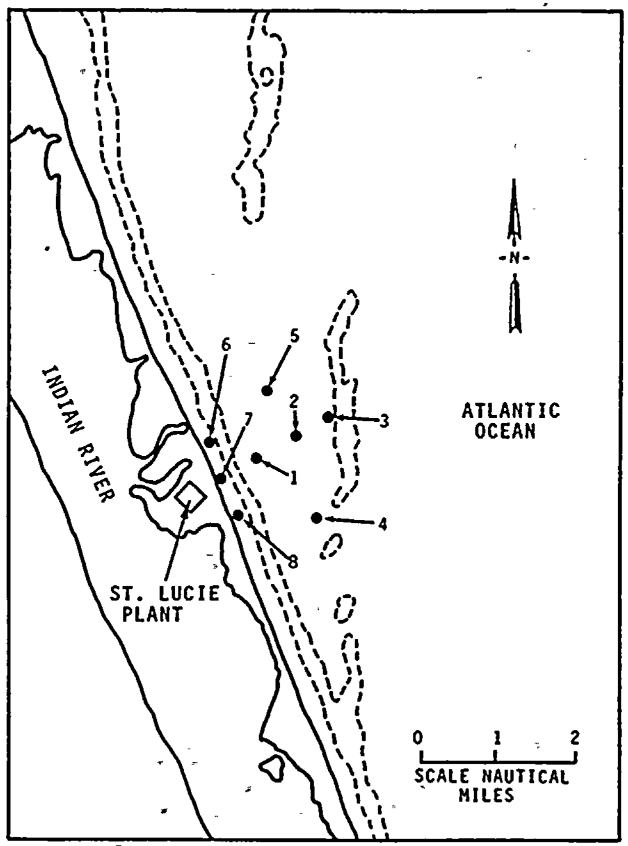

FIGURE 2.17 BIOLOGICAL MONITORING SITES

October and smaller peaks in December and March.[23] These values correlate well with cell counts and with nutrient levels. Thus, primary production is near average or below for coastal waters.[24] Generally, diatoms were dominant in the phytoplankton and the most abundant of these were Nitzhcia spp., Bellerochea sp., Chaetoceros spp., Thalassionema nitzschoides, and Skeletonema costatum. Blue-green algae were dominant at one station (Station III) in November 1971 and another in November 1972 (Station I). Dinoflagellates were dominant in July and consisted primarily of Ceratium spp. (Ref. 4, Figures 2.7-18 to 2.7-22). Detailed species lists are presented in progress reports from the Florida Department of Natural Resources to the applicant.[24,25,30]

2.7.2.2.2 Zooplankton

Zooplankton were sampled monthly starting September 1971 and data are available through July 1972. Counts of organisms per cubic meter are reported and range from 244 to 12,023. These are plotted in the applicant's Environmental Report (Ref. 4, Figures 2.7-18 to 2.7-22). Copepods comprised the majority of these with counts from 82 to 10,930/m^3 reported. A peak in numbers occurred in January with lows in November and July.

The inshore station (Station I) had fewest while Station III had the greatest numbers on most occasions. The most abundant copepods included Acartia, Paracalanus, Oithona, Temora, Undinula, Corycaeus, Eutherpina, and Labidocera. Chaetognaths (Sagita sp.) were numerous. Larvae included Oikopleura as well as various invertebrates and vertebrates (Ref. 4, p. 2.7-11). Ichthyoplankton (fish eggs and larvae) were present at numbers indicated in Table 2.5. They were not identified to species. Detailed species lists of zooplankters are presented in progress reports from the Florida Department of Natural Resources to the applicant.[24,25,30]

TABLE 2.5

ICHTHYOPLANKTON AT HUTCHINSON ISLAND
(Counts per m^3)

Month	Station I	II	III	IV	V	Mean
September 1971	-	-	40	-	-	8
November	2	-	2	-	-	1
January 1972	24	62	42	68	24	44
March	+	5	+	-	28	7
May	11	4	59	+	7	10
July	4	14	19	+	43	16
Mean N°/m^3	7	12	27	10	15	

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2.7.2.2.3 Fishes

Between September 1971 and March 1972 a single bi-monthly balloon trawl was made and resulted in collection of 39 individuals of 12 species (Ref. 4, p. 2.7-13). These are listed in Table 2.6. Beach seines at three stations between October 1971 and March 1972 yielded primarily anchovy (Engraulidae). Some 22 species were taken and are listed in Table 2.7 (Ref. 4, p. 2.7-13). Commercial fisheries are active for Spanish mackeral (Scomberomorus maculatus), king mackeral (S. cavalla), gray sea trout (Cynoscion nothus), bluefish (Pomatomus saltatrix), and pompano (Trachinotus carolinus) (Ref. 8, p. 7). Sport fishery catches include ladyfish (Elops saurus), snook (Centropomus undecimalis), mullet (Mugil spp.), and various billfish (Ref. 4, p. 2.7-14).

TABLE 2.6

FISH SPECIES TAKEN IN TRAWLS OFF HUTCHINSON ISLAND
(September-November 1971)

Synodontidae	
Synodus foetens	Inshore lizardfish
Serranidae	
Centropristis philadelphica	Rock sea bass
Gerreidae	
Eucinostomus gula	Silver jenny
Sparidae	
Archosargus probatocephalus	Sheepshead
Scorpaenidae	
Scorpaena brasiliensis	Barbfish
Triglidae	
Prionotus scitulus	Leopard searobin
P. martis	Barred searobin
Bothidae	
Bothus ocellatus	Eyed flounder
Citharichthys macrops	Spotted whiff
Etropus crossotus	Fringed flounder
Paralichthys albigutta	Gulf flounder
Syacium papillosum	Dusky flounder

TABLE 2.7

FISH SPECIES TAKEN IN BEACH SEINES ON HUTCHINSON ISLAND
(September 1971 - March 1972)

Clupeidae	
Brevoortia sp.	
Harengula pensacolae	Scaled sardine
Opisthonema oglinum	Atlantic threadfin herring
Sardinella anchovia	Spanish sardine
Engraulidae	
Anchoa cubana	Cuban anchovy
A. mitchelli	Bay anchovy
A. nasuta	Longnose anchovy
Engrualis eurystole	Silver anchovy
Pomatomidae	
Pomatomus saltatrix	Bluefish
Carangidae	
Caranx crysos	Blue runner
C. hippos	Crevalle jack
Chloroscombrus chrysurus	Atlantic bumper
Selene vomer	Lookdown
Trachinotus carolinus	Florida pompano
T. falcatus	Permit
Sparidae	
Lagodon rhomboides	Pinfish
Sciaenidae	
Leiostomus xanthurus	Spot
Menticirrhus littoralis	Gulf kingfish
Pogonias chromis	Black drum
Umbrina coroides	Sand drum

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Spanish mackeral are found in Florida waters between October and March, migrating northward in the spring. They apparently migrate near shore, as most are caught within a mile of the shoreline. Spanish mackeral spawn in the fall and, while small larvae have been collected near Cape Canaveral, eggs and larvae have not been reported at Hutchinson Island.[26,27] King mackeral spawn later than Spanish mackeral, but southeast Florida waters are not thought to be important spawning areas for the species.[28] They are generally found 8 to 10 miles offshore (Ref. 4, p. 2.7-15).

Bluefish are also present in winter months and are caught within 1 mile of shore. They spawn in water 60 to 300 ft deep, but spawning is thought to be limited to north of Cape Canaveral (Ref. 4, p. 2.7-15).

Mullet form schools and migrate from estuaries to open water prior to spawning in the fall and winter. They migrate very close to shore and are frequently caught in beach seines.[29]

2.7.2.2.4 Benthos

Diving surveys indicate few outcroppings and a bottom quite sparsely populated with surface organisms. No reefs or grasses were found but a few echinoderms (starfishes, urchins, and sanddollars) and a few scallops were reported. In some places empty scallop shells were numerous. The substrate consisted of sand and shell fragments (Ref. 9, p. 7).

Shipek grab samples of the benthos returned some 35 polychaete families with excellent diversity and numbers ranging from 130 to 1300 individuals per m^2. Mollusks were concentrated primarily at stations midway between the proposed discharge outlet and Pierce Shoal.[30] Again, good diversity was reported with total numbers ranging from 20 to 1300 individuals per m^2. Amphipods, isopods and decapods were also found in low numbers and with good diversity. Echinoderms were reported to be very small and consisted primarily of ophiuroids.

The substrate was much finer sand at Station I with III being intermediate. Stations II, IV and V have a sand-shell fragment composition. Densities of organisms were therefore lowest at Station I with the exception of bivalves which were higher there.

None of the species found was present in a sufficient density to suggest a commercial importance. Surveys by the Fish and Wildlife Service indicate large beds of scallops in other areas offshore, but 19 30-minute trawls in water 14 to 40 fathoms deep (over 6 miles off Hutchinson Island) yielded from zero to 1/2 bushel of scallops compared to several bushels per trawl in other areas off the Florida east coast (Ref. 4, p. 2.7-12).

2.7.2.2.5 Intertidal

Little information on the sandy intertidal zone is available, but it is known that sea turtles nest here as discussed in Section 2.7.1.

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2.7.2.2.6 Marine Vertebrates Other Than Fishes

Sea turtles mate within one mile of their nesting beaches, and are thus expected to mate in the Hutchinson Island area. Turtle hatchlings move into the ocean from their nests and migrate to unknown locations in the Atlantic.

Marine mammals in the area may include the manatee and porpoise although these have not been reported in the literature.

2.7.2.2.7 Rare and Endangered Species

None of the species of fishes reported by the applicant is included on the U.S. List of Endangered Fish and Wildlife,[31] nor in the 1973 edition of threatened wildlife of the United States (Ref. 4, p. 2.7-16). The green sea turtle (*Chelonia mydas mydas*), is included on the latter list (Ref. 4, p. 2.7-5). The Florida manatee is also endangered and may be present, although it has not been observed by the applicant.

2.8 Background Radiological Characteristics

In a cooperative program with the Florida State Division of Health, the applicant has been conducting a preoperational radiological surveillance of the plant site and environs since January 1971. More details on this program can be found in Section 6.1. Table 2.8 lists some typical results obtained from the survey. The background dose at the site is approximately 120 mrem/yr (Ref. 4, p. 2.8-1).

TABLE 2.8

TYPICAL BACKGROUND RADIOACTIVITY CONCENTRATIONS IN VARIOUS SAMPLED MEDIA IN THE REGION OF THE ST. LUCIE PLANT FOR 1971

	Gross B	K-40	Fe-55	Sr-90	Zr-95	I-131	Cs-137	Ce-144
Well Water (pCi/liter)	20							
Seawater (pCi/liter)	490	320						
Biota (Fish) (pCi/kg)	3000	2000	30	18				
Citrus (pCi/kg)	1800	1700		40			70	
Milk (pCi/liter)		150		6		<10	90	
Soil (pCi/kg)		400			100		200	
Beach Sand (pCi/kg)					170		200	400

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3. THE PLANT

3.1 External Appearance

As of September 1973, much of Hutchinson Island was still undeveloped, particularly in the area of the plant site (see Figures 2.2 and 3.1). Mangroves to a height of 15 to 25 ft cover most of the swampy areas. Australian pine to a height of 30 to 50 ft cover many of the higher areas.

The plant cannot be completely hidden from view in this terrain. The reactor and turbine buildings for Unit 2, along with associated facilities, will be located immediately adjacent to and south of Unit 1. The intake and discharge cooling canal system installed for Unit 1 will be shared by Unit 2. The two reactor containment vessel domes will be the tallest structures at 225.5 ft above mean low water (MLW). These buildings will be left in their natural (concrete) color. Plant lighting will be mainly confined to that required for security and personnel safety purposes.

Mangroves and Australian pines will effectively block the view of the plant from the ocean beach. As a condition of the operating license for Unit 1, plantings of Australian pine are required behind the dune line to minimize plant lighting effects on turtles.

The nearest point of general access to the plant is State Road A-1-A which runs within 1000 ft of the reactor buildings (centerline to centerline).

Plans for landscaping the site are not complete. The applicant indicates the ground area sloping from the road up to the plant will probably be grassed with plantings of trees and shrubs to blend in naturally with the surroundings. The borders of the intake and discharge canals passing under the road will be grassed. Vegetation bordering the road could block much of the view of the reactor buildings and associated facilities (see Figure 3.2) if it were determined by the landscape architect this is the most desirable landscaping approach.

A 100- to 200-ft wide border of naturally occurring vegetation (mainly mangroves) will be left between the plant site and Indian River. The only exceptions are the barge facility on Big Mud Creek and the emergency cooling canal from Big Mud Creek to the intake canal. These features are not visible from the mainland and are only visible from one location on State Road A-1-A.

The higher buildings can be seen from the mainland (see Figure 3.3), but the distance is approximately 1.5 miles. These buildings can also be seen from a few locations to the south of the plant (see Figures 3.4 and 3.5) and from the three causeways across to the island.

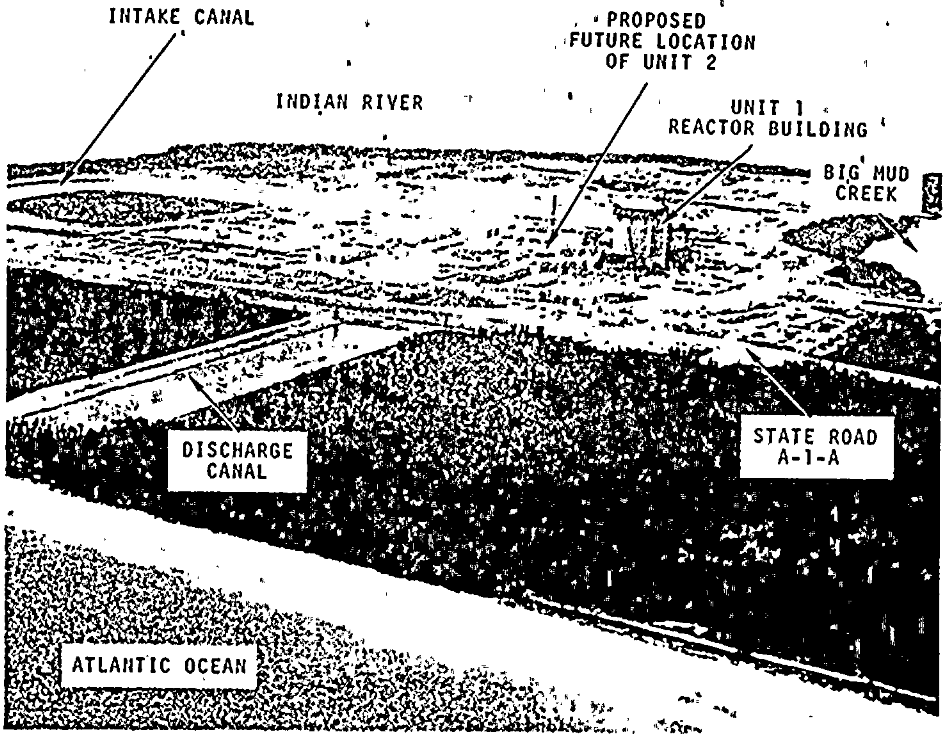

FIGURE 3.1 ST. LUCIE PLANT LOOKING SOUTHWEST

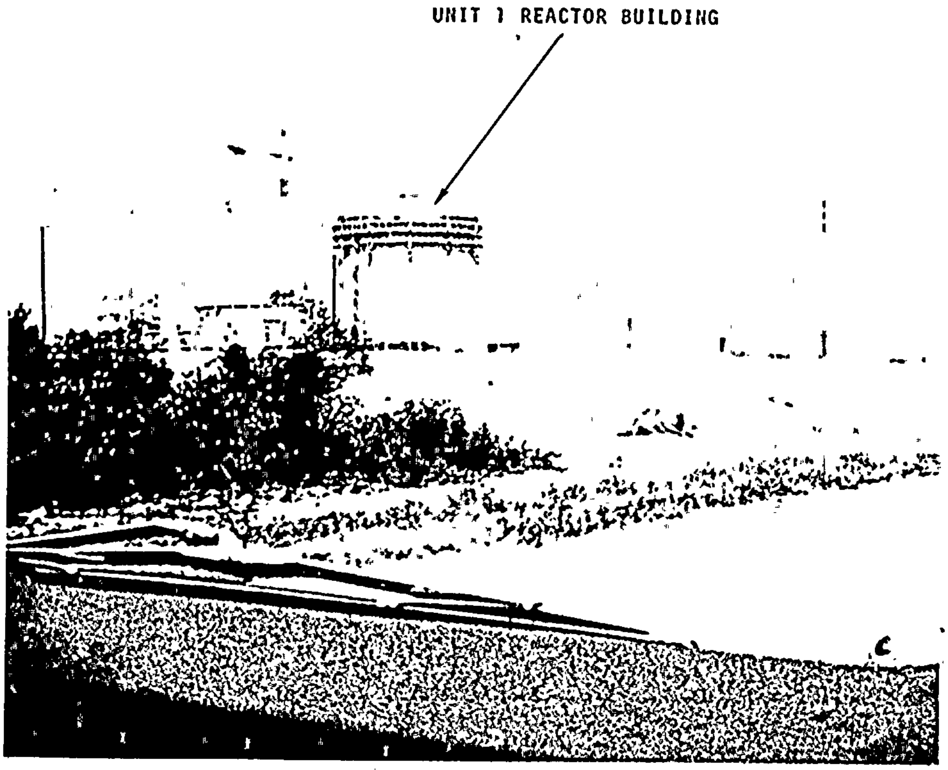

FIGURE 3.2 ST. LUCIE PLANT FROM HIGHWAY ADJACENT TO PLANT

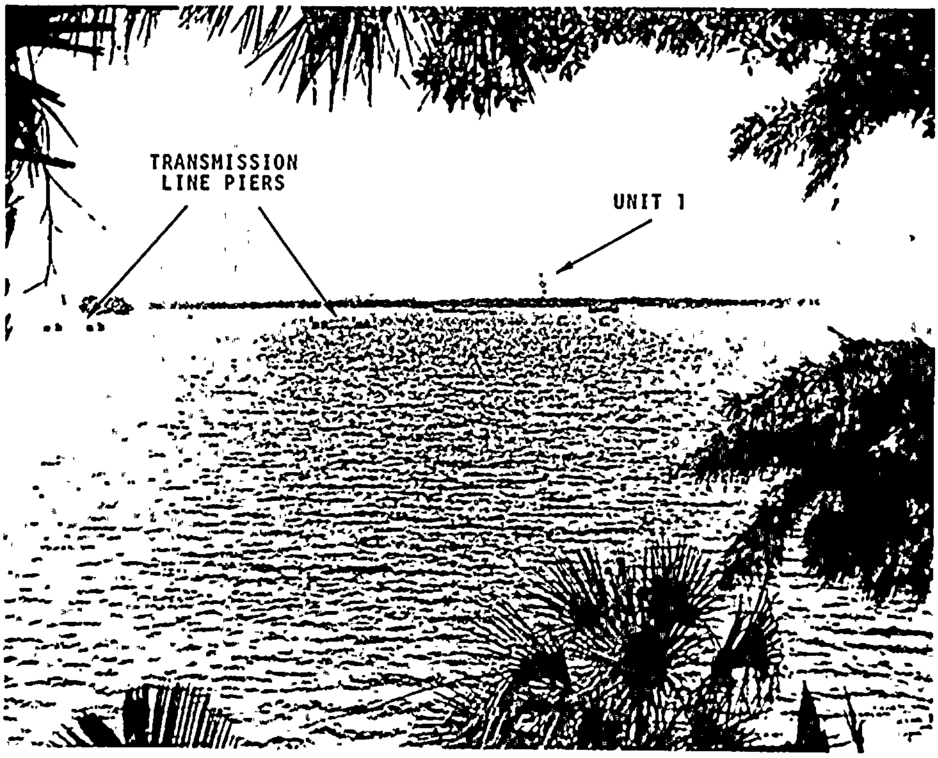

FIGURE 3.3 ST. LUCIE PLANT FROM WEST SHORE OF INDIAN RIVER

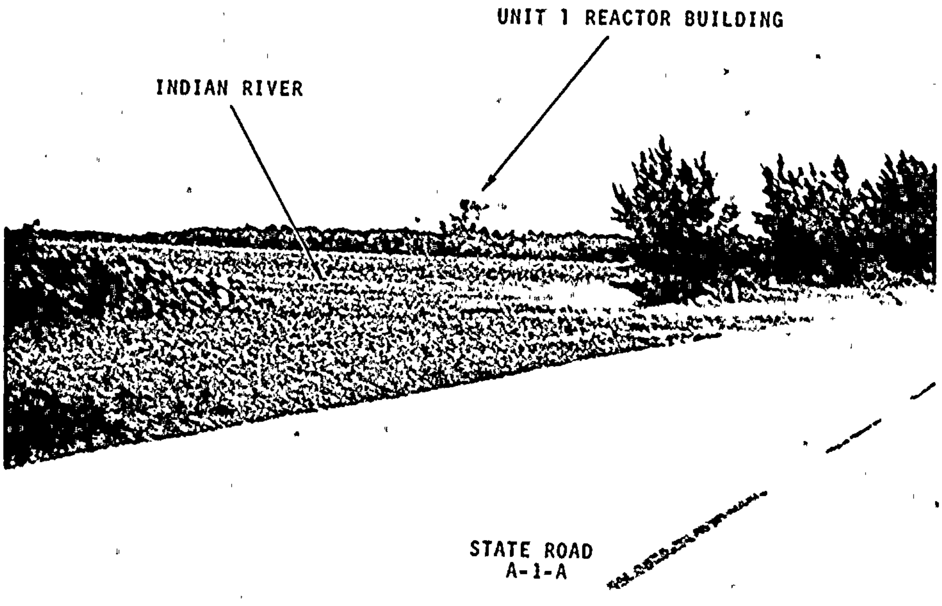

FIGURE 3.4 ST. LUCIE PLANT FROM HIGHWAY SOUTH OF PLANT

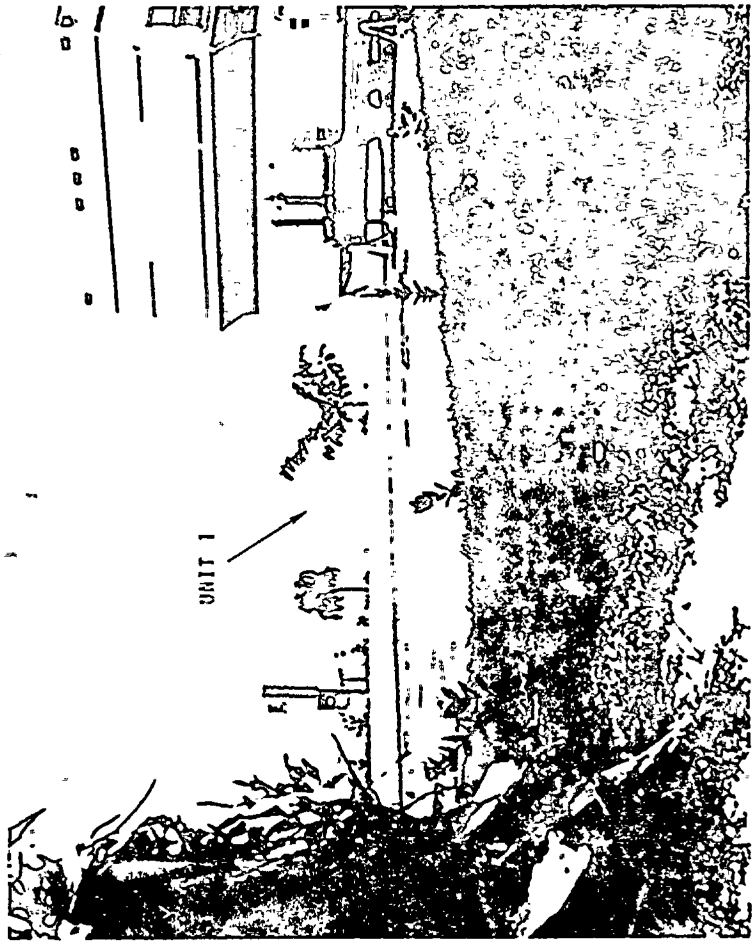

FIGURE 3.5 ST. LUCIE PLANT FROM NETTLES ISLAND TRAILER CAMPGROUND

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Approximately 830 acres of the site will be retained in a natural state unless additional plants are built there. This will include approximately 2-1/4 miles of ocean beach.

3.2 Reactor, Steam Electric System, Fuel Inventory

Unit 2 will be a pressurized water reactor designed and fabricated by Combustion Engineering, Incorporated. Westinghouse Electric Corporation will furnish the turbine-generator. The design thermal power rating of the reactor is 2560 MW, with an ultimate output of 2700 MW. Gross electrical power output is expected to be 850 MW and a net output of 810 MWe. Ebasco Services is the Engineer-Constructor.

The reactor (primary) coolant system consists of two closed-piping loops with water at 2250 psia pressure and reactor inlet and outlet temperatures of 540 and 601°F, respectively. Heat from the reactor coolant loops is transferred to a secondary coolant system in two steam generators. Here the water in the secondary system is converted to steam at 815 psia pressure to drive the turbine-generator. After leaving the turbine-generator, the secondary coolant steam is condensed back to water in condensers and recirculated back to the steam generators to repeat the cycle.

3.3 Plant Water Use

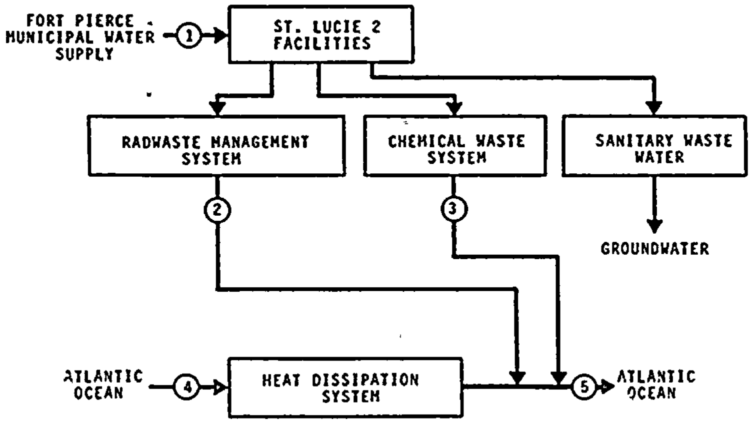
Water required for potable, sanitary and other general uses will be supplied by the Fort Pierce water system. Makeup water for the nuclear steam supply system will also be drawn from Fort Pierce. Approximately 210 gpm (0.5 cfs) will normally be drawn from the Fort Pierce water system for Unit 2 with peak flows to about 550 gpm (1.2 cfs). Figure 3.6 illustrates the water flow path through the various water use and cooling systems.

3.4 Heat Dissipation System

Heat generated by the nuclear steam supply system and not converted to electrical energy is rejected from the plant to ocean-water flowing in the condenser cooling system. This system is not shared with Unit 1 but is connected to shared plant intake and discharge canal and ocean piping systems. Major components of this canal and piping system are 1) two intake lines, 2) an intake canal, 3) a discharge canal, 4) two discharge lines, and 5) a possible future recirculation canal. Figure 3.7 presents a general plant view of the system. Design flow for Unit 2 is 530,000 gpm (1150 cfs) with maximum and normal temperature rises across the condensers of 24 and 21°F, respectively.

3.4.1 Ocean Intake System

The ocean intake structures constructed for Unit 1, which will also serve Unit 2, are located 1200 ft offshore and about 2400 ft south of the



WATER USE SUMMARY
ESTIMATED SYSTEM FLOW (GPM)

STATION	NORMAL	MAXIMUM	SHUTDOWN
1	210	550	--------
2	3	200	--------
3	200	500	--------
4	530,000	530,000	14,500
5	530,210	530,550	14,500

FIGURE 3.6 PLANT WATER USE SYSTEM

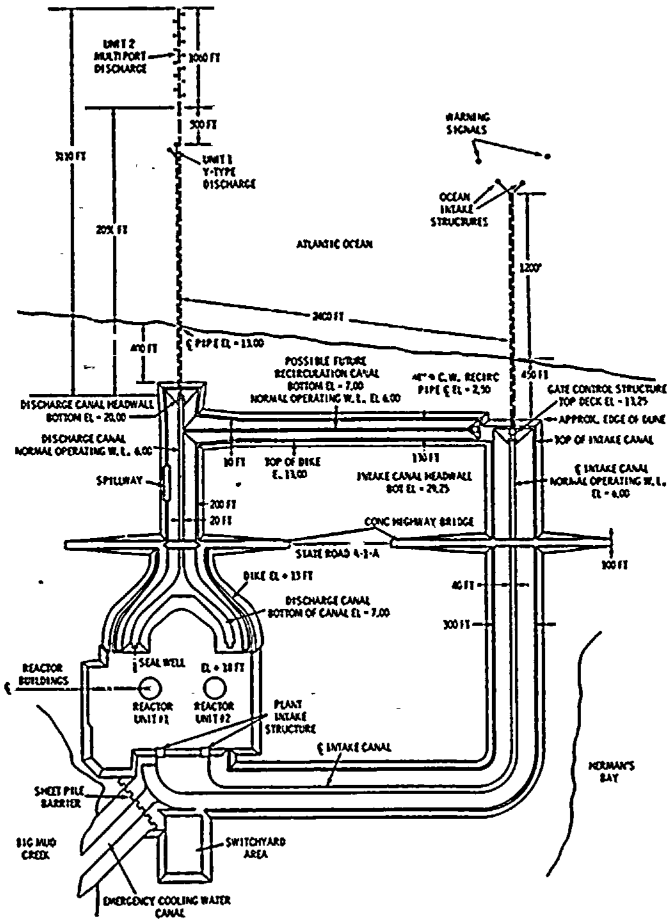


FIGURE 3.7 COOLING WATER SYSTEM

discharge structure. As shown in Figures 3.8 and 3.9, the top of the intakes are situated approximately 8 ft below the water surface at mean low water. A vertical section to prevent sanding and a velocity cap to minimize fish entrapment were installed for each pipe. No screens or grates are planned. Horizontal intake velocities will be about 1 fps with both units operating.

From the ocean intake point, water is drawn through two buried pipelines (ID-12.0 ft) at 10 fps to the intake canal. This 300-ft wide canal begins 450 ft west of the shoreline and carries the cooling water some 5000 ft to the plant intake structures. Each unit is provided with an independent plant intake structure adjacent to the canal. Pumps within these plant intake structures provide the suction to draw water from the ocean through the ocean intake structure, ocean pipelines and canals, and pump the water through the plant, the discharge canal, and under-ocean pipes to the ocean discharge pipes.

The plant intake structure for Unit 2 consists of four bays, each containing one coarse screen, traveling screen and circulating water pump. Approach velocities to each bay will be less than 1 fps. From this structure the water flows through a buried pipeline to the condensers at about 7 fps. An emergency water supply system has been installed for Unit 1 to provide a backup supply of cooling water to facilitate and maintain safe plant shutdown. This emergency water supply is obtained from Big Mud Creek via a canal connected to the intake canal. A sheet piling barrier wall separates the intake canal and the emergency canal. Passage of emergency cooling water through the sheet pile wall is controlled by remote manual actuation of pneumatic devices. Nine stub pipes are fitted with inflated rubber membranes for flow control. Each pipe is designed to pass cooling water at a rate of 14,500 gpm (32.3 cfs).

The pneumatic control plugs will be tested semi-annually with each one opened for no more than 30 minutes. An estimated 2 million gallons of water will be drawn from Big Mud Creek during each semi-annual test. A recent agreement with the Flood Control District limits the water drawn from Big Mud Creek to 4 million gallons per year for testing.[4] The emergency cooling canal is shown in Figure 3.10.

3.4.2 Discharge System

Heated water leaving the condenser flows through a buried pipeline for 500 ft to the discharge canal. This open canal is 200 ft wide and extends approximately 2200 ft to a point 400 ft west of the shoreline. There the discharged water is carried in one of two 12-ft diameter concrete pipes buried under the beach and ocean floor out to the ocean

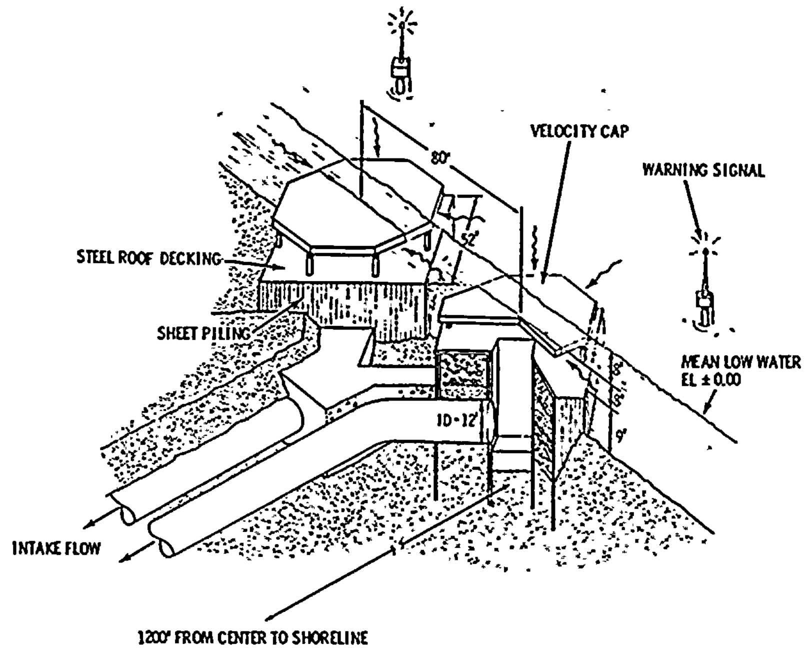


FIGURE 3.8 OCEAN INTAKE STRUCTURE

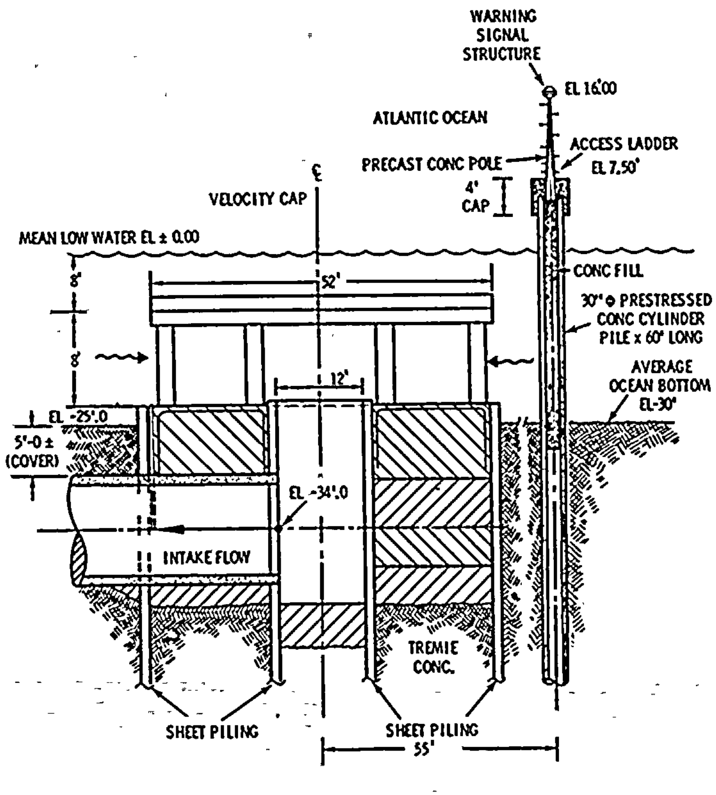


FIGURE 3.9 SIDE VIEW OF THE OCEAN INTAKE STRUCTURE

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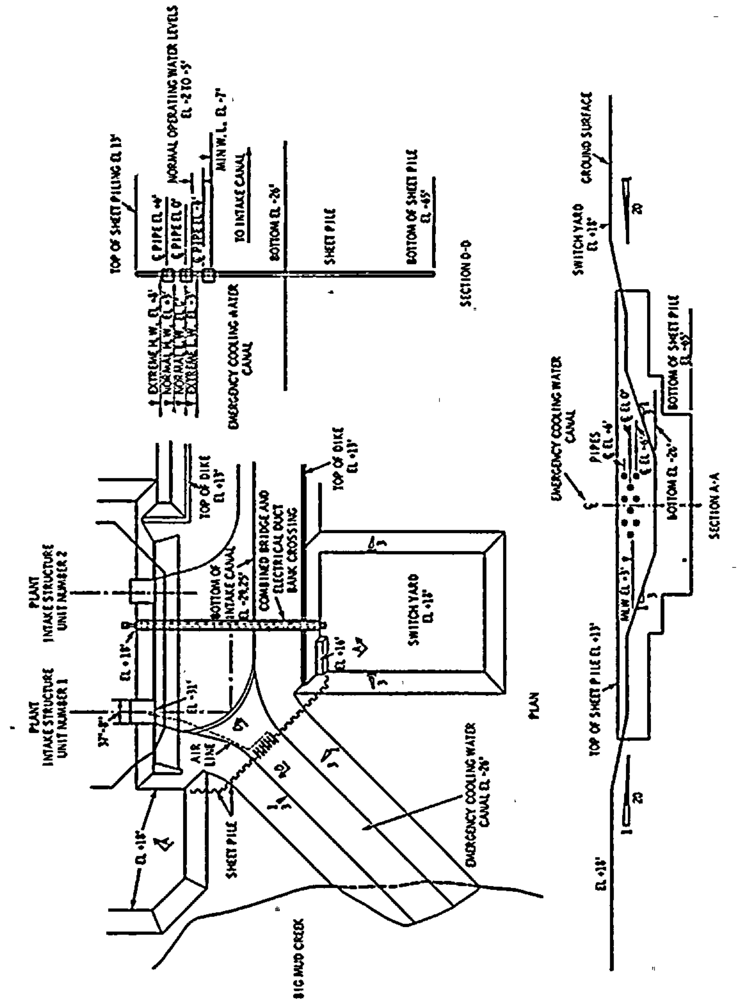

FIGURE 3.10 EMERGENCY COOLING WATER CANAL

discharge structures. One line, installed for Unit 1, extends about 1200 ft out from the shoreline. The other line, to be installed for Unit 2, will extend about 2800 ft out from the shoreline.

The Unit 2 ocean discharge structure, shown in Figure 3.11, consists of a 48 port diffuser line. Each port will be 1.5 ft in diameter, spaced 22.5 ft between centers and oriented to discharge horizontally. The jets will be mounted in an alternating manner on either side of a 1060-ft manifold. Jets on the same side of the line will be 45 ft apart. Ocean depth at the discharge point will be about 35 to 40 ft below MLW. Exit velocity of the discharged water from each port will be about 13 fps. The diffuser line will produce a relatively high degree of entrainment of ambient water and thus enhance the diluting characteristics of the plume.

The ocean discharge structure being installed for Unit 1 (shown in Figure 3.12), consists of a short transition section and a Y-type, high-velocity jet discharge; each port will be 7.5-ft in diameter. Ocean depth at the discharge point is -18 ft (MLW). A short sloping trench will be excavated to -36 ft with plans to line it with tremie concrete, sheet pilings and rip rap to prevent scour from the jet discharge. The centerline of the discharge ports will be 30 ft below the water surface. Exit velocity of the discharged water from each port will be 13 fps. The design is a high momentum type which produces a relatively high degree of entrainment of ambient water, thus enhancing the diluting characteristics of the outfall.

Some recirculation between the plant discharge and intake systems will occur because longshore currents prevail in a southerly direction; cross flow on the thermal plume will transport heated water towards the intake. This recirculation will not be significant during normal plant operations since the heated water will probably be confined to the upper 8 ft of the water column. Temperature rises of 1.5 to 3.0°F can be expected near the intake point, as a result of the interacting plumes of Units 1 and 2. No recirculation is expected during northerly currents or during slack current conditions.

3.4.3 Defouling System

Marine organisms will accumulate in the ocean intake lines possibly resulting in a need for periodic defouling. The applicant has studied various pipe materials and configurations to determine a design which could accommodate marine growth, thus eliminating the need for defouling. These studies indicate growth of fixed forms (barnacles, etc.) is probably limited and may be circumvented by oversizing the intake lines. Should

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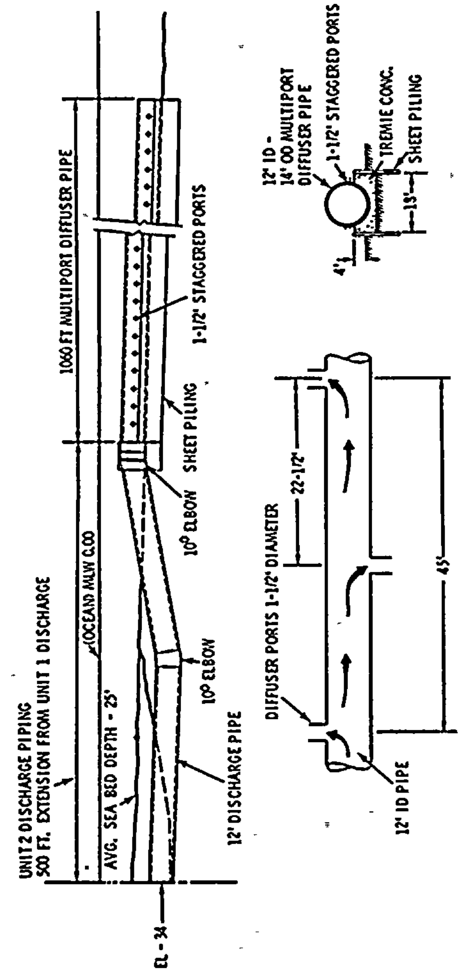

FIGURE 3.11 UNIT 2 OCEAN DISCHARGE STRUCTURE

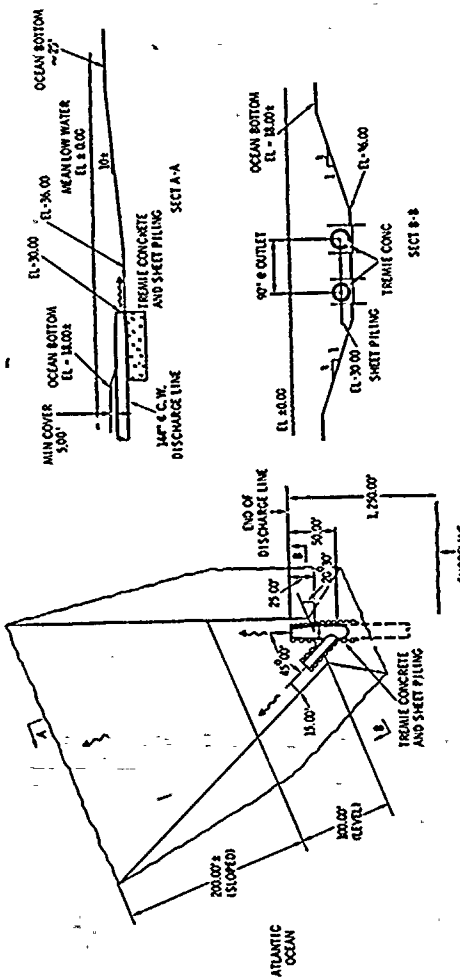

FIGURE 3.12 UNIT 1 OCEAN DISCHARGE STRUCTURE

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defouling be required, however, the applicant indicates various methods will be considered including using heated water from the discharge canal (via the recirculation canal shown in Figure 3.7). This procedure will not be used until reviewed by the staff for compliance with applicable water quality standards and other environmental requirements.

3.4.4 Single Unit Operation

For periods during which only one unit is operating, the applicant has two alternate schemes for reducing the surface temperature rise in the adjacent ocean waters. The first alternative involves flow dilution using the circulating water of the "down" unit to dilute the effluent of the operating unit. The second would employ diversion of flow to the Unit 2 diffuser line by means of a sluice gate in the discharge canal.

Hydrothermal calculations indicate that both schemes for water surface temperature reduction will satisfactorily achieve temperatures below those of applicable water quality standards and the NPDES requirements. A summary of hydrothermal calculation for various cases is presented in Table 3.1.

3.5 Radwaste Systems

During the operation of Unit 2 radioactive materials will be produced by fission and by neutron activation of corrosion products in the reactor coolant system. From the radioactive material produced, small amounts of gaseous and liquid radioactive wastes will enter the waste streams. These streams will be processed and monitored within the station to minimize the quantity of radionuclides ultimately released to the atmosphere and to the Atlantic Ocean.

The waste handling and treatment systems to be installed at the station are discussed in the applicant's Preliminary Safety Analysis Report, Environmental Report, and their amendments. In these documents, the applicant has prepared an analysis of its treatment systems and estimated the annual radioactive effluents.

Unit 1 and Unit 2 have separate radwaste treatment systems. While this statement is for Unit 2 and estimates releases from Unit 2, the estimated releases from both Unit 1 and Unit 2 have been considered in calculating the doses from the site. The applicant has committed to a similar steam generator blowdown system for Units 1 and 2. On this basis we have not used the estimated releases given in the FES for Unit 1, but have used the estimated releases for Unit 2 in calculating the doses for Units 1 and 2 in this FES.

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TABLE 3.1

HYDROTHERMAL CALCULATIONS FOR ALTERNATIVE TEMPERATURE REDUCTION SCHEMES

MODE OF PLANT OPERATION	UNITS IN OPERATION	NUMBER OF PUMPS IN OPERATION	TOTAL DISCHARGE FLOW (CFS)	DISCHARGE FLOW FROM UNIT NO. 1 (CFS)	JET VELOCITY FOR UNIT NO. 1 (FPS)	DISCHARGE FLOW FROM UNIT NO. 2 (CFS)	JET VELOCITY FOR UNIT NO. 2 (FPS)	MAXIMUM TEMPERATURE RISE (°F)	MAXIMUM PREDICTED SURFACE TEMPERATURE (°F)	
									UNIT 1	UNIT 2
NORMAL PLANT OPERATION	1 AND 2	8	2290	1145	13	1145	13.5	24	5.5	1.5
OPERATION WITHOUT FLOW DILUTION OR DIVERSION	2	4	1226	613	6.9	613	7.3	24	7.4	2
WITH FLOW DILUTION	1 AND 2 (UNIT NO. 1 WITH ΔT = 0)	6 (4 IN UNIT NO. 2; 2 IN UNIT NO. 1)	1822	911	10.31	911	10.74	18	4.2	1.1
WITH FLOW DILUTION	1 AND 2 (UNIT NO. 1 WITH ΔT = 0)	8	2290	1145	13	1145	13.5	12	2.1	0.5
WITH FLOW DILUTION	1 AND 2 (UNIT NO. 1 WITH ΔT = 0)	4	1354	677	7.66	677	7.86	12	2.6	0.8
WITH FLOW DIVERSION	2	4	1150	0	0	1150	13.5	24	0	1.5

The following subsections describe the waste treatment systems and an analysis is given based on the AEC model of the applicant's radioactive waste systems. The model has been developed from a review of available data from operating nuclear power plants, adjusted to apply over a 40-year operating life. The coolant activities and flows used in the staff's evaluation are based on experience and data from operating reactors. As a result, the parameters used in the model and the subsequent calculated releases vary somewhat from those given in the applicant's evaluation. The resulting differences do not lead to significant differences in the evaluation. The staff's liquid source terms are calculated by means of a revised version of the ORIGEN code which is described in ORNL 4628, Oak Ridge Isotope Generation and Depletion Code. The staff's gaseous source terms are calculated by means of the STEFFEG code as described in the report Analysis of Power Reactor Gaseous Waste Systems, F. T. Binford et al., 12th Air Cleaning Conference. The principal parameters used in the staff's source term calculations are given in Table 3.2. The bases for these parameters are given in Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactors, Vol. 2, Appendix B. Based on the following evaluation, we conclude that the liquid, gaseous, and solid waste treatment systems are acceptable and meet as low as practicable levels in accordance with 10 CFR Part 20 and Part 50.34a.

3.5.1 Liquid Waste Management System

The liquid waste management system will consist of process equipment and instrumentation necessary to collect, process, monitor, and recycle or dispose of potentially radioactive liquid wastes. Prior to releasing liquid waste, samples will be analyzed to determine the type and amounts of radioactivity present. Based on the results of the analyses, the wastes will be released under controlled conditions to the Atlantic Ocean or retained for further processing. Radiation monitoring will automatically terminate liquid waste discharge if radiation measurements exceed a predetermined level in the discharge line. A simplified diagram of the liquid radwaste treatment systems is shown in Figure 3.13.

The liquid waste management systems will be divided into two principal systems: the boron recovery system (BRS) and the liquid waste system. The BRS will process high grade water from the reactor coolant system which will normally be recycled for reuse in the plant after treatment. The liquid waste system will process water from equipment drains, floor drains, laboratory drains, decontamination drains, building sumps, and laundry wastes. Some of these wastes will be discharged after treatment,

TABLE 3.2

PRINCIPAL PARAMETERS AND CONDITIONS USED IN CALCULATING RELEASES OF RADIOACTIVE MATERIAL IN LIQUID AND GASEOUS EFFLUENT FROM ST. LUCIE UNIT 2

Reactor Power Level (MWt)	2700
Plant Capacity Factor	0.80
Failed Fuel[(a)]	0.25%
Primary System	
Volume of Coolant (ft^3)	9670
Letdown Rate to CVCS (gpm)	40
Shim Bleed Rate (gpm)	1.5
Leakage Rate to Secondary System (lb/day)	110
Leakage Rate to Auxiliary Building (lb/day)	160
Leakage Rate to Containment Building (lb/day)	240
Frequency of Degassing for Cold Shutdowns (per yr)	2
Secondary System	
Steam Flow Rate (lb/hr)	1.2×10^7
Mass of Steam/Steam Generator (lb)	9.5×10^3
Mass of Liquid/Steam Generator (lb)	1.3×10^5
Secondary Coolant Mass (lb)	1.3×10^6
Rate of Steam Leakage to Turbine Building (lb/hr)	1.7×10^3
Steam Generator Blowdown Rate (lb/hr)	7.0×10^3
Dilution Flow (gpm)	4.8×10^5
Containment Building Volume (ft^3)	2.5×10^6
Frequency of Containment Purges (per yr)	4
Iodine Partition Factors (gas/liquid)	
Leakage to Containment Building	0.1
Leakage to Auxiliary Building	0.005
Steam Leakage to Turbine Building	1
Steam Generator (carryover)	0.01
Main Condenser Air Ejector	0.0005
Decontamination Factors (Liquids)	

	Boron Recycle and Equipment Drains	Liquid Radwaste
I	1×10^5	1×10^4
Cs, Rb	2×10^3	1×10^5
Mo, Tc	1×10^5	1×10^6
Y	1×10^4	1×10^5
Others	1×10^5	1×10^5

(a) This value is constant and corresponds to 0.25% of the operating power fission product source term.

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TABLE 3.2 (continued)

	All Nuclides Except Iodine	Iodine
Waste Evaporator DF	10^4	10^3
BRS Evaporator DF	10^3	10^2

	Cation[(a)]	Anion[(a)]	Cs,Rb
Mixed Bed Demineralizer DF	10^2(10)	10^2(10)	2(10)
Anion Demineralizer DF	1(1)	10^2(10)	1(1)

(note: for two demineralizers in series, or for a polishing demineralizer, the DF for the second demineralizer is given in parenthesis)

	Removal Factor
Removal by Plateout	
Mo,Tc	10^2
Y	10
Containment Building Internal Recirculating System	
Flow Rate	2.0×10^4 CFM
Operating Period/Purge	16 hr
Mixing Efficiency	70%

(a) Does not include Cs, Mo, Y, Rb, Tc

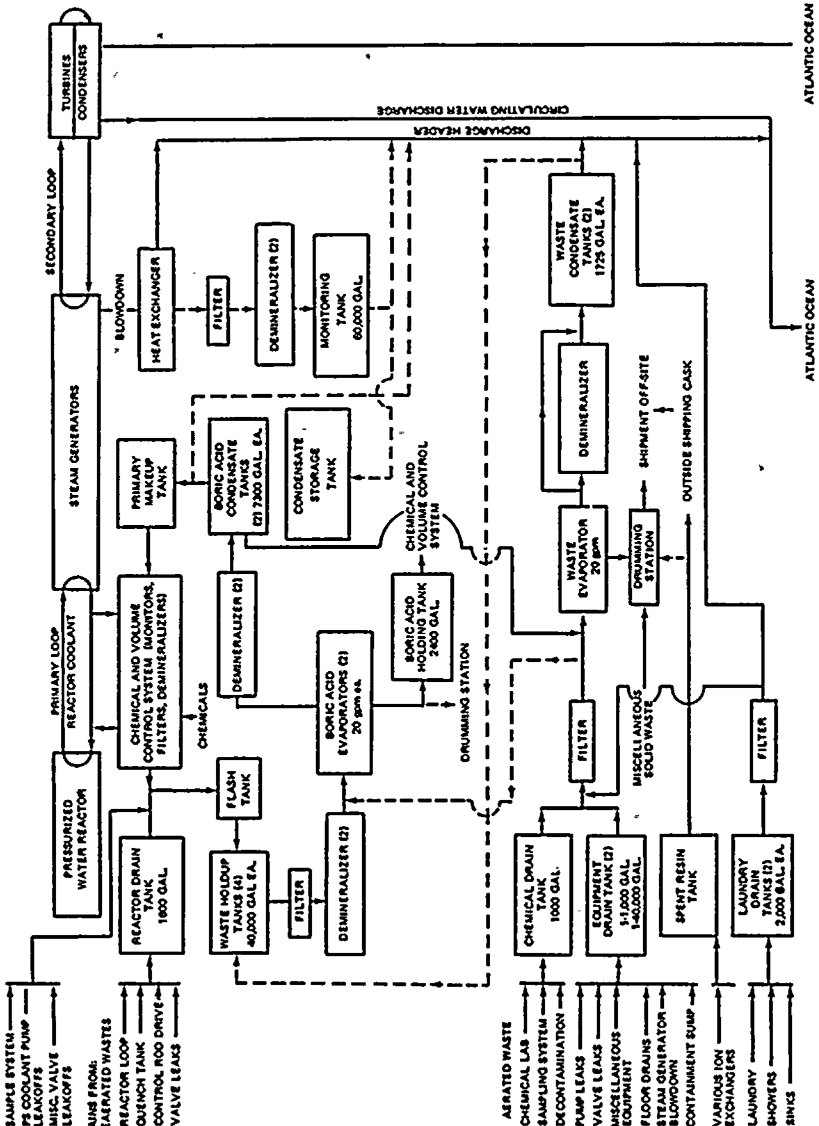

FIGURE 3.13 LIQUID WASTE TREATMENT SYSTEMS

and some will be reused. The BRS consists of holdup tanks, mixed-bed demineralizers, evaporators, and polishing anion demineralizers for processing. The liquid waste system consists of holdup tanks, an evaporator, and polishing mixed-bed demineralizers for processing. Both systems will be processed batchwise..

In addition to the preceding systems, the chemical and volume control system (CVCS) and the steam generator blowdown treatment system (SGBTS) are considered in our evaluation. The CVCS will process reactor grade water through mixed-bed and anion demineralizers to maintain boron control and reactor coolant purity, and will be the principal input to the BRS. The SGBTS will process steam generator blowdown during primary to secondary system leakages by cation and mixed-bed demineralization. Liquid leakage to the turbine building will be collected in the turbine building floor drain system and released without treatment.

3.5.1.1 The Boron Recycle System (BRS)

Primary coolant will be withdrawn from the reactor coolant system at approximately 40 gpm and processed through the CVCS. The letdown stream will be cooled and reduced in pressure, filtered, processed through one of two mixed-bed demineralizers, and sent to the volume control tank. The second mixed-bed demineralizer will be used intermittently for lithium and cesium control. Boron concentration will be controlled during core life by feed and bleed operation to the BRS, and at the end of core life by the anion deborating demineralizer in the CVCS. Radionuclide removal by the CVCS was evaluated by assuming 40 gpm letdown flow at primary coolant activity (PCA) through one mixed-bed demineralizer and 8 gpm flow through the other mixed-bed demineralizer.

Deaerated hydrogenated equipment drain wastes in the reactor containment will be collected in the reactor drain tank. The shim bleed from the CVCS letdown stream will be combined with the reactor drain tank stream and be routed to the flash tank where fission product gases and hydrogen will be removed, then to one of four holdup tanks for decay, and processed through a mixed-bed demineralizer, an evaporator, and a polishing anion demineralizer. We calculated the shim bleed input activity by applying the DF for a mixed-bed demineralizer to the shim bleed stream, assuming a 1.5 gpm flow and CVCS output activity. The reactor drain tank input flow to the BRS was assumed to be 240 gpd and PCA. Radioactive decay during collection in the holdup tanks was calculated in the ORIGEN code. The collection time was calculated to be 27 days assuming two of the 40,000-gal holdup tanks will be filled to 80% capacity using the combined shim bleed and reactor drain tank flow rates. Radionuclide removal by the BRS was based on the parameters in Table 3.2 for a mixed-bed demineralizer, an evaporator, and an anion demineralizer. Additional credit for radioactive decay during processing was based on transferring the holdup tank at the evaporator flow capacity (20 gpm), and for holdup decay in the boric acid condensate tanks. In our evaluation we assumed that equipment downtime, anticipated operational occurrences, and tritium control, will result in approximately 10% of the evaporator condensate stream being discharged to the Atlantic Ocean. The applicant expects that this stream will be recycled, but has assumed that the BRS stream will be discharged for purposes of the environmental impact analysis.

3.5.1.2 Liquid Waste System

Aerated radioactive wastes will be collected in the equipment drain tank, chemical drain tank and laundry drain tanks. The equipment drain tank and chemical drain tank will be processed through the evaporator and polishing demineralizer. Based on our parameters and information supplied by the applicant, the staff calculated the equipment drain tank input stream flow to be approximately 940 gpd at 0.07 PCA, and the chemical drain tank input stream flow to be 415 gpd at 0.04 PCA.

Assuming one of the two 25,000-gal equipment drain tanks will be filled to 80% capacity, the staff calculates the collection time will be 21 days. The staff calculated 2 days collection time for the 1,000-gal chemical drain tank. Radionuclide removal by the liquid waste system was based on the parameters in Table 3.2 for an evaporator and a polishing mixed-bed demineralizer. Additional credit for radioactive decay during processing was based on transferring the tank at the evaporator flow capacity (2 gpm) and for holdup decay in the waste condensate tanks. Our evaluation, like the applicant's, assumed that all of these processed wastes will be discharged.

Wastes from laundry and contaminated showers will be collected in the laundry drain tanks for analysis. Normally these wastes are of low activity and will be filtered and discharged. They may be processed by the liquid waste system. Based on the staff's parameters, it is assumed the laundry and shower tank activity will be equivalent to 10^{-4} $\mu Ci/cm^3$ and the release rate is expected to be 450 gpd.

3.5.1.3 Turbine Building Floor Drains

Waste collected by the turbine building floor drain system will contain radioactive materials resulting from secondary system leakage as well as leakage from nonradioactive cooling systems. The applicant has indicated that these wastes will not be treated prior to discharge. Based on the staff's parameters, it is assumed the activity discharged

through the turbine building floor drain system will be due to secondary system condensate leakage at a rate of 5 gpm. The quantity of activity released through this path will be approximately 0.07 Ci/yr. The staff concluded that the release of the turbine building floor drain wastes without treatment is acceptable.

3.5.1.4 Steam Generator Blowdown Treatment System (SGBTS)

The SGBTS as originally described in the PSAR considered a blowdown rate of 0.14 gpm being processed by the liquid waste system. The staff did not consider this system capable of handling the blowdown so that liquid release will meet AEC as low as practicable guidelines. The applicant has substituted a separate treatment system consisting of a heat exchanger and cation and mixed-bed demineralizer. The staff has thus analyzed the blowdown system with a blowdown rate of 14 gpm, processed by cation and mixed-bed demineralizers, and discharged to the ocean.

3.5.1.5 Liquid Waste Management System Summary

Based on the staff's evaluation of the waste treatment systems using the parameters in Table 3.2, we calculated the release of radioactive materials in the liquid wastes to be 4.0 Ci/yr, excluding dissolved gases and tritium. Based on previous experience at operating reactors the staff estimates the tritium releases to be 350 Ci/yr. The applicant has estimated the normal releases to be 0.1 Ci/yr excluding dissolved gases and tritium, and 226 Ci/yr of tritium. The difference between the staff's release values and those calculated by the applicant are due in part to the applicant's assumption of 0.1% failed fuel. The staff's calculations are based on 0.25% failed fuel. In addition, the applicant's evaluation is based on the system originally described in the PSAR, whereas the staff considered the modified system committed by the applicant.

Based on the staff's evaluation, the radioactivity in liquid effluents from Unit 2, exclusive of tritium and dissolved gases, are estimated to be less than 5 Ci/yr. The calculated whole body and critical organ doses are estimated to be less than 5 mrem/yr from the operation of Units 1 and 2. The staff's calculations indicate the liquid radwaste systems will reduce effluents to as low as practicable levels in accordance with 10 CFR Part 20 and Part 50.34a, and the staff therefore concludes the liquid radwaste systems are acceptable, contingent upon review of the SGBTS.

Table 3.3. summarizes the releases of liquid radioactive materials from St. Lucie Unit 2.

TABLE 3.3

ST. LUCIE UNIT 2 LIQUID RADIOACTIVE SOURCE TERM
(Ci/yr)

Na 24	3.6(-4)	Cs 139	2.8(-3)
P 32	1.0(-4)	Te 127m	3.6(-4)
P 33	3.5(-4)	Te 127	5.1(-4)
Cr 51	1.3(-3)	Te 129m	1.7(-3)
Mn 54	2.2(-4)	Te 129	1.1(-3)
Mn 56	6.2(-3)	I-130	7.4(-4)
Fe 55	1.2(-3)	Te 131m	1.6(-3)
Fe 59	7.3(-4)	Te 131	2.9(-4)
Co 58	1.2(-2)	I 131	4.1(-1)
Co 60	1.5(-3)	Te 132	2.6(-2)
Ni 63	1.2(-4)	I 132	3.4(-2)
Ni 65	3(-5)	Te 133m	7(-5)
Nb 92	2.7(-4)	Te 133	1(-5)
Sn 117m	9(-5)	I 133	2.5(-1)
W 185	5(-5)	Te 134	7(-5)
W 187	1.7(-3)	I 134	1.6(-3)
U 237	2(-5)	Cs 134m	6.7(-3)
Np 239	5.1(-4)	Cs 134	1.2(0)
Br 82	1.6(-4)	I 135	4.9(-2)
Br 83	4.8(-4)	Cs 135m	2.5(-4)
Br 84	5(-5)	Cs 136	6.0(-1)
Rb 86	3.8(-3)	Cs 137	1.0(0)
Rb 88	1.4(-1)	Ba 137m	2.8(-2)
Rb 89	6.4(-3)	Cs 138	8.2(-2)
Sr 89	4.9(-4)	Ba 139	4.9(-4)
Rb 90	2.5(-4)	Cs 140	5(-5)
Sr 90	1(-5)	Ba 140	5.6(-4)
Y 90	6(-5)	La 140	3.6(-4)
Rb 91	4(-5)	La 141	3(-5)
Sr 91	2(-4)	Ce 141	9(-5)
Y 91m	1.1(-3)	Ce 143	9(-5)
Y 91	2.6(-3)	Pr 143	7(-5)
Sr 92	1(-5)	Ce 144	5(-5)
Y 92	1.5(-4)	Pr 144	5(-5)
Y 93	7(-5)	Nd 147	3(-5)
Zr 95	8(-5)	Pm 149	2(-5)
Nb 95	8(-5)		
Zr 97	2(-5)	Total (excluding tritium)	4.0(0)
Nb 97m	2(-5)		
Nb 97	2(-5)		
Mo 99	5.5(-2)	Tritium	350 Ci/yr
Tc 99m	5.1(-2)		
Ru 103	6(-5)		
Rh 103m	6(-5)		
Ru 106	1(-5)		
Rh 106	1(-5)		
Te 125m	4(-5)		
Rh 105	2(-5)		

Note: Isotopes less than 5(-6) Ci/yr are not listed.

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3.5.2 Gaseous Waste Systems

The gaseous waste treatment and ventilation systems will consist of equipment and instrumentation necessary to reduce releases of radioactive gases and airborne particulates from equipment and building vents. The principal source of radioactive gaseous waste will be gases stripped from the primary coolant in the CVCS and BRS. Additional sources of gaseous wastes will be main condenser air ejector exhausts, ventilation exhausts from the auxiliary building and turbine structure, and gases collected in the reactor containment building. The principal system for treating gaseous wastes will be the waste gas system. The waste gas system will collect and store gases stripped from the primary coolant in three gas decay tanks, then release the gases to the atmosphere.

The containment atmosphere will be recirculated through HEPA filters and charcoal adsorbers prior to purging through additional HEPA filters. Ventilation exhausts from the auxiliary building will be processed through HEPA filters. The main condenser air ejector exhausts will be released without treatment. The steam generator blowdown will pass through a heat exchanger, not a flash tank as indicated originally in the PSAR, and thus there will be no releases to the atmosphere. The turbine is located on an open structure and thus there is no treatment for secondary system leaks. The gaseous waste treatment system is shown in Figure 3.14.

3.5.2.1 Waste Gas System

The waste gas system will collect and store gases stripped from the primary coolant in the CVCS, BRS, reactor drain tank, and the quench tank. The gases, consisting mostly of hydrogen and small amounts of radioactive gases will be held up for decay in one of three pressurized tanks (140 ft^3, 165 psig). After decay the gases will be released to the atmosphere. We calculated a holdup time of 25 days. The applicant calculates a 30-day holdup time.

The staff's evaluation considered a 25-day holdup time based on the proposed system. The staff estimates that approximately 5400 Ci/yr of noble gases and negligible iodine will be released from the waste gas tank releases. The applicant estimates that approximately 470 Ci/yr of noble gases and 0.0013 Ci/yr of Iodine-131 will be released. Staff estimates assume all the noble gases are stripped in the BRS whereas the applicant assumes a removal fraction of 0.9. The staff assumed a 25-day holdup time and the applicant assumed 30 days resulting in less release estimates for noble gases.

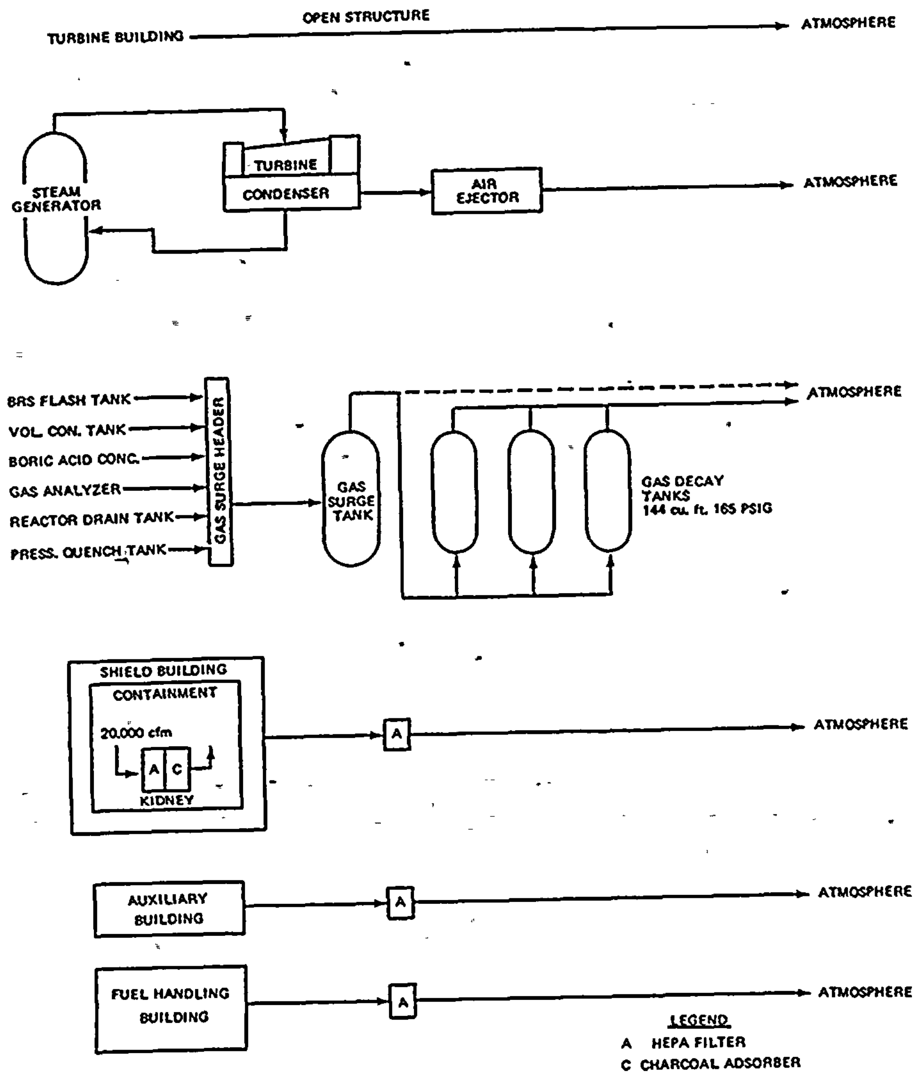

FIGURE 3.14 GASEOUS WASTE TREATMENT SYSTEMS

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3.5.2.2 Containment Purges

Radioactive gases will be released inside the reactor containment when primary system components are opened or when leaks occur in the primary system. The gaseous activity will be sealed within the containment during normal operation but will be released during containment purges. Prior to purging, the containment atmosphere will be recirculated through HEPA filters and charcoal adsorbers, two 10,000 cfm units, for particulate and iodine removal. Following recirculation the containment will be purged through HEPA filters to the atmosphere. The airborne activity was calculated based on the parameters for primary coolant leakage to the containment in Table 3.2. Radionuclide removal was based on 16 hr of recirculation system operation, 70% mixing efficiency, and a DF of 10 for the recirculation charcoal adsorber. We assume four containment purges annually. We calculated the containment purge releases to be 170 Ci/yr of noble gases and 0.01 Ci/yr of Iodine-131. The applicant estimated a release of 93 Ci/yr of noble gases and 0.09 Ci/yr of radioiodine. The applicant has considered the recirculation system in operation for 10 hr versus the staff's 16 hr, resulting in a higher Iodine-131 release estimate.

3.5.2.3 Auxiliary Building and Turbine Structure Releases

Radioactive gases will be released to the auxiliary building due to leakage from primary system components. The ventilation systems will be designed to ensure that air flow will be from areas of low potential to areas having a greater potential for the release of airborne radioactivity. Ventilation air will be exhausted through HEPA filters for particulate removal. The staff's calculated releases were based on the auxiliary building leakage rate and iodine partition factor listed in Table 3.2. Based on these parameters, the staff calculates the auxiliary building releases to be 1000 Ci/yr of noble gases and 0.1 Ci/yr for Iodine-131. The applicant estimated the releases to be 643 Ci/yr of noble gases and 0.23 Ci/yr of radioiodine.

Radioactive gases will be released to the turbine structure due to secondary system steam leakage. The turbine structure is not enclosed and releases will be discharged directly to the atmosphere. Staff calculated release values are based on 1700 lb/hr of steam leakage to the turbine area assuming all of the noble gases and iodine remain airborne as specified in the staff's parameters. On this basis the staff calculated the turbine area releases to be negligible for noble gases and 0.045 Ci/yr for Iodine-131. The applicant estimated the turbine area releases to be negligible for noble gases and 0.039 Ci/yr of radioiodine.

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The applicant has also estimated 2700 Ci/yr of noble gases and 0.004 Ci/yr of Iodine-131 released from other waste system vents. Staff estimates are included as part of the auxiliary building release term.

3.5.2.4. Steam Releases to the Atmosphere

The turbine bypass capacity to the condenser will be 45%. Staff analysis indicates that steam releases to the environs due to turbine trips and low power physics testing will have a negligible effect on our calculated source term.

3.5.2.5 Main Condenser Air Ejector Exhausts

The main condenser air ejector exhausts will contain radioactive gases resulting from primary to secondary system leakage. Iodine will be partitioned between the steam and liquid phases in the steam generators and between the condensing and noncondensable phases in the main condensers and air ejectors. Based on staff parameters listed in Table 3.2 the staff considered 110 lb/day of primary to secondary leakage, and partition factors of 0.01 and 0.0005 for iodine in the steam generators and main condenser air ejectors respectively. The staff calculates the main condenser air ejector releases to be approximately 1000 Ci/yr for noble gases and 0.15 Ci/yr for Iodine-131. The applicant estimated this release to be 430 Ci/yr for noble gases and 0.128 Ci/yr for radioiodine.

3.5.2.6 Gaseous Waste Summary

Based on the parameters given in Table 3.2, the staff calculates the total radioactive gaseous releases from Unit 2 to be approximately 7600 Ci/yr of noble gases and 0.31 Ci/yr of Iodine-131. The principal sources and isotopic distributions are given in Table 3.4. The applicant has calculated an overall release of approximately 4300 Ci/yr of noble gases and 0.18 Ci/yr of Iodine-131.

In its evaluation, the applicant applied a lower gas stripping efficiency (0.9) in the BRS than we used in the staff's evaluation (1.0). This affected the distribution of gases which remained in the system that leak to the building atmospheres, and that go to the gas storage tanks for decay. The staff considered less decay time (25 days) in the gas storage tanks than the applicant (30 days), resulting in more releases of noble

TABLE 3.4

ST. LUCIE UNIT 2 GASEOUS RADIOACTIVE SOURCE TERM

Ci/yr

Radionuclide	Decay Tanks	Reactor	Building Ventilation Auxiliary	Turbine	Blowdown Vent	Air Ejector Offgas	Total
KR-83m	(a)	(a)	1	(a)	(a)	1	2
Kr-85m	(a)	(a)	6	(a)	(a)	7	13
Kr-85	730	11	6	(a)	(a)	6	750
Kr-87	(a)	(a)	3	(a)	(a)	4	7
Kr-88	(a)	(a)	11	(a)	(a)	11	22
Kr-89	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Xe-131m	170	2	6	(a)	(a)	6	180
Xe-133m	1	1	12	(a)	(a)	12	26
Xe-133	4500	160	950	1	(a)	960	6600
Xe-135m	(a)	(a)	1	(a)	(a)	1	2
Xe-135	(a)	(a)	19	(a)	(a)	19	38
Xe-137	(a)	(a)	1	(a)	(a)	1	2
Xe-138	(a)	(a)	3	(a)	(a)	3	6
I-131	(a)	1.0E-02	1.0E-01	4.5-02	(a)	1.5E-01	3.1E-01
I-133	(a)	6.4E-03	1.1E-01	2.5-02	(a)	8.2E-02	2.2E-01

(a) <1 Ci/yr/unit noble gases, $<10^{-4}$ Ci/yr/unit iodine
(b) Rounded to two significant figures

gases. The applicant has assumed a better fuel performance (0.1%) than the staff (0.25% of the operating power fission product source term available for leakage to the primary system) for normal releases.

Based on staff evaluation of the gaseous waste treatment systems, the staff has calculated the release of radioactive materials in gaseous effluents from the operation of both Units 1 and 2 will result in a whole-body dose of less than 5 mrem/yr to individuals at or beyond the site boundary, and a dose of less than 15 mrem/yr to a child's thyroid through the pasture-cow-milk pathway from a cow located at the nearest potential pasture, 2 miles west of the plant. Staff calculations indicate that the gaseous radwaste systems will reduce radioactive effluents to doses which are as low as practicable in accordance with 10 CFR Part 20 and Part 50.34a and Regulatory Guide 1.42. The staff therefore concludes that the system is acceptable.

3.5.3 Solid Waste Systems

Solid waste containing radioactive materials will be generated during station operation. Wet solid wastes will consist mainly of spent demineralizer resins, and evaporator bottom concentrates. Spent demineralizer resins will be stored in the spent resin tank, and then sluiced to a spent resin shipping container, dewatered, and shipped offsite to a burial ground. The resins may also be solidified in cement. The evaporator bottom concentrates will be combined with a cement mixture, solidified, and stored for offsite shipment. The staff considers these wastes to be stored for 180 days for radioactive decay prior to shipment offsite.

Dry solid wastes will consist of ventilation air filters, contaminated clothing and paper, and miscellaneous items such as tools and laboratory glassware. Dry solid wastes will be compressed into 55-gal drums using a baling machine. Noncompressible solid wastes will be packaged for offsite shipment. Since dry solid wastes will contain much less activity than wet solid wastes, the staff did not consider the need for onsite storage of dry solid wastes in its evaluation.

3.5.3.1 Solid Waste Summary

Based on the staff's evaluation of similar reactors and operating reactor data, the staff estimates that an equivalent of approximately 600 drums of wet solid waste containing approximately 10 Ci/drum, and 450 drums of dry solid waste containing less than 5 Ci total, will be shipped offsite annually. Greater than 90% of the radioactivity associated with the solid waste will be long-lived fission and corrosion products, principally Cs-134, Cs-137, Co-58, Co-60, and Fe-55. The applicant estimates that

approximately 490 drums of solidified evaporator bottoms totaling approximately 6 Ci, 100 to 500 ft^3 of compressible dry solid wastes at 0.5 to 1 Ci, 256 ft^3 of demineralizer resins at 12 Ci after 6 months decay, and 500-1000 ft^3 of miscellaneous noncompressible solid wastes at 5 to 15 Ci, will be shipped offsite annually.

All containers will be shipped to a licensed burial site in accordance with AEC and DOT regulations. The solid waste system will be similar to systems which we have evaluated and found to be acceptable in previous license applications. Based on its similarity to acceptable systems, we find this solid waste system to be acceptable.

3.6 Chemical and Biocide Effluents

Normal plant operations such as regeneration of water treatment systems, condenser defouling, boric acid concentrator carry over, corrosion control, chemistry laboratory operations and laundry operations produce a variety of chemical wastes. The more significant quantities of chemical wastes (see Table 3.5) are produced by the water treatment, condenser defouling and boric acid concentrator systems. These liquid wastes, after appropriate neutralization are released to the discharge canal and ultimately to the ocean. A detailed analysis by the applicant of other plant operations indicates only trace quantities of chemicals will be released from these sources and no detectable impact on the environment is expected. Makeup water will be pumped from the Fort Pierce municipal system and treated for use in the primary and secondary cooling systems. The water treatment system utilizes ion exchange resin to demineralize Fort Pierce city water for plant processes. Sulfuric acid and sodium hydroxide are used for resin regeneration. The spent regeneration solution, which includes the ions extracted from the city water, will be discharged to a retention basin for neutralization and release in a controlled manner to the condenser cooling discharge system.

There will be a continuing small release of boric acid (about 95 lb/yr) in the effluent from the boric acid concentrators which will be fed into the condenser cooling discharge system.

There will be infrequent discharges of larger quantities of boric acid. When the reactor is started up and a shutdown occurs followed immediately by another startup (called "back-to-back startup" by the applicant) the boric acid holdup tank system will be overloaded. Approximately 2400 lb of boric acid will be released in a controlled manner over 4 hr to the condenser discharge cooling system. Boron concentration in the discharge will be approximately 2 ppm, less than ambient sea water concentrations. The frequency of this discharge is expected to be about once per year for Unit 2.

TABLE 3.5

MAJOR CHEMICAL RELEASES TO THE OCEAN

Chemical	Average Discharge, lb/hr	Concentration at Ocean Discharge, ppm	Ambient Seawater Concentration, ppm	Comment
Calcium	8.4	0.03	400	Chemicals extracted from Fort Pierce water in water treatment system and discharged after system regeneration.
Magnesium	1.1	0.005	1,270	
Sodium	170.	0.66	10,600	
Iron	<0.01	<0.001	0.002-0.02	
Bicarbonate[(a)]	8.8	0.03	0.41 (as HCO_3)	
Carbonate	2.5	0.01	0.41	
Sulfate	183.	0.71	7.7	
Chloride	14.2	0.06	19,000	
Fluoride	0.2	<0.001	1.4	
Silicon	1.6	0.006	0.2-4.0	
Boron	0.01	<0.001	4.6	Boric acid concentrator carryover. See text for abnormal releases of boron.
Chlorine	<120	<1.5[(b)]	0	Slime control in condenser--2 hr/wk
pH	7.0			
TDS	386	1.5		

(a) Probably all converted to carbonate in neutralizing basin.
(b) Concentration at condenser outlet. Essentially all converted to chloride at ocean discharge.

The other possible major discharge of boric acid will occur if the refueling water tank has to be drained for major maintenance (the applicant expects this to occur about once during plant lifetime). Approximately 8300 lb of boric acid would have to be discharged in a controlled manner. The concentration of boron in the discharged water would be approximately 4 ppm, less than that in ambient seawater.

A chlorine solution will be introduced successively into each of the four water boxes for the Unit 2 condenser cooling system (eight water boxes for both units) for approximately 15 minutes each day to control slime formation. Chlorine requirements for Units 1 and 2 will be about 700 lb/day. The quantity will be regulated such that the residual chlorine at the water box outlet will be no greater than 1.5 ppm at any time. With normal operating flows through both units, the chlorine will be diluted by a factor of 8 in the discharge canal to 0.19 ppm. Most of the residual free chlorine should be depleted by the time it reaches the ocean discharge. However, the staff required monitoring of total residual chlorine at the ocean discharge for Unit 1[2] to ensure no harmful effects to marine life. This monitoring program will be extended to Unit 2.

3.7 Sanitary Wastes and Other Effluents

3.7.1 Sanitary Wastes

The sanitary waste system installed for Unit 1 operation utilizes a septic tank and associated leaching fields for treatment and disposal of onsite sewage. Portable chemical toilets are used for the construction forces. The operating system is designed to accommodate a maximum of 100 persons per day. A 2300 gal tank is used for 24-hr retention of the daily flow, 2000 gal/day, and for storage of 300 gal of sludge. The tank and tile field system is installed about 300 ft west of the Unit 1 reactor building. Groundwater flow in this area is predominantly eastward toward the Atlantic Ocean. The applicant states the treatment system will comply with the State of Florida health regulations.[3]

While this sanitary waste system will normally be adequate for both Unit 1 and 2 operations, occasional plugging problems may occur. Therefore, the staff has recommended tying into municipal sewage treatment facilities as soon as a sewer line is installed down the island.

3.7.2 Refuse from Trash Racks

Debris carried into the intake canal and entering the plant intake structure will collect on the bar racks and vertical traveling screens. The four coarse screens consist of a fixed rack with 3" spacing to hold up large pieces of trash. The rack is cleaned with a manually operated rake that is lowered over the rack with the aid of a monorail hoist. The four traveling screens consist of a continuous belt of baskets fitted with copper mesh screen with a clear opening of 3/8". The basket speed is variable from 2.5 to 10 fpm. Debris is cleaned from the baskets by fixed spray nozzles that wash the debris into a sluiceway where it is routed to a sheet-pile holding pit or to the settling basin installed at the south end of the plant island. The screen wash water flow rate is approximately 250 gpm for each screen. The traveling screens are normally operated in the automatic mode where a differential water level across the baskets initiates operation.

3.7.3 Storm and Other Drainage

Roof and yard storm drainage will be routed directly to a storm water basin where it will percolate into the groundwater. Gravel-filled areas will be provided for the transformers to adsorb oil spillage.

3.7.4 Diesel Generator Emissions

Two 3500 kW diesel generator sets will be used for emergency power if offsite power is not available. Each generator set operating at full capacity will require a maximum of 240 gal/hr of No. 2 diesel fuel. Periodic starting and loading tests of these generators will release various pollutants into the atmosphere. Estimates of these pollutants are given in Table 3.6.

3.7.5 Condenser Tube Corrosion Products

Corrosion and subsequent erosion of the condenser tubes will release small quantities of copper and zinc to the discharge canal. The applicant estimates such releases to be about 7 ppb of which 80% is copper (Ref. 1, p. 3.6-5). Water velocity in the tubes will be maintained at less than 7 fps to reduce the potential for erosion. Condenser chlorination will minimize growth of shells and barnacles which cause tube erosion.

3.8 Transmission Facilities

The applicant installed a three-circuit, 240 kV transmission system for Unit No. 1. Each circuit has the capacity to carry the full output of 1 unit. Therefore, no additional circuits will be required for Unit 2. With both units operating, there will still be one spare circuit.

The three circuits proceed due west from the plant, across Indian River to join existing north-south trunks at the St. Lucie Substation 12.5 miles west of the plant (see Figure 3.15). Each circuit requires three towers in Indian River and one on each shore line. The mainland right-of-way is 660 ft wide including mainly pasture and swamp areas.

TABLE 3.6

ESTIMATED EMISSIONS FROM DIESEL GENERATORS[(a)]

Combustion Product	Emission Factor $lb/10^3$ gal	Emissions Per D-G Set lb/hr of operation
Particulate	25	6
Oxides of sulfur[(a)] (SO_x as SO_2)	58	16
Carbon monoxide	68	16
Hydrocarbons	27	6
Oxides of nitrogen (NO_x as NO_2)	348	145
Aldehydes (as HCHO)	4	1
Organic acids	7	2

(a) This table indicates the combustion products released per pound of fuel consumed for each 3500 kW diesel generator set based on manufacturers data and the U.S. Environmental Protection Agency's publication No. AP-42, February 1972, Compliance of Air Pollutant Emission Factors.

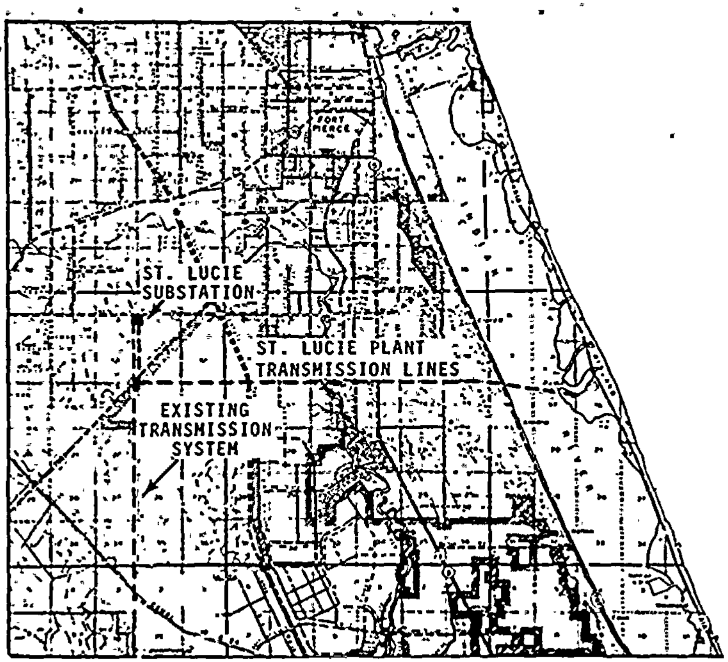

FIGURE 3.15 ST. LUCIE PLANT TRANSMISSION SYSTEM

3.9 Construction Plan

Site preparation for Unit 2 is scheduled to begin in February 1975, with fuel loading scheduled for September 1979, and commercial power operation in December 1979.

The plant will be constructed on portions of the site already filled during construction of Unit 1. Some of the facilities constructed for Unit 1 will be shared with Unit 2 including the transmission system, ocean intake structures, and intake and discharge cooling canals. The beach and ocean bottom will be excavated for installation of an additional discharge line.

The construction schedule is planned to maintain a relatively stable construction force on site, with a decline in construction activities for Unit 1 being offset by a buildup for Unit 2. The force is expected to average 750 workers with a peak of about 1400 between December 1977 and December 1978. The decline should begin in January 1979 reaching about 500 by the end of May 1979 and zero by March 1980 (Ref. 1, p. 4.1.1.

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REFERENCES

1. Florida Power and Light Company, St. Lucie Plant Unit No. 2, Environmental Report, AEC Docket No. 50-389, August 10, 1973.

2. USAEC, St. Lucie Plant Unit No. 1, Final Environmental Statement, Docket No. 50-335, p. V, June 1973.

3. Florida Power and Light Company, Hutchinson Island Plant Unit No. 1, Environmental Report, p. 35, May 20, 1971.

4. Florida Power and Light Company, Comments on the Draft Environmental Statement, St. Lucie Plant Unit No. 2, p. 29, April 1, 1974.

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4. ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND PLANT AND TRANSMISSION FACILITIES CONSTRUCTION

4.1 Impacts on Land Use

The primary impact on the land area occurred with the construction of Unit 1. This impact involved about 300 acres and resulted from approximately 2 million yards of fill being placed on a previously damaged mangrove swamp. This fill covered approximately 200 acres. In addition, excavation of the intake and discharge canals between ocean and reactor changed an additional 100 acres to waterways. More complete descriptions of these changes are included in the Final Environmental Statement related to St. Lucie Plant Unit No. 1 (June 1973) and in the Florida Power and Light Company Hutchinson Island Plant Environmental Report (May 1971).

The area of fill on which Unit 2 is to be located will be excavated for foundations with associated dewatering of the excavations. This will involve approximately five acres. Water extracted in this process will be directed to the intake or discharge canals. If turbidity is a problem, this water will be directed to a settling basin prior to discharge. The applicant assures such discharges will meet applicable State of Florida regulations for turbidity (Ref. 1, Amendment 1, p. 4.1-2).

While all construction for the intake lines will be complete during construction of Unit 1, installation of the discharge line for Unit 2 will involve recutting the beach and dune. Each excavation of the dune provides an unusual opportunity for wave action from a severe storm to cut through the island, and this extra potential continues to exist until dune stabilizing plants have been fully reestablished. Reexcavation will destroy the native dune stabilizing plants which the applicant was required to establish following installation of the line for Unit 1 (Ref. 2, p. iv). The applicant plans a temporary dune to provide partial protection to the island during the time the dune is excavated. However, normal protection will be attained only when native plants reach maturity with their network of roots acting as a deterrent to cutting. Therefore, the staff requires replanting the dune as soon as possible after excavation with dune stabilizing plants indigenous to the area.

This problem could have been eliminated had the applicant installed a stub line for Unit 2 through the dune at the time the Unit 1 line was installed. Then only a portion of the beach would have had to be reexcavated, and the dune plantings would not have been redisturbed.

Use of the site by the public for recreational purposes during construction and operation of Unit 2 should not be significantly affected beyond that resulting from the presence of Unit 1. The applicant has committed to unrestricted public access consistent with health and safety and plant protection conditions. However, use of the ocean beach in the vicinity of the discharge may be limited during the time of discharge line installation.

Since there will be no additional transmission rights-of-way required for Unit 2, there will be no affect on agriculture or water producing savanna lands in the surrounding areas.

Effects of construction on the terrestrial biota are discussed in Section 4.3.1.

4.2 Impacts on Water Use

As there is no freshwater on Hutchinson Island, potable water supplies at the plant site are brought in from the Fort Pierce municipal water system. Consumptive use of these supplies by the large labor force is estimated by the staff to be of insignificant impact.

Construction and placement of the ocean discharge line will temporarily impede near-shore boat traffic. However, significant impact on recreational water use is not anticipated. General construction activities in the ocean will create small scale turbidity currents as well as temporarily interrupt the natural littoral processes. Florida State Water Quality standards[3] will impose restrictions on such operations requiring turbidity not to exceed fifty (50) Jackson units. Considering the relatively small areal extent of the construction zone in the ocean, no significant impact on water use is envisioned.

4.3 Ecological Effects

4.3.1 Terrestrial

Approximately three-fourths (about 830 acres) of the site will remain essentially in its preconstruction state. As the remainder of the island becomes developed for human use, this substantial acreage may serve as a sanctuary for species which would otherwise be evicted from the island.

Construction activities on the beach and dune will cause another period of disruption to turtle nesting in the area. The applicant has committed to a daily nest identification and relocation program in the affected area during the turtle nesting season (Ref. 1, p. 4.1-4). This program would be similar to that required for Unit 1 (Ref. 2, p. iv).

Plant lighting could cause misorientation of turtle hatchlings with resulting increase mortalities. Therefore, during Unit 1 construction the applicant was required to plant Australian pine or other suitable plants as necessary behind the dune to provide a light shield for the beach and dune area (Ref. 2, p. v). If this light screen is disturbed for Unit 2

construction, the applicant has committed to replant pines as soon as possible (Ref. 1, p. 4.1-1). These pine plantings would be in addition to the planting of dune stabilizing plants. The roots of the pine are less effective deterrents to wind and wave action than are the native plants.

The applicant has committed to a program to control all edible refuse during plant construction and operation to limit the raccoon population and thus minimize the amount of predation on turtle nests. This program should include procedures to prevent deliberate feeding of raccoons in the area by construction and operating personnel.

The applicant is cognizant of the potential for bird disorientation during passage of storm fronts and has assured that outside lighting for construction will be reduced, subject to safety and security needs, during such weather fronts (Ref. 1, p. 4.1-3).

It is doubtful construction will have any other significant effects on the terrestrial biota beyond those from the generally increased amount of human activity in the area. Increased commercial development of the island appears inevitable and will have a much more serious effect on the terrestrial biota. Relative to the total acreage of the applicant's site, the number of people working there is small. In fact, as mentioned before, the unused portions of the site may serve as a major refuge for wildlife although the applicant has indicated no plans for specifically devoting this acreage as a long term natural area.

4.3.2 Aquatic

The condenser cooling water intake and discharge systems constructed for Unit 1 were designed for two-unit operation. Thus, little new construction having an impact on the aquatic environment will be required. However, a second discharge line with a multiport diffuser is planned for Unit 2 and will extend into the ocean beyond the discharge for Unit 1.

Construction of this discharge line will involve dredging a channel 20-ft deep about 2800 ft into the ocean. Sheet piling will be used to protect the first 1000 ft which will be 40-ft wide. Then there will be about 250 ft of unprotected channel 80-ft wide to the end of the Unit 1 discharge line. Finally, there will be an additional segment about 1600-ft long and 60-ft wide which will extend beyond the Unit 1 discharge and will contain the diffuser sections.

Some 17,600 m^2 (4.3 acres) of bottom area will be dredged and 82,000 m^3 (107,000 yd^3) of material will be removed. The spoils will be transported to shore and used for backfill. Any excess will be disposed in an approved onshore disposal area (Ref. 1, p. 4.1-4). Protection by sheet piling and onshore disposal of spoils should reduce the effect of siltation on aquatic ecosystems to an insignificant level.

Organisms dredged up will be lost. The applicant calculates these will number some 16 million polycheates, bivalves, echinoderms, amphipods, and decapods (Ref. 1, p. 4.1-6). This number is a very small portion of the total population of these organisms in the area and, in general, repopulation of benthic communities so disturbed takes place within about a year's time. No species of commercial importance are included in the benthic fauna in the area to be dredged, and the relatively narrow band of ocean bottom to be disrupted should return to its preconstruction condition in a short time. Thus, no significant long term or population effect on the aquatic ecosystem is expected to result from dredging activities associated with he construction of the discharge line.

For several years the condenser cooling system will be in use with only Unit 1 operating. Intake and discharge flows will be half the design flow with two units operating. This means the approach velocity at the intake structures will be only about 0.5 fps which is below that normally desirable to provide a warning signal to fishes to avoid the area. Conceivably increased entrapment in the intake canal may result. The staff requires the extent of actual fish entrapment in the canal be carefully monitored. If it becomes a problem, action should be taken to increase the intake velocity to about 1 fps (eg., close off one intake line or close off half the intake area at the intake structures). The effect of velocity on velocity cap function is discussed in greater detail in Section 5.5.2.1.

Similarly half the normal flow of heated water going out both discharge lines will result in unacceptably high ocean surface temperatures. This results from insufficient entrainment and dilution by the ambient water due to the low exit velocity. Maximum surface temperatures of 7.4°F and 2°F above ambient are predicted under these conditions for the Unit 1 and Unit 2 discharge points, respectively (see Section 3.4.2). Therefore, the staff recommends shutting off one of the two discharge lines (preferably the Unit 1 Y-type discharge line) once the Unit 2 multiport line becomes available. Operation with both discharge lines should be permitted only when Unit 1 is shut down or full dilution flow from the Unit 2 circulating pumps is available.

Dewatering of the construction site will take place and will require discharge either to Indian River or to the ocean. The applicant states dewatering waste will meet Florida water quality regulations relating to turbidity which restrict discharges to 50 Jackson units (Ref. 1, p. 4.1-2).

Most aquatic organisms are not adversely affected by even higher turbidity. Settling basins are already available and are used for water discharged into Indian River. Water discharged to the ocean will be put into the intake or discharge canal where settling will take place. No significant effect from dewatering is expected from discharge of waters meeting the state standard.

Chemicals used during plant construction and startup for cleaning piping and equipment will be discharged to the ocean after being routed to the settling basin south of the plant or the neutralization basin in the water treatment plant if neutralization is required prior to discharge. These chemicals will consist of alkaline solutions of trisodium phosphate, sodium bicarbonate, disodium phosphate, and detergents or wetting agents. Most of these ions are found in natural seawater and their discharge should have little effect on the ecosytem. However, the applicant will neutralize these wastes to meet water quality standards to ensure no significant damage to biota occurs (Ref. 1, p. 4.1-5).

4.4 Effects on Community

Construction of Unit 1 is scheduled for completion in September 1975. Construction of Unit 2 is scheduled to commence in early 1975. As a result there will be little overlapping of the construction forces for the two units.

The construction schedule and peak construction force for Unit 2 is expected to be essentially the same as for Unit 1. Since there is no evidence the work force for Unit 1 has created any special burden on local schools and other facilities and services, there are no reasons to expect the work force for Unit 2 would create any problems. In a locality geared to large influxes of seasonal visitors, the impact from a work force averaging 750 and peaking at about 1400 people should be insignificant.

Diesel powered machinery employed during construction releases some combustion products to the atmosphere creating intermittent and localized air pollution similar to that produced by any large construction project. Noise and dust should have no impact on residents of the area because the nearest residence is over 1.5 miles away.

4.5 Measures and Controls to Limit Adverse Effects During Construction

4.5.1 Applicant's Commitments

Construction activities associated with site preparation, the intake system, the discharge canal, the emergency cooling canal, and transmission lines are either in progress or completed for Unit 1. As these will be shared by both units, no additional impact is expected as a result of Unit 2 construction.

The following is a summary of the commitments made by the applicant to limit adverse effects during construction of the proposed plant.

(1) To minimize effects of constructing the discharge line for Unit 2, the applicant plans to:

- Construct a temporary dune and use sheet piling to protect against wave damage when the dune is cut. Natural plantings will be maintained as much as possible, and the disrupted area behind the dune will be replanted with Australian pine as a light screen to protect turtle hatchlings from misorientation due to plant lighting (Ref. 1, p. 4.1-1);
- Replant the dune as soon as possible after excavation with dune stabilizing plants indigenous to the area (Ref. 4, p. 3).
- Survey the beach area subject to construction activities for sea turtle nests and relocate any present if construction takes place on the beach during the nesting season (Ref. 1, p. 4.1-4);
- Dispose of dredge spoils at an approved onshore site (Ref. 1, p. 4.1-4a) and
- Use sheetpiling around the area being dredged to minimize siltation of the adjacent waters (Ref. 1, p. 4.1-5).

(2) Waste water from site dewatering will be settled in a series of basins to meet Florida water quality criteria prior to discharge (Ref. 1, p. 4.1-2).

(3) Chemical releases will be neutralized prior to discharge to meet pH standards (Ref. 1, p. 4.1-5).

(4) Elevated plant lighting will be shutdown to the extent possible during passage of storm fronts to minimize bird kills (Ref. 1, p. 4.1-4).

(5) Trash will be dumped on site and combustibles burned. The remaining trash will be covered with clean fill material (Ref. 1, p. 4.1-2).

(6) The applicant does not plan to restrict public access to areas between the plant and the ocean unless considerations of public safety require exclusion (Ref. 1, p. 4.1-2).

(7) Edible refuse will be carefully disposed of to prevent accessibility by raccoons with resulting increased turtle predation. This will include procedures to prevent deliberate feeding of raccoons (Ref. 4, p. 1).

(8) Discontinue use of the present septic system and connect to a municipal sewer treatment line if and when such a line is extended to the applicant's site (Ref. 4, p. 5).

4.5.2 Staff Evaluation

The staff has reviewed the potential effects of construction and the applicant's mitigation plans, and finds them acceptable with the following additional requirements:

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(1) Shielding outside lights installed for Unit 2 to minimize sky shine.

(2) Monitoring fish entrapment in the intake canal during the time only the Unit 1 circulating pumps are operating. If unusually large numbers of fishes are detected, intake flow-rate should be increased to provide an adequate warning signal to fishes in the immediate vicinity.

(3) Once the Unit 2 multiport discharge line is installed, heated water from Unit 1 should be routed through one discharge line only (preferably the multiport line).

4.6 Summary of Environmental Effects of Construction

Table 4.1 contains a summary of the identified environmental impacts from Unit 2 construction, their relative significance, any planned actions to minimize these effects and alternative actions available should the impacts become unacceptable.

TABLE 4.1

SUMMARY OF ENVIRONMENTAL IMPACTS DUE TO CONSTRUCTION

Potential Impact	Applicant's Plans to Mitigate (Section 4.5.1)	Expected Relative Significance	Corrective Actions Available and Remarks
1. Fish entrapment in intake canal (Section 4.3.2)	--	Probably insignificant increase during time only Unit 1 circulating pumps are operating.	Increase flow at intake structures to 1 fps by shutting off one line or blocking off half the intake area.
2. Discharge Line			
a. Dune integrity (Section 4.3)	Temporary dune and sheet piling during time dune is cut.	Possibility of major breach of island during storm.	Replanting of native dune stabilizing plants. Simultaneous installation of lines for both units through the dune to minimize dune disruption.
b. Turtle nesting (Section 4.3.1)	Nest survey and relocation.	Insignificant losses on population level.	Minimize activities during nesting season.
c. Benthic disruption (Section 4.3.2)	Sheet piling and on-shore spoil disposal.	Short-term minor impact.	Area should repopulate within 1 year.
d. Ocean surface temperatures (Section 4.3.2)	--	Insignificant if only one discharge line is used.	Close off one discharge line (Y-type preferably) until full flow from both units is available
3. Construction lighting			
a. Bird kills (Section 4.3.1)	Noncritical lights shutdown during storms.	Minor	--
b. Turtle nestling misorientation (Section 4.3.1)	Perimeter lights low directed down. Planting of Australian pine behind dune line as a condition of Unit 1 construction. Replanting as necessary after dune excavation for Unit 2.	Minor impact from total plant (both Units 1 and 2). Probably insignificant additional effect from Unit 2 construction.	Perimeter light shielding. Adjust light quality.
4. Turtle predation from raccoon increase (Section 4.3.1)	Control of edible refuse.	Probably minor.	More intensive garbage control; stricter procedures preventing raccoon feeding.
5. Waste water discharge (Section 4.3.2)	Settling of site dewatering waste.	Insignificant	Meets Florida standards.
6. Chemical wastes (Section 4.3.2)	Adjust pH of wash solutions to meet water quality standards.	Insignificant.	--
7. Air and noise pollution (Section 4.4)	--	Insignificant.	Air pollution meets Florida standards; monitored by State Department of Pollution Control
8. Work force effects on community (Section 4.4)	Unit 1 and 2 construction scheduled to maintain reasonably stable work force level.	Insignificant	--

REFERENCES

1. Florida Power and Light Company, St. Lucie Plant Unit No. 2, Environmental Report, AEC Docket No. 50-389, August 10, 1973.

2. USAEC, St. Lucie Plant Unit No. 1, Final Environmental Statement, Docket No. 50-335, June 1973.

3. State of Florida Department of Pollution Control, Rules of the Department of Pollution Control, Supplement No. 25, Chapter 17-3, pp. 8A.

4. Florida Power and Light Company, Comments on the Draft Environmental Statement, St. Lucie Plant Unit No. 2, April 1, 1974.

5. ENVIRONMENTAL EFFECTS OF OPERATION OF THE PLANT AND TRANSMISSION FACILITIES

5.1 Impacts on Land Use

Most of the operating impacts on land use will have occurred with the installation and operation of Unit 1. Unit 2 is expected to have little additional impact.

The major area of the site changed by fill was a modified mangrove swamp. The introduction of fill for Unit 1 provided a promontory of well-drained soil not previously present on the island. This promontory will continue to be used, for the construction of Unit 2, and will be fully grassed and landscaped only after both units are completed. Peripheral areas of this promontory, not in the construction area will undoubtedly start to develop new associations of herbaceous and woody plants atypical of the preexisting swamp. Depending on the effects of these new areas and the landscaping plans for the plant, the applicant may allow these areas to continue their natural development or may choose to establish a more controlled cover.

Most aesthetic impacts also occurred with the installation of Unit 1. These affect primarily residents along South Indian River Drive, boaters and fishermen using Indian River and future apartment, condominium and hotel/motel users if and when these developments occur near the applicant's site. The viewing distances involved, the mangrove screen around the Indian River site boundary and approximately two-thirds of the site left in its natural state all combine to minimize the aesthetic impact. However, the Unit 1 reactor and turbine buildings can be seen. With Unit 2, this visual impact will be increased.

The three transmission circuits across Indian River are the most readily visible feature of the plant, but no additional lines will be required for Unit 2.

With Unit 1 operating, the applicant plans to permit public access to and use of the beach and other areas of the site not within the immediate fenced operating area subject to any restrictions that may evolve in the development of Emergency and Industrial Security Plans for the plant. Unit 2 operation should not affect these plans. Existing small dirt roads will be used for access since there are no plans to develop the area for any recreational purposes nor are there plans for a visitors' center. The canals could become desirable fishing areas.

5.2 Impacts on Water Use

5.2.1 Groundwater

No fresh groundwater supplies have been found on Hutchinson Island, consequently there is no direct usage of groundwaters at the plant site.

However, subsurface waters receive inflows consisting of plant waste waters discharged to the sanitary treatment system and the settling basins. Pollutants such as coliform bacteria, nitrates, sulfates and other associated pollutants will be filtered and sorbed in the earth materials. As a result, no significant contamination of adjacent waters is expected from these sources. However, septic systems can plug up, although this is an infrequent occurrence with a properly maintained system. The applicant has committed to tying into municipal treatment facilities if and when a sewer line is run down the island to the vicinity of the plant.

5.2.2 Big Mud Creek

During normal plant operation, condenser cooling water will be drawn from the Atlantic Ocean. Provisions have been made to draw cooling water from Big Mud Creek in the event the normal supply is interrupted. This emergency cooling system will be tested semiannually. The applicant indicates each of the nine pneumatic plugs controlling flow will be tested individually for a period of no more than 30 min. Each stub pipe is capable of passing about 33 cfs of cooling water, and the total volume of water drawn from Big Mud Creek during each semiannual test is limited to 2 million gal. Because of the relatively small flow rate and short duration of the testing, no significant impact on the water use of Big Mud is envisioned. Furthermore, addition of Unit 2 will not alter the test frequency or flows. Therefore, there should be no additional impact as a result of Unit 2.

5.2.3 Atlantic Ocean

Impacts on water use resulting from Unit 2 operation will be primarily related to the chemical and thermal releases to the Atlantic Ocean. Chemical releases will consist of a variety of diluted liquid wastes resulting from such processes as demineralizer regeneration, corrosion control, condenser defouling, and laboratory and cleaning operations. Thermal releases associated with the once-through cooling system will amount to about two-thirds of the heat generated by the reactor or about 5.4×10^9 Btu/hr.

Chemical releases to the circulating water are discussed in Section 3.6 and Table 3.5 lists the estimated average concentrations. Discharged chemicals will exist in trace amounts and substantially below background levels. Thus, these chemical discharges are not expected to have a measurable impact on the use of the adjacent ocean waters.

Chlorine gas will be utilized for biological defouling of the condenser cooling system. The chlorine gas will be pumped into the circulating cooling water at a sufficient rate to provide a concentration of

5 ppm entering the condenser, for 15 min each day. The biocide will be controlled so the chlorine content of the circulating water leaving the condenser will contain a maximum free residual of 1.5 ppm. This, in turn, will be diluted by a factor of 8 in the discharge canal when the circulating pumps for both Units 1 and 2 are operating. The free chlorine will probably be completely depleted prior to entering the ocean. However, the possibility exists, some residual chlorine could persist in the receiving water in the vicinity of the discharge for several hours. An operating license condition was established for Unit 1 that concentrations of total residual chlorine be monitored at the ocean discharge to verify the absence of adverse environmental effects (Ref. 1, p. v). This condition should be continued for Unit 2 operation. Chlorine residuals such as monochloramine, dichloramine and trichloramine should be measured to ensure a complete description of the total chlorine residual.

The actual thermal plumes in the vicinity of the Unit 2 discharge will be highly variable as a result of wave action, reversing longshore currents, wind-driven currents and the plume interaction from the two discharge lines. However, conservative estimates of the extent and intensity of the thermal plumes at the ocean discharge point have been made by the applicant (Ref. 2, pp. 5.1-31 to 5.1-37) and confirmed by the staff. Several analytical approaches have been used to cross check the final estimates. Results from the Koh/Fan[3] and Jirka/Harleman[4] models predict maximum ocean surface temperature rises of 5.5°F and 1.5°F from the Unit 1 Y-type and Unit 2 multiport discharge lines, respectively, with both Units 1 and 2 operating at full capacity. This does not change the expected temperature rise and impact from the Unit 1 discharge line (Ref. 1, p. i).

The near-field temperature prediction for the Unit 2 discharge was used as a source temperature for the far-field prediction. Using the analytical technique developed by Ditmars,[5] the predicted temperature fields are shown in Table 5.1 for individual and combined discharge plumes. Figures 5.1 through 5.3 illustrate the spatial distribution of the combined plumes for various tidal conditions. The depth of influence of the combined plume will vary considerably in space and time but it is not expected to be more than 8 ft except in the immediate vicinity of the discharge points. Considering the combined plumes and a maximum southerly current, recirculation from discharge to intake points should be no more than 5%.

TABLE 5.1

PREDICTED ISOTHERM AREAS FOR COMBINED PLUMES FROM UNITS 1 AND 2 (REF. 2, P. 5.1-36)

Temperature Rise, °F	Area of Isotherm, Acres		
	Unit No. 1	Unit No. 2	Combined Plumes
5.0	4.6	0	4.6
4.0	11	0	11
3.0	35	0	35
2.0	180	0	180
1.5	565	<1	565
1.0	2860	512	3372

In summary, with both units operating the extent of the Unit 2 discharge thermal plume is relatively small and the predominant thermal regime is the Unit 1 plume. No measurable impact on water use is envisioned from Unit 2 operation.

However, if only one unit is operating, one of the two discharge lines should be shut off (preferably the Unit 1 Y-type discharge line) or the circulating pumps for the shutdown unit should be operated to maintain full flow dilution. Otherwise maximum ocean surface temperatures may reach 7.4°F and 2°F at the Units 1 and 2 discharge points, respectively, as described in Section 3.4.4. These temperatures would exceed applicable water quality standards and NPDES requirements.

5.2.3.1 Thermal Buildup

Because of the orientation of the Unit 1 discharge and its proximity to the Unit 2 discharge system, there exists a definite potential for a thermal buildup in the Unit 2 plume. The temperatures in the combined plume will not exceed the maximum conditions estimated for the Unit 1 plume, i.e., a maximum surface differential of 5.5°F. The presence of the Unit 1 plume could, however, increase the background ocean temperature in the vicinity of the Unit 2 discharge. As a result, the dilution capacity of the multiport diffuser system would be reduced.

Consequently, there is a question as to whether the combined plume from both units will meet the current NPDES surface temperature rise limit of 1.5°F specified for areas outside the zone of mixing (i.e., the 1.5°F isotherm is limited to 400 acres by the existing NPDES permit for the plant). However, the staff concludes this plume interaction should have no additional impact on marine life in the vicinity.

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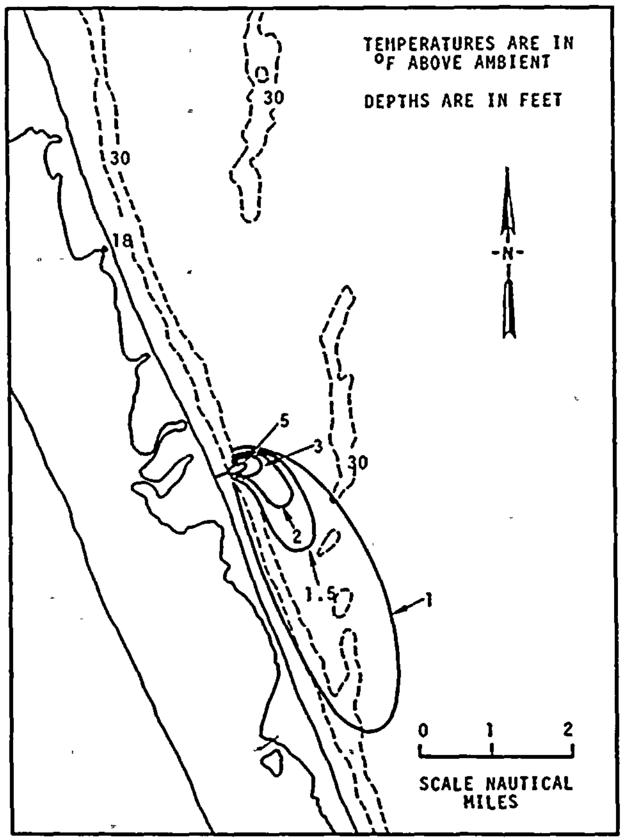

FIGURE 5.1 PREDICTED SURFACE WATER TEMPERATURE RISES DURING MAXIMUM OBSERVED SOUTHERLY CURRENTS OF 1.3 fps (Ref. 2, p. 5.1-62 to 5.1-63)

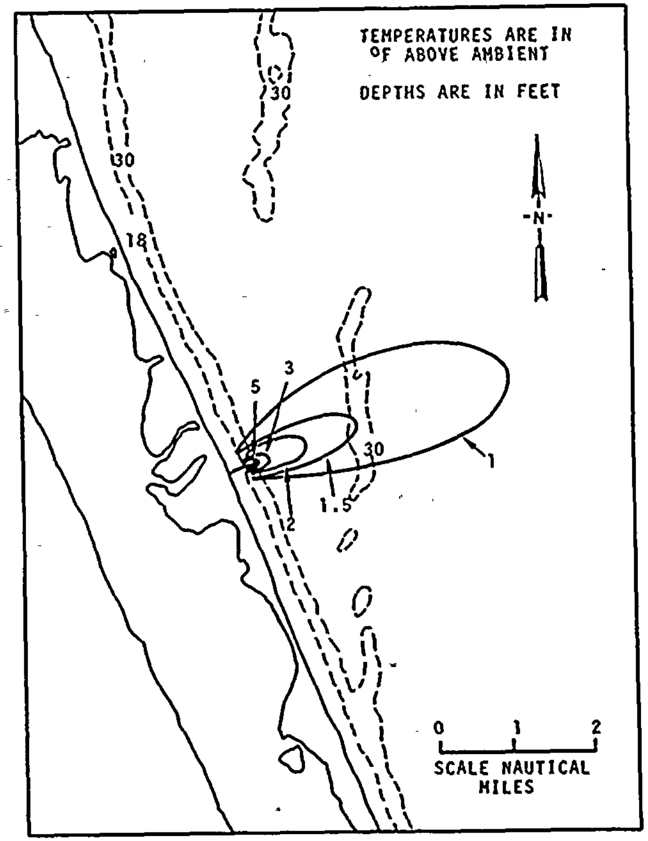

FIGURE 5.2 PREDICTED SURFACE WATER TEMPERATURE RISES DURING SLACK WATER (Ref. 2, p. 5.1-62 to 5.1-63)

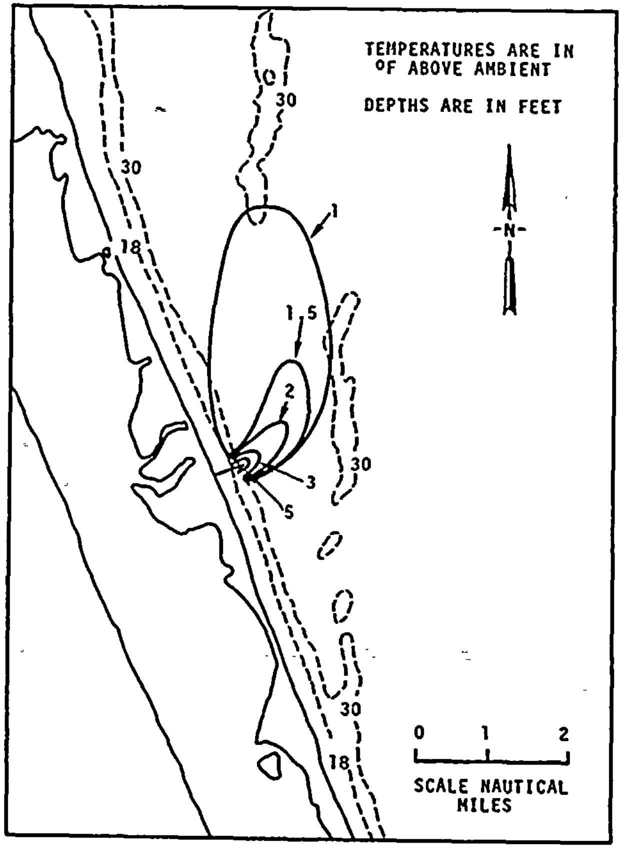

FIGURE 5.3 PREDICTED SURFACE WATER TEMPERATURE RISES DURING MAXIMUM OBSERVED NORTHERLY CURRENT OF 0.7 fps (Ref. 2, p. 5.1-62 to 5.1-63)

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5.3 Radiological Impact on Biota Other Than Man

5.3.1 Exposure Pathways

The pathways by which biota other than man may receive radiation doses in the vicinity of a nuclear power station are shown in Figure 5.4. Two recent comprehensive reports have been concerned with radioactivity in the environment and these pathways.[6,7] Depending on the pathway being considered, terrestrial and aquatic organisms will receive either approximately the same radiation doses as man or somewhat greater doses. Although no guidelines have been established for desirable limits for radiation exposure to species other than man, it is generally agreed the limits established for humans are also conservative for these species.[8]

5.3.2 Radioactivity in the Environment

The quantities of radionuclides expected to be discharged annually by Units 1 and 2 in liquid and gaseous effluents have been estimated by the staff and are given in Tables 3.3 and 3.4, respectively. The basis for these values is discussed in Section 3.5. For the determination of doses to biota other than man, specific calculations are done primarily for the liquid effluents.

Discussion concerning liquid dilution is presented in Section 5.2.3.

Doses to terrestrial animals near the plant (such as raccoons or beach mice) due to the gaseous effluents are quite similar to those calculated for man. For this reason, both the annual average atmospheric dilution factors locations of interest and the dose calculations for gaseous effluents are discussed in detail in Section 5.4.

5.3.3 Dose Rate Estimates

The annual radiation doses to both aquatic and terrestrial biota including man were estimated on the assumption of constant concentrations of radionuclides at a given point in both the water and air. Radiation dose has both internal and external components. External components originate from immersion in radioactive air and water and from exposure to radioactive sources on surfaces, in distant volumes of air and water, in equipment, etc. Internal exposures are a result of ingesting and breathing radioactivity (Figure 5.4).

The maximum doses to marine organisms will be delivered to fish, crustacea, molluscs, and certain seaplants. This is principally a consequence of accumulation in their structures of certain elements found in seawater. Estimates have been made of the quantities of elements present in a number of marine organisms relative to the quantities present in seawater. Values of relative biological accumulation of a number of waterborne elements by fish, crustacea, molluscs, and sea plants are provided in Table 5.2.

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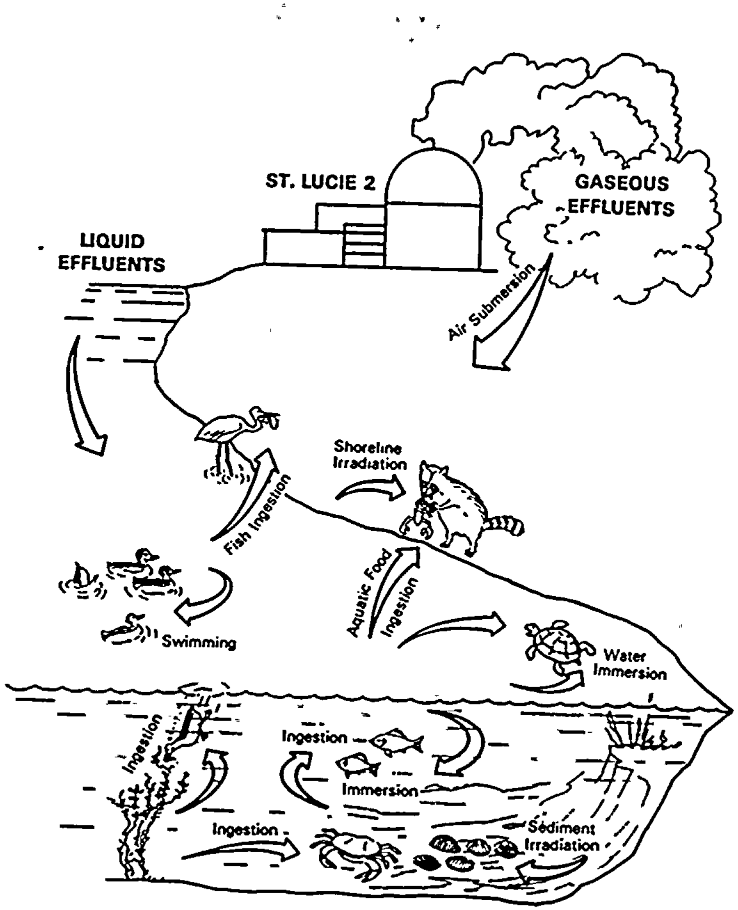

FIGURE 5.4 EXPOSURE PATHWAYS TO ORGANISMS OTHER THAN MAN

TABLE 5.2

SALTWATER BIOACCUMULATION FACTORS[9]
(pCi/kg organism per pCi/liter water)

Element(a)	Fish	Crustacea	Molluscs	Algae
hydrogen	1	1	1	1
sodium	1	1	1	1
phosphorus	10,000	10,000	10,000	100,000
chromium	100	1,000	1,000	1,000
manganese	3,000	10,000	50,000	10,000
iron	1,000	4,000	20,000	6,000
cobalt	100	10,000	300	100
nickel	500	100	100	100
bromine	3	10	10	100
rubidium	30	50	10	10
strontium	1	1	1	20
yttrium	30	100	100	300
zirconium	30	100	100	1,000
niobium	100	200	200	100
molybdenum	10	100	100	100
technetium	10	100	100	1,000
ruthenium	3	100	100	1,000
rhodium	10	100	100	100
tin	3	3	3	10
antimony	1,000	1,000	1,000	10,000
tellurium	10	10	100	1,000
iodine	20	100	100	10,000
cesium	30	50	10	10
barium	3	3	3	100
lanthanum	30	100	100	300
cerium	30	100	100	300
praseodymium	100	1,000	1,000	1,000
neodymium	100	1,000	1,000	1,000
promethium	100	1,000	1,000	1,000
uranium	10	10	10	67
neptunium	10	10	10	6

(a) All isotopes of an element have the same chemical behavior.

The highest doses would be received by marine organisms living in the discharge canal during full power operation. Algae entrained in the condenser cooling water would receive an external dose of about 1×10^{-5} mrad/hr from Unit 2 and about the same for Units 1 and 2 combined. Concentrations of radionuclides in the discharge canal will stay about the same even when Unit 2 becomes operational, because its radionuclide discharge and dilution flow will be the same as Unit 1. Thus, the doses to aquatic organisms in the canal will be substantially the same. Actually, since the effluent from Unit 2 will not be recirculated as in Unit 1, a slight decrease in concentration will take place. Fish, crustacea, molluscs, and certain sea plants would be expected to receive doses of 10, 60, 60 and 50 mrad/yr, respectively, from the liquid effluents of both Units 1 and 2, if they were living directly in the cooling water discharge canal during full power operation. Most of the dose to invertebrates is from the external irradiation from radiocesium accumulated in the bottom sediments of the canal. No dilution has been assumed for these estimates.

A bird such as a heron, assumed to consume 600 g/day of fish harvested from the discharge canal, would receive an internal dose of about 10 mrad/yr from Units 1 and 2. An animal such as a raccoon, assumed to consume 200 g/day of crustaceans and molluscs harvested frsm the discharge canal, would receive an internal dose of about 3 mrad/yr. A waterfowl such as a duck, assumed to consume 100 g/day of aquatic plants harvested from the discharge canal, would receive an internal dose of about 30 mrad/yr.

Species of considerable interest are the sea turtles which nest on the beach near the outfall. The dose received by a turtle swimming 3 months/yr in waters diluted to 1:20 that of the effluent would be 1×10^{-3} mrad/yr and the dose a turtle would receive while on the shore 24 hr/yr would be 8×10^{-3} mrad/yr. The internal dose received by a turtle from consuming seafood 3 months/yr in the vicinity would be 0.3 mrad/yr.

The literature relating to radiation effects on organisms is extensive, but very few studies have been conducted on the effects of continuous low-level exposure to radiation from ingested radionuclides on natural aquatic or terrestrial populations. The most recent and pertinent studies point out that, while the existence of extremely radiosensitive biota is possible and while increased radiosensitivity in organisms may result from environmental interactions, no biota have yet been discovered that show a sensitivity to radiation exposures as low as those anticipated in the area surrounding Units 1 and 2. The "BEIR Report" states that evidence to date indicates no other living organisms are very much more radiosensitive than man.[10] Therefore, no detectable radiological impact is expected in the aquatic biota or terrestrial mammals as a result of the quantity of radionuclides to be released into the Atlantic Ocean and into the air by Units 1 and 2.

5.4 Radiological Impact on Man

5.4.1 Basis for Estimates

The staff estimated the probable nuclide releases listed in Tables 3.3 and 3.4 from the plant based upon experience with comparable operating reactors and evaluation of the radwaste systems proposed for Units 1 and 2. Estimates were made of radiation doses to man at and beyond the site boundary via the most significant pathways among those given in Figure 5.5. These calculations are based on conservative assumptions regarding the dilutions of effluent gases and radionuclides in the liquid discharged, and the use by man of the plant surroundings.

5.4.2 Liquid Effluents

During routine reactor operation at full power, small quantities of radioactive nuclides will be released to the environment as discussed in Section 3.5 and listed in Table 3.3. Bioaccumulation factors used for the estimation of doses received through the consumption of marine organisms are listed in Table 5.2.

Since there are no freshwater wells on the island and the groundwater flows in this region are from west to east, no contamination of any drinking water supply is considered plausible.

The staff assumes persons will have access to the discharge canal and beaches near the discharge and will consume seafood harvested from these locations. During normal operation, the radioactive liquid waste will be diluted with condenser cooling water from the plant. While maximum effluent flow rates may reach 1200 cfs/unit, the normal flow of 1150 cfs/unit is used for this analysis. Due to the fact the discharge is north of the intake and prevailing coastal currents are north to south, there will be some recirculation of diluted liquid effluents from the Unit 1 outfall line. The staff estimates the average dilution of effluents at the intake, considering currents, winds and mixing, will be about 4% for both units operating together. Increases in doses to individuals and population taking into account this recirculation are estimated to be a maximum of 8% for Unit 1 operating by itself and about half this value for both Units 1 and 2 operating together. The doses from the liquid pathway estimated in this section account for this recirculation.

A conservative assumption is made that marine organisms will establish themselves in the discharge canal, although most organisms will be killed if an acceptable thermal defouling procedure is devised. If an individual spends 500 hr/yr on the banks of the discharge canal to harvest seafood living in the canal and this person consumes 18 kg of fish, 9 kg of crustacea and 9 kg of molluscs grown in the undiluted discharge water, it is estimated his total-body dose from eating this seafood would be

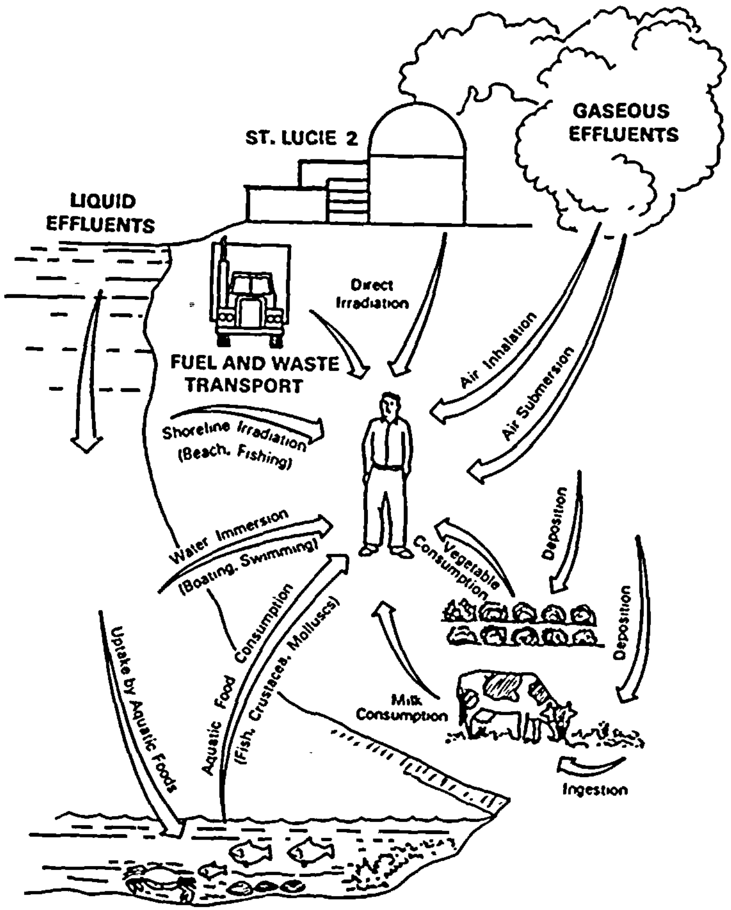

FIGURE 5.5 EXPOSURE PATHWAYS TO MAN

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0.2 mrem/yr from both Units 1 and 2. Under the same conditions the dose to the individual's gastrointestinal (GI) tract would be 0.05 mrem/yr, the dose to the thyroid would be 2 mrem/yr and the dose to his skeletal system (bone), would be 0.2 mrem/yr. During his 500 hr of fishing this individual would receive a slight dose from the direction radiation from the sides of the canal of about 0.2 mrem/yr to his total body from the deposited radiocesium.

A summary of doses resulting from both Units 1 and 2 operating together with a dilution flow of 2300 cfs and Unit 2 operating alone with a flow of 1150 cfs is given in Table 5.3. Doses due to Units 1 and 2 operating together and each operating alone are substantially the same (see discussion in Section 5.3.3). For full power operation of both Units 1 and 2, the dose to an individual consuming 18 kg of fish, 9 kg of crustaceans and 9 kg of molluscs harvested from the Atlantic Ocean near the discharge, would be less than one-tenth of the above due to the dilution in the ocean.

5.4.3 Gaseous Effluents

Most of the gaseous waste will be collected, compressed and stored in tanks at the plant prior to release. Storage capacity is adequate for a 25-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 matter.

The staff estimated radiation doses to persons in the environs of the plant from the gaseous effluent release rates given in Table 3.4 and the one year of meteorological data furnished by the applicant, March 1, 1971, to February 29, 1972, (Ref. 2, p. 6-36 to 6-42). Since the plant vent is located 184 ft above ground level and the containment building is higher than the plant vent, atmospheric dilution was calculated assuming a ground level release and a wake factor based on the height of containment building (200 ft). The highest air submersion doses will be received by people living, working or using recreational facilities in the vicinity of the plant.

5.4.3.1 Submersion Pathway

During reactor operation at full power, the highest dose rate at the plant boundary is expected to be at Big Mud Creek 0.1 mile NW of the plant where the annual average atmospheric dilution factor (X/Q) is 6.6×10^{-5} sec/m^3. At this location, the total-body dose was estimated to be 1×10^{-3} mrem/hr from both Units 1 and 2 combined. The skin dose would be somewhat higher (3×10^{-3} mrem/hr) from both Units 1 and 2 combined, because of the contribution from beta radiation. The air pathway doses from both units operating together will be about twice

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TABLE 5.3

RADIATION DOSE RATES TO INDIVIDUALS FROM LIQUID AND GASEOUS EFFLUENTS RELEASED FROM THE ST. LUCIE PLANT, UNITS 1 AND 2 (mrem/yr)

PATHWAY	ANNUAL EXPOSURE	SKIN BOTH (b)	SKIN UNIT 2 (c)	TOTAL BODY BOTH	TOTAL BODY UNIT 2	GI TRACT BOTH	GI TRACT UNIT 2	THYROID BOTH	THYROID UNIT 2	BONE BOTH	BONE UNIT 2
FISH (a)	18 kg	--	--	0.10	0.10	0.007	0.006	0.28	0.27	0.077	0.074
CRUSTACEA (a)	9 kg	--	--	0.089	0.086	0.028	0.027	0.69	0.66	0.063	0.061
MOLLUSCS (a)	9 kg	--	--	0.019	0.019	0.011	0.011	0.69	0.66	0.017	0.016
SHORELINE (a)	500 hr	0.20	0.19	0.17	0.17	(0.17)(d)	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
AIR SUBMERSION (e)	500 hr	1.4	0.71	0.46	0.23	(0.46)	(0.23)	(0.46)	(0.23)	(0.46)	(0.23)
INHALATION (e)	416 m³	--	--	--	--	--	--	0.94	0.47	--	--
ADULT MILK CONSUMPTION (f)	365 liters	--	--	--	--	--	--	0.18	0.072	--	--
VEGETABLE CONSUMPTION (g)	72 kg	--	--	--	--	--	--	1.4	0.070	--	--
INFANT MILK CONSUMPTION:											
FIRST REAL COW (f)	365 liters	--	--	--	--	--	--	1.7	0.85	--	--
NURSING MOTHER (h)	72 kg	--	--	--	--	--	--	3.5	1.7	--	--
AIR DOSE (1)											

(a) DISCHARGE CANAL
(b) BASED ON THE ESTIMATED RELEASES FROM UNITS 1 AND 2 COMBINED (TABLES 3.3 AND 3.4)
(c) BASED ON THE ESTIMATED RELEASES FROM UNIT 2 ONLY (TABLES 3.3 AND 3.4)
(d) ( ) INDICATES INTERNAL DOSE FROM EXTERNAL SOURCE
(e) PROPERTY LINE 0.1 MILE NW OF PLANT AT BIG MUD CREEK
(f) FROM FIRST REAL COW PASTURED 12 MONTHS/YR, 7.5 MILES SSW OF THE PLANT
(g) FROM GARDEN AT NEAREST RESIDENCE, 1.9 MILES WSW OF THE PLANT
(h) FROM NURSING MOTHER CONSUMING LEAFY VEGETABLES FROM NEAREST RESIDENCE 1.9 MILE WSW OF PLANT
(1) THE DOSE RATE IN AIR AT THE NEAREST SITE BOUNDARY (1 mile N) FROM BOTH UNITS IS 0.18 MILLIRADS (GAMMA) AND 0.6 MILLIRADS (BETA)

that of one unit operating alone. A boater remaining at this point for 500 hr/yr would receive a skin dose of 1 mrem/yr and a total-body dose of 0.5 mrem/yr. Individuals using the ocean beaches 0.6 miles NE of the plant, where the atmospheric dilution factor is 6.5×10^{-6} sec/m³, would receive a total-body dose of 0.05 mrem/yr and a skin dose of 0.1 mrem/yr from both Units 1 and 2 combined for 500 hr/yr occupancy.

The closest continually occupied dwelling is across Indian River on the mainland 1.9 miles WSW of the plant where the atmospheric dilution factor is about 5.5×10^{-7} sec/m³. The total-body dose to an individual residing at this location all year would be about 0.06 mrem/yr and the skin dose would be about 0.2 mrem/yr from both Units 1 and 2 combined.

5.4.3.2 Inhalation Pathway

Inhalation of radioiodine results in a radiation dose to the thyroid. The inhalation dose at the nearest residence (1.9 miles WSW), assuming continuous occupancy, is estimated to be 0.12 mrem/yr to the adult thyroid from both Units 1 and 2. The inhalation dose to a small child (2-gram thyroid) would be only 20% higher than that to an adult thyroid because of the reduced inhalation rate of the child. A fisherman remaining 500 hr/yr near the shore of Big Mud Creek (0.1 mile NW of the plant) would receive an inhalation dose of 0.9 mrem/yr from both Units 1 and 2 combined.

5.4.3.3 Terrestrial Food-Chain Pathway

There is some beef production west of the plant in an area primarily outside the 10-mile radius where the atmospheric dilution factor is of the order of 10^{-7} sec/m³. Therefore, the beef pathway is not a consideration.

Dairy herds supplying milk to the area are located beyond the 14-mile radius. The nearest private cow is 7.5 miles SSW of the plant where the atmospheric dilution factor is about 3.4×10^{-8}. The dose to the thyroid of an adult drinking milk at the rate of 1 liter/day, assuming the cow grazes 12 months/yr, is calculated to be 0.2 mrem/yr (Unit 1 plus Unit 2). Under the same conditions, the dose to a child's thyroid (2 grams) is conservatively calculated to be 2 mrem/yr from both Units 1 and 2 combined. Family cows were not observed nearer than 7 miles from the plant and little pasture land was available within 5 miles of the plant.

Fresh leafy vegetables cultivated near the plant could be a pathway for which airborne radioiodine could be ingested. A dose to an adult residing at the closest house 1.9 miles WSW of the plant consuming vegetables throughout the year was estimated. In addition, the dose to an infant nursing from its mother eating these vegetables was estimated.

A mother nursing a small child and eating 72 kg/yr of green leafy vegetables out of such a garden at the nearest residence would get an estimated dose to her thyroid of 1.4 mrem/yr. Her nursing child consuming all of her milk would obtain an estimated thyroid dose of 3.5 mrem/yr.[(a)] Both these doses would be derived from radioiodines released from both Unit 1 and Unit 2.

5.4.4 Direct Radiation

5.4.4.1 Radiation from the Facility

The direct radiation from the turbine building and contaminated water tanks on the site are expected to produce a small incremental dose to an individual standing at the nearest public access closest to each source. The sources responsible for the greatest exposure would be the refueling water tanks of both units. The closest approach to these tanks would be the highway in front of the plant (~820 ft). An individual at this location would probably receive a dose rate of less than 7×10^{-4} mrem/hr from one particular tank. An individual remaining at this location for 500 hr would receive an estimated total-body dose of 0.3 mrem. The dose from both tanks would be almost double this value. These doses were estimated assuming the refueling water tank activity was a maximum immediately after the refueling operation. In all probability, the actual dose derived from these tanks by an individual would be much less.

Direct radiation from the primary water storage tanks and condensate storage tanks would be less by at least a factor of 10. Radiation from the turbine is expected to be negligible, since it operates normally with a secondary water supply which normally contains very little radioactivity (as in other pressurized water reactors).

5.4.4.2 Transportation of Radioactive Material

The transportation of cold fuel to a reactor, of irradiated fuel from a reactor to a fuel reprocessing plant, and of solid radioactive wastes from a reactor to burial grounds is within the scope of the AEC report entitled, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants". The environmental effects of such transportation are summarized in Table 5.4.

5.4.5 Annual Radiation Dose to Population

Total radiation dose to the population residing within 50 miles of the plant was calculated for four pathways associated with the liquid effluents: consumption of locally harvested seafood, swimming, boating and shoreline activities at the ocean beach. The radiation dose to man from

(a) This assumes that 30% of the radioiodine intake of the mother is transferred to her milk.[11]

TABLE 5.4

ENVIRONMENTAL IMPACT OF TRANSPORTATION OF FUEL AND WASTE TO AND FROM ONE LIGHT-WATER-COOLED NUCLEAR POWER REACTOR[(a)]

Normal Conditions of Transport

Heat, weight, and traffic density			Environmental Impact Negligible
Exposed population	Estimated number of persons exposed	Range of doses to exposed individuals[(b)] (mrem/yr)	Cumulative dose to exposed population (man-rem/yr)
Transportation workers	200	0.01 to 300	4
General public			
Onlookers	1,100	0.003 to 1.3	3
Along route	600,000	0.0001 to 0.06	

(a) Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants," WASH-1238, December 1972.

(b) The Federal Radiation Council has recommended that the radiation doses from all sources of radiation other than natural background and medical exposures should be limited to 5,000 mrem/yr for individuals as a result of occupational exposure and should be limited to 500 mrem/yr for individuals in the general population. The dose to individuals due to average natural background radiation is about 130 mrem/yr.

consumption of produce is due almost entirely to radionuclides which concentrate in the green, leafy portions of the plant. Since tomatoes account for 99% of production other than citrus in this area and the leafy portion of the tomato plant is not usually consumed, this pathway was not considered.

From reports on Florida fish landings issued by the Department of Commerce 1970,[12] 1971,[13] and 1972[14] seafood landed in St. Lucie County averaged 1.6×10^6 kg/yr of fin fish, 3.8×10^3 kg/yr of crustaceans and 9.0×10^4 kg/yr of molluscs. Since these amounts are less than those reported eaten by the population in this region,[15] the staff assumed all this seafood is consumed locally. In calculating the dose from consumed seafood, it was further assumed 50% of the total catch was edible and only 20% of the harvest came from waters containing plant effluent radionuclides diluted to 1/20 that of the concentration in the discharge canal. The amount of contaminated water would increase by approximately a factor of 2 with both units operating. Thus, the 10% of seafood harvested in contaminated waters with one unit operating would become 20% with both operating. The decay time from the reactor discharge until the consumption of the seafood was taken to be 25 hr. These calculations indicate a dose of 0.04 man-rem/yr to the population within 50 miles of the plant because of seafood consumption (from both Units 1 and 2 combined).

In addition, the total population within 50 miles of the plant was assumed to spend 45,000 man-hr/yr swimming and boating, and 30,000 man-hr/yr in shoreline activities in the ocean and on the beach in the vicinity of the plant discharge. These recreational activities would result in a total-body dose of about 0.03 man-rem/yr to the approximately 450,000 persons living within 50 miles of the plant. The total-body dose from gaseous effluents to the 450,000 persons estimated to live within 50 miles of the plant by 1980 was calculated to be 0.56 man-rem/yr to the total body (from both units operating). Values of the population dose for the 1980 population at various distances from the plant are tabulated in Table 5.5.

The cumulative population dose due to transportation of solid wastes and irradiated fuel would be 14 man-rem/yr from both units 1 and 2. Table 5.6 tabulates the doses from various pathways to the population.

5.4.6 Occupational Radiation Exposure

Based on a review of the applicant's safety analysis report, the staff will determine that individual occupation doses can be maintained within the limits of 10 CFR Part 20. Radiation dose limits of 10 CFR Part 20 are based on a thorough consideration of the biological risk of exposure to ionizing radiation. Maintaining radiation doses of plant personnel within these limits insures that the risk associated with radiation exposure is no greater than those risks normally accepted by workers in other present day industries.[16]

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TABLE 5.5

CUMULATIVE POPULATION, ANNUAL POPULATION DOSE AND AVERAGE ANNUAL DOSE FROM GASEOUS EFFLUENTS AT SELECTED DISTANCES FROM THE ST. LUCIE PLANT UNITS 1 AND 2

Cumulative Radius (miles)	Cumulative 1980 Population	Cumulative(a) Annual Dose (man-rem)	Average(a) Annual Dose (mrem)
1	0	0	0
2	140	0.013	0.090
3	390	0.022	0.056
4	730	0.030	0.042
5	1,570	0.044	0.028
10	62,570	0.54	0.0086
20	104,855	0.64	0.0060
30	182,015	0.72	0.0040
40	264,715	0.76	0.0028
50	446,515	0.82	0.0018

(a) Based on calculated radionuclide releases from Units 1 and 2 operating together. Doses based on releases from Unit 2 only would be half these values.

TABLE 5.6

ANNUAL POPULATION DOSES FROM OPERATION OF THE ST. LUCIE PLANT

Pathway	Total Body Dose (man-rem)		Remarks
	Unit 1 & 2	Unit 2 Only	
Air Submersion	0.82	0.41	External dose to the nearly 450,000 people residing within a 50-mile radius of the plant from the radioactive gases released.
Ingestion of seafood	0.045	0.022	1.6×10^6 kg finfish and 9.4×10^4 kg shellfish taken from water during year at 1/20 discharge concentration
Beach recreation	0.030	0.015	3×10^4 man-hr of exposure along beaches adjacent to site where water is at 1/20 of discharge concentration
Transportation of spent fuel and wastes	14	7	
TOTAL	15	7.4	

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Using information compiled by the Atomic Energy Commission[17,18] and others[19,20] of past experience from operating reactor plants, it is estimated that the average collective dose to all onsite personnel at large operating nuclear reactor plants will be approximately 450 man-rem/yr/plant.

The total man-rem for St. Lucie will be influenced by several factors for which definitive numerical values are not available. These factors are expected to lead to lower doses to onsite personnel than estimated above. Improvements to the radioactive waste effluent treatment system to achieve offsite population doses as low as practicable have the potential for causing a small increase to onsite personnel doses, all other factors remaining unchanged. However, the applicant's implementation of Regulatory Guide 8.8[21] and other guidance provided through the staff review process is expected to result in an overall reduction of total doses from those currently experienced.

5.4.7 Evaluation of Radiological Impact

Based on conservative estimates, the total annual dose from all pathways received by the approximately 450,000 people who will be living within a 50-mile radius of the plant in 1980, but excluding doses to the plant work force described in Section 5.4.6, would be about 0.4 man-rem/yr from Unit 2 only. By comparison, the natural background dose to an individual of about 0.12 rem/yr results in an annual total of about 54,000 man-rem to the same population. Therefore, normal operation of the plant will contribute only an extremely small increment to the total-body radiation dose that area residents receive from natural background.

The 900 man-rem received as occupational onsite exposure is a small percentage of the annual total of about 54,000 man-rem delivered to the 1980 population living within a 50 mile radius of the St. Lucie Plants.

Operation of St. Lucie will result in a minor contribution to the dose received by the population in the plant area from natural background radiation. The estimated radiation doses to individuals and to the population from normal operation of the St. Lucie Plants support the conclusion in Section 8.4 that the releases of radioactive materials in liquid and gaseous effluents are as low as practicable.

5.5 Nonradiological Effects on Ecological Systems

5.5.1 Terrestrial

The overall effect on the terrestrial biota of adding an additional unit to the site is expected to be insignificant.

Plant lighting could conceivably cause some bird misorientation and resulting kills during storms. However, this impact was considered minor for Unit 1 (Ref. 1, p. v-7). The additional lighting required for Unit 2 should cause no significant increase in the number of kills.

Plant lighting may also cause misorientation of turtle hatchlings resulting in increased mortalities. With use of lights having no direct sky shine and the addition of tall plantings behind the dune to screen the beach and dune area from the lights, the impact on turtle hatchlings from Unit 1 operation was considered by the staff to be probably minor (Ref. 1, p. v-7). The additional lighting for Unit 2 should not significantly increase this impact, provided similarly shielded lights are used.

The additional staff for Unit 2 plus increased flows of water (and possibly increased aquatic life) in the intake and discharge canals increases the problem of refuse control. Improper storage and disposal of edible refuse and/or deliberate feeding can lead to an increased raccoon population and resulting increase in turtle predation. This problem was considered probably minor for Unit 1. The additional effect of Unit 2 will probably be insignificant if careful refuse control procedures are practiced, as will be required.

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Backwashings from the condenser intake screens must be disposed of in such a way that they do not become food for raccoons. Special surveillance of the canals is recommended, particularly if a warm water recirculation method is developed to defoul the intake lines, until the amount of fish kill is well established. If fish kill is common and leads to carcasses on the banks where they could serve as food for raccoons, special plans for their removal should be formulated and implemented.

5.5.2 Aquatic

The primary effects of plant operation on the aquatic environment will be those resulting from physical circulation of an additional 1150 cfs of ocean water and from thermal and chemical additions to this circulating water. Potential impacts include:

- Entrapment of fishes in the intake system,
- Impingement of organisms on the traveling screens,
- Passage of small organisms through the plant,
- Effects of chemicals on organisms passing through the plant,
- Effects of heat and chemicals in the discharge plume,
- Effects of the thermal plume as a blockage to fish and sea turtle movements,

- Cold shock resulting from simultaneous shutdown of both units,
- Scour of the ocean bottom,
- Effects of chemical discharges, and
- Effects of testing the emergency cooling canal.

Each of these is discussed in detail in the following sections.

5.5.2.1 Entrapment of Fishes in the Intake System

The ocean intake for the required cooling water is fully described in Section 3.4. A velocity cap will be used at the intake to minimize entrapment and impingement of fishes. Its design is similar to that employed by Southern California Edison Co. at their El Segundo and Huntington Beach fossil fuel plants. At El Segundo 272 tons of fish were entrapped during the first year of operation when no velocity cap was used and the flow vectors entering the intake were vertically downward. After installation of a velocity cap, flow characteristics were changed to horizontally radial, and only 15 tons of fish were entrapped in the following year. A similar cap was then designed and installed at the Huntington Beach plant with similarly favorable results.

These velocity caps are designed to provide a relatively high flow rate in a horizontal direction. Most fishes tend to swim against a current, even when their net movement is downstream, and are familiar with horizontal velocities. Higher velocities are also considered to frighten the fish, causing them to tend toward avoidance. Vertical velocities, however, are not commonly found naturally and a detection-response mechanism does not seem to exist for them in fishes. Thus, they may be drawn down into an intake structure and not recognize the danger until they are trapped in it and confused by the velocities within the pipe.

Maximum design flows at El Segundo are 3.5 fps and at Huntington Beach 2 fps. Even with velocities of 0.5 fps at Huntington Beach (one unit operating only) little fish entrapment was noted.[22] However, it is possible that some fish may seek the shadows of the intake for protection when velocities of less than 1 fps are present, and thus be drawn into the much higher velocity of the intake pipe. Thus, a canal monitoring program is recommended during the period of Unit 2 construction when only Unit 1 is operating. If significant numbers of fish are drawn into the intake canal, closure of one intake port will raise the intake velocity and assure adequate warning to fish in the area. Alternatively, a program of removal and return of fish to the ocean could be considered.

The darting speed of a fish (that which can be used only in single bursts) is generally considered to be 10 body lengths per second, while the sustained speed (that which can be sustained for a matter of several minutes) is 0.5 to 0.7 of the darting speed. Thus, fish of average shape (2 in. or more long) would be expected to be able to sustain at least a 1 fps swimming speed and could escape from the edge of the velocity cap. Even smaller fishes could escape if the danger were detected at a greater distance from the cap, as the velocity decreases roughly as the square of the distance from the center of the cap. Since velocity decreases quickly moving away from the cap, a single dart might also carry a smaller fish away from the danger.[23,24]

The ocean waters off Hutchinson Island do not appear to be a suitable nursery ground; large numbers of juvenile fishes are not expected and have not been found. The applicant has reported large numbers of engraulids in beach seine hauls, but these are generally confined to the shore zone and the adults are large enough to escape the 1 fps velocity. Adult Spanish mackerel and bluefish may be in the vicinity of the intake structure, but they should be capable of escaping the velocities at the cap edge.

Should fishes enter the velocity cap and the intake pipeline, the velocities in the pipeline will prevent their escape and they will be entrapped in the intake canal where they will remain until they are impinged on the intake screens, die, or are otherwise removed. With an adequate velocity at the intake structure, their numbers are expected to be small, and the effect of entrapment should be minor. A monitoring program will be required to determine the actual numbers of fishes entrapped. If fish entrapment is significant during single unit operation, several remedies are available including their removal and return to the ocean or blocking one of the intake lines to increase the velocity at the cap when only one unit is operating.

5.5.2.2 Impingement of Organisms on the Intake Screens

A pumphouse with a trash rack and traveling screens will be located at the end of the intake canal where the cooling water enters the plant. The traveling screen will be 3/8 in. mesh to prevent organisms and debris larger than the mesh size from passing into the plant. The screens will be automatically washed when they are sufficiently clogged to cause a drop in head pressure at the pumps. The washings are sluiced to a trash pit where they are collected for disposal (Ref. 2, p. 3.4-2).

Impingement losses are expected to be of minor significance because 1) the velocity caps at the ocean intake are expected to minimize the numbers of fishes entering the intake system, and 2) few large invertebrates such as crabs have been reported in the offshore waters near the intake and, as the intake is raised above the bottom, few of these are expected to enter the canal system.

5.5.2.3 Passage of Organisms Through the Plant

Phytoplankters, zooplankters, and fish eggs and larvae small enough to pass through the 3/8 in. intake screens will be subject to passage through the plant condenser system. They will experience physical effects of pumping and passage through piping systems as well as thermal and chemical effects before being discharged to the canal system. Thermal and chemical effects will continue during transport through the canal and discharge pipline and for some time after discharge to the ocean. Most of these organisms will be killed as a result.

The applicant's monitoring program has indicated an average of 282,000 phytoplankton cells/m^3 with a maximum of 1.09 million cells/m^3 at the sampling location nearest the intake. The majority of these are diatoms. This represents some 800 billion cells/day average (3 trillion cells/day maximum) passing through Unit 2. The applicant calculates this represents about 3,500 grams of phytoplankton/day (Ref. 2, p. 5.1-28). Since the intake is in the open ocean, this represents only a small portion of the phytoplankters passing the site. In addition, phytoplankters have a high reproduction rate and the loss will be replaced naturally within a short time. The dead phytoplankters will not be lost to the food web but will be returned in the discharge water, thereby minimizing the effect of their loss on organisms at higher trophic levels. Even assuming complete mortality, their passage through the plant is expected to be of insignificant impact.

Total zooplankton collected at the station nearest the intake numbered an average of 147,000/m^3. This would represent passage of about 4 billion organisms/day. About 70% of these are copepods, representing a weight of 4 million grams/day (Ref. 2, p. 5.1-29, Table 5.1-7). Like the phytoplankters, these represent only a small part of the total number of zooplankters passing the plant during a 24-hr period, and they will not be entirely lost to the food web. Thus, the impact of entrainment of zooplankters will be minor and is not likely to have a measurable effect on the ecosystem of the ocean waters adjacent to Hutchinson Island.

Fish eggs and larvae will also be subject to passage and will include some 20 million/day (Ref. 2, Table 5.1-7). While these have not been identified, the waters off Hutchinson Island are not thought to be important spawning or nursery areas for species of commercial importance. Thus, these are expected to represent a general population rather than a local one and, therefore, would be only a small fraction of the numbers passing the area. No measurable effect is expected on the local oceanic ecosystem from their passage through the plant.

5.5.2.4 Effects of Chemicals on Organisms Passing Through the Plant

Chemical discharges from Unit 2 are described in Section 3.6. Most of these will not result in a significant increase in normal seawater concentrations beyond natural fluctuitions and, therefore, will not have a significant impact. Exceptions are chlorine used for defouling for 15 min/day in each of two sections of the condensers, cyclohexylamine from steam generator blowdown, and copper resulting from condenser tube corrosion. In addition, dichromate might be accidentally released (Ref. 2, Section 3.6).

Chlorine will be diluted by a factor of 8 (or 4 if only the Unit 2 circulating pumps are operating) and simultaneous chlorination of both units will not take place. Thus, the free chlorine concentrations entering the discharge canal will be diluted to about 0.19 ppm, and this concentration will be further reduced by the chlorine demand of diluting seawater resulting in the formation of chloramines. While little information is available concerning free chlorine toxicity in seawater, it is highly toxic to freshwater organisms at levels of 0.1 ppm.[25] Lower levels greatly reduce marine phytoplankton productivity.[26] Thus, it is expected to contribute to a portion of the mortalities associated with passage of organisms through the plant; however, no effects are expected at the ocean discharge due to the rapid dilution. A monitoring program is planned to confirm that total residual chlorine at the discharge remains below levels harmful to marine life. If chlorine is determined to be a problem, the staff will require remedial measures (such as mechanical cleaning systems) to be taken.

Cyclohexylamines used in the steam system will be released at less than part per billion levels while their toxicity is low at concentrations of parts per million. Thus, no significant effect is expected from their use.

Copper at a few parts per billion is reported to retard growth of marine phytoplankton and is toxic at 50 ppb and 20°C to marine diatoms and denoflagellates. Thermal increments increase copper toxicity.[25] Corrosion of condenser tubes and resulting estimated copper releases of about 6 ppb may therefore, also contribute to mortalities due to passage through the cooling system.

5.5.2.5 Effects on Organisms in the Discharge Plume

During discharge of the warm water, planktonic organisms in the ocean will be mixed in varying proportions into the discharge plume and its thermal and chemical content. As the plume mixes with ambient ocean water, both the incremental temperature and the concentrations of chemicals will rapidly decrease. While chlorine residuals will likely not be measurable, the combined effects of heat and chemical forms may have some detrimental effect on phytoplankters entrained into the plume; however, as the exposure time will be short and the concentrations will

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be decreasing, mortalities to plankters should notresult in a measurable change in the populations of organisms in the local ecosystem. Sublethal effects might be expected, but the degree of reduced productivity should be insignificant to the local ecosystems.

5.5.2.6 Effects of the Discharge Plume on Fishes and Turtles

The thermal plume, described in Section 5.2, is primarily associated with Unit 1. Because of the design of the multiport discharge line for Unit 2, the maximum ocean surface temperature from Unit 2 is expected to be no more than 1.5°F. Unit 2 operation should increase the area of the 1°F isotherm from 2860 acres (with only Unit 1 operating) to 3372 acres (with both Units 1 and 2 operating). Thus, the overall additional impact of the Unit 2 thermal plume is expected to be insignificant.

The location of the thermal plume precludes interaction with the near-shore fishes found in the surf zone during most times. Thus, there should be no effect on mullet or engraulids found very near shore.

A rigorous survey designed to identify fishes in the potential plume zone has not been conducted; however, the ocean bottom does not include out-croppings or grasses conducive to nursery or spawning grounds and it is unlikely that a significant number of fishes breed near the coast in the vicinity of the discharge. In fact, plankton studies have indicated few fish eggs or larvae off Hutchinson Island.

King mackerel are primarily caught several miles offshore and the majority of them will, therefore, not be likely to encounter the plume. However, Spanish mackerel and bluefish are found about a mile offshore and the combined plumes of Units 1 and 2 may intercept a portion of their range. Since this area is not a spawning or nursery ground for any known species, thermal effects on fishes should be primarily limited to adult Spanish mackerel and bluefish. Bluefish demonstrate signs of thermal stress at temperatures of 30°C (86°F).[27] Ambient water temperatures are generally lower than 76°F from mid-November to mid-May, while bluefish are present only in the winter and migrate northward between February and April. Thus, even a 10°F increase in parts of the plume should have no significant effect on bluefish.

Spanish mackerel are also present only during the winter and, thus, should be similarly unaffected.

In general, fishes are capable of detecting thermal gradients in both the vertical and horizontal direction and will avoid lethal temperatures.[27] The plume is not expected to represent a block to migration as fishes can travel around or beneath it. However, it may be an attractant for fishes preferring its warmer waters. As the combined plume from Units 1 and 2 will pass over the intake structure, fishes attracted to it may have an increased likelihood of entrapment in the intake system. The Unit 2 plume will not significantly increase the predicted effect of the Unit 1 discharge at the intake area. Thus, the thermal plume is not expected to have a significant impact on fishes or their migration.

The major potential for interaction is with the sea turtle populations which frequent Hutchinson Island. Little data are available on the thermal tolerances of the sea turtle, particularly with respect to sublethal responses during mating, nest site selection, and hatchling migration. Green turtles mate within 1 mile of shore,[28] putting them potentially in the plume zone during the complex behavioral period of mating. Female green turtles are highly selective in choosing nesting sites, a procedure apparently involving several sensory processes.[28] Thermal effects on these processes could disrupt their breeding pattern as well as that of the loggerhead turtle if they behave similarly.

Turtle hatchlings are known to respond to increased temperatures by slowing activity. The mechanism prevents them from digging out of their sand-nests during hot daylight hours when they would be vulnerable to desiccation and predation while traveling down the beach to the water line. It has been postulated the response continues for a time after the young turtles emerge and water temperature could play a role in determining the degree of swimming activity. Should they cease swimming when they encounter the thermal plume, they would be carried by the currents and perhaps be susceptible to increased predation.[29]

The combined thermal plume from Units 1 and 2 could, therefore, have a significant effect on sea turtles, the degree of which cannot be accurately determined at this time. However, green turtle nesting has not been observed immediately adjacent to the plant and the staff believes the probable impact on other sea turtles is an acceptable one, particularly when balanced against the benefits to turtles of maintaining a large portion of the site adjacent to the ocean in its present condition. The staff required special studies of thermal effects on sea turtles as a condition of Unit 1 operation (Ref. 1, p. v). Furthermore, the staff believes the increased thermal plume area resulting from Unit 2 operation should have no significant additional impact.

5.5.2.7 Cold Shock

The combined thermal plume from Units 1 and 2 may warm the waters off Hutchinson Island and on Pierce Shoal and make them more attractive to the tropical communities found only a short distance south of the plant site. Should such tropical forms be established in the outfall zone, an unlikely simultaneous shutdown of both units or change in current direction could conceivably result in a cold kill. However, the staff believes a more probable result would be the movement of such fish to a more southerly and suitable area.

5.5.2.8 Scour of the Ocean Bottom

The ports of the planned diffuser will be 7 ft above the ocean bottom and 1-1/2 ft in diameter. They will be directed horizontally and the plume should not impinge on the ocean bottom; thus, no scouring is expected.

5.5.2.9 Effects of Testing the Emergency Cooling Canal

The applicant proposes that every 6 months the emergency cooling system will be tested resulting in approximately 2 million gal of water from Big Mud Creek entering the plant intake canal. Organisms present will pass through the plant and are expected to experience high mortality rates. However, this volume of water is only about one-third of the small tidal prism of Big Mud. Since this is a small part of the volume of Big Mud and only takes place twice a year, the staff judges the impact to be minimal and acceptable. Furthermore, this impact is associated only with Unit 1. No additional testing will be required as a result of Unit 2 operation.

5.6 Effects on Community

Operation of Unit 2 will require about 25 additional employees. This should result in a total community employment increase of 50 persons in the area because of an estimated increase of one service employee for each additional manufacturing employee. About 40 additional residences would be needed to house these persons because, on the average, about 1.25 persons/household are employed.

This small increase in total employment should have an insignificant effect on the surrounding communities. These persons are expected to reside primarily near the cities of Stuart and Fort Pierce, which are currently handling the Unit 1 construction force without significant problems.

The diesel generators supplying emergency power to the plant will be tested about semi-monthly for approximately one hour. Because of the infrequent operation, the limited combustion products involved, and the distance from surrounding communities, air pollution effects should be insignificant. See Table 3.6 for estimated emissions from diesel generators.

5.7 Summary of Environmental Effects of Operation

Table 5.7 contains a summary of the identified environmental impacts from the combined operation of Units 1 and 2 and incremental effects of Unit 2 operation, their relative significance, any planned actions to minimize these effects and alternative actions available should the impacts become unacceptable.

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TABLE 5.7

SUMMARY OF ENVIRONMENTAL IMPACTS DUE TO OPERATION

POTENTIAL IMPACT	APPLICANT'S PLANS TO MITIGATE	EXPECTED RELATIVE SIGNIFICANCE: UNITS 1 AND 2	EXPECTED RELATIVE SIGNIFICANCE: UNIT 2 ONLY	CORRECTIVE ACTIONS AVAILABLE AND REMARKS
1. BEACH ACCESS (SECTION 5.3)	WILL LEAVE IN "NATURAL STATE" AND ALLOW ACCESS WITHIN AEC SECURITY REQUIREMENTS	MINOR LOSS OF ACCESS TO RECREATION AREAS	INSIGNIFICANT	
2. PLANT AESTHETICS (SECTION 5.3)	LANDSCAPING, DIKES TO PREVENT LOSS OF VEGETATION	MINOR (DEPENDS ON INDIVIDUAL OPINION)	VERY MINOR INCREASE	SCREEN PLANTINGS, IMPROVED LANDSCAPING, UNDERGROUND TRANSMISSION LINES ACROSS INDIAN RIVER
3. PLANT LIGHTING	—			
A. BIRD KILLS (SECTION 5.5.1)		MINOR	INSIGNIFICANT	
B. TURTLE NESTING DIS-ORIENTATION (SECTION 5.5.1)	PERIMETER LIGHTS LOW, DIRECTED DOWN. PLANTING BEHIND DUNE LINE.	PROBABLY MINOR	INSIGNIFICANT	ADDITIONAL PLANTINGS. PERIMETER LIGHT SHIELDINGS. VARY LIGHT QUALITY
4. RACCOON POPULATION INCREASE (SECTION 5.5.1)	—	PROBABLY MINOR, INCREASE IN TURTLE NEST PREDATION	PROBABLY INSIGNIFICANT	STRICTER SANITATION AND EFFECTIVE PROCEDURES FOR REMOVAL OF EDIBLE WASTE, IN PARTICULAR, RAPID DISPOSAL OF FISH CARCASSES WHICH MAY BE KILLED IN CANALS. STRICTER PROCEDURES TO PREVENT DELIBERATE FEEDING.
5. ENTRAPMENT OF ORGANISMS IN INTAKE SYSTEM (SECTION 5.5.2.1)	INTAKE DESIGN, VELOCITY CAP	MINOR	MINOR	ALTERATION OF INTAKE STRUCTURE, REMOVAL OF ORGANISMS FROM CANAL AND RETURN TO SEA. CLOSED CYCLE COOLING. (IMPACTS OF COOLING SYSTEM)
6. IMPINGEMENT OF ORGANISMS ON INTAKE SCREENS (SECTION 5.5.2.2)	INTAKE VELOCITY < 1 FPS	MINOR	MINOR	REDUCTION IN APPROACH VELOCITY. CLOSED CYCLE COOLING.
7. PASSAGE OF ORGANISMS THROUGH THE CONDENSERS (SECTION 5.5.2.3)	—	MINOR	MINOR	REDUCTION IN SCREEN-MESH SIZE. CLOSED CYCLE COOLING.
8. ENTRAINMENT OF ORGANISMS IN THE DISCHARGE PLUME (SECTION 5.5.2.5)	—	INSIGNIFICANT	INSIGNIFICANT	CLOSED CYCLE COOLING. PRE-DILUTION (INCREASED ENTRAPMENT AND IMPINGEMENT)
9. THERMAL EFFECTS	—			
A. MIGRATORY FISHES (SECTION 5.5.2.4)		PROBABLY INSIGNIFICANT	INSIGNIFICANT	CLOSED CYCLE COOLING. PRE-DILUTION. CONVERT UNIT 1 DISCHARGE TO MULTIPORT.
B. TURTLES (SECTION 5.5.2.4)	—	PROBABLY MINOR	INSIGNIFICANT	CLOSED CYCLE COOLING. PRE-DILUTION. CONVERT UNIT 1 DISCHARGE TO MULTIPORT.
C. ATTRACTION OF TROPICAL SPECIES; COLD SHOCK (SECTION 5.5.2.4)	—	PROBABLY INSIGNIFICANT	INSIGNIFICANT	TIMING OF OUTAGES. COOLING OPTIONS AS ABOVE.
10. CHEMICAL DISCHARGE (SECTION 5.2.3)				
A. CHLORINE (SECTION 5.5.2.4)	INTERMITTENT USE. ONLY ONE OF FOUR BAYS CHLORINATED AT A TIME. MONITOR AT DISCHARGE	PROBABLY INSIGNIFICANT	INSIGNIFICANT	MECHANICAL DEFOULING. REDUCED CHLORINE CONCENTRATION
B. ION EXCHANGE WASTE (SECTION 5.2.3)	CONTROLLED RELEASE	INSIGNIFICANT	INSIGNIFICANT	
C. BORIC ACID (SECTION 5.2.3)	CONTROLLED RELEASE	INSIGNIFICANT	INSIGNIFICANT	
D. SANITARY (SECTION 5.2.3)	SEPTIC SYSTEM	INSIGNIFICANT IF PROPERLY MAINTAINED	INSIGNIFICANT	MEETS FLORIDA STANDARDS. SHOULD BE TIED TO COMMUNITY SYSTEM IF ONE BECOMES AVAILABLE.
11. SCOUR AT DISCHARGE (SECTION 5.5.2.4)	HORIZONTAL DISCHARGE 2 FT ABOVE OCEAN BOTTOM	INSIGNIFICANT	INSIGNIFICANT	
12. EMERGENCY COOLING CANAL TESTING (SECTION 5.5.2.4)	TEST FREQUENCY AND LENGTH OF TEST MINIMIZED	MINOR	NONE	
13. RADIATION RELEASE (SECTION 5.3 AND 5.4)	IN ACCORDANCE WITH AEC REGULATIONS	INSIGNIFICANT	INSIGNIFICANT	IMPROVED RADWASTE SYSTEM.
14. WORK FORCE EFFECTS ON COMMUNITY (SECTION 5.6)		INSIGNIFICANT	INSIGNIFICANT	
15. EMERGENCY DIESEL-GENERATOR OPERATION (SECTION 5.6)	SEMI-MONTHLY TESTING FOR ONE HOUR ONLY	INSIGNIFICANT REDUCTION OF AIR QUALITY BY INCREASE IN SUSPENDED PARTICULATES	INSIGNIFICANT	MONITORED BY STATE DEPT. OF POLLUTION CONTROL

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6. ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 Preoperational Programs

6.1.1 Terrestrial

Preoperational and operational surveillance of terrestrial life for radiological effects should include native species which derive their food from the immediate site. Such samples will serve as an independent indicator of possible unsuspected local contamination. Because of their abundance, omnivorous diet and relatively long life, the raccoon appears to be an appropriate animal to monitor. Two should be taken from as near the plant as possible each year and analyzed for their alpha, gamma and beta radionuclide contents. Similar analyses should be made of a native rodent, preferably the marsh rabbit.

The swamp area bounded by the intake and discharge canals east of State Road AIA will be supplied by water from the intake canal (Ref. 1, p. 4.1-4). Since some recycling of cooling water from the discharge will occur, this region should be monitored. Samples of mud from the vicinity of the inflow to the swamp should be monitored prior to operation of either unit as well as periodically following start up. These samples should be taken annually unless there is evidence of radionuclide buildup, in which case a new protocol of sampling should be initiated.

6.1.2 Aquatic

Since April 1971, the Florida Department of Natural Resources has conducted a comprehensive study of the oceanic ecosystems off Hutchinson Island under the applicant's sponsorship. Five offshore stations located adjacent to the plant site and three beach stations are sampled regularly.

At each of the offshore stations a surface and bottom water sample is taken monthly and analyzed for suspended inorganic particulate matter, chlorphyll a, phaeopigments and, since February 1972, orthophosphate, nitrate, nitrite, ammonia and silicate. At the same time temperature, dissolved oxygen and salinity are determined and surface currents are measured. Sediment size analysis is performed semiannually on samples from each of the five stations. Biological sampling which began in September 1971 includes plankton samples taken bimonthly until September 1972 and monthly since that time. Phytoplankton and zooplankton are identified and counted. Benthic samples are taken every second month at each station with a Shipek grab sampler. Organisms present are identified and counted. A 15-minute balloon trawl is also made each month at each of the stations for invertebrates and fishes. The beach stations are sampled with a 50-ft beach seine net to determine fish populations in the shore zone (Ref. 1, Section 6.1.1).

The continuation of preoperational monitoring through plant startup (planned in 1979) will provide an extensive data base against which effects of plant operation may be measured. This program should include careful monitoring of fish entrainment in the cooling canals with only Unit 1 operating to determine if the intake velocity should be increased from 0.5 fps to 1 fps as a better warning signal to fishes to avoid the intake structures.

Also, an adequate program to identify fish populations has not been conducted. At present a monthly otter trawl is made at each offshore station. Adult fishes have not been obtained in balloon trawls in significant numbers, although their presence is suspected based on sport and commercial catches. The applicant should investigate the use of other sampling techniques such as a variable mesh size gill net or a baited line to determine populations of fishes in the proposed intake and discharge areas. In addition, the applicant should attempt to identify and more extensively enumerate fish eggs and larvae.

The applicant also needs to develop an improved program to synthesize and analyze the data collected to note trends and identify seasonal or yearly variations sufficiently to determine whether plant operation produces fluctuations beyond those expected without the plant.

6.1.3 Meteorological

Since March 1971 the applicant has provided an onsite meteorological monitoring program. This program includes continuous monitoring of wind speed and direction, temperature at three recording levels, precipitation, barometric pressure and dew point temperature.

Temperature and wind data sensors are located on a guyed 200-ft steel frame tower located approximately 2400 ft northeast of Unit 1. The tower is situated in a relatively flat area densely covered by mangrove trees from 6 to 8 ft high.

The onsite monitoring system consists of the following equipment (Ref. 1, p. 6.1-4):

- Wind sensors - six bladed aerovanes are located at the 50- and 190-ft levels of the tower. The starting speed of the directional vane and the anemometer blades are equal to or less than 3.0 mph and 1.5 mph, respectively.

- Temperature sensors - platinum resistance thermometers are installed in Climet aspirated radiation shields at the 33-, 110-, and 200-ft levels with an overall sensor accuracy of 0.2°F.

- Rain gauge - a standard ESSA type weighing rain gauge is installed at ground level at the site near the tower.

- Dew point temperature - a lithium chloride dew cell with an accuracy of ±0.5°F between 10 and 90% relative humidity is installed at the 10-ft level of the tower.

- Barometric pressure - a Belfort microbarograph is located at the base of the tower to provide a continuous record of atmospheric pressure.

All data obtained by this system are recorded continuously on strip charts so that mean hourly values can be obtained. Hourly data are then summarized on a monthly and annual basis.

A rigorous data reliability program has been established to ensure quality meteorological data is obtained (Ref. 1, pp. 6.2-8a to 6.2-8e).

6.1.3.1 Air Quality

Air quality measurements in the region in which the site is included are the responsibility of the Florida State Department of Pollution Control, Southeast Region, Fort Lauderdale, Florida. High volume samplers are used to determine particulate concentrations for 24-hr periods at four stations within 35 miles of the site. These samples are taken at one of the four locations about twice each month, varying the locations from month-to-month. The closest station is at Fort Pierce, a distance of 9 miles NNW of the site. At this station chemical pollutants are also measured once every three months.

6.1.4 Preoperational Radiological Surveillance Program

The applicant initiated an environmental radiological monitoring program in January 1971 to determine preoperational background levels of radioactivity around the site (see Figure 6.1). This program is summarized in Tables 6.1 and 6.2. The program was established under a grant-support arrangement between the applicant and the Department of Health and Rehabilitative Services of the State of Florida. The program was developed by the same personnel and is similar to the operational radiation monitoring program in effect at the applicant's Turkey Point Nuclear Station. The onsite portion of the program is conducted by the applicant. State-collected samples are processed at the Orlando Regional Laboratory. Reports from the Division of Health are compiled quarterly and published as public information in the division's annual reports. The staff considers the preoperational monitoring program as presented in Table 6.1 to be adequate to determine the radiological characteristics of the area so that trends which might develop in the operating phase may be differentiated from normal background radiation.

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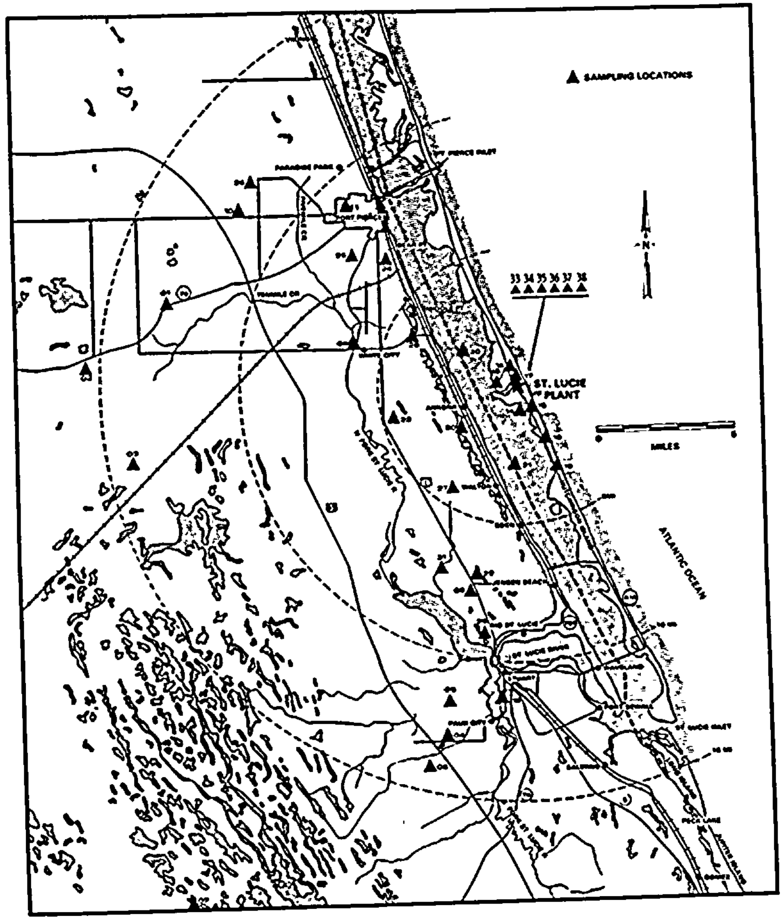

FIGURE 6.1 PREOPERATIONAL MONITORING PROGRAM, ST. LUCIE PLANT SAMPLING LOCATIONS

TABLE 6.1

PREOPERATIONAL AND OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

	CRITERIA AND SAMPLING LOCATIONS[a]	COLLECTION FREQUENCY[b]	ANALYSIS/COUNTING
1. AIR			
1.1 PARTICULATE AND IODINE	COMPARISON ONSITE VERSUS OFFSITE AND REFERENCE LOCATIONS 3 LOCATIONS ONSITE, NORTH, EAST, AND SOUTHEAST OF THE PLANT H 34, H 14, H 33[f] 6 LOCATIONS OFFSITE WITHIN A RADIUS OF 10 MILES OF PLANT H 08, H 09, H 10, H 12, H 30, H 32	WEEKLY	GROSS BETA GAMMA SPECTRAL ANALYSIS OF MONTHLY COMPOSIT IF INDIATED BY HIGH BETA ACTIVITY[e] RADIOACTIVE IODINE
1.2 DIRECT RADIATION	COMPARISON OF ONSITE VERSUS OFFSITE AND REFERENCE LOCATIONS 3 LOCATIONS ONSITE, NORTH, EAST, AND SOUTHEAST OF THE PLANT H 34, H 14, H 33[f] 6 LOCATIONS OFFSITE WITHIN A RADIUS OF 10 MILES OF PLANT H 08, H 09, H 10, H 12, H 30, H 32	MONTHLY	DETERMINE DIRECT RADIATION EXPOSURE BY TLD READOUT (MEAN OF 2 TLDs)
1.3 PRECIPITATION[c]	COMPARISON OF ONSITE VERSUS OFFSITE REFERENCE LOCATIONS 1 LOCATION ONSITE, SITE METEOROLOGICAL TOWER, H 34 3 LOCATIONS OFFSITE H 08, H 10, H 32	MONTHLY	GROSS BETA GAMMA SPECTRAL ANALYSIS[d] TRITIUM[d]
2. WATER			
2.1 SURFACE WATER			
2.1.1 DISCHARGE CANAL	1 LOCATION, EAST OF A1A, H 35 1 LOCATION, WEST OF A1A, H 36	MONTHLY	GAMMA SPECTRAL ANALYSIS TRITIUM Sr-89 AND 90
2.1.2 OCEAN	5 LOCATIONS, H 15, H 16, H 17, H 18, H 19	QUARTERLY	GAMMA SPECTRAL ANALYSIS TRITIUM Sr-89 AND 90 (IF DETECTED IN DISCHARGE CANAL)
2.1.3 INTAKE CANAL	1 LOCATION, H 37, EAST OF A1A AT BEGINNING OF OPEN CANAL	QUARTERLY	GAMMA SPECTRAL ANALYSIS TRITIUM Sr-89 AND 90 (IF DETECTED IN DISCHARGE CANAL)
2.1.4 ESTUARINE	1 LOCATION, BIG MUD CREEK, H 13	QUARTERLY	GAMMA SPECTRAL ANALYSIS TRITIUM Sr-89 AND 90 (IF DETECTED IN DISCHARGE CANAL)
2.1.5 RIVER (FRESH WATER)	1 LOCATION, ST. LUCIE RIVER AT US 1, H 29	QUARTERLY	GROSS BETA TRITIUM
2.1.6 INLAND (FRESH WATER)	1 LOCATION, WALTON ROAD AND MARSH, H 27 1 LOCATION, WEATHERBEE ROAD AND MARSH, H 28	SEMI-ANNUALLY	GROSS BETA TRITIUM

TABLE 6.1 (Continued)

	CRITERIA AND SAMPLING LOCATIONS[a]	COLLECTION FREQUENCY[b]	ANALYSIS/COUNTING
2. WATER (CONT'D)			
2.2 GROUND WATER (WELLS)	1 LOCATION, RESIDENCE, 7609 INDIAN RIVER DRIVE, H 30	SEMI-ANNUALLY	GROSS BETA TRITIUM
2.3 POTABLE WATER (WELLS)	1 LOCATION, CITY OF FT. PIERCE, DRINKING WATER SUPPLY, H 11 1 LOCATION, CITY OF STUART, DRINKING WATER SUPPLY, H 12 1 LOCATION, PORT ST. LUCIE, DRINKING WATER SUPPLY, H 31	QUARTERLY	GAMMA SPECTRAL ANALYSIS GROSS BETA TRITIUM
3. BOTTOM SEDIMENT			
3.1 DISCHARGE CANAL	1 LOCATION, EAST OF A1A, H 35 1 LOCATION, WEST OF A1A, H 36	QUARTERLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90
3.2 OCEAN	1 LOCATION, MOUTH OF DISCHARGE STRUCTURE, H 15 1 LOCATION, OFFSHORE, 1 MILE NORTH OF DISCHARGE, H 16 1 LOCATION, OFFSHORE, 1 MILE SOUTH OF DISCHARGE, H 19	SEMI-ANNUALLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90 (IF DETECTED IN DISCHARGE CANAL SEDIMENT)
3.3 BEACH (SAND)	1 LOCATION, PLANTOM BEACH, OPPOSITE DISCHARGE, H 38 1 LOCATION, EAST OF BLINK CREEK, 1 MILE NORTH OF DISCHARGE, H 16 1 LOCATION, NEAR INTAKE, 1 MILE SOUTH OF DISCHARGE, H 19	QUARTERLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90 (IF DETECTED IN DISCHARGE CANAL SEDIMENT)
3.4 ESTUARINE	1 LOCATION, BIG MUD CREEK, H 13	SEMI-ANNUALLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90 (IF DETECTED IN DISCHARGE CANAL SEDIMENT)
4. AQUATIC BIOTA			
4.1 CRUSTACEA			
LOBSTER OR CRAB OR SHRIMP	4 LOCATIONS, H 17, H 18, H 20, H 21	SEMI-ANNUALLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90
	1 LOCATION, DISCHARGE CANAL, WEST OF A1A, H 36	QUARTERLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90
4.2 FISH			
4.2.1 CARNIVORES (MANGROVE SNAPPER)	4 LOCATIONS, H 17, H 18, H 20, H 21	SEMI-ANNUALLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90
4.2.2 HERBIVORS (MULLET)	4 LOCATIONS, H 17, H 18, H 20, H 21	SEMI-ANNUALLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90
	1 LOCATION, DISCHARGE CANAL, WEST OF A1A, H 36	QUARTERLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90

TABLE 6.1 (Continued)

	CRITERIAL AND SAMPLING LOCATIONS(a)	COLLECTION FREQUENCY(b)	ANALYSIS/COUNTING
5. TERRESTRIAL			
5.1 MILK	1 LOCATION WITHIN 15 MILE RADIUS OF PLANT AND IN THE PREVAILING WIND DIRECTION FROM THE PLANT, H03 1 LOCATION, FLORIDA (STATE) MILK SHED	MONTHLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90 I-131
5.2 BIOTA			
5.2.1 FOOD CROP (CITRUS)	6 LOCATIONS, H 10, H 22, H 23, H 24, H 25, H 26	HARVEST TIME	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90
5.2.2 OTHER VEGETATION	5 LOCATIONS WITHIN A 10 MILE RADIUS OF PLANT, H08, H09, H 10, H 27, H 28	SEMI-ANNUALLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90
5.3 SOIL	5 LOCATIONS WITHIN A 10 MILE RADIUS OF PLANT, H08, H09, H 10, H 27, H 28	SEMI-ANNUALLY	GAMMA SPECTRAL ANALYSIS Sr-89 AND 90

(a) SAMPLES WILL BE TAKEN WHENEVER BIOLOGICALLY AVAILABLE

(b) FREQUENCY DEFINITIONS FOLLOW:

- WEEKLY - NOT LESS THAN 48 TIMES PER ANNUM - INTERVAL MAY VARY BY 3 DAYS
- MONTHLY - NOT LESS THAN 10 TIMES PER ANNUM - INTERVAL MAY VARY BY 15 DAYS
- QUARTERLY - NOT LESS THAN 4 TIMES PER ANNUM - INTERVAL MAY VARY BY 30 DAYS
- SEMI-ANNUALLY - NOT LESS THAN 2 TIMES PER ANNUM - INTERVAL MAY VARY BY 60 DAYS

(c) ANALYSIS WILL BE PERFORMED PROVIDED SUFFICIENT WET DEPOSITION OCCURS

(d) GAMMA SPECTRAL AND TRITIUM ANALYSIS WILL BE PERFORMED PROVIDED SUFFICIENT SIZE LIQUID SAMPLE IS COLLECTED

(e) IF MEAN OF GROSS BETA ACTIVITY OF THE 9 AIR SAMPLES EXCEEDS 10^{-12} μCi/cc (1 pCi/m^3)

(f) EAST OF A1A AND PLANT STRUCTURES -- TO BE INSTALLED WHEN CONSTRUCTION ACTIVITY PERMITS

TABLE 6.2. (Ref. 1, Section 6)

PRACTICAL REPORTING LIMITS

Gamma Spectroscopy

Nuclide	Vegetation and Water (μCi/mℓ)	Soil and Biota (μCi/mℓ)
Ce-144	9.7×10^{-8}	2.0×10^{-7}
I-131	1.7×10^{-8}	4.0×10^{-8}
Ru-106	8.3×10^{-8}	1.8×10^{-7}
Cs-137	1.7×10^{-8}	4.0×10^{-8}
Cs-134	1.7×10^{-8}	6.0×10^{-8}
Co-58	1.7×10^{-8}	6.0×10^{-8}
Co-60	1.7×10^{-8}	6.0×10^{-8}
Zr-95	1.4×10^{-8}	3.0×10^{-8}
Mn-54	1.4×10^{-8}	3.0×10^{-8}
Zn-65	3.1×10^{-7}	7.0×10^{-8}
K-40	1.8×10^{-8}	3.9×10^{-7}
Ba-140	1.7×10^{-8}	4.0×10^{-8}
Ra-226	5.7×10^{-8}	2.0×10^{-7}
Th-232	2.8×10^{-8}	1.0×10^{-7}

Other Analyses

Sr-90	8.0×10^{-7} μCi/g ash
Tritium	2.0×10^{-7} μCi/mℓ (1 liter sample)
Gross Alpha (water)	7×10^{-9} μCi/mℓ (1 liter sample)
Gross Alpha (ash)	7×10^{-6} μCi/g ash
Gross Beta (water)	3×10^{-9} μCi/mℓ (1 liter sample)
Gross Beta (ash)	1×10^{-5} μCi/g ash
Gross Beta - air particulate filters	7.7×10^{-12} μCi/mℓ (Based on a total flow of 2200 m^3)
Air Iodine Cartridges	7.7×10^{-12} μCi/cm^3
Milk I-131	10 pCi/ℓ

6.2 Operational Programs

6.2.1 Terrestrial

Monitoring for the purpose of detecting changes to plants and animals caused by the presence of the power generating plants is not practical since their presence is not the only change occurring in the vicinity of Hutchinson Island. Clearly the presence of the plant has an effect on the biota due to the increased level of human activity in the area as well as from the direct occupancy of land formerly the home of native plants and animals.

However, increased human activity also derives from newly built trailer parks, motels, and other developments occurring in the area. It is not feasible to differentiate effects on the biota which derive from the plant as compared with those arising from other sources. It is much more important to assure careful operation to minimize impacts through control of lighting, control of edible refuse, and minimizing plant related activities in the unoccupied portions of the site which surround the plant.

However, the preoperational monitoring programs described in Section 6.1.1 should be continued after operation. Also, surveys of turtle nesting and nest predation should be continued. In the event monitoring shows a significant change in turtle nesting or in frequency of nest predation by raccoons, plant practices should be reevaluated to determine whether changes in operating methods would be beneficial.

6.2.2 Aquatic

The applicant has not yet proposed an operational monitoring program for either Unit 1 or 2. The program for Unit 1 will have to be developed (as Technical Specifications) by the applicant and approved by the AEC before an operating license is granted. During the intervening time period collection of baseline data will continue, with alterations in the techniques and frequencies of sampling expected to result from review of the data. The operational monitoring programs should be similar to the preoperational studies and will be required to be comprehensive.

As part of the operational program for Unit 1, the applicant is required to monitor concentrations of total residual chlorine at the ocean discharge (Ref. 2, p. v). The aquatic biological monitoring program is to be extended also to fully assess the effects of plant operation on the ocean environment and, specifically, is to include sampling the cooling canals to determine entrainment and impingement effects. Furthermore, a study of thermal plume effects on turtle nesting and hatching activities is required (Ref. 2, p. v). These programs will be continued for Unit 2 operation.

6.2.3 Meteorological

The meteorological operational program will be basically a continuation of the preoperational program except that the data acquisition system will be installed in the plant control room. Meteorological data collected will be summarized and reported in the format and time period compatible with these then existing governmental regulations.

6.2.4 Operational Radiological Surveillance Program

The applicant states the proposed operational monitoring program will be an extension of the preoperational program with modifications as indicated by use of the preoperational program and experience in monitoring at the Turkey Point Station. In addition the staff recommends that the applicant consider the following modifications to its operational program:

(1) Analyze for Sr-90 in air particulates.

(2) Sample benthos, plankton and other aquatic vegetation in the discharge canal and perform gamma-scan and H-3 and Sr-90 analyses.

(3) Sample some terrestrial animals and water fowl in region around site.

(4) Sample forage at closest cow pasture.

(5) Make census of food producing farm animals within five miles of the plant at least once a year.

(6) Sample food products grown near the plant such as leafy vegetables, eggs, milk, meat when available.

The operational surveillance program will be detailed more fully in the Environmental Technical Specifications for the operating license.

6.3 Related Environmental Programs and Studies

No monitoring programs are being conducted other than those previously discussed.

REFERENCES

1. Florida Power and Light, St. Lucie Plant Unit No. 2, Environmental Report, AEC Docket No. 50-389, August 10, 1973.

2. USAEC, St. Lucie Plant Unit No. 1, Final Environmental Statement, Docket No. 50-335, June 1973.

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7. ENVIRONMENTAL EFFECTS OF ACCIDENTS

7.1 Postulated Plant Accidents Involving Radioactive Materials

A high degree of protection against the occurrence of postulated accidents in Unit 2 is provided through correct design, manufacture, and operation, and the quality assurance program used to establish the necessary high integrity of the reactor system, as will be considered in the Commission's safety evaluation. 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, even though they may be extremely unlikely; and engineered safety features are installed to mitigate the consequences of those postulated events which are judged credible.

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 Commission's safety review, extremely conservative assumptions are 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. Realistically computed doses that would be received by the population and environment from the accidents which are postulated would be significantly less than those to be presented in the 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 St. Lucie Plant, Unit No. 2, Environmental Report, dated August 31, 1973.

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. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate. The examples selected by the applicant for these cases are shown in Table 7.1. The examples selected are reasonably homogeneous in terms of probability within each class.

Commission 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 7.2. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table 7.2. The man-rem estimate was based on the projected population within 50 miles of the site for the year 2000.

TABLE 7.1

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

Class	AEC Description	Applicant's Examples
1.	Trivial incidents	Small continuous leaks.
2.	Small releases outside containment	Crack in CVCS piping.
3.	Radioactive waste system failure	Equipment leakage or malfunction, waste gas decay tank failure, failure of liquid waste holdup tank.
4.	Fission products to primary system (BWR)	Not applicable.
5.	Fission products to primary and secondary systems (PWR)	Fuel cladding defects and steam generator leakage. Steam generator tube rupture.
6.	Refueling accident	Fuel bundle drop inside containment. Fuel bundle drop outside containment.
7.	Spent fuel handling accident	Spent fuel transportation accident on site.
8.	Accident initiation events considered in design-basis evaluation in the Safety Analysis Report	Loss-of-coolant accident. Control element assembly ejection accident. Steam line rupture accident.
9.	Hypothetical sequence of failures more severe than Class 8.	Not considered.

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TABLE 7.2

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS[(a)]

Class	Event	Estimated Fraction of 10 CFR Part 20 limit at site boundary[(b)]	Estimated Dose to Population in 50-mile radius (man-rem)
1.0	Trivial Incidents	(c)	(c)
2.0	Small releases outside containment	(c)	(c)
3.0	Radwaste System failures		
3.1	Equipment leakage or malfunction	0.016	2.3
3.2	Release of waste gas storage tank contents	0.062	9
3.3	Release of liquid waste storage contents	0.002	0.25
4.0	Fission products to primary system (BWR)	N. A.	N. A.

(a) 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. Our evaluation of the accident doses assumes that the applicant's environmental monitoring program and appropriate additional monitoring (which could be initiated subsequent to a liquid release 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.

(b) Represents the calculated fraction of a whole body dose of 500 mrem, or the equivalent dose to an organ.

(c) These releases are expected to be in accord with proposed Appendix I for routine effluents (i.e., 5 mrem/yr to an individual from either gaseous or liquid effluents).

TABLE 7.2 (Continued)

Class	Event	Estimated Fraction of 10 CFR Part 20 limit at site boundary(b)	Estimated Dose to population in 50-mile radius (man-rem)
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	(c)	(c)
5.2	Off-design transients that induce fuel failure above those expected and steam generator leak	<0.001	<0.1
5.3	Steam generator tube rupture	0.02	3
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.003	0.48
6.2	Heavy object drop onto fuel in core	0.056	8.3
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel rack	0.002	0.3
7.2	Heavy object drop onto fuel rack	0.008	1.2
7.3	Fuel cask drop	0.05	7.3
8.0	Accident initiation events considered in design basis evaluation in the SAR		
8.1	Loss-of-Coolant Accidents		
	Small Break	0.035	9.5
	Large Break	0.028	16
8.1a	Break in instrument line from primary system that penetrates the containment	N. A.	N. A.
8.2a	Rod ejection accident (PWR)	0.003	1.6
8.2b	Rod drop accident (BWR)	N. A.	N. A.
8.3a	Steam line breaks (PWR's outside containment)		
	Small Break	<0.001	<0.1
	Large Break	<0.001	<0.1
8.3b	Steamline break (BWR)	N. A.	N. A.

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To rigorously establish a realistic annual risk, the calculated doses in Table 7.2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operations; 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 7.2 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 bases of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is judged 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 a 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.

The AEC is currently performing a study to assess more quantitatively these risks. The initial results of these efforts are expected to be available in 1974. This study is called the Reactor Safety Study and is an effort to develop realistic data on the probabilities and sequences of accidents in water cooled power reactors, in order to improve the quantification of available knowledge related to nuclear reactor accidents probabilities. The Commission has organized a special group of about 50 specialists under the direction of Professor Norman Rasmussen of MIT to conduct the study. The scope of the study has been discussed with EPA and described in correspondence with EPA which has been placed in the AEC Public Document Room (letter, Doub to Dominick, dated June 5, 1973).

As with all new information developed which might have an effect on the health and safety of the public, the results of these studies will be made public and would be assessed on a timely basis within the regulatory process on generic or specific bases as may be warranted.

Table 7.2 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 that are within the Maximum Permissible Concentrations (MPC) of 10 CFR Part 20. The table also shows the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident. Any of these integrated exposures would be much smaller than that from naturally occurring radioactivity. 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 realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small and need not be considered further.

7.2 Transportation Accidents Involving Radioactive Materials

As discussed in Section 5.4.4.2, the staff has recently completed an analysis of the potential impact on the environment of transporting fuel and solid radioactive wastes for nuclear power plants under existing regulations. The results of this analysis were published in a report entitled "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," dated December 1972. The report contains an analysis of the probabilities of occurrences of accidents and the expected consequences of such accidents, as well as the potential exposures to transport workers and the general public under normal conditions of transport.

For the St. Lucie Plant, the characteristics of the reactor fuel and wastes and the conditions of transport for the fuel and waste fall within the scope of the Environmental Survey of Transportation. The initial fuel supply for each unit will be supplied from Windsor, Connecticut. New fuel elements will be shipped approximately 1400 miles from the fabrication plant to the site by truck.

Each unit will replace about 72 of the 217 fuel bundles each year. Spent fuel elements will be shipped from the site by truck to Barnwell, South Carolina, a distance of about 500 miles.

The staff assumes solid radioactive wastes will be shipped by truck to the nearest disposal site, Moreland, Kentucky, a distance of about 800 miles. This will involve approximately 30-40 shipments per year for both units.

In accordance with the proposed amendment (Section F) to Appendix D of 10 CFR Part 50, published on February 5, 1973, and the subsequent rule-making hearings, Table 7.3 summarizes the environmental impact of accidents during transportation of fuel and waste to and from the plant. (Normal conditions of transport were summarized in Table 5.4.)

TABLE 7.3

ENVIRONMENTAL IMPACT OF ACCIDENTS DURING TRANSPORTATION OF FUEL AND WASTE TO AND FROM ST. LUCIE PLANT UNIT 2

Aspect	Environmental Risk
Radiological effects	Small
Common (nonradiological) causes	1 fatal injury in 100 years; 1 nonfatal injury in 10 years; $475 property damage per year

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8. IMPLICATIONS OF PROPOSED PROJECT

8.1 The Requirement For Power

The following analysis of the requirement for power in the applicant's system is based on data available in September 1973. The staff recognizes the effect the evolving energy crises may have on this forecast, and further analysis of this effect is described in Section 8.1.2.

Based on this overall analysis of the applicant's system which considered (1) growth in demand for power, (2) power conservation efforts, (3) system capabilities and reserve requirements, (4) composition of generation capability (base load versus peaking), (5) recent history of load curtailments, and (6) availability of power from outside the applicant's system, the staff concludes:

- Given system size and the expected growth in demand, annual additions of 1600 MW generation capability will be required by 1980.
- Without the generation capacity available from Unit 2, the applicant's system reserves will be inadequate after 1979.
- Importation of large, continuous blocks of power from outside the applicant's system is not feasible.

8.1.1 Change in Demand

Changes in the demand for power is a function of changes in population and consumption per customer. Population in the applicant's service area increased by 51% during the period 1960-1970. Consistent with this population growth, new customers in the system increased by 79% in the period 1962-1972, compared with a 24% gain for the nation as a whole. Population in the applicant's service area is expected to increase by 32% during the period 1970-1980 (see Table 8.1). This service area covers many of the principal Florida population centers, as seen in Figure 8.1.

In addition to population increases, the applicant indicates kilowatt-hour consumption per average residential customer has about doubled in the past 10 years.[1]

The combined effects of increases in population and unit consumption are responsible for the 182% and 234% respective growths in peak demand and energy sales experienced by the applicant since 1962. This growth rate is one of the highest in the nation as shown in Figure 8.2. The 1972 increase in energy sales of 12% over 1971 tends to confirm present expectations that this rate of growth in demand will continue.

TABLE 8.1

PRESENT, PAST AND PROJECTED POPULATION OF FLORIDA POWER AND LIGHT SERVICE AREA[2]

FPL Service Area:	1960	1970	1980
Brevard	111,400	230,000	285,500
Broward	333,800	620,100	920,000
Charlotte	12,600	27,600	45,300
Collier	15,800	38,000	64,000
Columbia	20,100	25,300	29,500
Dade	935,000	1,267,800	1,534,700
DeSoto	11,700	13,100	14,300
Flagler	4,600	4,500	4,600
Indian River	25,300	36,000	50,000
Lee	54,500	105,200	148,300
Manatee	69,200	97,100	120,800
Martin	16,900	28,000	40,500
Okeechobee	6,400	11,200	15,700
Palm Beach	228,100	348,800	472,600
Putnam	32,200	36,300	39,600
Sarasota	76,900	120,400	157,300
Seminole	54,900	83,700	161,500
St. Johns	30,000	30,700	31,300
St. Lucie	39,300	50,800	61,700
Suwannee	15,000	15,600	16,000
Volusia	125,300	169,500	227,500
TOTAL	2,219,100	3,359,700	4,440,700

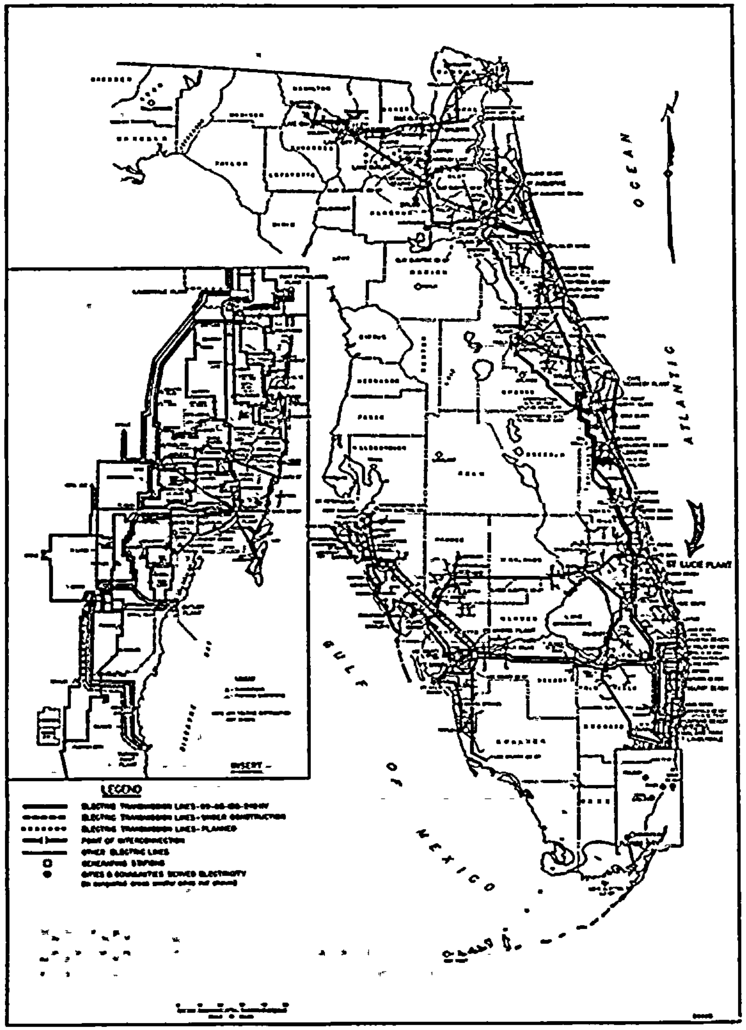

FIGURE 8.1 FLORIDA POWER AND LIGHT SERVICE AREA

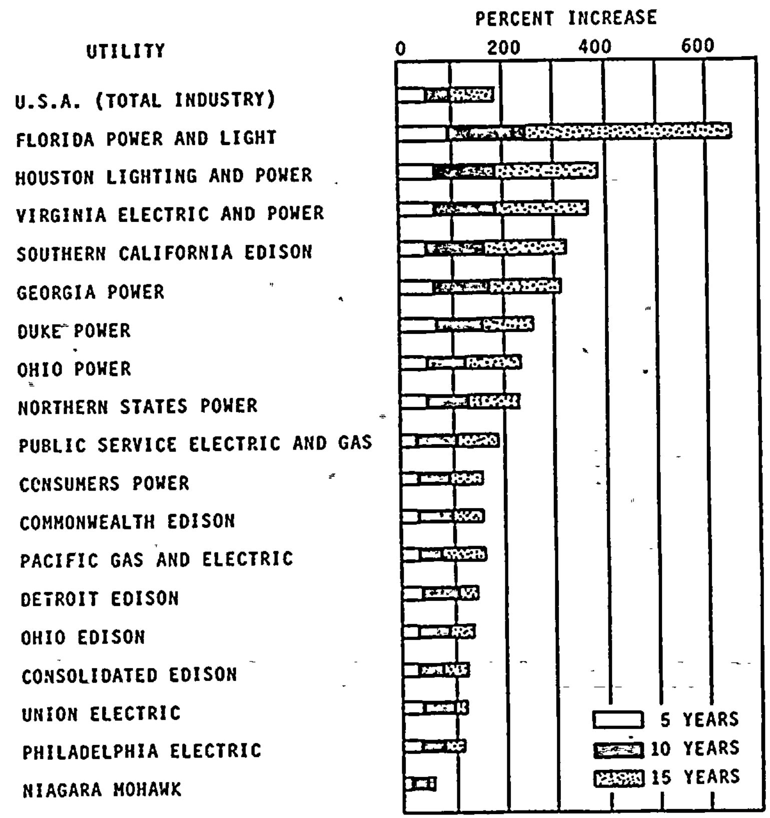

FIGURE 8.2 FIFTEEN YEAR (1955-1970) kW-hr SALES GROWTH OF UTILITIES WITH 1970 REVENUES IN EXCESS OF $250 MILLION VERSUS U.S. TOTAL[3]

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Annual growth in the applicant's system capabilities and corresponding peak loads for the period 1968 to 1972, as well as projections to 1982, are shown in Table 8.2.

8.1.2 The Impact of Energy Conservation and Substitution on Need for Power

Recent energy shortages have focused the Nation's attention on the importance of energy conservation as well as measures to increase the supply of alternative energy sources. The need to conserve energy and to promote substitution of other energy sources for oil and gas have been recommended by the Report to the President on the Nation's Energy Future as major efforts in regaining national energy self-sufficiency by 1980.[13] In the following sections, the staff considers conservation of energy as related to the need for the electricity to be produced by the St. Lucie plant.

8.1.2.1 Promotional Advertisement

In the past, electric utilities have attempted, through advertising, to accelerate the demand for electricity in their service areas. Generally, the major thrust of advertising was to promote demand during off-peak periods, thereby covering expensive peaking capacity with expanded lower cost baseload capacity. Notably electric space and water heating has been promoted to offset increasing air conditioning and, hence, summer peaking demands.

The applicant terminated promotional advertising in 1971 and by direct mail and mass media advertising disseminated information designed to promote efficient residential usage of electricity. Accordingly, elimination of promotional advertising is no longer an available measure for the applicant to dampen demand. On the other hand, promotional advertising by manufacturers of electrical appliances and equipment has not been eliminated. These manufacturers spent an estimated $450 million in promotional advertising in 1972.[15] Thus, it is doubtful that the applicant's reduced promotional advertising will have much, if any, significant impact on projected demand.

8.1.2.2 Change in Utility Rate Structure

The Federal Power Commission regulates the rates for interstate wholesale electric energy,[16] while the Florida Public Service Commission regulates the rates utilities charge the ultimate consumer in the applicant's area.[14]

Historically, utility rate structures were designed to encourage consumption of electricity by using the declining block rates, which reflected the declining average cost of furnishing additional kilowatt hours of

TABLE 8.2

FLORIDA POWER AND LIGHT COMPANY
SUMMER PEAK LOADS, CAPABILITIES AND RESERVES*
(Capability is Summer Peak Capability)

Year	One Hour Peak Load Gross (MW)	% Increase	Capability(a) (MW)	Reserve: With St. Lucie Unit No. 2 MW	Reserve: With St. Lucie Unit No. 2 %	Reserve: Without St. Lucie Unit No. 2 MW	Reserve: Without St. Lucie Unit No. 2 %
1968	3925	20.0	4298	373	9.4	373	9.4
1969	4470	13.9	5125	655	14.7	655	14.7
1970	5125	14.7	5569	444	8.7	444	8.7
1971	5525	7.8	6013	488	8.8	488	8.8
1972	6145	11.2	6857	712	11.6	712	11.6
1973	7105	15.6	8713	1608	22.6	1608	22.6
1974	7940	11.8	9397	1457	18.4	1457	18.4
1975	8820	11.1	10081	1261	14.3	1261	14.3
1976	9800	11.1	11731	1931	19.7	1931	19.7
1977	10925	11.5	13331	2406	22.0	2406	22.0
1978	12150	11.2	14131	1481	16.3	1981	16.3
1979	13525	11.3	15731	2206	16.3	2206	16.3
1980	15090	11.6	17681	2591	17.2	1741	11.5
1981	16760	11.1	19881	3121	18.6	2271	13.6
1982	18520	10.5	22081	3561	19.2	2711	14.6

(a) For years after 1972 see Table VIII-5 for a detailed description of planned additions.
Note: Capability does not reflect Turkey Point power curtailment to avoid exceeding Card Sound effluent temperature limits.

electrical energy to each customer. In the past the economic logic for declining block rates was never seriously disrupted. Today, however, under conditions of increasingly scarce fuel resources, declining block rates, by lowering the price of each additional kilowatt hour, may tend to encourage unnecessary use of electricity by individual consumers and also encourage individual consumers to use more and more electricity at the expense of other energy sources.

The most commonly mentioned alternatives to declining block rates to dampen demand for electricity are increasing block rates, peak load pricing and flat rates.

Table 8.2 presents some statistics on the average cost of electricity to consumers and the average energy (Kilowatt-hours) used per customer from 1964 through 1971. Statistics such as these indicate that across the United States even though the price of electricity has increased during the last few years, the demand is still increasing. The question that statistics such as these do not answer, is at what point will the costs of residential and commercial electricity cause the consumer to significantly decrease his demand. However, with sufficient economic incentive, total demand could be reduced, or at least its rate of growth reduced.

TABLE 8.3

STATISTICS ON COST AND CONSUMPTION OF ELECTRICITY[17]
(1964-1971)

	Average Cost to Consumers - Cents Per Kilowatt - Hour			Average Kilowatt - Hours Per Customer (Thousands)		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
1971	2.32	2.20	1.10	7.639	42.598	1,735.482
1970	2.22	2.08	1.02	6.700	40.480	1,695.087
1969	2.21	2.06	.98	6.246	37.607	1,666.019
1968	2.25	2.07	.97	5.706	35.009	1,578.366
1967	2.31	2.11	.98	5.220	32.234	1,481.496
1966	2.34	2.13	.98	4.931	30.238	1,445.802
1965	2.39	2.18	1.00	4.618	28.093	1,289.949
1964	2.45	2.26	1.02	4.377	25.450	1,217.878

Since the demand for electricity is also sensitive to such other factors as Gross National Product, the local economy, the substitution of electricity for more scarce fuels, population growth, and local temperature variations there are questions of how long it would take a rate change to have a detectable effect considering these other variables.

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8.1.2.3 <u>Load-shedding, Load Staggering and Interruptible Load Contracts to Reduce Peak Demand</u>

Load shedding is an emergency measure to prevent system collapse when peak demand placed upon the system is greater than the system is capable of providing. This measure is usually not taken until all other measures are exhausted.

The Federal Power Commission's report on the major load shedding that occurred during the Northeast Power Failure of November 9 and 10, 1965, indicates that reliability of service of the electrical distribution systems should be given more emphasis, even at the expense of additional costs.[18] This report identified several areas that are highly impacted by loss of power, such as elevators, traffic lights subway lighting, prison and communication facilities. It's the serious impact on areas such as these that result in load shedding as only a temporarily method to overcome a shortage of generating capacity during an emergency. It cannot be considered as a viable alternative for required additional capacity.

Load staggering has also been considered by the staff as a possible conservation measure. Basically this alternative involves shifting the work hours of industrial or commercial firms to avoid diurnal or weekday peaks. However, the staff considers the interference with customer and worker preferences as well as productivity to be of significant impact to make such proposals of questionable feasibility. As in the case of load shedding, load staggering cannot be considered as viable alternative for required additional capacity.

For interruptible load contracts to be effective in system planning, the load reduction must be large enough to be effective in system stability planning. Thus, this type contract is primarily related to industrial customers. The acceptability of interruptible load contracts to industrial customer depends upon balancing the potential economic loss resulting from unannounced interruptions against the saving resulting from the reduced price of electricity. If the frequency or duration of interruptions increase as a result of insufficient installed capacity, the customer will convert to a normal industrial load contract. Even if the applicant had 1200 MWe of interruptible load, it is speculative to project that customers would continue this contractual relationship if faced with frequent and long period with no electrical service.

8.1.2.4 <u>Factors Effecting the Efficient Utilization of Electrical Energy</u>

Promoting the efficient utilization of electrical energy by developing new standards for insulation, new lighting requirements for buildings and energy efficient labeling will result in reductions in long term growth of energy requirements in the applicant's service areas.

In general, municipalities adopt and enforce local building codes which govern the standards for buildings and structures. Apart from these requirements, the owner of a house or commercial building would increase the installed insulation only up to the point that the extra cost would be paid for by future savings in fuel consumption. An increase in the price of energy used for space heating or cooling would increase the economically optimum quantity of insulation. As local building codes are changed and insulation in existing structures increased, the change in both summer and winter demand in the applicants' service area will be reflected in their historical loads. However, it is speculative at this time to predict which codes will be changed and to what degree homeowners will add insulation so that the projected peak demand could be reduced.

With respect to new lighting requirements, electrical energy savings do to some extent, appear possible for both new and existing residential and commercial buildings. For example, encouraging residential customers in existing houses to use lower wattage electric bulbs and reduced usage is important in the next decade as an emergency conservation measure and will compliment savings brought about by institution of new standards and requirements in new house construction. Fluorescent lighting is about four times more efficient than incandescent lighting and is presently in widespread use in industry and commerce. Most residential houses have incandescent lighting. One study indicated that if all households in 1970 had changed to fluorescent from incandescent lighting, the residential use of electricity for lighting would have been reduced approximately 75% and total electrical sales would be reduced approximately 2.5%.[19] However, since the majority of residential lighting occurs in off peak hours, the reduction on peak demand would be less than one percent. Thus the decrease in peak demand resulting from such lighting changes is minimal.

The importance of energy efficiency labeling of applicances is that it will allow the consumer to select the most energy efficient appliance. Table 8.3 projects the average annual use of electricity by household appliances based on historical trends. As indicated space heating, water heating, air conditioning, freezers, cooking and clothes drying are among the large uses of electricity in residential appliances. Of these appliances, improvement in the efficiency of air conditioners has been a major area of consideration since air conditioners contribute substantially to the peak summer demand.

For instance, making air conditioners function with lower energy demand typically requires a combination of increased heat exchanger size and higher efficiency compressors. This results in higher initial cost. Estimates of the cost differential for a typical room air conditioner to double the efficiency from 5.5 BTU per watt to 11 BTU per watt is approximately $100.[19] For this conservation of energy method to be effective,

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TABLE 8.4

Projections of Average Annual Electricity Use[19]

	Average annual electricity use in households having the appliance (kWh/household)		
	1970	1980	1990
Refrigerators	1,300	1,600	1,800
Air conditioning			
Room	1,946	2,000	2,000
Central	3,560	3,600	3,600
Lighting	750	850	900
Space heating	14,588	15,000	15,000
Water heating	4,500	4,800	4,800
Clothes drying	993	1,000	1,000
Cooking	1,175	1,200	1,200
Television	417	440	470
Food freezers	1,384	1,500	1,600

the consumer must be convinced that it is profitable for him in the long-term to purchase the more expensive machine. This will require a public educational program and effective energy efficiency labeling. In addition, selection of central air conditioners by subdivision developers has historically been based on minimizing front end costs consistent with meeting local building codes. This approach continues to favor the lower cost units. Factors such as this lead to the conclusion that the reduction in peak demand due to energy efficient labeling is undeterminable at this time.

In addition the staff is aware that the National Institute of Occupational Safety and Health has recommended heat stress standard to the Occupational Safety and Health Administration which, if adopted, would require a significant number of employers to air condition their plants.[20] This possible requirement, coupled with future substitution of electrical energy for fuels in short supply, namely oil and natural gas, will tend to increase the demand for electrical power and thus make any reduction in the future peak demand for electricity due to this conservation of energy measure speculative.

8.1.2.5 Consumer Substitution of Electricity for Scarce Fuels

While conservation measures are rather quickly adopted in a "crisis" situation, the consumer's substitution of electrical energy for fuels such as oil or gas takes several years to result in a substantial upward impact on the need for power. The staff expects that substitution of electricity for scarce energy sources will likely accelerate in the applicant's service area because of the uncertainty of oil and gas supplies and the outlook for higher prices relative to the price of electricity produced from coal-fired or nuclear plants. Nationally, for instance, electric space heating is projected to grow from 7.6 percent for all homes in 1970 to 16 percent in 1980 and to 27 percent in 1990.[19] Other increases are forecasted in the growth of electric water heater and ranges. The advent of electric automobiles or other new uses of electricity cannot be discounted but are not now quantified in projecting need for power since the use of such items is speculative. It is the staff's evaluation that substitution effects will to some degree offset any savings from other conservation of energy techniques.

A second kind of substitution which is relatively important in considering the applicant's need to add the proposed nuclear plant to his system is the desirability of adding nuclear capacity as soon as possible in order to reduce fuel consumed by gas- or oil-fired units now forming a significant part of the applicant's system. This, in turn, will increase the availability of these material resources for other uses for which there is no available substitute.

8.1.3 System Reserve Capacity

Forecasts of system demands and capabilities must include reserve allowances to cover such contingencies as forced outages, delays in new plant and transmission line construction, scheduled and unscheduled maintenance, and variations in demand. On a national basis, power pools typically recommend a reserve margin of 15-25%.[5] For the period 1968 to 1972, the applicant's reserves were well below this recommended level, but they are expected to reach the 15-20% range in 1973 with the addition of several large generating units.

The addition of Unit 2 is necessary if the applicant is to maintain acceptable reserves during 1980 and beyond. The addition of the plant on schedule provides system reserves of 17.2% in 1980 and 18.6% in 1981, as shown in Table 8.2. One- and two-year delays in startup have a significant effect, resulting in reserves of 11.5 and 13.6%, respectively, for 1980 and 1981, which are about half the desirable 25% level for systems in the Florida subregion as stated by the Southeastern Electric Reliability Council.[6]

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In recent years reserve inadequacies in the applicant's system have contributed to load interruptions of increasing significance as shown in Table 8.3. This trend can be expected to continue if adequate reserve margins are not maintained.

8.1.4 Florida Reserve Capacity

As a member of the Florida Power Pool, the applicant's operations are closely coordinated with those of other major systems in Florida. The effects of delays in startup of the plant on the overall Florida reserve situation are shown in Table 8.4. A 1-year delay produces a decline in reserves from 20.4 to 17.1% for summer 1980. A 2-year delay produces a decline from 21.7 to 18.8% in summer 1981. System peak loads reached in January or February are generally higher than the summer peaks, producing decreases in reserves to 18.1 and 20.0%, respectively, for winter 1980-81 and 1981-82 assuming 1- and 2-year delays in startup. These reserve levels would be below what is considered normal for Florida. A recent study by the Federal Power Commission's Bureau of Power has concluded that, as one of the national regions with a critical reserve capacity situation, a 20% reserve would be inadequate for Florida and has used a reserve level of 28% as the necessary reserve level in its calculations.[8]

8.1.5 Other Sources of Power Availability

Power needed from Unit 2 cannot be provided through deferred retirement of older units. All units currently operating are of comparatively recent post-World War II vintage, and are scheduled to remain in service through 1980 and beyond. (The applicant plans additions to the system as shown in Table 8.5.)

The applicant will, on occasion, purchase sizable blocks of power for short durations to meet emergency needs, as well as small blocks of power for extended periods of time. However, the reserve situation experienced by the applicant is likewise experienced by most other Florida utilities. Consequently, sustained purchases of large blocks of power from these sources is not feasible.

Although an intertie exists with utilities to the north, these utilities do not possess sufficient reserves to permit export of substantial amounts of power, and the low-voltage interconnections now in existence are inadequate for this purpose. Interconnections of sufficient voltage may not be available before 1980.[11]

8.1.6 Conclusion

In view of the projections discussed above and the unavailability of purchased power, the staff concludes that additional generating capacity will be needed in the 1980 to 1982 time frame. Although each of the

TABLE 8.5

FLORIDA POWER AND LIGHT, RESULTS OF LOAD CURTAILMENT[7]

Date	Load Curtailment Period	Number of Customers	Amount of Load Curtailed kW
12/16/68	5:00 - 7:00	155	115,688
7/7/69	4:00 - 7:00 pm	46	87,240
7/8/69	4:00 - 7:00 pm	58	86,210
7/9/69	4:00 - 7:00 pm	67	77,980
1/8/70	5:00 - 9:00 pm	281	151,680
1/9/70	6:30 -10:30 am	204	131,080
1/9/70	5:00 - 9:00 pm	337	161,290
1/10/70	7:00 -10:30 am	254	148,910
1/10/70	5:00 - 9:00 pm	215	131,410
2/4/70	5:30 - 9:00 pm	182	122,660
7/15/70	4:45 - 7:00 pm	106	82,699 (Voluntary)
7/16/70	4:30 - 7:00 pm	98	72,603 (Voluntary)
7/27/70	4:00 - 7:00 pm	119	87,616 (Voluntary)
7/28/70	4:30 - 7:00 pm	118	79,665
7/31/70	12:00N-10:00 pm	211	173,592
8/3/70	3:00 - 7:00 pm	349	112,237 (Voluntary)
8/4/70	4:00 - 7:00 pm	108	80,422 (Voluntary)
8/5/70	4:00 - 8:00 pm	317	104,452 (Voluntary)
9/2/70	4:00 - 7:00 pm	257	105,570 (Voluntary)
9/3/70	4:00 - 7:00 pm	137	90,072 (Voluntary)
1/20/71	5:00 - 9:00 pm	467	175,272
4/29/71	4:00 - 8:00 pm	703	202,110
4/30/71	4:00 - 8:00 pm	498	149,372 (Voluntary)
6/16/71	4:00 - 7:00 pm	572	162,082 (Voluntary)
8/18/71	3:00 - 7:00 pm	684	245,788

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TABLE 8.5 (Continued)

Date	Load Curtailment Period	Number of Customers	Amount of Load Curtailed kW
7/3/72	4:00 - 8:00 pm	444	140,002
7/5/72	4:00 - 8:00 pm	477	180,871
7/28/72	4:00 - 8:00 pm	609	228,357
7/29/72	4:00 - 8:00 pm	321	87,728 (Voluntary)
9/7/72	4:00 - 8:00 pm	692	242,079
9/14/72	4:00 - 8:00 pm	671	256,170
9/15/72	4:00 - 8:00 pm	683	263,760
9/18/72	3:30 - 8:00 pm	678	266,142
9/19/72	3:30 - 8:00 pm	692	263,977
9/25/72	4:00 - 8:00 pm	668	241,032
9/26/72	3:00 - 7:00 pm	682	275,734
9/27/72	3:30 - 7:00 pm	704	262,546
5/28/73	4:00 - 8:00 pm	85	57,350 (Holiday)
5/29/73	2:00 - 8:00 pm	267	229,650

TABLE 8.6

SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL
FLORIDA SUBREGION

ESTIMATED CAPABILITY[9]

Period	Peak Hour Load	Total Capability	Reserve With St. Lucie Unit No. 2 MW	Reserve With St. Lucie Unit No. 2 % Peak	Reserve Without St. Lucie Unit No. 2 MW	Reserve Without St. Lucie Unit No. 2 % Peak
1973 Summer	12747	15593	2846	22.3	2846	22.3
73/74 Winter	13156	16233	3077	23.4	3077	23.4
1974 Summer	14190	17191	3001	21.1	3001	21.1
74/75 Winter	14578	18656	4078	28.0	4078	28.0
1975 Summer	15713	19906	4193	26.7	4193	26.7
75/76 Winter	16129	22214	6085	37.7	6085	37.7
1976 Summer	17408	22254	4846	27.8	4846	27.8
76/77 Winter	17863	23801	5938	33.2	5938	33.2
1977 Summer	19291	24439	5148	26.7	5148	26.7
77/78 Winter	19768	25261	5493	27.8	5493	27.8
1978 Summer	21316	25852	4536	21.3	4536	21.3
78/79 Winter	21861	26724	4863	22.2	4863	22.2
1979 Summer	23533	28862	5329	22.6	5329	22.6
79/80 Winter	24181	30684	6503	26.9	6503	26.9
1980 Summer	26001	31304	5303	20.4	4450	17.1
80/81 Winter	26693	32386	5693	21.3	4840	18.1
1981 Summer	28651	34877	6226	21.7	5373	18.8
81/82 Winter	29377	36098	6721	22.9	5868	20.0
1982 Summer	31504	39371	7867	25.0	7014	22.3
82/83 Winter	32212	39632	7420	23.0	6567	20.4

TABLE 8.7

GROSS SUMMER PEAK CAPABILITY AND UNIT ADDITIONS

Year	Unit Additions	Summer Capability (MW)	Fuel	System Nuclear Steam	Capability Fossil Steam	Fossil Gas Turbine (MW)	Total
1968					4,271	27	4,298
1969					5,098	27	5,125
1970					5,098	471	5,569
1971					5,098	915	6,013
1972					5,498	1,356	6,857
1973	Turkey Point No. 3 Turkey Point No. 4 Sanford No. 5	728 728 400	Nuclear Nuclear Fossil	1,456	5,898	1,356	8,713
1974	Ft. Myers Gas Turbines	684	Fossil	1,456	5,898	2,043	9,397
1975	Gas Turbines	684	Fossil	1,456	5,898	2,727	10,081
1976	St. Lucie No. 1 Manatee No. 1	850 800	Nuclear Fossil	2,306	6,698	2,727	11,731
1977	Manatee No. 2 Martin No. 1	800 800	Fossil Fossil	2,306	8,298	2,727	13,331
1978	Martin No. 2	800	Fossil	2,306	9,098	2,727	14,131
1979	Steam Turbine Steam Turbine	800 800	Fossil Fossil	2,306	10,698	2,727	15,731
1980	St. Lucie No. 2 Steam Turbine	850 1,100	Nuclear Fossil	3,156	11,798	2,727	17,681
1981	Steam Turbine Steam Turbine	1,100 1,100	Fossil Fossil	3,156	13,998	2,727	19,881
1982	Steam Turbine Steam Turbine	1,100 1,100	Fossil Fossil	3,156	16,198	2,727	22,081

Note: No retirements planned during this period.

conservation of energy measures evaluated has a potential for reducing the future demand for electricity, there is no reliable way at this time to quantify the reduction in power demand resulting from conservation of electricity methods which could be implemented by either federal, state, or local regulating bodies or voluntary actions of the public. Our ability to predict is speculative due to the uncertain nature of the effectiveness of the measures that may be taken, by substitutional effects, and by possible regulations that may require increased electrical demand. Finally, even if conservation of energy measures are effective in reducing the demand for electricity in the 1980's, the staff concludes that it is desirable to add nuclear capacity to reduce the amount of fuel consumed by gas or oil fired units thus increasing the availability of this resource for which there are no available substitutes.

8.2 Social and Economic Effects

Operation of Unit 2 affects the local region primarily through direct employment and payment of taxes. It affects the entire region of Florida through provision of electricity. This subsection will discuss only the local effects of plant operation. Section 8.3 will discuss the consequences of power availability on a regional basis.

8.2.1 Employment

Unit 2 will have a permanent operating staff of about 70 persons with an annual payroll of about $1,000,000. Since each job in the United States supports an average of 2.5 persons,[12] an estimated 175 persons will receive their basic support from operation of Unit 2. In addition, because each additional manufacturing job creates about one service job, the total persons supported by the operation is estimated to be about 350.

8.2.2 Households

In the United States there is an average of 0.78 households for each job. As a result it is estimated there will be about 275 additional households created in the vicinity of Hutchinson Island as a result of operation of Unit 2.

8.2.3 Taxes

Construction and operation of Unit 2 will add to the tax base a $365 million power plant plus residences with an estimated value of about $1 million. This will result in a significant increase in local tax payments with a less than proportional increase in services needed from local governmental bodies.

8.3 Consequences of Power Availability

Electricity is used in homes, offices, schools and factories which support additional jobs and produce goods further adding to the economy. In addition, particularly in Florida, electricity operates air conditioning equipment that increases comfort and productivity, operates amusement and tourist facilities and provides the basic services required by numerous retired persons. Failure to provide the electricity requested by customers would result in a lower standard of living for those customers.

If all other future additions to the applicant's generating capability occur as planned, operation of Unit 2 would result primarily in an increase in system reliability. This would be evident as a reduction in the number of load reductions due to lack of adequate reserve capacity. There would be increased economic benefits to customers because of less disruption of manufacturing and service activities and increased comfort due to fewer disruptions of air conditioning.

8.4 Unavoidable Adverse Environmental Effects

About 300 of the 1132 acres owned by the applicant was altered for the installation of Unit 1. The reactor building and associated facilities for Unit 2 will occupy about 5 acres of the existing filled area. Most of the original site area was mangrove swamp, with many of the mangroves killed as a result of flooding for mosquito control purposes in the 1930's and 1940's. The 300 acres of the site needed for the two units will consist of landscaped fill areas and cooling system canals. The remainder of the site will be left in its original state, predominately modified mangrove swamp, although future plants on the site may affect additional acreage.

The plant cannot be completely hidden from view in the flat, generally low growth terrain of Hutchinson Island. However, natural plantings will hide the plant from the ocean beach except for parts of the cooling system canals. The plant can be seen from the mainland residential areas, but the distance is approximately 1.5 miles. The principle visible facilities added to the site for Unit 2 will be the reactor and turbine generator buildings. The transmission lines and cooling canals installed for Unit 1 will serve Unit 2 also.

Turtle hatchlings could become disoriented by plant lighting and increased mortalities could result. Light is known to disorient turtle hatchlings although little is known about the relative effect of different intensities or light quality. Consequently, the staff proposed an operating license condition for Unit 1 that Australian pine planting be extended behind the dune line and the lights be shielded to minimize lighting effects on turtles. Pines disrupted for Unit 2 discharge line will be replanted. Migrating birds may also become disoriented by lighting during storms and may be killed from exhaustion or by hitting lights and supporting structures, but this is augmented very little by the presence of Unit 2.

Construction activities for the ocean discharge line will probably affect turtle nesting during one nesting season. However, a daily nest surveillance and relocation program is planned by the applicant to minimize short-term effects and no long-term effects are expected.

Cutting the beach and dune line for the Unit 2 discharge line increases the likelihood of wave damage and the danger of the island being cut in two during major storms. However, the applicant plans to minimize the time the beach will be cut and an excavation procedure is planned which will help maintain the protective dune line at all times. The staff has further recommended the dune be replanted with dune stabilizing plants indigenous to the area as soon as possible after dune construction is complete.

Fish may enter the Atlantic Ocean intake to the condenser cooling system and collect in the 5000-ft long intake canal. There is no way for these fish to return to the ocean. However, few fish have been found in the vicinity of the intake and, therefore, entrapment in the intake canal should be a minor problem.

Similarly, planktonic organisms will be entrained in the intake system. Most of these will be killed as they pass through the plant condensers. However, the concentration of these organisms in the vicinity of the plant intake is relatively small in comparison with many ocean locations and the Indian River, and the number expected to be entrained is a small fraction of the total in the area. Consequently the impact should be minor.

The maximum ocean surface temperature rise at the Unit 2 cooling discharge should be no more than 1.5°F. This should only increase the area of the Unit 1 1°F isotherm from 2860 acres to 3372 acres. Consequently the additional thermal impact from Unit 2 operation should be insignificant.

The total body dose from normal operation of Unit 2 to the estimated 450,000 people who will be living within 50 miles of the plant by 1980, excluding dose to the plant work force, is estimated to be about 0.4 man-rem/yr. This is less than the normal fluctuations in the 54,000 man-rem/yr natural background dose this population would receive. A person fishing extensively in the discharge canalw would receive the highest individual dose, conceivably up to 2 mrem/yr to his thyroid from seafood consumption.

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Transportation to and from the plant of non-irradiated and irradiated fuel and solid radioactive wastes which are packaged and shipped in Federally-approved containers and shielded casks will be subject to both the Commission's regulations in 10 CFR 70 and 71 and the Department of Transportation's (DOT) regulations in 49 CFR 170-179. The population dose resulting from the transportation of spent fuel and wastes from Unit 2 is estimated to be 7 man-rem. The probability of accidental release of any radioactivity during transport is sufficiently small, considering the form of the transported material and its packaging, that the likelihood of significant radiation exposure is remote. With use of proper packages and containers, continued surveillance and testing of packages, and conservative design of packages, the environmental risk is small.

Potential exposures to the population from postulated accidents during operation of the plant will depend on the type and magnitude of the accident that may result. When the different types of accidents are multiplied by their probability of occurrence, the potential annual radiation exposure of the population from all the postulated accidents is an even smaller fraction of exposure than that from natural background radiation and is, in fact, well within naturally occurring variations in the natural background. The environmental risks due to postulated accidents involving abnormal release of radioactivity during operation of Unit 2 are exceedingly small.

Plant operation should result in no significant increase in the level of nonradioactive air pollution in the area. Insignificant amounts of combustion products will be released from the plant during testing and emergency use of diesel-powered emergency generators.

8.5 Relationship Between Short-Term Uses and Long-Term Productivity

On a scale of time reaching into the future through several generations, the life-span of the plant would be considered a short-term use of the natural resources of land and water. The resource which will have been dedicated exclusively to the production of electrical power during the anticipated life-span of the station will be the land itself and the uranium consumed. No significant commitment of water for consumption or use will have been made, due to the relative size of the Atlantic Ocean compared to the water requirements for the plant. No deterioration of receiving water quality is anticipated due to the plant effluent.

Approximately 300 acres of the site will be devoted to the production of electrical energy by Units 1 and 2 for the next 30 to 40 years. The applicant states the remainder of the 1132 acres of the site, including approximately 2-1/4 miles of ocean beach, will be left in their natural state unless additional plants are built there.

At some future date, the plant will become obsolete and be retired. Many of the disturbances of the environment will cease when the plant is shut down, and the original ecosystem could be reestablished. Thus, the trade-off between production of electricity and small changes in the local environment is reversible. Recent experience with other experimental and developmental nuclear plants has demonstrated the feasibility of decommissioning and dismantling such plants sufficiently to restore their sites to their former use. The degree of dismantlement, as with most abandoned industrial plants, will take into account the intended new use of the site and a balance among health and safety considerations, salvage values, and environmental impact.

No specific plan for decommissioning the plant has been developed. This is consistent with the Commission's current regulations which contemplate detailed consideration of decommissioning near the end of a reactor's useful life. The licensee initiates such consideration by preparing a proposed decommissioning plan which is submitted to the AEC for review. The licensee will be required to comply with Commission regulations then in effect and decommissioning of the facility may not commence without authorization from the AEC.

To date, experience with decommissioning of civilian nuclear power reactors is limited to six facilities which have been shut down or dismantled: Hallam Nuclear Power Facility, Carolina Virginia Tube Reactor (CVTR), Boiling Nuclear Superheater (Bonus) Power Station, Pathfinder Reactor, Piqua Reactor, and the Elk River Reactor.

There are several alternatives which can be and have been used in the decommissioning of reactors: 1) remove the fuel (possibly followed by decontamination procedures); seal and cap the pipes; and establish an exclusion area around the facility. The Piqua decommissioning operation was typical of this approach; 2) in addition to the steps outlined in (1), remove the superstructure and encase in concrete all radioactive portions which remain above ground. The Hallam decommissioning operation was of this type; and 3) remove the fuel, all superstructure, the reactor vessel and all contaminated equipment and facilities, and finally fill all cavities with clean rubble topped with earth to grade level. This last procedure is being applied to decommissioning the Elk River Reactor. Alternative decommissioning procedures (1) and (2) would require long-term surveillance of the reactor site. After a final check to assure all reactor-produced radioactivity has been removed, alternative (3) would not require subsequent surveillance. Possible effects of erosion or flooding will be included in these considerations.

The staff concludes the benefits derived from the plant in serving the electrical needs of the area outweigh the short-term uses of the environment in its vicinity.

8.6 Irreversible and Irretrievable Commitments of Resources

Numerous resources are involved in constructing and operating a major facility such as the proposed plant. These resources include the land upon which the facility is located, the materials and chemicals used to construct and maintain the plant, the fuel used to operate the plant, the capital funds required, and the human talent, skill and labor involved.

Major resources to be committed irreversibly and irretrievably due to the operation of the plant are the land (during the life of the plant) and the uranium consumed by the reactor. Only that portion of the nuclear fuel which is burned up or not recovered in reprocessing is irretrievably lost to other uses. This will amount to approximately 25 metric tons of uranium-235 during an operating lifetime of 30 years. Most other resources are either left undisturbed or committed only temporarily during construction and plant operation, and are not irreversibly or irretrievably lost.

Of the land for Unit 2, it would appear only a small portion beneath the reactor, control room, radwaste and turbine-generator buildings would be irreversibly committed. Also, some components of the facility such as large underground concrete foundations and certain equipment are, in essence, irretrievable due to practical aspects of reclamation and/or radioactive decontamination. The degree of plant dismantlement will be determined by the intended future use of the site, which will involve a balance of health and safety considerations, salvage values, and environmental effects.

Use of the environment (air, water, land) by the plant does not represent significant irreversible or irretrievable resource commitments, but rather a relatively short-term investment. Biota of the region have been studied, and the probable impact of the plant is discussed in Sections 4 and 5. In essence, no significant short- or long-term damage or loss to the biota of the region is anticipated.

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9. ALTERNATIVES TO THE PROPOSED ACTION

The proposed action to construct St. Lucie Plant Unit 2 represents one alternative to providing the electric generation capability required by the applicant to meet increased demands for power as outlined in Section 8. Other alternatives to this proposed action include:

- A decision not to provide the power to be supplied by Unit 2
- Construction of an equivalent capacity nuclear plant at another site
- Use of alternative fuel (fossil or hydroelectric)
- Modification of the proposed condenser cooling system to utilize:
  - a cooling pond
  - a spray pond
  - dry cooling towers
  - mechanical-draft, saltwater cooling towers
  - natural-draft, saltwater cooling towers
  - dilution of the discharge water
- Alternative sanitary systems
  - extended aeration
  - installation of a sewage line to Fort Pierce
- Alternative biocide systems
  - mechanical cleaning
  - ozonization
- Alternative chemical systems
  - crystallization of wastes
  - reverse osmosis of supply water
- Alternatives to normal transportation procedures.

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An analysis of each of these alternatives is presented below. Based on these analyses, including a review of cost-benefit data supplied by the applicant, most of these alternatives were determined to be unacceptable and three were identified for further analysis as described in Section 10. These three are: 1) dilution of the discharge water; 2) oil-fired power plants, and 3) natural draft cooling towers.

9.1 Alternative Energy Sources And Sites

9.1.1 Not Provide the Power to be Supplied by St. Lucie Plant Unit 2

The need for power from Unit 2 was discussed in Section 8. It was concluded this power is needed if the applicant is to continue to maintain a high degree of system integrity in meeting future demands for power. A decision not to construct the plant will result in inadequate reserves for the applicant's systems after 1979, with increasing risk of load curtailments. Sufficient power is not available from deferred retirement

of existing units (no retirements are planned in the next few years) or from outside the applicant's system. Therefore, this alternative is considered unacceptable.

9.1.2 Installing Nuclear Facilities at Another Site

The Hutchinson Island site was originally selected as a site for a nuclear power plant (Unit 1) on the basis of the following criteria: 1) distance from population centers, 2) availability of adequate land area, 3) natural characteristics which could contribute to minimizing adverse environmental impacts, 4) proximity to the West Palm Beach load center, 5) access to navigable water, and 6) cooling provisions with a minimum environmental effect. The decision to install Unit 2 at that site was based on these same criteria plus the additional advantages of a lower construction and operating cost as a result of construction at an existing power plant site, minimum additional environmental impacts and inability to identify a more favorable site.

The applicant has two general types of sites available for power plants: 1) coastal sites using open cycle condenser cooling and 2) numerous inland or coastal sites adaptable to closed-cycle condenser cooling systems (cooling ponds or towers). Inland sites adequate for open-cycle cooling systems are not available because of undependable stream flows and restrictions on discharge water temperatures.

A comparison of the St. Lucie site to another coastal site is presented in Table 9.1. This alternate site can be defined as a typical east coast site, although the specific example used was located within a 40 mile radius of West Palm Beach. This comparison shows no significant advantages for the alternative site and a cost disadvantage. In addition, selection of the alternative site could cause reliability problems in the applicant's system during the one year delay in startup of the plant. Starting a new site would also result in additional environmental impacts because of the construction activities.

Inland sites using cooling ponds or lakes were not studied by the applicant and do not appear to have significant advantages relative to the St. Lucie site. The construction cost would be expected to be at least $70 million higher for the same reasons the alternative coastal site is more costly: namely additional site improvement and excavation, more cooling system construction, more engineering and cost escalation. In addition, a cooling pond or tower probably would also be required with concurrent extra cost.

The ecological impacts cannot be defined specifically until an inland site is selected. A new land area would need to be cleared for the site and, as a general rule, larger impacts would be expected because of occupancy of a large land area by a cooling pond plus consumptive use of a

TABLE 9.1

COMPARISON OF COASTAL POWER REACTOR SITES (Ref. 2, p. 9.3-2a)

Comparison Parameters	St. Lucie	Alternative Site
Total Construction Cost	$365,000,000	$435,000,000
Annual Fuel and Operating Costs	$ 21,000,000	The same if a second unit is built at site
Replacement Power Cost	0	$24,000,000
Access	On state highway On Intracoastal Waterway No railroad	On federal highway On Intracoastal Waterway No railroad
Geology	Typical Coastal Island	Same
Foundation Conditions	Similar conditions expected at both sites	Similar conditions expected at both sites
Land Use	Unoccupied island eventually probably would be developed	Same
Population	310,000 within 50 miles	Larger population because of closeness to major population centers
Hydrology	Once-through ocean cooling available	Same
Ecology	Coastal island	Same
Meteorology	Coastal island	Same

significant quantity of fresh water as makeup for evaporative and blowdown losses. Disposition of blowdown water and chemical wastes also could be a significant problem.

The selection of the St. Lucie site results in a lower economic cost and earlier provision of the needed power. Since other sites do not appear to have a potential for a significantly lower environmental impact, the St. Lucie site appears to be at least as satisfactory as any other site. By having Unit 2 adjacent to Unit 1, less land is committed than if separate sites were developed.

9.1.3 Alternative Fuels

An alternative to the St. Lucie nuclear plant would be the construction of an equivalent fossil fuel power plant at the Hutchinson Island site. Of the fossil fuels, coal and oil are commonly used in Florida. Use of natural gas is limited. Two small hydroelectric plants have been operated in Florida. However, due to the generally flat terrain, no hydroelectric sites exist with the power potential of the proposed plant.

Although the use of natural gas offers improved operating efficiencies and reduced air emissions over other fossil fuels, its long-term availability in quantities sufficient for base load power generation in Florida is questionable. Until adequate sources of natural gas are developed, the use of natural gas for new base load units is not considered by the staff to be an acceptable alternative.

The rapidly changing energy picture raises significant questions on future supplies, costs and environmental legislation pertinent to coal and oil usage for electric power generation. Until now, oil has been the major fuel used for electric power generation in Florida. Coal has not been used extensively by utilities on the east coast of Florida primarily because of long distances to sources of supply and high shipping costs.

In comparison with nuclear plants, the major environmental impacts associated with the use of coal and oil involve 1) reduced thermal impact and 2) increased volume of solid and gaseous combustion products. The higher thermal efficiency of a fossil plant results in a lower heat rejection requirement as compared to an equivalent capacity nuclear plant. As a consequence, an 850 MWe fossil plant rejects approximately 1270 MWt of heat including 165 MWt to the atmosphere and 1105 MWt to the ocean. By comparison, the proposed plant will reject 1715 MWt of heat, essentially all to the ocean.*

The volume of solid and gaseous waste products produced by fossil units, shown in Table 9.2, can be a significant environmental problem. Oil-fired units are generally better than coal in this regard, but neither can compare with the essentially zero emission of these wastes from nuclear plants.

TABLE 9.2

SOLID AND GASEOUS PRODUCTS FROM AN 850 MWe FOSSIL-FIRED PLANT[a,b]

Product	Coal[c] (metric tons/year)	Oil[d] (metric tons/year)
SO_2	28,000	18,700
NO_x	16,000	7,100
Particulates	2,400	2,400
Ash (all)	330,000	18,700

(a) 80% plant factor.
(b) These emissions comply with the standards of the Clean Air Act of 1970 (Federal Register, December 23, 1971), which are as follows: Particulates 0.10 lb/million Btu (oil and coal); SO_2, 1.2 lb/million Btu (coal) and 0.8 lb/million Btu (oil), NO_x, 0.7 lb/million Btu (coal) and 0.3 lb/million Btu (oil).
(c) 10,000 Btu/lb; 14% ash; 0.55% sulphur; 2,360,000 metric tons/year.
(d) 152,000 Btu/gal; 0.83% sulphur; 1,230,000 metric tons/year.

*Assuming operating efficiencies of 33 and 40% for nuclear and fossil plants, respectively.

In addition, environmental impacts result from the delivery and storage of these fossil fuels. An 850 MWe fossil plant requires approximately 2,360,000 metric tons of coal/yr or approximately 1,230,000 metric tons of oil/yr, assuming operation at an 80% plant factor. By comparison a nuclear facility requires only about 28 metric tons of fuel/yr.

Oil or coal plants require several barge shipments per week, and with oil there is the attendant risk of spills. Storage facilities would have to be constructed requiring sufficient acreage to handle 390,000 metric tons of coal or 205,000 metric tons of oil, assuming a minimum 60-day storage supply.

The applicant estimates an oil-fired unit could be built on the site for \$175 million (Ref. 2, p. 9.2-3), or \$190 million less than the proposed nuclear facility. A coal plant is estimated to cost about \$240 million (Ref. 2, p. 9.2-1). Because of the shorter construction time for a fossil plant, it is not expected construction of a fossil plant would delay startup.

Because of higher fuel costs for fossil plant operation in comparison to nuclear, incremental fuel cost would amount to a total, noncapitalized cost of \$2,230 million for a coal plant and \$1,320 million for an oil plant, assuming a 30-year plant life. This converts to an incremental fuel cost present value of \$704 million and \$462 million, respectively based on a discount rate of 8.75%.[a]

In summary, conversion of the present plant to a fossil facility is feasible but involves large cost penalties with no significant net improvement in environmental impact. A fossil plant would produce less waste heat, although the environmental effects of heat from the proposed nuclear facility are considered insignificant. Conversely, a fossil plant would produce substantial solid and gaseous combustion products, and the impact on Indian River of an oil spill would be major.

Solar, wind, fusion, and geothermal power were excluded from consideration because they will not be practically available in this area at the time the additional power is required.

9.2 Alternative Plant Design

9.2.1 Cooling Ponds and Canals

The use of either fresh- or saltwater cooling ponds or canals without sprays is not feasible primarily because insufficient surface area exists at or near the site. A fresh- or saltwater cooling pond would require a surface area of about 1800 acres to dissipate the heat from Unit 2 to the atmosphere. Makeup and blowdown requirements would be

(a) Present value analysis is discussed in Section 10.

similar to that required for a natural-draft cooling tower: approximately 70 cfs for saltwater or 50 cfs for freshwater. This volume of freshwater makeup is not available at the site, hence the freshwater pond is not feasible. Production of freshwater by desalination is too costly at present. The annual cost, assuming a desalination cost of $0.50/1000 gal, would be about $3,600,000.

9.2.2 Saltwater Spray Pond or Canal

A saltwater spray pond or canal would require approximately 100 to 200 acres including a band of land around the pond for drift deposition. Spray systems of the size necessary would be made up of power spray modules as opposed to spray heads fed by piping because of the excessive cost of piping for such a large area. Makeup and blowdown requirements would be generally the same as for natural-draft cooling towers, or approximately 70 cfs and 50 cfs, respectively. Heat dissipation to the ocean would be approximately 4% of that released by the proposed once-through system because of blowdown requirements.

The major impact from a saltwater spray pond would be from salt deposition. No quantitative data are available on the drift problems associated with spray systems. However, salt concentrations and deposition on the areas immediately surrounding the pond would probably severely limit the numbers and diversity of plant and animal species. Drift quantities are reported to be an order of magnitude greater than for mechanical-draft cooling towers, although the larger droplet size results in a smaller deposition area.[3] In addition, spray modules have not been proven reliable as yet for continous saltwater service. Fogging could also occur infrequently and could affect travel on State Road A-1-A.

Therefore, on the basis of probable major salt drift impact and unproven system reliability, saltwater spray pond cooling is considered by the staff to be an unacceptable alternative.

9.2.3 Dry Cooling Towers

In a dry cooling system heat is rejected directly to the atmosphere without using water as an intermediate heat receiver. Obvious advantages of this system are the elimination of the need for a saltwater makeup supply and the elimination of water and salt drift from the tower. Disadvantages include losses in plant efficiency due to increased turbine back pressures, condenser replacement costs, large land and capital requirements, increased plant power requirements for cooling tower fans, and increased noise. The dry cooling system would be composed of about 20 mechanical-draft air cooler modules for Unit 2 alone, rendering 20 acres of the site unusable for other purposes. A system of condensate storage tanks would also be required with a total capacity of 400,000 gal. The total capital cost is estimated to be about $70 million.

Dry cooling towers have not been developed in a size capable of meeting the cooling needs of the proposed plant. In addition, it is questionable whether they could be designed to operate at an acceptable efficiency level under the temperature conditions prevailing at the Hutchinson Island site. Dry cooling towers are therefore considered by the staff to be an unacceptable alternative to the proposed design.

9.2.4 Natural- and Mechanical-Draft Saltwater Cooling Towers

In a cooling tower the heat rejected by condensing steam is carried away into the atmosphere primarily by the evaporation of water. An air flow is provided by either fans or thermally induced draft. The applicant has stated a natural-draft system for Unit 2 would consist of a natural-draft cooling tower, a new circulating water pump house, cooling tower booster pumps, piping from the condenser to the cooling tower and from the cooling tower back to the condenser (Ref. 2, p. 10.1-10). Makeup and blowdown systems would also be required.

A natural-draft cooling tower for Unit 2, designed to operate in summer conditions with a water flow of 1200 cfs and temperature range of 24°F, would be massive. It would be approximately 480 ft in diameter and 400 ft high. About 70 cfs of makeup water would be required to replace the 50 cfs of blowdown and 20 cfs lost in evaporation and drift for Unit 2.

Arrangements for pumping and channeling the circulating water flow for natural-draft and mechanical-draft saltwater cooling towers are very similar. The main differences are in the towers themselves. Two mechanical-draft towers would be required for Unit 2. Each tower would be approximately 480 ft long, 70 ft wide and have 12 fan modules. The top of the fan modules would be about 85 ft above sea level. The fan diameter would be about 28 ft in diameter, and about 4500 hp would be required to drive the fans.

Among the major disadvantages of the saltwater cooling towers are salt drift, plume aesthetics, visual intrusion of the towers and, in the case of the mechanical-draft towers, noise. Salt drift can cause damage to equipment and vegetation. Saltwater cooling towers produce drift whose maximum impact may be up to a mile away. However, for a coastal setting such as the St. Lucie site, additional drift is likely to be low relative to ambient levels. Jersey Central Power and Light Company calculated annual salt drift concentrations from a natural-draft tower, using a conservative drift rate of 0.00375%, would be an order of magnitude less than natural levels.[4] Improved tower design could lead to lower drift levels. Based on these conclusions no unacceptable environmental impact is likely to occur for salt drift from natural-draft towers. However, no data are available to verify this assessment.

The natural-draft tower and its accompanying plume would dominate the site skyline. In general, natural-draft cooling towers create only a few hours per year of fog at the point of maximum plume contact with the ground. Observations indicate the frequency of ground level fogging from natural-draft towers is indeed quite small. The elevated plumes from natural-draft towers are persistent, generally being a few miles in length, although plume lengths of 20 to 30 miles have been reported.[5-10] These plumes generally rise well above the surface and frequently rise above naturally existing cloud layers. Theoretical analysis suggests no ground fogging problems.

Precipitation attributable to cooling towers has been reported.[7,8] Precipitation initiation or production does not appear to be a common occurrence, although little is known, and it is impossible to assess the exact interaction with natural precipitation processes.

A much more significant environmental impact can be expected from a mechanical-draft cooling tower. Motors and fans in a mechanical-draft cooling tower would increase background noise levels in the surrounding area. The plume can be expected to reach ground level more often. Theoretical analysis shows the plume intersecting zero elevation up to 70 hr/yr in the vicinity of the plant. The effects would be strongest on the applicant's property and over adjacent water surfaces. Hence, the potential exists for the plume interfering with plant operations, navigation in the nearby areas and travel on State Road A-1-A.

The acceptability of mechanical-draft saltwater cooling towers has not yet been demonstrated for conditions prevailing at Hutchinson Island. The major concern is salt carryover and drift. The applicant plans a test of tower behavior at their Turkey Point site, but critical data needed from the program are not expected for 2 to 4 years.[11]

In summary, mechanical-draft saltwater cooling towers are technically feasible but are considered not acceptable because of the significant environmental impact from noise, salt carryover and drift. Natural-draft towers are ecologically feasible but have the aesthetic disadvantage of the visual intrusion of the tower and plume.

9.2.5 Discharge Water Dilution System

It is feasible to dilute the heated effluent from the condenser cooling system to attain lower temperatures at the discharge. The proposed recirculation canal could be used to divert water from the intake canal to the discharge canal, bypassing the condenser. For example, at an estimated capital cost of $4.7 million an additional 1150 cfs of water could be added to the discharge system increasing by 50% the amount of cooling water discharged with both Units 1 and 2 operating, but at lower temperatures. This would require 1) an additional intake line, 2) possibly

a second multiport diffuser line and 3) adding an appropriate pumping system. By this dilution scheme, the maximum ocean surface temperature rise would be decreased from 1.5°F to less than 1°F above ambient.

However, insignificant environmental impact is expected from the temperatures associated with the system presently planned for Unit 2. Therefore, other than reducing surface temperatures slightly, no significant improvement would be expected from dilution. On the other hand, increasing the volume of water drawn through the pumping systems, would significantly increase the number of entrained organisms.

The staff has concluded the temperatures resulting from the presently proposed system will result in insignificant environmental impact. Hence, the staff concludes the additional costs associated with this alternative are not balanced by environmental gains.

9.2.6 Alternative Sewage Treatment

As described in Section 3.7.1 approximately 2000 gpd of sanitary wastes will be passed through a 2300 gal septic tank and then dispersed into an adjacent 900 ft^2 filter bed. The filter bed is situated in an area where the effluent would percolate down through the permeable ground until it reaches the water table. Groundwater flow in this area is predominately eastward toward the Atlantic Ocean.

While loading of the filter bed does not appear to be a problem, considering the permeability of the filter bed, the fact remains the effluent will be septic. Should the porosity of the filter bed decrease with use, the septic effluent could surface and become a health hazard to plant personnel

An alternative sewage treatment method is extended aeration modification of the activated sludge process, followed by disinfection. In this process, raw sewage continuously flows into an aeration tank where it is continuously air sparged to provide oxygen for the biological degradation of the organic components of the waste. The aeration tank is sized to provide approximately a 24-hr retention time for the sewage. Contents of the aeration tank continuously overflow into a settling tank that provides a minimum of 4 hr retention time; here the scum and settled solids aare returned to the aeration tank for further treatment, while the clarified effluent flows into a chlorine contactor for chlorination to kill any remaining pathogenic bacteria prior to release into the circulating water discharge canal. Periodicallly, the excess sludge is removed to a landfill site.

It is the staff's opinion installation of an extended aeration plant is not warranted at this time unless operating experience with the septic system indicates unexpected problems. However, if and when a municipal system sewer line is extended down the island to the vicinity of the plant, the applicant should connect to this system to forestall any possible future plugging problems with the septic tank system.

9.2.7 Biocide System Alternatives

Chlorination will be used to control biofouling of the main condenser system. The chlorination program will be conducted so that Units 1 and 2 are never chlorinated simultaneously. The program will produce a maximum chlorine concentration of 0.2 ppm in the discharge canal (0.4 ppm if the circulating pumps for only one unit are operating). The applicant plans to monitor total chlorine levels at the ocean discharge to determine any impacts on the marine biota.

If marine life is affected by this chlorination program, two mechanical alternatives are available for controlling biofouling in the condenser: one which circulates sponge rubber balls through the condenser tubes and one which utilizes captive nylon brushes. In the absence of a chlorination program, the circulating water inlets would have to be cleaned manually during plant shutdowns.

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The sponge ball system would require installation of a ball-injecting device on the inlet piping and a collecting screen on the outlet piping. The total number of balls required would be about 10% of the total number of condenser tubes. Screens on the outlet piping would restrict water flow through the condenser and therefore increase the temperature rise across it.

The captive brush system would require installation of a basket at each end of each condenser tube and a brush for each tube. Cleansing would be accomplished by reversing flow through the condenser on a periodic basis. Reverse flow through the condenser would not be as large as forward flow. During reverse flow the temperature rise across the condenser would be elevated.

In view of the very low suggested discharge limits, the use of chlorine as biocide should be carefully controlled. Alternative biocides such as ozone and acrolein have been proposed in the literature, but the feasibility of employing them has not been clearly established.

9.2.8 Chemical System Alternatives

The chemical system for water treatment for Unit 2 will consist of two 600 gpm demineralizers and associated equipment. Sulfuric acid and caustic soda wastes generated by the system would be neutralized and discharged to the combined circulating water flow of Units 1 and 2. An alternative to the discharge of these wastes into the circulating water flow would be to

crystallize and concentrate the dissolved solids in the wastes by evaporation and centrifugation. Solids could be stored in rain-proof shelters onsite for the life of the plant. Distilled water produced by the process would be used as feed to the demineralized system.

Another alternative which would substantially decrease ion exchange resin regeneration waste is the use of a reverse osmosis process to pretreat the feed water to the demineralizer. The reverse osmosis process could remove 90% or more of the dissolved salts, and therefore reduce the amount of regeneration chemicals by an equivalent amount.

The staff concludes the existing system of dilution in the ocean is not ecologically objectionable because the sodium and sulfate ions are a natural constituent of seawater and the amounts added to the discharge do not change the seawater concentration to an objectionable degree.

9.2.9 Normal Transportation Procedures For Alternatives

Alternatives, such as special routing of shipments, providing escorts in separate vehicles, adding shielding to the containers, and constructing a fuel recovery and fabrication plant on the site rather than shipping fuel to and from the station, have been examined by the staff for the general case. The impact on the environment of transportation under normal or postulated accident conditions is not considered to be sufficient to justify the additional effort required to implement any of the alternatives.

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5. G. E. McVehil, Evaluation of Cooling Tower Effects at Zion Nuclear Generating Station, Final Report to Commonwealth Edison Company, Chicago, Illinois, by Sierra Research Corporation, Boulder, CO, pp. 37-38, 1970.

6. Florida Power and Light Company, St. Lucie Unit No. 1 (formerly Hutchinson Island), Environmental Report, Supplement 8, October 25, 1972.

7. Pollution Control Council, Pacific Northwest Area, A Survey of Thermal Power Plant Cooling Facilities, pp. 21, 31, 1969.

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10. G. F. Bierman, G. A. Kunder, J. F. Sebald and R. F. Visbisky, Characteristics, Classification and Incidence of Plumes from Large Natural Draft Cooling Towers, presented at the American Power Conference 33rd Annual Meeting, Chicago, IL, pp. 10-11, April 22, 1971.

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10. BENEFIT-COST ANALYSIS

A benefit-cost analysis for a power plant at a specific site normally consists of two phases: 1) an overall analysis for the power plant describing the general benefits and costs for production of the electricity at the selected site and 2) a benefit-cost analysis of the primary design variables for the specific power plant (usually the alternative fuels and waste heat disposal systems).

In the following sections, benefits and costs for producing electricity by Unit 2 at the St. Lucie site are first discussed using the proposed nuclear power plant as the reference case. Then the alternatives selected for analysis are described, and a benefit-cost analysis of these alternatives is made to determine the most favorable alternative.

10.1 Energy Generating Costs

The total cost for generating electricity at a power plant includes both economic and environmental costs. Economic costs are the dollars of income needed to 1) pay the current out-of-pocket expenses and 2) recover the capital investment necessary for construction of the physical plant. Repayment of the capital investment is normally assumed to consist of a uniform series of payments into a sinking fund that will have a value equal to the original investment at the time of the plant retirement. The usual method for calculating energy generating costs is to add three costs together: operation and maintenance (O & M) costs, fueling cost, and annual return on capital. Generally O & M costs are essentially constant from year to year, fueling cost is directly related to the quantity of electricity produced, and annual return on capital is a fixed percentage of the total capital investment determined primarily by current bond interest rates, stock dividend rates and tax rates. For Unit 2, the estimated energy generating cost (assuming operation at a 80% plant factor)[a] are shown in Table 10.1.

Environmental costs for generating the electricity result from the release of heat, chemicals, and radioisotopes to the environment plus the social impacts due to construction of the plant. These are summarized in Section 10.3 (specifically in Table 10.2).

(a) If the plant factor was reduced to 70% or 60%, total electricity costs would increase to about 14.2 or 16.1 mills/kW-hr respectively.

TABLE 10.1

1980 ENERGY GENERATING COST
ST. LUCIE UNIT 2

	Present Worth ($ millions)	Annual Cost ($ millions)	Mills/kW-hr
Operation and Maintenance (includes insurance and licensing costs)	60	5.7	0.9
Fuel	157	15	2.5
Capital	365	55.1	9.2
TOTAL	582	75.8	12.6

10.2 Summary of Benefits

10.2.1 Power Generation

Unit 2 is designed to operate at approximately 850 MWe. At the anticipated plant factor of 80%, annual power generation will be about 6.0 billion kW-hr/yr.

10.2.2 Employment

Construction of Unit 2 will require approximately 4400 man-years of construction employment during a 5-year period. The peak construction force is estimated to be about 1400 people, and the permanent operating staff will be about 25 persons. On the basis of one service or support job created for each industrial position, this results in a total long-term increase of about 50 jobs in the area. No other changes in employment are expected to result from construction and operation of the plant.

10.2.3 Tax Generation

Construction of Unit 2 will add to the tax base a $365 million power plant plus an estimated 30 residences worth about $1 million in surrounding

TABLE 10.2

ALTERNATIVES DATA SHEET

[illegible]

TABLE 10.2 (Continued)

			CLOSED-CYCLE COOLING SYSTEMS		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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communities. This assumes the new jobs are additive, but only about two-thirds will result in construction of new residences.

10.3 Summary of Costs and Environmental Effects

10.3.1 Capital Cost and Related Resource Commitments

Construction of Unit 2 is estimated to cost about $365 million. The distribution between labor and materials is estimated to be about $119 million for labor and $84 million for site materials and factory equipment. Permanent resource commitments include the construction materials used, particularly the materials in and around the reactor. These probably will be unavailable for other uses for decades because of creation of long half-life radioisotopes by neutrons.

Land occupied by the reactor and turbine buildings probably is permanently committed to industrial use. Demolition and removal of the massive concrete foundation and shielding structures would be more costly than the present value of the land. Obsolescence of existing facilities, however, would not preclude modification of the buildings and contents to accommodate future industrial activities.

10.3.2 Operating Cost and Related Resource Commitments

The operating cost (including fuel) for Unit 2 is estimated to be about $20,700,000 annually, including insurance. Miscellaneous operating materials include items such as office supplies, protective clothing and water treatment chemicals. Maintenance materials are typical, e.g., oils, greases, paints and repair parts.

10.3.3 Aesthetics

Addition of the Unit 2 facilities to the site will add primarily an extension to the existing turbine buildings plus a rounded reactor dome; however, this will have a minor additional aesthetic impact. Nearest residences are approximately 1.5 miles away across Indian River, and this distance tends to minimize the overall visual impact. The tall containment building precludes camouflaging and can be seen easily. However, most other plant buildings have been designed to present a low profile and to help them blend into the surroundings.

10.3.4 Water Pollution

The primary chemical impurities released to the ocean are sodium sulfate and chlorine. Since sodium sulfate is a "soft" chemical found in all natural waters, the net effect on seawater quality is negligible. Chlorine is expected to be at a low enough concentration to have an insignificant effect (Section 5.5.2). Radionuclides released to the ocean from the radwaste facilities are estimated to cause a negligible integrated radiation dose of about 0.04 man-rem/yr. Thermal discharges to the once-through cooling system from Unit 2 are expected to have insignificant affect on aquatic resources (Section 5.5.2). As a result, reduction in thermal releases by use of a closed-cycle cooling system would provide an insignificant environmental benefit.

10.3.5 Air Pollution

There will be no significant release of particulates or noxious chemical compounds to the atmosphere. There will be a release of small amounts of exhaust fumes from diesel generators during periodic testing of emergency electrical equipment. This is estimated to be about 0.1 tons of particulates, 0.3 tons of SO_2 and 3 tons of NO_x per year.

10.3.6 Radiological

Radionuclides released to the air from radwaste facilities are not expected to produce significant radiation exposure of the population when compared with the natural background radiation. Total body dose to the individual residing nearest the plant is calculated to be about 0.03 mrem/yr from the release of gaseous effluents. Dose to the 2-gram thyroid of an infant consuming milk from the nearest grazing cows could be 0.8 mrem/yr. Total dose to the approximately 450,000 persons expected to be living within 50 miles of the plant in 1980 is estimated to be 0.4 man-rem/yr. The dose to the general population from shipments of spent fuel and wastes are estimated to be 7 man-rem/yr. The dose to plant personnel is expected to be 450 man-rem. This expected additional dose will be negligible in comparison to the natural background dose of 54,000 man-rem/yr for these same persons.

10.3.7 Loss of Aquatic Life

Losses of aquatic life due to capture of fish on the intake structure screens plus passage of small fish, organisms and fish eggs through the circulating water systems were examined in Section 5.5.2. The loss in quantities of phytoplanktons, zooplanktons, fish larvae, fish eggs and fish was concluded to be minor.

The probable additional effect of plant operation on turtles was concluded to be minor and acceptable, particularly when balanced against the benefits of maintaining a large portion of the site adjacent to the ocean in its present condition.

10.4 Benefit-Cost Balance

10.4.1 Alternatives Selected for Benefit-Cost Analysis

The alternatives of not providing the power or importing power from other utilities are not considered viable alternatives. As explained in Section 8, not providing the power would reduce the applicant's reserve capacity to 11% by 1980 and would also reduce the generating reserve of the entire Florida Power Pool to 17% (when the desirable reserve is 28%). Purchase of sufficient power to replace that from Unit 2 is not possible because the applicant already is purchasing whatever power is available from adjacent utilities.

In Section 9, three alternatives to the plant and six alternative cooling systems were identified. Table 10.2 presents a summarized description of the most competitive alternatives. The alternatives can be classified into four categories: alternative sites, alternative fuels, once-through cooling systems, and closed-cycle cooling system.

A satisfactory alternative site was not identified because all other sites result in significantly higher costs and at least a one year delay in startup of the plant.

The oil-fired plant is the most promising alternative plant design based on data available prior to November 1973. Data recently furnished by the applicant confirms this.[2]

Comparison of the open-cycle cooling systems reveals that a dilution system appears to be the most promising alternative because most of the temperature reduction benefit is obtained with a relatively small cost. Comparison of the four closed-cycle alternatives reveals the natural-draft tower is the most promising because of lowest environmental impact. These three most favorable plant and cooling system alternatives are compared to the proposed plant in the final benefit-cost analysis described below.

10.4.2 Benefit-Cost Analysis

Analysis of the general characteristics of the alternatives reveals all alternatives considered have essentially the same benefits as described in Section 10.2 (i.e., all alternatives result in essentially the same power generation, employment, and tax generation). As a result, the comparison of the alternatives can be made solely on the basis of costs.

The plant and cooling system alternatives selected for the final analysis and their significant costs are summarized in Table 10.3. Because the various capital and operating costs occur at different times, a present worth calculation has been used. Each of the monetary costs on Table 10.3

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TABLE 10.3

SUMMARY OF ADDITIONAL IMPACTS OF ALTERNATIVES TO ST. LUCIE PLANT UNIT 2

MONETARY COSTS (MILLIONS OF DOLLARS)	REFERENCE CASE (EXISTING DESIGN)	ADDITIONAL COST OF ALTERNATIVES		
		OIL-FIRED PLANT	EFFLUENT DILUTION	NATURAL DRAFT COOLING TOWER
CAPITAL COSTS	365	(190)	5	36
CAPITALIZED FUEL AND OPERATING COSTS	217	429	2	6
TOTAL PRESENT WORTH	582	239	7	42
ENVIRONMENTAL CONSIDERATIONS	REFERENCE CASE IMPACT	ADDITIONAL ENVIRONMENTAL IMPACT (FROM REFERENCE CASE)		
LAND USE				
AREA DIVERTED	5 ACRES	195 ACRES	NONE	20 ACRES
SHORELINE USE	NONE	OIL UNLOADING FACILITIES	NONE	NONE
WATER USE				
AQUATIC RESOURCES	NEGLIGIBLE IMPACT ON FIN AND SHELL FISHING. ENTRAINMENT EXPECTED TO BE MINOR. OVERALL EFFECTS ON FISH EGG AND LARVAL PASSAGE CONSIDERED MINOR.	PROBABLY NO SIGNIFICANT DIFFERENCE. FISH AFFECTED BY POTENTIAL OIL SPILLS	INCREASED ENTRAINMENT EFFECTS. INCREASED PHYSICAL DAMAGE TO ORGANISMS SUBJECT TO PASSAGE. DECREASES THERMAL INCREMENT BUT INCREASES VOLUME DISCHARGED WITH UNKNOWN NET EFFECT ON ENTRAINED ORGANISMS.	GREAT DECREASE IN THERMAL INCREMENT AND IN VOLUME OF WATER USED. BLOWDOWN WOULD INVOLVE DISCHARGE OF HIGH SALINITY WATERS WITH UNKNOWN EFFECTS ON BIOTA. DESTRUCTION OF ALL ENTRAINED BIOTA.
AESTHETICS	VERY MINOR VISUAL IMPACT FROM ADDITIONAL REACTOR AND TURBINE BUILDINGS	MINOR IMPACT FROM BOILER AND STACK STRUCTURES AND SMOKE FROM STACK	NONE	MAJOR IMPACT FROM 500 FOOT TALL COOLING TOWER AND HIGH LEVEL FOG.
FUEL AND WASTE TRANSPORTATION	61 TRUCKLOADS/YEAR	NO TRUCKS. 250 BARGES/YEAR	NONE	NONE
WASTE PRODUCTS	7 MAN-REM/YR 1,370 TONNES Na_2SO_4/YR 58 TONNES Cl_2/YR 0.1 TONNES PARTICULATES/YR 0.3 TONNES SO_2/YR 3.3 TONNES NO_x/YR	NO ARTIFICIAL RADIOACTIVITY RELEASES 10 LESS TONNES Cl_2/YR 2,400 TONNES PARTICULATES/YR 19,000 TONNES SO_2/YR 7,000 TONNES NO_x/YR 19,000 TONNES ASH/YR	NONE	NONE

represents the amount of money that must be invested in 1979, at 8.75% interest to provide the funds necessary to cover the related expenditure during the following 30 years; i.e., to the assumed end of the useful life of the plant. Alternatives to the existing design are presented in terms of differential costs relative to the existing design.

The second column of Table 10.3 lists the costs for the reference case and the related environmental impacts. The final cost is $365 million. Annual fuel and operating costs are estimated at $20.7 million. Over the anticipated operating period for the station these annual expenses are equivalent to a present capital cost of about $582 million. The remainder of the column shows the environmental impact of the existing design.

The third column shows the differential costs associated with an oil-fired plant. Its capital cost is estimated to be $175 million. Fuel and operating costs for 30 years for the oil plant are estimated to be $1,845 million (present worth of $646 million) or $1,224 million more than the reference case because of the higher fueling costs for oil than for nuclear. The remainder of the column shows that the environmental impact for the oil plant would be undesirably higher than for the reference case. The remaining columns are the results of similar analyses of the costs and environmental impacts for the other listed alternatives.

Based on comparison of the foregoing plant and cooling system alternatives, it is apparent none of these alternatives result in a significant reduction in environmental cost in comparison to the reference case. In addition, all of the alternatives result in an economic cost that cannot be balanced by an environmental benefit.

Based on this analysis, the staff concludes the benefits of constructing and operating St. Lucie Unit No. 2 as proposed by the applicant outweigh the identifiable environmental and economic costs from this action.

REFERENCES

1. Florida Power and Light Company, 1972 Annual Report, February 12, 1973.

2. Letter from William H. Regan, Jr. to Dr. Robert E. Uhrig, Florida Power Light, January 28, 1974.

11. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to paragraphs A.6 and D.1 of Appendix D to 10 CFR 50, the Draft Environmental Statement (DES) of February was transmitted, with a request for comment, to:

Federal Agencies

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Environmental Protection Agency
Federal Energy Office
Federal Power Commission

Florida State Agencies

Department of Natural Resources
Department of Pollution Control
Division of Health
Office of the Governor
Public Service Commission

Local Agencies

County Administrator, St. Lucie County

In addition, the AEC requested comments on the Draft Environmental Statement from interested persons by a notice published in the Federal Register on February 8, 1974 (39 FR 4937).

Comments in response to the requests referred to above were received from:

Advisory Council on Historic Preservation
Department of Agriculture
Department of Commerce
Department of Health, Education, and Welfare
Department of the Interior
Department of Transportation
Environmental Protection Agency

Federal Power Commission
Florida State Department of Administration
Florida State Department of Pollution Control
Florida State Department of Natural Resources
Florida Public Service Commission
County Administrator, St. Lucie County
Florida Power and Light Company

Appendix A reproduces the comments received. The applicant's responses to the comments are contained in Appendices B and C. The staff's consideration of these comments and the disposition of the issues involved are reflected in part by revised text in other sections of this Statement and in part by the following discussion.

11.1 The Site

11.1.1 Geology and Seismology

Comment: (Interior A-8)

The very brief description of geology and seismology on page 2-13 is inadequate for an assessment of the geologic environment. The distribution and physical properties of the materials on which Unit 2 would be founded have not been described, except for the statement that the Anastasia formation is highly permeable and the Hawthorne formation is semipermeable. The plant would evidently be constructed on a layer of compacted artificial fill of considerable thickness having a surface elevation of about 18 feet above sea level, but no further information has been provided on the composition or physical properties of the fill, or whether the initial surface layer of 4 to 6 feet of peat was removed prior to emplacement of the fill.

The discussion of seismology is limited to a description of the general distribution of historical earthquakes in the region. Information on the intensities of these earthquakes is entirely lacking, except for the qualitative statement that earthquakes in Florida have been "of low to moderate intensity." No mention has been made of ground accelerations, operating-basis earthquake, or design-base earthquake. Seismic design parameters to be used in the design of Unit 2 should be identified, the methods of their derivation should be discussed, and any environmental impacts related to geology and seismology should be evaluated. The environmental statement should also provide assurances that the geology and seismology of the site of St. Lucie Plant, Unit 2, have been taken into account as prescribed in AEC's "Seismic and Geologic Siting Criteria for Nuclear Power Plants" (10 CFR 100, Appendix A, Federal Register, Vol. 36, No. 228, November 25, 1971).

Response:

In the interest of brevity, the staff has summarized information on site geology and seismology pertinent to the assessment of environmental impact of this plant. A detailed assessment of the adequacy of site geology and seismology is available to the public in the applicant's Safety Analysis Report and will be in the staff's Safety Evaluation Report.

11.1.2 Meteorological and Hydrologic Interactions

Comment: (Interior A-10)

In at least four places in the draft environmental statement reference has been made to the possibility of Hutchinson Island being cut in two in the vicinity of the St. Lucie Plant during major storms (p. ii, paragraph 5; p. 4-1, paragraph 3; p. 4-8, item 2a; p. 8-13, paragraph 3). Although this potential hazard would evidently be confined largely to the period during which the discharge line is being installed, and construction plans have been outlined to minimize this hazard, concerns arise from the fact that the 15-foot-high dune ridge is the primary barrier against severe wave action during a storm cutting the island in two and the fact that even after the period of excavation this potential continues to exist until dune stabilizing plants have reestablished their roots. No information has been provided on the area of the island in which the hazard of wave damage is greatest, or which, if any, parts of the nuclear plant would be threatened by such damage. The lack of data on topography and surface drainage of the site makes it difficult or impossible to independently assess the probable risks, although it seems probable that the greatest threat would be immediately north of the discharge canal, near the head of Big Mud Creek.

Concern also arises from the fact that Unit No. 1 is scheduled for initiation of commercial operations mid-1975 while construction for Unit No. 2 is not scheduled to begin until early 1975. This suggests that the hazard may exist during a period when the plant will be in commercial operation. Because of the foregoing circumstances, we believe that the environmental statement should provide the following additional types of information: (1) a description of protective barriers from erosion by hurricane-driven waves and tides, since hurricanes have occurred in Florida about 1.6 times annually from 1885 to 1958; (2) a description of the relation between the 15-foot-high coastal dune ridge and the 18-foot-high artificual fill beneath the plant, to indicate whether stabilization of the latter material is required or is proposed; (3) an estimate of the schedule for construction of the new discharge line in relation to the operation of Unit 1; (4) an assessment of the maximum credible damage that might result from wave erosion during the period of construction of the discharge line and before vegetation became reestablished, including any potential damage to plant facilities; (5) adequate data on the topography and geology of the site to support an independent assessment of the environmental risks and of the proposed mitigative measures.

Comment: (Commerce A-5)

The area of the facility site was described as "flat and low" (Section 2.2) and that the plant site was to be raised to about 18 feet above mean sea level (Section 2.4). The temporary dune (Section 4.0) will provide some protection but this is not to be considered adequate for protection against a full hurricane, especially since the anchoring root systems of local vegetation will be removed.

Although the 18-feet height appears to be reasonable security against storm surges based upon available data from past storms, there has been no attempt to evaluate potential storm surge for possible future storms. Of course, authoritative data of this nature is usually unavailable without recourse to an extensive investigation, but the potential for storm surge is sufficiently significant to warrant the expense of such an investigation.

There is also a realistic danger from erosion as a result of hurricane induced wave action. It is not unusual to hear reports of sand dunes 20- to 30-feet high and with several hundred feet of lateral extent being completely washed away under prolonged exposure to hurricane induced wave action. This erosion problem is dealt with in the planning of community protection against hurricanes, and it is within this context that we mention the problem and refer its solution to the proper authority.

In the planning of Unit No. 1, which is now under construction, we made a similar comment on the storm surge potential.

It would be our recommendation that a study be made to determine storm surge heights which would be likely to occur in this area as it is quite vulnerable to hurricane activity. We also suggest that you seek expert advice concerning the problem of site erosion.

Response:

The normal beach line with its crest stabilized by indigenous plants is the major protection against wave overrun. Overrun and restructuring of the island is a remote possibility with the narrowest points being most

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susceptible to cutting through and significantly changing the terrestrial environment. Thus, the construction permit condition (item 7b, p. v) emphasizes the necessity for the earliest possible restoration of the dune vegetation where it is disturbed for the discharge line.

Plant safety aspects are considered separately as part of the Preliminary Safety Analysis Report and the staff's evaluation contained in the Safety Evaluation Report. These reports consider foundation material for the site, the Probable Maximum Hurricane and its related surges and wave crests.

11.1.3 Items of Historical and Archaeological Interest

Comment: (Advisory Council on Historic Preservation A-2)

Although the Atomic Energy Commission indicates that "no historical damage will be done by this project" (p. 2-13), there is no evidence to support a similar finding with respect to archaeological resources in the project area. The Advisory Council requests that it be provided with specific information as to the nature and extent of any archaeological resources. Such information is also necessary for the purpose of compliance with the Executive Order.

Response:

As the site has previously been surveyed for Unit 1 and essentially all of the land clearing for both units was accomplished during the construction of Unit 1, there is virtually no potential for discovery of objects of historical, archaeological, architectural, or cultural significance during construction of Unit 2.

11.2 Construction

11.2.1 Site Preparation

Comment: (Interior A-9)

It is recognized on page 4-1 that reexcavation of the beach and dune ridge "could have been eliminated if the applicant had installed a stub line for Unit 2 through the dune at the time the Unit 1 line was installed. This past action is now irrelevant unless a similar future situation could be averted.

However, the statement does not mention the possible future need for additional units at this plant. Assurances should be included in the environmental statement that possible future construction requirements have been foreseen and that consideration has been given to accomplishing such work in conjunction with the presently proposed work, particularly in the case of excavation across the beach ridge or any other work involving exceptionally fragile environments.

Response:

The staff stated the potential for environmental damage would have been minimized if the discharge line had been installed through the dune and beach during installation of Unit 1. The applicant has indicated willingness to include construction of the discharge pipe for Unit 2 during construction for Unit 1, if permits can be obtained from the proper authorities. As to additional units at the site, the applicant has not requested a construction permit from the staff for any such units. Any construction associated with additional units would have to comply with the Commission's regulations, 10 CFR Part 50.

11.2.2 Outdoor Recreation Facilities

Comment: (Interior A-8)

The 1,132-acre tract of land owned by the applicant is located in an area of rapid residential and commercial development. A concomitant to that expansion will be increasing demands for public outdoor recreation opportunities, especially the kinds of beach-water related opportunities which the 830 acres of unused land at the project site, including 2.25 miles of prime ocean beach, can provide.

The applicant currently allows recreation on its land at the project site on an unregulated basis. It is indicated on page 4-1 that use of the site by the public for recreational purposes during construction and operation of Unit 2 should not be significantly affected beyond that resulting from the presence of Unit 1. Item 6 given on page 4-6 states that, "the applicant does not plan to restrict public access to areas between the plant and the ocean unless considerations of public safety require exclusion". It is also indicated in several other places in the statement that the applicant plans to allow recreational use of its lands to the extent possible within certain limits necessary for health and safety reasons.

We are pleased that the applicant has chosen not to restrict recreational use of its property beyond that necessary; however, we think that the opportunity to improve the amount and quality of recreational use should not be ignored. The applicant is a major utility with the ability to obtain land and other resources through condemnation proceedings. Therefore, it follows that the use of these resources should also be in the overall public interest.

Based on the present and future needs for recreational opportunities in the project area, we suggest that the applicant develop a land use plan for those areas not directly needed in the production of electrical energy which would include picnic tables, rest rooms, turnouts for parking, and other related facilities or preferably enter into a utility-public partnership for developing greater recreational use of utility lands and waters. Several possibilities which should be considered by the applicant and addressed in the final enviornmental statement follow.

1. An agreement with a local level of government whereby the applicant would retain full rights of ownership but the governmental unit would provide basic facilities aimed at improving access and recreation. This arrangement could be a plus for the applicant's public relations program and would insulate the applicant from direct involvement in providing recreation.

2. Modest development, under agreement with a local level of government with use controlled by special use permits.

3. A lease back arrangement with the applicant retaining full rights of ownership, but under which a local governmental unit would manage the area and assume responsibility for users.

Comment: (Interior A- 9)

Hutchinson Island is a nesting area for several species of sea turtles. Since development of the shoreline to the north and south of the St. Lucie site is rapidly occurring, the 2.25-mile shoreline under the applicant's control will probably become increasingly important as turtle nesting habitat during the near future. Under present Florida law, green, loggerhead, trunkback, leatherback, hawksbill, and ridley turtles and their nests and eggs are protected during the months of May-August in St. Lucie County. Therefore, recreational plans should contain provisions necessary to adequately protect the turtle resource during the nesting season.

Response:

These suggestions have been called to the attention of the applicant and the St. Lucie County Administrator. The staff concludes these options should be a matter of local choice. The applicant's present plan not to develop the site, but allow public access to the extent safety and security permit, is a reasonable option with minimal environmental impact. This does not preclude later development of the site as suggested. The Environmental Technical Specifications for the operating license will give assurance that sea turtles will be adequately protected.

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11.3 Radiological Aspects

11.3.1 Radioactive Waste Treatment

Comment: (EPA A-17)

The AEC staff has noted that potential steam releases to the environment due to turbine trips and low-power physics testing have been analyzed. It was concluded that such releases are negligible as compared to the total calculated gaseous source-term. We request that the bases for the analysis and its results be provided in the final statement. Also, we request that, in the final statement, the AEC clarify whether or not the turbine building drain releases are to be sampled and monitored, as suggested by the Regulatory Guide 1.21.

Response:

The bases for our statement are given in draft Regulatory Guide 1.BB, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Pressurized Water Reactors," pp. B98-B100, which is given in the "Attachment to Concluding Statement of Position of the Regulatory Staff, Public Rulemaking Hearing on Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Practicable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactors," February 20, 1974.

The applicant will be required to sample and monitor turbine building floor drains in order to comply with General Design Criterion 64.

11.3.2 Noble Gas Releases

Comment: (Commerce A-5)

The major portion of the routine noble gas release to the outside atmosphere comes from the decay tanks (5400 Ci out of a total of 7648). There are three such tanks where bases are contained for a period of about 1 month before release to the atmosphere. No specification is given as to the period and frequency of release to the atmosphere. We can only assume that the period is short (few hours) and the frequency on the order of 12 times per year. This being the case, the use of an annual average dilution factor of 1.7×10^{-5} sec m^{-3} at a distance of 0.1 mile N.W. of the plant (see page 5-15) is erroneous and the subsequent total-body dose calculations are meaningless.

Response:

The releases of noble gas from the applicant's decay tanks will be done on essentially a random basis with respect to meteorological conditions. Thus, over the life of the plant an annual average dilution factor will serve to determine the average dose to an individual. No doubt, at some of the release periods, the dilution factor will be lower than average; but on the other hand, these should be ameliorated by above average dilution factors during other periods of release.

11.3.3 Location of Cows

Comment: (EPA A-14)

Our calculation for a milk ingestion dose to a six-month old child (consuming one liter of milk per day produced by a cow at the nearest potential pasture two miles west) is about 40 mrem/yr for both units. To ensure that the thyroid dose due to milk consumption does not exceed the provisions of the proposed Appendix I to 10 CFR Part 50, the applicant should develop a program to identify the actual location of milk cows as part of their operational environmental surveillance program. Documentation of this commitment should be provided in the final statement.

Response:

We concur that a cow census will be included in the radiological monitoring program. This will be required in the development of the Environmental Technical Specifications.

11.3.4 Milk Sampling

Comment: (EPA A-14)

The preoperational and operational environmental radiological surveillance program includes a single monthly milk sample taken at a point 14 miles west of the plant site. We recommend that once the facility begins operation, milk samples be taken from the nearest identified cow (7.5 miles SSW) or any dairy animals found closer to the plant.

Response:

The Environmental Technical Specifications will require that milk samples be taken from dairy animals at varying distances from the plant, including the nearest cow.

11.3.5 Apparent Inconsistency in Whole Body Doses

Comment: (EPA A-17)

The AEC should explain the discrepancy between the staff's statement (p. 3-30) that "...the operation of Units 1 and 2 will result in a whole body dose of about 5 mrem/yr..." and the breakdown of whole body doses in Table 5.3 of the draft statement showing a total whole body dose of less than 1 mrem/yr.

Response:

The statement on p. 3-30 should have read "...whole body dose of less than 5 mrem/yr..." As the "as low as practicable" guideline is 5 mrem/yr, the staff was able to conclude (in the last sentence of the paragraph) that the gaseous waste treatment system is acceptable. The staff estimated radiation doses from gaseous effluent releases are given in Table 5.3.

11.3.6 Radiological Environmental Monitoring

Comment: (Commerce A- 6)

The radiological environmental program should include aquatic vegetation among the samples to be analyzed for radioactivity (Table 6.1).

Response:

We concur that aquatic vegetation will be included in the radiological sampling program. This will be required in the development of the Environmental Technical Specifications.

11.3.7 Solid Waste Burial

Comment: (Interior A- 9)

The solid radioactive wastes that would result from operation of Unit 2 have been estimated to include annually about 1,050 drums having a total activity of approximately 6,000 curies. These wastes are described as consisting of spent demineralizer resins, evaporator bottom concentrates, ventilation air filters, contaminated clothing and paper, and miscellaneous items such as tools and laboratory glassware. According to page 3-32, the wastes would be shipped offsite to an unspecified licensed burial ground. It is stated that "greater than 90% of the radioactivity associated with the solid waste will be long-lived fission and corrosion products, principally Cs-134, Cs-137, Co-60, and Fe-55." It would be advisable to identify

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the planned burial site and to discuss Federal and State licensing provisions for the site in connection with: (1) its hydrogeologic suitability to isolate wastes of the St. Lucie Plant from the biosphere; (2) surveillance and monitoring of the site; and (3) any remedial or regulatory actions that might be necessary during the period in which the wastes would be hazardous.

Response:

The concerns expressed with regard to hydrogeologic suitability, monitoring, and compliance with appropriate regulations for the waste burial site will be addressed in the Environmental Impact Statement for the appropriate burial site.

11.3.8 Plant Accidents

Comment: (Interior A-10)

Discussion of accident probabilities is purely qualitative (e.g., "so small that their environmental risk is extremely low"), but it is noted that a quantitative assessment of risks is currently under study. We presume that the environmental effects of the most serious (Class (9) accidents are being evaluated, despite their low probability, and believe that the results of the study, if available, should be summarized in the final environmental statement. The often repeated assurance that in AEC's judgment the environmental risk is extremely low has not yet been supported by facts provided in an environmental statement for a nuclear power plant. As the number of plants increases, the need for a quantitative assessment of the environmental risk becomes proportionally greater. The consequences of an accident of this severity could have far-reaching effects on land and in the estuarine areas which could persist for centuries.

Response:

As stated on page 7-5, initial results of the Reactor Safety Study are expected to be available in 1974. The staff position regarding Class 9 accidents is stated in Section 7.1.

11.4 Non-Radiological Aspects

11.4.1 Thermal Plume Analysis

Comment: (EPA A-16)

The Unit 1 and 2 discharge plumes were evaluated independently for a zero ambient current condition, using the Koh/Fan model to predict surface temperatures. We do not believe this model is applicable to the Unit 1 discharge because the discharge port is in only 9.14 m (30 ft) of water and will rest in a sloping trench lined with concrete, sheet pilings and rip-rap. The Koh/Fan model assumes an infinite body of water available for dilution, and the depth and proximity to the ocean floor of the Unit 1 discharge port would not, in our opinion, yield valid results under this model.

Reference is made in the Environmental Report to a physical/hydraulic model study of the Unit 1 discharge by which, the draft statement indicates, the Koh/Fan model predictions are validated. We would anticipate that the Koh/Fan model, when applied to shallow discharges, would underestimate surface temperature while hydraulic models generally overestimate surface temperature. We recommend that the hydraulic analysis be included in the final statement so that an independent evaluation of the two models can be made.

We are not aware of the existence of any comprehensive analytical technique, other than a physical hydraulic model, which can predict the behavior of a multiple-port diffuser in a current situation. We believe an analysis based on a "conservative", no current, situation can be misleading where there are tidal currents. While tidal fluctuations provide dilution, they also spread the plume over a wider area. Tidal and wind induced currents could cause considerable interaction between the discharges from Unit 1 and 2 and the cooling water intake structure resulting in recirculation. These effects are complicated and cannot be analyzed without a physical/hydraulic model.

Response:

The hydrothermal analysis performed for Unit 1 is presented in the Final Environmental Statement for Unit 1. These calculations were performed with considerable conservatism and cross-checked by comparison with physical hydraulic and other mathematical model results. These comparisons agree well and indicate conservatism at higher temperatures.

The near-field analysis for the Unit 2 multiport diffuser was also performed with considerable conservatism, e.g., ignoring cross-currents and atmospheric cooling. The staff believes the estimates for plume extent and intensity are representative and sufficient for the assessment of environmental impact.

The applicant is currently sponsoring a comprehensive physical hydraulic model study at the University of Iowa. It is anticipated that the result of these studies will provide considerable data on plume behavior and recirculation, but these results are not available at the time this Environmental Statement is being prepared (May 1974).

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Because of the plume interaction produced by reversing tidal currents, variability of wind induced currents, and the proximity of the ocean outfalls, it is highly probable that individual plumes will not be separately distinguishable.

11.4.2 Recirculation

Comment: (Commerce A-5)

It is apparent that the area is lacking in oceanographic data or the writers are unaware of it as evidenced by the bibliography. In any event, we do not believe there are enough data presented to be as conclusive as indicated in Chapter Five. The thermal plume may not perform as shown and is drawn as far as we can tell on conjecture as opposed to data.

From the drawings in Chapter Three of the intake and discharge structures together with the schematic plumes of Chapter Five, we would guess the discharged hot water will be flowing toward and covering the intake more often than not. On the basis of past geological work in this general area, we have found the coastal waters having a net and prevailing movement to the south.

As both nuclear units will be using the same system of intake and discharge, we believe the locations of the intake and discharge points should be reassessed and the possibility of a new location of one or the other be considered, i.e., flip-flop and/or extended farther offshore.

Response:

The thermal analysis conducted for this plant is described in Section 5.2.3, page 5-3. The actual thermal plume configuration in the far-field will be highly variable because of several factors: plume interaction, wave action, reversing longshore currents and wind-driven currents. As a result, the thermal plumes do not lend themselves to exacting analyses with available state-of-the-art plume models. However, conservative estimates of the extent and intensity of the plumes have been made which are adequate for the assessment of environmental impact.

It is anticipated that during maximum southerly currents the combined plumes will be swept over the ocean intakes. The heated water, however, is expected to be confined to the upper layer of the water with a depth of influence less than 8 ft, whereas the top of the intake is at an 8 ft depth at lowest tide conditions. Periodic recirculation of heated water is estimated to be no more than 5%.

Because the Unit 2 plume will not significantly increase the thermal effect of the discharge from Unit 1, and the thermal effect of Unit 1 is predicted to be minimal, the staff concludes there is no requirement to relocate either the intake or discharge points.

11.4.3 Effect of Thermal Discharge on Aquatic Biota

Comment: (Commerce A-6)

It appears as though the intake and discharge are placed so that recirculation may occur. According to EPA (1973)1/, "overall biological damage is reduced if the intake is the long leg and the discharge the short leg of the cooling water system."

Comment: (EPA A-16)

Although (as we commented on the draft statement for Unit No. 1) the thermal discharge from this plant may not raise receiving water temperatures sufficiently to have any significant direct effect on aquatic biota, there may be some indirect effects. For example, it has been observed that warm discharge water can attract aquatic organisms. This attraction may be enhanced should recirculation or any other factor lead to the buildup of a sizable region of warmed water between intake and discharge structures or increase the area of the thermal plume appreciably. As a consequence, it has been noted that increased numbers of various species in the vicinity of a plant generally increase the rate of entrainment in the cooling system intake water. In spite of the fact that such observations have occurred primarily at plants located on freshwater lakes or rivers, it is possible that a similar situation could develop, particularly during the winter months, at plants (such as St. Lucie) situated on salt water bodies.

Response:

Section 5.5.2.6 has been modified to incorporate these comments.

1/ U. S. Environmental Protection Agency, 1973. Reviewing Environmental Impact Statements--Power Plant Cooling Systems, Engineering Aspects. Environmental Protection Technology Series, EPA-660/2-73-016, October 1973. EPA, Corvallis, Oregon 97330, page 15, criterion # 1.

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11.4.4 Impingement and Entrapment of Aquatic Biota

Comment: (Commerce A- 6)

Any impinged organism will be killed. The possibility of using a horizontal traveling screen and a bypass into the emergency cooling water canal should be considered and discussed.

Comment: (Interior A- 9)

The problem of fish entrapment in the intake system is considered in detail on pages 3-9, 4-3, 4-4, 4-6, 5-24 and 5-25. The concensus is that entrapment will be small due to the use of velocity caps. In all probability, such will be the case, but due to the magnitude of possible damage to fish from entrapment, we suggest that viable alternatives to remove and return trapped fish to the ocean should be presented if monitoring indicates that unacceptable losses are occurring.

Comment: EPA A-17)

The FWPCA requires the application of the best available technology (for protection of aquatic biota) to cooling water intake structures. The velocity cap, as proposed by the applicant, should afford the degree of protection required to minimize significant adverse impact at this plant. In this regard, we are in concurrence with the AEC licensing condition that careful monitoring be conducted and remedial action instituted, if necessary. In addition, we recommend that the applicant fully evaluate the provision of escape mechanisms for viable organisms entrapped in the intake canal and on the intake screens. The intake canal, as presently designed, precludes any opportunity for escape and guarantees that entrapped organisms will be killed during the periodic flushing of the intake conduit with high temperature recirculated water, which is required for antifouling. The extent to which the St. Lucie Plant cooling system will entrain aquatic organisms, the impact of this entrainment on the biological system, and possible mitigating measures should be discussed in detail in the final statement.

Response:

While impingement is expected to be of minor significance, the Applicant has agreed to investigate fish removal systems if entrapment and impingement become significant problems. Horizontal screens and bypass systems as well as other methods to reduce entrapment and impingement should be included in such an evaluation.

At this time the Applicant does not plan thermal defouling of the intake system. Organisms in the intake canal will not be periodically killed by this procedure. If defouling is required in the future, the Applicant's plans will be reviewed by the AEC to assure minimal environmental impact.

11.4.5 Velocity Caps

Comment: (Commerce A-6)

Higher velocities (1 fps) will increase the entrainment of fish eggs, larvae, zooplankton, etc. According to EPA (1973)1/, "the effectiveness of offshore velocity caps is not universally accepted."

Response:

Planktonic organisms (phytoplankters, zooplankters, fish eggs, and larvae) are not capable of swimming against any significant current, but move with it. Thus, the number of them passing through the station cooling system is directly related to the volume of water pumped, and is independent of the intake velocity. Thus, reducing the velocity at the ocean intake by enlarging the structure or modifying its design without changing the volume of water utilized would not change the numbers of plankters passed through the plant. While the effectiveness of velocity caps may not be universally accepted, they do have benefits in reducing entrapment of fishes in offshore intakes and are recommended in the EPA document referenced by the reviewer.

11.4.6 Phytoplankton and Zooplankton Populations

Comment: (Commerce A-6)

Reference is made to phytoplankton and zooplankton passing the plant. We question whether these organisms are really passing the plant, whether they are part of a relatively stable population.

Response:

Planktonic organisms drift with water currents which are discussed in Section 2.5. The longshore currents are predominately southerly at 0.6 ft per second, indicating a replacement of the water mass subject to effects of the plant. Thus, planktonic organisms passing the site are subject to continuous movement and replacement. The populations of them subject to the plants influence are changing in both location and time scales.

1/ U. S. Environmental Protection Agency, 1973. Reviewing Environmental Impact Statements--Power Plant Cooling Systems, Engineering Aspects. Environmental Protection Technology Series, EPA-660/2-73-016, October 1973. EPA, Corvallis, Oregon 97330, page 16, criterion # 4.

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11.4.7 Monitoring of Fish Populations

Comment: (Commerce A-6)

The discussion of fish eggs and larvae in the area cannot be considered adequate until the kinds of larvae and eggs are identified, and until it is determined whether the waters off Hutchinson Island are important spawning or nursery areas for any species of fish. Some fish may not be of direct communical importance, but they may play an important role in the food web of commercially valuable species.

Response:

The staff has recommended an increased level of effort in preoperational monitoring of fish stocks, Section 6.1.2, and the Applicant has initiated an increased frequency of sampling. Based on the available information, the staff expects no measurable effect on the local ecosystem due to passage of fish eggs and larvae through the station.

11.4.8 Alternatives to Chlorination of Condensers

Comment: (EPA A-17)

Chlorination of the condenser units will be conducted for approximately 15 minutes each day. This will result in the discharge of residual chlorine to the ocean. We anticipate that limitations established in the National Pollutant Discharge Elimination System Permit-will be sufficient to protect aquatic biota at the discharge. However, the applicant's monitoring program should provide evidence of any significant impact. We recommend that the applicant take whatever steps are necessary to permit incorporation in the plant design of an alternative condenser antifouling system (i.e., mechanical cleaning should monitoring produce evidence of harmful effects at the discharge).

Response:

This comment has been incorporated in Section 5.5.2.4.

11.4.9 Sea Turtles and Construction Activities

Comment: (Commerce A-6)

It is stated that "Construction activities on the beach and dune will cause another period of disruption to turtle nesting in the area." We suggest that construction schedules be adjusted, if possible, to avoid interfering with turtle movements and nesting activities in the area.

Response:

Adjusting construction schedules to avoid turtle nesting activity, which takes place during the summer months, is not feasible due to the length of time required for this construction activity (greater than 6 months) and because winter is the period of increased storms and construction on the discharge line during winter increases the potential for beach damage.

11.4.10 Australian Pine and Sea Turtle Nesting Areas

Comment: (Interior A-9)

According to page ii the planting of Australian pine was required as a condition to permits connected with Unit 1. The purpose in requiring the plantings behind the dune line was to minimize disorientation of turtle hatchlings toward lights at the construction site. Australian pine grow well in sand, with extensive root systems and dense shade such that virtually no plants can grow under them. Based on our understanding of problems on the Gulf Coast and experience in the Everglades National Park, once established, these trees proliferate and are very difficult to control. If these trees proliferate to the point that they encroach into the turtle nesting area, the dense root networks could prohibit successful nesting.

We suggest that the National Park Services's Superintendent of the Everglades National Park who has had experience with the Australian pine should be consulted along with appropriate State and other Federal agencies as to the advisability of its use for the stated purpose.

Response:

Australian pine, or other suitable plants, were required as a condition for Unit 1. Page ii of this Environmental Statement has been revised to reflect this position. The fact that these pine do tend to proliferate and can be difficult to control is one factor to be considered by the Applicant in selecting these plantings. The site has an existing stand of Australian pine behind a portion of the beach crest and there appears to be no evidence of this stand encroaching on or preventing growth of other native vegetation on the dune crest. Furthermore, there is no evidence to suggest this Australian pine stand has impacted turtle nesting in the immediate vicinity.

The suggestion that the Everglades National Park Superintendent be consulted on selecting proper plantings for a light shield has been passed on to the Applicant.

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11.4.11 Noise Levels from Diesel Generators

Comment: (EPA A-18)

Although the locality of the plant site is now sparsely populated, a key point noted in the draft statement is future population growth, particularly with respect to tourism. Land areas adjacent to the plant site are zoned R-4 (residential, motel, hotel) and development plans have already been submitted for two high rise motels, a trailer park/campground and condominium type structures "near" the plant. Since significant changes in population distribution can occur during the construction period, future noise problems should be addressed in the final draft of the referenced EIS. Particular attention should be given to the planned permanent auxiliary power sources which will consist of two 3500 kw diesel-powered generators. These units will be used during shutdown testing procedures and for auxiliary A. C. power. Noise control measures should be taken with respect to potential land use of adjacent areas to insure property boundary line noise levels of less than L_{an} of 55 dBA (day-night sound level).

Response:

The diesel-generator units will be operated only if emergency auxiliary power is required and for periodic quality assurance testing. The staff concludes the noise level from infrequent operation of these units will be virtually undetectable at the plant boundary.

APPENDIX A

COMMENTS ON

DRAFT ENVIRONMENTAL STATEMENT

Advisory Council
On Historic Preservation
1522 K Street N.W. Suite 430
Washington D.C. 20005

March 6, 1974

MAR 12 1974

50-389

Mr. Daniel R. Muller
Assistant Director for Environmental
Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

This is in response to your request of February 11, 1974 for comments on the environmental statement for the proposed St. Lucie Plant, Unit No. 2, St. Lucie County, Florida. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that while you have discussed the historical, architectural, and archeological aspects related to the undertaking, the Advisory Council needs additional information to adequately evaluate the effects on these cultural resources. Please furnish additional data indicating:

<u>Compliance with Executive Order 11593 of May 13, 1971.</u>

1. In the case of land under the control or jurisdiction of the Federal Government, a statement should be made as to whether or not the proposed undertaking will result in the transfer, sale, demolition, or substantial alteration of potential National Register properties. If such is the case, the nature of the effect should be clearly indicated.

2. In the case of lands not under the control or jurisdiction of the Federal Government, a statement should be made as to whether or not the proposed undertaking will contribute to the preservation and enhancement of non-federally owned districts, sites, buildings, structures, and objects of historical, archeological, architectural, or cultural significance.

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<u>The extent of archeological resources in the project area.</u> Although the Atomic Energy Commission indicates that "no historical damage will be done by this project" (p. 2-13), there is no evidence to support a similar finding with respect to archeological resources in the project area. The Advisory Council requests that it be provided with specific information as to the nature and extent of any archeological resources. Such information is also necessary for the purpose of compliance with the Executive Order.

Should you have any questions on these comments or require any additional assistance, please contact Jordan Tannenbaum (202-254-3974) of the Advisory Council staff.

Sincerely yours,

Ann Webster Smith

Ann Webster Smith
Director, Office of Compliance

[illegible] 1974

Docket No. 50-389

Advisory Council on Historic
Preservation
ATTN: Mr. Jordan Tannenbaum
1522 K Street, NW
Suite 430
Washington, D. C. 20005

Dear Mr. Tannenbaum:

As we discussed by telephone on April 15, 1974, I intend to expand Section 23, Historic and Archeological Sites and National Landmarks, of the St. Lucie, Unit 2 Draft Environmental Statement.

The "unexplored middens and mounds" that are mentioned in the DES are located on the north end of the Florida Power and Light Company property. This portion of the property is on the opposite side of Big Mud Creek from Units 1 and 2, and will be left in its natural state. As the site had previously been surveyed for Unit 1 and essentially all of the land clearing for both units was accomplished during the construction of Unit 1, there is virtually no potential for discovery of objects of historical, archeological, architectural, or cultural significance during construction of Unit 2.

I trust that our discussion has given you the additional information required for the Advisory Council to adequately evaluate the effects on cultural resources of the proposed St. Lucie Plant, Unit No. 2.

Sincerely,

[illegible]

F. A. St. Mary, Project Manager
Environmental Projects Branch 4
Directorate of Licensing

50-389

Advisory Council
On Historic Preservation
[illegible]
Washington, D.C. [illegible]

April 22, 1974

RECEIVED APR 23 1974

Mr. F. A. St. Mary
Project Manager
Environmental Projects Branch 4
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. St. Mary:

The Advisory Council on Historic Preservation has reviewed your letter of April 18, 1974, containing the requested additional data on the environmental statement for the St. Lucie Plant, Unit No.2, in St. Lucie County, Florida and its effect on historical, archeological, architectural and cultural resources in the project area. The Council has determined that the U.S. Atomic Energy Commission has satisfactorily responded to its March 6, 1974, comments on the Draft Environmental Statement.

The Advisory Council appreciates your cooperation in the resolution of this matter.

Sincerely yours,

Ann Webster Smith
Director, Office of Compliance

0573

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
State Office, P. O. Box 1208, Gainesville, FL 32602

March 19, 1974

Mr. John F. O'Leary
Director of Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. O'Leary:

Re: Draft Environmental Impact Statement - St. Lucie Plant, Unit No. 2, Florida Power and Light Company, Docket No. 50-389

Our staff has reviewed your detailed draft environmental impact statement for the St. Lucie Plant. It appears to us that all environmental impacts have been determined and evaluated adequately.

We appreciated the opportunity to comment on this statement.

Sincerely yours,

W. E. Austin
State Conservationist

cc: K. E. Grant
F. M. Tschirley

B120

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

50-389

April 10, 1974

RECEIVED APR 23 1974

Mr. Daniel R. Muller
Assistant Director for Environmental
Projects
U.S. Atomic Energy Commission
Washington, D. C. 20545

Docket No. 50-389

Dear Mr. Muller:

The draft environmental impact statement for St. Lucie Plant No. 2 Florida Power and Light Company, which accompanied your letter of February 11, 1974, has been reviewed and the following comments are offered for your consideration.

Physical Oceanography Aspects

It is apparent that the area is lacking in oceanographic data or the writers are unaware of it as evidenced by the bibliography. In any event, we do not believe there are enough data presented to be as conclusive as indicated in chapter five. The thermal plume may not perform as shown and is drawn as far as we can tell on conjecture as opposed to data.

From the drawings in chapter three of the intake and discharge structures together with the schematic plumes of chapter five, we would guess the discharged hot water will be flowing toward and covering the intake more often than not. On the basis of past geological work in this general area, we have found the coastal waters having a net and prevailing movement to the south.

As both nuclear units will be using the same system of intake and discharge, we believe the locations of the intake and discharge points should be reassessed and the possibility of a new location of one or the other be considered i.e, flip-flop and/or extended farther offshore.

The major portion of the routine noble gas release to the outside atmosphere comes from the decay tanks (5400 Ci out of a total of 7648). There are three such tanks where gases are contained for a period of about 1 month before release to the atmosphere. No specification is given as to the period and frequency of release to the atmosphere. We can only assume that the period is short (few hours) and the frequency on the order of 12 times per year. This being the case, the use of an annual average dilution factor of 1.7×10^{-5} sec m^{-3} at a distance of 0.1 mile N.W. of the plant (see page 5-15) is erroneous and the subsequent total-body dose calculations are meaningless.

Meteorological and Hydrologic Interactions

The area of the facility site was described as "flat and low" (section 2.2) and that the plant site was to be raised to about 18 feet above mean sea level (Section 2.4). The temporary dune (Section 4.0) will provide some protection but this is not to be considered adequate for protection against a full hurricane, especially since the anchoring root systems of local vegetation will be removed.

Although the 18-feet height appears to be reasonable security against storm surges based upon available data from past storms, there has been no attempt to evaluate potential storm surge for possible future storms. Of course, authoritative data of this nature is usually unavailable without recourse to an extensive investigation, but the potential for storm surge is sufficiently significant to warrant the expense of such an investigation.

There is also a realistic danger from erosion as a result of hurricane induced wave action. It is not unusual to hear reports of sand dunes 20 to 30-feet high and with several hundred feet of lateral extent being completely washed away under prolonged exposure to hurricane induced wave action. This erosion problem is dealt with in the planning of community protection against hurricanes, and it is within this context that we mention the problem and refer its solution to the proper authority.

In the planning of Unit No. 1, which is now under construction, we made a similar comment on the storm surge potential.

3234

It would be our recommendation that a study be made to determine storm surge heights which would be likely to occur in this area as it is quite vulnerable to hurricane activity. We also suggest that you seek expert advice concerning the problem of site erosion.

Special Items

Section 4.3.1, Impacts on Land Use--Terrestrial

It is stated that "Construction activities on the beach and dune will cause another period of disruption to turtle nesting in the area." We suggest that construction schedules be adjusted, if possible, to avoid interfering with turtle movements and nesting activities in the area.

Section 5.5.2.1, Entrapment of Fishes in the Intake System

Higher velocities (1 fps) will increase the entrainment of fish eggs, larvae, zooplankton, etc. According to EPA (1973)[1], "the effectiveness of offshore velocity caps is not universally accepted."

In addition, it appears as though the intake and discharge are placed so that recirculation may occur. According to EPA (1973)[2], "overall biological damage is reduced if the intake is the long leg and the discharge the short leg of the cooling water system."

Section 5.5.2., Impingement of Organisms on the Intake Screens

Any impinged organism will be killed. The possibility of using a horizontal traveling screen and a bypass into the emergency cooling water canal should be considered and discussed.

Section 5.5.2.3, Passage of Organisms Through the Plant

Reference is made to phytoplankton and zooplankton passign the plant. We question whether these organisms are really passing the plant, or whether

1/ U.S. Environmental Protection Agency, 1973. Reviewing Environmental Impact Statements--Power Plant Cooling Systems, Engineering Aspects. Environmental Protection Technology Series, EPA-660/2-73-016, October 1973. EPA, Corvallis, Oregon 97330, page 16, criterion # 4.

2/ Ibid, page 15, # 1.

they are part of a relatively stable population.

The discussion of fish eggs and larvae in the area cannot be considered adequate until the kinds of larvae and eggs are identified, and until it is determined whether the waters off Hutchinson Island are important spawning or nursery areas for any species of fish. Some fish may not be of direct communical importance, but they may play an important role in the food web of commercially valuable species.

Section 6, Environmental Measurements and Monitoring Programs

The radiological environmental program should include aquatic vegetation among the samples to be analyzed for radioactivity (table 6.1).

Thank you for giving us an opportunity to provide these comments, which we hope will bed assistance to you. We would appreciate receiving a copy of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary for
Environmental Affairs

B121

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C.

MAR 28 1974

50-389

RECEIVED APR 2 1974

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

Thank you for your letter of February 11 requesting comments on the draft Environmental Impact Statement for St. Lucie Plant, Unit No. 2, Docket Number 50-389. Based on the review by appropriate program agencies and regional offices, we have determined that the plant can be constructed and operated without undue impact on the environment.

Specifically, there will be no unacceptable health impact due to radiation or radioactivity from the plant operation. The routine discharges from the plant will fall within limits prescribed by the Atomic Energy Commission's "low as practicable" criteria. The draft report includes estimates of doses resulting from a variety of accidents, ranging from class 1 through class 8. All of the calculated doses would be acceptable from a public health standpoint, particularly in view of the probably low frequency of occurrence of such doses. The largest dose to an individual at the site boundary would be 31 millirems resulting from class 3 accident involving a rad waste system failure consisting of the release of the contents of a waste gas storage tank. The resultant dose to the population within a 50 mile radius of the plant from this accident would be 9-man rem. The largest population dose to those residing within a 50-mile radius of the plant would be 16-man rem resulting from a large break in the primary coolant system for the plant. The projected dose to an individual at the site boundary from such an incident would be 0.023 millirems.

Page 2 - Mr. Muller

Based on information contained in the report, it is not anticipated that an undue or unusual impact would result to community facilities either from the construction or operation of the plant. No such impact has occurred as a result of construction of Unit #1. The nature of the site surroundings are such that the population is subjected to normal seasonal fluctuations due to tourists, etc., such that the contribution to such fluctuations from employees either temporary or permanent at the plant would have a very low relative impact.

It has been noted that the AEC staff has recommended approval of this plant for construction based on its analysis and evaluation as set forth in this statement. This approval is subject to certain restrictions related to possible environmental effects. The effects, with one exception, are related to possible impact on natural wildlife including fish and turtles, as well as other miscellaneous environmental effects not directly related to health considerations. One provision, however, is that the applicant will discontinue use of the present septic tank system for sewage disposal and connect to a municipal sewer treatment line if and when such a line is extended to the applicant's site.

Thank you for the opportunity to comment on this statement.

Sincerely,

Charles Custard
Director
Office of Environmental Affairs

2811

United States Department of the Interior
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

In reply refer to:
PEP ER 74/253

APR 23 1974

50-389

Dear Mr. Muller:

Thank you for your letter of February 11, 1974, transmitting the draft statement, dated February 1974, on environmental considerations for St. Lucie Plant, Unit 2, St. Lucie County, Florida.

Our comments are presented according to the format of the statement or according to subjects.

Outdoor Recreation

The 1,132-acre tract of land owned by the applicant is located in an area of rapid residential and commercial development. A concomitant to that expansion will be increasing demands for public outdoor recreation opportunities, especially the kinds of beach-water related opportunities which the 830 acres of unused land at the project site, including 2.25 miles of prime ocean beach, can provide.

The applicant currently allows recreation on its land at the project site on an unregulated basis. It is indicated on page 4-1 that use of the site by the public for recreational purposes during construction and operation of Unit 2 should not be significantly affected beyond that resulting from the presence of Unit 1. Item 6 given on page 4-6 states that, "the applicant does not plan to restrict public access to areas between the plant and the ocean unless considerations of public safety require exclusion. It is also indicated in several other places in the statement that the applicant plans to allow recreational use of its lands to the extent possible within certain limits necessary for health and safety reasons.

We are pleased that the applicant has chosen not to restrict recreational use of its property beyond that necessary; however, we think that the opportunity to improve the amount

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and quality of recreational use should not be ignored. The applicant is a major utility with the ability to obtain land and other resources through condemnation proceedings. Therefore it follows that the use of these resources should also be in the overall public interest.

Based on the present and future needs for recreational opportunities in the project area, we suggest that the applicant develop a land use plan for those areas not directly needed in the production of electrical energy which would include picnic tables, rest rooms, turnouts for parking, and other related facilities or preferably enter into a utility-public partnership for developing greater recreational use of utility lands and waters. Several possibilities which should be considered by the applicant and addressed in the final environmental statement follow.

1. An agreement with a local level of government whereby the applicant would retain full rights of ownership but the governmental unit would provide basic facilities aimed at improving access and recreation. This arrangement could be a plus for the applicant's public relations program and would insulate the applicant from direct involvement in providing recreation.

2. Modest development, under agreement with a local level of government with use controlled by special use permits.

3. A lease back arrangement with the applicant retaining full rights of ownership, but under which a local governmental unit would manage the area and assume responsibility for users.

Geology and Seismology

The very brief description of geology and seismology on page 2-13 is inadequate for an assessment of the geologic environment. The distribution and physical properties of the materials on which Unit 2 would be founded have not been described, except for the statement that the Anastasia formation is highly permeable and the Hawthorne formation is semipermeable. The plant would evidently be constructed on a layer of compacted artificial fill of considerable thickness having a surface elevation of about 18 feet above sea level,

JOHNNY HORIZON '76

Let's Clean Up America For Our 200th Birthday

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but no further information has been provided on the composition or physical properties of the fill, or whether the initial surface layer of 4 to 6 feet of peat was removed prior to emplacement of the fill.

The discussion of seismology is limited to a description of the general distribution of historical earthquakes in the region. Information on the intensities of these earthquakes is entirely lacking, except for the qualitative statement that earthquakes in Florida have been "of low to moderate intensity." No mention has been made of ground accelerations, operating-basis earthquake, or design-base earthquake. Seismic design parameters to be used in the design of Unit 2 should be identified, the methods of their derivation should be discussed, and any environmental impacts related to geology and seismology should be evaluated. The environmental statement should also provide assurances that geology and seismology of the site of St. Lucie Plant, Unit 2, have been taken into account as prescribed in AEC's "Seismic and Geologic Siting Criteria for Nuclear Power Plants" (10 CFR 100, Appendix A, Federal Register, Vol. 36 No. 228, Nov. 25, 1971).

Sea Turtles

Hutchinson Island is a nesting area for several species of sea turtles. Since development of the shoreline to the north and south of the St. Lucie site is rapidly occurring, the 2.25-mile shoreline under the applicant's control will probably become increasingly important as turtle nesting habitat during the near future. Under present Florida Law, green, loggerhead, trunkback, leatherback, hawksbill, and ridley turtles and their nests and eggs are protected during the months of May-August in St. Lucie County. Therefore, recreational plans should contain provisions necessary to adequately protect the turtle resource during the nesting season.

According to page ii the planting of Australian pine was required as a condition to permits connected with Unit 1. The purpose in requiring the plantings behind the dune line was to minimize disorientation of turtle hatchlings toward lights at the construction site. Australian pine grow well in sand, with extensive root systems and dense shade such that virtually no plants can grow under them. Based on our understanding of problems on the Gulf Coast and experience in the Everglades National Park, once established, these trees proliferate and are very difficult to control. If these trees proliferate to the point that they encroach into the turtle nesting area, the dense root networks could prohibit successful nesting.

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We suggest that the National Park Service's Superintendent of the Everglades National Park who has had experience with the Australian pine should be consulted along with appropriate State and other Federal agencies as to the advisability of its use for the stated purpose.

Intake Systems

The problem of fish entrapment in the intake system is considered in detail on pages 3-9, 4-3, 4-4, 4-6, 5-24 and 5-25. The concensus is that entrapment will be small due to the use of velocity caps. In all probability, such will be the case, but due to the magnitude of possible damage to fish from entrapment, we suggest that viable alternatives to remove and return trapped fish to the ocean should be presented if monitoring indicates that unacceptable losses are occurring.

Solid Waste Summary

The solid radioactive wastes that would result from operation of Unit 2 have been estimated to include annually about 1,050 drums having a total activity of approximately 6,000 curies. These wastes are described as consisting of spent demineralizer resins, evaporator bottom concentrates, ventilation air filters, contaminated clothing and paper, and miscellaneous items such as tools and laboratory glassware. According to page 3-32, the wastes would be shipped offsite to an unspecified licensed burial ground. It is stated that "greater than 90% of the radioactivity associated with the solid waste will be long-lived fission and corrosion products, principally Cs-134, Cs-137, Co-60, and Fe-55." It would be advisable to identify the planned burial site and to discuss Federal and State licensing provisions for the site in connection with: (1) its hydrogeologic suitability to isolate wastes of the St. Lucie Plant from the biosphere; (2) surveillance and monitoring of the site; and (3) any remedial or regulatory actions that might be necessary during the period in which the wastes would be hazardous.

Site Preparation

It is recognized on page 4-1 that re-excavation of the beach and dune ridge "could have been eliminated if the applicant had installed a stub line for Unit 2 through the dune at the time the Unit 1 line was installed. This past action is now irrelevant unless a similar future situation could be averted.

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However, the statement does not mention the possible future need for additional units at this plant. Assurances should be included in the environmental statement that possible future construction requirements have been foreseen and that consideration has been given to accomplishing such work in conjunction with the presently proposed work, particularly in the case of excavation across the beach ridge or any other work involving exceptionally fragile environments.

In at least four places in the draft environmental statement reference has been made to the possibility of Hutchinson Island being cut in two in the vicinity of the St. Lucie Plant during major storms (p. ii, paragraph 5; p. 4-1, paragraph 3; p. 4-8, item 2a; p. 8-13, paragraph 3). Although this potential hazard would evidently be confined largely to the period during which the discharge line is being installed, and construction plans have been outlined to minimize this hazard, concerns arise from the fact that the 15-foot-high dune ridge is the primary barrier against severe wave action during a storm cutting the island in two and the fact that even after the period of excavation this potential continues to exist until dune stabilizing plants have reestablished their roots. No information has been provided on the area of the island in which the hazard of wave damage is greatest, or which, if any, parts of the nuclear plant would be threatened by such damage. The lack of data on topography and surface drainage of the site makes it difficult or impossible to independently assess the probable risks, although it seems probable that the greatest threat would be immediately north of the discharge canal, near the head of Big Mud Creek.

Concern also arises from the fact that Unit No. 1 is scheduled for initiation of commercial operations mid-1975 while construction for Unit No. 2 is not scheduled to begin until early 1975. This suggests that the hazard may exist during a period when the plant will be in commercial operation. Because of the foregoing circumstances, we believe that the environmental statement should provide the following additional types of information: (1) a description of protective barriers from erosion by hurricane-driven waves and tides, since hurricanes have occurred in Florida about 1.6 times annually from 1885 to 1958; (2) a description of the relation between the 15-foot-high coastal dune ridge and the 18-foot-high artificial fill beneath the plant, to indicate whether stabilization of

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the latter material is required or is proposed; (3) an estimate of the schedule for construction of the new discharge line in relation to the operation of Unit 1; (4) an assessment of the maximum credible damage that might result from wave erosion during the period of construction of the discharge line and before vegetation became re-established, including any potential damage to plant facilities; (5) adequate data on the topography and geology of the site to support an independent assessment of the environmental risks and of the proposed mitigative measures.

Plant Accidents

Discussion of accident probabilities is purely qualitative (e.g., "so small that their environmental risk is extremely low,") but it is noted that a quantitative assessment of risks is currently under study. We presume that the environmental effects of the most serious (class 9) accidents are being evaluated, despite their low probability, and believe that the results of the study, if available, should be summarized in the final environmental statement. The often repeated assurance that in AEC's judgment the environmental risk is extremely low has not yet been supported by facts provided in an environmental statement for a nuclear power plant. As the number of plants increases, the need for a quantitative assessment of the environmental risk becomes proportionally greater. The consequences of an accident of this severity could have far-reaching effects on land and in the estuarine areas which could persist for centuries.

We hope these comments will be helpful to you in the preparation of the final environmental statement.

Sincerely yours,

Nathaniel Reed

Assistant Secretary of the Interior

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
400 SEVENTH STREET SW
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

• 25 MAR 1974

RECEIVED MAR 28 1974

50-389

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of 11 February 1974 addressed to Mr. Benjamin O. Davis concerning the draft environmental impact statement for the St. Lucie Plant, Unit No. 2, St. Lucie County, Florida.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. We have no comments to offer nor do we have any objection to the project.

The opportunity to review this draft statement is appreciated.

Sincerely,

[signature]

[illegible]

2621

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

26 APR 1974

OFFICE OF THE ADMINISTRATOR

RECEIVED APR 26 1974

50-389

Mr. L. 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 impact statement in conjunction with the application of Florida Power and Light Company for a construction permit for the proposed St. Lucie Plant Unit No. 2. Our detailed comments are enclosed.

Although we anticipate that the thermal discharges from the St. Lucie plant utilizing the proposed once-through cooling system will meet federally approved water quality standards for the State of Florida, this type of system does not comply with Section 301 requirements under the Federal Water Pollution Control Act Amendments of 1972 (FWPCA). According to current EPA proposed regulations for Section 301, some form of "evaporative external cooling...in a closed, recirculating cooling system" is required. The discharge permit to be issued by EPA under the National Pollutant Discharge Elimination System, instituted by Section 402 of the FWPCA, will be conditioned to reflect the Section 301 requirement. It should be noted, however, that Section 316(a) of the Act can provide an opportunity for modification of the requirement if the applicant can demonstrate that less stringent effluent limitations (i.e., in this case, the use of the once-through system) will assure adequate protection and propagation of aquatic biota.

2

According to our independent analysis, the thyroid dose from radioiodine consumption via the cow-milk-child pathway, based on the nearest potential pasture, exceeds the design bases objectives of the proposed Appendix I (40 mrem/yr). In addition to the environmental surveillance to be required by the AEC, the applicant should develop a program to identify the location of milk cows in the plant's vicinity in order to assure that the real doses are maintained within applicable regulatory limits throughout the lifetime of the plant.

In light of our review and in accordance with EPA procedures, we have classified the project as ER (Environmental Reservations) and have rated the draft statement Category 1 (Adequate Information). If you or your staff have any questions concerning our classification or comments, we will be happy to discuss them with you.

Sincerely yours,

Sheldon Meyers
Sheldon Meyers
Director
Office of Federal Activities

Enclosure

3811

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EIS# D-AEC-06124-FL

ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

APRIL 1974

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

St. Lucie Plant, Unit No. 2

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency has reviewed the draft environmental impact statement for the St. Lucie Plant, Unit 2, prepared by the U.S. Atomic Energy Commission and issued on February 11, 1974. The following are our major conclusions:

1. With the exception of gaseous radioiodine releases, the proposed gaseous and liquid waste treatment systems are expected to be capable of limiting radionuclide releases and, therefore, the related offsite doses, to levels within the guidance of the proposed Appendix I to 10 CFR Part 50.

2. According to our independent analysis, the thyroid dose from radioiodine via the cow-milk-child pathway, based on the nearest potential pasture, is 40 mrem/yr. This exceeds the guidance of the proposed Appendix I as given in the concluding statement for the Regulatory Docket Rm-50. Thus the applicant should develop an environmental monitoring program (including provisions to identify the location of milk cows) in order to assure that the real doses are maintained within the provisions of applicable regulatory limits and guides throughout the lifetime of the plant.

3. We anticipate that the thermal discharge from the St. Lucie Plant will comply with Federally approved standards for the State of Florida. However, the plant will be required to comply with the provisions of Section 301 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA). Proposed guidelines for this section, calling for closed-cycle cooling, were published in the Federal Register on March 4, 1974. The applicant has recourse, however, under Section 316(a) of the FWPCA if he can demonstrate that Section 301 requirements are unnecessarily stringent in terms of environmental protection.

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RADIOLOGICAL ASPECTS

Radioactive Waste Treatment

The proposed gaseous and liquid waste treatment systems are expected to limit radionuclide releases and the resultant offsite doses to levels within those proposed in Appendix I to 10 CFR Part 50, with the exception of the potential dose to a child via the cow-milk pathway based on the nearest potential pasture. We agree with the applicant's decision (and commitment) to route the steam generator blowdown to a heat exchanger and a separate demineralizer treatment system. This will enable the releases from this pathway to be consistent with the state-of-the-art capability.

The AEC staff has noted that potential steam releases to the environment due to turbine trips and low-power physics testing have been analyzed. It was concluded that such releases are negligible as compared to the total calculated gaseous source-term. We request that the bases for the analysis and its results be provided in the final statement. Also, we request that, in the final statement, the AEC clarify whether or not the turbine building drain releases are to be sampled and monitored, as suggested by the Regulatory Guide 1.21.

Dose Assessment

Our calculation for a milk ingestion dose to a six-month old child (consuming one liter of milk per day produced by a cow at the nearest potential pasture two miles west) is about 40 mrem/yr for both units. To ensure that the thyroid dose due to milk consumption does not exceed the provisions of the proposed Appendix I to 10 CFR Part 50, the applicant should develop a program to identify the actual location of milk cows as part of their operational environmental surveillance program. Documentation of this commitment should be provided in the final statement.

The preoperational and operational environmental radiological surveillance program includes a single monthly milk sample taken at a point 14 miles west of the plant site. We recommend that once the facility begins operation, milk samples be taken from the nearest identified cow (7.5 miles SSW) or any dairy animals found closer to the plant.

EPA expects that the results from current and planned joint EPA-AEC and industry-cooperative field studies in the environs of operating nuclear power facilities will greatly increase knowledge of the process and mechanisms involved in the exposure of man to radiation produced through the use of nuclear power. We believe that, overall, the cumulative assumptions utilized to estimate various human doses are conservative. As more information is developed, the models used to estimate human exposures will be modified to reflect the best data and most realistic situations possible. Based on the results of these cooperative studies, it is possible that the scope and extent of present environmental monitoring programs may be relaxed.

Transportation

EPA, in its earlier reviews of the environmental impact of transportation of radioactive material, agreed with the AEC that many aspects of this program could best be treated on a generic basis. The generic approach has reached the point where on February 5, 1973, the AEC published for comment in the Federal Register a rulemaking proposal concerning the "Environmental Effects of Transportation of Fuel and Waste from Nuclear Power Reactors." EPA commented on the proposed rulemaking by a letter to the AEC, dated March 22, 1973, and by an appearance at the public hearing on April 2, 1973.

Until such time as a generic rule is established, EPA is continuing to assess the adequacy of the quantitative estimates of environmental radiation impact resulting from transportation of radioactive materials provided in environmental statements. The estimates provided for this station are deemed adequate based on currently available information.

Reactor Accidents

EPA has examined the AEC analysis of accidents and their potential risks which the AEC has developed in the course of its engineering evaluation of reactor safety in the design of nuclear plants. Since these accident issues are common to all nuclear power plants of a given type, EPA concurs with the AEC's approach to evaluate the environmental risk for each accident class on a generic

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basis. The AEC has in the past and still continues to devote extensive efforts to assure safety through plant design and accident analyses in the licensing process on a case-by-case basis. EPA, however, favors the additional step now being undertaken by the AEC of a thorough analysis on a more quantitative basis of the risk of potential accidents in all ranges. We continue to encourage this effort and urge the AEC to press forward to its timely completion and publication. EPA believes this will result in a better understanding of the possible risks to the environment.

We are pleased to note in the draft statement the discussion of the Reactor Safety Study and the commitment for timely public presentation of its results. If the AEC's efforts indicate that unwarranted risks are being taken at the St. Lucie Plant, we are confident that the AEC will assume appropriate corrective action. Similarly, if EPA efforts related to the accident area uncover any environmentally unacceptable conditions related to the safety of the St. Lucie Plant, we will make our views known.

NON-RADIOLOGICAL ASPECTS

Thermal and Biological Effects

The Environmental Protection Agency reviewed the draft environmental impact statement for St. Lucie, Unit No. 1, issued September 13, 1972. Our comments on that statement were submitted to the AEC on November 17, 1972, and are included in the final environmental statement for that facility, issued in June 1973.

Our comments on the present draft statement reiterate EPA's previous comments on the draft of St. Lucie Unit No. 1 which, in our opinion, are pertinent to an evaluation of the facility as a whole.

Condenser cooling at the St. Lucie Plant will be accomplished using a once-through system with an Atlantic Ocean intake and discharge canal system. The intake structures, shared by Units 1 and 2, are located 365.8m (1200 ft.) offshore. Condenser cooling water discharge for Units 1 and 2 flows 152m (500 ft.) through a buried pipeline to an open canal. From a point some 122m (400 ft.) west of the shoreline, Unit 1 discharge water is piped to a high-velocity jet ocean discharge structure 366m (200 ft) from the shoreline and Unit 2 discharge water is piped through a second line to a 48-port diffuser line extending from 536.4 to 853.4m (1760 to 2800 ft.) offshore. In our opinion, this proposed condenser cooling water system should enable the St. Lucie Plant to operate in compliance with Florida water quality standards. The State standards require that thermal discharges not adversely affect beneficial water uses or significantly affect fish and wildlife. Further, it is stipulated that monitoring be conducted to assure that such conditions are met.

In addition to compliance with thermal standards, the St. Lucie facility will be required to comply with Section 301 of the FWPCA which stipulates that cooling systems of steam electric plants must employ the "Best Practicable Control Technology Currently Available" by July 1, 1977, and the "Best Available Technology Economically Achievable" by July 1, 1983. Proposed guidelines for this section were published in the Federal Register of March 4, 1974. They call for the application of, "...evaporative external cooling to achieve

essentially no discharge of heat, except from the cold-side blowdown, in a closed, recirculating cooling system." Thus, the proposed effluent limitations do not provide for once-through cooling systems such as at St. Lucie.

Section 316(a) of the FWPCA provides a means for further consideration of thermal effluent limitations required under Section 301, if it can be demonstrated by the applicant that, for a specific plant, less stringent requirements will "...assure the pro[t]ection and propagation of a balanced, indigenous population of shell-fish, fish, and wildlife in and on the body of water into which the discharge is made." If this can indeed be demonstrated for the St. Lucie Plant, the Administrator may then impose an appropriate effluent limitation which could allow the use of the planned once-through system.

Prior to operation of the St. Lucie Plant, the applicant is required to obtain a discharge permit under the National Pollutant Discharge Elimination System (NPDES), as instituted by Section 402 of the FWPCA. EPA will consider, in part, compliance with water quality standards, the requirements of Section 301 of the Act, and the biological impacts of the proposed cooling system, prior to issuance of this permit. Our assessment of these factors and the possible outcome of any Section 316(a) proceedings will determine the conditions imposed by the permit.

Unit 1 will operate with an NPDES permit issued by EPA Region IV, Atlanta, Georgia. In part, this permit will limit the surface water temperature rise to 0.83°C (1.5°F) outside a 162 hectare (400 acre) mixing zone. It is anticipated that the mixing zone size restriction will have to be amended to provide a larger allowable area when both units 1 and 2 are operating, provided this larger area is consistent with environmental protection as identified in any 316(a) proceedings. However, the data presented in the draft statement are not sufficient to enable a projection of the total area which can be expected to exceed 0.83°C (1.5°F) above ambient. In any event, implementation of the AEC licensing condition to discharge cooling water from both units through the Unit 2 diffuser, when operational, will require amending of the Unit 1 NPDES Permit.

The Unit 1 and 2 discharge plumes were evaluated independently for a zero ambient current condition, using the Koh/Fan model to predict surface temperatures. We do not believe this model is applicable to the Unit 1 discharge because the discharge port is in only 9.14m (30 ft) of water and will rest in a sloping trench lined with concrete, sheet pilings and rip-rap. The Koh/Fan model assumes an infinite body of water available for dilution, and the depth and proximity to the ocean floor of the Unit 1 discharge port would not, in our opinion, yield valid results under this model.

Reference is made in the Environmental Report to a physical/hydraulic model study of the Unit 1 discharge by which, the draft statement indicates, the Koh/Fan model predictions are validated. We would anticipate that the Koh/Fan model, when applied to shallow discharges, would underestimate surface temperature while hydraulic models generally overestimate surface temperature. We recommend that the hydraulic analysis be included in the final statement so that an independent evaluation of the two models can be made.

We are not aware of the existence of any comprehensive analytical technique, other than a physical hydraulic model, which can predict the behavior of a multiple-port diffuser in a current situation. We believe an analysis based on a "conservative," no current, situation can be misleading where there are tidal currents. While tidal fluctuations provide dilution, they also spread the plume over a wider area. Tidal and wind induced currents could cause considerable interaction between the discharges from Unit 1 and 2 and the cooling water intake structure resulting in recirculation. These effects are complicated and cannot be analyzed without a physical/hydraulic model.

Although (as we commented on the draft statement for Unit No. 1) the thermal discharge from this plant may not raise receiving water temperatures sufficiently to have any significant direct effect on aquatic biota, there may be some indirect effects. For example, it has been observed that warm discharge water can attract aquatic organisms. This attraction may be enhanced should recirculation or any other factor lead to the buildup of a sizable region of warmed water between intake and discharge structures or increase the area of the thermal plume appreciably. As a consequence, it has been noted that increased numbers of various species in the vicinity of a plant generally increase the rate of entrainment in the cooling system intake water. In spite of the fact that such observations have occurred primarily at plants located on freshwater lakes or rivers, it is possible that a similar situation could develop, particularly during the winter months, at plants (such as St. Lucie) situated on salt water bodies.

The FWPCA requires the application of the best available technology (for protection of aquatic biota) to cooling water intake structures. The velocity cap, as proposed by the applicant, should afford the degree of protection required to minimize significant adverse impact at this plant. In this regard, we are in concurrence with the AEC licensing condition that careful monitoring be conducted and remedial action instituted, if necessary. In addition, we recommend that the applicant fully evaluate the provision of escape mechanisms for viable organisms entrapped in the intake canal and on the intake screens. The intake canal, as presently designed, precludes any opportunity for escape and guarantees that entrapped organisms will be killed during the periodic flushing of the intake conduit with high temperature recirculated water, which is required for antifouling. The extent to which the St. Lucie Plant cooling system will entrain aquatic organisms, the impact of this entrainment on the biological system, and possible mitigating measures should be discussed in detail in the final statement.

Chlorination of the condenser units will be conducted for approximately 15 minutes each day. This will result in the discharge of residual chlorine to the ocean. We anticipate that limitations established in the National Pollutant Discharge Elimination System Permit will be sufficient to protect aquatic biota at the discharge. However, the applicant's monitoring program should provide evidence of any significant impact. We recommend that the applicant take whatever steps are necessary to permit incorporation in the plant design of an alternative condenser antifouling system (i.e. mechanical cleaning) should monitoring produce evidence of harmful effects at the discharge.

Monitoring

The monitoring studies presently being carried out by the applicant or recommended by the AEC staff assure that continued attention will be given to potential environmental impacts. We request that results of the monitoring program to date be included in the final statement and continue to be made available to EPA and other interested parties as they are developed. If monitoring of the intake canal reveals significant destruction of aquatic organisms during flushing operations, it is recommended that the applicant provide some means of seining viable organisms for removal prior to flushing.

ADDITIONAL COMMENTS

During the review, we noted in certain instances that the draft statement did 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 St. Lucie Plant, Unit 2. The cumulative effects, 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 AEC should explain the discrepancy between the staff's statement (p. 3-30) that "...the operation of Units 1 and 2 will result in a whole body dose of about 5 mrem/yr ..." and the breakdown of whole body doses in Table 5.3 of the draft statement showing a total whole body dose of less than 1 mrem/yr.

2. The AEC staff has estimated the occupational dose to onsite operating personnel to be approximately 400 to 500 man-rem/yr. Since Unit 1 is expected to go into commercial operation soon after December 1975, the AEC staff should also estimate an expected dose to onsite construction personnel. The AEC should identify the occupational radiation exposure category of Unit 2 construction personnel and also should indicate to what degree the applicant will include such personnel in its exposure monitoring program.

3. Although the locality of the plant site is now sparsely populated, a key point noted in the draft statement is future population growth, particularly with respect to tourism. Land areas adjacent to the plant site are zoned R-4 (residential, motel, hotel) and development plans have already been submitted for two high rise motels, a trailer park/campground and condominium type structures "near" the plant. Since significant changes in population distribution can occur during the construction period, future noise problems should be addressed in the final draft of the referenced EIS. Particular attention should be given to the planned permanent auxiliary power sources which will consist of two 3500 kw diesel-powered generators. These units will be used during shutdown testing procedures and for auxiliary A.C. power. Noise control measures should be taken with respect to potential land use of adjacent areas to insure property boundary line noise levels of less than an L_{dn} of 55 dBA (day-night sound level).

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FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

50-389

APR 3 1974

RECEIVED APR 4 1974

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Office of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter dated February 11, 1974, requesting comments on the AEC Draft Environmental Statement related to the proposed issuance of a construction permit to the Florida Power and Light Company (Applicant) for the construction of the St. Lucie Plant Unit No. 2 (Docket No. 50-389). The proposed 850-megawatt unit would be located on Hutchinson Island on the east coast of Florida in St. Lucie County and would share the same site on which Unit No. 1 is currently under construction and which is scheduled for commercial service in December 1975. Unit No. 2 is scheduled for commercial service in December 1979.

These comments by the Federal Power Commission's Bureau of Power staff are made in compliance with the National Environmental Policy Act of 1969 and the August 1, 1973, Guidelines of the Council on Environmental Quality, and are directed to the need for the capacity represented by the St. Lucie Plant Unit No. 2, and to related bulk power supply matters.

In preparing these comments, the Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report and Amendments thereto; related reports made in accordance with the Commission's Statement of Reliability and Adequacy of Electric Service (Docket No. R-362); and the staff's analysis of these documents together with related information from other FPC reports. The staff generally bases its evaluation of the need for a specific bulk power facility upon long-term considerations as well as upon the load-supply situation for the peak load period immediately following the availability of the new facility. It

should be noted that the useful life of the St. Lucie Unit No. 2 is expected to be 30 years or more. During that period, the unit will make a significant contribution to the reliability and adequacy of electric power supply in the Applicant's service area.

The Applicant is a member of the Florida subregion of the Southeastern Electric Reliability Council (SERC) which coordinates the planning of the members' bulk power facilities. The Applicant is interconnected with other utility systems located in peninsular Florida; however, no formal power pool exists. A group of electric systems, including the Applicant, formed the Florida Electric Power Coordinating Group, effective October 1, 1972, "to assure an adequate and reliable electric power supply in Florida at the lowest possible cost consistent with economic factors and environmental standards established in the public interest." Active coordination of planning, construction, and utilization of generation and transmission facilities in Florida was included as a means of attaining the objectives of this coordinating group.

The difference in capability of the unit, as shown in table 8.2 and table 8.4 of the Draft Environmental Statement (850 versus 853 megawatts), is trivial and has no significant effect upon the conclusions reached.

The historical annual peak (winter) loads on the Applicant's system reflect an average annual rate of load growth of 11.8 percent, which was projected for the 1973-1982 period. The projected loads for the SERC area as a whole have been reported at an annual rate of growth of 9.0 percent. Both the annual growth rate of load on the Applicant's system and that of the SERC area as a whole are greater than the 7.2 percent historic annual load growth for the contiguous United States. This may be due in part to the steady growth of economic activity in this area. Although the winter peaks of the Florida systems are slightly greater than the preceding summer peaks, the summer peak loads are generally of longer duration than winter peak loads, and both present planning and operating problems.

Florida systems use a reliability planning criterion that the loss-of-load probability will not exceed one day in ten years. Many U. S. systems report the use of the same criterion with the general result that the magnitude of reserve margins fall within a range of 15 to 25 percent of annual peak load. The Bureau of Power staff recognizes that the peninsular nature of the service area of the Florida systems favors the consideration of the upper range for planned reserve margins, primarily due to the need for a higher degree of self-reliance where support from surrounding systems is limited.

2902

The Draft Environmental Statement reports a 1980 summer reserve margin of 2,591 megawatts, or 17.2 percent of Applicant's peak load with the subject unit available; and 1,741 megawatts, or 11.5 percent, if it is not available. The 1980 summer reserve margin for the Florida systems is reported to be 5,303 megawatts, or 20.4 percent of the peak load with St. Lucie Unit No. 2 in service; and 4,450 megawatts, or 17.1 percent, if the unit is not available.

The Bureau of Power staff concludes that the additional capacity equivalent to that represented by the St. Lucie Unit No. 2 is desirable to provide for the projected load growth of the affected systems and to provide reserve capacity with which to withstand normally encountered contingencies, thus affording a reasonable level of reliability of service to their customers.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

STATE OF FLORIDA

Department of Administration

Division of State Planning

860 Apalachee Parkway • IBM Building

TALLAHASSEE

32304

(904) 488-2371

Reubin O'D. Askew, Governor

L. K. Ireland, Jr., Secretary of Administration

Earl M. Starnes, State Planning Director

March 28, 1974

RECEIVED APR 1 1974

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

Functioning as the state planning and development clearinghouse contemplated in U. S. Office of Management and Budget Circular A-95, we have reviewed the following draft environmental impact statement:

U. S. Atomic Energy Commission - St. Lucie Plant Unit No. 2 Florida Power and Light Company, Docket No. 50-389. SAI No. 74-0743E.

During our review we referred the environmental impact statement to the following agencies, which we identified as interested: Department of Agriculture and Consumer Services; Board of Trustees of the Internal Improvement Trust Fund; Department of Community Affairs; Department of Commerce; Game and Fresh Water Fish Commission; Department of Health and Rehabilitative Services; Department of Natural Resources; Department of Pollution Control; Public Service Commission; Department of State - Division of Archives, History and Records Management; Department of Transportation; and the Environmental Information Center. Agencies were requested to review the statement and comment on possible effects that actions contemplated could have on matters of their concern. Letters of comment on the statement are enclosed from the Department of Agriculture and Consumer Services - Division of Forestry; Department of Community Affairs; Department of Commerce; Game and Fresh Water Fish Commission; Department of Natural Resources; Department of Pollution Control; Public Service Commission; and Department of Transportation. No further responses were received.

In accordance with the Council on Environmental Quality guidelines concerning statements on proposed federal actions affecting the environment, as required by the National Environmental Policy Act of 1969, and

Mr. Daniel R. Muller
Page Two
March 28, 1974

U. S. Office of Management and Budget Circular A-95, this letter, with attachments, should be appended to the final environmental impact statement on this project. Comments regarding this statement and project contained herein or attached hereto should be addressed in the statement.

We request that you forward us copies of the final environmental impact statement prepared on this project.

Sincerely,

Ed Maroney

E. E. Maroney, Chief
Bureau of Intergovernmental Relations

EEM/Wdp
Enclosures
cc: Mr. John Bethea
Mr. Charles Blair
Mr. T. Mabry Ervin
Mr. O. J. Keller
Mr. Joel Kuperberg
Mr. William Partington
Mr. John Lisle
Mr. Hamilton Oven
Mr. R. Charles Shepherd
Mr. Harmon Shields
Mr. Don Spicer
Mr. H. E. Wallace
Mr. Robert Williams

STATE OF FLORIDA

Department of Administration

Division of State Planning

725 SOUTH BRONOUGH

TALLAHASSEE

32304

(904) 488-2401

Reubin O'D. Askew, Governor

L. K. Ireland, Secretary of Administration

Earl M. Starnes, State Planning Director

TO: Mr. John Bethea, Director
Department of Agriculture & Consumer Services
Collins Building
Tallahassee, Florida 32304

DATE: FEB 26 1974

DUE DATE: ~~MAR 1 8 1974~~

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI 74-0743E

RETURN TO DSP

Please review and comment to us on the above draft environmental impact statement, copy attached. In reviewing the statement, you should consider possible effects that actions contemplated could have on matters of concern to your agency.

If you feel that a conference is needed for discussion of the project or resolution of conflicts, or if you have questions concerning the statement, please call Mr. Estus Whitfield at (904) 488-2401. Please check the appropriate box below, attach any comments on your agency's stationery and return to ICR or telephone "no adverse comments" by the above due date.

On that date, we intend to consider all review comments received and develop a state position on the project. In both telephone and written correspondence please refer to the above SAI number.

Sincerely,

Ed Maroney

Chief
Bureau of Intergovernmental Relations

Enclosure cc: Mr. Charles Logan

DIVISION OF STATE PLANNING — FEB 28 1974 — RECEIVED — SAI NO. ____

TO: Bureau of Intergovernmental Relations

FROM:

SUBJECT: DEIS Review and Comments

☑ No Comments

☐ Comments Attached

Reviewing Agency: Florida Division of Forestry

Date: 2/28/74

Signature: [signature]

Title: Resource Development Specialist

STATE OF FLORIDA

Department of Administration

Division of State Planning

725 SOUTH BRONOUGH

TALLAHASSEE

32304

(904) 488-2401

Reubin O'D. Askew, Governor

L. K. Ireland, Jr., Secretary of Administration

Earl M. Starnes, State Planning Director

Jim

2-27-74

TO: Mr. Ed Trombetta, Sec.
Department of Community Affairs
Howard Building
Tallahassee, Florida 32302
Attn: Mr. Charles Shepherd

DATE: FEB 25 1974

DUE DATE: MAR 18 1974

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI 74-0743E

Please review and comment to us on the above draft environmental impact statement, copy attached. In reviewing the statement, you should consider possible effects that actions contemplated could have on matters of concern to your agency.

If you feel that a conference is needed for discussion of the project or resolution of conflicts, or if you have questions concerning the statement, please call Mr. Estus Whitfield at (904) 488-2401. Please check the appropriate box below, attach any comments on your agency's stationery and return to ICR or telephone "no adverse comments" by the above due date.

On that date, we intend to consider all review comments received and develop a state position on the project. In both telephone and written correspondence please refer to the above SAI number.

Sincerely,

Ed Maroney

Chief
Bureau of Intergovernmental Relations

Enclosure cc: Mrs. Christine Searcy

DIVISION OF STATE PLANNING — MAR 6 1974 — SAI NO. ____

TO: Bureau of Intergovernmental Relations

FROM:

SUBJECT: DEIS Review and Comments

☒ No Comments

☐ Comments Attached

Reviewing Agency:

Signature: [signature] 3/4/74

Date:

Title:

STATE OF FLORIDA

Department of Administration

Division of State Planning

725 SOUTH BRONOUGH

TALLAHASSEE

32304

(904) 488-2401

Earl M. Starnes, State Planning Director

Reubin O'D. Askew, Governor

L. K. Ireland, Jr., Secretary of Administration

TO: Mr. Joe Gerry
Department of Commerce
Collins Building
Tallahassee, Florida 32304

DATE: FEB 25 1974

DUE DATE: MAR 18 1974

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI: 74-0743E

Please review and comment to us on the above draft environmental impact statement, copy attached. In reviewing the statement, you should consider possible effects that actions contemplated could have on matters of concern to your agency.

If you feel that a conference is needed for discussion of the project or resolution of conflicts, or if you have questions concerning the statement, please call Mr. Latus Whitfield at (904) 488-2401. Please check the appropriate box below, attach any comments on your agency's stationery and return to IGR or telephone "no adverse comments" by the above due date.

On that date, we intend to consider all review comments received and develop a state position on the project. In both telephone and written correspondence please refer to the above SAI number.

Sincerely,

Ed Maroney
Chief
Bureau of Intergovernmental Relations

Enclosure

****

TO: Bureau of Intergovernmental Relations

FROM: Fl. Dept. of Commerce

SUBJECT: DEIS Review and Comments

☒ No Comments

☐ Comments Attached

Reviewing Agency:

Signature: [signature]

Date: 1 March 74

Title: Adm., Business Dev.

FLORIDA GAME AND FRESH WATER FISH COMMISSION

C. A. PEACOCK, JR., Chairman; JAMES B. WINDHAM; WILLIAM H. BLAKE; O. L. PEACOCK, JR.; HOWARD DOOM

DR. O. E. FRYE, JR., Director
H. E. WALLACE, Assistant Director

FARRIS BRYANT BUILDING, 620 South Meridian, Tallahassee, Florida 32304

DIVISION OF STATE PLANNING, Bureau of Intergovernmental Relations — MAR 14 1974 — RECEIVED — SAI NO.

March 13, 1974

Mr. E. E. Maroney
Chief
Bureau of Intergovernmental Relations
Department of Administration
Tallahassee, Florida

Re: SAI 74-0743E, Draft Environmental Statement, St. Lucie Power Plant, Unit No. 2, St. Lucie County, Fla. Power and Light Co.

Dear Mr. Maroney:

The Environmental Section of the Florida Game and Fresh Water Fish Commission has reviewed the above referenced environmental statement, and we have no objections to the construction of St. Lucie Plant Unit No. 2 provided the applicant complies with the stipulations of the United States Atomic Energy Commission as outlined on page v of this statement. These conditions, along with those specified for construction of Unit No. 1, should minimize the adverse environmental impacts of this facility and provide the basis for assessment of the impact subsequent to commercial power operation.

If our office can be of further assistance, please contact us.

Very truly yours,

O. E. Frye, Jr.
Director

OEF/LS/rs

Florida Department of Transportation

Reubin O'D. Askew, Governor

Walter L. Revell, Secretary

March 19, 1974

Mr. Edgar E. Maroney
Chief, Bureau of Intergovernmental Relations
Division of State Planning
Department of Administration
660 Apalachee Parkway
Tallahassee, Florida 32304

Dear Mr. Maroney:

Subject: Draft Environmental Impact Statement
United States Atomic Energy Commission
St. Lucie Plant, Unit 2
St. Lucie County
SAI 74-0743E

We have reviewed the transportation aspects of the subject statement and feel that the slightly increased traffic load will have no significant impact upon either the highways or the surrounding environment. However, if future traffic proves to be substantial and requires future expansion or modification of the highways to be utilized, we request that the Florida Power and Light Company coordinate directly with:

Mr. Ben Simpson
District Engineer, Fourth District
Florida Department of Transportation
P. O. Box 22838
Ft. Lauderdale, Florida 33315.

We appreciate the opportunity to comment on this statement at this early date.

Very truly yours,

RAY G. L'AMOREAUX, DIRECTOR
DIVISION OF PLANNING & PROGRAMMING

W. N. Lofroos, P.E.
Chief, Bureau of Planning

DIVISION OF STATE PLANNING — MAR 20 1974 — RECEIVED — SAI NO.

WNL:RFK/rh

cc: Mr. Ben Simpson

STATE OF FLORIDA

DEPARTMENT OF POLLUTION CONTROL

2562 EXECUTIVE CENTER CIRCLE, EAST
MONTGOMERY BUILDING, TALLAHASSEE, FLORIDA 32301

P. BALJET, Executive Director

DAVID H. LEVIN, Chairman

March 21, 1974

Re: SAI - 74-0743E
Draft Environmental Statement
St. Lucie Plant Unit No. 2
Florida Power and Light Co.

Mr. E. E. Maroney
Bureau of Intergovernmental Relations
Division of State Planning
Department of Administration
660 Apalachee Parkway
Tallahassee, Fla. 32304

Dear Mr. Maroney:

The Department of Pollution Control has reviewed the above referenced Draft Environmental Statement relative to the St. Lucie Plant Unit No. 2, Florida Power and Light Company.

The Department of Pollution Control under Florida Administrative Code Chapter 17-17 has the responsibility for certification of power plants in the State of Florida. The Department is presently reviewing the impact of St. Lucie Plant Unit 2 and the Board will determine whether the permit to construct and operate the power plant will be granted or denied or under what conditions.

During the construction phase, a second discharge line with a multiport diffuser is planned for Unit 2 which will extend beyond the discharge line for Unit 1 and will involve dredging a channel 20 feet deep and 2800 feet into the ocean. This dredging will require a permit and certification by the Department prior to construction.

Sincerely,

Tim S. Stuart, Ph.D.
Chief
Bureau of Environmental Programs

DIVISION OF STATE PLANNING — MAR 25 1974 — RECEIVED — SAI NO.

TSS:sll

W. R. MIDDLEMAS, Board Member; GEORGE RUPPEL, Board Member; ALICE C. WAINWRIGHT, Board Member; W. D. FREDERICK, JR., Board Member

B130

STATE OF FLORIDA

Department of Administration

Division of State Planning

725 South Bronough

Tallahassee

32304

(904) 488-2401

TO: Mr. Randolph Hodges, Ex. Director
Department of Natural Resources
Larson Building
Tallahassee, Florida 32304

DATE: FEB 25 1974

DUE DATE: MAR 18 1974

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI: 74-0743E

Please review and comment to us on the above draft environmental impact statement, copy attached. In reviewing the statement, you should consider possible effects that actions contemplated could have on matters of concern to your agency.

If you feel that a conference is needed for discussion of the project or resolution of conflicts, or if you have questions concerning the statement, please call Mr. Estus Whitfield at (904) 488-2401. Please check the appropriate box below, attach any comments on your agency's stationery and return to ICR or telephone "no adverse comments" by the above due date.

On that date, we intend to consider all review comments received and develop a state position on the project. In both telephone and written correspondence please refer to the above SAI number.

Sincerely,

Ed Maroney

Chief
Bureau of Intergovernmental Relations

Enclosure cc: Mr. William Beckham

TO: Bureau of Intergovernmental Relations

FROM:

SUBJECT: DEIS Review and Comments

☐ No Comments
☒ Comments Attached

Reviewing Agency:

Signature: James G. Smith

Date: 3/19/74

Title: Administrative Assistant

DIVISION OF STATE PLANNING
Bureau of Intergovernmental Relations
MAR 21 1974
RECEIVED
SAI NO.

State of Florida

DEPARTMENT OF NATURAL RESOURCES

LARSON BUILDING / TALLAHASSEE 32304

March 19, 1974

Mr. Edgar E. Maroney, Chief
Bureau of Intergovernmental Relations
Department of Administration
IBM Building, Third Floor
Tallahassee, Florida 32304

Dear Mr. Maroney:

Pursuant to your memorandum request of February 25, 1974, the Department staff has reviewed the draft environmental impact statement pertaining to the St. Lucie Plant Unit No. 2, Florida Power and Light Company (SAI No. 74-0743E).

Some of our staff feel that a more knowledgeable review of such environmental impact statements can be made once the collection of baseline data concerning marine resources in the Hutchinson Island area has been completed. Collection of such data is being carried out by personnel of our St. Petersburg Marine Laboratory who plan an analysis of the potential impact of such projects on marine resources.

Although at this time we have no adverse comments concerning this draft environmental impact statement, we may have additional comments at a later time in response to its publication in the Federal Register.

Sincerely,

James G. Smith
Administrative Assistant

JGS:rt

TO: Bureau of Intergovernmental Relations

FROM: Florida Public Service Commission

SAI: 74-0743 E

SUBJECT: DEIS Review and Comments

☒ No Comments
☐ Comments Attached

Reviewing Agency:

Signature: [illegible]

Date: Feb. 27, 1974

Title: Sr. Engineer

DIVISION OF STATE PLANNING
MAR 1 1974
SAI NO.

The St. Lucie County

BOARD of COUNTY COMMISSIONERS

P. O. BOX 700

Fort Pierce, Florida 33450

February 21, 1974

Mr. Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing
United States Atomic Energy Commission
Washington, D. h. 20545

Re: Florida Power & Light St. Lucie Plant Unit No. 2
Your Docket No. 50-389

Dear Mr. Muller:

We have reviewed the draft environmental impact documentation forwarded to us in your letter dated February 11, 1974 and have no objections to your findings. This matter was discussed at our Board meeting February 19, 1974.

Very truly yours,

Weldon B. Lewis, P. E.
County Administrator

WBL/iw
cc: Ed Brewer, Florida Power & Light Company, West Palm Beach
Al Zinni, Florida Power & Light Company, Fort Pierce

1519

P.O. BOX 3100 MIAMI, FLORIDA 33101

FPL
FLORIDA POWER & LIGHT COMPANY

April 1, 1974

Mr. Angelo Giambusso, Deputy Director
for Reactor Projects
Directorate of Licensing
Office of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Giambusso:

Re: St. Lucie Plant Unit No. 2
Environmental Report - Amendment 5
Docket No. 50-389

Enclosed are two hundred (200) copies of Florida Power & Light Company's comments on the Draft Environmental Statement. These comments are submitted as Amendment 5 to the Applicant's Environmental Report and include the information requested by Mr. William H. Regan, Jr. in a letter of March 8, 1974.

Very truly yours,

J. A. DeMastry for

Robert E. Uhrig
Director of Nuclear Affairs

REU:ach
Encl.

APPROVED:

J. J. Hudiburg
Executive Vice President

STATE OF FLORIDA)
) SS
COUNTY OF DADE)

J. J. HUDIBURG, being first duly sworn, deposes and says:

That he has executed the foregoing instrument; that the statements made in this said instrument are true and correct to the best of his knowledge, information and belief; and that he is authorized to execute the instrument on behalf of said Applicant.

J. J. Hudiburg

Subscribed and sworn to before me

this 1st day of April, 1974

Evelyn D. Kemp
Notary Public in and for the County of Dade,
State of Florida

My Commission expires Notary Public, State of Florida at Large. My Commission Expires July 13, 1977. Bonded by American Fire & Casualty Co.

2837

HELPING BUILD FLORIDA

B132

FLORIDA POWER & LIGHT COMPANY

COMMENTS ON THE

DRAFT ENVIRONMENTAL STATEMENT

ST. LUCIE PLANT UNIT NO. 2

APRIL 1, 1974

DOCKET NO. 50-389

TABLE OF CONTENTS

I. Introduction

Florida Power and Light Company ("FPL") hereby submits the following comments on the Draft Environmental Statement prepared by the staff of the Atomic Energy Commission with respect to the proposed St. Lucie Plant Unit No. 2 ("St. Lucie 2").

These comments are submitted by way of amendment to the Applicant's Environmental Report. The data contained herein, to the extent inconsistent with the Environmental Report ("ER"), as amended to date, is to be regarded as superseding earlier data. For ease of review these comments are organized in narrative style; specific page changes to the ER, if and as necessary, will be submitted in a subsequent amendment.

II. Proposed Conditions of the Construction Permit

Applicant has reviewed the conditions on the construction permit proposed by the AEC staff (DES, p. v); the applicant has no objections to conditions a thru h but suggests a minor modification to condition c. Each of the proposed conditions is addressed below.

(1) Measures to control raccoon predation: The DES proposes the following condition:

> "a) During construction and operation the applicant will implement strict procedures to control and dispose of edible refuse, including procedures to prevent deliberate feeding, to limit raccoon population increases with resulting increased turtle predation (Section 4.3.1)."

During plant operation the generating plant will be completely enclosed by a security barrier designed to deny or impede unauthorized access to the generating plant. This barrier, consisting primarily of fencing, will be illuminated during darkness and will be monitored by electronic devices and patrolled by security personnel. All edible refuse generated by the operating plant will be stored within this barrier prior to sanitary disposal. The presence of the barrier, protective illumination and personnel movement in and around the barrier will substantially discourage entry of raccoons. Raccoons are not known to enter the barrier enclosing FPL's Turkey Point Nuclear Generating Plant even though the natural environment surrounding the Generating Station area included a large raccoon population.

Edible refuse is primarily generated within building areas such as the service building. This refuse will be collected and stored in heavy-duty bulk containers prior to sanitary disposal.

During construction, extensive barriers such as those previously mentioned which enclose an operating plant are not present. Some areas of the construction site are fenced. This fence along with the presence of personnel, lighting, and related construction activity will discourage the presence of raccoons. Edible refuse is normally deposited in metal refuse containers which are regularly emptied and the refuse disposed of in a sanitary manner. Regular policing of the construction area for trash results in the collection of any edible refuse not deposited in trash containers. Personnel are instructed to refrain from engaging in acts which would disturb the ecological balance of the area, including feeding of wildlife. Persons familiar with the construction site have been questioned, and the presence of raccoons in the construction area has not been noticed.

It is Florida Power and Light's opinion, therefore, that edible refuse generated during construction and operation will not contribute to substantive raccoon population increases. In any event, however, measures as described above, will be taken to assure the same.

(2) Restoration of Dunes: The DES proposes the following condition:

> "b) In restoring the ocean dune to its original condition after installation of the Unit 2 discharge line, the applicant will replant the dune at the earliest feasible time with dune stabilizing plants indigeneous to the area (Section 4.1). These plantings will be in addition to the applicant's planned replanting of the Australian pine light screen if disturbed."

After installation of the Unit No. 2 discharge line, FPL will restore the dune line to approximately original contours. Further, FPL will replant the restored dune with vegetation native to the area. This rapid replanting of the restored dune will reduce erosion and will speed recovery of the dune area to its undisturbed condition. In addition, FPL will plant Australian pines if the existing light screen is disturbed by Unit 2 discharge construction.

(3) Measures to Monitor Fish Entrapment: The DES proposed the following condition:

> "c) The applicant will monitor fish entrapment in the cooling canals during the time the velocity entering the intake structures is about 0.5 fps. If the entrapment rates are excessive, the applicant will take necessary action to increase the intake velocity to approximately 1 fps (Section 4.3.2)."

The Applicant plans to monitor fish entrapment in the intake canal during the first year of operation to determine the extent of fish entrapment. During this year of operation, both intake lines will be in service with either or both lines passing water at various times depending on the plant cooling water requirements and the extent of barnacle growth in the lines which may require adjusting the water velocity within the lines. Thus, the water velocity thru the intake velocity caps is expected to range between 0.5 and 1.0 fps. It is not now certain whether the lower intake water velocity will cause more or less fish to become entrapped. It should also be noted that even though fish might enter the intake canal via the intake velocity caps, they will not necessarily be impinged on the intake structure traveling screens since velocities in the canal are low, on the order of 0.5 fps.

In view of the fact that there may be more than one acceptable method of reducing fish entrapment, Applicant suggests modifying the second sentence of Condition c, to read as follows:

> If entrapment rates are excessive, Applicant would take action as may be necessary to reduce entrapment to acceptable levels such as, but not limited to, increasing the water velocity through the intake caps. (Section 4.3.2)

(4) Flow control out of discharge lines: The DES proposes the following condition:

> "d) The applicant will shut off the Unit 1 Y-type discharge to force all flow out the Unit 2 multiport line as soon as it becomes available and when only one unit is operating with total cooling system flow of 1150 cfs (Section 4.3.2)."

A bulkhead is presently installed across the opening to the Unit 2 discharge pipe at the headwall. This bulkhead effectively shuts off flow to the Unit 2 pipe so that construction of the line will be free from disturbances caused by the operation of the discharge canal during that period when Unit 1 is operating alone.

To preclude a condition whereby Unit 1 is operating and the single unit discharge is flowing through both discharge lines, the bulkhead will be left in place until the Unit 2 Circulating Water System is operative.

When both units are operational, the applicant will use a flow control device to divert single unit flow (only one unit operating) through the Unit 2 multiport diffuser.

Applicant does not construe condition d, to prohibit the use of the Unit 1 Y-type discharge if the multiport line is out of service for inspection, maintenance or repair; provided, however, that the discharge in such circumstances must meet applicable water quality requirements. It may be advisable to clarify condition d, in this regard.

(5) Connection to Municipal Sewer Line: The DES proposes the following condition:

> "e) The applicant will discontinue use of the present septic system and connect to a muncipal sewer treatment line if and when such a line is extended to the applicant's site (Section 5.2.3)."

The distribution pipes for the leaching fields in the present septic system are at elevation +16(MLW) ocean, which is approximately 16 feet above the ground water table. Since no fresh ground water supplies are available on Hutchinson Island there exists no potential for contamination of any consumable water sources by sanitary sewage. However, participation in available municipal sewer treatment lines, if extended to the site, is acceptable as an alternate method of disposal and will be employed if and when such a line extends to the site.

(6) Measures to Avoid Unnecessary Impacts of Construction: The DES proposes the following condition:

> "f) The applicant shall take the necessary instigating action, including those summarized in Section 4.5 of this Environmental Statement, during construction of the plant to avoid unnecessary adverse environmental impacts from construction activities."

The actions summarized in Section 4.5 of the DES are, in fact, now being implemented in the construction of St. Lucie 1 and will be continued through the construction of St. Lucie 2 including such other action as may be required to avoid unnecessary environmental impacts.

(7) Control Program to Assure Compliance with Construction Permit Conditions: The DES proposes the following condition:

> "g) A control program shall be established by the applicant to provide for a periodic review of all construction activities to assure those activities conform to the environmental conditions set forth in the construction permit."

The activities in question will be conducted by Ebasco Services under the cognizance of the Construction Department of FPL and will be in accordance with the conditions set forth in the construction permit. The Construction Department's activities will be subject to a control program which is part of FPL's Quality Assurance program. The program provides for regular and periodic review of construction permit activities by at least two separate groups to assure compliance with the requirements of the construction permit. The Quality Assurance Department Construction Group is located on site and performs day to day surveillance of construction activities. The Quality Assurance Department Audit Group

performs periodic audits of all aspects of FPL nuclear activities including those of the on-site quality assurance group.

(8) Prior Written Notification to Director of Licensing: The DES proposes the following condition:

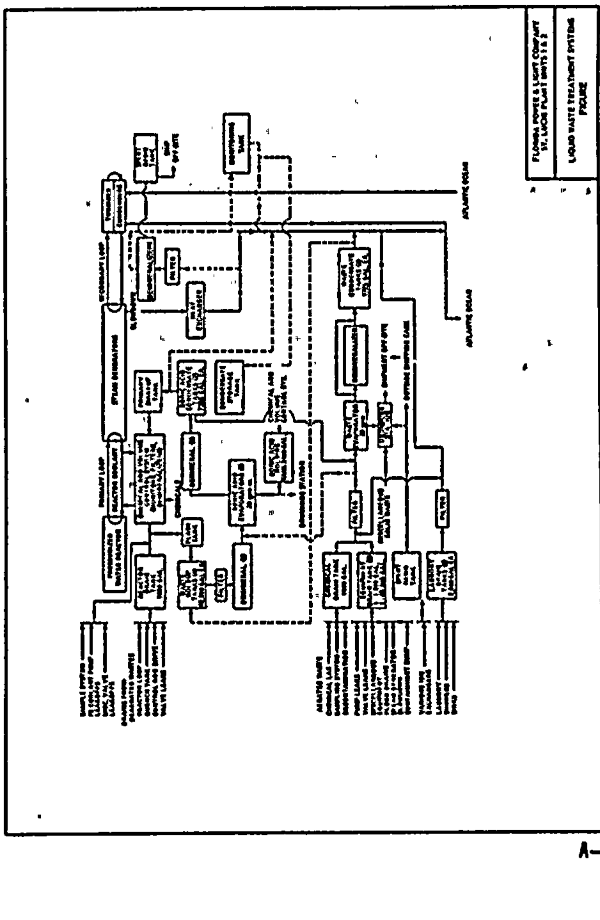
> "h) Before engaging in a construction activity which may result in a significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this Environmental Statement, the applicant shall provide written notification to the Director of Licensing, U. S. Atomic Energy Commission."

Prior to engaging in a construction activity which may result in a significant adverse environmental impact which was not previously addressed by the Staff and the Applicant in the Environmental Statements, prior written notification will be provided to the Director of Licensing, U. S. Atomic Energy Commission.

As discussed in item (7), above, quality assurance measures will be taken to ensure complete compliance with construction permit conditions. The Quality Assurance Department's audits of all aspects of FPL nuclear activities will include audits of necessary administrative systems to assure such compliance. Among the systems to be audited will be one which will require that appropriate evaluation be performed with respect to activities that may result in a significant adverse environmental impact that was not previously evaluated or that is significantly greater than that evaluated in the Environmental Statement.

III Steam Generator Blowdown System

On page 3-24 in section 3.5.1.4, the Staff states: "The applicant has verbally committed to a separate treatment system with at least a process capability equivalent to a heat exchanger and a mixed-bed demineralizer,



and will submit the proposed system for our review." The system to which Applicant now has committed formally is the system, the design of which has been submitted in Amendment 6 to the PSAR, described below.

Steam generator blowdown is utilized to maintain the total dissolved solids (TDS) content of steam generator secondary side coolant within normal operating limits. Primary to secondary leakage would result in some activity accumulation within the steam generator secondary. Thus, under these circumstances the blowdown stream would have an activity level associated with it. Should this activity level exceed a specified limit, the blowdown stream would be processed prior to its release via the discharge canal. Three blowdown process streams provide this capability. Each stream can process the total combined blowdown (40 gpm or greater) from both Units 1 and 2.

Radiological evaluations of normal liquid releases performed by the Staff have been based on a blowdown rate of 14 gpm, processing by mixed bed demineralizers, and discharge to the ocean. The process system has a capability in excess of that assumed in the Staff's analysis. Revisions to the liquid waste management system (PSAR Amendments 4 through 6) are reflected by modifications contained in the attached WMS diagram.

IV Fish Monitoring

The staff, after reviewing the FPL Environmental Report for St. Lucie Unit No. 2, commented on page 6-2 of the DES that " an adequate program to identify fish populations in the area of the plant has not been conducted."

An additional program has been initiated since the FPL Environmental Report was written. At present, an otter trawl is being made monthly, both day and night, at each station to collect invertebrates and fishes found near the bottom. All the data are being analyzed by a computer program and the outcome integrated and synthesized to develop, if possible, a predictive model of the overall effect on a particular species of a change in any one parameter.

V Measures To Protect The Environment During Construction

The applicant has commited to those measures necessary for protection of the environment during the construction of proposed St. Lucie Plant Unit No. 2. These commitments have been outlined in Section 4.5.1 of the DES and are the result of cooperation between the applicant and the Staff in evaluation of construction impact.

VI Use of Big Mud Creek

Section 5.2.2 of the DES describes the environmental impact of the proposed withdrawal of emergency cooling water from Big Mud Creek. Applicant offers the following comment to clarify that paragraph and to explain why it is necessary to use water from Big Mud Creek at all. As described below and in section 5.2.2 of the DES, water use from Big Mud Creek will be minimized consistent with regulatory and testing requirements.

USAEC Regulatory Guide 1.27, entitled, "Ultimate Heat Sink" requires that "suitable redundancy in features be provided for the cooling water system to assure that its safety function can be accomplished." This cooling water system is called the "Ultimate Heat Sink", and is further defined as "that complex of water sources, including necessary retaining structures, and the canals or conduits connecting the sources with, but not including, the cooling water system intake structures for a nuclear power unit." It should be emphasized that this water is not used to provide emergency cooling directly to the reactor core.

For the St. Lucie Units, two water sources and their associated canals and conduits comprise the ultimate heat sink for the plant. The primary source of water is the Atlantic Ocean which together with the ocean intake structure, intake conduits, intake canal, and intake structure bay area constitute the preferred source of emergency cooling water. The secondary source of emergency cooling water is Big Mud Creek which is connected to the Atlantic Ocean through the Indian River and inlets at Ft. Pierce and St. Lucie. The secondary source utilizes an emergency intake canal connecting Big Mud Creek with the intake canal area in front of the intake structures.

As indicated, the primary source of cooling water for dissipating heat during normal or emergency shutdown is the Atlantic Ocean via the circulating water system intake, described above. Two 12.0 ft I.D. reinforced concrete pipes take ocean water from about 1200 ft off-shore. The pipelines are buried their entire length except at the intake velocity cap structure. A 300 ft wide canal carries the water to the intake pump structure.

Because of the redundancy requirement mentioned above in Regulatory Guide 1.27, a second source of cooling water is connected to (but isolated from) the intake canal for use as a backup. This source is Big Mud Creek.

Big Mud Creek is a natural body of water extending easterly from the Indian River just north of the plant site. Big Mud Creek is dredged to a minimum elevation of -40 ft MLW with a minimum 250 ft. bottom width. A barge channel has been dredged from Big Mud Creek across the east side of the Indian River to the channel of the Intracoastal Waterway. The Intracoastal Waterway is a 9 - 12 foot deep channel running north-south in the Indian River. The Indian River is connected via inlets to the ocean at Ft. Pierce to the north and at St. Lucie to the south.

The intake canal in front of the intake structure is separated from Big Mud Creek by a sheet pile and concrete barrier wall which is placed midway in the emergency cooling canal. The barrier maintains separation between the primary and secondary sources of emergency cooling water during normal plant operation. To assure passage of emergency water

through the sheet pile wall, nine stub pipes (normally plugged with pneumatic devices) penetrate the wall.

Before water from Big Mud Creek will be used, the Ocean Intake System will have to become blocked or inoperative to the extent that less than 3% of the flow the system is designed for will pass from the Ocean to the Intake. A schematic diagram showing water supply sources and consumption for both normal operation and emergency shutdown with loss of the Ocean Intake is shown in figure 2.4 of the DES. The likelihood of such an event is considered extremely remote.

Postulating such a condition, however, the plant would begin a shutdown procedure and the pneumatic devices would be deflated, allowing water to flow through the sleeves in the barrier wall. The amount of water drawn from Big Mud Creek for use in the plant would depend upon the number of intake cooling water pumps operating. The design capacity of each pump is 14,5000 gpm and only one pump is required for shutdown of a unit, however, normal shutdown is usually accomplished using two pumps.

Besides the emergency condition noted above, water from Big Mud Creek will be used during normal semi-annual tests of the pneumatic plug operation. Each of the nine pneumatic plugs controlling flow will be tested individually for a period of no more than 10 minutes. The flow passing from Big Mud Creek to the Intake Canal will depend upon the relative elevations of the water on either side of the Barrier and the elevation of the plug (Elev. -6,0.0 or +6 ft). There are three stubs at each elevation (9 total) but only six are at or below the water line. Each stub pipe is capable of passing up to 33 cfs of cooling water, and the total volume of water drawn from Big Mud Creek during each semi-annual test is limited to no more than 2 million gallons by agreement with the Flood Control District. Additionally, testing will not be conducted during times of high aquatic productivity in the Indian River, such as spawning. In summary, the use of water from Big Mud Creek is limited to a semi-annual removal of up to 2 million gallons and the unlikely use of 29,000 gpm for emergency cooling purposes. Having the capability of using water from Big Mud Creek assures full compliance with AEC Regulatory Guides and gives maximum assurance of the safe operation of the St. Lucie Units.

VII Transmission Facilities

As stated in section 3.8 of the DES, St. Lucie Unit No. 2 will use the transmission facilities which are being constructed for use by St. Lucie Unit No. 1. No additional transmission line circuits will be required for Unit No. 2.

As of March 15, 1974, the construction status was as follows:

CIRCUIT #1

On structures, both steel towers on the river crossing and concrete structures on the land portion have been completed. The conductor on the river crossing has been installed. Wire work began on the land portion during the week of March 18. Completion is scheduled for April 12, 1974.

CIRCUIT #2

71% of the steel towers have been installed. The towers in the Indian River have been erected. Approximately 7 concrete structures have been set in the land portion. Completion is scheduled for August, 1974.

CIRCUIT #3

Approximately 57% of the steel structures have been

installed. The steel towers in the Indian River have been erected. Approximately 7 of the concrete structures have been set on a land section. Completion is scheduled for August, 1974.

VIII Natural Draft Cooling Towers

The discussion of natural draft cooling towers in Section 9.2.4, pages 9-8 and 9-9 of the Draft Environmental Statement may give the impression that natural draft cooling towers are ecologically preferable to the proposed cooling system because they have only an aesthetic disadvantage of visual intrusion of tower and plume. Further perusal of evaluations in Table 10.2, pages 10-3 and 10-4, Table 10-3, page 10-8 and the next to the last paragraph on page 10-9 reveals that a natural draft cooling tower, in addition would offer a potential threat to migratory birds, suppress plant life and reduce number of plant species in downwind areas because of salt drift, have a major visual impact and have a high salinity blowdown with unknown net effects on biota. Thus, it would not result in a significant reduction of environmental cost associated with the ocean outfall discharge system.

The foregoing assumes that a natural draft cooling tower is technologically feasible at this site. However, no existing natural draft cooling towers have been designed to withstand the hurricane winds that may occur at the site. In addition, the prevailing air temperatures and humidities in this area probably would have an adverse effect on the efficiency of natural draft towers. No large natural draft towers have been constructed nearer to this site than the Georgia foothills. Thus, Applicant does not believe that natural draft cooling towers constitute a reasonable alternative to the proposed ocean outfall.

IX Energy Conservation as an Alternative to St. Lucie 2

The St. Lucie 2 unit is planned as base load capacity. Even if customer demand grows at a considerably lower rate than forecasted by FPL, additional base load capacity will be needed in 1980. Moreover, the attractiveness of nuclear power as base load capacity has increased because of uncertainties in the availability and cost of fossil fuels, on which FPL is heavily dependent (See Amendment 4 to ER, dated February 25, 1974, which updates estimated cost and availability of alternative fuels). As demonstrated below, energy conservation measures cannot obviate the need for St. Lucie 2.

However, FPL is extremely interested in the conservation of energy and has consistently informed its customers of available energy conservation measures and discouraged wasteful uses.

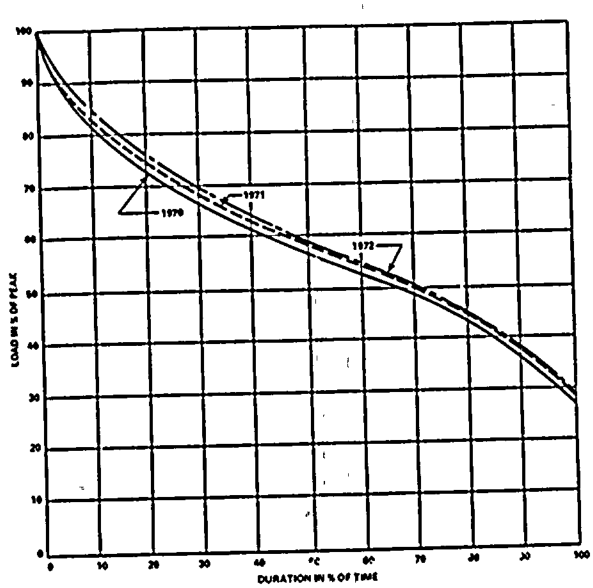
1. The Need for Nuclear Base Load Capacity

a) The Load Duration Curve

The relationship between the demand for electricity vs. time is illustrated by a "load duration curve." 1/ The load duration curve is an important tool in planning capacity additions. An actual load duration curve for 1972 (as well as curves for 1970 and 1971) appears as ER Figure 1.1-2, reproduced here as Figure 1, and the estimated load duration curve for 1980 is ER Figure 1.1-3, reproduced here as Figure 2. A load duration curve shows the total time, within a specified time, that the load equalled or exceeded the power value shown. The upper left hand termination point of the curve represents the maximum demand experienced in the peak hour of a year.

1/ A load duration curve may be constructed for any period of time. Annual load duration curves are used most often in system planning and are used in this presentation.

FIGURE 1

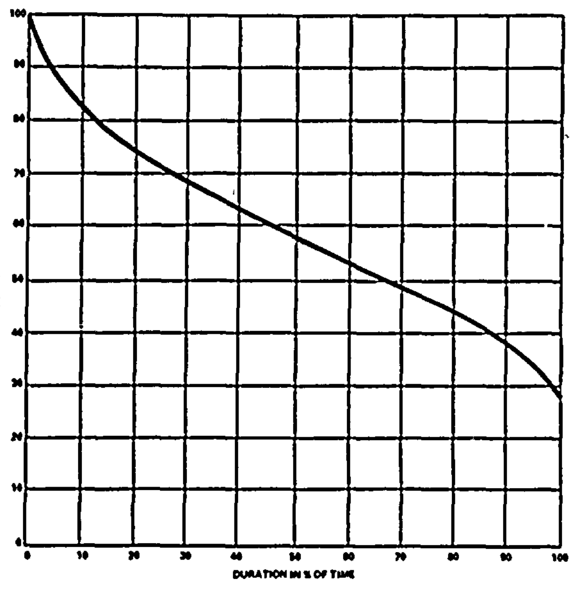


FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

ANNUAL LOAD DURATION CURVE
1970, 1971, 1972

FIGURE 1.1-2

FIGURE 2



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PROJECTED ANNUAL LOAD DURATION CURVE – 1973-1982

FIGURE 1.1-3

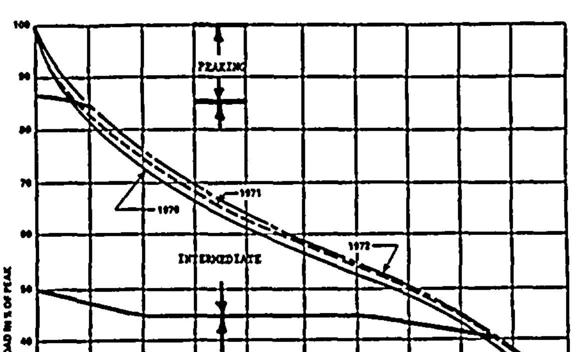
The lower right hand termination point represents the lowest demand experienced in any hour in the year. Intermediate points on the curve indicate the duration of any particular level of demand (load). For example, in 1980 it is estimated that 70% of the time the demand will be greater than or equal to 50% of the peak demand.

b) Base Load, Intermediate and Peaking Capacity

"Base load" capacity consists of generating units that a utility expects to operate at almost all times that the capacity is available. Figure 3 is a 1972 load duration curve with capacity drawn into the graph. Base load units are those that are expected to run at least 70 - 80% of the time. The lines indicating increments of capacity are sloped to account for scheduled and estimated unscheduled unavailability of the generating units, plus the economic dispatch of those units. Planned outages for maintenance (including refueling of nuclear units), will be scheduled to provide the maximum system reliability. The Company makes every effort to assure that all possible capacity is available during peak periods.

A maximum amount of energy, kilowatt hours (Kwh), per kilowatt of capacity (Kw) is produced by the base load type units. Therefore, it is desirable to minimize the fuel cost of generating this energy at the expense of considerable capital expenditure. Of course, nuclear generation, with its high capital cost and low fuel consumption, accomplishes this objective. By comparison, a fossil unit must consume an additional increment of expensive and scarce coal, oil or gas to produce each Kwh. Because of this difference, nuclear generation is always inserted at the bottom of the load duration graph, thereby "pushing up" fossil generation and pushing some of the utility's least efficient fossil generation into peaking unit status.

FIGURE 3



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

ANNUAL LOAD DURATION CURVE
1970, 1971, 1972

Peaking capacity is at the opposite end of the scale. It is used sparingly, usually less than 10% of the time, to meet peak demands. Accordingly, such capacity must not have a high fixed (or capital) cost; and the variable cost, made up mostly of fuel, is relatively less important. Peaking capacity is usually comprised of a combination of natural gas turbine units and older, less efficient fossil units. However, FPL's entire peaking capacity in 1972 consisted of gas turbine units. In fact, some gas turbine capacity was used by FPL for intermediate generation.

Intermediate generation consists of those units that are used more often than peaking units, but less than base load units. The lower portion of the "intermediate band" of the load duration curve is usually made up of fossil units that were pushed up from the base load band by nuclear or more efficient fossil capacity. And, as stated above, the upper portion of the intermediate band on Figure 3 is made up of gas turbine units.

c) FPL - 1972

In 1972, FPL generated 31,498,000 Kwh of electricity, almost all with fossil fuels. [1/] Much of the fossil fuel consumed was low sulfur oil, which is now in very short supply. Also, a large quantity of natural gas was consumed by FPL's gas turbine units. The Federal Power Commission has adopted a policy of limiting the consumption of natural gas for electric generation to the extent practicable.

Had nuclear generation been available in 1972, each Kwh generated by the nuclear unit(s) would have replaced a Kwh that was produced by natural gas

[1/] Turkey Point 3, FPL's first nuclear plant, was in operation for a few days in December, 1972. The amount of energy produced commercially was very small and is not shown on Figure 3.

or low sulfur oil. FPL's need for non-fossil fueled, base load capacity, added after 1972, would not have been dependent on any increase in customer usage. As Figure 3 illustrates, 3,427 Megawatts (Mw) served as base load capacity in 1972. Only 1,456 Mw of that fossil fueled capacity would have been pushed up to intermediate status by addition of the Turkey Point nuclear units in 1973 if there had been no growth in customer demand from 1972 to 1973. In fact, peak demand rose 980 Mw from 1972 to 1973.

4) FPL - 1980

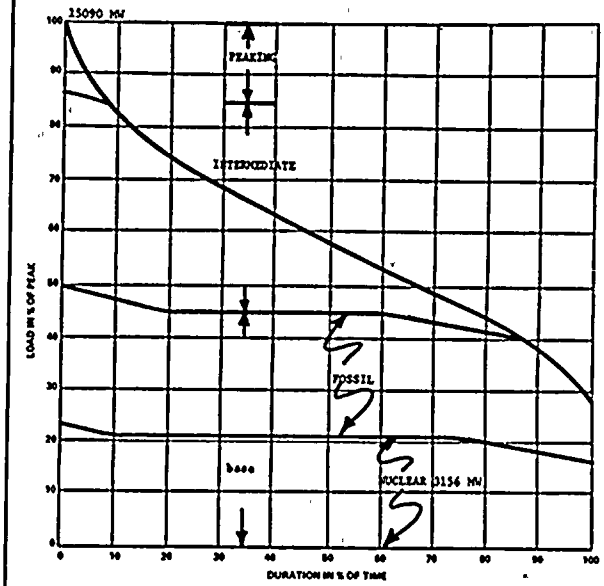
Figure 4 shows an estimated FPL load duration curve for 1980. It projects a peak demand of 15,090 Mw (60 minute gross), and reflects an estimated requirement of 6,790 Mw of base load capacity. The four planned nuclear units—Turkey Point 1 and 2 and St. Lucie 1 and 2—would equal 3,156 Mw, or approximately 46% of FPL's base load capacity. The remainder of FPL's base load capacity would be comprised of large fossil units, probably burning low sulfur oil. Of course, all intermediate and peaking capacity, as well as all reserve capacity—which is above the load duration curve and, therefore, not shown—would be fossil fueled.

It is apparent from comparing Figure 3 with Figure 4 that the nuclear generating units replace fossil units at the bottom of the load duration curve, and the fossil units that are consequently pushed up on the graph serve growth in customer demands.

2. Energy Conservation as an Alternative

Energy conservation measures can be divided generally between those that are intended to result in an overall decline in energy consumption and those that concentrate on reducing the peak demand, without regard for usage off peak.

FIGURE 4



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PROJECTED ANNUAL LOAD DURATION CURVE - 1973-1982

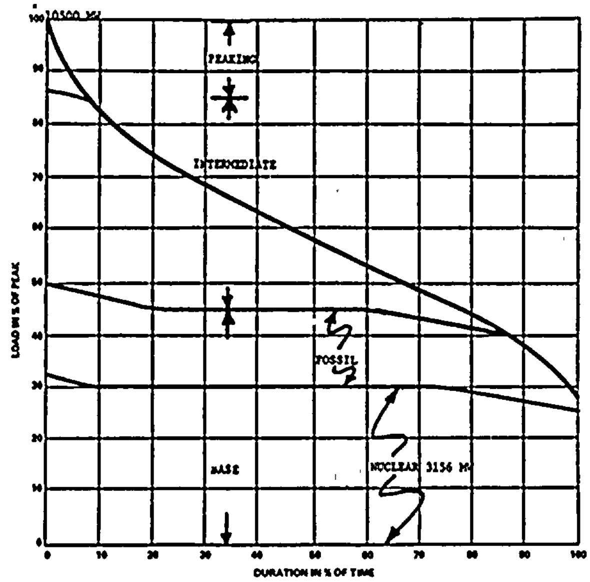
a) Overall Decline

Public consciousness that energy is a depletable resource that should not be wasted can lead to an overall decline in the rate of growth in energy consumption. Better home insulation, lower thermostat settings in winter, higher thermostat settings in summer, elimination of unnecessary lighting and design of new buildings with regard for energy consumption are all measures which should lead to an overall reduction in growth of consumption of electricity. This decline should affect usage in each hour.

Figure 5 shows a hypothetical load duration curve for 1980. Peak demand is assumed to be 10,500 Mw, instead of FPL's forecasted 15,090—representing 50% less growth of demand from 1972-1980 than forcasted by FPL—6,145 Mw-10,500 Mw vs. 6,145 Mw 15,090 Mw. It is assumed that the shape of the load duration curve will not change, reflecting a balanced (as to time during the year) decline in consumption growth. Comparing Figures 5 and 4, the need for base load capacity has decreased from 6,790 Mw to 4,725 Mw. The Turkey Point and St. Lucie Units, 3,156 Mw, together with several fossil units, are still needed to provide base load capacity. The real difference between the two graphs is that, in Figure 5, very little natural gas and much less low sulfur oil would be utilized by FPL to generate electricity. Of course, the assumption used in Figure 5 is extreme, and, in the Applicants judgement, completely unrealistic.

With regard for the instability in availability and price of oil and the pressing need for low sulfur oil in all parts of the United States, FPL undoubtedly would choose to construct St. Lucie 2 even if energy conservation measures could be expected to reduce forecasted growth in consumption by 50%.

FIGURE 5



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PROJECTED ANNUAL LOAD DURATION CURVE - 1973-1982

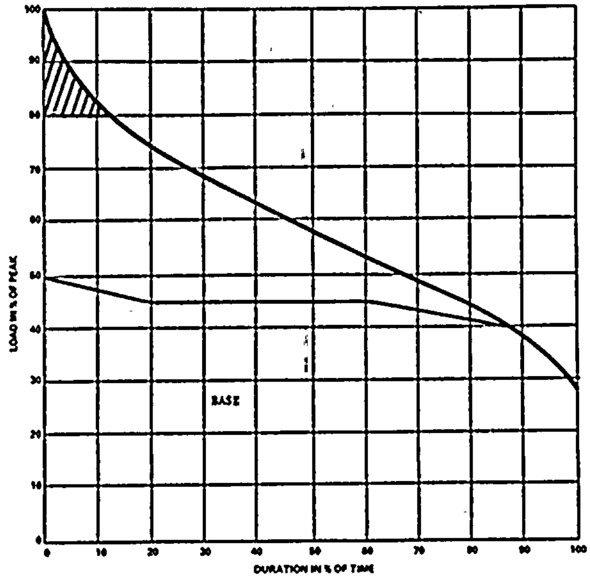
b) Reduction of Peak Demand

The discussion at 8.1 of the DES, based in large part on FPL's ER, is not sufficient basis for consideration of energy conservation alternatives. It emphasizes peak demands and the need to add capacity in order to meet forecasted peak demands. In fact, meeting peak demand is almost an incidental function of base load capacity. Even the most drastic reduction in peak demand would not affect FPL's need for base load nuclear capacity. Instead such a reduction would reduce the need for peaking capacity.

This principle is illustrated by Figure 6, which is a projected load duration curve for 1980 with the peak, above 80% of the forecasted peak, "chopped off." Such a perfect leveling of usage during peak hours could be achieved only by interrupting selected customers and/or by shedding the load imposed by particular communities or geographical regions so as to reduce peak usage. A less graphically perfect leveling out arguably could be achieved by imposition of economic penalties on "on-peak" users.

Nuclear capacity is planned on the basis of the right hand side of the load duration curve and with practically no regard for peak demand. The "energy conservation alternative" most commonly mentioned in AEC proceedings--imposition of a higher price on those who contribute to peak demand--actually contemplates diversion of usage from "on-peak" to "off-peak" times. This would occur because any increase in "on-peak" rates, would probably shift consumption to "off-peak" periods. The result is a leveling of the entire load duration curve, increasing the need for base load capacity.

FIGURE 6



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PROJECTED ANNUAL LOAD DURATION CURVE - 1973-1982

Accordingly, a reduction in peak demand will not reduce the need for base load nuclear capacity, and would probably increase that need.

3. FPL's Energy Conservation Efforts

Even though energy conservation cannot remove the need for St. Lucie 2, FPL is interested in conserving energy and in reducing peak demand. FPL's efforts in this direction are set forth in response to the Staff's questions, transmitted to FPL on March 8, 1974.

Q.1. (a) Describe the duration and intensity of the advertising programs conducted by the applicant during the last three years.

(b) If promotional advertising has been terminated, when was this type advertising terminated.

A.1. Promotional advertising to encourage the use of electricity was terminated by Florida Power & Light Company in 1971. Since then, Florida Power & Light Company has been conducting communications programs to educate the public in wise energy management and conservation. The rapid population growth occurring in Florida has been emphasized to the public by Florida Power & Light Company to encourage energy conservation. Furthermore, since 1971 Florida Power & Light Company has stressed energy conservation during the peak summer hours when air conditioning loads are highest. These conservation programs have been utilized in addition to an environmental awareness program emphasizing the part played by electricity in meeting the problems of pollution.

The "Watt Watcher" program has been developed extensively to inform the public of methods by which electrical energy can be conserved.

A copy of the "Watt Watcher's Guide to Economy and Efficiency," which has been distributed widely in both English and Spanish languages, is Enclosure 1. In addition to recommendations for optimum use of appliances, Florida Power & Light Company developed suggestions for appliance maintenance to reduce energy requirements. Furthermore, company representatives visit public and private schools within the Florida Power & Light Company service area on a weekly basis to involve teachers and students in the program.

An example of one of the current programs is one which teaches customers how to read their electric bills. By stressing that consumption (kilowatt-hours) is the only item on their bills which the customers can directly control, this program draws together the previous programs on conservation methods, and at the same time emphasizes that it is the consumer who controls consumption. Present programs are being communicated to the public through the newspaper (30 newspapers) and radio (44 stations) media. Plans also are being formulated to utilize 13 television stations.

Q.2. Identify the regulatory commissions or bodies that regulate the retail price of electricity in the applicant's service area.

A.2. The Florida Public Service Commission is the regulatory commission which regulates the price of electricity in the area serviced by Florida Power & Light Company.

Q.3. (a) Describe the various types of interruptible sale contracts that the applicant has. (b) Provide the size (MWe) of interruptible sale for each type described in 3(a).

A.3. While Florida Power & Light Company has no contracts which

Provide for total interruption of service to a customer, the Company has developed two rate schedules which are available to customers who contract to curtail their *demands* upon request by the Company. These two rate schedules are: CG - Curtailable General Service (Enclosure 2), and CI - Curtailable Industrial Service (Enclosure 3). Both provide economic incentives to customers who are willing to accept occasional partial curtailments in service. Moreover, both rates are designed to reward high monthly load factor, and ratchet provisions penalize those whose annual peak demand substantially exceeds normal requirements. Approximately 260 customers are served under schedule CG, and 3 customers are served under schedule CI. These customers constitute a power load of 250 Mw which is curtailable, if necessary, during the peak hours of the year.

Q.4. Describe the applicant's record of load shedding and load curtailment methods used in the last five years. Information should be supplied as cumulative duration of time by month and by methods. This information should include 3% voltage reduction, 5% voltage reductions, curtailment of electric power usage by the utility, voluntary curtailment by large commercial and industrial customers, and discontinuing service to contractually interruptible loads.

A.4. FPL's Procedure for Emergency Load Management is set forth in Enclosure 4. Steps 1 and 2 on Enclosure 4 do not involve interruption or curtailment of service to customers other than

FPL itself and those who have contracted to curtail their *demands* when requested. While these two steps are the first measures taken during an emergency, they are, to some extent, planned curtailments. On the other hand, all of the Steps beyond Step 2 are genuine emergency measures which result in the interruption of service to customers who are under no contractual obligation to curtail their usage.

Step 3 consists of the Phases shown on Enclosure 5. This, from Phase 2 on, is "*load shedding*"--the *automatic disconnection* of portions of FPL's service area. The result is a local, and possibly regional, electric blackout. Because FPL operates in parallel with other electric systems in Florida, a decline in system frequency which results in the necessity to shed load affects the entire state. Enclosure 6 lists the occasions that load has been shed in the past 5 years.1/ Obviously, depriving whole communities of electricity is not an acceptable means of reducing peak demand. Accordingly, FPL resorts to Step 3 only in emergencies, where the loss of one or more generating or major transmission facilities requires action to avoid a cascading power failure.

1/ It should be noted that the duration of periods during which load was shed is not included. Since load shedding is used to prevent further degeneration of the mismatch between load demand and generating capacity, relaxation of load shedding depends on the availability of generating capacity to pick up more load. This, in turn, *depends* on the configuration of the entire Florida Power & Light Company System, which will change as a result of the particular situation. Consequently, it is impractical to identify when the previously shed loads are all regained.

A summary of all curtailments of the loads of individual customers is contained in Enclosure 7. FPL has not experienced voltage reductions during the period 1969-1973. Studies by the Company have indicated that insignificant savings of energy would result from voltage reductions on the FPL system; and such reductions can cause damage to electric motors and equipment.

Q.5. Describe any impact on demand resulting from the recent conservation activities in the applicant's service area.

A.5. As stated above, customers representing 250 Mw of load have converted to the CG and CI rates. It is more difficult to measure the effect of the customer education program. However, energy usage during the winter 1973-1974 was appreciably lower than projected. For at least the past 25 years, FPL's sales have increased at a rate of *approximately* 12% annually. An 11% increase has been projected for the year 1974. Instead, in November, 1973, an increase in Kwh sales of only 3% over November, 1972 was experienced. December, 1973, showed an increase of 6% over December, 1972; and January, 1974, showed a decrease of .09% as compared with January, 1973. Florida has experienced mild weather during these months; but, unquestionable, cutbacks in use of electricity by FPL customers have also contributed to this reduction in consumption.

X. Alternative Sites

Section 9.1.2 of the Draft Environmental Statement compares the impact of the addition of Unit No. 2 at the St. Lucie site with the alternative of installing such a unit on another coastal site. The FPL Environmental Report perhaps discusses in more detail how the environmental impacts caused by construction of a new unit at a new site will be much greater than that caused by further development at the existing site.

Section 9.2 of the FPL Environmental Report points out that:

(1) At a new site a deep excavation of perhaps 40 feet must be made for the entire plant area in order to prepare the foundation material to support the heavy loads imposed, while the area to be occupied by the proposed facility at St. Lucie has already been excavated to a 60 foot depth and backfilled with suitable compacted material when Unit No. 1 was constructed.

(2) At a new site, circulating water intake and discharge canals would have to be dug, while at St. Lucie the existing circulating water canals can be utilized.

(3) At a new site, a new transmission corridor would be required, while at St. Lucie the transmission corridor and construction were virtually completed as part of the initial construction at that site.

It was also pointed out that initial construction at any new site would have to be planned as a multiple unit installation in order to prove economical, thus the additional incremental impact at a new site would, in fact, be even greater than the factors previously mentioned for the addition of just one unit.

The applicant believes that these points must be emphasized in that part of the FES which discusses site alternatives in order to provide a true perspective on the overwhelming advantages of the St. Lucie site from an environmental standpoint.

XI Hobe Sound

Applicant suggests that at the end of Section 2.2 or at another appropriate place in the DES the Staff may wish to make reference to the Wildlife Sanctuary at Hobe Sound, which is approximately 20 miles southeast of the plant site. At this considerable distance from the site, the environmental effects of the St. Lucie facility are essentially non-existent.

In terms of thermal effluents, it is obvious from the Staff's discussion in Section 5.2.3 that no effects will be detectable at a distance of 20 miles from the planned site. Indeed, the 1° isotherm resulting from the combined operation of Units 1 and 2 is only 3,372 acres. Any variation which might remotely occur in the thermal gradient at Hobe Sound would be well within the magnitude of those variations which normally occur as a result of meteorological conditions.

The Staff's analysis in Section 5.4 of the DES demonstrates that, near the plant, normal operation of the facilities will contribute only a small increment (from both liquid and gaseous effluents) to the total body dose otherwise received from natural background radiation. At a distance of 20 miles, the radiological effects of plant operation on Hobe Sound will be undetectable.

XII MISCELLANEOUS COMMENTS

A) Pages 1-2 and 1-3: Status of Reviews and Approvals: The list of reviews and approvals should be revised. The Florida Electric Power Plant Siting Act, Chapter 73-33, 403.501, and 403.516, now encompasses the permit requirements under the Florida Department Pollution Control, Chapter 17-17, of the power plant certification status. This includes the fourth, sixth, seventh, eight, ninth, and tenth items in the table on pages 1-2 to 1-3. Additionally, the Florida Public Service Commission must review the application from the standpoint of power requirements. The applicant has filed applications for the above approvals. Applications for other permits will be filed in a timely manner.

B) Page 2-25, Third to last paragraph: Add the following sentence to the end of the paragraph: "While Section 2.73 of the Environmental Report lists several species of 'rare or endangered' animals, which may visit or be resident on Hutchinson Island, the Applicant has found no evidence that they reside on the site."

C) Page 3-7, Section 3.2, last paragraph: In the first sentence, delete the words "each comprised of 176 fuel rods." and insert the words, "73 of which will contain 236 fuel rods per assembly, 80 of which will contain 220 fuel rods per assembly and 64 of which will contain 230 fuel rods per assembly" (contained in PSAR Amendment 4).

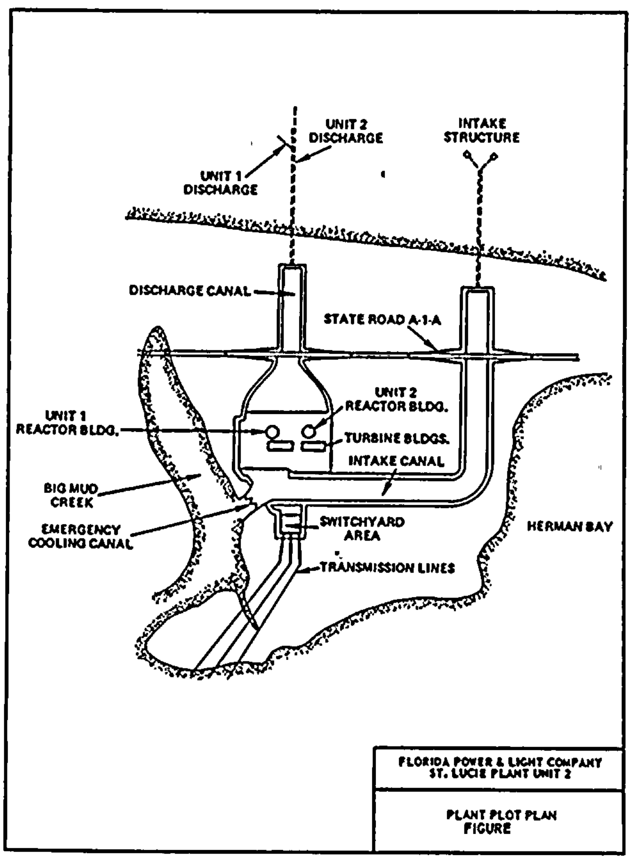
In the second sentence, delete the words "in a 0.44 inch diameter", and insert in lieu thereof "in a 0.382 inch (outer diameter)".

In the last sentence, substitute "81.6" for "85.4".

D) On page 3-9, Section 3.4.1: In the second paragraph, substitute "400" for "450".

In the last paragraph, revise the second sentence to read as follows: "a recent agreement with the Flood Control District limits the water drawn from Big Mud Creek to 4 million gallons per year for testing."

E) Pages 3-14 to 3-16: Substitute the following for Section 3.4.3 "Since a potential for marine growth on the inside of the intake pipe lines exists, present design considerations allow for the installation of oversized intake pipes. This design consideration should mitigate biological fouling as a problem during plant operations. Accordingly, Florida Power & Light Company has no present plans to use thermal defouling or any other defouling measures on the ocean intake lines. As a contingency, studies of alternative systems will be reviewed should marine growth become a problem in later years. Even though thermal defouling may be among alternatives to be considered, no such system for this purpose will be installed until subsequent experience shows it to be necessary and it has been reviewed by the AEC Staff to assure its compliance with applicable water quality and other environmental requirements." Since the applicant's present plans do not provide for thermal defouling, the recirculational canal in the site plot plan should be revised for the FES as depicted in the attached figure.



F) Page 3-34, last paragraph: Change "Chlorine gas will be pumped" to "A chlorine solution will be introduced." With dilution and the chlorine demand of the dilutant water, concentration of free residual chlorine will be 0.1 ppm or less at the terminus of the discharge canal.

G) Page 3-35, Section 3.7.2: Substitute the following revised section: "The four coarse screens consist of a fixed rack with 3" spacing to holdup large pieces of trash. The rack is cleaned with a manually operated rake that is lowered over the rack with the aid of a monorail hoist. The four traveling screens consist of a continuous belt of baskets fitted with copper mesh screen with a clear opening of 3/8". The basket speed is variable from 2.5 to 10 fpm. Debris is cleaned from the baskets by fixed spray nozzles that wash the debris into a sluiceway where it is routed to a sheet-pile holding pit or to the settling basin installed at the south end of the plant island. The screen wash water flow rate is approximately 250 gpm for each screen. The traveling screens are normally operated in the automatic mode where in a differential water level across the baskets initiates operation."

H) Page 3-37, Section 3.7.5: Delete the sentence which reads "Strainers will be installed to reduce the amount of particulates passing through the condenser tubes." and replace with "Water velocity in the tubes will be maintained at less than 7fps to reduce the potential for erosion."

I) Page 4-1: In order to minimize impact on the natural beach dune during construction of the Unit 2 ocean discharge line, the Staff states that it will be advantageous to install a stub line for Unit 2 through the dune at the same time the dune is breached for the Unit 1 discharge line. Applicant recognizes that it may be advantageous to install a stub line for Unit 2 through the dune at the same time the dune is breached for the Unit 1 discharge line. However, the process of obtaining the required permits, as well as the design, procurement and construction schedules of Unit No. 1, may preclude this. The Applicant is conducting an investigation to determine the feasibility of installing a stub line for Unit 2 during the construction of the Unit 1 discharge line. If the Unit 2 stub line can be installed simultaneously with the construction of the Unit 1 discharge line, the Applicant will make an effort to do this, subject to Commission approval. If not, the Applicant will insure that adverse effects are minimal by (i) providing a temporary dune line during construction of the Unit 2 line, and (ii) by replanting the dune line with natural plants indigenous to the area.

J) Page 5-7, Section 5.2.3.1: It should be noted that the existing NPDES permit applies only to Unit 1. Timely application will be made for an appropriate NPDES permit for Unit 2.

K) Page 9-4, Section 9.1.3

Geothermal energy is currently being developed as a power source in Europe and to a limited extent in the northern part of this country. However, there are no known sources of geothermal energy in Florida. Solar power and power generated by the wind are also being studied. Neither of these sources are expected to be commercially feasible within the time frame involved here; and, in any event neither could serve as a source of base load generation. None of these can be considered a viable alternative.

Nuclear fusion is being developed as a future source of energy, but an experimental demonstration fusion plant is not expected to be built

before 1990. Therefore, fusion cannot be considered a viable alternative at this time.

L) NUMERICAL CHANGES

Page 2-14: Change the tidal range in the Indian River from "1 ft." to "0.5 ft".

Pages 3-26 to 3-30: In accordance with the assumptions and calculations used in Amendment No. 3 to the Environmental Report, the following changes should be made:

Page 3-26, Section 3.5.2: Change Y 91m 1.1 (3) to Y 91m 1.1 (-3).

Page 3-27, Section 3.5.2.2: Change 430 Ci/yr to 93 Ci/yr; change 0.14 Ci/yr to 0.09 Ci/yr radioiodine; change 50 lb/hr to 10 lb/hr.

Page 3-29, Section 3.5.3.2: Change 210 Ci/yr to 643 Ci/yr; change 0.022 of Iodine-131 to 0.23 Ci/yr of radioiodine; change 10 gpm to 20 gpm; change 0.0073 Ci/yr of Iodine - 131 to 0.039 Ci/yr radioiodine.

Page 3-30, Section 3.5.2.3: Change 1.43 Ci/yr for Iodine - 131 to 0.128 Ci/yr for radioiodine; change 1.6 Ci/yr to 0.18 Ci/yr; change 0.14 gpm to 14 gpm.

Page 5-15, Section 5.43: Change the height of the plant vent from 140 to 184 feet.

FLORIDA POWER & LIGHT COMPANY

Fourth Revised Sheet No. 8.501
Cancels Third Revised Sheet No. 8.501

CURTAILABLE GENERAL SERVICE -- Rate Schedule CG

AVAILABLE:

In all territory served.

APPLICATION:

This rate is available to any customer who contracts to curtail his Demand by 200 kw or more upon request of the Company from time to time.

SERVICE:

Single or three phase, 60 cycles and at any available standard voltage.

All service required on premises by Customer shall be furnished through one meter. Stand-by or resale service not permitted hereunder.

MONTHLY RATE:

DEMAND CHARGE

$670 for the first 200 kw or less of Demand.
$2.80 per kw for the next 300 kw of Demand
$1.62 per kw for each additional kw of Demand.

ENERGY CHARGE

1.21¢ per kwh for the first 280 kwh per kw of Demand.
0.76¢ per kwh for all additional kwh.

OFF-PEAK CREDIT

$1.00 per each kw that the On-Peak Demand is less than the Demand during the current billing period, but not more than $1.00 per kw times 80% of the billing Demand.

Minimum: The charge for the currently effective Demand.

Adjustment: The amount computed at the above Monthly Rate shall be adjusted minus or plus by an amount calculated in accordance with the formulae specified in the Company's Fuel and Tax Adjustment Clauses which are incorporated by reference as a part of this Rate Schedule and as filed with the Florida Public Service Commission.

DEMAND:

The Demand is the kw to the nearest whole kw, as determined from the Company's demand meter for the 30-minute period of Customer's greatest use during the month as adjusted for power factor, but never less than any excess above 200 kilowatts of the greatest such adjusted measured demand in the preceding eleven months.

ON-PEAK DEMAND:

On-Peak Demand is the kw to the nearest whole kw as determined from the Company's recording demand meter for any 30-minute interval during a period of curtailment requested by Company.

TERM OF SERVICE:

Not less than one year.

RULES AND REGULATIONS:

Service under this schedule is subject to orders of governmental bodies having jurisdiction and to the currently effective "General Rules and Regulations for Electric Service" on file with the Florida Public Service Commission. In case of conflict between any provision of this schedule and said "General Rules and Regulations for Electric Service" the provision of this schedule shall apply.

Issued by: Marshall McDonald, President
Effective: November 30, 1973

Enclosure 2

FLORIDA POWER & LIGHT COMPANY

Fifth Revised Sheet No. 8.540
Cancels Fourth Revised Sheet No. 8.540

CURTAILABLE INDUSTRIAL SERVICE - Rate Schedule CI

AVAILABLE:

In all territory served.

APPLICATION:

This rate is available to any industrial customer who contracts to curtail his demand at the request of the Company.

SERVICE:

All service required on the premises by the Customer shall be furnished through one meter at an available transmission voltage of 69 kv or higher.

MONTHLY RATE:

CURTAILED SERVICE

$34,340 for the first 6,000 kw or less, including 3,000,000 kwh

$5.05 per kw for demands in excess of 6,000 kw, including 500 kwh per kw.

Kwh used in addition to the above quantities shall be billed at 7.32 mills per kwh.

UNCURTAILED SERVICE

When the Customer fails to comply to the Company's request to curtail load in the amount contracted for, the charge for demands in excess of 6,000 kw becomes $6.25 per kw applicable to the uncurtailed kw of demand during the current billing period.

Adjustment: The amount computed at the above Monthly Rate shall be adjusted minus or plus by an amount calculated in accordance with the formulae specified in the Company's Fuel and Tax Adjustment Clauses which are incorporated by reference as a part of this Rate Schedule and as filed with the Florida Public Service Commission.

DEMAND:

The kilowatts determined from Company's demand meter for the 30-minute period of Customer's greatest use during the month adjusted for power factor, but not less than 80% of the maximum kw so determined during the 12 months ending with the current month, nor ever less than the kw contracted for.

(Continued on Sheet No. 8.541)

Issued by: Marshall McDonald, President
Effective: November 30, 1973

Enclosure 3

FLORIDA POWER & LIGHT COMPANY

Fourth Revised Sheet No. 8.541
Cancels Third Revised Sheet No. 8.541

(Continued from Sheet No. 8.540)

Rate Schedule CI - Page 2

TERM OF SERVICE:

Not less than one year.

SPECIAL CONDITIONS:

The Customer will provide and maintain all transformers and related facilities necessary for handling and utilizing the energy delivered hereunder. The Company, at its option, may install metering equipment on the low voltage side of the transformers and, in such case, both the demand indication and the energy registration will be increased to compensate the Company for transformer losses by computing such losses based upon the manufacturer's data pertaining to the specific transformers installed.

RULES AND REGULATIONS:

Service under this schedule is subject to orders of governmental bodies having jurisdiction and to the currently effective "General Rules and Regulations for Electric Service" on file with the Florida Public Service Commission. In case of conflict between any provision of this schedule and said "General Rules and Regulations for Electric Service" the provision of this schedule shall apply.

Issued by: Marshall McDonald, President
Effective: May 10, 1973

Enclosure 4

PROCEDURE FOR EMERGENCY LOAD MANAGEMENT

General

Emergency load control is most likely to become necessary during extreme cold or hot weather, and this procedure has been prepared accordingly. It may be necessary, however, to utilize this procedure during normal weather in the event of prolonged loss of major generation or transmission facilities.

Load Control Procedures

When it has been determined that emergency load control measures will necessary, it will be accomplished by one or more of the steps listed below. The order in which these steps are to be taken will depend somewhat on the situation in the various major generation areas of the system.

The general outline of procedure and channels of communication is shown on the accompanying chart (not included). The detailed procedure for each step is given below:

Step 1 - Reduce non-essential utility loads.
General Office - Transfer load to emergency diesel generators. Other Company Facilities - Turn off all unnecessary lights particularly outside lights consistent with safe operating and security practices. This includes outside lights for substations, power plants and service centers. Turn off or reduce air conditioning load where possible.

Step 2 - Notification of Customers with Curtailment Clauses in Contract
When this step is to be taken, Group Vice President - Divisions, will notify the appropriate division general managers by telephone, of the customers to be requested to drop load. Group Vice President - Divisions, will confirm this request by mailing to the division general managers an Emergency Load Control Notice with copies to interested General Office personnel.

The division general manager will have the necessary contacts made. The next day, or as soon as possible thereafter, he will advise Director of Rate and Research Department by telephone, the load reduction effected and confirm by mail.

Step 3 - Activate Step 0 underfrequency relays to the extent required to maintain FPL's spinning reserve allocation.

Step 4 - Request Large Customers to Voluntarily Reduce Load
Each division general manager is to keep Group Vice President - Divisions, currently advised of customers in his division that will voluntarily reduce load during an extreme emergency.

Upon notification by Group Vice President - Divisions, that Step 4 is to be taken, division general managers are to contact these customers to request their cooperation in load reducing. On the following day a report of customers cooperating in an estimate of load reduction effected is to be telephoned to Director of Rate and Research Department and confirmed by mail.

Step 5 - Reduce System Voltage - Upon the direction of Manager of System Operations, feeder regulators will be blocked in accordance with the Emergency Load Management manual, approximately 15 to 30 minutes prior to reducing system voltage.

Step 6 - Appeal to the Public - In the event that major generation or transmission facilities are lost for a prolonged time and the foregoing load control measures are not sufficient or practicable, appeals are to be made to the public in the form of frequent spot announcements over radio and TV facilities.

Appropriate announcements and plans for getting them on the air are to be prearranged by Director of Corporate Communications. This step is to be taken only upon the authority of Chairman of the Board, President & Chief Executive Officer, Executive Vice President (Corporate Communications, Right of Way, Tax, and Personnel) or Group Vice President - Divisions.

Step 7 - Interrupt Service - Pre-selected distribution feeders which do not serve loads essential to the public welfare will be interrupted on a rotating basis. Manager of System Operations, will keep records of interruptions so as to insure equitable rotation.

Enclosure 3

Emergency Procedures During Declining System Frequency

Emergency procedures will be implemented as follows:

Phase 1: From 60.0 Hz to 59.2 Hz, all operating reserves and emergency measures should be utilized to the fullest practicable extent. The manner of utilization of these reserves will depend greatly on the behavior of the system during the emergency.

In cases where frequency declines rapidly, only that capacity on line and automatically responsive to frequency (spinning reserve), and such items as interconnection assistance, and load reductions by automatic means are of assistance in arresting the decline in frequency.

If the frequency decline is gradual, the system dispatcher(s) of the system(s) in trouble should invoke non-automatic emergency procedures. This would include the starting of gas turbines, interrupting load, purchasing power, etc. These efforts should continue until the frequency decline is arrested. Generally speaking, it is the responsibility of the system(s) in trouble to take whatever action is necessary to restore the frequency to 60 Hz, and the system dispatcher(s) of such system(s) should take the lead in taking positive action, discribing the trouble, asking for assistance, etc. If his actions do not produce results fast enough, the other system dispatchers may have to apply their judgements in assessing a given situation, taking action, and/or rendering assistance without being requested. No hard and fast rules can be made except that all possible cooperation and communications between system dispatchers will be required. If interruptible loads are counted as spinning reserves they should be capable of being disconnected from the system by underfrequency relays to assure their removal prior to Phase 2.

Phase 2: At 59.0 Hz shed with automatic load shedding relays not less than 10 percent of system load. No intentional time delay should be used beyond that absolutely required to avoid improper relay operation.

Phase 3: Between 58.8 and 58.7 Hz inclusive, shed additional load with automatic load shedding relays in an amount not less than 10 percent of system load existing prior to Phase 2. This amount of load should be shed in two nearly equal steps at 58.8 and 58.7 Hz. No intentional time delay should be used beyond that absolutely required to avoid improper relay operation.

Phase 4: Between 58.6 and 58.5 Hz inclusive, shed additional load with automatic load shedding relays in an amount not less than 10 percent of the system load existing prior to Phase 2. This amount of load should be shed in two nearly equal steps at 58.6 and 58.5 Hz. No intentional time delay should be used beyond that absolutely required to avoid improper relay operation.

Phases 5 through 11 not shown.

FLORIDA POWER & LIGHT COMPANY
RECORD OF LOAD SHEDDING
(1969 through 1973)

DATE	TIME	CAUSE	LOAD SHED
1/28/69	6:08 P.M.	Loss of Port Everglades Plant	255 MW
8/5/69	6:08 P.M.	Loss of Port Everglades Plant	568 MW
8/18/71	5:48 P.M.	Loss of five Lauderdale gas turbines	131 MW
4/3/73	9:37 A.M.	Loss of Turkey Point 3 and Port Everglades 3 & 4	1230 MW
4/4/73	9:14 A.M.	Loss of Turkey Point 3 and Port Everglades 3 & 4	1330 MW
6/23/73	2:05 P.M.	Dade-Flagami 138 KV circuit faulted	2190 MW

Enclosure 6

FPL - RESULTS OF LOAD CURTAILMENT

Date	Load Curtailment Period	Number of Customers	Amount of Load Curtailed-Kw
12/16/68	5:00 - 7:00 PM	155	115,688
7/7/69	4:00 - 7:00 PM	46	87,240
7/8/69	4:00 - 7:00 PM	58	86,210
7/9/69	4:00 - 7:00 PM	67	77,980
1/8/70	5:00 - 9:00 PM	281	151,680
1/9/70	6:30 - 10:30 AM	204	131,080
1/9/70	5:00 - 9:00 PM	337	161,290
1/10/70	7:00 - 10:30 AM	254	148,910
1/10/70	5:00 - 9:00 PM	215	131,410
2/4/70	5:30 - 9:00 PM	182	122,660
7/15/70	4:45 - 7:00 PM	106	82,699 - Voluntary
7/16/70	4:30 - 7:00 PM	98	72,603 - Voluntary
7/27/70	4:00 - 7:00 PM	119	87,616 - Voluntary
7/28/70	4:30 - 7:00 PM	118	79,665
7/31/70	12:00 N - 10:00 PM	211	173,592
8/3/70	3:00 - 7:00 PM	349	112,237 - Voluntary
8/4/70	4:00 - 7:00 PM	108	80,422 - Voluntary
8/5/70	4:00 - 8:00 PM	317	104,452 - Voluntary
9/2/70	4:00 - 7:00 PM	256	105,570 - Voluntary
9/3/70	4:00 - 7:00 PM	137	90,072 - Voluntary
1/20/71	5:00 - 9:00 PM	467	175,272
4/29/71	4:00 - 8:00 PM	703	202,110
4/30/71	4:00 - 8:00 PM	498	149,372 - Voluntary
6/16/71	4:00 - 7:00 PM	572	162,082 - Voluntary
8/18/71	3:00 - 7:00 PM	684	246,788

FPL - RESULTS OF LOAD CURTAILMENT (CONT.)

Date	Load Curtailment Period	Number of Customers	Amount of Load Curtailed kW
7-3-72	4:00 - 8:00 PM	444	140,002
7-5-72	4:00 - 8:00 PM	577	180,871
7-28-72	4:00 - 8:00 PM	609	228,357
7-29-72	4:00 - 8:00 PM	321	87,728 (Voluntary)
9-7-72	4:00 - 8:00 PM	692	242,079
9-14-72	4:00 - 8:00 PM	671	256,170
9-15-72	4:00 - 8:00 PM	683	263,760
9-18-72	3:30 - 8:00 PM	678	266,142
9-19-72	3:30 - 8:00 PM	692	263,977
9-25-72	4:00 - 8:00 PM	668	241,032
9-26-72	3:00 - 7:00 PM	682	275,734
9-27-72	3:30 - 7:00 PM	704	262,546
5-28-73	4:00 - 8:00 PM	85	57,350 (Holiday)
5-29-73	2:00 - 8:00 PM	267	229,650

Enclosure 7

APPENDIX B

FLORIDA POWER & LIGHT COMPANY'S

PARTIAL RESPONSE TO

COMMENTS RECEIVED ON THE

DRAFT ENVIRONMENTAL STATEMENT

B146

P.O. BOX 3100 MIAMI, FLORIDA 33101

FLORIDA POWER & LIGHT COMPANY

April 17, 1974

RECEIVED APR 30 1974

Mr. William H. Regan, Jr., Chief
Environmental Projects Branch #4
Directorate of Licensing
Office of Regulations
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Regan:

Re: St. Lucie Plant Unit 2 - Docket No. 50-389
<u>Responses to Comments on the Draft Environmental Statement</u>

In accordance with your letter of April 2, 1974, Florida Power & Light Company submits the following response to the comments on the Draft Environmental Statement forwarded by your letters of April 2,4 and 9.

In their letter dated March 6, 1974, the Advisory Council on Historic Preservation requests that it be provided with specific information as to the nature and extent of any archeological resources in the project area.

Enclosed are letters from the State of Florida Board of Archives and History reporting the results of an archeological survey of the project area. The area reported as having mounds and middens and the unsurveyed areas will not be affected by the proposed construction on St. Lucie Unit 2.

Very truly yours,

Robert E. Uhrig
Director of Nuclear Affairs

REU:lc
Attach.

cc: Mr. Jack R. Newman
Pacific Northwest Laboratories (Attn: Mr. R. Widrig)

STATE OF FLORIDA

BOARD OF ARCHIVES AND HISTORY

June 17, 1969

Mr. Norris Kincaid
Florida Power and Light Company
General Office Building
Miami, Florida 33101

Dear Mr. Kincaid:

The enclosed archaeological survey report from A. R. Saltus covers only those areas of planned construction. Please note the field map indicating the presence of significant archaeologial remains bordering Blind Creek. Should the Florida Power and Light Company plan development in this area, the Florida Board of Archives and History would require adequate time for archaeological field research. The Hammock areas situated between Big Mud Creek and Blind Creek are to date unsurveyed. We plan to complete our surface reconnaissance within the next few weeks.

The Florida Power and Light Company's cooperation in these sites of historic significance is truly appreciated. It is only through such interest and cooperation that Florida's rapidly disappearing historic heritage can be properly researched and interpreted.

Very sincerely,

L. Ross Morrell
State Archaeologist

LRM/sr

Enclosure

HELPING BUILD FLORIDA

STATE OF FLORIDA

BOARD OF ARCHIVES AND HISTORY

May 28, 1969

Ross Morrell
State Archeologist
Board of Archives and History
401 E. Gaines Street
Tallahassee, Florida 32301

Dear Ross:

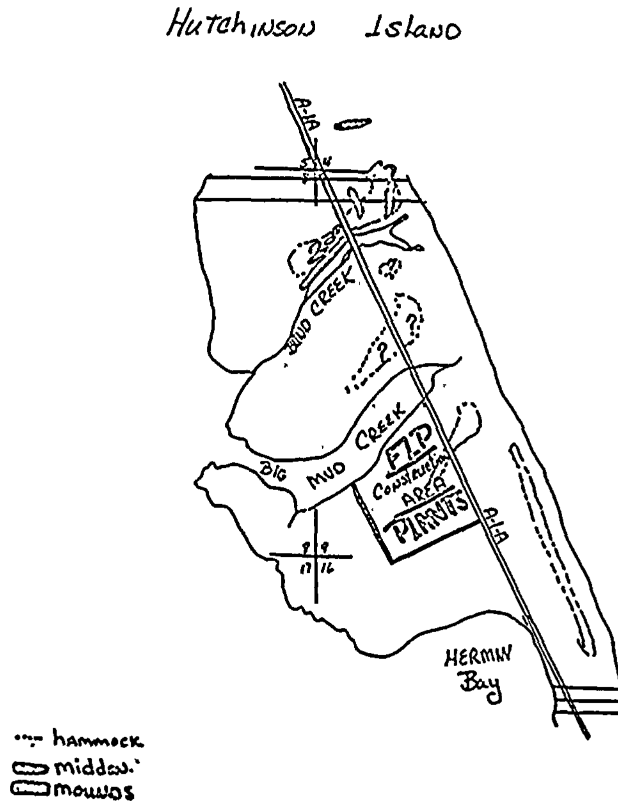
The area in which Florida Light and Power is to construct their power plants has been site surveyed. This area lies on the peninsula between Herman's Bay on the South and Big Mud Creek to the North. All of this area will not be under construction. The area from Mud Crest to 2,300 South and A1A to 2,400 feet West, incompassed the construction area. No habitation is evident with much of the area under one to two feet of water, lying on top of 3 to 5 feet of black muck. One small hammock tounges into the area rising two to three feet above the water level. Very few oaks are in the area with vegetation mostly of palm and low shrubs and vines.

The remainder of Florida Light and Power's land as yet has not been completely surveyed. North of Blind Creek there is a large midden and sterile mounds West of A1A. On the East end of this same hammock, which is divided by A1A, there is a long high (4 to 8 foot elevation) mound with a high burial mound at one end. The burial mound was destroyed during the Naval occupation of this area in WW II. The long mound however, still exists with smaller mounds slightly to the West, yet still East of A1A. Aerials of the burial mound, as it was before WW II, are available.

The area between Blind Creek and Big Mud Creek has yet to be done completely. When this is completed a detailed report will follow. It seems appropriate to inform you that no historical damage will be done by this project as planned to date.

Respectfully,

Allen R. Saltus Jr.



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APPENDIX C

FLORIDA POWER & LIGHT COMPANY'S

PARTIAL RESPONSE TO

COMMENTS RECEIVED ON THE

DRAFT ENVIRONMENTAL STATEMENT

P. O. BOX 013100, MIAMI, FLORIDA 33101

FLORIDA POWER & LIGHT COMPANY

May 3, 1974

Mr. William H. Regan, Chief
Environmental Projects Branch #4
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Regan:

Re: St. Lucie Plant Unit 2 - Docket No. 50-389
Second Set of Responses to Comments on the
Draft Environmental Statement

We have reviewed the Commerce Department, Interior Department and Environmental Protection Agency comments on the Draft Environmental Statement for St. Lucie Unit 2. Our responses to the most significant comments are provided in the attached itemized statements. Where several agencies made comments on similar subject matter, reference is made to only one of the respective items to minimize repetition.

Yours very truly,

Robert E. Uhrig
Director of Nuclear Affairs

REU:nch
Encl.

cc: Mr. Jack R. Newman
Mr. Richard Widrig

Department of Commerce Letter, April 10, 1974

Item 1 - Physical Oceanography Aspects

Chapter 5 of the St. Lucie Plant Unit 2 Environmental Report discusses in detail the thermal analysis and effects of the heat dissipation system. Even though the discussion presented in Chapter 5 of the AEC's Draft Environmental Statement is based on a similar analysis, details of the analysis can be found in the Environmental Report. The conceputal design of the heat dissipation system and the thermal-hydraulic analysis of the heat dissipation system for the St. Lucie Plant is based on the use of analytical models and conservative assumptions. The accuracy of these models has been verfied in both the laboratory and in the field. The analysis and discussion in Chapter 5 of the Environmental Report shows that the surface temperature rises and isotherm areas are confined to a very small area with a minimal environmental impact.

The analysis considers both the near field and the far field characteristics of the jet. The methodology for the preliminary analysis of the near field characteristics is based on the works of Brooks (3*) and others (4 to 12,14). This analysis was refined using the results from Koh and Fan's (13) model and Jirka and Harleman's model (20) which showed an absolute maximum ocean temperature rise of 1.5F from Unit No. 2 and 5.5F from Unit No. 1 when operating the plant at full capacity during September weather conditions. Some of the typical results obtained with the aid of the above models are shown in Figures 5.1-2 and 5.1-7 and Tables 5.1-1 and 5.1-2. However, in obtaining these results, assumptions have been made to add conservatism to the values obtained.

For the far field analysis of the Unit No. 2, the near field temperature rise discussed above (that is 1.5F) is used as the near source boundary condition. Even though the studies conducted by Adams (18) and others (17,19) show that the average temperature rise would be much lower than 1.5F (for instance, studies of Baumgartner and others (17) predict a surface temperature rise of about 0.35F), the far field analysis shown in Chapter 5 is carried out assuming an initial source temperature of 1.5F to add a degree of conservatism to the results obtained.

Ditmars (22) has developed a model which gives the far field temperature distribution in large flow environments for heated sources of finite extent. The final equation in Ditmars model is given as follows:

$$\frac{T}{T_0} = \frac{e^{-\frac{KS}{hv}}}{2} \cdot \left[erf\left(\frac{z+b/2}{2b} \sqrt{\frac{24}{\left[1+\frac{8K_{z_0}X}{vb^2}\right]^3-1}} \right) - erf\left(\frac{z-b/2}{2b} \sqrt{\frac{24}{\left[1+\frac{8K_{z_0}X}{vb^2}\right]^3-1}} \right) \right]$$

The details of the nomenclature and the values of the coefficients in the above formulation are explained in Chapter 5 of the Environmental

*Numbers in the superscript refer to the references presented in Section 5.1 of the Environmental Report. The referenced tables and figures are also from Chapter 5 of the Environmental Report.

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Report and in other publications (23 to 27). Using the above analysis, an estimate of the temperature in the far field region and temperature reduction was made and the isotherms were prepared. These are shown in Figures 5.1-4 through 5.1-6 and Table 5.1-3.

A similar far field analysis for Unit No. 1 is carried out assuming an initial source of 5.5F (31 to 34). Even though both Pritchard's technique and Ditmar's model (22) were examined for the far field predictions, because of the inherent conservatism in Pritchard's technique, the present analysis is carried out using Pritchard's technique. The results of the analysis are presented in Table 5.1-4 and Figures 5.1-8 through 5.1-10.

The discussion presented above shows the characteristics of thermal plume for Units 1 and 2 individually. The combined effects when the thermal plume from Unit No. 1 interferes with the plume from Unit No. 2 are discussed in Chapter 5 of the Environmental Report. The analysis shows that the near field effects of interference (36 to 39) would be to reduce the near field surface temperature rises resulting from discharges of Unit No. 1. More specifically, interference would result in a reduction of the surface areas affected by the 5F, 4F, 3F and 2F isotherms of temperature rise. Correspondingly, the interference would increase the far field surface areas affected by the 1.5F and 1F isotherms of temperature rise. Using a "linear superposition" technique of adding the two areas enclosed by the isotherms, the effective isotherm area after interference is determined. The areas obtained for different isotherms are shown in in Table 5.1-5, Figures 5.1-14 through 5.1-16 show the predicted superposed isotherm pattern.

No recirculation between the plant discharge and intake systems is expected during northerly currents or during slack current conditions. Some recirculation will occur because long shore currents prevail in a southerly direction. However, this recirculation would be insignificant during normal plant operation because of the separation distance between discharge and intake (2400 ft) and because of the design of the intake itself. In Chapter 5, a detailed estimate of the recirculation is made. The previous analysis of the far field effects show that the surface temperature rise that could be expected near the intake point would be on the order of 0.5F or less for Unit No. 2 and 1F for Unit No. 1 individually. Assuming no selective withdrawal of bottom waters into the intake, average temperature rise of water withdrawn at the intake, as a result of recirculation, would be about 0.2 to 0.3F for Unit No. 2 and about 0.5F for Unit No. 1. Selective withdrawal of bottom waters would act to further reduce this temperature rise. When both units are in operation, an estimate of the combined effect of recirculation shows that it would be on the order of 0.5F. Therefore, recirculation, if any, should not pose significant problems.

Details of the analyses presented above are given in the Environmental Report. There it is shown that the heat dissipation system as presented creates an insignificant environmental impact. The design objectives of the heat dissipation system of Unit No. 2 are to take maximum advantage of the existing facilities of Unit No. 1. This will minimize the environmental impact resulting from construction. Other alternatives, such as the interchange of the presently planned intake and discharge arrangements would not result in significant environmental gains.

Item 2 - Routine Noble Gas Release

The gas decay tank design basis is presented in PSAR Section 11.3.2. There are three tanks provided; it normally takes 12.6 days to fill a single tank and a tank is discharged at a controlled rate after 30 days. It is possible that a single tank could be discharged in about six (6) hours; however, the discharge will most likely occur over a period of one to two days.

The release rate and time of release are controlled variables subject to technical specification limits. Since the releases can be controlled to occur over a period from many hours to days and to occur many times per year, it is reasonable to treat the periodic gas decay tank releases as a continuous point source release. The appropriate χ/Q for the equivalent continous release model is the sector annual average value.

Item 3 - Meteorological and Hydrologic Interactions

The safety of the plant in regards to hurricanes has been evaluated in terms of the Probable Maximum Hurricane (PMH), discussed in Section 2.4.5 of the PSAR, and defined as representing an event approaching the physical upper limit of hurricane intensity considered reasonably probable for a general meteorological area. Maximum winds speeds of 158 mph, hourly average wind speeds of 115 mph and a 12.6 feet probable wave height that could break over the beach were used in the analysis. The plant is designed to withstand the effects of this hurricane. Storm surges and erosion as a result of hurricane induced wave action are included in the analyses which, for conservation, consider the natural dunes to be nonexistent. The first substantial barrier is the highway embankment 800 ft east of the plant. Erosion at the rate of 50cy per front foot is considered in the analysis. The results of the analysis provide a minimum margin against the wave, runup of about 5 ft (22.0ft-17.2ft) which is considered adequate. No additional analysis in regards to surges or erosion is considered necessary.

Item 4 - Impacts on Land Use-Terrestrial

Section 4.1.6 of the Environmental Report describes actions planned to minimize effects of construction on wildlife habitats. It states if construction is active in the beach area during the turtle breeding season, a nest surveillance and relocation program will be instituted on those areas of the beach affected by construction activity.

Item 5 - Entrapment of Fishes in the Intake System and Impingement of Organisms on the Intake Screens

In Amendment 5 to the St. Lucie Unit No. 2 Environmental Report (Applicant's comments on the DES), Florida Power & Light Company states our plans to "to monitor fish entrapment in the intake canal during the first year of operation to determine the extent of fish entrapment." Also in Amendment 5 we further commit to take action as may be necessary to reduce entrapment should the entrapment rates become excessive. In this case, the installation of a fish removal system would be considered. It should also be noted that even though fish might enter the intake canal via the intake velocity caps, they will not necessarily be impinged on the intake structure traveling screens since velocities in the canal are low, on the order of 0.5 fps for single plant operation and 0.9 fps for two plant operation.

Horizontal traveling screens tested to date have all required a considerable flow of water parallel to the fish-guiding portion of the screen. Such situations are generally found only on rivers. The horizontal traveling screen is generally considered relatively ineffective in an intake canal such as that at the St. Lucie Plant. Even if horizontal traveling screens were feasible, the bypass of fish and other organisms into Big Mud Creek would not be warranted. The introduction of organisms which may not normally occur in the Indian River may produce unforeseen ecological consequences and unforeseen consequences to the organisms themselves.

Concern is also expressed that high intake velocities (1 fps) will increase entrainment of fish eggs, larvae, zooplankton, etc. The methods used to calculate values for entrainment of zooplankton, fish eggs and larvae in Section 5.1.3 of the Environmental Report are flow rather than velocity dependent. Accordingly, these calculations remain valid for intake velocities of 1 fps.

Regarding velocity caps experience indicates that offshore velocity caps have been effective in Southern California where employed. In addition, EPA comments on the St.Lucie 2 DES state that "The velocity cap, as proposed by the applicant, should afford the degree of protection required to minimize significant adverse impact at this plant."

Item 6 - Passage of Organisms Through the Plant

The phytoplankton and zooplankton that pass by the plant are being carried by the prevailing ocean current because they are not large enough or mobile enough to swim independently. They are part of a population of such organisms that live their entire life cycle - reproduction, growth to maturity, death - while floating in ocean waters. The distribution of such plankters is not related to any one geographic location, nor stable in the context of a fixed group of species in a specific locale. The kinds of fish eggs and larvae found in the Hutchinson Island area are being identified as part of a preoperational biological study described in Section 6.1.1.2 of the Environmental Report.

Item 7 - Environmental Measurements and Monitoring Programs

To date, no marine vegetation other than phytoplankton has been found in the Atlantic Ocean offshore of Hutchinson Island. For this reason, aquatic vegetation has not been included as an item for radiation monitoring.

Department of Interior Letter, April 23, 1974

Item 1 - Outdoor Recreation

Florida Power & Light Company's land use plans for those areas at the St. Lucie site not directly needed in the production of electrical energy are being developed and when completed will be submitted to the appropriate agencies for review and approval.

Item 2 - Geology and Seismology

The geology and seismology section of the PSAR for St. Lucie Unit 2 (section 2.5) provides the detailed information and analyses required by 10 CFR 100, Appendix A.

Item 3 - Sea Turtles

As required by the AEC in the St. Lucie Unit No. 1 Environmental Statement, Florida Power & Light "will plant Australian pine or other suitable plants as a light screen along the beach dune line bordering its property to minimize turtle disorientation." No light screen planting associated with Unit 1 has yet been accomplished. Prior to selecting suitable plants, their effects on sea turtle nesting will be considered. The Australian pine species has existed for many years on and behind the dune line of the Florida Power & Light Company property, yet has not proliferated to the turtle nesting areas on the beach. Any portion of the light screen that is disturbed for the Unit 2 construction will be restored.

Item 4 - Intake Systems

See Item 5 under the Department of Commerce letter.

Item 5 - Solid Waste Summary

Commercial operation of St. Lucie Unit 2 is scheduled for over five years in the future. It is conceivable that additional burial sites may be licensed prior to operation of this unit, thus, specification of the site to receive solid radwaste from Unit 2 operation is premature. However, licensed facilities do exist. For example, solid wastes from the Applicant's Turkey Point facility are shipped to a licensed burial site at Barnwell, South Carolina.

Item 6 - Site Preparation

Florida Power & Light Company is continuing the investigation to determine the feasibility of installing a stub line for Unit 2 during the construction of the Unit 1 discharge line as discussed in Amendment 5 to the Environmental Report.

Presently, there are no additional units planned for the St. Lucie site.

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Environmental Protection Agency Letter, April 26, 1974

Item 1 - Dose Assessment

In Section 11.3.9 of the St. Lucie Plant Unit 2 Preliminary Safety Analysis Report (PSAR) dose potential via the cow-milk-child pathway is addressed for a distance of 2.5 miles west of the plant; the sole purpose of which is to estimate the upper limits of exposure which could be conceived for this pathway. Located between residential property and the Savannas the area is covered with dense foliage and is primarily swampy. Although some form of agricultural activity could be initiated, grazing would be quite limited and supplemental feedings would be required. Grazing animals would not eat existing vegetation exclusively. Additionally, building wake factors, cloud depletion due to deposition and nuclide decay in transport, all of which would reduce the amount of radionuclide deposition on vegetation in the grazing area, are not considered in the calculation. Thus, exposure through the cow-milk pathway, as calculated by the Applicant, is conservative.

The Environmental Report (ER) is required to assess the real world dose potential, therefore, the nearest existing cow is used as the basis for calculations as required by revised Regulatory Guide 1.42 (March, 1974) Dose estimates for this location (7.5 miles) and associated assumptions are presented in detail in Section 5.3 of the ER and Section 11.3.9 of the PSAR. The Applicant will also periodically check the general area to assure introduction of cows closer than 7.5 miles is detected. This requirement will be included in the Radiological Environmental Surveillance Program for the St. Lucie Plant.

Item 2 - Thermal and Biological Effects

a. Federal Water Pollution Control Act

Florida Power & Light Company plans shortly to initiate proceedings in accordance with Section 316(a) of the FWPCA to obtain thermal effluent requirements compatible with the currently proposed condenser cooling system.

b. Physical Oceanography Effects

See Item 1 under the Department of Commerce letter.

c. Entrapment in the Intake System

See Item 5 under the Department of Commerce letter.

d. Thermal Flushing

Florida Power & Light Company has no present plans to use thermal defouling or any other defouling measures on the ocean intake lines. This matter is discussed in more detail in Amendment 5 to the Environmental Report.

e. Chlorination

As stated in Amendment 5 to the Environmental Report, with dilution and the chlorine demand of the dilutant water, the concentration of free residual chlorine will be 0.1 ppm or less at the terminous of the discharge. At this concentration, reasonable assurance is provided that there will be no unacceptable adverse effects on aquatic biota in the Atlantic Ocean. Appropriate action would be taken in the unlikely event of unacceptable adverse effects.

Item 3 - Unit 2 Construction Personnel

Prior to critical operations of Unit 1, the construction area for Unit 2 will be separated from the Unit 1 plant by the Unit 1 Generating Station fencing which will have its southern boundary adjacent to the Unit 1 Auxiliary Building. The areas outside of the Unit 1 fenced Generating Station area will be established as "unrestricted areas" in accordance with 10 CFR 20. FPL's radiation monitoring program will require monitoring of the radiation levels at the Unit 1 Generating Station perimeter to verify that they are maintained within applicable regulatory requirements for "unrestricted areas," thus eliminating the need for individual personnel monitoring outside of the Generating Station area.

Unit 2 construction personnel whose duties require them to enter the Unit 1 Cnerating Station will be governed by the Unit 1 radiation monitoring procedures in use at that particular time.

Item 4 - Diesel Generator Noise

The normal auxiliary power for St. Lucie Unit 2 is obtained from two auxiliary power transformers which are fed from the main generator. Two additional transformers, fed from the transmission system, are provided to furnish auxiliary power in the event the main generator is not available. Two 3500 KW diesel-generator sets are provided to supply emergency auxiliary power for emergency plant shutdown. Supply of auxiliary power from the emergency diesel-generator is required only in the event of the loss of power from the off-site transmission system. The diesel generator sets are also started and tested on a semi-monthly basis to demonstrate their readiness.

The two diesel-geneator sets are enclosed in a reinforced-concrete building and are also equipped with a suitable sound muffling system.

APPENDIX D

ENVIRONMENTAL GLOSSARY

In discussing the environmental effects of construction and operation of nuclear power plants and fuel reprocessing facilities, it is necessary to use words and phrases that may be unfamiliar. The following glossary lists and defines a number of the more frequently used terms that appear in environmental reports and statements.

Aerobic	Living or active only in the presence of oxygen
Algae	Any plant of the algae group comprising practically all seaweeds and allied freshwater or nonaquatic forms. Sizes range from unicells (microscopic; 30 millionths of an inch) to seaweeds (up to a few hundred feet in length)
Alluvium	Sand, gravel, soil or similar material deposited by running water
Ambient	Surrounding on all sides
Anadromous	Pertaining to an organism that lives most of its adult life in sea water but spawns in freshwater streams.
Anaerobic	Living or active in the absence of free oxygen
Aphotic zone	An area within the water column in which light does not penetrate with sufficient intensity to maintain photosynthesis
Aquifer	A body of earth material capable of transmitting water at a rate sufficient for economic extraction by wells
Autotrophic	Self nourishing; denoting those organisms that do not require an external source of organic material but can utilize light energy and manufacture their own food from inorganic materials; e.g., green plants
Baseload plant	A large electrical generating station which is operated at the highest possible plant factor to furnish part of the utility's normal continuous electrical load
Benthic	Referring to life on the bottom of a body of water. (The noun *benthos* refers to organisms attached to or crawling on the bottom.)

Bioaccumulation — The ability of living organisms to concentrate chemical elements upon uptake or ingestion

Biochemical oxygen demand (BOD) — The quantity of oxygen required by micro-organisms to stabilize the organic matter in a body of water (by aerobic chemical reactions)

Biocide — A chemical agent which will destroy living organisms

Biomass — The amount of living matter in the form of one or more kinds of organisms present in a particular habitat; usually expressed as weight of organisms per unit area of habitat (if in suspension: per unit volume)

Biota — The plants and animals (flora and fauna) of a region

Blowdown — A release from any closed system for the purpose of controlling or influencing the chemistry or physics

Brackish water — Moderately salty, nonpotable water such as found in estuarine zones or marshes near the sea

Carnivore — Pertains to an animal that feeds on other animals

Catadromous — Pertaining to organisms that spend most of their life in freshwater but migrate to the sea to spawn

Chelating agent — Usually an organic substance which combines generally with metals to permit removal from liquid effluents

Chemical oxygen demand (COD) — Measurement of the oxygen equivalent of that portion of organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant

Chloramine — A compound formed by the substitution of chlorine for one or more hydrogen atoms in an ammonia structure

Chlorine demand — Chlorine demand of water is the difference between the amount of chlorine applied to a treated supply and the amount of free, combined, or total available chlorine remaining at the end of the contact period

Cold shock — A phenomenon which occurs when an aquatic organism is subjected to a rapid decrease in temperature

Combined cycle generating unit — A generating unit that utilizes both a gas turbine and a steam turbine. The turbine exhaust is utilized in the fossil-fired steam boiler resulting in greater total efficiency. In addition to increased turbine efficiency, this system features rapid start and base-load capability.

Copepods — A group of minute aquatic organisms (about 0.1 in. long) that have rounded bodies and a pair of elongated oarlike swimming appendages; found everywhere in shallow waters and part of the open-water plankton of ponds, lakes and oceans

Crustacean — An animal having a hard but flexible exoskeleton

Curie — A quantity of radioactive material decaying at the rate of 3.7×10^{10} disintegrations/sec

Demersal — Pertains to those aquatic organisms that live near the bottom of a body of water

Detritus — The mass of nonliving matter composed of dead organisms (and their fragments) and the inorganic constituents such as clay particles and sand grains

Diatoms — Unicellular greenish-brown plants with a siliceous covering (*exoskeleton*); often forming unicellular chains

Discount rate — The cost of money used in determining the present value of a future expenditure

Dissolved oxygen (D.O.) — Concentration of oxygen in water, usually expressed in milligrams per liter (mg/l) or parts per million (ppm)

Diurnal — 24 hour daily cycle

Drift — Heavier-than-air liquid droplets emitted from a cooling tower with the plume which are generally deposited in the vicinity of the tower

Ecosystem — A system made up of a community of animals, plants, and bacteria, and the physical and chemical environment with which it is interrelated

Endemic — Peculiar to a particular people or locality

Entrainment — The water and the associated suspended biological organisms which are taken into a power generating facility. These organisms are thus exposed to thermal, chemical and mechanical changes within the condenser cooling system prior to being discharged to the receiving waters.

Entrapment — Entrapment refers to a situation where organisms, principally fish, are subjected to a system that will not allow for their safe return to their natural habitat, i.e., impingement and subsequent death on intake screens.

Epilimnion — That portion of a deep stratified lake above the thermocline that has approximately the same temperature as the surface

Estuary — That portion of a coastal stream influenced by the tide of the body of water into which it flows; a bay at the mouth of a river where the tide meets the river current; an area where fresh and marine waters mix

Euphotic zone — The lighted region of a body of water that extends vertically from the water surface to the depth of effective light penetration

Eutrophication — The process whereby water bodies undergo an increase in available plant nutrients (notably phosphates and nitrates) resulting in an increase in biological productivity in the water

Free chlorine — The chlorine gas component of residual chlorine

Fry — The young of fishes or of some other animals, as frogs

Gamete — Either of the two germ cells which unite to form a new organism

Genera — A taxonomic category comprising a group of structurally related species

Habitat — The specific type of place or location where an organism lives

Halocline — Zone in which the salinity of a body of water changes rapidly with increasing depth

Herbivore — An organism that feeds on plant material

Hypolimnion — In a thermally stratified lake the zone which extends from the thermocline to the bottom; usually devoid of oxygen and high in carbon dioxide

Impingement — The act of coming in violent contact with; used in the context of organisms striking intake structure screens and racks and being retained there

Invertebrates — Animals without an internal skeletal structure (without a backbone); e.g., insects, clams, lobsters

Isotherm — The line on a chart connecting points having the same temperature at a given time

Larva — An embryo that becomes self-sustaining and independent before it has assumed the characteristic features of its parents

Limnetic — The open-water zone of a body of water such as a lake. In general this level will be at the depth at which the light intensity is about 1% of full sunlight intensity.

Littoral — Growing or living underwater near the shore

Macrophyte — Large plant

Man-rem — A measure of the total absorbed dose received by a large number of persons (the absorbed dose in man-rem is the product of the number of persons in the group times the average dose absorbed in rem by each member of the group)

Nannoplankton — Very minute plankton not retained in a plankton net equipped with No. 25 silk bolting cloth (mesh, 0.03 to 0.04 mm)

Nekton — Collective term for the actively swimming organisms in oceans and lakes

Nutrients — Elements or compounds essential as raw materials for organism growth and development; e.g., carbon, oxygen, nitrogen, phosphorus, etc.

Old field — Land used for agriculture which has been allowed to revert to the native state

Oligotrophic — Term generally applied to a relatively deep body of water which lacks an extensive littoral zone and is poor in dissolved nutrients, plankton is usually scarce and productivity is low

Omnivore	An animal which may subsist on plant foods, animal foods, or both
Pelagic	Habitat zone comprising the open waters of a basin
Phytoplankton	Plankton consisting of plant life
Plankton	Passively floating or weakly swimming aquatic organisms, incapable of regulating their mobility; consists of both plants (phytoplankton) and animals (zooplankton)
Poikilothermal	Animals whose temperature varies with that of the surrounding medium; cold-blooded animals
Pycnocline	The zone in which the density of a body of water increases rapidly with increasing depth
Rad	A measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit mass of tissue (1 rad = 100 ergs/gm)
Rem	A measure of absorbed dose in terms of its estimated biological effect relative to a dose of one roentgen of X-rays
Reserve margin	The difference between installed capacity and projected annual peak load, expressed as a percent of projected annual peak load
Residual chlorine	Chlorine (in several forms) that is available to react after the chlorine demand is satisfied
Roentgen	A unit of exposure to ionizing radiation, specifically the amount of X or gamma radiation that produces a charge of one electrostatic unit in one cm^3 of dry air
Salinity	Parts per thousand by weight of the dried solid residues obtained from water when all organic matter has been oxidized, all bromides and iodides replaced by chlorides, and all carbonates converted to oxides usually expressed in grams/kilogram or parts per thousand (ppt)
Sessile	Permanently attached and not free to move about
Spawn	To shed the sex cells, especially as applied to animals that shed eggs and sperm directly into water

Spray module	Cooling system unit which ejects heated water into the air through nozzles into canals or ponds
Stratification	The process of dividing into layers. In the context of a deep lake, the dividing into layers of different temperatures.
Succession	The orderly process of community change; the sequence of communities which replace one another in a given area
Symbiosis	The intimate living together of two organisms of different species for mutual or one-sided benefit
Taxonomic	Relating to the systematic distinguishing, ordering and naming of type groups within a subject field
Thermal inversion	A reversal of normal atmospheric temperature gradient; increase of temperature of air with increasing altitude
Thermocline	The zone (in a body of water) in which the temperature changes rapidly with increasing depth
Trophic	Pertaining to, or connected with, nutrition or feeding
Vertebrates	Animals that have an internal skeletal system (with a backbone); e.g., fish, man
Zooplankton	Minute planktonic animals that feed on phytoplankton and, in turn, form food for young fish

APPENDIX C

PERMITS AND LICENSES

JOINT
PUBLIC NOTICE

U. S. Environmental Protection Agency
Region IV, Consolidated Permits Branch
345 Courtland Street, N. E.
Atlanta, Georgia 30365
404/881-2328

in conjunction with

Florida Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301
904/488-4807

Public Notice No. 81-FL195 October 15, 1981

NOTICE OF PROPOSED REISSUANCE OF NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT AND NOTICE OF CONSIDERATION FOR STATE CERTIFICATION

The U. S. Environmental Protection Agency proposes to reissue a National Pollutant Discharge Elimination System (NPDES) Permit to Florida Power and Light Company, Post Office Box 529100, Miami, Florida 33152, for its St. Lucie Nuclear Plant, Units 1 and 2, Hutchinson Island, St. Lucie County, Florida, NPDES Permit No. FL0002208.* The application describes two discharges from the plant which generates from the plant which generates and transmit electricity, SIC Code 4911. The discharges enter the Atlantic Ocean off Hutchinson Island. This area has been classified by the State of Florida as Class III - Recreation - Propagation and Management of fish and Wildlife - Surface Waters.

The proposed NPDES permit contains limitations on the amounts of pollutants allowed to be discharged and was drafted in accordance with the provisions of the Clean Water Act (33 U.S.C. Section 1251 et seq.) and other lawful standards and regulations. The pollutant limitations and other permit conditions are tentative and open to comment from the public.

Persons wishing to comment upon or object to permit reissuance or to the proposed permit limitations and conditions, or wishing to request a public hearing, are invited to submit same in writing within thirty (30) days of the date of this notice to the Enforcement Division, Environmental Protection Agency, 345 Courtland Street, N. E., Atlanta, Georgia, 30365, **ATTN:** Ms. Earline Hanson. The NPDES Number should be included in the first page of comments.

All comments received within the 30-day period will be considered in the formulation of final determinations regarding the permit. Any interested person may within the 30-day period request a public hearing. Where there is a significant degree of public interest in the proposed permit reissuance, the EPA Regional Administrator will hold a public hearing.

*The proposed action will combine a reissuance of the Permit for Unit 1 with an initial issuance of a permit for Unit 2.

After consideration of all written comments and of the requirements and policies in the Act and appropriate regulations, the EPA Regional Administrator will make determinations regarding the permit reissuance. If the determinations are substantially unchanged from those announced by this notice, the EPA Regional Administrator will so notify all persons submitting written comments. If the determinations are substantially changed, the EPA Regional Administrator will issue a public notice indicating the revised determinations. Requests for evidentiary hearing may be filed after the Regional Administrator makes the above-described determinations. Additional information regarding evidentiary hearing is available in 40 CFR Subpart E, 45 FR 33498 (May 19, 1980), or by contacting the Legal Branch at the address above or at 404/881-3506.

The administrative record, including application, fact sheet and/or draft permit, a sketch showing the exact location of the discharge, comments received, and additional information on hearing procedure is available by writing the EPA address above, or for review and copying at 345 Courtland Street, 2nd floor, Atlanta, Georgia, between the hours of 8:15 a.m. and 4:30 p.m., Monday through Friday. A copying machine is provided for public use at a charge of 20¢ per page.

The Florida Dept. of Environmental Regulation has been requested to certify the discharge(s) in accordance with the provisions of Section 401 of the Clean Water Act (33 U.S.C. Section 1251 et seq.). Comments on issuance of certification, including a request for public hearing, must be submitted to the state agency address above within thirty (30) days of the date of this public notice. If a public hearing is held, as described above, the state agency will co-chair the hearing in order to receive comments relative to state certification.

The United States Nuclear Regulatory Commission will publish a notice of the availability of an operating phase Draft Environmental Impact Statement (DEIS) for Unit 2 at the St. Lucie site on or about October 23, 1981. A copy of the draft NPDES Permit and Rationale will be included in the DEIS.

Please bring the foregoing to the attention of persons who you know will be interested in this matter.

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Permit No.: FL0002208

DRAFT 10/15/81

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et. seq; the "Act"),

Florida Power and Light Company
Post Office Box 529100
Miami, Florida 33152

is authorized to discharge from a facility located at

St. Lucie Nuclear Power Plant
Units 1 and 2
Hutchinson Island
St. Lucie County, Florida

to receiving waters named Atlantic Ocean

from discharge points enumerated herein, as serial numbers 001, 002 003, 004, 005, 006, 007 and 008

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof. The permit consists of this cover sheet, Part I 11 pages(s), Part II 12 page(s) and Part III 3 page(s).

This permit shall become effective on

This permit and the authorization to discharge shall expire at midnight, (5 Years)

____
Date Signed

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on effective date and lasting through start of Unit 2 chlorination the permittee is authorized to discharge from outfall(s) serial number(s) 001 - Condenser cooling water and auxiliary cooling water discharged to the Atlantic Ocean (includes other plant wastes). Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations	Monitoring Requirements	
	Instantaneous Maximum	Measurement Frequency	Sample Type
Flow—m^3/Day (MGD)	N/A	Hourly	Pump logs
Discharge Temperature °C(°F)	45(113) 1/	Hourly	Recorders
Temperature Rise °C(°F)	16.7(30) 1/	Hourly	Recorders
Total Residual Oxidants (mg/l)	0.1 2/	1/week	Multiple Grabs
Mixing Zone Temperature °C(°F)	3/	N/A	N/A
Condenser Chlorine Addition (minutes/day)	N/A	Daily	Log

Discharge of intake screen backwash is permitted without limitation or monitoring requirements.

Auxiliary cooling water systems for Unit 1 may be continuously chlorinated; however, TRO shall not exceed a maximum instantaneous concentration of 0.03 mg/l prior to entry into the Atlantic Ocean from this source. An intensive sampling program shall be instituted for at least 30 days following start of system chlorination to assure compliance. In the event that TRO levels at the terminus of the discharge canal equal or exceed 0.02 mg/l, permittee shall implement a minimization study as indicated in Part III.J.

Permittee shall investigate the availability of continuous recording TRO monitors with low levels of sensitivity (0.01 to 0.03 mg/l) and shall field test such unit(s). Not later than the start of Auxiliary cooling water system chlorination, permittee shall install a continuous TRO recorder, if an acceptable device is found, at the terminus of the discharge canal. In the event that a continuous recorder cannot be installed by start of chlorination, efforts shall continue (with progress reports submitted quarterly) and monitoring for TRO shall be 1/week on not less than six grab samples during daylight hours. Additional grab samples shall be conducted during period(s) of TRO discharge from condensers.

(CONTINUED)

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on effective date and lasting through start of Unit 2 chlorination the permittee is authorized to discharge from outfall(s) serial number(s) 001 - Condenser cooling water and auxiliary cooling water discharged to the Atlantic Ocean (includes other plant wastes).

(CONTINUED)

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Intake temperature and flow at plant intake and all other parameters in the discharge canal prior to discharge to the Atlantic Ocean.

1/ Under the following conditions the maximum discharge temperature shall be limited to 47.2°C(117°F) and the temperature rise to 17.8(32): (1) Condenser and/or circulating water pump maintenance, (2) trottling circulating water pumps to minimize use of chlorine, and (3) fouling of circulating water system. In the event that discharge temperature exceeds 45°C(113°F) permittee shall notify the Chief, Water Enforcement Branch in a manner similar to that provided for in Part II.A.3.c. (5 days).

2/ Total residual oxidants (TRO) shall not exceed a maximum instantaneous concentration of 0.1 mg/l. TRO shall not be discharged from Unit 1 condensers for more than two hours per day.

3/ The ambient ocean surface temperature shall not exceed 36.1°C(97°F) as an instantaneous maximum at any point.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of Unit 2 chlorination and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 001 and 008 - Condenser cooling water and auxiliary cooling water discharged to the Atlantic Ocean (includes other plant wastes) from Units 1 and 2, respectively.

Such discharges shall be limited and monitored by the permitted as specified below:

Effluent Characteristic	Discharge Limitations: Instantaneous Maximum	Monitoring Requirements: Measurement Frequency	Monitoring Requirements: Sample Type
Flow—m^3/Day (MGD)	N/A	Hourly	Pump logs
Discharge Temperature °C(°F)	45(113) 1/	Hourly	Recorders
Temperature Rise °C(°F)	16.7(30) 1/	Hourly	Recorders
Total Residual Oxidants (mg/1)	See Below	1/week	Multiple Grabs
Free Residual Oxidants (mg/1)	See Below	1/week	Multiple Grabs
Mixing Zone Temperature °C(°F)	36.1(97) 2/	See Part III.I.	
Condenser Chlorine Addition (minutes/day unit)	120 per unit	Daily	Log

Discharge of intake screen backwash is permitted without limitation or monitoring requirements.

Free available oxidants shall not exceed and average concentration of 0.2 mg/1 and a maximum instantaneous concentration of 0.5 mg/1 at the outlet corresponding to an individual condenser during any chlorination period. Neither free available oxidants (FAO) nor total residual oxidants (TRO) may be discharged from either unit condensers for more than two hours in any one day and not more than one unit may discharge FAO or TRO from its condensers at any one time. Additionally, TRO shall not exceed a maximum instantaneous concentration of 0.10 mg/1 at any time as measured in the discharge canal prior to discharge to the Atlantic Ocean.

Auxiliary cooling water systems for Units 1 and 2 may be continuously chlorinated; however, TRO shall not exceed a maximum instantaneous concentration of 0.03 mg/1 prior to entry into the Atlantic Ocean from this source. An intensive sampling program shall be instituted for at least 30 days following start of system chlorination to assure compliance. In the event that TRO levels at the terminus of the discharge canal equal or exceed 0.02 mg/1, permittee shall implement a minimization study as indicated in Part III.J.

(CONTINUED)

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of Unit 2 chlorination and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 001 and 008 - Condenser cooling water and auxiliary cooling water discharged to the Atlantic Ocean (includes other plant wastes) from Units 1 and 2, respectively.

(CONTINUED)

Not later than three years after promulgation or July 1, 1987, whichever is earlier, there shall be no discharge of TRO. Notwithstanding the foregoing, the permittee may upon successfully showing the Director, Enforcement Division, that the facility must use chlorine for cooling water system biofouling control, discharge the minimum amount of TRO necessary to operate the facility. In no case shall TRO be discharged for more than two hours per day nor shall the TRO exceed an instantaneous maximum of 0.1 mg/l. Not later than one year after promulgation, permittee shall submit a proposed implementation schedule to expeditiously provide controls necessary to comply with these requirements. Note: In the event that BAT regulations for control of TRO or chlorine are promulgated in a manner inconsistent with the October 14, 1980, proposed guidelines, requirements of this paragraph will be modified consistent with the promulgated regulations (40 CFR 423).

Permittee shall investigate the availability of continuous recording TRO monitors with low levels of sensitivity (0.01 to 0.03 mg/l) and shall field test such unit(s). Not later than the start of Auxiliary cooling water system chlorination, permittee shall install a continuous TRO recorder, if an acceptable device is found, at the terminus of the discharge canal. In the event that a continuous recorder cannot be installed by start of chlorination, efforts shall continue (with progress reports submitted quarterly) and monitoring for TRO shall be 1/week on not less than six grab samples during daylight hours. Additional grab samples shall be conducted during period(s) of TRO discharge from condensers.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Intake temperature and flow at plant intakes and all other parameters in the discharge canal prior to discharge to the Atlantic Ocean, except that TRO and FRO shall also be monitored at the condenser discharge for each Unit prior to entry into the plant discharge canal.

1/ Under the following conditions the maximum discharge temperature shall be limited to 47.2°C(117°F) and the temperature rise to 17.8(32): Condenser and/or circulating water pump maintenance, and (2) fouling of circulating water system. In the event that discharge temperature exceeds 45°C(113°F) permittee shall notify the Chief, Water Enforcement Branch in a manner similar to that provided for in Part II.A.3.c. (5 days).

2/ The ambient ocean surface temperature shall not exceed 36.1°C(97°F) as an instantaneous maximum at any point.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 002 1/ - Low volume waste discharge to intake canal from Units 1 and 2

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day) Daily Avg	Daily Max	Other Units (mg/1) Daily Avg	Daily Max	Monitoring Requirements Measurement Frequency	Sample Type
Flow—m^3/Day (MGD)	N/A	N/A	N/A	N/A	1/week	Calculation
Oil and Grease	41(90)	55(120)	15	20	1/week	Grab
Total Suspended Solids	82(180)	270(600)	30	100	1/week	Composite

Prior to the start of discharges from Unit 2, quantity limitations shall be one-half of the limitation shown.

In the event that this waste is directed to an evaporation/percolation pond from which there is no discharge, these effluent limitations and monitoring requirements will not apply.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/batch on a grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): discharge from the neutralization basin prior to mixing with any other waste stream.

1/ Serial number assigned for identification and monitoring purposes.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 003 1/ - Pre-operational metal cleaning wastes from Unit 2 and similar cleaning operations discharged to discharge canal
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/batch (lbs/batch)	Other Units (mg/l) Daily Avg	Other Units (mg/l) Daily Max	Monitoring Requirements Measurement Frequency	Monitoring Requirements Sample Type
Flow—m^3/Day (MGD)	2/	N/A	N/A	1/day	Determination(s)
Oil and Grease	2/	15	20	2/	Grab
Total Suspended Solids	2/	30	100	2/	Composite
Copper, Total	2/	1.0	1.0	2/	Composite
Iron, Total	2/	1.0	1.0	2/	Composite
Phosphorus as P	2/	1.0	1.0	2/	Composite

Metal cleaning wastes shall mean any cleaning compounds, rinse waters, or any other water-borne residues derived from cleaning any metal process equipment. The quantity of pollutants discharged from this source shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentrations listed above.

In the event that this waste is directed to an evaporation/percolation pond from which there is no discharge, these effluent limitations and monitoring requirements will not apply.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored on representative grab samples.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): discharge from the metal cleaning wastes treatment facility(s) prior to mixing with any other waste stream.

1/ Serial number assigned for identification and monitoring purposes.
2/ The total quantity of each pollutant discharged shall be reported. In no case shall the quantity discharged exceed the quantity determined by multiplying the volume of the batch of metal cleaning waste generated times the concentrations noted above (i.e., 3.8 kg (8.3 lbs) of iron, copper and phosphorus; 57 kg (125 lbs) of oil and grease; and 114 kg (250 lbs) of total suspended solids per million gallons of metal cleaning waste generated). The permittee shall also report the frequency of measurement used to adequately quantify the pollutants discharged. Total volume of wastewater generated and discharge shall be reported.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 004 1/ - Radwaste System Discharge to discharge canal from Units 1 and 2.
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day)		Other Units (mg/1)		Monitoring Requirements	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow—m^3/Day (MGD)	N/A	N/A	N/A	N/A	1/batch	Calculation
Oil and Grease	4.1(9.0)	5.5(12.0)	15	20	1/batch 2/	Grab
Total Suspended Solids	8.2(18)	27.0(60.0)	30	100	1/batch	Grab

Prior to the start of discharges from Unit 2, quantity limitations shall be one-half of the limitation shown.

In the event that metal cleaning wastes are discharged through this serial number, limitations shall not exceed those provided for outfall serial number 003.

This discharge is regulated by the Nuclear Regulatory Commission under the provisions of its operating license and is monitored and reported to the Nuclear Regulatory Commission. No additional monitoring of the radiological aspects of this discharge are required herein.

The pH shall not be less than N/A standard units nor greater than 9.0 standard units and shall be monitored 1/batch.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): discharge from the radwaste system prior to mixing with any other waste stream.

1/ Serial number assigned for identification and monitoring purposes.
2/ If radwastes is passed through filter and demineralizer system, sampling shall be 2/month on representative batches. If data for a one-year period indicates that all oil and grease determinations are less than 10 mg/1, this monitoring may be discontinued.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 005 1/ - Dewatering wastes from Unit 2 construction discharged to intake or discharge canal.
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
	Daily Max	Daily Avg	Measurement Frequency	Sample Type
Flow–m^3/Day (MGD)	N/A	N/A	2/month	Calculation
Total Suspended Solids (mg/l)	55	115	2/month	Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): point(s) discharge prior to entering the intake or discharge canals.

1/ Serial number assigned for identification and monitoring purposes.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on effective date and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 006 1/ - Sewage Treatment Plant Discharge

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
	mg/l (except as noted)			
	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow—m^3/Day (MGD)	N/A	64(0.017)	1/week	Instantaneous
BOD_5	30	60	1/quarter	Grab 2/
Total Suspended Solids	30	60	1/quarter	Grab 2/
Fecal Coliform organisms/100 ml	N/A	N/A	1/quarter	Grab

In addition to the specific limits, the daily average effluent BOD5 and suspended solids concentrations shall not exceed 10 percent of the respective daily average influent concentrations.

Effluent shall be aerobic at all times.

C-13

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Sewage treatment plant discharge prior to mixing with any other waste streams.

1/ Serial number assigned for identification and monitoring purposes.
2/ Influent and effluent.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on effective date and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 007 1/ - Steam Cleanup System Blowdown to discharge canal from Units 1 and 2
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow—m^3/Day (MGD)	N/A	N/A	2/	Calculation
Oil and Grease (mg/l)	15	20	2/	Grab
Total Suspended Solids (mg/l)	30	100	2/	Grab
Total Iron (mg/l)	1.0	1.0	2/	Grab
Total Copper (mg/l)	1.0	1.0	2/	Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): point(s) of discharge prior to entering the discharge canal.

1/ Serial number assigned for identification and monitoring purposes.
2/ One per discharge event or one per week whichever is more frequent. Total volume of batch and period of discharge shall be reported.

A. MANAGEMENT REQUIREMENTS

1. Discharge Violations

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant more frequently than, or at a level in excess of, that identified and authorized by this permit constitutes a violation of the terms and conditions of this permit. Such a violation may result in the imposition of civil and/or criminal penalties as provided in Section 309 of the Act.

2. Change in Discharge

Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application at least 180 days prior to commencement of such discharge. Any other activity which would constitute cause for modification or revocation and reissuance of this permit, as described in Part II (B) (4) of this permit, shall be reported to the Permit Issuing Authority.

3. Noncompliance Notification

a. Instances of noncompliance involving toxic or hazardous pollutants should be reported as outlined in Condition 3c. All other instances of noncompliance should be reported as described in Condition 3b.

b. If for any reason, the permittee does not comply with or will be unable to comply with any discharge limitation specified in the permit, the permittee shall provide the Permit Issuing Authority with the following information at the time when the next Discharge Monitoring Report is submitted.

(1) A description of the discharge and cause of noncompliance;
(2) The period of noncompliance, including exact dates and times and/or anticipated time when the discharge will return to compliance; and
(3) Steps taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

c. Toxic or hazardous discharges as defined below shall be reported by telephone within 24 hours after permittee becomes aware of the circumstances and followed up with information in writing as set forth in Condition 3b. within 5 days, unless this requirement is otherwise waived by the Permit Issuing Authority:

(1) Noncomplying discharges subject to any applicable toxic pollutant effluent standard under Section 307(a) of the Act;
(2) Discharges which could constitute a threat to human health, welfare or the environment. These include unusual or extraordinary discharges such as those which could result from bypasses, treatment failure or objectionable substances passing through the treatment plant. These include Section 311 pollutants or pollutants which could cause a threat to public drinking water supplies.

d. Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

4. Facilities Operation

All waste collection and treatment facilities shall be operated in a manner consistent with the following:

a. The facilities shall at all times be maintained in a good working order and operated as efficiently as possible. This includes but is not limited to effective performance based on design facility removals, adequate funding, effective management, adequate operator staffing and training, and adequate laboratory and process controls (including appropriate quality assurance procedures); and

b. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Permit Issuing Authority.

c. The permittee, in order to maintain compliance with this permit shall control production and all discharges upon reduction, loss, or failure of the treatment facility until the facility is restored or an alternative method of treatment is provided.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to waters of the United States resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature of the noncomplying discharge.

6. Bypassing

"Bypassing" means the intentional diversion of untreated or partially treated wastes to waters of the United States from any portion of a treatment facility. Bypassing of wastewaters is prohibited unless all of the following conditions are met:

a. The bypass is unavoidable-i.e. required to prevent loss of life, personal injury or severe property damage;

b. There are no feasible alternatives such as use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down time;

c. The permittee reports (via telephone) to the Permit Issuing Authority any unanticipated bypass within 24 hours after becoming aware of it and follows up with written notification in 5 days. Where the necessity of a bypass is known (or should be known) in advance, prior notification shall be submitted to the Permit Issuing Authority for approval at least 10 days beforehand, if possible. All written notifications shall contain information as required in Part II (A)(3)(b); and

d. The bypass is allowed under conditions determined to be necessary by the Permit Issuing Authority to minimize any adverse effects. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration to the extent feasible.

This requirement is waived where infiltration/inflow analyses are scheduled to be performed as part of an Environmental Protection Agency facilities planning project.

7. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the United States.

8. Power Failures

The permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures either by means of alternate power sources, standby generators or retention of inadequately treated effluent. Should the treatment works not include the above capabilities at time of permit issuance, the permittee must furnish within six months to the Permit Issuing Authority, for approval, an implementation schedule for their installation, or documentation demonstrating that such measures are not necessary to prevent discharge of untreated or inadequately treated wastes. Such documentation shall include frequency and duration of power failures and an estimate of retention capacity of untreated effluent.

9. Onshore or Offshore Construction

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any waters of the United States.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Permit Issuing Authority and/or authorized representatives (upon presentation of credentials and such other documents as may be required by law) to:

a. Enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit;

b. Have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit;

c. Inspect at reasonable times any monitoring equipment or monitoring method required in this permit;

d. Inspect at reasonable times any collection, treatment, pollution management or discharge facilities required under the permit; or

e. Sample at reasonable times any discharge of pollutants.

2. Transfer of Ownership or Control

A permit may be transferred to another party under the following conditions:

a. The permittee notifies the Permit Issuing Authority of the proposed transfer;

b. A written agreement is submitted to the Permit Issuing Authority containing the specific transfer date and acknowledgement that the existing permittee is responsible for violations up to that date and the new permittee liable thereafter.

Transfers are not effective if, within 30 days of receipt of proposal, the Permit Issuing Authority disagrees and notifies the current permitttee and the new permittee of the intent to modify, revoke and reissue, or terminate the permit and to require that a new application be filed.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Act, (33 U.S.C. 1318) all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State water pollution control agency and the Permit Issuing Authority. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act (33 U.S.C. 1319).

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, terminated or revoked for cause (as described in 40 CFR 122.15 et seq) including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;

c. A change in any condition that requires either temporary interruption or elimination of the permitted discharge; or

d. Information newly acquired by the Agency indicating the discharge poses a threat to human health or welfare.

If the permittee believes that any past or planned activity would be cause for modification or revocation and reissuance under 40 CFR 122.15 et seq, the permittee must report such information to the Permit Issuing Authority. The submission of a new application may be required of the permittee.

5. Toxic Pollutants

   a. Notwithstanding Part II (B)(4) above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge authorized herein and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revoked and reissued or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

   b. An effluent standard established for a pollutant which is injurious to human health is effective and enforceable by the time set forth in the promulgated standard, even though this permit has not as yet been modified as outlined in Condition 5a.

6. Civil and Criminal Liability

   Except as provided in permit conditions on "Bypassing", Part II (A) (6), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

   Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act (33 U.S.C. 1321).

8. State Laws

   Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges; nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

10. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

11. Permit Continuation

A new application shall be submitted at least 180 days before the expiration date of this permit. Where EPA is the Permit Issuing Authority, the terms and conditions of this permit are automatically continued in accordance with 40 CFR 122.5, provided that the permittee has submitted a timely and sufficient application for a renewal permit and the Permit Issuing Authority is unable through no fault of the permittee to issue a new permit before the expiration date.

C. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Monitoring results obtained during each calendar month shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1). Forms shall be submitted at the end of each calendar quarter and shall be postmarked no later than the 28th day of the month following the end of the quarter. The first report is due by the 28th day of the month following the first full quarter after the effective date of this permit.

Signed copies of these, and all other reports required herein, shall be submitted to the Permit Issuing Authority at the following address(es):

Permit Compliance Branch
Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

3. Test Procedures

Test procedures for the analysis of pollutants shall conform to all regulations published pursuant to Section 304(h) of the Clean Water Act, as amended (40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants").

4. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The person(s) who obtained the samples or measurements;

c. The dates the analyses were performed;

d. The person(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of all required analyses.

5. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1). Such increased frequency shall also be indicated.

6. Records Retention

The permittee shall maintain records of all monitoring including: sampling dates and times, sampling methods used, persons obtaining samples or measurements, analyses dates and times, persons performing analyses, and results of analyses and measurements. Records shall be maintained for three years or longer if there is unresolved litigation or if requested by the Permit Issuing Authority.

D. DEFINITIONS

1. Permit Issuing Authority

The Regional Administrator of EPA Region IV or designee.

2. Act

"Act" means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended by Public Law 95-217 and Public Law 95-576, 33 U.S.C. 1251 et seq.

3. Mass/Day Measurements

a. The "average monthly discharge" is defined as the total mass of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such month. It is, therefore, an arithmetic mean found by adding the weights of the pollutant found each day of the month and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Daily Average" or "Monthly Average" in Part I of the permit and the average monthly discharge value is reported in the "Average" column under "Quantity" on the Discharge Monitoring Report (DMR).

b. The "average weekly discharge" is defined as the total mass of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and/or measured divided by the number of daily discharges sampled and/or measured during such week. It is, therefore, an arithmetic mean found by adding the weights of pollutants found each day of the week and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Weekly Average" in Part I of the permit and the average weekly discharge value is reported in the "Maximum" column under "Quantity" on the DMR.

c. The "maximum daily discharge" is the total mass (weight) of a pollutant discharged during a calendar day. If only one sample is taken during any calendar day the weight of pollutant calculated from it is the "maximum daily discharge". This limitation is identified as "Daily Maximum," in Part I of the permit and the highest such value recorded during the reporting period is reported in the "Maximum" column under "Quantity" on the DMR.

4. Concentration Measurements

a. The "average monthly concentration," other than for fecal coliform bacteria, is the concentration of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such month (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all the samples collected during that calendar day. The average monthly count for fecal coliform bacteria is the geometric mean of the counts for samples collected during a calendar month. This limitation is identified as "Monthly Average" or "Daily Average" under "Other Limits" in Part I of the permit and the average monthly concentration value is reported under the "Average" column under "Quality" on the DMR.

b. The "average weekly concentration," other than for fecal coliform bacteria, is the concentration of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such week (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all samples collected during that calendar day. The average weekly count for fecal coliform bacteria is the geometric mean of the counts for samples collected during a calendar week. This limitation is identified as "Weekly Average" under "Other Limits" in Part I of the permit and the average weekly concentration value is reported under the "Maximum" column under "Quality" on the DMR.

c. The "maximum daily concentration" is the concentration of a pollutant discharged during a calendar day. It is identified as "Daily Maximum" under "Other Limits" in Part I of the permit and the highest such value recorded during the reporting period is reported under the "Maximum" column under "Quality" on the DMR.

5. Other Measurements

a. The effluent flow expressed as M^3/day (MGD) is the 24 hour average flow averaged monthly. It is the arithmetic mean of the total daily flows recorded during the calendar month. Where monitoring requirements for flow are specified in Part I of the permit the flow rate values are reported in the "Average" column under "Quantity" on the DMR.

b. Where monitoring requirements for pH, dissolved oxygen or fecal coliform are specified in Part I of the permit the values are generally reported in the "Quality or Concentration" column on the DMR.

6. Types of Samples

a. Composite Sample - A "composite sample" is any of the following:

(1) Not less than four influent or effluent portions collected at regular intervals over a period of 8 hours and composited in proportion to flow.

(2) Not less than four equal volume influent or effluent portions collected over a period of 8 hours at intervals proportional to the flow.

(3) An influent or effluent portion collected continuously over a period of 24 hours at a rate proportional to the flow.

b. Grab Sample: A "grab sample" is a single influent or effluent portion which is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the total discharge.

7. Calculation of Means

a. Arithmetic Mean: The arithmetic mean of any set of values is the summation of the individual values divided by the number of individual values.

b. Geometric Mean: The geometric mean of any set of values is the N^{th} root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

c. Weighted by Flow Value: Weighted by flow value means the summation of each concentration times its respective flow divided by the summation of the respective flows.

8. Calendar Day

a. A calendar day is defined as the period from midnight of one day until midnight of the next day. However, for purposes of this permit, any consecutive 24-hour period that reasonably represents the calendar day may be used for sampling.

B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

   a. All effluent limitations shall be met on effective date or start of discharge

   b. Aquatic monitoring program (Part III.F.)
      (1) Implement - Continuing
      (2) Annual Reports - April 30 of each year

   c. Discharge structure operation (Part III.G.)
      (1) Operational scheme - December 31, 1981
      operation of Unit 2 condenser pumps

   d. Thermal Plume Monitoring (Part III.I.)
      (1) Study Plan - Three months prior to fuel loading of Unit 2
      (2) Report - 15 months after commercial operation date of Unit 2

   e. Auxiliary Cooling System Chlorine Minimization (Part III.J)
      (1) Implement - Start of system chlorination
      (2) Status reports - Quarterly (4 reports)
      (3) Final Report - 15 months after implementation

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

PART III

OTHER REQUIREMENTS

A. There shall be no discharge of polychlorinated biphenyls compounds such as those commonly used for transformer fluid.

B. The company shall notify the Regional Administrator in writing not later than sixty (60) days prior to instituting use of any additional biocide or chemical used in cooling systems, other than chlorine, which may be toxic to aquatic life other than those previously reported to the Environmental Protection Agency. Such notification shall include:

    1. name and general composition of biocide or chemical,
    2. quantities to be used,
    3. frequencies of use,
    4. proposed discharge concentrations, and
    5. EPA registration number, if applicable.

C. Plant stormwater which is uncontaminated by plant wastes may be discharged without limitation or monitoring requirements.

D. Intake screen backwash may be discharged without limitation or monitoring requirements.

E. All environmental monitoring reports submitted to the U. S. Nuclear Regulatory Commission shall be submitted to EPA.

F. Permittee shall continue the approved non-ragiological aquatic monitoring program (revised continuation of existing program) which serve as St. Lucie 1 operational and St. Lucie 2 pre-operational and operational. The program will continue for at least two years after Unit 2 begins commercial operation. After this period the program will be evaluated by the Permittee and EPA to assess the continued need or possible deletion and/or modification of the program. Reports shall be submitted annually not later than April 30 of the year following the reporting period.

G. Subsequent to the commercial operation date of Unit 2, heated water shall be discharged from the Unit 2 multiport discharge line when only one unit is operating. Periods of short-term, one-unit operation shall not be subject to this requirement. Not later than December 31, 1981, a proposed operational scheme, including a definition of "short-term", shall be submitted for approval by the Director, Enforcement Division and State Director to assure conformance with these requirements.

H. If an applicable standard or limitation is promulgated under sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in this permit or controls a pollutant not limited in this permit, this permit shall be promptly modified or revoked and reissued to conform to that effluent standard or limitation.

I. Permittee shall implement a monitoring program to assure compliance with temperature limitations provided herein and with thermal requirements of the Florida Water Quality Standards. Such program to include field surveys, infrared thermal imagry overflights and/or other monitoring to assure compliance. A study plan shall be submitted for approval not later than three months prior to fuel loading of Unit 2 and shall be expeditiously implemented on approval. A report shall be submitted not less than 15 months after implementation.

J. Permittee shall conduct a chlorine minimization program for the auxiliary cooling water system if the TRO concentration levels at the terminum of the discharge canal during continuous chlorination of the auxiliary system(s) equal or exceed 0.02 mg/L. Such study if required, shall be conducted generally in conformance with techniques and concepts published in Appendix A, FR 68354, October 14, 1980, to the extent implementable on the auxiliary cooling system at the St. Lucie Plant. Implementation of the plan, if required, shall be no later than 30 days after the Permittee becomes aware that the concentration level of TRO equals or exceeds 0.02 mg/L. Brief status reports shall be submitted quarterly with the first report due at the end of the third full month following implementation of the study. A final report shall be submitted not less than the end of the fifteenth full month of the implementation.

K. Copies of reports submitted in accordance with Part III.F. shall be forwarded by the permittee as follows:

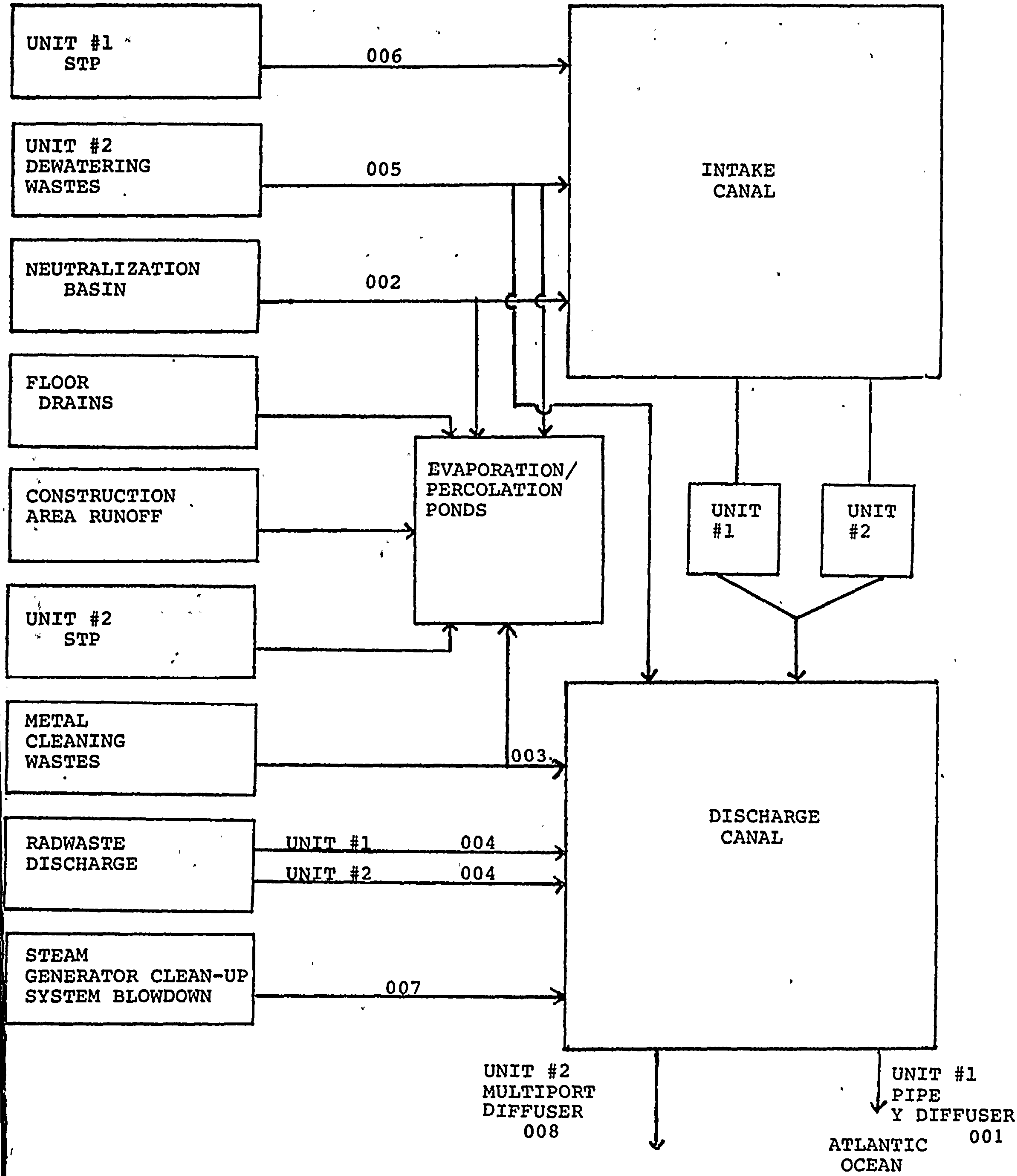
Number of Copies	Addressee
2	Director, Enforcement Division, EPA(Atlanta)
1	Chief, Ecology Branch, EPA(Athens)
2	Florida Dept. of Environmental Regulation (Tallahassee)
2	Assistant Director for Environmental Technology USNRC (Washington)
2	Regional Director, Fish and Wildlife Service (Atlanta)
2	Regional Director, National Marine Fisheries Service (St. Petersburg)

Additionally, two copies of all plans and reports submitted in accordance with Parts III. G, I and J shall be submitted to FLDER (Tallahassee) and USEPA (Atlanta) and one copy to EPA (Athens).

L. The State of Florida Department of Environmental Regulation has certified the discharge(s) covered by this permit with conditions (Attachment B). Section 401 of the Act requires that conditions of certification shall become a condition of the permit. The monitoring and sampling shall be as indicated for those parameters included in the certification. Any effluent limits, and any additional requirements, specified in the attached state certification which are more stringent supersede any less stringent effluent limits provided herein. During any time period which the more stringent state certification effluent limits are stayed or inoperable, the effluent limits provided herein shall be in effect and fully enforceable. (Note: Certification will be attached prior to permit issuance).

ATTACHMENT A
NPDES No. FL0002208

ST. LUCIE PLANT
WASTEWATER FLOW DIAGRAM



PERMIT RATIONALE
ST. LUCIE NUCLEAR POWER PLANT
UNITS 1 and 2
FLORIDA POWER AND LIGHT COMPANY
October 22, 1981

I. Applicable Regulations

A. The proposed conditions provide for compliance with (1) Effluent Guidelines and Standards for the steam electric power generating point source category (40 CFR 423) as promulgated on October 8, 1974 (39 Federal Register 36186), and with proposed guidelines revisions published on October 14, 1980 (45 FR 68328), for plant chemical wastes; and (2) a tentative determination under Section 316(b) of the Clean Water Act for the plant cooling water intake; as well as,

B. Provisions of the Florida Water Quality Standards (Chapters 17-3 and 17-4 Florida Administrative Code). The receiving waters have been classified by the State of Florida as Class III - Recreation - Propagation and Management of Fish and Wildlife - Surface waters.

II. Effluent Limitations

A. Outfall Serial Numbers (OSN) 001 and 008 - Once through condenser cooling water and auxiliary cooling water:

1. Temperature: Discharge temperature of 45°C(113°F), except under specific abnormal operating conditions when limitation is 47.2°C(117°F) and temperature rise of 16.7°C(30°F) and 17.8°C (32°F), respectively. Limitations are as requested by the applicant and are supported by biological sampling data.

2. Total residual oxidants (includes total residual chlorine):
   a. An instantaneous maximum limitation of 0.1 mg/l due to condenser chlorination for a maximum period of two hours per day per unit. Limitation is based on Water Quality Standards requirements which are more stringent than effluent guidelines. Florida Standards (17-4.244(4)) preclude a maximum pollutant concentration within a mixing zone which exceeds the amount lethal to 50 percent of the test organisms in 96 hours (96-hr LC50) for a species significant to the indigenous aquatic community. The 96-hr LC50 value for Blue Crabs of 0.10 mg/l has been used to establish the effluent limit.

b. An instantaneous maximum limitation of 0.03 mg/l due to continuous chlorination of auxiliary cooling systems has been included as a best professional judgement. A minimization study is required if TRO levels from this source exceed 0.02 mg/l at the terminus of the discharge canal.

c. Requirements of the October 8, 1974, promulgated and October 14, 1980, proposed regulations and a reopener provision have been included also.

B. OSN 002 - Low volume wastes: Limitations are as required by promulgated and proposed 423.12(b)(3). Quantity limitations are computed using a waste flow of 0.72 MGD, based on historical records from Unit 1.

C. OSN 003 - Metal cleaning wastes: Limitations are as required by promulgated 423.12(b)(5) and proposed 423.13(g), except that a best professional judgement limitation for phosphorus of 1.0 mg/l has been included.

D. OSN 004 - Radwaste: Limitations are as required by promulgated and proposed 423.12(b)(3) for low volume wastes using a flow of 0.07 MGD, based on historical records for Unit 1. NOTE: The radioactive component of this discharge is regulated by the U. S. Nuclear Regulatory Commission and is not subject to NPDES permitting requirements. Comments relative to the radioactive component of this discharge should be directed to NRC and may not be considered by EPA in its permitting decisions.

E. OSN 005 - Dewatering Wastes from Unit 2 Construction: Concentration limitations on total suspended solids are included based on best professional judgement and historical records. Due to the highly variable nature of this waste flow, quantity limitations are not provided.

F. OSN 006 - Sewage treatment plant discharge: Limitations are generally based on secondary treatment requirements (40 CFR 102) for domestic waste. However, the one-day maximum, limitations of 60 mg/l each for total suspended solids and biochemical oxygen demand (BOD) proposed is extrapolated from the seven-day average limitation of 45 mg/l presented in the regulations. This extrapolation was made to conform with the proposed monitoring frequency.

G. OSN 007 - Steam cleanup system blowdown: Limitations are based on promulgated 40 CFR 423.12(b)(6). Quantity limitations are not included due to the infrequent nature (normally recycled) and variable flow of the waste stream.

H. Quantity Limitations: Quantity limitations are calculated as follows:

Quantity (lbs/day)=8.345 x Flow (MGD) x Allowed Concentration (mg/

where: 8.345 is the appropriate conversion factor, flows are based on historical data from Unit 1 and information provided by the applicant, and concentrations (mg/l) are as provided in applicable subsections of 40 CFR 423.

I. Proposed Permit Period: Five years. The NPDES permit requires compliance with the most stringent requirements of either the promulgated (October 8, 1974) or proposed (October 14, 1980) regulations (40 CFR 423.12, etc.). Data on priority pollutants has been submitted from Unit 1. Samples can not be collected from Unit 2 waste sources since the Unit is not yet in operation. Evaluation of data submitted by the applicant for Unit 1 and expected effluent quality from Unit 2, have led the permit writer to the tentative conclusion that additional treatment for priority pollutants is not likely for any pollutants and that a full five-year permit should be issued. However, to assure that this judgement is correct, a reopener clause is included in the permit (Part III.H.) in the event that more stringent requirements are ultimately promulgated by EPA.

ST. LUCIE NUCLEAR PLANT
316(b) Finding for Best Technology Available

Section 316(b) of P.L. 95-217 requires that the location, design, construction and capacity of cooling water intake structures reflect the best technology available (BTA) for minimizing adverse environmental impacts. Decisions relating to BTA are to be made on a case-by-case basis using such factors as size and type of water body and relative magnitude of flow withdrawn for cooling (40CFR, Pt. 402). Through deliberations between Florida Power and Light Company (FPL) and several government agencies, BTA was determined for the St. Lucie Nuclear Plant intake system prior to plant operation.

FINDINGS

The 2-unit 1612 net MW St. Lucie Nuclear Plant is located on a 1130-acre site of Hutchinson Island, Florida approximately midway between Ft. Pierce and St. Lucie inlets. The nuclear plant is bound on the west by the Indian River and on the east by the Atlantic Ocean.

The condenser cooling water is provided by a once-through circulating water system which consists of intake and discharge pipes in the ocean linked by canals to the nuclear plant. The ocean intake for Units 1 and 2 is located 1200 ft from the Atlantic shoreline in a high energy/low impact area characterized by water turbulence and shifting sand or sand-shell substrate with a lack of bottom cover or outcroppings. The unstable substrate precludes the establishment of macrophytes or attached benthic communities. From the ocean intake point, water is drawn through 2 buried pipelines (I.D. - 12.0 ft) at 10 fps to the intake canal. This 300-ft wide canal begins 450 ft west of the shoreline where it funnels the cooling water some 500 ft to the nuclear plant intake structures (bars and screens). Pumps at the nuclear plant provide a design flow of 2290 cfs (5.62 x 10^6 m^3/day) for condenser cooling through the nuclear plant. Approach velocities to each of 8 traveling screens are less than 1.0 fps. Traveling screen washings are sluiced to a trash pit where organisms and trash are collected for disposal.

The top of the ocean intakes (Figure 1) are situated approximately 8 ft below the water surface at mean low water. A vertical section to prevent sanding and bottom organism migration and a velocity cap to minimize fish entrapment were installed for each pipe. Presently, with one unit operating, horizontal intake velocities are 0.5 fps; with both units, velocities will increase to approximately 1.0 fps. The design of the ocean intake is similar to that employed by Southern California Edison Company at their El Segundo fossil fuel plant. At El Segundo, 272 tons of fish were entrapped during the first year of operation when no velocity cap was used and the flow vectors entering the intake were vertically downward. After installation of a velocity cap with maximum design flows of 3.5 fps, only 15 tons of fish were entrapped in the following year (94.5% reduction) (USAEC, 1974). Velocity caps are designed to provide flow rate in a horizontal radial direction because fish are familiar with horizontal velocities, and they usually will tend to swim against a current even when their net movement is downstream. Vertical velocities, however, are not commonly found in nature, and a detection response mechanism does not seem to exist for them in fishes (USAEC, 1974).

The Florida Department of Natural Resources' Miami Research Laboratory in conjunction with FPL conducted preoperational baseline environmental studies of the marine environment adjacent to the St. Lucie Nuclear Plant from September 1971 to July 1974. In 1975, Applied Biology, Inc. continued the monitoring through 1980. Unit 1 was placed on-line in 1976. The nuclear plant was base loaded throughout 1977, 1978, 1979 and 1980. Monitoring information pertaining to entrapment of fishes and invertebrates over the years shows that:

- The primary commercial fishes in St. Lucie and Martin Counties are Spanish Mackerel, King Mackerel, and Bluefish. During the past 5 years, only 5 Spanish Mackerel, 10 King Mackerel and 24 Bluefish have been collected in the intake canal by gill netting designed to determine accumulations of fishes and shellfishes in the canal.

- The greatest yearly canal catch over the past 5 years was 1501 fish in 1980. Total estimated fish biomass lost to the Atlantic Ocean that year was 6818 kg or about 0.2% of the St. Lucie and Martin County commercial catches. A total of 121 shellfish weighing 42.5 kg was also collected during the same period.

- Five species of marine turtles are found along Hutchinson Island. The most common is the Atlantic loggerhead turtle followed by the green turtle, leatherback turtle, hawksbill turtle, and the Atlantic Ridley turtle. The leatherback turtle and the Florida population of green turtles are classified as endangered species by the Federal Government [CFR 41 (208):47180-47198; CFR 43:32,808], and all marine turtles are protected by Florida Statute 307.12; 1974.

o Total sea turtle entrapment in the St. Lucie intake canal over a 6-year period amounted to 572 loggerheads, 51 greens, 6 leatherbacks, 1 hawksbill, and 1 Atlantic Ridley. Annual entrapment of all 5 species has ranged from 0 to 173.

o Ichthyoplankton was generally abundant during the spring and summer of each year. The most common larval fishes were herrings and anchovies. Eggs and larvae collected averaged from 0.13 to $5.50/m^3$ as compared to the baseline sampling of $0.23/m^3$. These concentrations are substantially lower than concentrations found in a more productive area, the upper Indian River, where mean densities of eggs and larvae were $132.83/m^3$ (Applied Biology, Inc. and Ray L. Lyerly and Associates, 1980).

o Average egg and larval populations in the intake canal (0.889 eggs/m^3 and 0.080 larvae/m^3) were lower than average populations found offshore.

o To put the impact of entrainment into perspective, an offshore boundary was determined for the region from which ichthyoplankton is potentially withdrawn by the nuclear plant. The distance between the designated offshore boundary and the shoreline is 3500 m and the average depth is 9.2 m for a calculated cross-sectional area of 32,200 m^2. The percentage loss estimates from 1976 through 1980 for fish eggs ranged from 0.13 to 0.50 and for fish larvae losses ranged from 0.01% to 0.18%.

Ecology Branch staff has been assessing power plant impacts over the past decade. There is nothing in the monitoring information reviewed that, in our opinion, warrants a detailed 316(b) study nor the continued monitoring of the intake for fishes and invertebrates. The design, capacity and location of the ocean intake structure of the St. Lucie Nuclear Plant reflects, in our opinion, BTA for minimizing adverse impacts upon these organisms.

In view of the declining world populations of marine turtles, the Hutchinson Island turtle rookery is of special importance in maintaining marine turtle populations. Because of the nuclear plant's location on Hutchinson Island and the protected status of sea turtles, it is our opinion that continued monitoring of turtle entrapment is necessary to fully evaluate intake location, design and capacity.

REFERENCE

Applied Biology, Inc. and Ray L. Lyerly and Associates. 1980. Biological and environmental studies at the Florida Power and Light Co. Cape Canaveral Plant and the Orlando Utilities Commission Indian River Plant. Vol. I.

U.S. Atomic Energy Commission. 1974. Final EIS related to construction of St. Lucie Plant Unit 2, Florida Power and Light Company Docket No. 50-389.

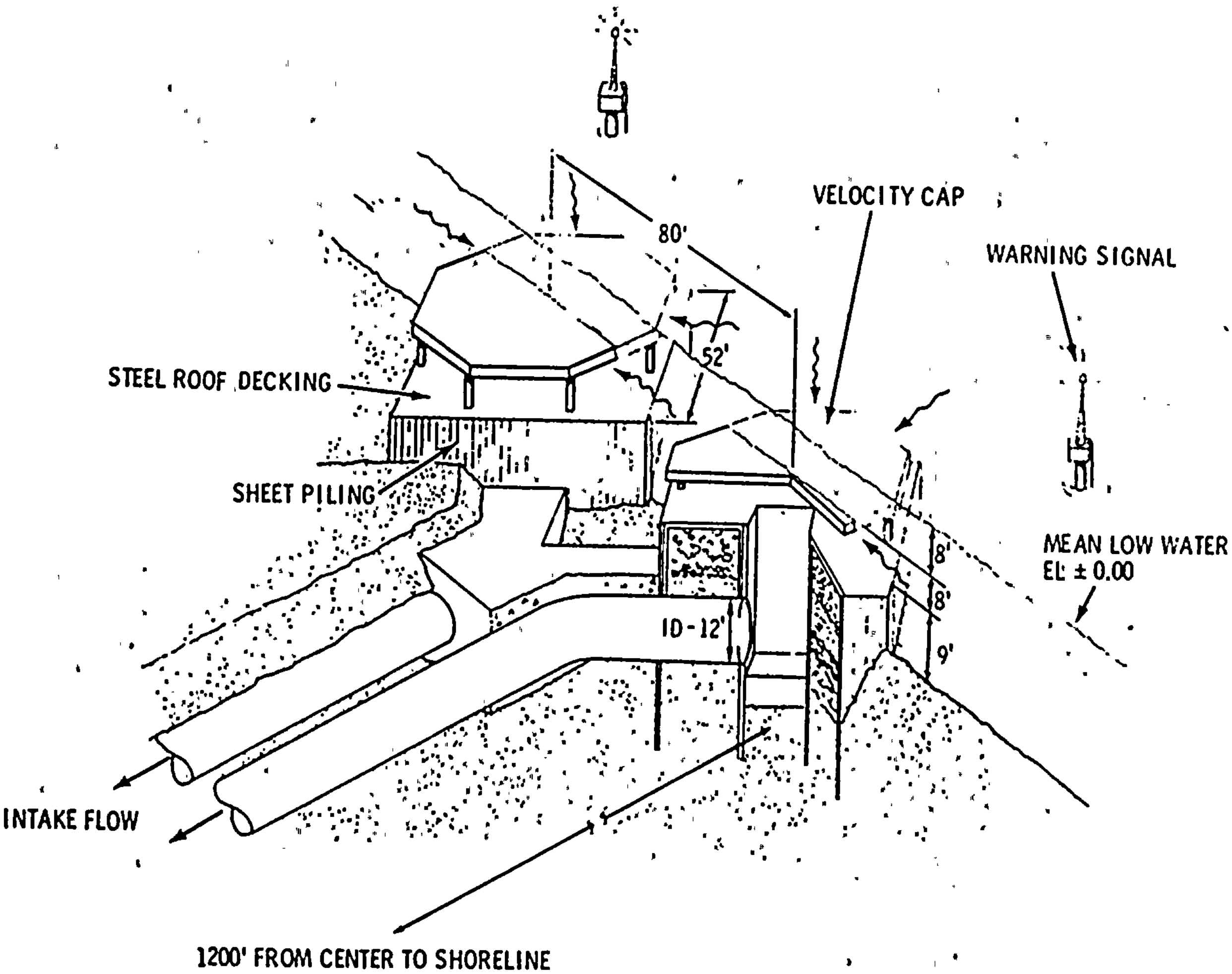


FIGURE 1. OCEAN INTAKE STRUCTURE

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

September 28, 1981

Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: St. Lucie Unit 2
Docket No. 50-389

Dear Mr. Eisenhut:

The Department of Environmental Regulation (DER) has reviewed the Environmental Report for the Operational License for Florida Power & Light Company (FPL) St. Lucie Plant Unit 2. The changes in plant design that have occurred since the construction license was granted requires that the state license be modified.

Review of the modified multiport diffuser indicated that a mixing zone must be designated for the thermal discharge pursuant to Section 17-3.05, Florida Administrative Code in order that the discharge be in compliance with the State water quality criteria. The DER proposes to designate a thermal mixing zone of 10.7 acre feet. Special Condition II A.2 will be changed to read.

2. Thermal Mixing Zone

The heated water discharged from the multiport diffuser shall not exceed 17°F above ambient outside of a thermal mixing zone of 10.7 acre-feet. The mixing zone shall be bounded by an area 1385.5 feet long extending seaward from the most landward discharge port, 21.0 feet to either side of the discharge pipe axis and 8.0 feet in height above the bottom of the discharge ports.

After consultation with the Environmental Protection Agency the DER will be modifying other conditions of certification dealing with effluent limitations, monitoring and sewage treatment as illustrated below.

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Condition II. B. should be modified to the following:

II.B. Chemical

Liquid wastes discharges shall not contain concentrations of pollutants ~~at-the-point-of-discharge-which may-be-measured-in-the-discharge-canal~~ in excess of the following limitations:

1.	Chlorine (Free Available Chlorine): at condenser discharge at end of discharge canal	0.2 mg/l average) 2 hr. 0.5 mg/l maximum) 0.1 mg/l maximum
2.	Oil and Grease:	15 mg/l Daily average from low volume waste, pre-operational metal cleaning wastes, and radwaste discharges
3.	Polychlorinated biphenyls or other polycyclic Halogenated compounds:	None
~~4.~~	~~Copper~~	~~20 ppb~~
~~5.~~ 4.	Boron:	4 mg/l (net)
~~6.~~	~~Cyclohexylamines:~~	~~0.5 mg/l~~
7.	TSS:	30 mg/l Daily average 100 mg/l Daily Maximum at the discharge from the low volume wastes, metal cleaning wastes and radwaste discharges

Condition III.A.1. should be modified as follows:

1. Chemical - the following parameters shall be monitored ~~in the-intake-and/or-discharge~~ and reported to the Department quarterly:

Parameter	Sampling Location	Type of Sample	Frequency Of Sampling
Flow	** Intake	Pump Logs	hourly
Temperature	** Intake/POD	- -	hourly
~~pH~~	~~*-POD~~	~~Grab~~	~~weekly~~
~~TDS~~	~~*-POD~~	~~Grab~~	~~monthly~~
TSS	Neutralization Basin	Composite	weekly
Oil and Grease	~~POD~~ Neutralization Basin	~~8-hour-Composite~~ Grab	weekly
~~Dissolved-Oxygen~~	~~*-POD~~	~~Grab~~	~~weekly~~
Free ~~and-Total~~ Chlorine Residual	~~*-POD~~ Condenser Outlet	Multiple Grabs	weekly during chlorination
Total Chlorine Residual	* POD	Multiple Grabs	weekly during chlorination
Boron	* POD	Grab	when batch dis-Charges are required ***
~~Copper~~	~~*-POD~~	~~Grab~~	~~monthly~~

* May be monitored in discharge canal at the location specified in III.A.2.b.
** May be monitored in intake canal (Plant Intake Structure)
*** From the refueling water storage tank and nonaerated waste hold up tanks (4).

III.A.2. Thermal - The monitoring of the thermal discharge shall be accomplished ~~by-supplementing-the-program-required-by-the-NPDES-Permit-No.--FL0002208-for-Unit-No. 1-by-adding-two-recording-thermographs~~ as follows:

a.) At the surface of the water ~~at a point of maximum sur face temperature of a~~ the discharge from Unit No. 2 the temperature shall be monitored twice annually in August and September by boat or by thermal image photography.

Condition III.B. should be modified to reflect the new biological monitoring program.

Condition VIII. should be modified as follows:

Delete existing language and replace with: Sanitary wastes shall be collected and treated in accordance with Chapter 17-6, FAC, and DER permits DO56-34536 and DC56-37127 or as maybe subsequently reissued or modified.

With these changes the Department of Environmental Regulation has no objection to the issuance of an Operational License to St. Lucie No. 2.

Sincerely,

Hamilton S. Oven, Jr.

Hamilton S. Oven, Jr., P.E.
Administrator
Power Plant Siting Section

HSOjr:my

cc: Charles Kaplan, EPA
Robert Samworth, NRC