NUREG-75/019

Final

environmental statement

related to the proposed

SOUTH TEXAS PROJECT UNITS 1 AND 2

HOUSTON LIGHTING & POWER COMPANY
CITY PUBLIC SERVICE BOARD OF SAN ANTONIO
CENTRAL POWER AND LIGHT COMPANY
CITY OF AUSTIN

DOCKET NOS. 50-498 AND 50-499

MARCH 1975

UNITED STATES NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

NUREG-75/019

FINAL ENVIRONMENTAL STATEMENT

by the

OFFICE OF NUCLEAR REACTOR REGULATION

U. S. NUCLEAR REGULATORY COMMISSION

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SOUTH TEXAS PROJECT
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HOUSTON LIGHTING & POWER COMPANY

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CITY OF AUSTIN

Docket Nos. 50-498 and 50-499

Issued: March 1975

Available from
National Technical Information Service
Springfield, Virginia 22161
Price: Printed Copy $8.50 ; Microfiche $2.25

SUMMARY AND CONCLUSIONS

This Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission, Division of Reactor Licensing.

1. This action is administrative.

2. The proposed action is the issuance of a construction permit to the Houston Lighting and Power Company, acting as Project Manager on behalf of itself, the City Public Service Board of San Antonio, Central Power and Light Company, and the City of Austin, for the construction of the South Texas Project (STP) Units 1 and 2, located in Matagorda County, Texas (Docket Nos. STN 50-498 and 50-499).

   The plant will employ two identical pressurized water reactors to produce up to approximately 3800 megawatts thermal (MWt) each. A steam turbine generator will use this heat to provide 1250 MWe (net) of electrical power capacity per unit. The exhaust steam will be cooled by the flow of water in a closed-cycle system incorporating an off-stream cooling lake utilizing makeup water from the Colorado River. Blowdown from the cooling lake will be discharged into the Colorado River.

3. Summary of environmental impact and adverse effects:

   a. A total of 12,352 acres will be utilized for the STP site. Construction-related activities on the site will disturb about 610 acres, not including the 7310 acres of land inundated by the STP cooling lake and embankments, which will be constructed in conjunction with the project (Sect. 4.1).

   b. Approximately 400 miles of transmission-line corridors will require about 5685 acres of land for the rights-of-way (Sect. 3.8).

   c. An access road and a railroad spur will affect about 60 acres. Farm to Market Road 521 will be rerouted north around the STP exclusion area (Sects. 4.1.4 and 4.1.5).

   d. Plant construction will involve extensive community impacts. Two families will be displaced from the site. Traffic on local roads will increase due to construction and commuting activities. The influx of construction workers' families (2100 peak work force) is expected to cause no major housing or school problems. There will be a demand for increased services in Matagorda County (Sect. 4.4).

   e. The total flow of circulating water will be 4044 cfs, which will be taken from and returned to the STP cooling lake. The STP cooling lake will receive an average of 54,000 acre-ft/year (102,000 acre-ft/year maximum) of unappropriated water from the Colorado River. The consumptive use of water from the Colorado River will amount to about 2.6% of the river's average annual historical flow. Direct rainfall will contribute, on the average, 25,000 acre-ft/year. Cooling lake blowdown will increase the Colorado River total dissolved solids concentration incrementally by about 460 ppm. The thermal alterations and increases in total dissolved solids concentrations will not significantly affect the aquatic productivity of the Colorado River (Sect. 5.3).

   f. Operation of the STP cooling lake makeup station will be conditioned to reduce entrainment losses of ichthyoplankton and crustacean larvae to acceptable levels (Sect. 5.5.2.1.1).

   g. The proposed plan to alter Little Robbins Slough and the resultant 65% reduction in the watershed supplying freshwater inflow to the upper marsh may cause the displacement of numerous freshwater species and reduce its desirability as a nursery for estuarine-dependent organisms. Studies to determine the need for freshwater makeup will be required (Sect. 4.3).

   h. The risk associated with accidental radiation exposure is very low (Sect. 7).

   i. No significant environmental impacts are anticipated from normal operational releases of radioactive materials. The estimated dose to the offsite population within 50 miles from operation of the project is 6.67 man-rems/year, less than the normal fluctuations in the 33,000 man-rems/year natural background dose this population now receives (Sect. 5.4).

4. Principal alternatives considered:

    a. Purchase of power

    b. Alternative energy systems

    c. Alternative sites

    d. Alternative heat dissipation methods

5. The following Federal, State, and local agencies were asked to comment on this Environment 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 Power Commission
    Office of the Governor, State of Texas
    County Judge, Matagorda County

The following organizations submitted comments on the Draft Environmental Statement, which was published in November 1974:

    Department of Agriculture (AGR)
    Department of the Army, Corps of Engineers (ARM)
    Department of Commerce (DOC)
    Department of Health, Education and Welfare (HEW)
    Department of the Interior (INT)
    Department of Transportation (DOT), U.S. Coast Guard
    Environmental Protection Agency (EPA)
    Federal Power Commission (FPC)
    Office of the Governor, State of Texas (TEX)
    Houston Lighting and Power (HLP)
    Sierra Club (SC)
    Advisory Council on Historic Preservation (ACHP)
    Triangle Cattle Company (TCC)
    Southern Methodist University (SMU)

Copies of these comments are in Appendix A of this Final Environmental Statement. The staff has considered these comments and the responses are located in Sect. 11.

6. This Environmental Statement was made available to the public, to the Council on Environmental Quality, and to other specified agencies in November 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 South Texas Project against environmental and other costs and considering available alternatives, the staff concluded that the action called for under the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 is the issuance of construction permits for the facilities subject to the following limitations for the protection of the environment:

    a. The applicant shall take the necessary mitigating actions, including those summarized in Sect. 4.5 of this Environmental Statement, during construction of the plant and associated transmission lines to avoid unnecessary adverse environmental impacts from construction activities.

    b. In addition to the preoperational monitoring programs described in Sect. 6.1 of the Environmental Report, with amendments, the staff recommendations included in Sect. 6.1 of this document shall be followed. These monitoring programs shall include the following special studies:

(1) A study program, as outlined in Sects. 5.5.2.1.1 and 6.1.3.2, will be implemented to obtain data necessary to assess the potential significance of the loss of ichthyoplankton and crustacean larvae through entrainment.

(2) A study program, as outlined in Sect. 6.1.3.2, shall be implemented to obtain the data necessary to assess the value of Little Robbins Slough as a nursery. Construction activities shall be limited so as not to reduce the watershed and freshwater inflow to Little Robbins Slough until after December 1, 1975. After December 1, 1975, construction activities shall be performed so as to minimize watershed removal until completion of the study program.

c. The turbine building liquid releases shall be continuously monitored as specified in 10 CFR Part 50, Appendix A, Criteria No. 64.

d. Before engaging in a construction activity not evaluated by the Commission, the applicant will prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity 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 a written evaluation of such activities and obtain prior approval of the Director of Reactor Licensing for the activities.

e. The applicant shall establish a control program which shall include written procedures and instructions to control all construction activities as prescribed herein and shall provide for periodic management audits to determine the adequacy of implementation of environmental conditions. The applicant shall maintain sufficient records to furnish evidence of compliance with all the environmental conditions herein.

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. Nuclear Regulatory Commission, Division of Reactor Licensing (staff), in accordance with the Commission's regulation 10 CFR 51, which implements the requirements of the National Environmental Policy Act of 1969 (NEPA).

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.

Pursuant to 10 CFR 51, the NRC Division of Reactor Licensing prepares a detailed Statement on the foregoing considerations with respect to each application for a construction permit or full-power operating license for a nuclear power reactor.

When application is made for a construction permit or a full-power operating license, the applicant submits an environmental report to the NRC. 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 10 CFR 51.

This evaluation leads to the publication of a Draft Environmental Statement, prepared by the Division of Reactor Licensing, which is then circulated to Federal, State, and local governmental agencies for comment. Interested persons are also invited to comment on 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 benefit-cost 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.

Single copies of this Statement may be obtained by writing the Director of the Division of Reactor Licensing, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. James A. Long III is the NRC Environmental Project Manager for this Statement. He may be contacted (301-443-6980) if there are questions regarding the contents of this Statement.

Effective January 19, 1975, activities under the U.S. Atomic Energy Commission regulatory program were assumed by the U.S. Nuclear Regulatory Commission in accordance with the Energy Reorganization Act of 1974. Any references to the Atomic Energy Commission (AEC) contained herein should be interpreted as Nuclear Regulatory Commission (NRC).

1. INTRODUCTION

1.1 THE PROPOSED PROJECT

Pursuant to the Atomic Energy Act of 1954, as amended, and the Commission's Regulations in Title 10, Code of Federal Regulations, an application was filed by Houston Lighting and Power Company (HL&P), acting as Project Manager on behalf of itself, the Central Power and Light Company (CPL), the City of San Antonio, and the City of Austin (hereinafter collectively referred to as the applicant) for a construction permit to build two pressurized-water nuclear reactors designated as the South Texas Project (STP) Units 1 and 2 (Docket Nos. 50-498 and 50-499), each of which is designed for initial operation at approximately 3800 megawatts thermal (MWt) with a nominal gross electrical output of about 1250 MW. The proposed facility is to be located on the applicant's site in Matagorda County, Texas, approximately 12 miles south of Bay City on the west side of the Colorado River.

Regulation 10 CFR 51 requires that the Director of Nuclear Reactor Regulation, or his designee, analyze the Environmental Report submitted by the applicant and prepare a detailed statement of environmental considerations. It is within this framework that this Environmental Statement related to the construction of the South Texas Project (STP) has been prepared by the Division of Reactor Licensing (staff) of the U.S. Nuclear Regulatory Commission.

Major documents used in the preparation of this statement were the applicant's Environmental Report (ER),[1] Preliminary Safety Analysis Report (PSAR),[2] and supplements thereto issued for South Texas Project. Independent calculations and sources of information were also used as a basis for the assessment of environmental impact. In addition, some of the information was gained from visits by the staff to the South Texas Project site and surrounding areas in June and August 1974. Although data from all of these sources were examined by the staff in making its assessments, only brief summaries of the most pertinent data are given in this statement. To avoid repetition, the staff has provided references to the sources of detailed information, much of which is found in the applicant's Environmental Report.

As a part of its safety evaluation leading to the issuance of construction permits and operating licenses, the Commission makes a detailed evaluation of the applicant's plans and facilities for minimizing and controlling the release of radioactive materials under both normal conditions and potential accident conditions, including the effects of natural phenomena on the facility. Inasmuch as these aspects are considered fully in other documents, only the salient features that bear directly on the anticipated environmental effects are repeated in this environmental statement.

Copies of this Draft Environmental Statement and the applicant's Environmental Report (ER) are available for public inspection at the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C., and in the Public Document Room at the Matagorda County Court House, Bay City, Texas.

1.2 STATUS OF REVIEWS AND APPROVALS

To construct the South Texas Project and related facilities, the applicant is required to apply for and receive certain permits, licenses, and other authorizations from a number of Federal and State agencies and, in some cases, from regional and local agencies. Certain of these permits and licenses are listed in Table 1.1.

REFERENCES FOR SECTION 1

1. Houston Lighting and Power Company, *South Texas Project, Units 1 and 2, Environmental Report*, Docket Nos. 50-498 and 50-499, July 1, 1974, and subsequent amendments.

2. Houston Lighting and Power Company, *Preliminary Safety Analysis Report, South Texas Project, Units 1 and 2,* Docket Nos. 50-498 and 499, July 1, 1974, and subsequent amendments.

Table 1.1. Federal, State, and local authorizations required for construction and operation of the South Texas Project

Agency	Permit or approval	Status
	Federal	
Nuclear Regulatory Commission	Construction permit	Docketed July 1974
	Operating license	Future
Environmental Protection Agency	Permit for waste discharges	Future
U. S. Army Corps of Engineers	Permit for construction of the intake and discharge structures on the Colorado River	Future
	Permit for installation of permanent pilings on navigable waters (Colorado River)	Approved Nov. 14, 1973
	State	
Texas Water Rights Commission	Permit for appropriation and diversion of water from the Colorado River	Submitted Jan. 2, 1974
	Permit for construction of the intake and discharge structures on the Colorado River	Submitted Jan. 2, 1974
Texas Water Quality Board	Permit for sanitary waste disposal	Future
	Permit for return of blowdown to the Colorado River	Future
	Permit for construction and operation of sanitary treatment facilities	Future
	Section 401 FWPCA Certification	Submitted Jan.27, 1975
Texas Highway Department	Permits as necessary for the rerouting of FM 521	Future
Texas Air Control Board	Permits for release of gaseous effluents into the atmosphere	Future

2. THE SITE

2.1 SITE LOCATION

The applicant plans to locate the South Texas Project (STP), Units 1 and 2, in sparsely populated and essentially rural Matagorda County, Texas. The proposed project is to be located approximately 12 miles south of Bay City on the west side of the Colorado River. The location of Unit 1 will be longitude 96°02'53" west, latitude 28°47'42" north; Unit 2 will be located at longitude 96°03'00" west, latitude 28°47'42" north. Figure 2.1 shows the general area within 50 miles of the proposed plant site. The site area, illustrated by the site development plan in Fig. 2.2 consists of approximately 12,352 acres. The local relief of the area is characterized by generally flat land, approximately 23 ft above mean sea level. The west branch of the Colorado River flows through the site boundary as well as several sloughs, one of which feeds Kelly Lake, a 34.4-acre water body in the northeast corner of the site. The site and its immediate environs fall within the Coastal Prairie, which extends as a broad band parallel to the Texas Gulf Coast.

The nearest commercial airport with scheduled passenger service is the Victoria County Airport, in Victoria, Texas. There are 20 small runways in use within 10 miles of the site to support crop-dusting operations. The nearest pipeline is a 16-in. natural-gas line 2.1 miles WNW from the plant.

There are 4 roadways within 5 miles of the site. The nearest road is the Farm to Market Road (FM) 521, about 0.75 mile south of the reactor building. The portion of FM 521 passing through the site will be rerouted north around the exclusion area. Farm to Market Roads 1095, 3057, and 2668 are located 4.5 miles west, 4.5 miles NNE, and 4.8 miles ENE respectively. The nearest railroad lines belong to the Santa Fe and the Missouri Pacific Companies and are located 7 miles east and 7 miles north respectively.

2.2 REGIONAL DEMOGRAPHY, LAND USE, AND WATER USE

2.2.1 Regional demography

The State of Texas increased in population between 1960 and 1970 at a faster rate than the population of the United States (16.9% vs 13.3%). However, the growth rate of this period for Texas was the second lowest since data have been available beginning in 1850. There was only a 10.1% increase during the 1930–1940 period. Between 1960 and 1970 the population increased 24.1% in the urban areas and decreased by 4.9% in the rural areas.

Towns and cities within 50 miles of the STP site are shown in Fig. 2.1. The estimated 1970 population within 10 miles of the site was 3025 persons; within 5 miles, it was 217 persons. The closest incorporated communities are Bay City and Palacios, both of which lie beyond the 10-mile radius. Matagorda, an unincorporated community, is about 8 miles southeast of the plant. Two residential developments, Selkirk Island and Exotic Isle, are approximately 4 miles from the plant to the southeast. Together, the developments represent 367 homes or retirement sites scheduled to reach completion by 1980. Communities with a population of 1000 or more in 1970, within 50 miles of the site, are given in Table 2.1. Table 2.2 shows the present and projected populations within the 5-, 10-, and 50-mile radii. Additional details and sector population projections are presented in the ER, Sect. 2.2.

The nearest permanently occupied residence is 2.8 miles WSW of the plant Nearby schools are the Tidehaven High School (8 miles NNW), the Tidehaven Intermediate School (8.5 miles NNW), both located in Elmaton, Texas, and the Matagorda Elementary School (8 miles SE) in Matagorda, Texas. The combined 1972–1973 enrollment of these schools was 420 students.

The only hospital facilities within the county are Matagorda General Hospital located in Bay City and Wagner General Hospital in Palacios. The Matagorda General Hospital has three surgical rooms, 136 beds, and a 29-bed convalescent-nursing center. Also located in Bay City is the Bay Villa Convalescent Home with a 106-bed capacity. Wagner General Hospital in Palacios has a 43-bed capacity.

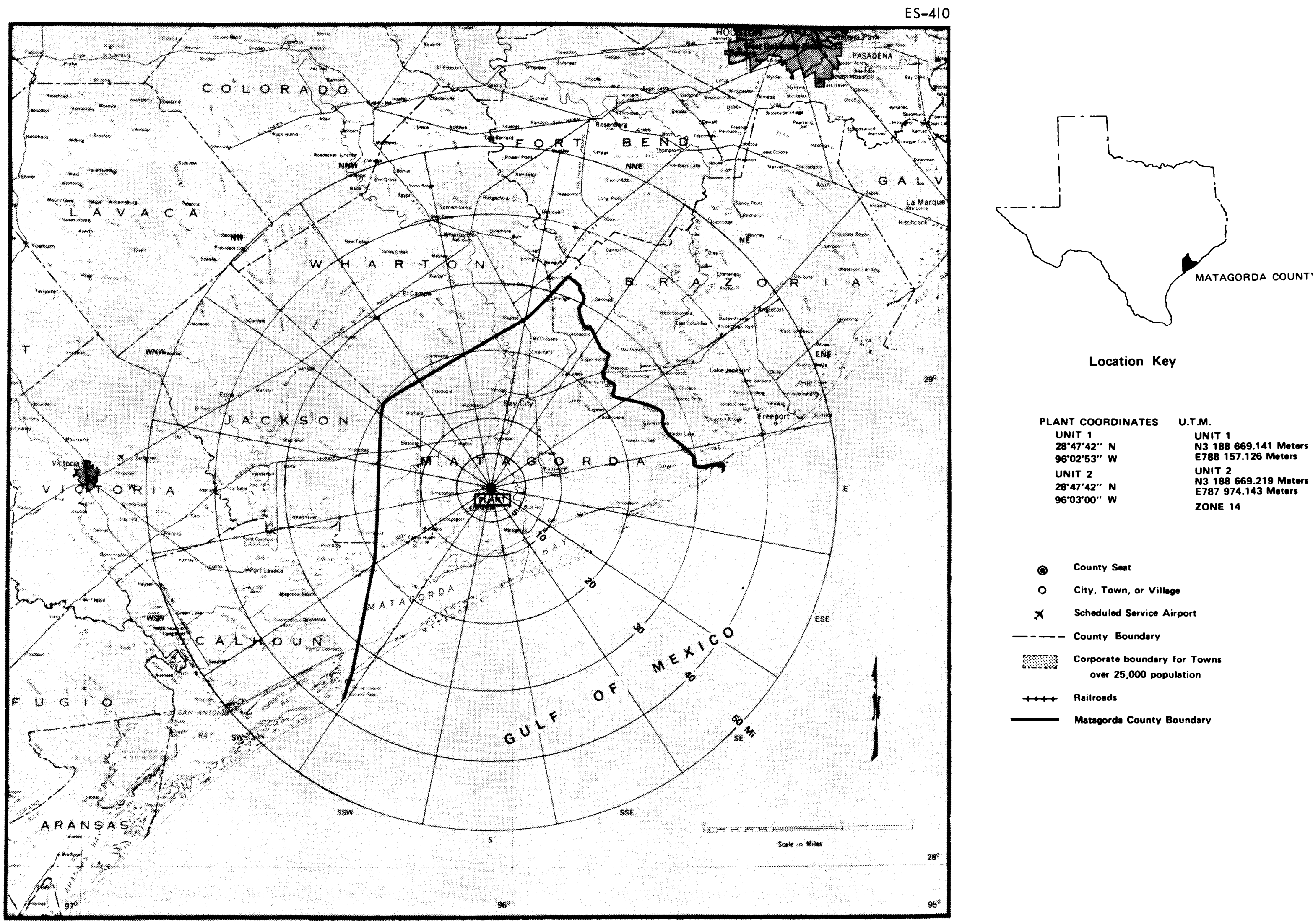

Fig. 2.1. Region surrounding the South Texas Project. <u>Source</u>: ER, Fig. 2.1-1.

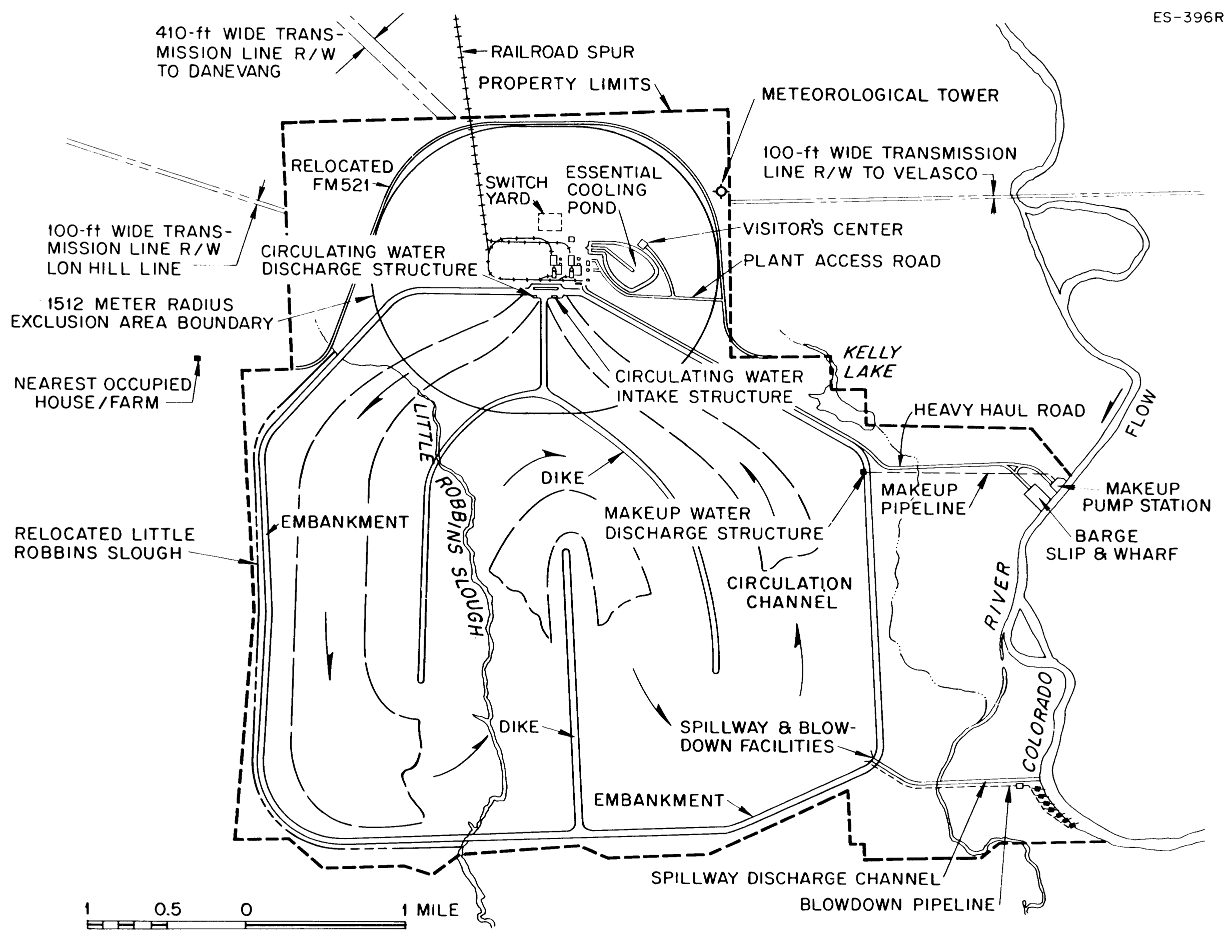

Fig. 2.2. Site development plan. Source: PSAR, Fig. 2.1-4.

Table 2.1. Communities with a population of 1000 or more in 1970 within 50 miles of the site

Community	Population (1970)	Distance from site (miles)	Direction
Bay City	11,733	12	NNE
Palacios	3,642	12	WSW
Van Vleck	1,051	19	NNE
Sweeney	3,191	26	NE
El Campo South	1,880	30	NNW
Ganado	1,640	33	WNW
Point Comfort	1,446	33	WSW
Brazoria	1,681	35	ENE
West Columbia	3,335	35	NE
Port Lavaca	10,491	37	WSW
Wharton	7,881	37	N
Edna	5,332	39	WNW
Jones Creek	1,268	39	ENE
Lake Jackson	13,376	42	ENE
Richwood	1,452	42	ENE
Clute	6,023	44	ENE
Freeport	11,997	45	ENE
Needville	1,024	45	NNE
Angleton	9,770	46	NE
Angleton South	1,017	47	NE
Seadrift	1,092	48	WSW

Source: ER, Table 2.2-1.

Table 2.2. Present and projected populations in the region surrounding the plant

Year	0–5 miles	0–10 miles	0–50 miles
1970	217	3,025	176,239
1980	1,159	4,376	263,688
1990	1,208	5,028	441,609
2000	1,255	5,628	589,727
2010	1,293	6,219	708,448
2020	1,332	6,759	795,975

At present there are no developed public recreation facilities along the Colorado River between Bay City and Matagorda. There are no State or Federal wildlife reserves along the river in the site vicinity, although duck and geese are prevalent near the Gulf, resulting in some hunting activity along the lower reaches of the river.

The only major industry in the area is the Celanese Chemical Company which employs between 400 and 500 workers and is located approximately 5 miles NNE of the site.

2.2.2 Land use

Agriculture is the most important industry in Matagorda County. According to the 1969 Census of Agriculture, approximately 106,000 acres of the total 740,736 acres in the county are in harvested cropland. Of this acreage, about 57,000 are irrigated. Crop production includes rice, grain, sorghum, corn, cotton, turf grass, and soybeans. Rice is the largest crop grown, making Matagorda County the third largest rice producing county in Texas. The income attributable solely to rice is in excess of $26,000,000 annually.

The beef cattle industry utilizes a large area in the county and is the second most important agricultural enterprise with an income exceeding $6,000,000 each year. Beef cattle are the only livestock of economic value located near the proposed STP. There are six ranches with approximately 3600 head of cattle (total) within 10 miles of the site. There are no dairies within 10 miles, and there are no known cows or goats which produce milk for human consumption within 5 miles of the site.

2.2.3 Water use

Present water use in the area is primarily for domestic, irrigation, and livestock purposes.

2.2.3.1 Groundwater

Essentially all irrigation, industrial, public, and municipal and drilling supply groundwater comes from a deep aquifer. There are no riverbank wells within the environs of the proposed site (ER, Table 2.2-4).

2.2.3.2 Surface water

All potential surface water users in Texas must file for permission with the Texas Water Rights Commission. A summary of the applications, claims, and certified filings for surface water use in the environs of the STP is presented in the ER, Table 2.2-5.

The applicant has filed for a permit from the Texas Water Rights Commission to divert unappropriated water from the Colorado River at a rate of 102,000 acre-ft/year. This water will be used initially to fill and then, during the operating life of the plant, as makeup for the 187,000 acre-ft cooling lake and the 342 acre-ft essential cooling pond.

2.3 HISTORICAL AND ARCHAEOLOGICAL SITES AND NATURAL LANDMARKS

2.3.1 Historic sites and natural landmarks

A review of the *National Register of Historic Places* and the *National Registry of Natural Landmarks* has shown no listings for historic structures or places within 5 miles of the proposed STP, or as being endangered by the primary or alternate transmission-line corridors. The Texas State Historical Preservation Coordinator states that no sites in the STP area are listed on or are under consideration as nominations for the *National Register of Historic Places* (Appendix C).

2.3.2 Archaeological sites

The archaeological potential of the STP area and transmission-line corridors was assessed in a study by the Texas Archaeological Survey and the University of Texas at Austin. The report on archaeological investigations of the site area states that "with the careful application of standard archaeological survey field techniques no archaeological sites or features could be isolated" (ER, Sect. 2.3.2).

2.4 GEOLOGY AND SEISMOLOGY

2.4.1 Geology

The site is situated on the Gulf Coastal Plain section of the Coastal Plain Physiographic Province. This physiographic province lies within the Coastal Plain Tectonic Province. The site vicinity is underlain by four Pleistocene formations, namely the Beaumont (250- to 1400-ft thick), the Montgomery (40- to 80-ft thick), the Bentley (400- to 1000-ft thick), and the Willis (80- to 85-ft thick). The Pliocene Goliad formation (840- to 1050-ft thick) is beneath the Willis. Estimates vary, but as much as 45,000 ft of sediments may overlie pre-Mesozoic basement rock in the site area. The Beaumont formation contains some water-bearing sand beds.

The project site covers 12,352 acres and borders the west bank of the Colorado River. The site has less than 15 ft of relief in the 4.25 miles from the northern to the southern boundary. The plant grade is at an elevation of approximately 30 ft MSL. The plant site area is approximately 40 ft higher than the present Colorado River channel bottom.

Small mounds (pimple mounds) are present in the project site area and vicinity and at many other areas of the West Gulf Coastal Plain. The mounds are approximately 2 ft high, round or elliptical, and 50 ft or less in diameter. Most pimple mounds have been modified by plowing. These mounds are a product of deposition and subsequent erosion during river flood stages in the geologic past.

2.4.2 Seismology

The Gulf Coast of Texas is a relatively inactive seismic area. Faults within the Coastal Plain are characterized as growth faults whose activity results in "creep" as opposed to the more severe ground movements usually associated with seismic activity on tectonic faults. Seismic reflection surveys reveal little evidence of faulting in the immediate vicinity of the site. If faults do occur beneath the site area, there is apparently no indication that they extend upward closer than 6000 ft below the ground surface.

2.5 HYDROLOGY

2.5.1 Surface waters

2.5.1.1 Colorado River

The Colorado River flows along the easterly side of the plant site and is a navigable channel from its mouth at the Gulf of Mexico to about 23 river miles upstream. A number of dams are located on the river, which is about 890 miles long from its origin in New Mexico to the Gulf. One of these dams, Mansfield Dam, has the largest impoundment, Lake Travis. All major tributaries are above Lake Travis and are regulated by dams.

Flow rates vary over a large range. The average flow rate at Bay City, Texas, approximately 16 miles upstream from the site, was 2353 cfs based on records from 1948 to 1970. Maximum recorded daily flow was 84,100 cfs. The 7-day 10-year low flow was 1.0 cfs.

The lower reaches of the Colorado River up to 32 river miles from the Gulf of Mexico are tidal. The mean tidal range at the mouth is 0.5 ft and is diurnal. Water will be pumped from the Colorado River to the proposed cooling lake in accordance with a permit for which application has been made to the Texas Water Rights Commission.

2.5.1.2 Other hydrologic features

Freshwater

The only drainage structure of an appreciable size other than the Colorado River is Little Robbins Slough, which has a drainage area of 23,480 acres. A portion of the slough will be inundated by the cooling lake. This portion will be rerouted along the west embankment of the lake. Several small irrigation canals supply water for agriculture outside the site boundary.

Salt water

The three saltwater features near the STP site are the Gulf Intracoastal Waterway (GIWW), Matagorda Bay, and the Gulf of Mexico.

The Gulf Intracoastal Waterway is a shallow-draft navigational waterway stretching from Apalachee Bay, Florida, to Brownsville, Texas. The waterway crosses the Colorado River 6.5 miles downstream from the site. Matagorda Bay is a shallow estuarine bay of about 300 sq miles. The Colorado River divides the bay, crossing to the Gulf of Mexico over a land bridge. Part of the Colorado River flows into Matagorda Bay via Parker's Cut.

2.5.2 Groundwater hydrology

The principle groundwater source in the STP site is the Gulf Coast aquifer. The aquifer consists of a shallow and a deep zone separated by an impervious layer 200-ft thick near the plant site. The deep aquifer is highly developed because of its good quality. Extensive pumping has caused reversal of groundwater gradients in some areas causing the saltwater–freshwater interface to move inland. However, this does not appear to be a problem at the STP site area.

Groundwater flow in the two aquifer layers is completely different. Water in the shallow aquifer zone flows to the southeast at approximately 15 ft/year, while water in the deep aquifer zone flows to the west at about 45 ft/year.

The deep aquifer zone is recharged from precipitation and stream percolation at least 8 to 10 miles beyond the northern boundary of Matagorda County — well away from the site. The shallow aquifer zone also does not appear to be recharged from sources within or to the south of the STP site.

2.5.3 Water quality

The United States Geological Survey (USGS) and the Texas Water Quality Board have been collecting water quality data on the lower Colorado River since September 1967. The applicant has given both information on the sampling locations (ER, Fig. 2.5-9) and the USGS data (ER, Tables 2.5-3 through 2.5-9). There is evidence of a saltwater wedge, which normally reaches 22.5 miles upstream of the Gulf. The wedge can reach a maximum of 32 miles upstream during periods of low flow or can be absent entirely during periods of heavy precipitation. In the period 1961 to 1972, low and high temperatures were about 48°F and 85°F respectively (ER, Fig. 2.5.11).

Groundwater quality is different in the shallow and deep aquifer zones. The deep aquifer above 900 ft, referenced to ground surface, is of good quality and is generally acceptable for irrigation and domestic and industrial use; the water below 900 ft is mineralized and unacceptable for these uses. Heavy pumping has caused saltwater intrusion into the deep aquifer in shoreline areas of the Gulf. Water quality can be rated as marginal to poor in the shallow aquifer and deteriorates closer to shore. Well water from the shallow aquifer was found to be alkaline and generally hard (ER, Tables 2.5-25, 26, and 27).

2.6 METEOROLOGY

2.6.1 Regional climatology

Because the STP site is located in the flat coastal plains of Southern Texas about 15 miles from the Gulf of Mexico, the climate is predominantly humid subtropical, influenced during much of the year by the anticyclonic circulation of the Azores-Bermuda high pressure system. Winters are generally short and mild, with an occasional incursion of continental polar air bringing cooler temperatures and northwest winds. Summers are long, hot, and humid, with maritime tropical air masses predominating over the area.

2.6.2 Local meteorology

Climatological data from Victoria (about 60 miles west of the site), Galveston (about 75 miles east-northeast of the site), Houston (about 70 miles northeast of the site), available data from Allens Creek Nuclear Generating Station (about 60 miles north of the site), available onsite data, and additional climatological information presented in the applicant's Environmental Report, Sect. 2.6, have been considered in assessing the local meteorological characteristics of the site.

Mean monthly temperatures at the site may be expected to range from about 55°F in January to about 83°F in July and August.[1-4] The record maximum temperature in the area was 110°F, reported at Victoria in July 1939;[3] the record minimum temperature in the area was 8°F, reported at Galveston in February 1899.[2]

Annual average precipitation in the site area ranges from about 36 in. at Victoria[3] to about 46 in. at Houston[1] with most stations in the site area averaging around 42 to 43 in.[1-4] Precipitation is well distributed throughout the year. The maximum 24 hr rainfall in the area was 14.35 in. reported at Galveston in July 1900.[2] Snowfall is generally negligible in the area, although 15.4 in. fell in a 24-hr period at Galveston in February 1895.[2]

Relative humidity is generally high throughout the year, averaging about 75% in the area.[1] Heavy fog occurs frequently in the site area. Victoria experiences fog about 40 days per year, predominantly during the winter months.

The applicant has presented one full year of onsite wind data from the 10-m level for the period July 20, 1973 through July 20, 1974.[5] These data indicate prevailing winds from the southeast, south-southeast, and south occur about 44% of the time. Wind data from the 10-m level have also been presented from Allens Creek (October 1972 through September 1973), Corpus Christi (March 1955 through September 1960), and Victoria (September 1953 through August 1958), and from about the 140-ft level at Galveston (October 1958 through September 1963.[4] Prevailing winds from the southeast, south-southeast, and south at the NWS station in the area are: 44.6% at Corpus Christi, 33% at Victoria, and 37% at Galveston. Mean wind speeds range from about 8 mph at Allens Creek to about 14 mph at Corpus Christi. Average wind speeds for the period July 20, 1973 through July 20, 1974 of concurrent data at Victoria and the STP site are 10.3 and 10.7 mph respectively. Figures 2.3 and 2.4 show the onsite wind rose at the 33- and 195-ft levels, respectively, for the period July 20, 1973 through July 20, 1974.

2.6.3 Severe weather

Types of severe weather expected in this area are thunderstorms, tornadoes, and hurricanes. As a result of circulation patterns that bring warm, moist, unstable air from the Gulf of Mexico in all months of the year, thunderstorms can be expected in all months. At Houston, thunderstorms can be expected about 59 days annually.[1]

Since the STP site is located near the center of a two-degree latitude-longitude square, tornado occurrences were examined for the two-degree square. During the period 1955–1967, 138 tornadoes were reported in this two-degree square, giving a mean annual tornado frequency of 2.7 for a comparable one-degree square containing the site.[6] The computed recurrence interval for a tornado at the plant site is 550 years.[7]

In the period 1871–1971, about 36 tropical storms, hurricanes, and depressions passed within 50 miles of the site.[8] The "fastest mile" wind speed reported at Galveston was 100 mph in September 1900.[2] In the period 1963–1970, there were about four atmospheric stagnation cases totalling about 16 days.[9]

2.7 ECOLOGY OF THE SITE AND ENVIRONS

2.7.1 Terrestrial ecology

2.7.1.1 Soils

Soils of the STP site belong to three major groups: the Lake Charles-Bernard-Midland, the Edna-Katy-Telferner, and the Miller-Norwood-Pledger-Associations (Ref. 10, Tables 1-3 and 1-80, and Fig. 1-4). The site soils are quite fertile and with abundant water and mild climate result in a high agricultural potential.

2.7.1.2 Producers

A summary of land classification units and plant communities of the site is presented in Appendix B, Table 1, and a vegetation map is given in Fig. 2.5. The site area is heavily cultivated, with only 25% remaining in natural plant communities. Ricelands occupy 30% of the site, with rice comprising an important cash crop. Rice farming accounts for over 50% of the use of croplands developed from coastal prairies.[11] The ricelands presently provide favorable habitat for many wetland game species. Two distinct natural plant associations are present over the remaining onsite acreage: coastal prairie and southern floodplain forest. Rare and endangered species and those restricted to a single plant association whose range overlaps the site are listed in Appendix B, Table 2.

A summary of the types of plant communities found in the coastal prairies (Bluestem-Sacahuista prairie) of the site is presented in Appendix B, Table 1. Principal climax plants are tall bunch grasses such as big bluestem, seacoast bluestem, and coast sacahuista. Much of the coastal prairie is being invaded by mesquite and live oak.

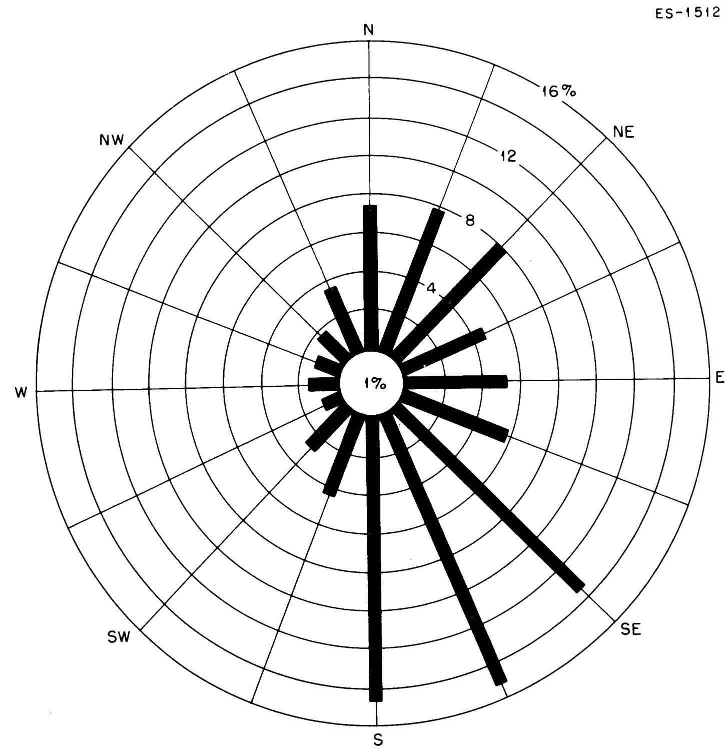

Fig. 2.3. Percent occurrence of wind by direction, onsite data at 33 ft aboveground, from July 20, 1973 through July 20, 1974.

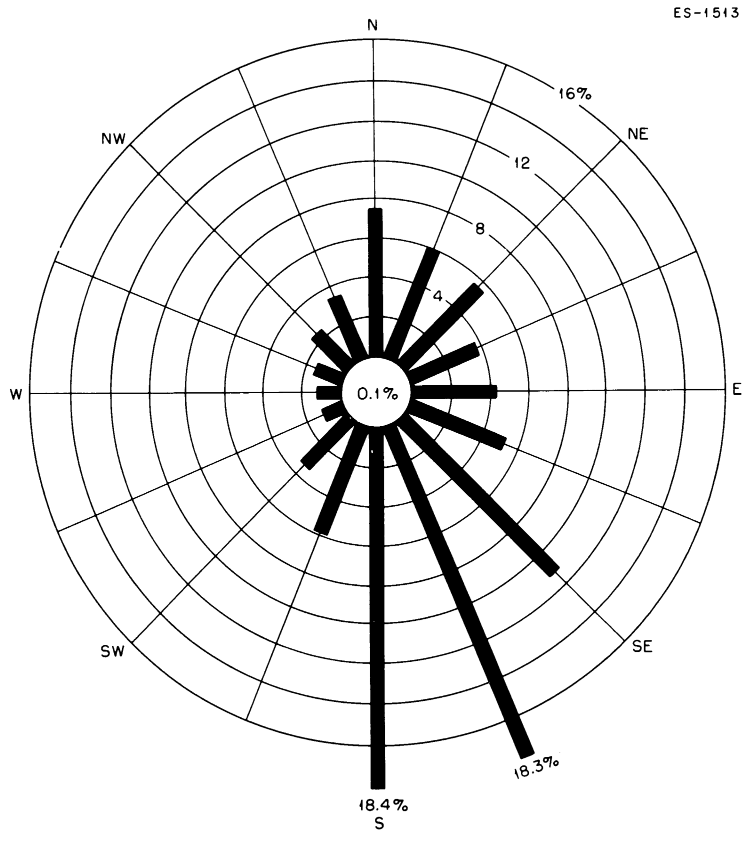

Fig. 2.4. Percent occurrence of wind by direction, onsite data at 195 ft aboveground, from July 20, 1973 through July 20, 1974.

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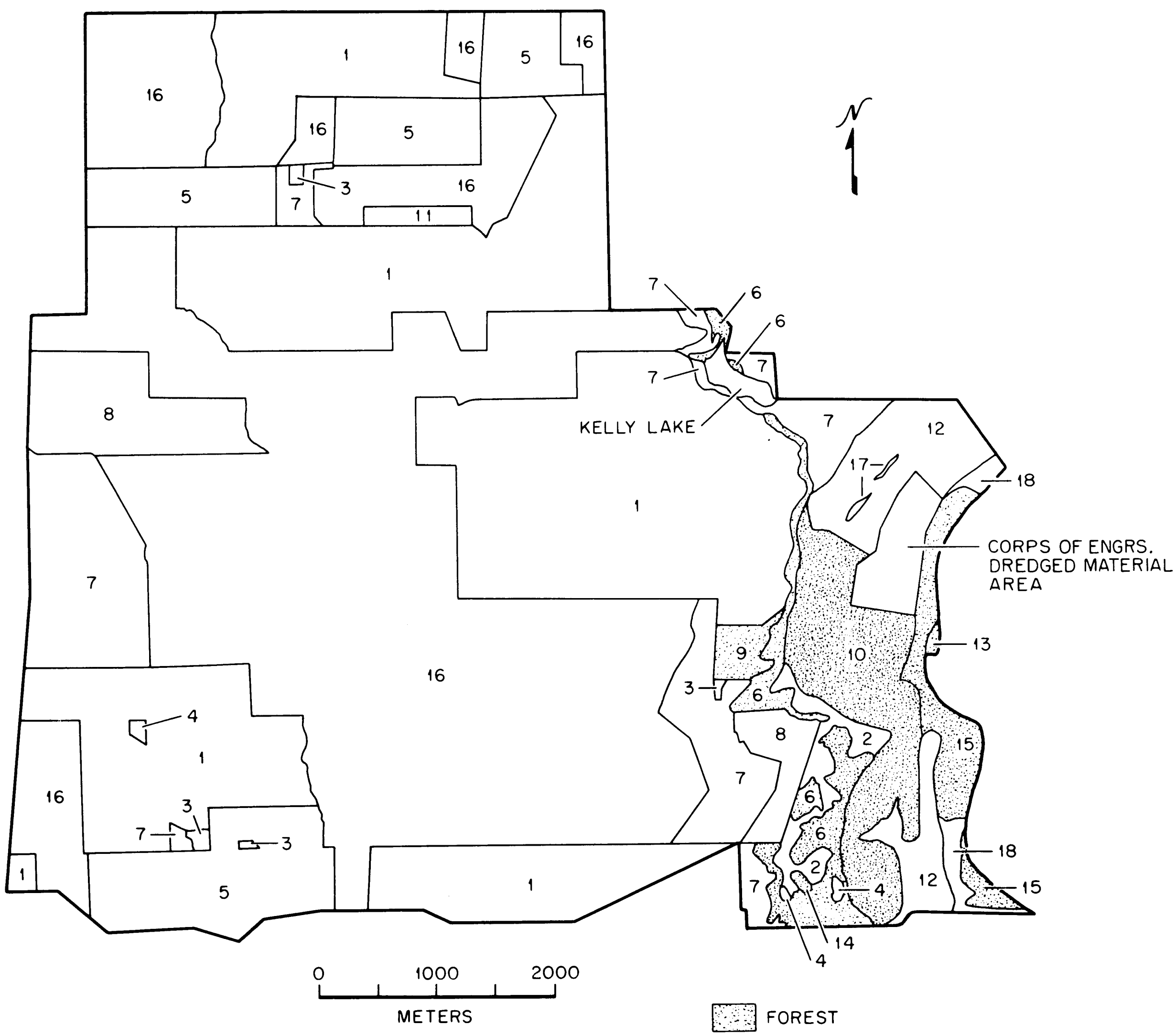

1 — ANNUAL IRRIGATED CROPLAND
2 — TREE SAVANNA
3 — RESIDENTIAL
4 — WET MEADOW
5 — ANNUAL NON-IRRIGATED CROPLAND
6 — MIXED BROADLEAF EVERGREEN DECIDUOUS FOREST
7 — PASTURE
8 — PERENNIAL NON-IRRIGATED CROPLAND
9 — BROADLEAF EVERGREEN SCRUBLAND
10 — BOTTOMLAND FOREST
11 — DECIDUOUS SCRUBLAND SAVANNA
12 — BOTTOMLAND CLEARED
13 — BARREN LAND
14 — SWAMP
15 — RIPARIAN FOREST
16 — FALLOW
17 — MARSH
18 — RIPARIAN, CLEARED

Fig. 2.5. South Texas Project vegetation and land use types, 1974.
Source: ER, Suppl. to Amendment 1.

Southern floodplain forest is typically swamp and Bayou forest which occurs along the Colorado River and along stream margins of the southern United States. A summary of plant communities found in the southern floodplain forest (bottomland woods) of the site is presented in Appendix B, Table 1. The more important trees which compose this type of forest are bald cypress, swamp tupelo, water oak, swamp hickory, sweet gum, water ash, sycamore, and blackgum. A rich understory of small trees and shrubs is present. The understory consists of several species, including the swamp privet, which are confined to this association. The floodplain forest communities of the site have been greatly modified due to past cutting of trees and annual spraying with herbicides.

To the south at the site boundary and immediately adjacent to the coast, coastal marsh (southern cordgrass prairie) is found. These marshes are complex wetlands made up of several communities: freshwater marsh, ponds, wet meadows dominated by coastal sacahuista, salt meadows, brackish ponds, salt marshes, and sand prairies. A preliminary listing of plant species of the upper areas of this marsh are given in the ER, Suppl. to Amendment 1, Table 228. In general, the vegetation changes as salinity increases. This marsh system will be discussed in more detail in Sect. 4.3.3.

2.7.1.3 Consumers

The site is included within the Texan biotic province[12] and has rich fauna comprised of a mixture of prairie, forest, and marshland species (ER, Sect. 2.7). The floodplain forests provide nesting sites for several fish-eating birds. The salt- and brackish-to-freshwater marshes along the coast are used extensively by a rich assortment of wintering birds. This biotic province is the wintering ground for the American migratory waterfowl of the central flyway. The most important foods of these waterfowl are cord, spike, and saw grass.

The freshwater parts of coastal marshes just south of the site provide habitats for 41% of the species observed by the applicant. The brackish and saltwater portion of the marsh provides habitats for fewer species (25% of the observed fauna). This marsh system is presently used by several rare and endangered wildlife species and provides potential habitat for several more (Appendix B, Table 3).

Much of the coastal prairie of this biotic province has been converted to rice production. These ricefields are man-made freshwater marshes which are used extensively by wintering waterfowl, waders, shorebirds, rails, and gallinules. Potential game species of the Texan biotic province are listed in Appendix B, Table 3. A total of 41 economically important species have been observed using the site or adjacent areas. Goose counts on rice fields and upland pastures of the site ranged from a low of 3189 birds on November 12, 1973, to as high as 7200 on January 3, 1974 (ER, Table 2.7-5).

2.7.2 Aquatic ecology

Figure 2.6 shows the STP environs with respect to adjacent coastal features of Texas. A map of the STP aquatic environs designating the applicant's sampling stations is shown in Fig. 2.7. The aquatic environment on and adjacent to the STP site includes several complex, interrelated subsystems which make up a large estuarine ecosystem. The important subsystems include: (1) Robbins Slough (including both branches of Little Robbins Slough) and adjacent freshwater and brackish marshes south to the Gulf Intracoastal Waterway (GIWW); (2) lower Colorado River; (3) Matagorda Bay; (4) Gulf of Mexico; and (5) Gulf Intracoastal Waterway. A brief description of these subsystems in relation to the STP site is described below.

2.7.2.1 Physical

Robbins Slough

Construction of the cooling lake will remove 65% of the Little Robbins Slough drainage area above the site's southern boundary (Fig. 2.7).[10] Approximately 7 stream miles of Little Robbins Slough lie within the STP site boundary. Here, it resembles a sluggish creek. About 1.5 miles south of the site, Robbins Slough widens into a large, open, estuarine marsh of approximately 4300 acres which extends south to the GIWW. The upper reaches of the marsh are fresh water while the lower reaches are brackish due to saltwater intrusion (ER, Suppl. to Amendment 1). At station 16, salinity was less than 1 ppt, or virtually fresh water.

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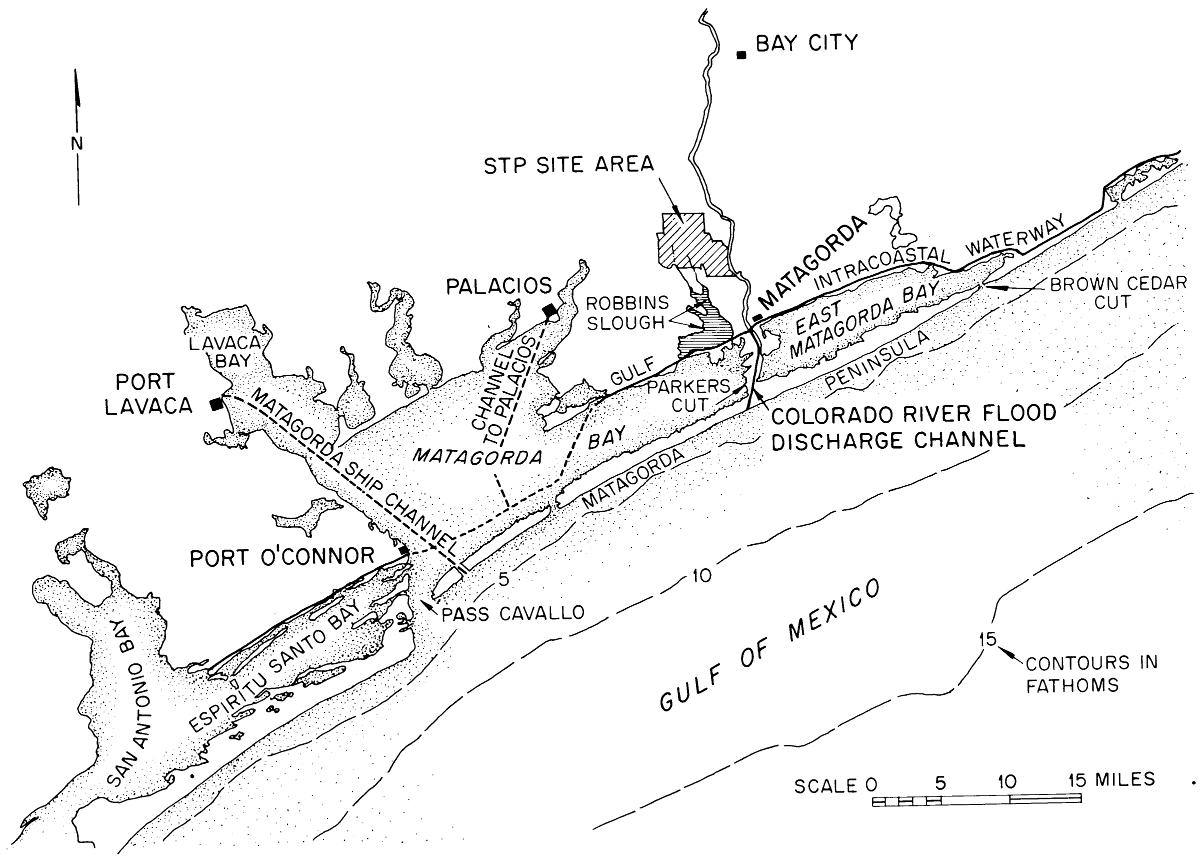

Fig. 2.6. South Texas Project site environs with respect to adjacent coastal features.

ES 383

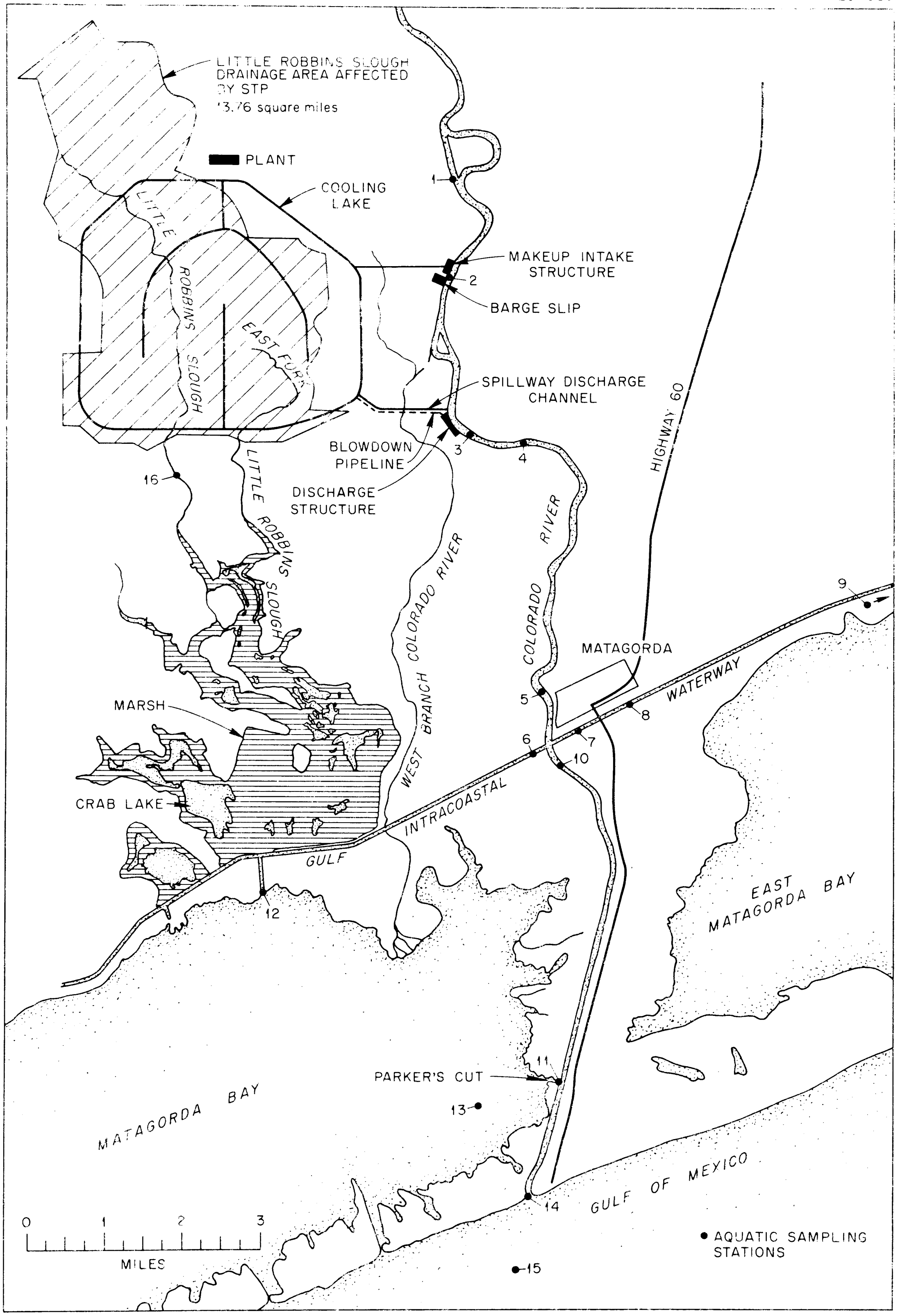

Fig. 2.7. STP sampling stations on the Lower Colorado River.
Source: ER, Fig. B11-1 (2.7-5).

The Colorado River

The Colorado River flows into the Gulf of Mexico 12 miles below the STP site. Tidal influences extend as far as 32 miles upstream from the river mouth, and a saltwater wedge may move upstream along the bottom the same distance with the maximum upstream penetration occurring during periods of low flow. A graphic representation of the Colorado River salt wedge phenomenon is shown in Fig. 5.9, and salinity data during the sampling period is shown in Appendix B, Table 4.

The distribution and densities of aquatic plant and animal species found in estuarine rivers are determined in part by salinity gradients in the river; therefore, the position of the above mentioned salt wedge has an important effect on the biological characteristics of the Colorado River. Because the applicant's baseline study was carried out during one of the wettest years in history (1973),[10] the salt wedge and the freshwater to saltwater species distribution were probably shifted downstream further than would be expected during years of normal river flow volume.

Matagorda Bay

This 300-sq-mile bay is formed by a 45-mile-long barrier island parallel to the coastline. Near the site, the eastern arm is divided by the Colorado River Delta, forming East Matagorda Bay which is very shallow with depths averaging approximately 1.1 m at mean low water.[13] Matagorda Bay, directly to the south of the STP site, is also fairly shallow with an average depth of about 0.9 m.[13] During the period March through June, 1962, salinities ranged from 17 to 30 ppt.[13] Under the weather and discharge conditions existing in 1973-74, calculations yielded salinities ranging from 1.8 to 12.9 ppt in Matagorda Bay (station 13) compared to 16.3 to 32.2 ppt in the Gulf of Mexico (station 15; ER, Table 2.5-10). Heavy rains and river discharge may greatly dilute bay waters, which occurred in October 1973 when salinities at station 13 dropped to 1.8 ppt.

Gulf of Mexico

During high river discharge, fresh water may flow several miles offshore before mixing completely with Gulf waters. The Gulf is characterized by small tidal ranges with a mean diurnal tidal range of about 0.7 ft at Matagorda Bay (ER, p. 2.5-12).

Gulf Intracoastal Waterway (GIWW)

The Gulf Intracoastal Waterway intersects the Colorado River 6.5 miles above the Gulf of Mexico. Except in the immediate vicinity of the Colorado River, the GIWW seems more under the influence of Matagorda Bay than the river during periods of normal river flow. Salinity of GIWW waters, for example, generally followed the regime exhibited in Matagorda Bay rather than that in the Colorado River. During the June through December 1973 sampling period, salinities in the GIWW ranged from 1.1 to 16.3 ppt at station 6 near the Colorado River, and from 3.3 to 12.1 ppt at station 9 approximately 5 miles east of the river.

2.7.2.2 Biological

Phytoplankton

Phytoplankton (and aquatic macrophytes in the marshes) are the primary producers in the aquatic ecosystems in and near the site, and thus constitute the foundation upon which the complex food webs of the area are built.

Sampling by the applicant at 16 different stations over a 1-year period yielded 524 taxa representing six major divisions. Densities, composition by divisions, numbers of species, and dominant species by station and month, and a species list are given in Table B-10-9 of Ref. 10.

Generally, densities and number of species of phytoplankton were lowest in the summer, followed by slight increases in the fall (Appendix B, Table 5). October floods resulted in a temporary decline in densities and diversities at most stations. These parameters remained more or less stable until February when both suddenly increased at upriver stations and remained quite high until summer. Highest densities and number of species were observed in May at station 16 in Little Robbins Slough.

At all of the sampling stations, diatoms usually dominated phytoplankton communities, but green algae, blue-green algae, and dinoflagellates often achieved considerable abundance and occasional superiority in numbers of individuals at several stations.

Zooplankton

A total of 319 species of zooplankton representing nine phyla were identified during the site study. Protozoans (101 sp.), rotifers (75 sp.), copepods (31 sp.), and cladocerans (27 sp.) contributed the majority of species.

Zooplankton displayed a general trend toward increasing densities and species diversity from upstream to downstream stations, presumably as a result of the meeting of freshwater, estuarine, and marine species at the more saline downstream stations (ER, Sect. 2.7.2.4). Bay stations also demonstrated relatively high densities and species diversity.[13] Late spring samples yielded highest densities at most stations followed by another lower peak in early fall. Postlarvae of commercially valuable brown shrimp (*Penaeus aztecus*) were collected in greatest numbers at midriver and downriver stations during May through August. The more immature stages (zoea and megalops) of commercially valuable shrimp and crab appeared in greatest densities from February through May. Densities were far greater at downriver stations than at upriver stations. Zoea achieved highest densities in March, whereas megalops densities peaked in May when investigators estimated 551 individual megalops of one crab species per cubic meter at station 11. This compares with estimates of only one per cubic meter for all species at station 2 at the site of the proposed makeup intake structure.

Ichthyoplankton

Estuarine waters in the site area serve as nursery grounds for many Gulf fish, including commercial and game fishes. Eggs and larvae of largely estuarine-dependent fishes representing 59 taxa were collected from the site area during the period June through May.[10] Relative abundance of fish eggs and larvae at each station is presented in Appendix B, Table 6. As with other organisms collected at this site, densities and diversity increased toward the downstream stations. Upriver stations 1, 2, and 3 together contributed less than 1% of the total catch per unit effort of eggs and larvae. Largest numbers of eggs and larvae occurred in fall and spring. Game and commercially valuable species represented in the ichthyoplankton included croakers, menhaden, shad, sardines, anchovies, blue and channel catfish, seatrout, drums, flounders, and soles.

Macroinvertebrates

The 36 taxa of macroinvertebrates collected during the sampling program included several species of considerable commercial importance, particularly white shrimp, brown shrimp, and blue crab.[10] Again, midriver and downriver stations exhibited the greatest number of species.

River shrimp (*Macrobrachium ohione*), an important forage species, dominated collections at stations 1 through 4, especially in fall and spring, but very few were collected at downriver stations. Most of the other macroinvertebrates collected were marine or estuarine (primarily shrimp and crabs) displaying overwhelming preference for the saltier downriver and bay stations. Even so, a few white shrimp, brown shrimp, net-clinger shrimp, and blue crabs were usually taken at upriver stations. Another freshwater shrimp, the grass shrimp (*Palaemonetes kadiakensis*), dominated collections in Little Robbins Slough. This station also yielded a few blue crabs, but no other estuarine or marine macroinvertebrates. Brown shrimp occurred in greatest numbers during middle and late spring, while white shrimp demonstrated maximum abundance during August through November. Besides serving as important nursery grounds for gulf shrimp, the Matagorda Bay-lower Colorado system yielded shrimp catches totaling 2,000,000 lb in 1970.[10] The annual blue crab catch from Matagorda Bay has declined in recent years from nearly 2,000,000 lb in 1962 to only 300,000 lb in 1967.[10]

One important inhabitant of Matagorda Bay not collected by the applicant is the eastern oyster *Crassostrea virginica*. The eastern arm of the bay near the Colorado River delta is presently the major center of oyster production near the STP site.[10]

Benthic invertebrates constitute an important food supply for many juvenile and adult stages of fish, shrimp, and crabs, including those species using the estuary as a nursery.

Due most likely to the stress caused by fluctuating salinities, flows, and turbidity characteristic of many estuarine river channels, the benthos of the lower Colorado River exhibits relatively low densities and species diversity.[10] Lowest benthic densities and diversity occurred at stations 1 through 4 (adjacent to the STP site) where fluctuation in bottom water salinity are usually large and frequent.[10] Freshwater oligochaetes, bivalves, chironomids, and mayflies dominated the benthos at these upriver stations. Both density and number of species tended to increase toward the river's mouth, presumably due to higher and more stable salinity levels at the downriver stations which allow the establishment of marine and estuarine benthic assemblages. Densities were also very high at bay stations. Polychaete worms usually dominated downriver and bay stations. Other organisms important at these stations include gastropods, bivalves, crustaceans, and rhynchocoels.

Fish

The majority of the fish caught during the baseline study require estuarine waters for at least part of their life cycle.[14,15] Many species were of commercial, sports, or forage value including gulf menhaden, bay anchovy, striped mullet, seatrouts, drums, croakers, pompano, flounders, and tarpon. Among freshwater species caught, channel, blue, and flathead catfish, buffalo, and several sunfish species are important in numbers and value. In 1970, 411,400 lb of finfish were landed in Matagorda County. Appendix B, Table 7 presents a list of all species collected from the study area during the applicant's baseline survey.

River flow, through its influence on salt wedge intrusion, appeared to be the most important factor in determining the number and kinds of fish caught at river stations. During periods of high river flow collecting efforts at upriver stations (adjacent to the STP site) usually resulted in relatively few fish, most of which were freshwater species. Sampling at downriver stations during these periods netted moderate numbers of both freshwater and estuarine species.[10] Figure 2.8 is a graphic representation of this phenomenon that occurred during the high-river discharges of October 1973. Low river discharges allowed the salt wedge to move further upstream, bringing along estuarine and marine fishes, which dominated the catch during these periods. Consequently, periods of low river flow usually produced the largest catches.

Midriver, downriver, and bay stations generally exhibited greater numbers of species and greater abundance than upriver stations because of influx of young-of-the-year estuarine species. Trawling usually amassed slightly greater numbers and greater weight (per trawl minute) of fishes at downriver and bay stations than at upriver stations. Station 2, at the site of the proposed STP makeup intake structure, generally produced the smallest catches in terms of both numbers and weight.

Freshwater species, particularly mosquitofish, red shiners, and sunfishes, dominated seining collections from station 16 in the upper reaches of Little Robbins Slough. Channel catfish, carp, and brackish water species such as silversides, striped mullet, and killifish were also present at station 16. The fish fauna of the lower reaches of the slough was more typically estuarine with gulf menhaden the dominant species collected during the single sampling period in June 1974. Other estuarine-dependent species collected here include ladyfish, crevalle jacks, black drum, spot, bay anchovies, striped mullet, and tidewater silversides. The presence of many of these species, particularly their young, indicates utilization of the slough as a breeding ground and nursery.

No fishes listed as threatened by the United States Department of the Interior Fish and Wildlife Service or the Endangered Species Committee of the American Fisheries Society were collected in the applicant's baseline study.[16,17]

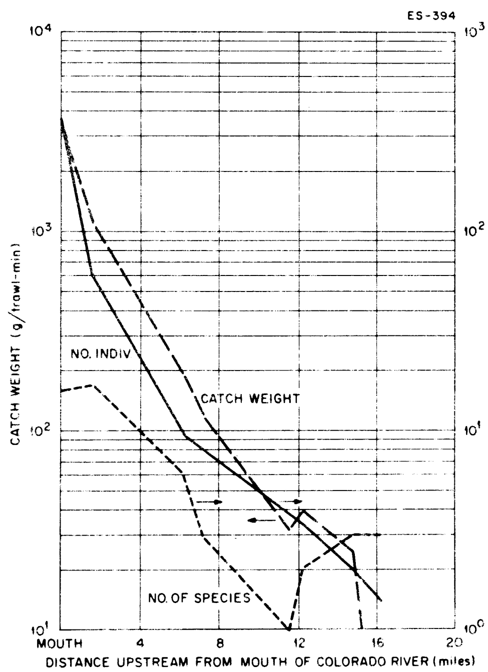

Fig. 2.8. Number of fish species and mean number and weight (in grams) per trawl-minute vs distance upstream from the mouth of the Colorado River for October (STP site, 1973).

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3. THE PLANT

3.1 EXTERNAL APPEARANCE

A view of the proposed plant from the southwest is shown in Fig. 3.1. Prominent features are the two reactor-containment vessels, the two turbine-generator buildings, and the electrical switch-yard. Each of the reactor buildings will be a reinforced concrete structure with a domed roof about 145 ft high and 110 ft in diameter.

The exterior of the plant will consist primarily of a gray-textured concrete surface and will be constructed to present a low skyline. The turbine-generator buildings will have neutral colored sheet metal siding.

The plant will be visible from the nearest highway, FM-521, which will be relocated from its present position just south of the plant to a path north of the exclusion area, maintaining an average distance of about 1 mile.

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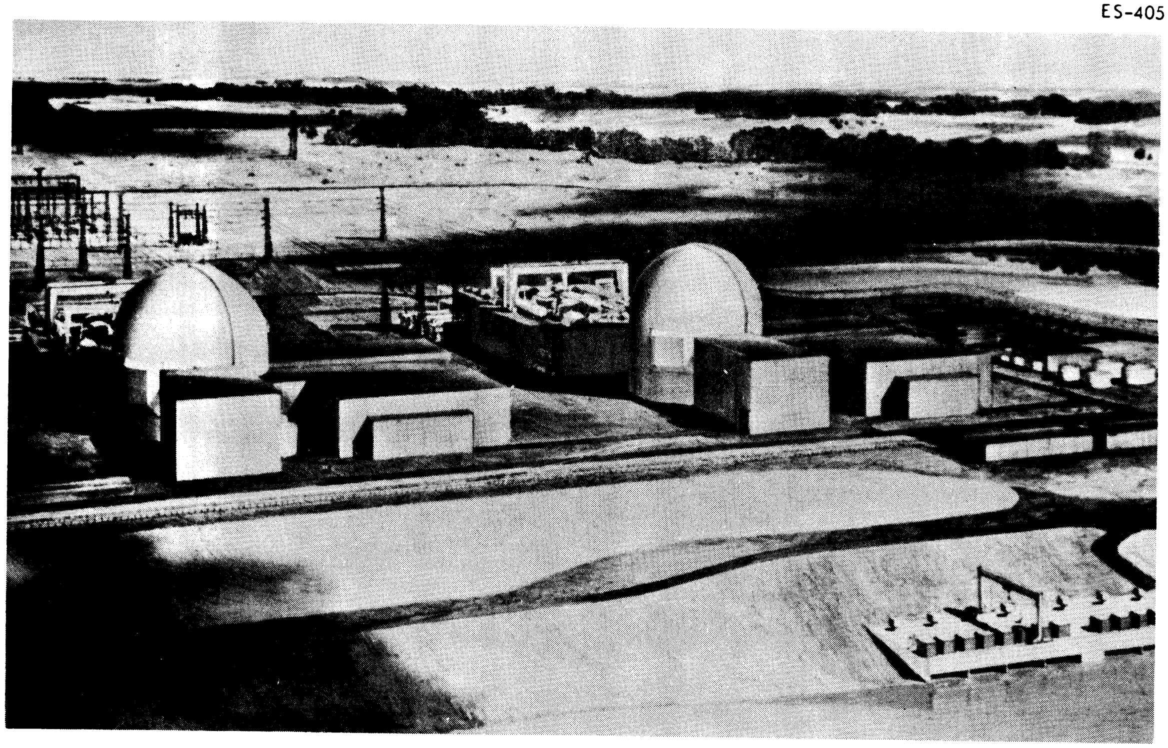

Fig. 3.1. Artist's conception of the South Texas Project, Units 1 and 2, from the southwest. Source: ER, Fig. 3.1-1.

3.2 REACTOR, STEAM-ELECTRIC SYSTEM, AND FUEL INVENTORY

The plant will consist of two pressurized water nuclear reactor steam supply systems and two turbine generators supplied by Westinghouse Electric Corporation. The remainder of the plant will be designed by Brown and Root, Incorporated, the architect-engineer. Each nuclear steam supply system will consist of a reactor vessel and four primary coolant loops, each with a circulating pump and a steam generator. The rated power level of each reactor core is 3800 MWt, and the rated gross output of each turbine generator is 1312 MWe. About 62 MWe of this output will be for in-plant use, and the net rating for each unit will be about 1250 MWe. These ratings are also the ultimate ratings for the plant.

Each reactor core will contain 193 fuel assemblies, each of which will contain 264 fuel rods consisting of cylindrical uranium dioxide pellets sealed inside zirconium alloy tubes. The total mass of uranium dioxide in each core will be 126.8 tons.

At design power, water pressurized to 2250 psia will be heated to 624°F (329°C) in the reactor vessel and pumped to the steam generator tubes. Here the pressurized water will transfer its heat to the steam system water to produce steam of 1060 psia and 552°F (289°C) at the turbine throttle valve. The steam will pass through the turbine, and then it will be cooled and condensed by the steam condenser. Condensation will take place on the outer surfaces of the condenser tubes, which in turn will be cooled by the cooling lake water pumped through them. The condensate will then be recycled back to the steam generators.

3.3 PLANT WATER USE

The major water requirements of the plant are due to evaporation and blowdown from the 7000-acre cooling lake, which supplies the 4044-cfs circulating water for the main power plant condensers. Auxiliary cooling water for mechanical equipment is also supplied from the lake.

At full-power operation, the temperature rise of the circulating water passing through the plant will be 19 F° (10.6 C°). This temperature rise will be lower at less-than-full-load operation. Estimates provided by the applicant of monthly plant factors and corresponding circulating water temperature rises are shown in Table 3.1.

Table 3.1. Predicted average monthly plant factors and circulating water temperature rises

Month	Plant factor	Circulating water temperature rise, F°
January	0.75	14.25
February	0.75	14.25
March	0.75	14.25
April	0.75	14.25
May	0.80	15.20
June	0.86	16.34
July	0.88	16.72
August	0.88	16.72
September	0.85	16.15
October	0.78	14.82
November	0.76	14.44
December	0.76	14.44

Source: ER, Amendment 1, Table 3.4-3.

The essential cooling pond supplies water for plant shutdown use in addition to normal plant operation.

Service water for several of the plant closed-loop systems, potable water supply, laundry, and sanitary systems is supplied from onsite wells.

Table 3.2 and Fig. 3.2 illustrate projected plant water usage for maximum, minimum, and shutdown conditions.

3.4 HEAT DISSIPATION SYSTEM

3.4.1 General description

Circulating water and part of the auxiliary cooling water for the plant will be drawn from and discharged to the cooling lake, as shown in Fig. 2.2. Cooling water will be necessary for the safe shutdown of the plant and will be drawn from and discharged to the essential cooling pond. Makeup water for the cooling lake and the essential cooling pond will be pumped from the Colorado River, except when the river flow is too low to permit water withdrawal. During these low-flow periods, makeup for the essential cooling pond will be supplied from wells.

Table 3.2. Plant water use for two units (flow in gpm)[a]

Figure 3.2 line number	Maximum power (80% plant factor)	Minimum power (25% plant factor)	Shutdown conditions
1	130	130	24
2	30	30	0
3	100	100	24
4[b]	0	0	0
5	20	20	24
5a	16	16	20
5b	4	4	4
6	80	80	0
7	60	60	0
7a	20	20	0
7b[c]	40	20	0
8	20	20	0
9	64	60	0
10[c]	20	20	20
11	1.81×10^6	4.52×10^5	0
12	6×10^4	6×10^4	0
13	1.81×10^6	4.5×10^5	0
14[d]	250	250	250
15	60	60	60
16	500	500	0
17	3.33×10^4	1.9×10^4	1.32×10^4
18	8.34×10^3	8.34×10^3	8.34×10^3
19	3.0×10^4	3.0×10^4	9.0×10^4
20	140	140	140
21	310	310	280
22	3.92×10^4	2.5×10^4	1.90×10^4
23	1.53×10^4	1.53×10^4	1.53×10^4
24	5	5	5
25	900	900	900

[a]All values and loads are based on an expected average year.
[b]As required.
[c]Radwaste flow shown is maximum expected for intermittent discharges. Average flow is 0.35 gpm.
[d]Makeup is from the Colorado River when possible and from wells at other times.
Source: ER, Amendment 3, Table 3.3-1.

To maintain the cooling lake water quality, some water will be discharged back to the Colorado River. To maintain water quality in the essential cooling pond, some water will be discharged into the cooling lake.

3.4.2 Plant heat dissipation system

The circulating water will be withdrawn from the cooling lake through an intake structure located on the northeast portion of the lake, as shown in Fig. 2.2. Details of this structure are shown in ER, Amendment 1, Fig. 3.4-9d. It will be a conventional structure with trash racks followed by traveling screens located in front of the circulating water pumps. The intake structure will be divided into eight bays, each housing a 505.5-cfs pump to provide the total of 4044 cfs circulating water flow. Each of these pump bays will contain two smaller bays (a total of 16 for the structure) housing the trash racks and the traveling screens. The maximum velocity through these screens will be 4.3 fps. The invert of the structure will be at 15 ft mean sea level (MSL). A depression having an invert at 11 ft MSL will be excavated in front of the intake structure. The slope of the transition between the intake structure invert and the depression invert will be 1 ft vertical per 10 ft horizontal. The slope of the transition between the depression invert and the lake intake channel invert of 21 ft MSL will be 1 ft vertical per 5 ft horizontal.

The circulating water will be pumped from the intake structure through the steam condensers and then to the discharge structure. There will be four ducts running from the intake structure to the steam condensers and four ducts running from the steam condensers to the discharge structure. Table 3.3 lists the water velocities, temperatures, static pressures, and holdup times in the various parts of the circulating water system. At full load, the water temperature increase will be 19 F°. At partial loads, the circulating water flow rates will remain the same, but the temperature increase will be proportional to the plant load.

ES-400

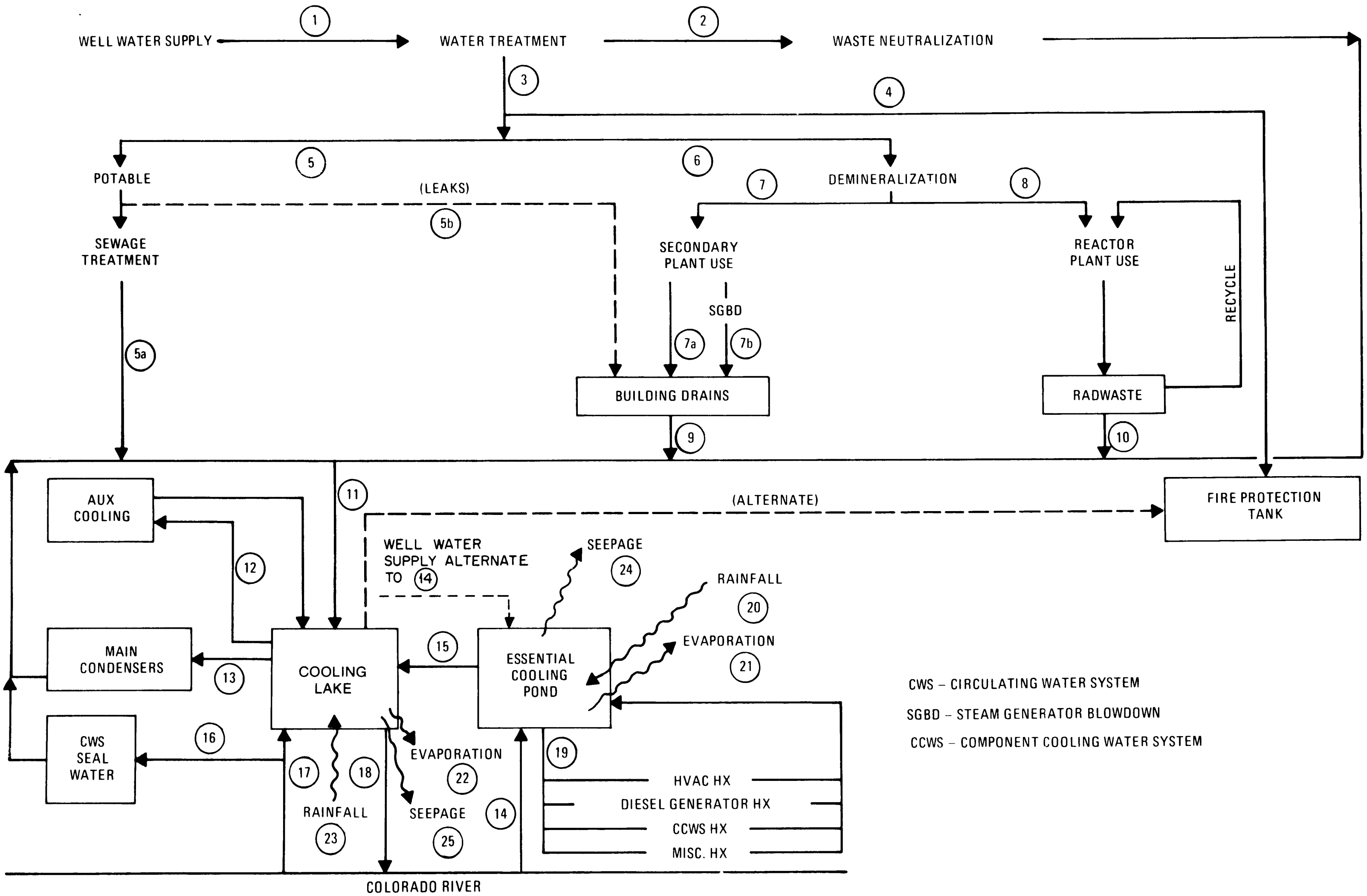

Fig. 3.2. Plant water use diagram. Source: ER, Amendment 3, Fig. 3.3-1.

Table 3.3. Flow conditions in the circulating water system

Location	Water velocity (fps)	Water temperature above inlet (°F)	Static water pressure (psig)	Static water pressure at:	Holdup time (sec)	Accumulated time from intake (sec)
Pump discharge to trunk line (four per reactor)	10.1	0	17	Pump discharge	24.7	24.7
Trunk line to condenser manifold (two per reactor)	9.7	0	34	8 ft MSL at condenser	167.5	192.2
Condenser manifold to condenser (six per reactor)	10.2	0	34	Inlet manifold	2.5	194.7
Condenser (one per reactor)	8.5	19	25	Lowest condenser tubes	6.6	201.3
Condenser to condenser manifold (six per reactor)	10.3	19	20	8 ft MSL at condenser	2.4	203.7
Condenser manifold to outfall	9.7	19	20	Outlet manifold	260.3	264.0

Source. ER, Amendment 1, Table 3.4-1A.

The warmed water from the discharge circulating water ducts passes directly into the northwest portion of the lake, as shown in Fig. 2.2. The invert of these four 11.5-ft-diam pipes will be at 8.25 ft MSL, and the velocity of the water discharging from these pipes will be about 9.7 fps. The invert of the discharge structure will be at 7 ft MSL, and there will be a smooth transition between this invert and the pipe invert. In front of the discharge structure, the lake discharge channel will have an invert at 7 ft MSL for a 20-ft distance. Then the discharge channel invert will gradually increase to 21 ft MSL on a slope of 1 ft vertical per 5 ft horizontal. The discharge channel will be lined with riprap or soil-cement for erosion protection. Additional details of the circulating water discharge structure are shown in ER, Amendment 1, Fig. 3.4-9e.

Heat from the discharged circulating water will be dissipated to the atmosphere from the cooling lake surface primarily by evaporation. Some heat will be dissipated to the atmosphere by thermal radiation and convection.

The cooling lake will be constructed west of the Colorado River by building a 13-mile-long embankment having a crest varying in elevation from 65 to 66.25 ft MSL, as shown in Fig. 2.2. About 7 miles of internal dikes having crests at 52 ft MSL will be built within the cooling lake to guide the flow of circulating water.

Over 7000 acres of land will be inundated by the cooling lake. This includes part of Little Robbins Slough, which will be relocated just outside the western boundary of the lake, as shown in Fig. 2.2. The natural ground elevation within the cooling lake varies from 15 to 29 ft MSL. Channels having inverts at 21 ft MSL will be excavated within the lake to assure continuity of water flow between the circulating water discharge and intake for all water levels down to this elevation.

The area and capacity curves for the cooling lake are shown in Fig. 3.3. A summary of the cooling lake water volumes and surface areas at water levels of interest is given in Table 3.4.

3.4.3 Makeup water facilities

Makeup water for the cooling lake will be pumped from the Colorado River at the makeup water intake structure located at river mile 14.6, upstream from the Gulf, as shown in Fig. 2.2. This water will be pumped to the outfall structure located on the east side of the cooling lake through two 1.23-mile-long 9-ft-diam pipes. The rate that water will be diverted from the river will depend on the river flow. The maximum allowable diversion rate will be 55% of that portion of the Colorado River flow exceeding 300 cfs as measured at the Bay City, Texas, gauge (ER, p. 5.1-4). The instantaneous rate of water diversion will not exceed 1200 cfs, and the annual rate of water diversion will not exceed 102,000 acre-ft per year.

The makeup water intake structure will have four 200-cfs pumps and four 100-cfs pumps. The number of pumps operating at any one time will depend on the river flow. For finer control of the water diversion rate, there will be bypass lines (with control valves) installed around the pumps.

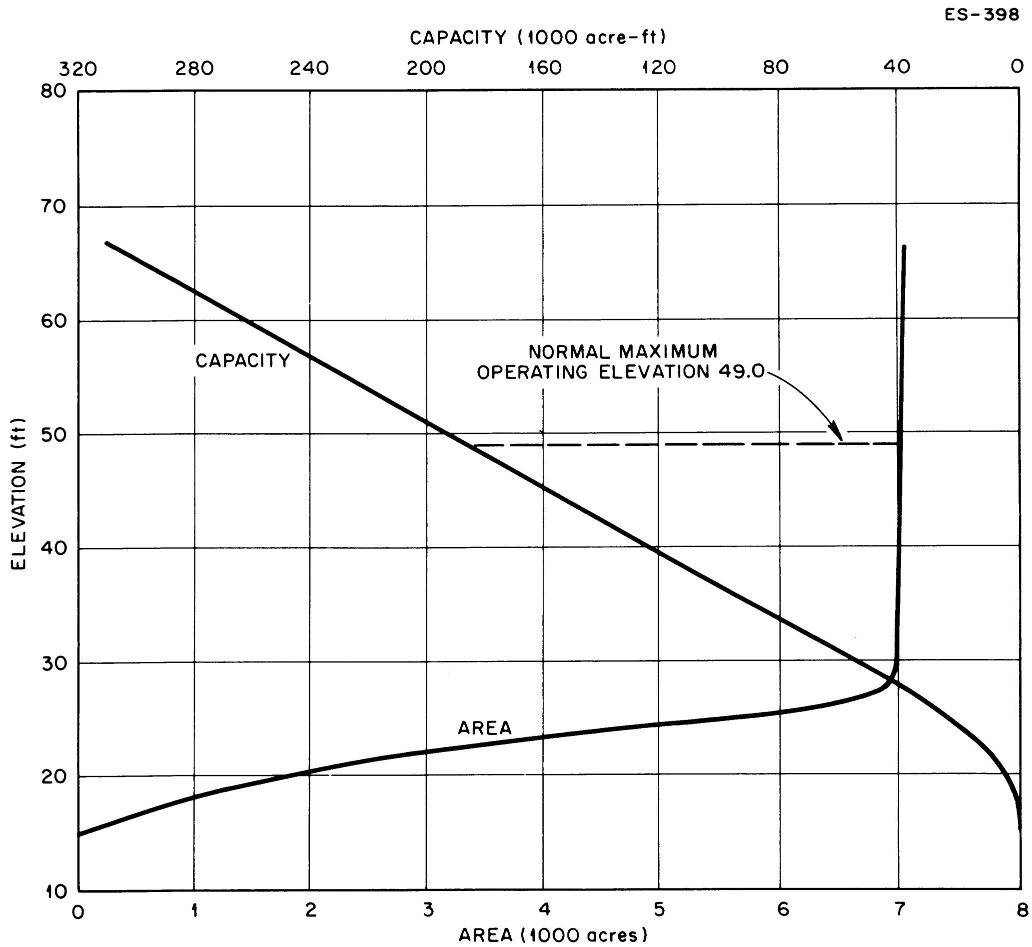

Fig. 3.3. Area and capacity curves for South Texas Project cooling lake. Source: ER, Fig. 3.4-3.

Table 3.4. Volume and surface area at South Texas Project cooling lake

	Elevation	Acre-ft	Acres
Design minimum operating level	25.5	22,500	5900
Projected minimum operating level	25.8	27,000	6100
Normal maximum operating level	49	187,000	7000
Probable maximum flood level	52.1	209,000	7000

Sources: ER, pp. 3.4-2 and 3.4-3 and Table 3.4-2; PSAR, p. 24–49.

The intake water structure trash racks and traveling screens will be located 200 ft in front of the pumps, as shown in Fig. 3.4. Further details of the structure are shown in Fig. 3.4-9 of the ER. Between the screens and pumps will be two siltation basins to allow the sediment in the makeup water to settle. A weir with a crest elevation of -2.2 ft MSL will be located between these two basins to help improve water quality. The siltation basins will be dredged as necessary to assure their effectiveness (ER Amendment 1, p. 3.4-8a).

The trash racks will be located on the front side of the intake structure along the riverbank. The length of this structure along the riverbank will be 392 ft. Sufficient space will be provided between the trash racks and the traveling screens to allow free passage of fish. Trash accumulating on the front of the trash racks will be removed by a trash rake. The traveling screens will be rotated during the pumping operation, when visual inspection of screens indicates that an excessive amount of debris has accumulated. After rotation, the screens will be washed and the sluice receiving the debris will be diverted either to the river or to a trash basket. The maximum velocity through the traveling screens will be 1 fps.

The makeup water discharge structure will have a baffled 30-ft-wide apron to dissipate the energy of the discharge from the two 9-ft-diam pipes having inverts at 50.5 ft MSL. Further details of this structure are shown in the ER, Amendment 1, Fig. C8-1.

3.4.4 Cooling lake discharge facilities

When the cooling lake water level exceeds the normal maximum operating level of 49 ft MSL, the excess water can be released through a gated spillway located at river mile 12.6 as shown in Fig. 2.2. Details of this spillway (ER, Fig. 3.4-5) show that the crest of the ogee will be at 40 ft MSL at the bottom of four 6- x 10-ft slide gates. This will allow a 24-ft crest length for the water flow. Water flowing over this crest will flow into a 31.5-ft concrete chute to a stilling basin and then through a 225-ft-wide sodded earthen channel to the Colorado River.

When the cooling lake water level is equal to or exceeds 47 ft MSL, water can be discharged to the river through a 1.1-mile-long 90-in.-diam blowdown line. The inlet of the blowdown line will be near the spillway at a 29-ft MSL elevation, which is above the 15-ft MSL natural ground elevation at that particular location. A coarse bar screen, such as bars mounted on a 6-in.-sq pitch, will be placed over the inlet of this line.

The blowdown line will branch into seven 3-ft-diam valved pipes for distributing the discharge into the river. This arrangement is shown in Fig. 3.5. The branches will discharge water at an angle of 45° to the direction of river flow. The centerlines of these branch pipes at the river will be at a -5.5-ft MSL elevation and spaced 250 ft apart.

The rate of discharge will depend on the flow conditions in the river and the season. No discharge will occur if the freshwater flow, as determined by the Bay City gage minus the makeup water pumping rate, is less than 800 cfs. Also, the river water must be flowing toward the Gulf at a velocity of 0.4 fps or greater at the time of discharge. When these conditions are met, the rate of discharge will be between 80 and 308 cfs. Figure 3.6 shows the relation between the permissible discharge (blowdown) rate and the freshwater and the total flow rates in the river at the point of discharge. Both minimums shown in this figure must be met before water can be discharged.

Two or more of the 3-ft-diam branches shown in Fig. 3.5 will be used for discharging water. The maximum flow rate through each branch will be 44 cfs. If the water discharge rate is 88 cfs or less, two branches will be used; if the water discharge rate is between 88 and 132 cfs, three branches will be used, etc.

3.4.5 Essential cooling pond

A separate cooling pond will be located just east of the plant area as shown in Fig. 2.2. This essential cooling pond will be used during normal plant operation and will ensure a safe plant shutdown. It will be excavated from the normal ground elevation of 25 ft MSL to a level of 17 ft MSL. The embankment surrounding the pond will have a 34-ft MSL crest, and the internal dike will have a 38-ft MSL crest. The normal water level within the pond will be 25 ft MSL, which gives a water surface area of about 46 acres.

Water for the plant is pumped from the pond through a conventional water intake structure having trash racks followed by traveling screens located on the northwest side of the pond. It is pumped through the plant and discharged back into the pond from the ends of the pipes located on the other side of the internal dike. In front of the discharge pipes and toward the pond will be a reinforced concrete apron to prevent erosion in the vicinity of the discharge. During normal operation the temperature rise of the water being pumped through the plant will be about 10 F°.

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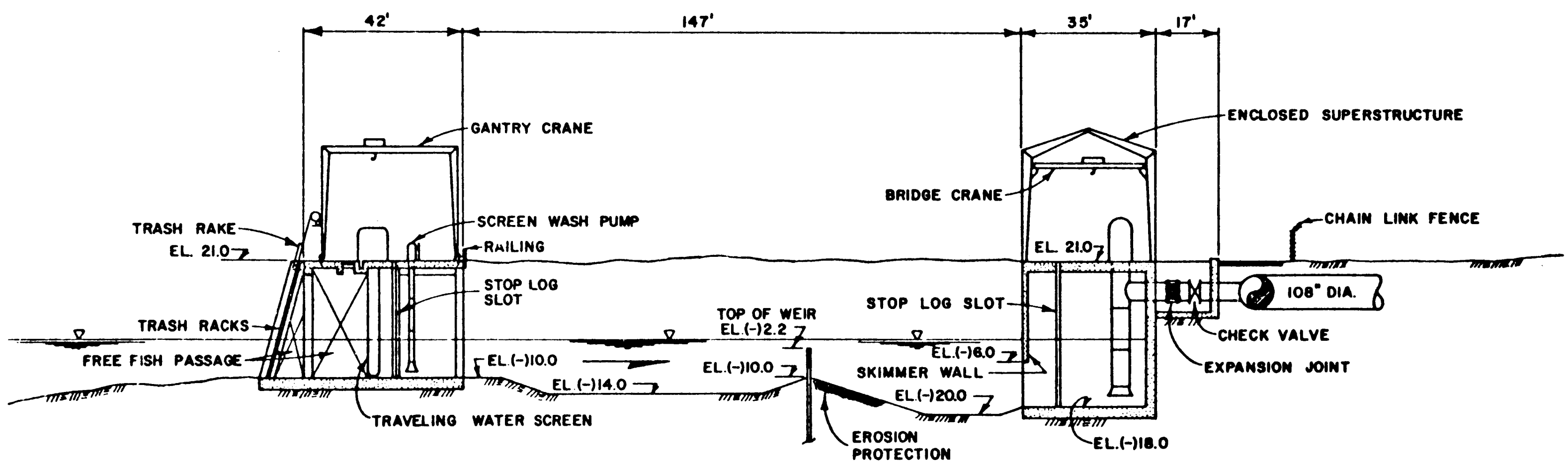

Fig. 3.4. Makeup water intake structure. Source: ER, Fig. 3.4-9.

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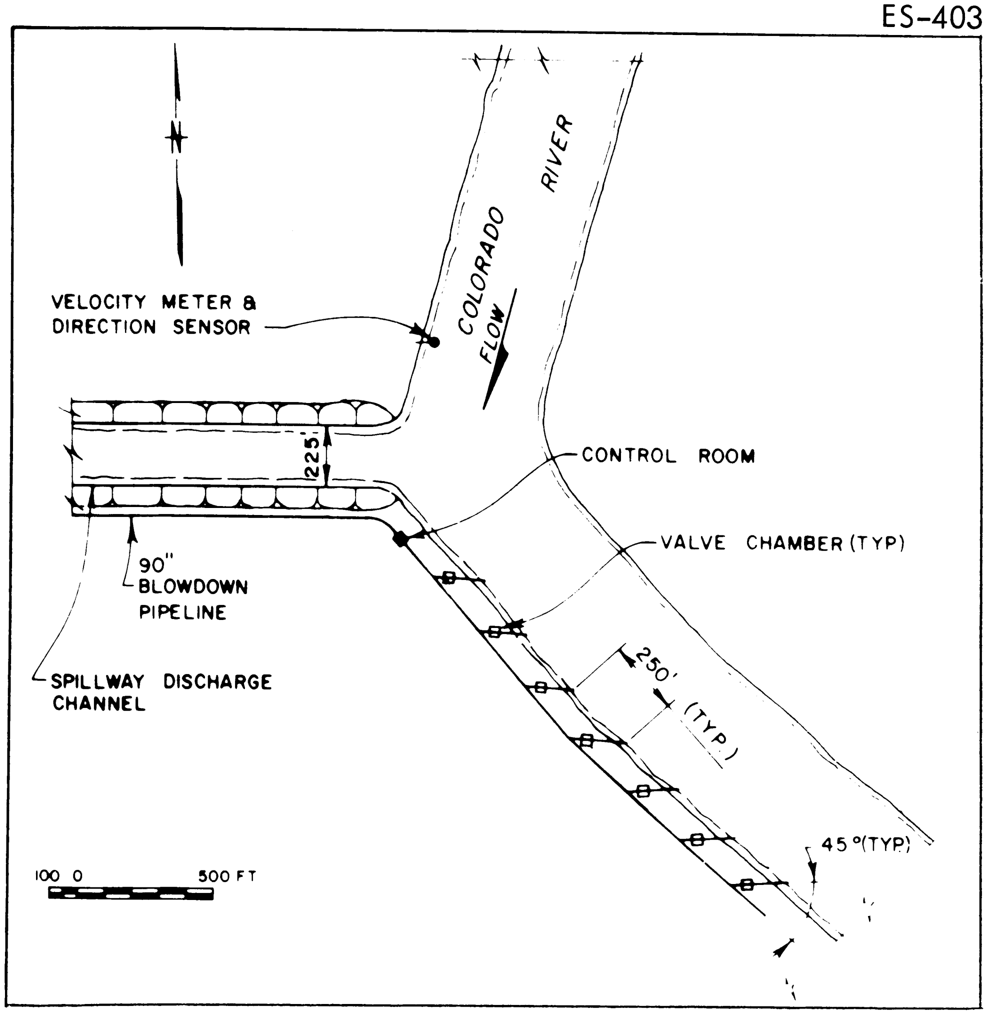

Fig. 3.5. Cooling lake blowdown facilities. Source: ER, Fig. 3.4-7.

There will be a 250-gpm (0.56-cfs) continuous makeup for the essential cooling pond. Whenever possible, this makeup water will be pumped from the Colorado River by a 250-gpm pump located at the makeup water intake structure through an approximately 16,000-ft-long 6-in.-diam line. Otherwise, the makeup water will be provided by onsite wells. Blowdown from the essential cooling pond will be through an approximately 400-ft-long 3-in.-diam pipe that will terminate at the circulating water discharge structure.

3.5 RADIOACTIVE WASTE SYSTEMS

During the operation of the South Texas Project, Units 1 and 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 plant to minimize the quantity of radionuclides ultimately released to the atmosphere and to the Colorado River by way of the cooling lake.

The waste handling and treatment systems to be installed at the plant are discussed in the applicant's PSAR (through Amendment 11) and ER (through Amendment 4). In these documents, the applicant has prepared an analysis of the treatment systems and has estimated the annual radioactive effluents.

ES-397

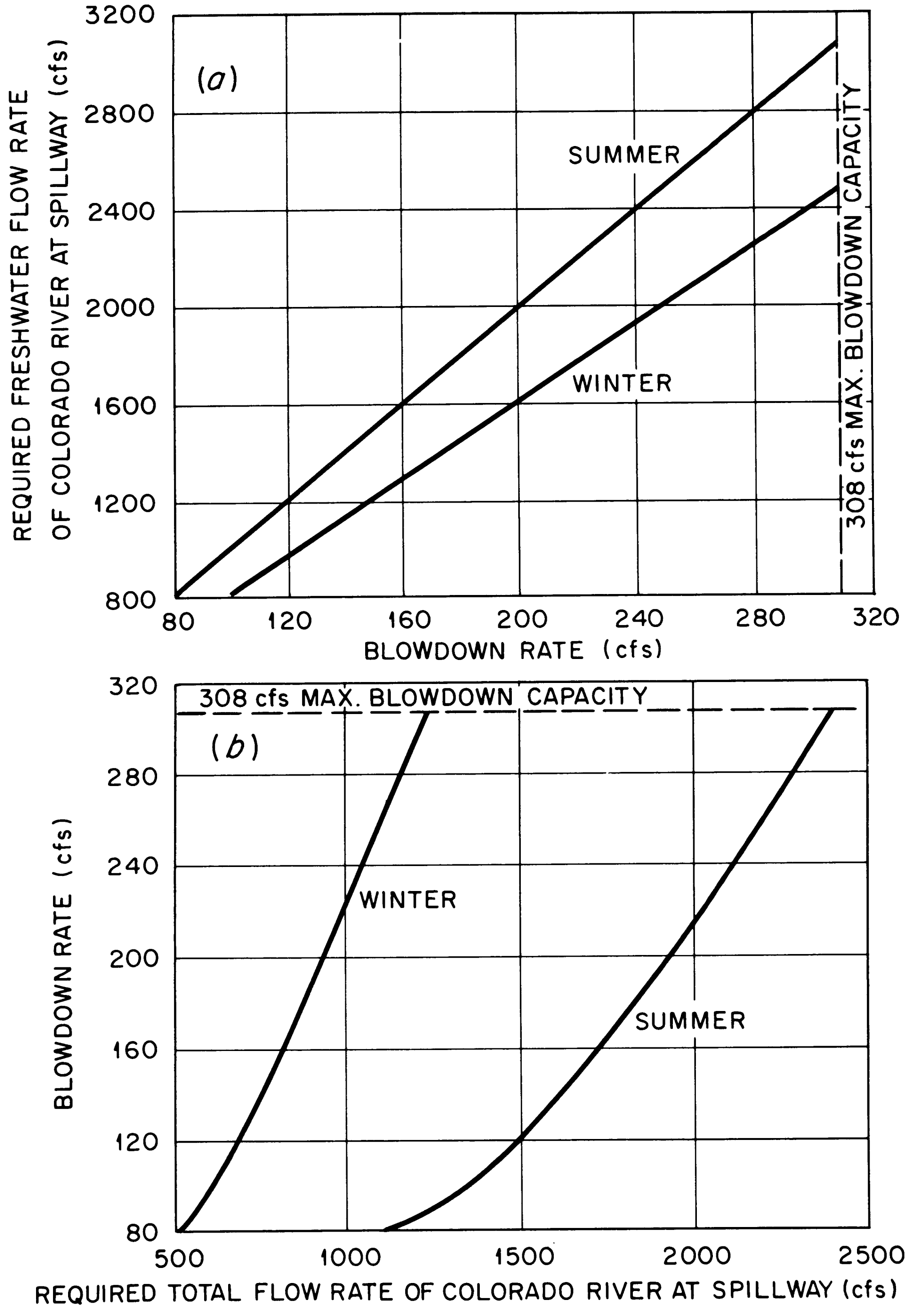

Fig. 3.6. Permissible cooling lake blowdown rates. (a) Freshwater flow rate of Colorado River at spillway, cfs. (b) Required total Colorado River flow rate at spillway, cfs. Source: ER, Fig. 3.4-11.

In the following paragraphs the waste treatment systems are described, and an analysis is given based on the staff model of the applicant's radioactive waste systems. The staff 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 evaluation are based on experience and data from operating reactors. As a result, the parameters used in the staff model and the subsequent calculated releases vary from those given in the applicant's evaluation. The staff evaluation was based on the parameters in WASH-1258 and the *Concluding Statement of Position of the Regulatory Staff, ALAP-LWR Effluents* (with attachment, *Draft Regulatory Guides for Implementation*), Docket No. RM-50-2, February 20, 1974. The liquid and gaseous source terms were calculated by the PWR-GALE code as described in *Draft Regulatory Guide 1.BB*, which is a revised version of the ORIGEN and STEFFEG codes given in WASH-1258. The principal parameters used in the staff source-term calculations are given in Table 3.5. South Texas Project, Units 1 and 2, will have independent radioactive waste systems.

Table 3.5. Principal parameters and conditions used in calculating releases of radioactive material in liquid and gaseous effluent from South Texas Project, Units 1 and 2

Reactor power level, MWt	3800
Plant capacity factor	0.80
Failed fuel[a]	0.25%
Primary system	
Mass of coolant, lb	5.82×10^5
Letdown rate to CVCS, gpm	100
Shim bleed rate, gpm	1.9
Leakage rate to secondary system, lb/day	110
Leakage rate to auxiliary building, lb/day	160
Leakage rate to containment building, lb/day	240
Secondary system	
Steam flow rate, lb/hr	1.7×10^7
Mass of steam/steam generator, lb	1.2×10^4
Mass of liquid/steam generator, lb	1.1×10^5
Secondary coolant mass, lb	1.75×10^6
Rate of steam leakage to turbine building, lb/hr	1.7×10^3
Steam generator blowdown rate, gpm	20
Containment building volume, ft^3	3.3×10^6
Frequency of containment purges, per year	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	0.0005

Decontamination factors (DF), liquids

	I	Cs, Rb	Mo, Tc	Y	Others
Boron recovery system	10^5	2×10^4	10^5	10^4	10^6
High conductivity waste treatment system	10^6	2×10^5	10^6	10^5	10^7
Low conductivity waste treatment system	10^4	10^5	10^6	10^5	10^5

	All nuclides except iodine	Iodine
Waste evaporators	10^4	10^3
BRS evaporator	10^3	10^2

	Cation[b]	Anion[b]	Cs, Rb
Mixed-bed demineralizer (H^+OH^-)[c]	10^2 (10)[d]	10^2 (10)	2(10)
Mixed-bed demineralizer ($LiBO_3$)[e]	10	10	2

Removal factor	
Removal by plateout	
Mo, Tc	10^2
Y	10

[a]This value is constant and corresponds to 0.25% of the operating-power fission-product source term.
[b]Does not include Cs, Mo, Y, Rb, Tc.
[c]Applies to all mixed-bed demineralizers except CVCS letdown demineralizer.
[d]For two demineralizers in series, or for a polishing demineralizer, the DF for the second demineralizer is given in parenthesis.
[e]CVCS letdown demineralizer.

3.5.1 Liquid wastes

Liquid radioactive waste will be processed on a batch basis to permit optimum control of releases. Prior to being released, samples will be analyzed to determine the types and amounts of radioactive materials present. Based on the results of the analyses, the wastes will be retained, recycled and reprocessed, or released under controlled conditions to the cooling lake. A signal from a radiation monitor will automatically terminate liquid waste discharges if radiation measurements exceed a predetermined level in the discharge line. A simplified diagram of the liquid radioactive waste treatment system is shown in Fig. 3.7.

The liquid waste system will be divided into three subsystems: (1) the liquid waste processing system (LWPS), (2) the turbine building wastes, and (3) the condensate polishing regeneration waste system (CPRW). In addition to the preceding three systems, the chemical and volume control system (CVCS) and the boron recycle system (BRS) are considered in the staff's evaluation.

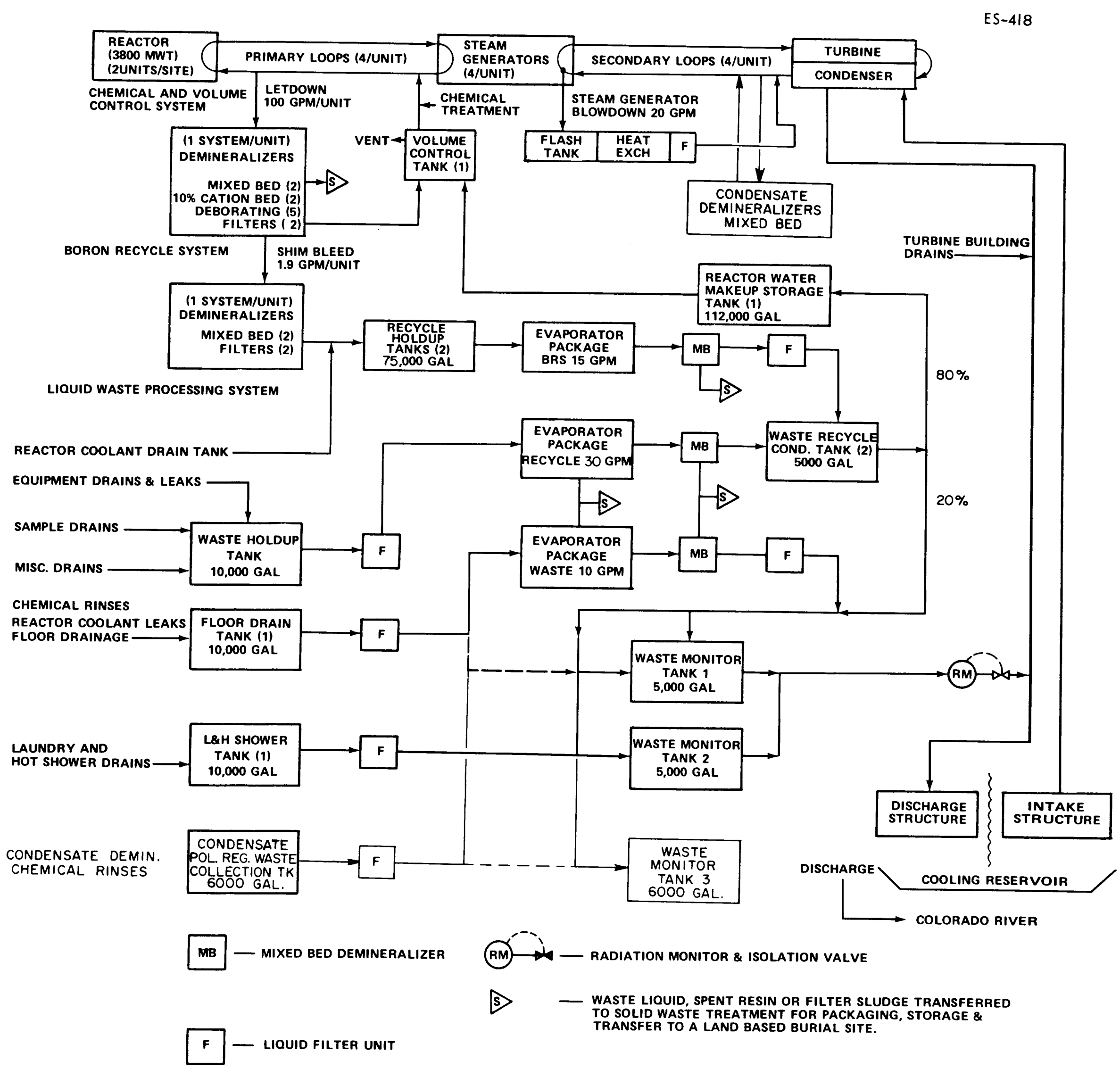

Fig. 3.7. Liquid radioactive waste treatment system for the South Texas Project.

3.5.1.1 Chemical and volume control system (CVCS)

A letdown stream of approximately 100 gpm of primary coolant will be removed from the reactor coolant system for processing through the CVCS. The letdown stream will be cooled through the regenerative and letdown heat exchangers, reduced in pressure, filtered, and processed through one of two mixed-bed (Li_3BO_3 form) demineralizers. One of two cation demineralizers will be valved into the process stream when further purification is required. To reduce the amounts of radioactive liquids generated during refueling operations, five demineralizers with the boron thermal regeneration scheme are used. When spent, all nine demineralizers will be transferred to the spent resin storage tank for treatment in the solid waste system. In the evaluation of the purification provided for the letdown stream, the staff assumed an input flow of 100 gpm at primary coolant activity and applied the decontamination factors listed in Table 3.5 for the CVCS mixed-bed (Li_3BO_3) demineralizer. The staff also assumed that 10% of the letdown stream will pass through a cation demineralizer.

Approximately 2 gpm of the purified letdown flow will be processed through the BRS as shim bleed for boron control. The shim-bleed stream will be treated by one of two mixed-bed demineralizers, and the staff applied the decontamination factors listed in Table 3.5. Primary-coolant-grade water from equipment drains, equipment leakoffs, and relief valves inside the containment will be collected in a 350-gal reactor-coolant drain tank. The staff estimated that the BRS input from the shim-bleed and the reactor-coolant drain tank wastes will average 3000 gpd. The combined streams will be collected in one of two 75,000-gal recycle holdup tanks.

The staff calculated the decay time provided by the holdup tanks to be approximately 20 days based on 3000 gpd input flow filling one tank to 80% capacity while the second tank is being processed. Liquid collected in the recycle holdup tanks will be processed batchwise through a 15-gpm BRS evaporator. The concentrated bottoms will be pumped either to the boric acid tank for reuse in the plant or to the solid waste management system (SWMS) for disposal. The staff's evaluation considered the concentrated evaporator bottoms to be processed through the solid waste system. The BRS evaporator condensate will be processed through a nonregenerative mixed-bed demineralizer and collected either in the reactor makeup water storage tank for reuse in the plant or diverted to the waste recycle tanks in the LWPS for sampling and discharge. Using the decontamination factors in Table 3.5 for the BRS evaporator and condensate demineralizer, the staff calculated the holdup time due to processing to be 4 days based on processing the contents of one recycle tank through the BRS evaporator at 80% of the design flow rate. It was assumed that 80% of the evaporator condensate will be recycled for reuse in the plant, while 20% will be discharged for tritium control and to maintain the plant water balance. The applicant's evaluation assumed approximately the same distribution of recycle and discharge flows.

3.5.1.2 Liquid waste processing system (LWPS)

Low-conductivity wastes, primarily from equipment drains outside the reactor containment, will be collected in a 10,000-gal waste holdup tank, processed through a 30-gpm recycle gas stripper-evaporator and mixed-bed demineralizer, and collected and monitored in one of two 5000-gal waste recycle condensate tanks. The treated liquid will be pumped to the reactor makeup water storage tank for reuse, recycled to the BRS or the LWPS for reprocessing, or pumped to a waste monitoring tank for monitoring and release to the cooling lake. Based on information submitted by the applicant and the parameters for liquid waste volumes and activities given in WASH-1258, vol. 2, Appendix A, the staff estimated the total flow in this system to be 760 gpd at 0.09 PCA. The staff calculated the collection time in the waste holdup tank to be 5.3 days based on filling the tank to 80% of the single tank capacity. The staff calculated the system processing time to be 3.8 days based on the recycle evaporator flow rate and storage time in the waste recycle condensate tanks.

High-conductivity wastes, primarily from floor drains, nondetergent decontamination operations, and radiochemistry lab drains, will be collected in a 10,000-gal floor drain tank, sampled to determine the degree of processing required, processed as necessary through a 10-gpm waste evaporator and a nonregenerative mixed-bed demineralizer, collected and monitored in a 5000-gal waste monitoring tank, and released to the cooling lake. If the radioactivity is above a predetermined level, the waste will be recycled for additional treatment.

Detergent wastes from laundry, hot shower, and decontamination operations will be collected in a 10,000-gal laundry and hot shower tank, processed through a 25-μ filter and stored in a 5000-gal waste monitoring tank for sampling and analysis. Based on the results of the sample analysis, the detergent wastes will be discharged to the cooling lake or retained for further treatment. Based on the assumption of 450 gpd of detergent waste at 10^{-4} μCi/ml, the staff calculated a release of approximately 0.06 Ci/year per reactor from this source. The applicant's evaluation did not provide a separate release estimate for detergent wastes.

Based on information submitted by the applicant and the parameters for liquid waste volumes and activities given in WASH-1258, vol. 2, Appendix A, the staff estimated the total flow in the system to be 610 gpd at 0.05 PCA. The staff calculated the collection time in the floor drain tank to be 6.5 days based on filling the single tank to 80% capacity at 610 gpd. The staff calculated the system processing time to be 2.2 days based on the waste evaporator design flow rate of 10 gpm. In both systems the evaporator bottoms and demineralizer resins will be disposed of as solid waste. There will be no regeneration LWPS of demineralizer resins.

The applicant proposes to recycle all of the clean wastes to the primary system. In its evaluation the staff assumed 10% of the clean wastes and 100% of the dirty wastes will be discharged. On this basis and using the parameters given in Table 3.5, the staff calculated releases from the LWPS to be approximately 0.13 Ci/year per reactor, excluding tritium and dissolved gases. The applicant calculated 0.12 Ci/year per reactor, excluding tritium and dissolved gases for the LWPS. The difference between the staff's calculated releases and those of the applicant are due primarily to differences in estimates of short-lived fission product release. The applicant, based on lower estimates of input volumes to the LWPS, estimated a holdup time of about 30 days, while the staff calculated a holdup time of 9 days. The applicant had also assumed an operating-power fission-product source term of 0.25%.

3.5.1.3 Turbine building floor drains and detergent wastes

Wastes collected by the turbine building floor drain system will normally contain less than 10^{-4} μCi/ml, and these wastes will not be treated prior to discharge. Based on the assumption of a 7200-gpd leak rate at main steam activity, the staff calculated a release of approximately 0.04 Ci/year, excluding tritium, from this source. The applicant calculated the turbine building releases to be 0.043 Ci/year per reactor, excluding tritium, based on an operating-power fission-product source term of 0.25%.

3.5.1.4 Condensation polishing regeneration waste (CPRW)

Blowdown from the steam generators will normally be filtered and returned to the condenser, but there will be provisions to treat the secondary loop using condensate-polishing mixed-bed demineralizers. Regenerate wastes from these demineralizers will be collected in a 6000-gal CPRW tank, monitored for radioactivity, and processed through the LWPS waste evaporator or transferred to a 6000-gal monitoring tank for sampling and analysis prior to discharge.

In its evaluation the staff assumed the blowdown rate will be approximately 340 gpm (1% of the main steam flow rate) and that the condensate demineralizers will process 65% of the secondary loop flow, with 100% of the CPRW treated by the LWPS, and that 10% of the CPRW will be discharged. Based on these assumptions the staff calculated that approximately 0.04 Ci/year per reactor, excluding tritium, will be released from this source. The applicant's evaluation did not provide a separate release estimate for CPRW to the cooling lake.

3.5.1.5 Liquid waste summary

Based on the evaluation of the liquid waste systems the staff calculated the releases of radioactive materials in liquid wastes to be approximately 0.21 Ci/year per reactor, excluding tritium and dissolved gases. This release was normalized using the parameters in WASH-1258, vol. 2, Appendix A, to 0.5 Ci/year per reactor to account for equipment downtime and anticipated operational occurrences (Table 3.6). The staff calculated the tritium release to be approximately 350 Ci/year per reactor. The applicant estimated liquid releases to be approximately 0.16 Ci/year per reactor, excluding tritium and dissolved gases, and 500 Ci/year per reactor for tritium.

3.5.2 Gaseous waste

The principal source of radioactive gaseous wastes will be gases stripped from the primary coolant in the BRS. Additional sources of gaseous wastes will be main condenser air removal system off-gases, gases collected in the reactor containment building, and ventilation exhausts from other buildings. The principal system for treating gaseous wastes will be the gaseous waste processing system (GWPS). Ventilation air from the containment, auxiliary, and fuel buildings, and gaseous wastes from the GWPS, will be exhausted through the unit vent atop the containment building.

The gaseous waste and ventilation treatment systems are shown schematically in Fig. 3.8.

Table 3.6. Calculated release of radioactive materials in liquid effluent from South Texas Project, Units 1 and 2

Radionuclide	Release per unit (Ci/year)	Radionuclide	Release per unit (Ci/year)
Na-24	0.00002	Mo-99	0.12
P-33	0.00002	Tc-99m	0.11
Cr-51	0.00008	Te-127	0.00001
Mn-54	0.00101	Te-129m	0.00003
Mn-56	0.00014	Te-129	0.00002
Fe-55	0.00008	I-130	0.00088
Fe-59	0.00005	Te-131m	0.00003
Co-58	0.0045	I-131	0.075
Co-60	0.0088	Te-132	0.00044
Nb-92	0.00002	I-132	0.0035
Mo-99	0.0016	I-133	0.044
Tc-99m	0.0015	I-134	0.00014
W-187	0.00009	Cs-134m	0.00003
Np-239	0.00001	Cs-134	0.017
Br-82	0.00015	I-135	0.0085
Br-83	0.00004	Cs-136	0.0018
Rb-86	0.00002	Cs-137	0.025
Rb-88	0.00003	Ba-137m	0.001
Y-90	0.00005	Cs-138	0.00006
Y-91m	0.00048	All others	0.00009
Y-91	0.016	Total (except tritium)	0.5
Y-92	0.00013		
Y-93	0.0001	Tritium	350 Ci/year per reactor

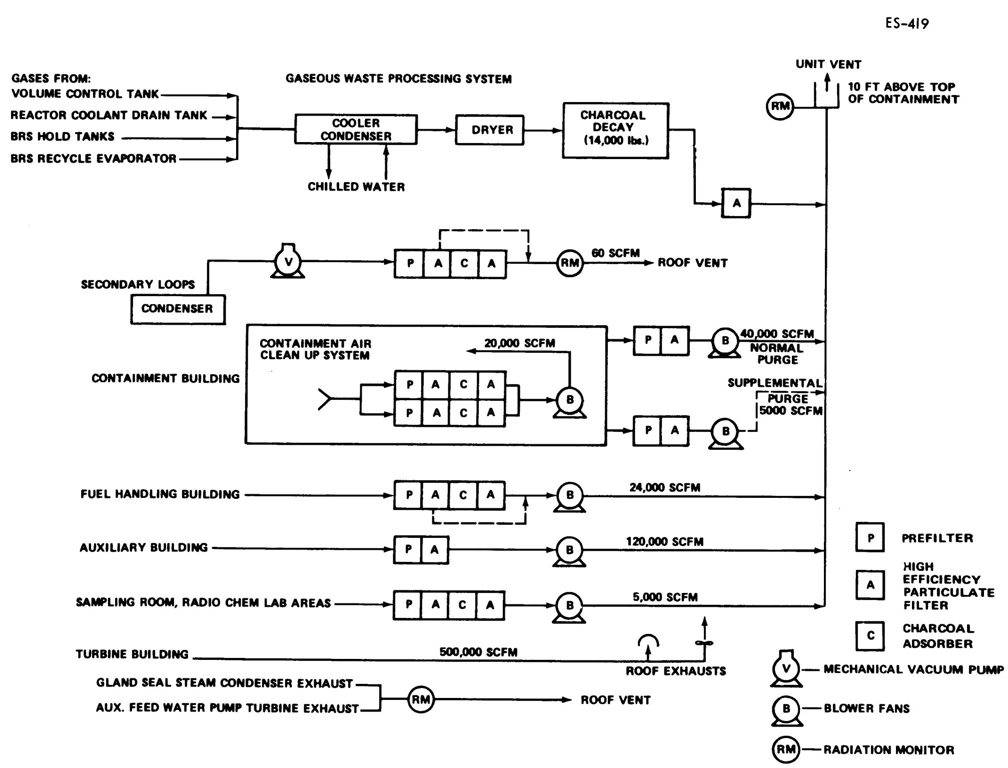

Fig. 3.8. Gaseous radioactive waste treatment system for South Texas Project.

3.5.2.1 Gaseous waste processing system (GWPS)

The GWPS will be designed to collect and process gases stripped from the primary coolant along with cover gases from miscellaneous tanks. Gaseous inputs will include a continuous 0.7-scfm hydrogen purge of the CVCS volume control tank and smaller quantities of radioactive gas from the boron recycle evaporator, reactor coolant drain tank, and the recycle holdup tanks. Input gases will be processed through a refrigerant cooler, a regenerative air dryer, and four 145-ft^3 charcoal decay tanks containing a total of 7 tons of charcoal. The staff assumed inlet gas conditions to the charcoal decay tanks will be approximately 80°F at 0°F dew point and an average flow of 1 scfm. Based on the dynamic adsorption coefficients given in WASH-1258, the staff calculated a holdup time in the charcoal decay tanks of 3.65 days for krypton and 67.5 days for xenon radionuclides. On this basis, the staff calculated the GWPS releases to be approximately 1200 Ci/year per reactor for noble gases and negligible (less than 10^{-4} Ci/year) for iodine-131. The applicant calculated the GWPS releases to be 1590 Ci/year per reactor for noble gases and negligible for I-131, based on an operating-power fission-product source term of 0.25% and a gas stripping efficiency in the volume control tank of 40% (compared to the staff's value of 100%).

3.5.2.2 Main condenser off-gas releases

Off-gas from the main condenser vacuum pumps will contain radioactive gases resulting from primary to secondary system leakage. Iodine will be partitioned between the steam and water in the steam generators and between the condensing and noncondensing phases in the main condenser. Main condenser off-gas will be processed through a charcoal adsorber prior to release. In its evaluation, the staff considered 110 lb/day primary to secondary system leakage, partition factors for radioiodine of 0.01 and 0.0005 in the steam generator and main condenser, respectively, and an iodine decontamination factor of 10 for the charcoal adsorber on the off-gas line. On this basis, the staff calculated the main condenser off-gas releases to be approximately 160 Ci/year per reactor for noble gases and 0.009 Ci/year per reactor for iodine-131. The applicant calculated the releases from the main condenser to be approximately 300 Ci/year per reactor for noble gases and 0.0165 Ci/year per reactor for iodine-131. The difference between the staff's calculated release values and those calculated by the applicant are due to the assumed gas stripping (GWPS).

3.5.2.3 Containment ventilation system

Radioactive gases will be released inside the reactor containment when primary system components are opened or when leakage occurs from the primary system. The containment atmosphere will be recirculated through the containment air cleanup system (CACS) at approximately 20,000 scfm, prior to purging the containment building. The CACS will consist of two parallel trains, each containing high-efficiency particulate air (HEPA) filters and an activated charcoal adsorber. The gases will be exhausted from the plant vent after passing through HEPA filters and being monitored for radioactivity. The staff calculated the containment airborne activity based on 240 lb/day of primary coolant leakage to the containment and a partition factor of 0.1 for radioiodine. The staff also assumed four purges of the containment per year. On this basis the staff calculated releases from the containment to be approximately 23 Ci/year per reactor for noble gases and 0.013 Ci/year per reactor for iodine-131. These terms are essentially the same as those calculated by the applicant.

3.5.2.4 Ventilation systems for other buildings

Radioactive material will be introduced into the plant atmosphere due to leakage from equipment, processing, or holding radioactive materials. Ventilation air from the auxiliary and fuel buildings will be processed at 144,000 scfm through HEPA filters, monitored for radioactivity, and released through the plant vent. Ventilation air from the fuel building will also be processed through charcoal filters prior to release.

The staff estimates that 160 lb/day of primary coolant will leak to the auxiliary and radioactive waste buildings. Since the letdown stream is above 212°F when it enters the auxiliary building, the staff assumed a partition factor of 0.005 for radioiodine. On this basis the staff calculated the auxiliary and fuel building releases to be approximately 160 Ci/year per reactor for noble gases and 0.046 Ci/year per reactor for iodine-131. The applicant calculated the auxiliary and fuel building releases to be approximately 440 Ci/year per reactor for noble gases and 0.05 Ci/year per reactor for iodine-131. The difference between the staff's calculated release values and those calculated by the applicant are due to the assumed gas stripping (GWPS) efficiency.

Ventilation air at 500,000 scfm from the turbine building will be released through the building roof vents without treatment. The staff estimates that 1700 lb/hr of steam will leak to the turbine building atmosphere and all noble gases and radioiodine released with the steam will remain airborne. On this basis the staff calculated the turbine building vent releases to be less than 1 Ci/year per reactor for noble gases and 0.019 Ci/year per reactor for iodine-131. The applicant calculated the turbine building releases to be negligible for noble gases and iodine-131.

3.5.2.5 Steam releases to the atmosphere

The turbine bypass capacity to the condenser will be approximately 40%. The staff analysis indicates that steam releases to the environment due to turbine trips and low-power physics testing will have a negligible effect on calculated source terms.

3.5.2.6 Gaseous waste summary

Based on the evaluation of the gaseous waste treatment systems, the staff calculated the total releases of radioactive materials in gaseous wastes to be approximately 1550 Ci/year per reactor for noble gases and 0.087 Ci/year per reactor for iodine-131 (Table 3.7). The applicant estimated the gaseous releases to be approximately 2390 Ci/year per reactor for noble gases and 0.08 Ci/year per reactor for iodine-131.

Table 3.7. Calculated releases of radioactive materials in gaseous effluent from South Texas Project, Units 1 and 2

	Release per unit (Ci/year)					
	GWPS[a]	Building ventilation		Turbine building	Condenser vacuum pump	Total
		Containment	Auxiliary			
Kr-83m	*b*	*b*	2	*b*	2	4
Kr-85m	*b*	*b*	9	*b*	9	18
Kr-85	1050	1	1	*b*	1	1050
Kr-87	*b*	*b*	5	*b*	5	10
Kr-88	*b*	*b*	16	*b*	16	32
Kr-89	*b*	*b*	*b*	*b*	*b*	*b*
Xe-131m	50	3	*b*	*b*	*b*	53
Xe-133m	*b*	1	2	*b*	2	5
Xe-133	107	18	106	*b*	107	340
Xe-135m	*b*	*b*	1	*b*	1	2
Xe-135	*a*	*a*	13	*a*	13	26
Xe-137	*b*	*b*	*b*	*b*	*b*	*b*
Xe-138	*b*	*b*	4	*b*	4	8
I-131	*b*	0.013	0.046	0.019	0.009	0.087
I-133	*b*	0.007	0.069	0.013	0.006	0.095

[a]Gaseous waste processing system.
[b]Less than 1 Ci/year noble gases; less than 10^{-4} Ci/year iodines.

3.5.3 Solid wastes

The solid waste management system (SWMS) will be designed to process two general types of solid wastes: wet wastes (which require solidification and packaging) and dry solid wastes (which require packaging only). Wet solid wastes will consist mainly of spent filter cartridges, demineralizer resins, and evaporator concentrates, and will contain radioactive materials removed from liquid streams during processing. Dry solid wastes will consist mainly of low-activity ventilation air filters, contaminated clothing, paper, and miscellaneous solid wastes, such as irradiated primary system components, and will be handled on a case-by-case basis based on their size and activity.

The principal sources of spent demineralizer resins will be four 75-ft^3 CVCS demineralizers, five 75-ft^3 boron thermal regeneration demineralizers, two 75-ft^3 and one 30-ft^3 BRS demineralizers, two 30-ft^3 LWPS demineralizers, and the condensate polishing demineralizers. Spent resins from these demineralizers will be collected in the 4000-gal CPRW spent resin storage tank and the 2600-gal LWPS spent resin storage tank, sluiced to a solidification holdup tank for dewatering, mixed with a solidification agent and catalyst, and solidified in 55-gal drums.

Concentrated wastes from the LWPS evaporators and the CVCS boric acid evaporator will be pumped from their respective concentrate holdup tanks to the 750-gal solidification holdup tank. Concentrates from the solidification holdup tank and a solidification agent will be pumped simultaneously to shipping containers.

Based on its evaluations of PWRs with similar liquid waste systems, the staff has determined that approximately 600 drums/reactor of wet solid wastes packaged as a solid in 55-gal drums will be generated annually. The staff estimates these to contain approximately 5000 Ci of radioactivity, principally Cs-137 and Cs-134. The applicant estimates that wet solid wastes shipped offsite will consist of approximately 600 drums/reactor containing 4000 Ci of activity.

Dry solid wastes will be packaged in 55-gal drums. Compressible wastes, for example, clothing and contaminated rags, will be compressed using a hydraulic baler. The staff estimates the dry solid wastes to be approximately 350 drums/year per reactor containing a total of 5 Ci. The applicant estimates are essentially the same.

3.6 CHEMICAL AND BIOCIDE WASTES

The operation of the South Texas Project will result in chemical wastes that will be discharged into the Colorado River. The chemical wastes can be considered to result from (1) the concentration effect on the dissolved solids in the river water because of evaporation in the cooling lake (Table 3.8) and (2) those chemicals added to various reactor systems which will eventually be dumped into the Colorado River via the cooling lake (Table 3.9).

3.6.1 Circulating water system

Chlorine will be injected into the circulating water system via a diffuser located in the inlet bays of the circulating water intake structure. The system will be designed to provide two 20-min shock doses per day at a maximum dose of 6 ppm to the circulating water (4044 cfs); therefore, the total dosage of chlorine to the system will be approximately 3750 lb/day.

The system will be designed so that a free chlorine residual of 0.2 ppm downstream of the condensers will result. All circulating water will be returned directly to the cooling lake. The applicant has made no estimate of the concentration of combined residual chlorine which will enter the cooling lake. However, the staff considers that, while the free residual chlorine will react rapidly upon being discharged, the combined residual chlorine plus other reaction products of chlorine (other than chloride ion), such as chloro-organics, may persist for much longer periods. While the staff cannot give exact figures as to the resulting concentrations of such reaction products, it is considered that a fairly large percentage of the added chlorine may be in such form. Therefore, it is required that the applicant monitor for total residual chlorine and that the discharge from the cooling lake to the Colorado River be such that residual chlorine levels are below detectable limits.

3.6.2 Nonnuclear regenerative waste

The makeup water requirements for the plant will be met by utilizing demineralization techniques. Well water (80 gpm) will be passed through demineralizer trains which will be regenerated using NaOH and H_2SO_4. The regeneration wastes will be treated in a waste treatment basin before being pumped into the circulating water system for discharge to the cooling lake. The applicant estimates that 37,000 gpd will be processed under normal conditions and a maximum of 85,000 gpd under extreme conditions. Release rates to the circulating water outfall will be 20 gpm and 60 gpm respectively. It is estimated that the wastes will contain a total dissolved solids (TDS) concentration of 6400 ppm. The process will involve the usage of a maximum of about 3500 lb/day of H_2SO_4 and 1900 lb/day of NaOH (ER, p. 3.6-2). It should be noted, however, that the pumped waste will be essentially neutral and will contain the H_2SO_4 and NaOH as a neutral salt (Na_2SO_4).

3.7 SANITARY WASTES AND OTHER EFFLUENTS

3.7.1 Temporary

The applicant has indicated that a prefabricated package waste treatment plant suitable for 2000 workers will be installed on the site. Effluents from the plant will be released into the relocated Little Robbins Slough. The system will meet the requirements of the Texas State Department of Health.

Table 3.8. Increase in chemical concentration of effluent to the Colorado River due to cooling lake concentration, ppm

Chemical parameter	Colorado River at site[a]		Cooling lake, probable maximum concentration[b]	Incremental increase in Colorado River[c] (two passes)
	Maximum surface concentration at intake location	Minimum surface concentration at discharge location		
Biological oxygen demand (BOD)	4	<1	16[e]	3.3
Chemical oxygen demand	36.8[d]	9	147	31
Dissolved oxygen	13.5	6.2		
Sulfate	50	35	200	37
Chloride	69	48	276	51
Nitrate	9.5	<0.2	38	8.4
Phosphate	0.54	0.10	2.2	0.46
Total dissolved solids (TDS)	581	214	2300[f]	460

[a]A *Report on the Ecology of the Lower Colorado River – Matagorda Bay Area of Texas, June 1973 through July 1974.*
[b]Assuming 4 cycles of concentration (ER, p. 10.4–!).
[c]Assuming the same water segment passes the discharge twice (ER, p. 3.4–6a) and a minimum dilution factor of 8:1 (ER, p. 3.4–12).
[d]ER, Table 2.5–22.
[e]The applicant estimates that BOD may reach 35 ppm, (ER, p. 5.1–16).
[f]The applicant's 40-year analysis of the cooling lake indicated that TDS was ≤2000 ppm 75% of the time but reached values as high as 12,600 ppm due to extreme drawdowns during drought periods. Other chemical parameters would reach proportionately higher values during these periods. However, no blowdown occurred when TDS was greater than 2000 gpm (ER, Fig. 3.4–16).

Table 3.9. Chemicals added to liquid effluents during plant operation

Chemical	Total discharge (lb/day)	Concentration in effluent to cooling lake (ppm)[a]
Phosphate, PO_4^{3-}	22	0.001
Sulfate, SO_4^{2-}	3390	0.15
Sodium, Na^+	1070	0.05
Chlorine[b]	3750	
Free chlorine		0.1
Chlorine reaction		
Products (Cl^-, chloramines, etc.)		2.9

[a]Assuming both units are operating.
[b]Will occur for only two 20-min periods/day.

3.7.2 Permanent

The applicant has indicated plans for a sanitary waste system adequate for 150 persons having a sanitary waste flow of 9000 gpd. The system will be built around an extended-aeration activated-sludge plant which will provide for coarse screening, comminution, aeration, sedimentation, and chlorination. The system will meet the requirements of the Texas Water Quality Board.

3.8 TRANSMISSION SYSTEMS

An extensive description of the transmission lines is given by the applicant in the ER, Sect. 3.9. A summary description is given below.

Six new 345-kV transmission circuits will be required. These six circuits will require three separate right-of-way corridors leaving the STP switchyard. Two of the six circuits will go from the site northeast to the Velasco substation of the Houston Lighting and Power Company (HL&P) on double-circuit steel towers. Three double-circuit lines will go from the site to the Danevang tie point northwest of the site. There the corridor branches and sends two circuits to the Hill Country substation of the City Public Service of San Antonio (CPS) on double-circuit steel towers and sends a separate circuit in a northerly direction to the Glidden substation of the City of Austin Electric Utility (COA) on single-circuit steel structures. The remaining circuit will go from the site to the Lon Hill substation of the Central Power and Light Company (CPL) on double-circuit steel towers.

The routes of these lines are indicated in Fig. 3.9; other information on the lines is given in Table 3.10.

All proposed transmission routes will intersect railroad rights-of-way. For all lines combined, there will be a total of 18 intersect points. No railroad rights-of-way are used as transmission route rights-of-way. Railroad rights-of-way should be affected only to the extent that they are intersected by the transmission system rights-of-way.

Table 3.11 illustrates the degrees of transmission line visibility from frequently traveled public roads. These estimates include only those roads that have a traffic volume of 500 or more vehicles per day. The visibility criteria depends on the height of the vegetation bordering the roadside, the distance from the line to the road, and the topography between the line and the road. The overall transmission statistics indicate that 129 highway miles of visibility will result from a total of 398.7 miles of transmission line corridors.

The water bodies crossed by the transmission routes are primarily those associated with marsh areas. A few rivers and small streams are also crossed. Where vegetation must be cleared, re-planting of stream banks is planned to help control erosion.

Route location was specifically selected to avoid forested areas; however, a few small woodland areas will be encountered along certain routes. The most important ecological consideration along the proposed transmission routes will be discussed in Sect. 4.3.

Residential developments were avoided whenever possible in route selection. The routes traverse primarily rural farm and grazing lands, with the exception of minimal spans of urban areas approaching the substations at Lon Hill and Velasco.

3.9 TRANSPORTATION CONNECTIONS

3.9.1 Railroad spur

A railroad spur will be constructed to the site from the nearest existing line, the Missouri Pacific Railroad 7 miles north of the proposed plant site (Fig. 2.2). The spur line will use a 100-ft-wide right-of-way, as do most of the other railroad systems in the area. The spur line must meet the construction requirements of the State of Texas Railroad Commission.

3.9.2 Access road

A permanent access road will be constructed from the site to FM 521, which will have to be rerouted north of the plant. The access road will be constructed from the northeast side of the plant to FM 521. A heavy haul road will be constructed from the plant to the barge slip and wharf.

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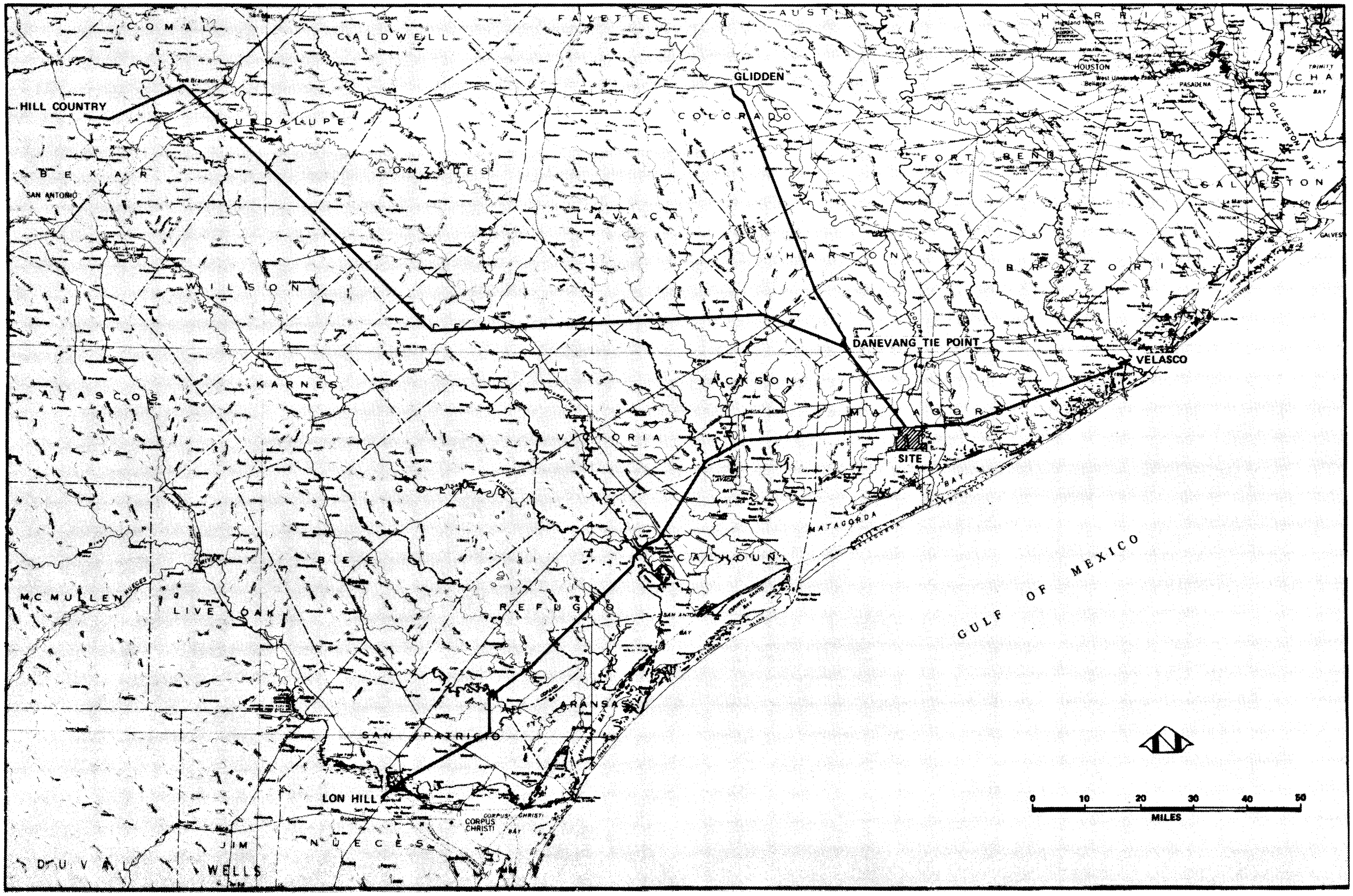

Fig. 3.9. South Texas Project transmission routes. Source: ER, Fig. 3.9-1.

Table 3.10. South Texas Project transmission lines

Line	Utility	Length (miles)	Voltage (kV)	Width of corridor (ft)	Towers: Type	Towers: Number	Towers: Approximate height (ft)
STP[a] to Velasco substation	HL&P[b]	43.7	345	100	Steel double circuit	~232	127–168
STP to Lon Hill substation	CPL[c]	125.7	345	100	Steel double circuit	~666	127–168
STP to Danevang tie point	All STP utilities	18.4	345	340[d]	Steel triple circuit	~100	127–168
Danevang tie point to Glidden substation	COA[e]	52.9	345	150	Steel single circuit	~280	72–98
Danevang tie point to Hill Country substation	CPS[f]	158.0	345	100	Steel double circuit	~237	127–168

[a]South Texas Project.
[b]Houston Lighting and Power Company.
[c]Central Power and Light Company.
[d]The width of this main corridor from the Danevang tie point to about 6.5 miles from the STP site is 340 ft; from the 6.5-mile point to the site, an additional 138-kV circuit used for emergency power for STP will necessitate that the width be 400 ft.
[e]City of Austin Electric Utility.
[f]City Public service of San Antonio.

Table 3.11. Summary of degrees of visibility from frequently traveled public roads

	Intersection with public roads: Total[a] intersection points	Intersection with public roads: Intersection[a] points in visible surrounding	Intersection with public roads: Highway miles	Parallel with public roads, highway miles	Tower construction in urban areas: Total intersection points	Tower construction in urban areas: Highway miles	Total: Highway miles	Total: Transmission line miles
Lon Hill substation to site (CP&L)	14	13	56	11	1	1	68	125.7
Hill Country substation to Davenang tie point (CPS)	17	9	30	0			30	158
Davenang tie point to site (all utilities)	3	3	12				12	18.4
Velasco substation to site (HL&P)	4	4	12		1	1	13	43.7
Glidden substation to Davenang tie point (City of Austin)	3	2	6				6	52.9
						Total of all lines	129	398.7

[a]Excluding urban.
Source: ER, Table 3.9–19.

3.9.3 Pipelines

Makeup and blowdown lines will be constructed from the lake to the Colorado River. The earth removed for this construction will be replaced.

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

4.1 IMPACTS ON LAND USE

The site area (ER, Fig. 2.1-2) consists of approximately 12,352 acres. The areas that will be affected by construction of the plant and plant-related facilities are indicated in Table 4.1. The single largest commitment of land will be in conjunction with cooling lake construction and will require approximately 7300 acres.

Table 4.1. Summary of major areas affected by construction activities

Construction activity	Land area affected by construction (acres)	Completed area (acres)
Cooling lake and embankments	7608	7310
Plant and plant facilities	150	68
Essential cooling pond and embankments	70	60
Access road and heavy haul road	66	28
Railroad spur	20	10
Makeup and blowdown pipelines	9	0
Relocation of FM 521	80	36
Spillway discharge	70	50
Relocation of Little Robbins Slough	148	50
Barge slip	4	3

4.1.1 Plant-related facilities

Construction of the plant will require excavating a considerable area to approximately 50 ft below the existing terrain. Excavated materials will be hauled to designated stockpile, spoil, or fill areas. No dredging or blasting will be required.

During the initial phases of construction, existing undergrowth and vegetation will be removed. This is done to facilitate the grading operations for leveling of the site to the design grade. Merchantable logs and pulpwood will be sold, while the remaining vegetation will be burned in accordance with State and local regulations.

The construction of the plant will cause some smoke and dust near the construction area but should have no adverse impact on air quality. From prior experience, the staff judges the audible range of construction activities to be one-half mile. Since the area is sparsely populated, the overall impact of these fairly localized effects will be minimal.

A total of 5 to 6 miles of temporary roads will be cleared and surfaced with a stabilized material to resist wear and erosion. After construction of the plant has been completed, the roads will be eliminated and the rights-of-way will be graded and replanted. Permanent onsite roads will be installed and surfaced in accordance with standard road construction practices.

A temporary parking area during construction will occupy 27 acres and will be surfaced with gravel and shell. A concrete batch plant will occupy about 5 acres. The land occupied in both these cases will be only temporarily disturbed and will be reseeded and landscaped at the completion of construction activities.

Construction of the power plant will entail large quantities of building materials. Table 4.2 lists the estimated quantities of the major materials required for construction. Of the major materials used, only concrete and reinforcing steel are considered nonrecyclable at this time.

Table 4.2. Major construction materials[a]

	Unit 1	Unit 2	Common Units 1 and 2	Total
Structural steel, tons	3,100	3,100	10	>6,200
Concrete, yd^3	143,000	143,000	44,000	330,000
Formwork, fbm	1,712,500	1,712,500	175,000	3,600,000
Reinforcing steel, tons	16,000	16,000	4,000	36,000
Mechanical piping, tons	2,500	2,500		5,000
Mechanical steel, tons	4,500	4,500		9,000

[a]Many other materials such as copper, lead, and plastic will be used to a lesser extent.

[b]Aggregate to be used for construction will come from quarries in Colorado and Victoria Counties. Total amount of stone to be used in 3,600,000 tons.

Source: ER, Table 4.3-1.

The movement of these construction materials over farm roads will have a significant impact on traffic levels and on local road maintenance requirements. It is evident that the local road maintenance requirements will increase substantially.

4.1.2 Cooling lake

The cooling lake and embankments represent the largest commitment of land in the project. These embankments will be primarily constructed of rolled earth fill removed from within the lake area.

The construction of the embankments will necessitate the excavation, hauling, dumping, and compacting of approximately 23 million yd^3 of dirt. The stripping operation associated with the base of the embankments will precede the deposition of fill material. To aid compaction and reduce dust, the embankment fill material will be wetted to the proper moisture content. To control erosion on the embankments, the outer slope surfaces will be seeded and the interior slopes will be stabilized with soil cement. The applicant plans to construct a service road along the top of the embankments for maintenance access.

4.1.3 Transmission lines

The area affected by the transmission lines is described in Sect. 3.8. The staff believes that transmission line construction can be accomplished without a significant long-term or permanent adverse effect on agricultural production along the right-of-way and adjoining properties. A small area of land will be taken out of production permanently (land occupied by transmission line tower bases), as discussed in Sect. 4.3.1.

During construction, temporary disruption of agriculture will result from the movement of vehicles along the right-of-way and the temporary storage of tower materials. After completion of construction, the ground surface will be graded, planted, or otherwise treated so that the effects of vehicular movement will not cause erosion or will not affect restoration of the land to agricultural use. Access to the rights-of-way will be provided by existing public and private roads.

4.1.4 Railroad spur

The rail spur line and the area affected are described in Sect. 3.9. The right-of-way is flat to very gently rolling terrain. Only a small amount of cut and fill will be required in preparation of the right-of-way and grade. No major stream crossings are required. Any minor tributary streams crossing the right-of-way will require simple bridging structures. The staff does not expect that the construction activity or the movement of heavy equipment and materials required in construction of the spur will cause any serious or permanent disruption of present land uses.

4.1.5 Access road

The access road is described in Sect. 3.9. Rerouting FM 521 and building the access road to the plant area will affect about 96 acres of land. A heavy haul road from the plant to the barge slip and wharf will require that another 50 acres onsite be cleared.

4.1.6 Makeup and return pipelines

These underground pipelines and the areas affected are discussed in Sect. 3.9. Table 4.1 lists the number of acres that will be disturbed by the excavation necessary to bury the pipes. Once the pipelines are laid, the ground will be replanted with native or adaptive grasses that will provide erosion control.

The staff concludes that the impacts on land use are acceptable.

4.2 IMPACTS ON WATER USE

4.2.1 Surface water

Construction of diversion and return facilities on the Colorado River will cause local turbidity increases and permanent alteration of the aquatic environment in the immediate vicinity. These effects may reduce aquatic productivity near the site and are discussed in Sect. 4.3. There are no significant recreational or commercial uses of the Colorado River in the site area. The structures are all shoreline features and will not protrude into the navigable waterway.

Construction of the barge slip will cause a loss of a shallow water area and a 350-ft section of steep bank. Silt loading will increase over the 4- to 6-month construction period.

Little Robbins Slough will be relocated outside of the west cooling lake embankment. The aquatic and terrestrial impacts of this relocation are discussed in Sect. 4.3. The filling of the 7000-acre cooling lake will require 187,000 acre-ft of unappropriated water from the Colorado River over a 3-year period. The impacts of this withdrawal are discussed in Sect. 5.2.1.

The staff concludes that the impacts on surface water are acceptable and that turbidity increases due to construction will not influence upstream or downstream users of the Colorado River.

4.2.2 Groundwater

Dewatering required during construction will be only from the shallow aquifer zone and will extend to a depth of 80 ft below ground surface in the area of the reactor containment buildings. The drawdown zone will extend up to 4000 ft from the dewatered area. The majority of this area is within the site boundary and no adverse environmental impacts are anticipated. The effects of dewatering are expected to last for about 3.5 years from the start of foundation construction to the end of the period of gradual raising of groundwater level.

One or two wells drawing on the deep aquifer will supply 300 to 400 gpm during hours of construction. In the event of fire, this may be increased to 600 to 700 gpm.

The staff concludes that construction impacts on existing groundwater sources are acceptable.

4.3 EFFECTS ON ECOLOGICAL SYSTEMS

4.3.1 Terrestrial

4.3.1.1 Power station and cooling lake

The land areas involved in construction are shown in Table 4.1 and discussed in Sect. 4.1. About 67% of the 12,352-acre site will be affected. Excavation of the cooling lake will eliminate approximately 7600 acres of terrestrial habitat; another 625 acres will be cleared for siting the power plant buildings and associated facilities such as roads, railroad spurs, pipelines, materials storage areas, concrete plants, canals, and the essential cooling pond. Construction impacts on soils, producers (plants), and consumers (animals) have been treated in the following sections. The potential effect due to the loss of freshwater drainage to Little Robbins Slough is discussed in Sect. 4.3.3.

Soils

The only substantial effect that might be incurred by the physical environs is associated with erosion on disturbed areas. For the proposed project, however, the generally flat terrain is not conducive to serious soils erosion via upland runoff. The applicant plans to implement various erosion control measures around the construction site (ER, Sect. 4.1.1.1.1). The staff believes that with the implementation of measures, as discussed in Sect. 4.5, erosion will be held to acceptable levels.

Producers

Native and cropland plant communities that will be disturbed by construction activities include about 6757 acres of agricultural lands, 1270 acres of coastal prairie, and 189 acres of southern floodplain forests (Table 4.3).

Table 4.3. Changes in acreage of land classification units and plant association as a result of construction on the site[a]

	Preconstruction acreage	Postconstruction acreage	Acres affected	Percent loss
Natural communities				
Coastal prairie	1609	339	1270	79
Southern floodplain forest	1505	1316	189	13
Subtotal	3114	1655	1459	47
Man-dominated communities				
Cropland	5320	1612	3708	69
Pasture	1430	129	1301	91
Fallow	2333	585	1748	75
Spoil and barren	144	144	0	0
Residential	11	2	9	82
Subtotal	9238	2472	6766	73
Total	12352	4127	8225	67

[a]Transmission line acreage within the site boundary is not included in the changes.

Ricelands (rice and fallow) comprise the overwhelming proportion (87%) of the row-crop properties involved (ER, Table 4.1-2). To place the apparent loss of riceland inventories in perspective, it can be stated that these inventories comprise 6% of the current producing ricelands of Matagorda County and/or about 0.7% of Texas ricelands (ER, 4.1.1.2.1).[1] The impact of this loss of cropland is discussed in detail in Sect. 10.2.2. Considered from the standpoint of potential acreage, about 2% of the coastal prairie ricelands in Matagorda County are included within project bounds (Appendix B, Table 8).

Flora

With regard to individual floral components, it is notable that six native plant species considered rare or endangered in Texas[2,3] occur in an area adjacent to the proposed wildlife preserve (Appendix B, Table 9). Two more species that are restricted to a single plant association were observed on the site. One occurred in Little Robbins Slough and the other in the bottomland woods. An evaluation of these eight species is given in Appendix B, Table 9. The effects of construction on these eight plant species are judged by the staff to be minor. Swamp privet will be benefited since it grows in areas that will be set aside as a wildlife preserve.

Consumers

Construction activities will have a direct effect on the consumer populations of the site. Clearing, excavating, filling, and grading will kill many of the less mobile species, such as terrestrial invertebrates, terrestrial amphibians and reptiles, and small mammals. Most birds and mammals will leave the immediate vicinity of construction as activities increase. The more adaptable species are expected to return as construction activities subside. Increased traffic in the area will result in an increase in road kills of mammals, amphibians, and reptiles.

An indirect effect of construction activities on consumer populations occurs through loss of suitable habitat. Many of the less mobile and/or highly territorial consumer species such as soil and litter invertebrates, amphibians, breeding birds, and certain small mammals will be unsuccessful in relocating suitable habitat. Some mobile and/or nonterritorial organisms may be able to move to other areas of their preferred habitats. The loss of habitat exerts much greater impact on species restricted to single habitats than on those found in many different kinds of cover. The staff implemented a scheme for evaluating potential losses based upon the number and kinds of habitats in which a species occured. Each of the potential species that could be affected by the project was assigned to one of 30 ecological groups. Appendix B, Table 10 provides the numbers of potential and observed species for each of the 30 ecological groups.

The present fauna is not dominated by species from any one ecological group. The site and adjacent areas still support a very rich and diverse fauna; however, ubiquitous wetland species account for only 22% of the observed species and cropland wetland 15% (Appendix B, Table 10). Of all wildlife species observed on or adjacent to the site, only 32% can inhabit the proposed cooling lake, and 33% of the species will be able to use the site per se (Appendix B, Table 10). Wildlife that cannot adapt to the proposed habitat alteration include 148 species (56%) dependent upon habitats which will be inundated by the lake and 59 species (22%) using habitats of the type which will be markedly altered for site construction (Appendix B, Table 10). In view of these rather large percentages, the staff concludes that construction will result in substantial reduction in species richness at the STP site. However, these populations comprise only a small percentage of the total regional populations.

The impacts from habitat alteration usually result in a population reduction of those species that cannot adapt and use the altered habitat. These population reductions will not be significant for the species unless it is rare, restricted to a single habitat, endangered, or presently listed on the Audubon Blue Lists. Appendix B, Table 11 lists 24 species that meet one or more of these criteria and were reported as occurring on the site. For 15 of the species, no reduction in population is anticipated. All of these are visitors to the site and do not use the site for breeding. Ten of these are listed on the Audubon Blue Lists. All ten of these are ubiquitous carnivorous species, and thus population declines probably are the results of effects other than habitat alteration. Suitable habitat occurs adjacent to the site as represented by low site population estimates. Many of these adjacent areas are probably not at carrying capacity and can be expected to absorb the influx of displaced mobile organisms.

Six of the species occur in areas that are being set aside as a 1700-acre wildlife preserve and thus will be benefited by the project. Three of these are restricted forest species that are permanent residents of the site and breed in the lowland woods adjacent to the Colorado River. The other three species, ubiquitous wetland species, are using Kelly Lake, lowland sloughs, marshes, and the Colorado River, all of which will not be altered and will be set aside in the wildlife refuge.

Three of species deserving mention are the fulvous tree duck, yellow-billed cuckoo, and the American alligator. The fulvous tree duck and the yellow-billed cuckoo are not endangered at the present time, but populations of these two species have declined recently.[4] The staff concludes the minor population reductions will not be significant regionally.

The only endangered species occurring on the site is the American alligator (*Alligator mississippiensis*). The population in the Robbins Slough complex appears to be expanding at the present time. Suitable habitat for nest construction is restricted to the freshwater portions of the estuary and Little Robbins Slough. This type of habitat would not be available in the proposed cooling lake, and thus site construction would remove approximately 62% of existing nesting habitat within the site boundary. Large alligators will be able to use the lake as a feeding ground, but successful nesting and survival of young will only occur in adjacent shallow-water habitats. Loss of a large part of the Little Robbins Watershed due to cooling lake construction will further reduce this alligator nesting habitat. Recommended mitigative measures include diversions of water into the upper areas of the estuary, as discussed in Sect. 4.3.3, to stop any further reduction of nesting habitat.

4.3.1.2 Transmission lines

The physical details of the transmission system have been discussed in Sect. 3.8 and in the ER, Sect. 3.9. Approximately 398 miles of transmission line will be constructed, with a total land area of 5685 acres affected (Table 4.4). The impacts on soils, producers, and consumers have been treated in the following sections.

Soils

The construction impacts on the soils of terrestrial ecosystems will be similar to those discussed in Sect. 4.3.1. However, the erosion potential will be much greater along the Danevang to Hill Country transmission route than that discussed for the site. The other transmission routes occur mainly in the same type of terrain and vegetation as that of the site, and thus erosion potential will be the same. Only the extreme western end of the Danevary Hill Country line that crosses the Edwards plateau (Juniper-oak savanna) encounters soils that have a potential for severe erosion (ER, Sect. 4.2.5.1).

The applicant plans to follow construction techniques as outlined in Table 4.2-3 of the ER, combined with the restriction of construction activity to periods of low precipitation to minimize erosion potentials on the Edwards plateau. The staff concludes that with mitigating measures proposed by the applicant during construction (Sect. 4.5), impacts due to soil erosion should be held to acceptable levels.

Table 4.4. Summary of land classification and natural communities found within the transmission line right-of-way

Land classification	Acreage	Percent of right-of-way
Natural communities		
Forest and woodlands		
Southern floodplain forest	491	9
Oak hickory forest	266	5
Juniper oak savanna	115	2
Mesquite-acacia brushlands	693	12
Prairie[a]	442	08
Marshlands	328	06
Subtotal	2335	41
Man-dominated communities		
Croplands	2016	35
Pastures	1298	23
Urban	36	$\leq$1
Subtotal	3350	59
Total	5685	100

Producers

Most of the right-of-way will be maintained in present land use except where the line transverses woodlands and areas occupied by tower bases. Woodland right-of-way to be cleared includes approximately 491 acres of southern floodplain forest communities, 266 acres of oak hickory forest communities, and 115 acres of juniper oak savanna (Table 4.4). Of the eight potential native plant associations crossed by the transmission routes, only three of these are unique to Texas (Appendix B, Table 8). The affect of transmission line construction upon these eight plant associations is judged by the staff to be minor.

Consumers

Attwater's prairie chicken (*Typmanuchu cupido attwateri*), an endangered species,[5] was observed in several locations along the transmission line rights-of-way. Nineteen males were observed using 170 acres of suitable range that occurred under the proposed Lon Hill right-of-way for Refugio County (ER, p. 4.2-6). Estimates indicate that the area is inhabited by 60 to 70 birds (ER, Sect. 4.2.3.1), which is approximately 40% of the birds of Refugio County.[1] Nineteen to 25 males were observed booming in a flax field adjacent to 35 acres of suitable range under the proposed Hill Country right-of-way for Victoria County (ER, p. 4.2-6). Approximately 40% of the birds of Victoria County are using this site. The main reason for the decline of this endangered species is the loss of habitat due to changing land-use practices, deterioration of the remaining habitat, and specific unfavorable climatic conditions and predations.[4] Habitat destruction can be identified as the single greatest factor in population loss. In this context, approximately 1 acre of prairie chicken range will be altered for STP lines. To further reduce potential impact, the applicant plans no construction in the two areas described (approximately 4 and 2 miles of right-of-way, respectively) between March 1 and June 15 (ER, Fig. 4.2-2C and 4.2-4C). The staff recommends that these 6 miles of right-of-way be avoided from January 1 to June 1, since the males begin to set up booming ground territories in late December.[6] Routine line maintenance and planned ground inspection should also take this into consideration. Furthermore, it is recommended that the applicant, in cooperation with the land owners and the Texas Fish and Game Department, adopt management practices for these two areas that will preserve the prairie chicken range found along and adjacent to these six miles of right-of-way. With mitigative measures discussed above, the status of the prairie chicken should not be altered in this part of Texas.

The Aransas National Wildlife Refuge is located within 6 miles of a proposed right-of-way. This refuge is used by the endangered whooping crane (*Grus americana*) for wintering. The staff concluded that the proposed right-of-way is sufficiently distant to avoid significant detrimental impacts on this refuge.

4.3.2 Aquatic

Construction activities at the South Texas Project will affect the biota in three existing aquatic ecosystems: (1) the Little Robbins Slough; (2) the lower Colorado River; and (3) the Robbins Slough marsh complex. In addition, construction activities will include creation of the South Texas Project cooling lake.

4.3.2.1 Construction impacts on Little Robbins Slough

Cooling lake construction

Impacts on the Little Robbins Slough ecosystem due to cooling lake construction include: (1) elimination of aquatic habitat in the upper reaches of the slough, and (2) increased siltation and suspended solids in the lower reaches of Little Robbins Slough.

Excavation of the cooling lake site will permanently destroy approximately 4 stream miles of the west branch and 2 stream miles of the intermittent east branch of the slough. These losses will be replaced with a single drainage ditch along the western boundary of the cooling lake embankment. Following construction, the ditch will probably be colonized by a number of aquatic species from undisturbed adjacent wetlands. These include invertebrates such as grass shrimp, crayfish, and blue crabs and fish such as red shiners, mosquitofish, silverband shiners, sailfin mollies, green sunfish, warmouth, bluegill, white crappie, tidewater silversides, striped mullet, and several species of killifish.[7]

The applicant plans to straighten and deepen a portion of Little Robbins Slough south of the lake. However, the benefit derived from increased flow capacity in the ditch will probably be outweighed by the impact of additional removal of wetland habitat. The staff requires the applicant to limit straightening and channelization of Little Robbins Slough to the area within the site boundary.

Siltation and suspended solids

Grading and excavation on the construction site will increase the potential for drainage erosion and siltation of local surface waters. Increased siltation and resulting turbidity can influence biota in the lower reaches of Little Robbins Slough. Reduced primary productivity,[8-11] impairment of gill function[11] and clogging of feeding mechanisms,[12] and physical blanketing of stream bottoms by sediment[11,13,14] constitute phenomena known to occur as a direct result of erosion and subsequent siltation. The applicant is aware of the potential problem and will implement erosion control measures to minimize soil losses (ER, p. 4.1-3). Additionally, the construction site runoff will be treated by the installation of sedimentation basins and will be directly discharged, after sedimentation, to the Colorado River rather than to Little Robbins Slough. With the mitigating measures outlined (Sect. 4.5), the staff believes that siltation should not cause serious impacts.

Discharge of wastes

During the early stages of construction, the work force will use portable toilets from which wastes will be periodically hauled offsite (ER, p. 3.7-1). Construction wastes from about 2000 people working 10 hr/day at the site (40 to 200 gpm) will be treated in a small sewage treatment plant in compliance with local and State laws (ER, p. 4.1-16). Treated wastes with a residual chlorine level of 1.0 ppm and a BOD_5 level of 18 to 20 ppm will then be discharged directly to the Colorado River at rates of 0.09 to 0.45 cfs (ER, p. 4.1-16).

Other wastes, such as those from the concrete mixing plant, and spilled oil and gasoline from heavy equipment, will be discharged to settling basins or cleaned up as appropriate.

4.3.2.2 Construction impacts on the Colorado River

Construction of a barge slip, makeup intake structure, discharge structure, and cooling lake spillway will cause limited adverse impacts on the lower Colorado River. An additional impact may result from discharge of groundwater from dewatering operations.

Barge slip construction

Construction of the barge slip requires excavation of approximately 50,000 yd^3 of earth from an area 350 x 350 ft along the west bank of the Colorado (ER, p. 4.1-14). Excavation will be carried out behind sheet piling, which should reduce releases of suspended solids and subsequent downstream increases in turbidity and siltation (see Sect. 4.3.2.1 for a discussion of siltation effects). The staff estimates the permanent loss of less than 1 acre of benthic habitat, including resident biota.

Intake structure

Construction of the makeup intake structure will take place behind a cofferdam and will result in the permanent loss of approximately 400 linear ft of shoreline and littoral habitat (less than 1 acre), as the latter are replaced by concrete foundations and riprapped retaining walls (ER, p. 4.1-15). Another 200 ft of shoreline and littoral habitat will be disturbed. Silt loading and turbidity will temporarily increase (12 to 15 months). The staff considers the loss of habitat and benthic fauna acceptable.

Discharge structure and lake spillway

Impact of construction of the cooling lake spillway and multiport discharge structure on the Colorado will be similar to that described above for the barge slip and intake structure.

The staff concludes that no significant long-term adverse impacts will be sustained by the lower Colorado ecosystem from construction of these four structures and the attendant estimated loss of less than 2 acres of river bottom habitat.

Construction runoff and sewage effluents

Effluents from site dewatering operations will be released to the Colorado River near the location of the barge slip, at rates up to 5.6 cfs (ER, p. 4.1-17). Tests of groundwater at the site have indicated the presence of mercury at concentrations greater than the maximum levels recommended for public water supplies and for protection of aquatic life (ER, Table 2.5-26).[15-16] However, similar concentrations apparently prevail in the Colorado River as well. Therefore, provided that dewatering discharges do not exceed 5.6 cfs, additional toxicity to aquatic biota would not be expected as a result of construction (Sect. 11.4.1). Sedimentation basins will be discharged to the Colorado River from sedimentation basins.

Sewage treatment effluents and construction site runoff will be discharged to the Colorado River from sedimentation basins.

Cooling lake fill

Entrainment losses of ichthyoplankton and crustacean larvae during cooling lake fill may significantly reduce some fish and crustacean populations in the Colorado River-Matagorda Bay Estuary. This potential impact and the study to develop makeup procedures to reduce entrainment losses to acceptable levels are discussed in Sect. 5.5.2.1.1.

4.3.2.3 Predicted limnological and biological characteristics of the cooling lake

The applicant does not plan to make the cooling lake available for public use or for recreational purposes (ER, p. AI-316). The lake is not expected to contribute significantly to the biota of adjacent waters. Consequently, biological development within the cooling lake does not assume major importance in the present analysis.

Colorado River water will be pumped into the 7000-acre lake starting in 1978. Filling will take approximately 3 years (ER, p. 4.1-17). Initially, water quality will be similar to that of freshwater portions of the river. However, turbidity in the cooling lake may be lower because of suspended sediment removal in the settling basin behind the makeup pump station. The staff concurs with the applicant's estimate of about 600 (average) ppm total dissolved solids (TDS) for the new lake, as based on TDS levels measured in the Colorado River.[17]

At normal maximum operating elevation, the cooling lake will hold 187,000 acre-ft of water and vary in depth from 20 to 34 ft. Internal diking, as shown in Fig. 2.2, will reduce the fetch available for wind action and consequently increase the probability of thermal stratification during the hot summer months (ER, p. 3.4-2). The use of soil cement on the steep sides of embankments and dikes will probably limit littoral plant communities to periphytic algae. The bottom of the lake will be relatively sterile due to preconstruction clearing and excavation.

Excavation and relocation of Little Robbins Slough will preclude any contributions to the biota of the cooling lake by the slough. Initially, the major biological features of the cooling lake will reflect those in the Colorado River when river flow is high enough to maintain freshwater conditions. With time, the community structure will evolve from essentially a tenuous riverine community toward one more typical of other freshwater impoundments in Texas.[18] Crustaceans and fishes likely to enter the cooling lake during filling are given in the ER, Table 4.1-3. However, many species will fail to establish viable populations. Through makeup entrainment, game fishes such as largemouth bass and channel catfish will be present and may display good growth initially. White crappie typically establish large stunted populations in Texas reservoirs. Eventually, rough and forage species such as carpsucker, gizzard- and threadfin shad, smallmouth buffalo, and carp can be expected to dominate fish communities.[18]

4.3.3 Impacts on Robbins Slough marsh complex

The staff's ability to properly assess the potential impacts of STP construction on the marsh complex are limited due to the lack of adequate sampling in the marsh. The marsh complex is shown in detail in Fig. 4.1.

4.3.3.1 Physical

Construction of the cooling lake and other plant facilities will remove about 5800 acres (or 27%) of the total Little Robbins-Robbins Slough watershed. This 5800 acres represents 65% of the drainage area north of the southern boundary of the site (Fig. 2.2). The estimates of construction effects on the drainage characteristics of Little Robbins Slough are summarized in Table 4.5. The estimated average annual total discharge through the upper reaches of the slough of 11,240 acre-ft/year is expected to drop to 3950 acre-ft/year, a 65% reduction, upon construction of the cooling lake. From the standpoint of the slough as a whole, down to the Gulf Intracoastal Waterway (GIWW), this loss of freshwater represents approximately 27% of the total surface water input (ER, p. AI-277-278). However, groundwater may contribute a significant amount of fresh water to the slough.

4.3.3.2 Biological

The Robbins Slough marsh complex, ranging from fresh water in the upper reaches to brackish water near the GIWW, serves as a permanent home for many freshwater and brackish water vertebrates and invertebrates. The marsh is also a breeding ground and nursery for several estuarine and marine vertebrates and invertebrates, as discussed in Sect. 2.7.2. The critical importance of such ecosystems to wildlife is discussed in Sect. 2.7.1.

Reduced freshwater inflow to the marsh will convert an unknown amount of freshwater marsh to brackish water marsh and coastal prairie. Loss of freshwater marsh will adversely affect populations of freshwater fish, plants, aquatic insects, and other aquatic invertebrates such as the presently plentiful grass shrimp (*Palaemonetes kadiakensis*). Species of freshwater fish and invertebrates in Robbins Slough that are expected to suffer population declines as a result of freshwater inflow are listed in Table 4.6.

The most significant potential impact on wetland wildlife due to changes in the marsh concerns waterfowl. Drying up of some of the marsh areas coupled with increased salinity of others would necessitate the movement of these species to other areas that are already saturated with large winter populations. Freshwater marshes are preferred over saline marshes by waterfowl because of a greater abundance of plant food and the need for fresh drinking water. The Robbins Slough marsh complex carries approximately 24,000 ducks and geese annually and contributes about 1% of all such wetland habitat in the central flyway of the United States (ER, Question D-7). If one-half of these freshwater marshes are lost due to reduced flows in Robbins Slough caused by construction of the cooling lake, a moderate impact on the regional waterfowl population will occur.

The conversion to brackish and saline water should not unduly stress most estuarine-dependent organisms in the slough, since salinities are not likely to exceed those in the GIWW and Matagorda Bay (17 to 30 ppt in Matagorda Bay and somewhat lower in the GIWW).[19,20] However, many larval and juvenile forms prefer lower salinities because food is often more abundant in areas of low salinity, and marine predators such as comb jellies and large fish are usually excluded.[21,22]

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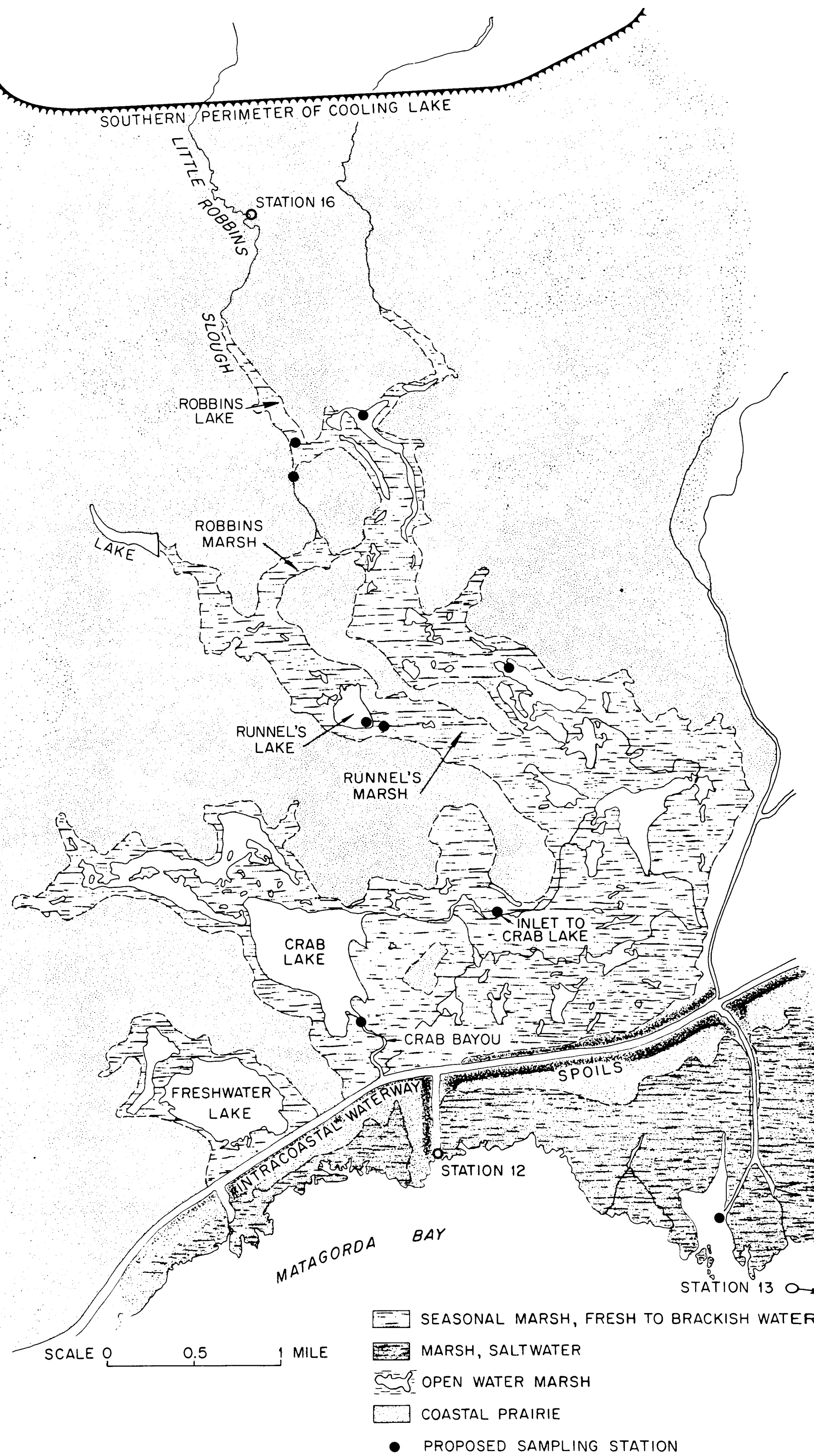

Fig. 4.1. Little Robbins Slough marsh complex adjacent to the proposed STP site.

Table 4.5. Little Robbins Slough changes in drainage characteristics due to lake construction

	Little Robbins Slough	East Fork	Total[a]
Existing drainage area, $miles^2$	9.33	4.43	13.76
Drainage area after lake construction $miles^2$	4.57	0.23	4.80
Percent reduction	51	95	65
Estimated 22-year average annual discharge from rainfall, acre-ft	6,300	3,000	9,300
Estimated 22-year average annual discharge from irrigation return flow, acre-ft	1,300	640	1,940
Estimated 22-year average annual total discharge, acre-ft	7,600	3,640	11,240 (15.5 cfs)
Estimated average annual discharge after lake construction, acre-ft	3,760	190	3,950 (5.45 cfs)

[a]This data applies only to the drainage area north of the southernmost boundary of the site (that area directly affected by plant construction).
Source: ER, p. 2.5-27b.

Table 4.6. Partial list of animals subject to population declines or extirpation due to reduction in freshwater inflow to Robbins Slough

Fish	**Crustaceans**
Red shiner	Crayfish (*Cambarellus shufeldti*)
Silverband shiner	Crayfish (*Procambarus clarkii*)
Bullhead minnow	River shrimp (*Macrobrachium ohione*)
Carp	Mysids (*Mysidacea*)
Channel catfish	Grass shrimp (*Palaemonetes kadiakensis*)
Green sunfish	**Insects**
Warmouth	Midges (Chironomidae)
Bluegill	Beetles
Longear sunfish	Mayflies
Bantam sunfish	Biting midges (Ceratopogonidae)
White crappie	Dragonflies and Damselflies (Odonata)
Molluscs	**Annelids**
Snails (Gastropoda	Oligochaetea
	Leeches

In Texas waters, post-larvae of white shrimp apparently prefer salinities ranging from 5 to 10 ppt while brown shrimp post-larvae generally select waters of 10 to 20 ppt salinity.[23] No white or brown shrimp were collected anywhere in Robbins Slough during the applicant's single reconnaissance sampling in June 1974. However, station 12 in the cut between Matagorda Bay and the GIWW (Fig. 4.1), which would provide the most direct route to Robbins Slough, consistently yielded greater numbers of both white and brown shrimp than at most other stations (Table 4.7). Furthermore, post-larvae and juveniles of the penaeid shrimp (white, brown, and pink), Atlantic croaker, sand seatrout, pinfish, and southern flounder are believed to utilize relatively low salinity marshes[24] that are similar to those in Robbins Slough. Other estuarine dependent species actually found by the applicant within the Robbins Slough marsh complex included ladyfish, gulf menhaden, bay anchovy, crevalle jack, black drum, fat sleeper, and striped mullet. The small size of many of these fishes suggests utilization of the lower brackish portions of the slough as a nursery.

4.3.3.3 Conclusions

The staff's assessment of the impact of reduced freshwater inflow to Robbins Slough is necessarily tentative because of insufficient data regarding groundwater inflow, enumeration of species present and their distributions in time and space, and population sizes. In addition, salinity data is lacking for the area between the GIWW and the freshwater portions of the slough.

Table 4.7. Mean catch[a] by station of brown shrimp and white shrimp taken by trawling during June 1973 through May 1974

Stations	Brown Shrimp	White Shrimp
1	0.0	0.5
2	0.0	0.3
3	0.0	5.2
4	0.2	7.0
5	31.3	23.6
10	12.9	44.3
11	5.0	12.4
12	24.8	123.3
14	3.0	12.5

[a]Mean catch reported as mean number of individuals.

Source: NUS Corporation, *A Report on the Ecology of the Lower Colorado River – Matagorda Bay Area of Texas, June 1973 through July 1974,* Docket Nos. STN 50-498 and STN 50-499, Supplemental Data to Amendment 1, Oct. 1, 1974.

However, the staff expects the following interrelated impacts on Robbins Slough to result from construction of the cooling lake on the watershed:

1. As much as a 65% reduction in surface water inflow to the upper freshwater marsh resulting in (a) reduced nutrient input to the marsh, and (b) a shift in the salinity gradient toward the upper reaches of the slough.

2. permanent loss of an unknown amount of highly productive freshwater marsh to less productive brackish water marsh and coastal prairie;

3. diminished populations of birds, alligators, and other aquatic herptiles, freshwater fish, invertebrates, and aquatic plants;

4. some reduction in the slough's desirability as a nursery for estuarine-dependent organisms such as menhaden, drum, croaker, mullet, ladyfish, penaeid shrimp, and oysters;

5. possible erosion of a limited amount of marshland.

In the case of Robbins Slough, these impacts will generally be subtle rather than catastrophic, but the high intrinsic value of estuarine marshes and waters (5% capitalized dollar estimates include about $7000/acre for fish production[25,26] alone) requires special consideration be given them. Consequently, the staff requires that the applicant conduct a study to determine the need for diversion of water from the Colorado River and the parameters required to minimize impacts on the marsh complex. Construction will be performed to minimize watershed removal and thereby assure the validity of the study.

4.3.4 Summary of environmental effects of construction

Table 4.8 contains a summary of the identified environmental impacts from construction of the plant, their relative significance, any planned actions to minimize these effects and alternative actions available should the impacts become unacceptable.

4.4 SOCIAL AND ECONOMIC EFFECTS

The social and economic consequences resulting from the construction of a facility of this magnitude are expected to be extensive. The project will cause increased demands on the local, relatively fixed supply of consumer products, housing, and private and public services. Although it is recognized that the local population will be impacted in many ways, for the purposes of this analysis, only those ramifications which can be of greatest importance to the surrounding communities are considered.

Table 4.8. Summary of environmental impacts due to construction

Potential impact	Applicant's plans to mitigate	Expected relative significance	Corrective actions available and remarks
Increases in total suspended solids (TSS) and siltation	Ditches, berms, dikes, sedimentation basins	Temporary reduction in some aquatic populations near construction activity	Total suspended solids in runoff discharged shall not exceed TSS levels in river at time of discharge. See Sect. 4.5.2
Discharge of wastes	Sewage treatment plant	Temporary but significant for an unknown distance downstream in Little Robbins Slough	Tertiary treatment of wastes with subsequent discharge into Colorado River rather than into Robbins Slough
Loss of approximately 6 stream miles of upper Little Robbins Slough	Replace with drainage ditch near western boundary of site	Permanent loss of habitat and its flora and fauna	
Loss of benthic habitat in Colorado River due to makeup, discharge, spillway, and barge/slip construction		Not significant. Less than 3 acres lost	
Reduction of surface freshwater inflow to Robbins Slough	None	Permanent loss of freshwater marsh. Brackish water marsh will become saltier. Potentially significant impact on freshwater organisms, some estuarine dependent organisms and wildlife	Damage can be minimized by careful diversion of 4000 to 7000 acre-ft of water from Colorado River to upper reaches of slough
Loss of approximately 6747 acres of cropland, 1270 acres of coastal prairie, and 189 acres of southern floodplain forest	Setting aside 1700 acres of wildlife habitat, which includes extensive segments of floodplain forest, into a wildlife preserve	Permanent loss of habitat and its flora and fauna. Decrease in faunal richness for the area. Approximately 6% reduction in rice production for Matagorda County	Habitat loss can be minimized when practicable by maintaining rice on lands outside exclusion area to provide food and cover for wetland game species

4.4.1 Physical impacts

Within the STP site there are only two households (involving six persons) that will be displaced by the project. Additionally, 26 farm operators will have to give up their operations on the site. The proposed alignments of the rights-of-way for the railroad spur, road, pipelines, and transmission lines have been located in such a way that no additional farm homes and households will be displaced (ER, Sect. 8.2.2).

Construction activity, particularly in the early stages of site preparation, will involve clearing, excavation, and grading. Construction noise should be only a minor nuisance to the local population. Air pollution resulting from airborne dust and possibly smoke may create a local nuisance for short periods.

Construction activity potentially could have a serious impact on local water quality. Pollution of groundwater resources, as well as surface stream flows, will be controlled. With the large concentration of workers at the site, provisions must be made for sanitary treatment and disposal of sewage to preclude any pollution of water resources. The applicant will obtain a permit for sewage disposal from the Texas Water Quality Board.

The anticipated daily traffic flow during peak construction periods into and out of the plant site is approximately 1200 to 1500 passenger cars and trucks. This represents a 300% increase in traffic density on FM-521. The frequency of accidents is expected to increase during the peak period of construction. In addition, increased traffic congestion will require traffic control at major intersections and road improvements to meet peak demands. This, together with the need to relocate some roads, will cause some temporary inconvenience (ER, Sect. 4.1.1.3.2).

4.4.2 Population growth and construction worker income

The STP will require over 2100 workers during the peak period of construction. Most of the workers will move into the region for the time they are needed if they are not already permanent residents. The two towns most likely to receive the largest influx of people are Bay City and Palacios. The 1970 census of Matagorda County showed a total population of 27,913.

Based on similar projects, the staff estimates that about 50% of the construction work force will be motivated to live in the vicinity of the site, primarily due to the long duration of the project and its remoteness from the Houston metropolitan area. Based on an average family size of 3.5 for the Houston Metropolitan Statistical Area (HSSA),[1] the population could increase by about 3500 persons. The staff estimates that approximately 70% of the new residents will have families, and the remaining 30% will be single men or men who will live in the area during the week and return home on weekends, resulting in a projected increase in population close to 2450 persons. An increase in primary employment will normally cause corresponding increases in employment in other fields such as service workers, sales personnel, teachers, etc. In the Houston area, approximately one worker in eight is employed in the service trades.[1]

The construction employment expected during the period in which the plant is to be built is given in Table 4.9.

Table 4.9. Construction man-hours and employment for the South Texas Project, 1976–1982

Year	Man-hours	Average number employed
1976	1,720,400	930
1977	2,998,600	1,621
1978	3,899,800	2,108
1979	3,883,400	2,099
1980	2,654,500	1,435
1981	1,179,800	638
1982	49,100	27
Total	16,385,600	8,858

Source: ER, Table 8.1-12.

The major impacts of population growth and increased income will be felt in Matagorda County, and these are assessed below.

4.4.3 Impact on community services

Housing data from the 1970 census show that there were 523 vacant (sale or rental) housing units in Bay City and Palacios, the two largest towns in Matagorda County. The census also listed 702 vacant housing units for the entire county. Local officials, however, indicate that there is presently very little available housing. In discussions with those officials, the staff learned that plans have been made to remedy the situation by developing several mobile home parks and apartment complexes. There are presently four trailer parks located in the Bay City area, with a current 300-trailer capacity. An 80-unit apartment complex has recently been completed in Bay City and 400 additional units are proposed. In Palacios, there are a total of 80 trailer spaces and plans for an additional 26 spaces. An 18-unit apartment building is also proposed for future development. On the basis of the experience of previous similar construction ventures, the staff concludes that the predominant housing demand in the area will be for rental units and that the majority of the need will probably be met by construction of new mobile home parks and additions to existing parks.

The Bay City Municipal Water System is considered adequate for the city's needs during the construction period. The sewage system for the Bay City service area is currently operating at 50% capacity and should prove more than adequate. The water facilities in Palacios should also prove adequate during the STP construction period, but present sewage treatment facilities will have to be expanded and the necessary plans have already been formulated. Any new Matagorda County residences outside of Bay City and Palacios will have to rely on individual wells or water systems provided by developers and on septic tanks for sewage disposal.

There are currently three full-time police officers and 55 volunteers associated with the Bay City Police Department. The fire department is composed of three part-time firemen and 16 volunteers. An increase of both full-time and part-time police and fire personnel may be required, depending on population increases. Palacios currently has a volunteer fire department and a full-time police department composed of 4 officers.

One major impact on county and city service in Matagorda County is road maintenance. The traffic and loads on FM 521 will increase substantially over current levels. State Highways 35 and 60 will also have increased traffic levels. FM 521 will have to be rerouted around the exclusion area.

The staff concludes that there will be a need for some increased services in Matagorda County. The financing of the increased services is discussed in the following section.

4.4.4 Impact on local institutions

A variety of taxes, franchise and other payments, will be collected by the appropriate governmental authorities. The tax rates and assessment rates used are those currently in force (ER, Sect. 8.1.2.1).

Preliminary information indicates that the total valuation of the STP, subject to property taxes, will approximate $503,235,000 when completed. (Property owned by San Antonio and Austin, which is 44% of the property value, is public property and therefore exempt from property taxation.) This will increase the assessed valuation of Matagorda County from about $121 million to somewhat more than $217 million, an increase to more than twice the 1970 assessed valuation.

As shown in Table 4.10, maximum property taxes resulting from STP are estimated to be $6,576,000. The major recipient will be the Palacios Independent School District with $4,378,000 per year or 67% of the total taxes. Matagorda County will receive about $1,993,000 in ad valorem taxes or some 30% of the STP total property tax. The net present value of the lifetime benefit of taxes will be about $62,214,000 (ER, Sect. 8.1.2.1).

Table 4.10. Estimated additional property taxes to be collected from the South Texas Project site

Estimated 100% taxable value	$898,634,000
Less 44% of value exempt because of public ownership	$395,398,960
Estimated additional value subject to property taxes	$503,235,040

Taxing authority	1973 Tax rate per $100 of value[a]	1973 Assessment ratio (%)[a]	Tax revenue (tax rate X ratio X taxable value)
State of Texas	$0.17	24	$205,320
County special ad valorem	$0.30	24	$362,329
Matagorda County ad valorem	$0.95	24	$1,147,376
Hospital district	$0.30	24	$362,329
Navigation district	$0.10	24	$120,776
Palacois Independent School District	$1.45	60	$4,378,145
Total annual property taxes			$6,576,275
Net present value for lifetime of the plant			$62,214,135

[a]These rates and ratios are those presently existing and, therefore, represent maxima, since either or both will probably be reduced, thereby reducing the burden on existing taxpayers.

Source: ER, Table 8.1-10.

The Bay City School District will be able to accommodate the increased enrollment expected during the construction of the plant. Small increases in enrollment will occur in the Palacios Independent School District and are expected to be absorbed with only minor modifications.

The staff visited local officials of Matagorda County during a site visit in June 1974. County officials as well as city officials of Bay City and Palacios were aware of the potential local impacts which might result from the construction of the plant. The sentiment and attitude expressed appeared to be in favor of the plant.

There is, as with any project of this nature, some risk that the proximity of a large number of construction workers may overstimulate expansion of such activities as retail sales, mobile home park development, and various other consumer services. In such a situation, the decline ininduced income and employment as STP construction work diminishes may impose hardships on local residents if not compensated for by other factors. Careful planning by civic leaders and businessmen should forestall the adverse impacts of such changes on the local economy.

The staff concludes that the applicant has identified the major impacts and has the capability for ensuring that the extent of the impacts will be acceptable. This can best be accomplished by providing local jurisdictions with financial aid in sufficient time to provide the services required for construction-related impacts.

4.4.5 Impact on recreational capacity of area

There is limited recreational demand for the site property as it now exists. People coming into the area for recreation would prefer to go to the bay for hunting and fishing, as they do now. Although there are no plans to develop the cooling lake for recreational use, there are plans for a visitors' information center, two picnic areas, and a wildlife preserve.

Construction of the intake and discharge facilities for the makeup and return pipelines to the cooling lake will only affect recreational use in the Colorado River at the construction area for a short time.

The staff concludes that there will be no significant impact on recreation during construction.

4.5 MEASURES AND CONTROLS TO LIMIT ADVERSE EFFECTS DURING CONSTRUCTION

4.5.1 Applicant commitments

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

1. In an effort to control erosion following initial clearing and grading activities, surface drainage from cuts, fills, spoil areas, etc., will be controlled by ditches, dikes, berms, and sedimentation basins with controlled outlets (ER, p. 4.1-3).

2. Due to the flat nature of the terrain and the lack of natural drainage streams in the immediate vicinity of the plant site, drainage ditches will be constructed to carry storm water away from the site (ER, p. 4.1-4).

3. Scrap material generated during construction activities will be sorted for salvageable items. All chemical, petroleum, and nonsalvageable items will be hauled from the plant site and disposed of in accordance with local regulations (ER, p. 4.1-5).

4. Temporary roads will be watered during any dry period as necessary to control dust (ER, p. 4.1-5).

5. Earth fill for the embankment will be obtained from the cooling lake site to the maximum extent possible, thus minimizing the construction impacts on the areas surrounding the lake (ER, p. 4.1-6).

6. Embankment fill material will be wetted to reduce dusting (ER, p. 4.1-6).

7. No waste construction materials or dirt will be disposed of by dumping into the river (ER, p. 4.1-6).

8. Temporary parking areas, temporary roads, and the land occupied by the batch plant, upon completion of construction activities, will be cleared and relandscaped to conform with the natural surroundings (ER, p. 4.1-7).

9. Where possible, in order to minimize impact, periods of peak construction activity will be timed to coincide with the periods of least sensitive phases in the life cycles of the more important animals on the site (ER, p. 4.1-10).

10. In order to minimize the impact of noise on the local populace, pile driving operations will normally be performed only during daylight hours over a period of approximately six months (ER, p. 4.1-10a).

11. Vegetation clearing along transmission line rights-of-way will be limited and selective (ER, p. 4.2-3).

12. Timing to avoid the breeding season and, where necessary, the use of all-terrain equipment in wetlands, will minimize the impact on sensitive marshland habitat and associated biota located within transmission line rights-of-way (ER, p. 4.2-4).

13. Where vegetation must be cleared from stream banks along the transmission line rights-of-way, the land will be reseeded with adapted species of low-growing vegetation and grasses to control erosion (ER, p. 4.2-5).

14. To assure minimal impact on Attwater's prairie chicken, construction in the two booming areas along the transmission routes will be scheduled to avoid the nesting period, March 1 to June 25 (ER, p. 4.2-6).

15. No new access roads will be constructed along any of the transmission corridors (ER, p. 4.2-8).

16. Implementation of high-standard construction techniques to minimize soil erosion, combined with the restriction of construction activity to periods of low precipitation, will result in minimum erosion as a result of transmission-line construction (ER, p. 4.2-12).

17. Construction will be scheduled to avoid unharvested fields whenever possible. Whenever it is necessary to disturb or destroy field crops, all surface construction marks will be removed by disking, and farm operators will be adequately compensated (ER, p. 4.2-14).

18. At any point where the right-of-way crosses a surface road, sufficient brush or trees will be arranged to screen the cleared right-of-way where necessary (ER, p. 4.2-15).

19. No herbicides will be used during the course of clearing or construction activities, thus avoiding any contamination of water or danger to wildlife (ER, p. 4.2-15).

20. Traffic control measures will be implemented as required to control truck traffic and assure safe operations in the vicinity of small local communities, presently uncontrolled in rural areas and school bus pickup points (ER, p. 4.1-11).

21. Withdrawal of water from the Colorado River for filling of the cooling lake will be avoided to the maximum extent possible during low-flow periods (ER, p. 2.4-12).

The following applicant commitments are found in the response to Question D-18 of Amendment 1 to the ER.

22. Excavation materials will be hauled to designated stockpile, spoil, or fill areas.

23. The side slopes of the excavation of the plant will be designed to have natural stability and the surface will be seeded with grass to prevent surface erosion. The flow of water down the side slope surface will be controlled by berms and directed by ditches and gutters to areas to be pumped into storm drains.

24. Outer slope surfaces of the reservoir will be seeded to reduce erosion, and the interior slopes will be stabilized by the use of soil cement.

25. The construction of the river makeup pump station and screening structures will not cause additional siltation or slough-off losses to the river.

26. The bottom of the barge slip will be graded and covered with crushed stone, gravel, or shell to stabilize the bottom and reduce siltation and erosion. Clearing of trees and vegetation will be confined to a small area.

27. A sheet pile retaining wall will be constructed to localize disturbance of aquatic habitat in the barge slip construction area.

28. In heavily wooded areas, the right-of-way for transmission lines will be cleared of all debris. If the property owner does not claim timber in sparsely-populated rural areas, it will be disposed of by burning in accordance with regulations for "Outdoor Burning in Rural Areas" (Texas Air Control Board Regulation I, Section 101.25).

29. In urban or more densely populated rural areas, the timber will be cut into small bolts and buried in poorly-drained sections of the transmission line right-of-way or will be removed. Limbs and other cleaning debris will be chipped and spread to provide mulch.

30. Trees removed from cultivated fields during construction of transmission lines will not be left in fields or pastures.

31. Cleanup and restoration of areas affected by clearing and construction will be conducted.

32. All areas which are temporarily altered during construction will be seeded with grasses which are adapted to the heavy moist soils of the site to prevent erosion.

33. The temporary road extending from FM 521 to the north and south of the Station area on completion of the plant construction will be eliminated and the rights-of-way graded and replanted to blend with natural surroundings.

34. Measures will be taken to maintain the existing drainage routes in the bottomland when the intake and discharge lines are laid in place.

35. No direct discharge of wastes into the Colorado River during construction is planned. Wastes from a small sewage treatment plant (2,000 employees/10 hours/day) will be treated in accordance with state and local laws and returned to the relocated Little Robbins Slough at rates varying from 40 to 200 gpm. (Applicant modified - see Sect. 11.3.1.3)

36. Long-term temporary construction roads will be surfaced with a stabilized material to resist wear and erosion due to traffic.

4.5.2 Staff evaluation

Based on a review of the anticipated construction activities and their expected environmental effects, the staff concludes that the measures and controls committed to by the applicant, as summarized above, are adequate to ensure that adverse environmental effects will be at a minimum practicable level, with the following additional precautions:

1. Total suspended solids in construction runoff discharged to the Colorado River shall not exceed the TSS levels in the river at the time of discharge or sedimentation basins, sized to hold the water from a 10 year-24 hour rainfall event, shall be utilized prior to discharge.

2. Sewage waste shall be discharged after treatment to the Colorado River.

3. A study shall be performed to determine the need for diversion of water from the Colorado River to Little Robbins Slough and the parameters required to minimize impacts on the marsh complex. Any water so diverted shall be limited to no more than 150 ppm TSS and 1500 ppm TDS. Construction shall be performed to minimize watershed removal as specified in Sect. 6.1.3.2.

4. In riparian woodlands, initial clearing for transmission line corridors shall be done in such a manner as to leave all roots of woody plants intact so that the interlaced roots can help prevent bank erosion.

5. Along transmission line right-of-way inhabited by Attwater's prairie chicken, construction in booming areas shall be scheduled to avoid the courting and nesting period, January 1 to June 1. The applicant, in cooperation with land owners and the Texas Fish and Game Department, shall adopt management practices which will preserve the prarie chicken range found along and adjacent to the right-of-way.

6. Only tall tree species shall be eliminated from woodland rights-of-way, leaving shrubs and grasses for a more stable ground cover. Shrubs provide a greater variety of food and cover for wildlife than grasses alone.

7. The applicant shall limit the straightening and channelization of Little Robbins Slough to the area within the site boundary.

8. The applicant shall visibly flag transmission lines which cross open water or estuarine areas with colored balls to minimize avian collisions.

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5. ENVIRONMENTAL EFFECTS OF OPERATION OF THE STATION AND TRANSMISSION FACILITIES

5.1 IMPACTS ON LAND USE

5.1.1 Station operation

Of the 12,352-acre site, approximately 4127 acres will not be altered by construction. Approximately 1700 acres of bottomland habitat adjacent to the Colorado River will be set aside as a wildlife preserve. A visitors' center, picnic area, and boat slip on the Colorado River will use another 100 acres. The remainder of the site, approximately 2327 acres, will be left in its natural state as much as possible and thus will revert to native vegetation via successional processes. The staff recommends that, where practicable, land outside of the exclusion area be allowed to continue being used as it is at present.

5.1.2 Transmission lines

Of the 398 miles of right-of-way required, approximately 59% is agricultural land and 41% is natural communities, of which 15% is heavily wooded (Table 4.4). The presence of transmission lines is not expected to significantly affect agricultural production; however, heavily wooded areas will be cleared as required. The applicant has tried to avoid environmental sensitive areas in choosing the transmission line routes.

5.2 IMPACTS OF WATER USE

5.2.1 Surface water

The maximum annual diversion of water from the Colorado River will be 102,000 acre-ft. To protect the quality of the water in Matagorda Bay, makeup pumping will occur only when river flow is greater than 300 cfs, and then only up to 55% of the excess over 300 cfs, with total withdrawal not exceeding 1200 cfs. Blowdown is permitted only when the net river flow after makeup diversion is greater than 800 cfs. Permits for withdrawal of and discharge to all streams have been filed with the Texas Water Rights Commission and the Texas Water Quality Board.

The total yearly evaporation in the cooling lake ranges from 63,000 to 80,000 acre-ft. There are other small losses due to ground seepage. Rainfall into the cooling lake will replace about 25,000 acre-ft of these losses annually. Therefore, the total consumptive use of Colorado River water is estimated to be 40,000 to 45,000 acre-ft per year. Presently, it is estimated that about 30% of the rain falling on the site flows into the Colorado River - Matagorda Bay estuary. Therefore, the total water loss due to building and operating the STP with the cooling lake is estimated to be 47,000 to 53,000 acre-ft/year.

The applicant's summary of the expected cooling lake operation from 1949 to 1988, based on streamflow and meteorology records from 1949 to 1971 and extrapolated to 1988, is given in Table 5.1.

5.2.2 Groundwater

Withdrawal from the deep aquifer zone is expected to average only about 130 gpm during plant operation, which should cause a negligible effect on the water table. No withdrawal will be made from the shallow aquifer zone.

Seepage of water from the cooling lake is estimated to be 2 cfs, or about 1450 acre-ft/year after steady state is attained (ER, p. 5.1-33). This seepage is expected to end up in the shallow aquifer zone without affecting the groundwater level. No intrusion of seepage into the deep aquifer zone is expected.

Table 5.1. Summary of the applicant's cooling lake operation study (1949–1988)

Items		Monthly	Yearly
Adjusted river flows, acre-ft	Max	421,447	1,385,746
	Min	0	41,515
	Av	39,032	468,352
Maximum allowable pumping, acre-ft	Max	70,887	307,065
	Min	0	2,080
	Av	9,621	115,449
Actual pumped, acre-ft	Max	60,052	102,000
	Min	0	2,030
	Av	4,472	53,666
Induced evaporation, acre-ft	Max	3,280	
	Min	1,970	
	Av	2,604	31,250
Gross natural evaporation, acre-ft	Max	5,110	36,750
	Min	982	26,540
	Av	2,660	31,910
Rainfall, acre-ft	Max	10,860	37,400
	Min	0	11,630
	Av	2,050	24,560
Net natural evaporation, acre-ft	Max	4,678	22,721
	Min	(–) 8,352	(–) 7,063
	Av	612	7,342
Blowdown, acre-ft	Max	15,158	56,119
	Min	0	0
	Av	1,119	13,425
TDS concentration in cooling lake, ppm	Max	12,643	
	Min	600	
	Av	1,933	
Water level in cooling lake, ft MSL	Max	49.0	
	Min	25.8	
	Av	43.6	

Source: ER, Table 3.4-2.

5.2.3 Water quality standards

Texas Water Quality Board Standards,[1] which are approved by the Region VI Environmental Protection Agency Office, indicate that there are no temperature requirements for privately owned reservoirs that are constructed principally for industrial cooling purposes. The STP cooling lake is such a body of water.

The standards shown below (Source: ER, p. 2.5-22) apply to discharges into the Colorado River (blowdown from the cooling lake):

1. dissolved oxygen, not less than 5.0 mg/liter;

2. pH range, 6.7–8.5;

3. fecal coliform, logarithmic average not more than 200 per 100 milliliters;

4. temperature, maximum upper limit 95°F and 1.5°F above natural condition during summer season and 4°F above natural condition for spring, fall, and winter.

The temperature standard allows for a mixing zone of up to 25% of the cross-sectional area of the stream. Studies of the water discharging into the Colorado River indicate that this standard will be met as discussed in Sect. 5.3.

The EPA has published regulations concerning thermal discharges and effluent guidelines for steam electric power generating plants. The staff has evaluated the effluents associated with the construction and operation of the STP. These effluents are expected by the staff to conform with the EPA limitations and reflect the "best available technology economically achievable." In some instances the development of specific operating limitations may have to be incorporated in the technical specifications of the operating licenses. The staff anticipates no violation of State or Federal standards for either thermal or chemical releases to the Colorado River.

5.3 EFFECTS OF OPERATION OF HEAT DISSIPATION SYSTEM

5.3.1 Cooling lake behavior

Water evaporation rates from the cooling lake were determined by both the applicant and the staff. The applicant determined the evaporation rates and other lake behavior patterns using 1949 through 1971 historical data. The applicant used the 1949 through 1965 data to predict the evaporation rates and other lake behavior patterns for the 1972-1988 time period.

The applicant's summary of evaporation rates for the 1949-1988 period are shown in Table 5.1. Natural evaporation rates for 1949 through 1965 were obtained from the data of Kane,[2] and those for 1966 through 1971 were calculated from pan evaporation records at nearby weather stations. Induced evaporation rates were estimated by the method outlined in Harbeck et al.[3] using Victoria, Texas, weather data. The average of the monthly evaporation rates for a three-year period running from February 1953 through January 1956 are shown in Table 5.2. These averages were determined by the "Cooling Reservoir Fog Predictor" model (ER, Amendment 1, pp. AI-327 through AI-344). Also shown in Table 5.2 are the averages of the monthly and annual evaporation rates calculated by the staff for the 1962-1972 time period, using again the Victoria, Texas, weather data. The staff used a cooling-pond model, which is summarized in Ryan and Harleman,[4] and assumed that the heat exchange to the atmosphere is described by the relations of Ryan and Stolzenbach.[4,5]

Table 5.2. Cooling lake evaporation losses (acre-ft)

Month	Average of applicant's estimates for February 1953 through January 1956[a]			Average of staff's estimates for 1962–1972 time period		
	Natural	Forced	Total	Natural	Forced	Total
January	1,631	2,021	3,652	1,158	2,414	3,572
February	2,006	2,050	4,056	1,628	2,008	3,636
March	2,259	2,630	4,889	2,414	1,982	4,396
April	2,378	2,901	5,279	2,617	2,436	5,053
May	3,049	3,254	6,303	3,190	2,914	6,104
June	3,987	3,217	7,204	3,979	2,924	6,903
July	4,003	3,324	7,327	4,391	3,213	7,604
August	3,723	3,330	7,053	4,033	3,487	7,520
September	3,044	3,111	6,155	3,070	3,754	6,824
October	3,374	3,217	6,591	2,764	3,685	6,449
November	2,268	2,459	4,727	1,815	3,456	5,271
December	1,965	2,297	4,262	1,065	3,081	4,146
Annual total	33,687	33,811	67,498	32,124	35,359	67,478

[a]ER, Amendment 1, p. AI-396.

Comparing the average annual cooling lake evaporation rate of the applicant with that of the staff, both shown in Table 5.2, it can be seen that the staff's result is about the same as the applicant's. However, comparing the staff's result in Table 5.2 with the applicant's result in Table 5.1, the staff's result is about 7% higher. In addition, the applicant's result in Table 5.2 is about 7% higher than his value in Table 5.1. These discrepancies are due, in part, to differences in meteorological conditions during the two time periods and also to different assumptions used in the various models. However, the discrepancies are within the expected accuracy of the models. Therefore, the staff generally concurs with the applicant on evaporation losses from the cooling lake.

There is considerable variation in the rate that water will be evaporated from the cooling lake from month to month, as shown in Table 5.2, and from year to year, as shown in Table 5.3. The staff's calculations show that annual evaporation rates can range from 63,100 to 74,200 acre-ft. Part of this evaporation loss will be made up by rain falling directly into the cooling lake, which will be, on the average, 24,560 acre-ft/year, as shown in Table 5.1. This is not sufficient to replace the water that will evaporate from the lake, and therefore additional water will have to be withdrawn from the Colorado River. There will also be considerable variation in the amount of rain that will fall into the lake from month to month[6,7] and the amount of water that is available in the Colorado River for makeup (Sect. 2.5.1.1).

Table 5.3. Staff's estimated total annual cooling lake evaporation losses (acre-ft)

Year	Evaporation loss
1954	69,874
1955	66,508
1956	68,980
1957	65,733
1962	73,437
1963	74,161
1964	69,058
1965	65,266
1966	65,334
1967	67,968
1968	63,147
1969	66,414
1970	64,295
1971	68,299
1972	66,574

To assure that there will be sufficient water in the cooling lake to dissipate the waste heat from the plant at all times, the applicant made a detailed study of the cooling lake (ER, Sect. 3.4.2.1). In this study the historical hydrological and meteorological data discussed at the beginning of this section were used and the water makeup and blowdown restrictions discussed in Sects. 3.4.3 and 3.4.4 were applied. The makeup water restrictions took into account the desirability of supplying 150,000 acre-ft/year of fresh water from the Colorado River to Matagorda Bay to preserve water quality in the bay.[8] The freshwater flow rate is equivalent to 12,500 acre-ft/month, and, for all months that makeup water is withdrawn from the river, the freshwater flow to the bay will not drop below this value (ER, p. 3.4-11). The staff reviewed this approach and concurs with the applicant that this will be the case.

Results of the studies shown in Fig. 5.1 indicate that there would have been sufficient water in the cooling lake to dissipate waste heat at all times. The minimum lake operating level of 25.8 ft MSL would have occurred in 1956, which was during the period-of-record drought (PSAR, Amendment 1, p. 2.4-49).

Equilibrium temperatures predicted by the applicant and the staff are in agreement and are shown in Fig. 5.2.

Predicted circulating water intake and discharge temperatures at the plant factors listed in Table 3.1 are shown in Fig. 5.3. To predict these temperatures, the staff used a simplified two-stage model,[4] and assumed a dilution coefficient of five for the first, 500-acre, recirculating flow stage (dilution coefficient would be unity for no mixing).[9,10] It was assumed that the remainder of the lake is the second (plug-flow) stage. The applicant's values are only slightly higher than the staff's. The staff calculated the effect of increasing the plant factor to 1.0, and the results are shown in Fig. 5.4. Comparing the circulating water intake temperatures in Figs. 5.3 and 5.4, it can be seen that the effect of increasing the plant factor to 1.0 is negligible.

Comparing the circulating water intake temperatures in Figs. 5.3 and 5.4 with the equilibrium temperatures in Fig. 5.2, the staff's calculations indicate that they will be nearly the same. The staff calculated that the maximum amount by which the circulating water intake temperature would exceed the equilibrium temperature would be 0.5°F (May 1962).

Both the staff and the applicant predicted that the highest cooling lake temperatures would occur in July. Temperature distributions in the cooling lake during this month are shown in Table 5.4. The staff and the applicant agreed that 1953 would have been the year of highest lake temperatures. However, the staff's calculations indicated that July 1958 would have been the month of highest temperatures, while the applicant's calculations indicated that July 1952 would have had the highest temperatures. In every case, the staff's calculated temperatures are slightly below the applicant's. Therefore, the staff concludes that the applicant's cooling lake water temperatures are reasonable and conservative.

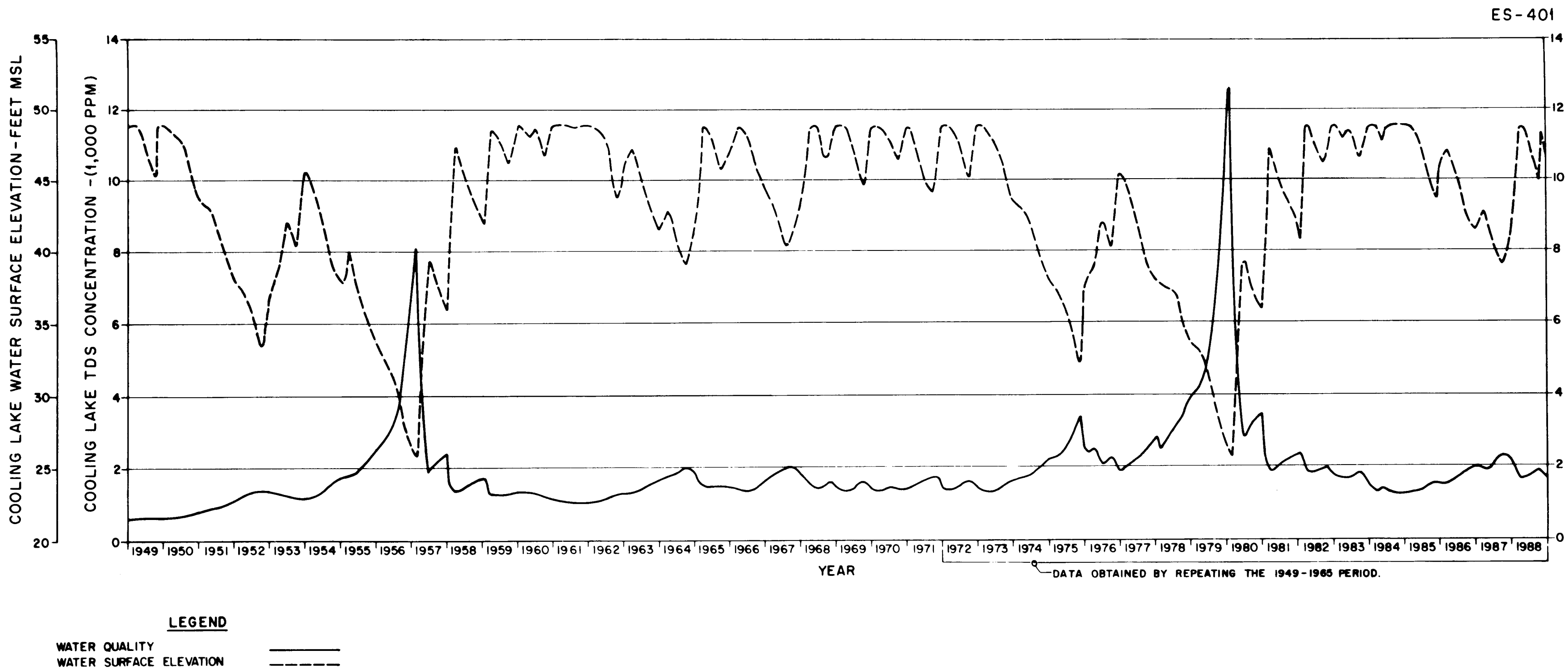

Fig. 5.1. South Texas Project cooling lake water level and water quality. <u>Source</u>: ER, Fig. 3.4-16.

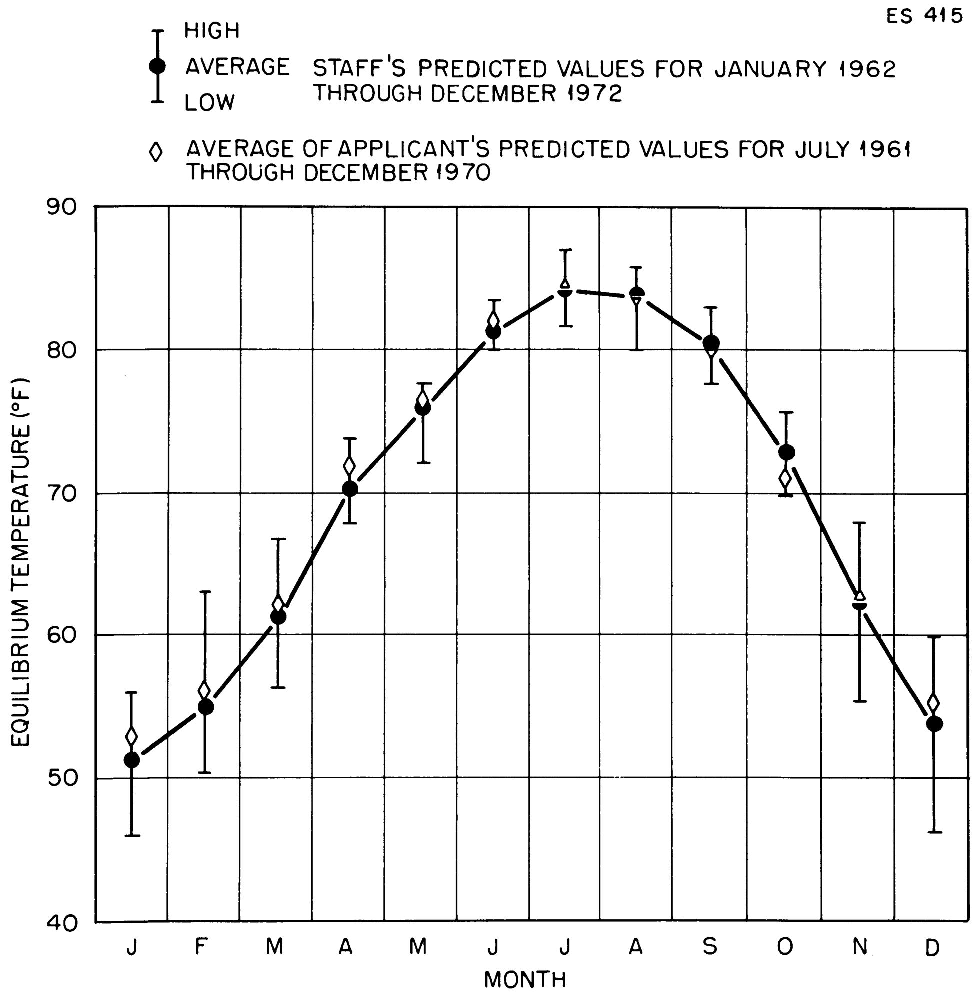

Fig. 5.2. Predicted equilibrium temperatures for South Texas Project cooling lake.

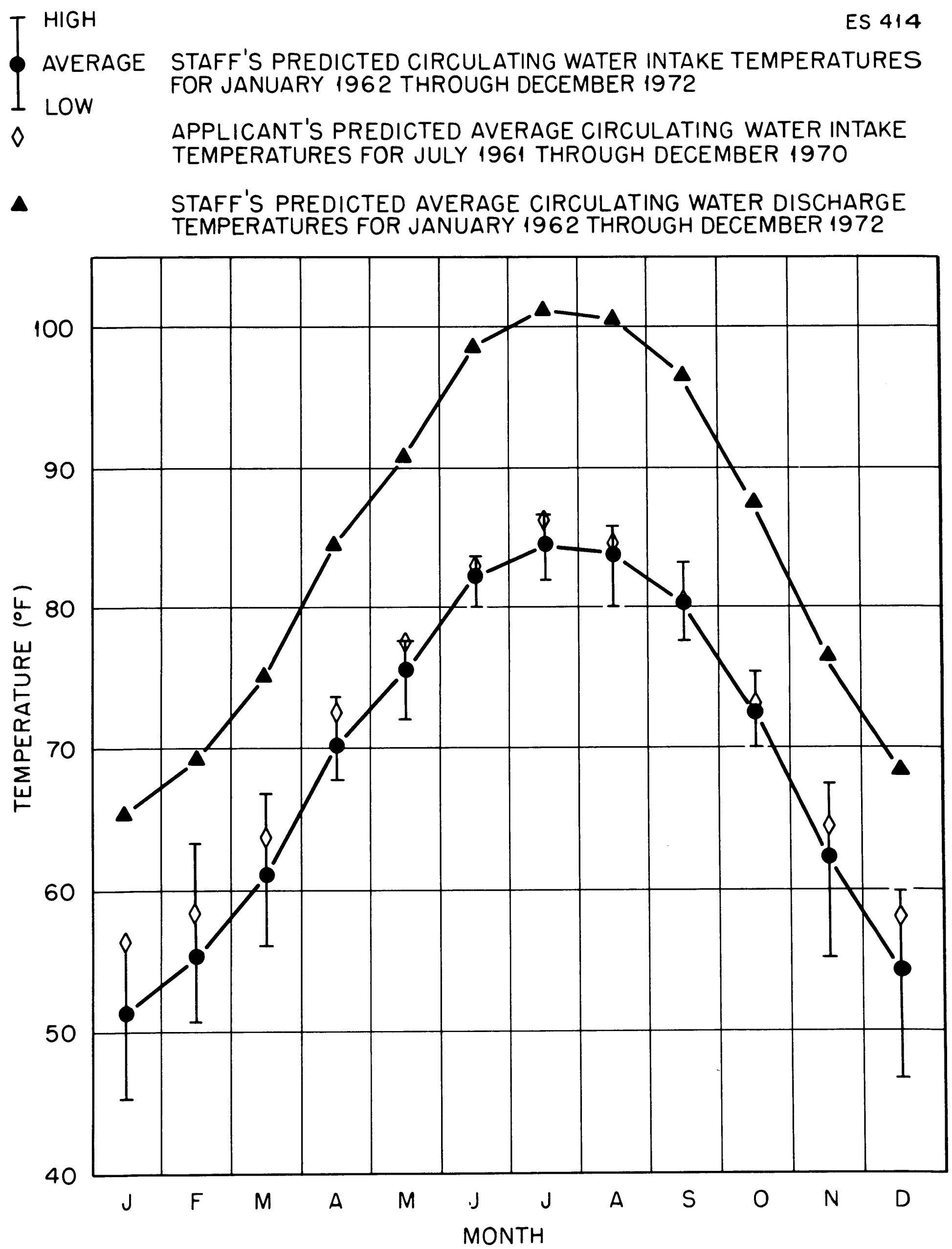

Fig. 5.3. Estimates of the circulating water intake and discharge temperatures at the predicted average monthly plant factors.

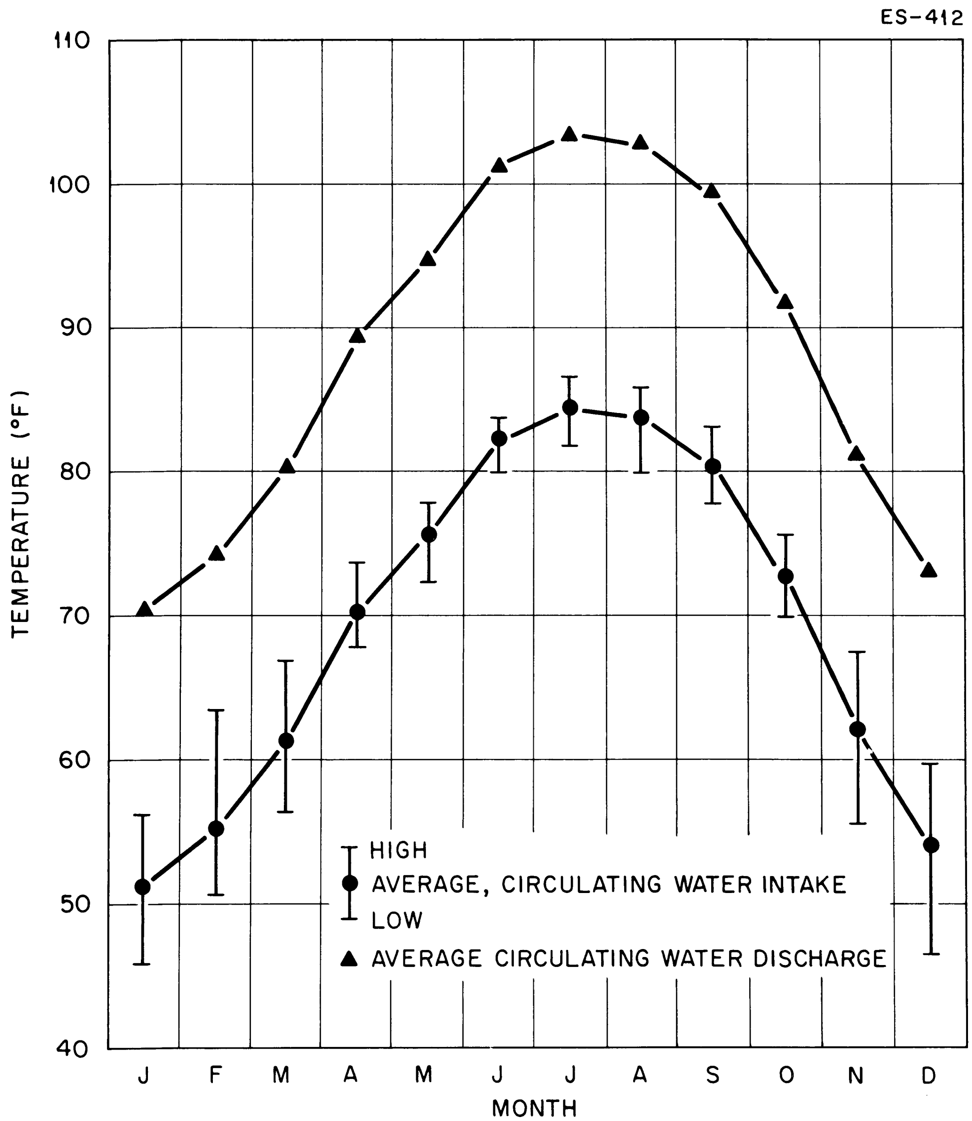

Fig. 5.4. Staff's estimate of the circulating water intake and discharge temperatures for January 1962 through December 1970 at 100% plant factor.

Table 5.4. Cooling lake temperature (°F) distribution for the month of July

Surface area within isotherm, acres	Applicant's predicted values				Staff's predicted values			
	Average year (1959) at 80% plant factor[a]	Average year (1959) at 100% plant factor[a]	Hottest yeat (1953) at 100% plant factor[b]	Hottest month (1952) at 100% plant factor[c]	Average year (1963) at 88% plant factor	Average year (1963) at 100% plant factor	Hottest year (1953) at 100% plant factor	Hottest month (1958) at 100% plant factor
0	105.8	108.1	109.6	110.4	100.9	103.1	106.4	107.8
500					94.7	96.0	99.3	100.7
1000	99.5	100.9	101.6	102.8	90.0	90.7	93.9	95.3
2000	95.6	96.5	97.1	98.3	86.0	86.1	89.4	90.7
3000	93.1	93.6	94.3	95.5	84.7	84.7	88.0	89.4
4000	91.4	91.8	92.7	93.8	84.3	84.3	87.6	89.0
5000	90.3	90.5	91.6	92.6	84.2	84.2	87.5	88.9
6000	89.5	89.7	91.0	91.9	84.1	85.5	87.4	88.9
7000	89.0	89.1	90.5	91.4	84.1	85.5	87.4	88.8

[a] ER, Amendment I, Table 3.4-3.
[b] ER, Amendment 1, Table 3.4-4.
[c] ER, Amendment 1, Table 3.4-5.

5.3.2 Effects of cooling lake discharge on the Colorado River

The rate that water can be discharged (blowdown) into the Colorado River will be limited by the excess temperatures that it may produce. (No water will be discharged into the river if the cooling lake water level is below 47 ft MSL, as discussed in Sect. 3.4.4.) The Texas Water Quality Standards[1] state that, except for a mixing zone at this location in the river, the difference between the mixed water temperature and the natural water temperature cannot exceed 4F° in fall, winter, and spring and 1.5F° in the summer. These same standards state that, because of the varying local conditions, there is no single criterion regarding the size of the mixing zone but that normally it should not exceed 25% of the cross-sectional area and/or volume of flow of the stream or estuary.

The applicant stated that the cooling lake blowdown water temperatures would not exceed the natural river temperatures by more than 6.9F° in the fall, winter, and spring or 4.3F° in the summer. The staff estimated, by potential flow analysis, that the cooling lake blowdown will have about the same temperature as the cooling lake itself at the circulating water intake structure. The applicant estimated the natural Colorado River temperatures at the site for the years 1962 through 1970 using the method of Edinger and Geyer.[11] The staff concurs with this approach. Monthly values of natural river temperatures have been estimated (ER, Fig. 2.5-11). Differences between the staff's estimated cooling lake blowdown temperatures and the predicted natural river temperatures during 1962 through 1970 are shown in Table 5.5. In all cases except July and August of 1970, these temperature differences are less than the maximum values predicted by the applicant. However, in July and August of 1970, the net river flow rate would be negligible (ER, Fig. 3.4-10), and therefore no cooling lake water would be discharged to the river. The staff concurs with the applicant's values of the differences between the cooling lake blowdown and the natural river water temperatures.

Table 5.5. Staff estimation of the differences between the cooling lake temperature (T_L) at the blowdown line inlet and Colorado River temperature (T_R) at the blowdown line outlet

Month	Temperature difference: $(T_L - T_R)$, F°								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Jan.	−0.1	−1.4	3.0	−2.1	−6.0	−1.2	−0.5	−2.2	−2.9
Feb.	3.7	2.5	−0.8	−1.1	−0.6	−3.5	−4.4	−3.8	−0.9
Mar.	2.4	1.9	1.9	−1.4	0.0	−1.0	−0.5	−1.8	−0.9
Apr.	3.8	1.1	−0.5	−1.0	−3.7	−1.0	−2.4	−1.7	−2.3
May	2.3	1.8	0.3	0.0	−0.3	1.8	−0.3	−0.1	−1.6
June	0.6	0.4	0.7	1.9	1.2	1.1	−0.2	1.1	3.9
July	2.8	0.3	1.8	1.8	0.1	−1.1	−0.6	−0.4	5.0
Aug.	1.0	1.2	1.8	2.8	−1.3	0.2	0.3	−0.5	5.2
Sept.	0.8	−1.1	0.1	−0.4	0.5	−1.1	−1.7	2.1	3.1
Oct.	0.3	1.6	2.2	1.2	−1.6	−0.4	0.5	−1.3	−1.1
Nov.	1.5	−2.2	−1.6	−0.5	−1.4	−0.8	−2.6	−7.5	−0.9
Dec.	−2.0	−2.3	−0.6	−2.0	−4.8	−5.4	−2.7	−1.6	−5.4

At the edge of the 25% mixing zone in the river, the applicant determined that water temperature would not exceed the natural river temperature by more than 3.26F° in fall, winter, and spring or by 1.10F° in the summer. Most of the time these differences would be much less (ER, pp. 5.1-10 and 5.1-11). In all cases, the temperatures at the edge of the mixing zone would be within the limits permitted by the Texas Water Quality Standards.[1]

Calculations were performed on an hourly basis using the historical meteorological data described in Sect. 5.3.1 and the mode of cooling lake blowdown operation described in Sect. 3.4.4. It was assumed in this particular analysis that the initial temperature difference between the blowdown water and the natural river water would be 6.9F° at all times in the fall, winter, and spring and 4.3F° in the summer. This is a conservative assumption.

The method of Koh and Fan[12] was modified to predict these temperature differences at the edge of the mixing zone (ER, pp. 5.1-4 through 5.1-6 and Appendix 6.1-B). The staff compared the temperature differences predicted by this modified Koh and Fan model with those predicted by the

Hirst model[13] for several cases. This comparison is shown in Table 5.6, where it can be seen that the temperature differences predicted by the two models agree favorably. Therefore, the staff concludes that the temperature differences predicted at the edge of the 25% mixing zone in the Colorado River are reasonable.

Table 5.6. Comparison of blockage temperature differences in the Colorado River predicted by applicant and staff mixing models

River temperature (°F)	River water velocity (fps)	Initial temperature difference (°F)	Discharge water velocity (fps)	Blockage temperature differences	
				Applicant model[a] (°F)	Staff model[b] (°F)
70	0.4	6.9	4.14	1.56	1.22
70	0.4	6.9	6.22	2.00	1.52
70	0.4	4.3	4.14	0.95	0.75
70	0.4	4.3	6.22	1.22	0.95
70	1.0	6.9	4.14	0.49	0.63
70	1.0	6.9	6.22	0.92	0.89
70	1.0	4.3	4.14	0.28	0.37
70	1.0	4.3	6.22	0.55	0.70
55	0.4	6.9	6.22	1.94	1.52
55	1.0	6.9	6.22	0.87	0.88

[a]ER, pp. 5.1-4 through 5.1-6 and Appendix 6.1-B.

[b]E. A. Hirst, *Analysis of Round, Turbulent, Buoyant Jets Discharged to Flowing Stratified Ambients,* ORNL-4685, Oak Ridge National Laboratory, Oak Ridge, Tenn., June 1971.

Because of the tidal cycle in the river at the point of blowdown, it is possible that blowdown water can be discharged to a portion of river water that has received blowdown water during the previous tidal cycle. To account for this, it was assumed at the point of blowdown that the river water and blowdown water released during the previous tidal cycle are mixed and that none of the excess heat has been dissipated to the atmosphere. This is a conservative assumption, and therefore the staff concludes that the applicant's method of predicting the influence of the tidal cycles on the river water temperatures at the discharge point is conservative.

Beyond the mixing zone in the river, the rate that heat would be dissipated from the river to the atmosphere was predicted using the method of Pritchard and Carter.[14] Comparing the heat exchange coefficients between the water and the atmosphere that are used in the Pritchard and Carter model (ER, Table 5.1-3) with those of Ryan and Stolzenbach,[4,5] the exchange coefficients used in the Pritchard and Carter model are significantly lower. Therefore, the staff concludes that the predictions of the Colorado River temperatures beyond the mixing zone are conservative.

In summary, the staff concludes that the effects of water discharges from the STP cooling lake on the Colorado River are reasonable and acceptable. The staff further concludes that these discharges will be within the limits given in the Texas Water Quality Standards.[1]

5.4 RADIOLOGICAL IMPACTS

5.4.1 Radiological impact on biota other than man

5.4.1.1 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 Fig. 5.5. Two recent comprehensive reports[15,16] have been concerned with radioactivity in the environment and these pathways. These reports give a more detailed explanation of the subjects that will be discussed below. 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 that the limits established for humans are also conservative for these species.[17]

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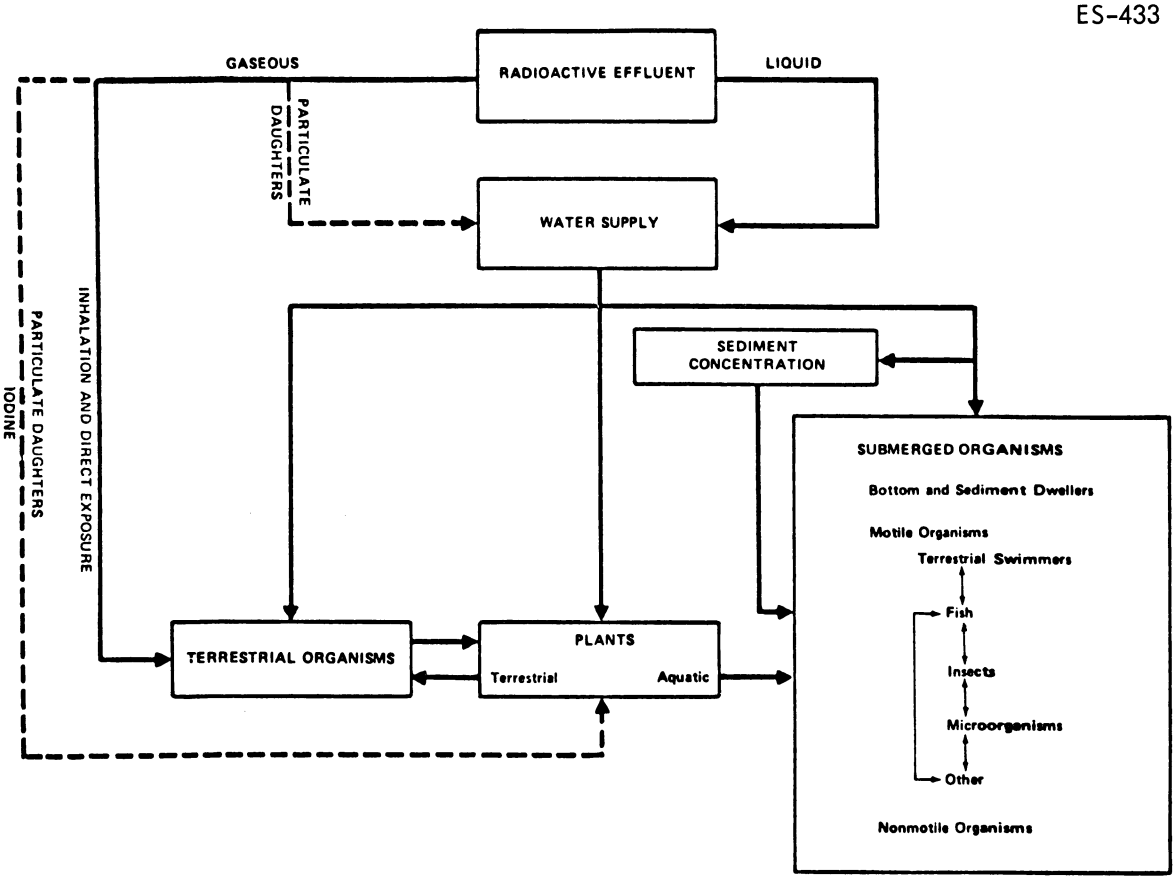

Fig. 5.5. Generalized exposure pathways for organisms other than man.

5.4.1.2 Radioactivity in the environment

The quantities and species of radionuclides expected to be discharged annually by the South Texas Project in liquid and gaseous effluents have been estimated by the staff and are given in Tables 3.6 and 3.7 respectively. The basis for these values is discussed in Sect. 3.5. For the determination of doses to biota other than man, specific calculations are done primarily for the liquid effluents. The liquid effluent quantities, when diluted in the South Texas Project cooling lake, would produce an average gross activity concentration, excluding tritium, of 4.0×10^{-2} pCi/ml in the plant discharge area. Under the same conditions, the tritium concentration would be 42 pCi/ml.

Doses to terrestrial animals, such as rabbits or deer, due to the gaseous effluents are quite similar to those calculated for man (Sect. 5.4.2). For this reason, both the gaseous effluent concentrations at locations of interest and the dose calculations for gaseous effluents are discussed in detail in Sect. 5.4.2.

5.4.1.3 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. Referring to Fig. 5.5, 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.

The maximum doses to marine organisms will be delivered to fish, crustacea, molluscs, and certain sea plants. This is principally a consequence of physiological phenomena exhibited by these organisms that result in the concentration in their structures of certain elements found in saline water. 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 5.7. As may be seen, variations in bioaccumulation factors range over several orders of magnitude from one chemical element to another.

Table 5.7. Marine bioaccumulation factors

Element	pCi/kg of organism per pCi/liter of water			
	Fish	Crustacea	Molluscs	Algae
Cr	100	1,000	1,000	1,000
Mn	3,000	10,000	50,000	10,000
Fe	1,000	4,000	20,000	6,000
Co	100	10,000	300	100
Ni	500	100	100	100
Zn	5,000	5,000	50,000	1,000
Ag	1,000	5,000	5,000	1,000
W	10	10	100	100
Rb	30	50	10	10
Sr	1	1	1	20
V	30	100	100	300
Zr	30	100	100	1,000
Nb	100	200	200	100
Mo	10	100	100	100
Ru	3	100	100	1,000
Rh	10	100	100	100
Sb	1,000	1,000	1,000	10,000
Te	10	10	100	1,000
I	20	100	100	10,000
Cs	30	50	10	10
Ba	3	3	3	100
Ce	30	100	100	300
Pr	100	1,000	1,000	1,000
Nd	100	1,000	1,000	1,000
Pm	100	1,000	1,000	1,000
Np	10	10	10	6
Pu	3	200	200	1,000

Sources:

A. M. Freke, "A Model for the Approximate Calculation of Safe Rates of Discharge of Radioactive Wastes into the Marine Environments," *Health Phys.* 13: 743 (1967).

S. E. Thompson, C. A. Burton, D. J. Quinn, and Y. C. Ng, *Concentration Factors of Chemical Elements in Edible Aquatic Organisms,* Report UCRL-50564 (Rev. 1), Lawrence Livermore Laboratory, California, Oct. 10, 1972.

Fish, crustacea, molluscs, and sea plants would be expected to receive doses of 6, 59, 19, and 48 millirads/year, respectively, if they were to inhabit the cooling lake. Following discharge to the receiving waters, the coolant water from the plant is soon diluted by a factor of approximately 9. The annual doses to aquatic biota are reduced by a corresponding amount. The discharge is further mixed and diluted as it moves from the discharge zone. As a consequence of this and the accompanying radioactive decay, the estimated doses will decrease with distance from the region of discharge.

External doses to terrestrial animals other than man are determined on the basis of gaseous effluent concentrations and direct radiation contributions at the locations where such animals may actually be present. Terrestrial animals in the environs of the plant will receive approximately the same external radiation doses as those calculated for man. Table 5.8 lists the doses due to gaseous effluents. Table 5.8a shows the comparison of calculated doses from plant operation with proposed Appendix I design objectives.

Table 5.8. Annual individual doses due to gaseous effluents

Location	X/Q (sec/m^3)	Dose (millirems/year)		
		Total body	Skin	Thyroid
Site boundary (1600 m N)	1.4×10^{-6}	1.4×10^{-2}	1.7×10^{-1}	1.1×10^{-1} [a]
Nearest cow (7 miles E)	2.6×10^{-8}	1.9×10^{-4}	3.4×10^{-3}	3.5×10^{-1} [b]
Nearest residence (2.4 miles WNW)	3.5×10^{-7}	3.3×10^{-3}	4.5×10^{-2}	8.6×10^{-2} [c]
Visitors' center (800 m ENE)	8.8×10^{-7}	7.0×10^{-3}	1.4×10^{-1}	8.1×10^{-2} [a]
Nearest beach (1.7 miles ESE)	1.4×10^{-7}	1.4×10^{-3}	2.3×10^{-2}	1.1×10^{-2} [a]

[a] Dose to thyroid of adults due to inhalation of air at this location.
[b] Dose to thyroid of a child due to consumption of 1 liter/day of milk from a cow grazing 12 months/year at this location.
[c] Dose to thyroid of adults due to inhalation and consumption of green, leafy vegetables at this location.

Table 5.8a. Comparison of calculated dose from plant operation with Appendix I design objective doses[a]

Criterion	Proposed Appendix I design objective dose	Calculated doses
Liquid effluents		
Dose to total body or any organ from all pathways	5 millirems/year	0.20 millirem/year[b]
Gaseous effluents		
Gamma dose in air	10 millirads/year	0.03 millirad/year
Beta dose in air	20 millirads/year	0.25 millirad/year
Dose to total body of individual	5 millirems/year	0.003 millirem/year[c]
Dose to skin of an individual	15 millirems/year	0.04 millirem/year[c]
Radioiodines and particulates		
Dose to any organ of an individual from all pathways	15 millirems/year	0.14 millirem/year[d]

[a] As presented in *Concluding Statement of Position of the Regulatory Staff,* Docket No. RM-50-2, pp. 25–30, U.S. Atomic Energy Commission, Feb. 20, 1974.
[b] Dose to thyroid from eating fish crustacea and molluscs near lake discharge.
[c] Dose for full-time occupancy of residence 2.4 miles WNW.
[d] Dose to child's thyroid via pasture-cow-milk-ingestion pathway (7.0 miles E).

An estimate can be made for the ingestion dose to a terrestrial animal such as a duck, which is assumed to consume only aquatic vegetation growing in the water in the cooling lake. The duck ingestion dose was calculated to be about 49 millirads/year, which represents an upper limit estimate since equilibrium was assumed to exist between the aquatic organisms and all radionuclides in water. A nonequilibrium conditon for a radionuclide in an actual exposure situation would result in a smaller bioaccumulation and therefore in a smaller dose from internal exposure.

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 the South Texas Project. In the "BEIR" report,[18] it is stated in summary that evidence to date indicates that no other living organisms are very much more radiosensitive than man. 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 Colorado River and into the air by the South Texas Project.

5.4.2 Radiological impact on man

5.4.2.1 Exposure pathways

Routine power generation by the South Texas Project will result in the release of small quantities of fission and activation products to the environment. This evaluation will provide dose estimates that can serve as a basis for a determination that releases to unrestricted areas are as low as practicable in accordance with 10 CFR 50 and within the limits specified in 10 CFR 20. The NRC staff has estimated the probable radionuclide releases from the South Texas Project based upon experience with comparable operating reactors and an evaluation of the radioactive waste system. These releases have been discussed in Sect. 3.5.

Estimations were made of radiation doses to man at and beyond the site boundary via the most significant pathways among those diagrammed in Fig. 5.6. The calculations are based on conservative assumptions regarding the dilutions of effluent gases and radionuclides in the liquid discharge and on the use by man of the plant surroundings. In general, radiation doses calculated by the staff are intended to apply to an average adult. Specific persons will receive higher or lower doses, depending upon age, living habits, food preferences, or recreational activities.

Based upon experience at comparable operating nuclear power reactors, an estimate has been made of the occupational radiation exposures expected to result from plant operation.

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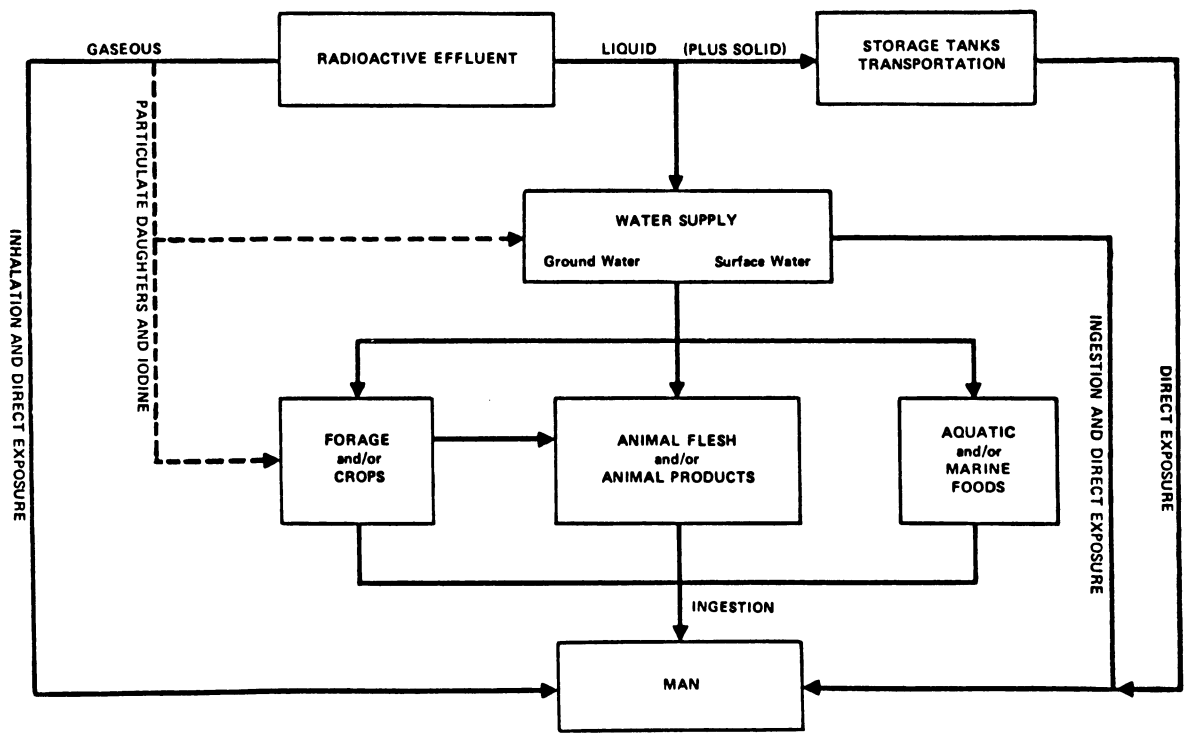

Fig. 5.6. Generalized exposure pathways to man.

5.4.2.2 Liquid effluents

Expected radionuclide releases in the liquid effluent have been calculated for the South Texas Project and are listed in Table 3.6. This effluent is released periodically from the cooling lake into the Colorado River, only when the flow rate of the river exceeds 800 cfs. Since this flow is greater than the adjusted average flow of 647 cfs, it was used in calculating all concentrations and doses due to liquid effluents in the river. The long-term average discharge flow from the lake, 13,425 acre-ft (18.5 cfs), was used to calculate concentrations in the lake. Under these conditions, the gross activity concentration, exclusive of tritium, in the discharge from the lake is estimated to be 4.0×10^{-2} pCi/ml. Under the same conditions, the tritium concentration would be 42 pCi/ml, as stated in Sect. 5.4.1.2.

During normal reactor operations, a fraction of the noble gases produced will be released in the liquid effluent and subsequently discharged into the Colorado River. The NRC Directorate of Regulatory Operations has analyzed operating reactor radioactive liquid effluent for noble gas content, and, under conditions of highest annual average noble gas concentrations in the discharge water, no significant doses would be delivered to human beings.

Consumption of water represents a potentially significant exposure pathway to the population. However, there are no drinking water supplies within 100 miles of the plant that could be affected by the effluents. In addition, no potential exists for groundwater contamination.

Other pathways of relative importance involve recreational use of the river in the vicinity of the discharge zone. Individual doses from consuming fish or invertebrates caught in the immediate discharge area were evaluated using the biological accumulation factors listed in Table 5.7 and standard models.[19] Swimming, boating, and fishing in the discharge region were also included in the evaluation.

Based on its evaluation of liquid radioactive waste releases, the staff calculated that the whole body and critical organ doses will be less than 5 millirems/year at or beyond the site boundary and that the proposed systems will be capable of limiting the release of radioactive materials in liquid effluents to less than 5 Ci/year/reactor. The staff finds that the proposed liquid radioactive waste system is capable of reducing effluents to as low as practicable levels in accordance with 10 CFR Part 20 and 10 CFR Part 50.36(a). Based on these findings, the staff concludes that the proposed liquid radioactive waste system is acceptable. Table 5.9 summarizes the potential individual doses from the liquid effluents.

Table 5.9. Annual individual doses from liquid effluents

Location	Pathway	Dose (millirem/year)			
		Total body	GI tract	Thyroid	Bone
Coolant discharge region	Fish ingestion	7.6×10^{-3}	7.0×10^{-3}	2.8×10^{-2}	4.6×10^{-3}
	Invertebrate ingestion	1.8×10^{-2}	1.1×10^{-1}	6.6×10^{-2}	3.8×10^{-3}
	Swimming (100 hr/year)	3.8×10^{-5}			
	Boating (100 hr/year)	1.9×10^{-5}			
	Standing on shore (500 hr/year)	8.0×10^{-2}			

5.4.2.3 <u>Gaseous effluents</u>

Radioactive effluents released to the atmosphere from the plant will result in the most significant radiation doses to the public. Staff estimates of the probable gaseous and particulate releases listed in Table 3.7 were used to evaluate potential doses. All dose calculations were performed using annual average site meteorological conditions and assuming that releases occur at a constant rate. Radioactive gases are released near ground level from the plant; thus doses result from immersion in the dispersed radioactive gases.[20]

The primary food pathway to man involves the ingestion by dairy cows of radioiodine deposited onto grazing areas. Consumption of milk from these cows can result in exposure to the human thyroid. Doses to a child's thyroid which would result from consuming 1 liter of milk daily from a cow grazing 12 months annually were calculated for the nearest farm using recognized models.[20]

Another food pathway to man which is of secondary importance involves the consumption of leafy vegetables subject to deposition of the radionuclides released to the atmosphere. The thyroid dose resulting from the consumption of leafy vegetables produced at the nearest farm or residence during the growing period was evaluated.

Based on the evaluation of the applicant's proposed gaseous radioactive waste treatment system, the staff calculated that the annual air dose due to gamma radiation at or beyond the site boundary will not exceed 10 millirads, the annual air dose due to beta radiation at or beyond the site boundary will not exceed 20 millirads, the annual dose to an individual by all pathways as evaluated in Sect. 5.4 will not exceed 15 millirems, and the annual total quantity of iodine-131 released will not exceed 1 Ci/reactor. The staff finds the proposed gaseous radioactive waste system to be capable of reducing effluents to as low as practicable levels in accordance with 10 CFR Part 20 and 10 CFR 50.36(a), and, therefore, the staff finds the gaseous radioactive waste system to be acceptable.

All doses due to gaseous effluents are summarized in Table 5.8.

5.4.2.4 Solid wastes

Based on the evaluation of the solid waste system, the staff concludes that the system design will accommodate the wastes expected during normal operations, including anticipated operational occurrences in accordance with existing NRC, local, and Federal regulations. The wastes will be packaged and shipped to a licensed burial site in accordance with NRC and Department of Transportation Regulations. Based on these findings, the staff concludes that the solid waste system is acceptable.

5.4.2.5 Direct radiation

5.4.2.5.1 Radiation from the facility

The plant design includes specific shielding of the reactor, holdup tanks, filters, demineralizers, and other areas where radioactive materials may flow or be stored, primarily for the protection of plant personnel. Direct radiation from these sources is therefore not expected to be significant at the site boundary. Confirming measurements will be made as part of the applicant's environmental monitoring program after plant startup. Low-level radioactivity storage containers outside the plant are estimated to contribute less than 0.01 millirem/year at the site boundary.

5.4.2.5.2 Transportation of radioactive material

The transportation of cold fuel to a reactor, of irradiated fuel from the reactor to a fuel reprocessing plant, and of solid radioactive wastes from the reactor to burial grounds is within the scope of the NRC 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 5.10.

TABLE 5.10. 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	0.0 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	

[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.
[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.

5.4.2.5.3 Occupational radiation exposure

Based on a review of the applicant's safety analysis report, the staff has determined that individual occupational doses can be maintained within the limits of 10 CFR 20. Radiation dose limits of 10 CFR 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 ensures that the risk associated with radiation exposure is no greater than those risks normally accepted by workers in other present-day industries.[21] Using information compiled by the Commission[22] of past experience from operating nuclear reactor plants, it is estimated that the average collective dose to all onsite personnel at large operating nuclear plants will be approximately 450 man-rems per year per unit. The total dose for this plant will be influenced by several factors for which definitive numerical values are not available. These factors are expected to lead to doses to onsite personnel lower than those estimated above. Improvements to the radioactive waste effluent treatment system to maintain offsite population doses as low as practicable may cause an increase to onsite personnel doses, if all other factors remain unchanged. However, the applicant's implementation of Regulatory Guide 8.8 and other guidance provided through the staff radiation protection review process is expected to result in an overall reduction of total doses from those currently experienced. Because of the uncertainty in the factors modifying the above estimate, a value of 900 man-rems will be used for the occupational radiation exposure for the two-unit plant.

5.4.2.6 Summary of annual radiation doses

The combined dose (man-rem) due to gaseous effluents to all individuals living within a 50-mile radius of the plants was calculated using the projected 1980 population data furnished by the applicant (ER, Sect. 2.2). Values for the man-rem dose at various distances from the plants are summarized in Table 5.11.

Table 5.11. Cumulative population, annual cumulative dose, and average annual total-body dose due to gaseous effluents in selected annuli about the plant

Cumulative radius (miles)	Cumulative population (1980)	Annual cumulative dose (man-rem)	Average annual dose (millirem)
1	0	0.0	0.0
2	0	0.0	0.0
3	48	0.000	2.8×10^{-3}
4	383	0.000	8.4×10^{-4}
5	1,156	0.001	6.4×10^{-4}
10	4,373	0.002	4.8×10^{-4}
20	30,193	0.005	1.7×10^{-4}
30	55,034	0.007	1.2×10^{-4}
40	158,795	0.012	7.6×10^{-5}
50	263,685	0.014	5.2×10^{-5}

The cumulative dose resulting from the consumption of shrimp harvested in the vicinity of the Colorado River was estimated. It was conservatively assumed that all the population within 50 miles of the plant consumed 2.5 g of shrimp per day which were caught in the region of the river where the coolant water discharges were diluted by the entire river flow of 800 cfs, which is the minimum during which discharge to the river is permitted.

The exposed fishing and boating population was estimated to be 2000, and each person was assumed to be exposed during 100 hr/year of swimming and 500 hr/year of boating in the mixing zone.

The population dose from all sources, including natural background, cloud immersion, consumption of fish, consumption of molluscs and crustacea, recreation, transportation, and occupational exposure, is summarized in Table 5.12.

5.4.2.7 Evaluation of radiological impact

The average annual dose from gaseous effluents to persons living in unrestricted areas within 50 miles of the plant is less than 0.001 millirem/year, as shown in Table 5.10. Maximum individual doses due to liquid and gaseous effluent releases are less than 5 millirems/year, as seen in Tables 5.7 and 5.8. These values are only a few percent of the natural background exposure of 125 millirems/year,[23] are below the normal variation in background dose, and represent no measurable radiological impact.

Using conservative assumptions, the total man-rem in unrestricted areas from plant operation received by the revised estimated 1980 population of 264,000 persons who will live within a 50-mile radius of South Texas Project would be about 6.67 man-rem/year. By comparison, an annual total of about 33,000 man-rems is delivered to the same population as a result of the average natural background dose rate of about 0.125 rem/year in the vicinity of the South Texas Project.

The 900 man-rems estimated as occupational onsite exposure are a small percentage of the annual total of about 33,000 man-rems delivered to the 1980 population living within a 50-mile radius of the South Texas Project.

Effluents from plant operation will then be an extremely minor contributor to the radiation dose that persons living in the area normally receive from natural background radiation. The estimated radiation doses to individuals and to the population from normal operation of the plant support the staff conclusions that the releases of radioactive materials in liquid and gaseous effluents are as low as practicable in accordance with 10 CFR 50.34(a).

Table 5.12. Summary of annual total-body doses to the population within 50 miles

Category	Population dose (man-rems/year)
Natural environmental radioactivity	33,000
Nuclear plant operation	
Plant work force	900
General public	
Gaseous cloud	0.02
Fish ingestion	0.02
Invertebrate ingestion	0.47
Recreation (fishing, swimming, boating)	0.16
Transportation of nuclear fuel and radioactive wastes	6

5.4.3 Environmental effects of the uranium fuel cycle

The environmental effects of uranium mining and milling, production of uranium hexafluoride, enrichment of isotopes, fabrication of fuel, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level and high-level radioactive wastes are within the scope of the NRC report (WASH-1248) entitled *Environmental Survey of the Uranium Fuel Cycle*. The contribution of such environmental effects is summarized in Table 5.13 and the effects are sufficiently small as not to affect the conclusions significantly.

5.5 NONRADIOLOGICAL EFFECTS ON ECOLOGICAL SYSTEMS

5.5.1 Impacts on terrestrial ecosystems

5.5.1.1 Impacts of station operation

Because of the nature of the cooling system, the major ecological impacts of plant operation will be on the aquatic environment of the area. The staff concludes that the operation of STP will have only minor nonradiological impacts on the terrestrial ecosystems of the local area.

The staff estimates that the air pollutants resulting from operation of the emergency diesels and auxiliary steam boilers will have no noticeable effects at the site boundary even under stagnant meteorological conditions (ER, Table 3.7-2).

Noise levels associated with the operation of the plant are not expected to constitute a serious disturbance to wildlife. Sources of noise include the main power transformers [90 dB(A) at 6 ft], steam release valves, and diesel engines. The staff considers it likely that resident wildlife species will become accustomed to routine noises of this level.

Some disturbance and increased mortality of wildlife may occur as a result of activities and motor vehicle movement around the site. In the judgment of the staff, these disturbances will not be serious.

Table 5.13. Summary of environmental considerations for uranium fuel cycle

Normalized to model LWR annual fuel requirement

Natural resource use	Total	Maximum effect per annual fuel requirement of model 1,000-MWe LWR
Land (acres)		
Temporarily committed	63	
Undisturbed area	45	
Disturbed area	18	Equivalent to 90 MWe coal-fired power plant.
Permanently committed	4.6	
Overburden moved (millions of metric tons)	2.7	Equivalent to 90 MWe coal-fired power plant.
Water (millions of gallons)		
Discharged to air	156	≈2% model 1000 MWe LWR with cooling tower.
Discharged to water bodies	11,040	
Discharged to ground	123	
Total	11,319	<4% of model 1000 MWe LWR with once-through cooling.
Fossil fuel		
Electrical energy (thousands of MW-hour)	317	<5% of model 1000 MWe LWR output.
Equivalent coal (thousands of metric tons)	115	Equivalent to the consumption of a 45-MWe coal-fired power plant.
Natural gas (millions of scf)	92	<0.2% of model 1000-MWe energy output.
Effluents—chemical (metric tons)		
Gases (including entrainment)[a]		
SO_2	4,400	
NO_2[b]	1,177	Equivalent to emissions from 45-MWe coal-fired plant for a year.
Hydrocarbons	13.5	
CO	28.7	
Particulates	1,156	
Other gases		
F^-	0.72	Principally from UF_6 production enrichment and reprocessing. Concentration within range of state standards – below level that has effects on human health.
Liquids		
SO_4^-	10.3	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 constitutents that require dilution and the flow of dilution water are: NH_3 – 600 cfs. NO_3 – 20 cfs. Fluoride – 70 cfs.
NO_3^-	26.7	
Fluoride	12.9	
Ca^{2+}	5.4	
Cl^-	8.6	
Na^+	16.9	
NH_3	11.5	
Fe	0.4	
Tailings solutions (thousands of metric tons)	240	From mills only – no significant effluents to environment.
Solids	91,000	Principally from mills – no significant effluents to environment.
Effluents – radiological (curies)		
Gases (including entrainment)		
Rn-222	75	Principally from mills – maximum annual dose rate <4% of average natural background within 5 miles of mill. Results in 0.06 man-rem per annual fuel requirement.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.032	Principally from fuel reprocessing plants – whole body dose is 6 man-rem per annual fuel requirements for population within 50-mile radius. This is <0.007% of average natural background dose to this population. Release from Federal Waste Repository of 0.005 Ci/year has been included in fission products and transuranics total.
Tritium (thousand)	16.7	
Kr-85 (thousands)	350	
I-129	0.0024	
I-131	0.024	
Fission products and transuranics	1.01	
Liquids		
Uranium and daughters	2.1	Principally from milling – included in tailings liquor and returned to ground – no effluents; therefore, no effect on environment.
Ra-226	0.0034	From UF_6 production – concentration 5% of 10 CFR 20 for total processing of 27.5 model LWR annual fuel requirements.
Th-230	0.0015	
Th-234	0.01	From fuel fabrication plants – concentration 10% of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Ru-106	0.15[c]	From reprocessing plants – maximum concentration 4% of 10 CFR 20 for total reprocessing of 26 annual fuel requirements for model LWR.
Tritium (thousands)	2.5	
Solids (buried)		
Other than high level	601	All except 1 Ci comes from mills – included in tailings returned to ground – no significant effluent to the environment, 1 Ci from conversion and fuel fabrication is buried.
Thermal (billions of Btu's)	3,360	<7% of model 1000-MWe LWR.
Transportation (man-rem): exposure of workers and general public.	0.334	

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

[b]1.2% from natural gas use and process.

[c]Cs-137 (0.075 Ci/AFR) and Sr-90 (0.004 Ci/AFR) are also emitted.

Source: Paragraph 51.20(e), 10 CFR 51.

5.5.1.2 Impacts on transmission line operations

The operational impact of the transmission lines will be more or less determined by right-of-way management practices.

Control procedures planned by the applicant include the use of herbicides where the rights-of-way cross wooded lands. The herbicides which the applicant intends to use are shown in Table 5.14, along with their dilution and application rates. In order to minimize potential adverse impacts, the staff will require that the applicant adhere to a plan for selective basal application of herbicides. This procedure will avoid damage to nontarget areas caused by herbicide drift, which is often associated with applications from aircraft or large ground rigs. The applicant should consult appropriate state fish and game agency personnel and pesticide control regulations for recommendations and approval of chemicals prior to undertaking any spraying on rights-of-way.

Table 5.14. Active ingredients, dilution rates, and application rates of herbicides used along transmission line right-of-way

Trade name and active ingredients	Dilution rate	Application rate
Dow Estron 2-4-50S		
2-4-5-T trichlorophenoxy acid Propolene glycol butyl etherester	3 gal in 97 gal diesel oil	1 pint per stem every 3–5 years
Tordon 10K pellets		
4-amino-3, 5, 6-trichloropicolinic acid as the potassium salt Acid equivalent: 4-amino-3, 5, 6-tricholoropicolinic acid		1 lb of pellets applied to each towerbase every 3–4 years
Total kill		
2-4 dichlorophenoxy acetic acid Propolene glycol butyl ether ester 5-bromo-3-sec butyl-6-methyluracil	2 gal in 98 gal diesel oil	1 pint per stem every 3–5 years

Source: ER, Questions E-14.

Ozone is recognized as a major component of the photochemical air pollution-oxidant complex and is known to be extremely toxic to a wide range of plant species. One source of ozone production is believed to be associated with high-voltage transmission lines and substations. The contribution of ozone generated by these facilities to ambient levels in the vicinity of transmission lines has not appeared in the literature. Preliminary studies conducted by the staff indicate that concentrations beneath two 500-kV transmission lines did not reach levels high enough to show visible damage to vegetation beneath or adjacent to the lines. Any possible deleterious effects on vegetation directly beneath the lines and more adjacent to the corridors, which could be affected by chronic exposure to ozone drift, have not been identified and are expected to be minimal, particularly for STP power distribution that is limited to 345 kV.

In terms of possible avian collisions with lines, Arend[24] has reported that large diameter overhead transmission cables operating at voltages higher than 100 kV are seldom hazardous to birds, even in dense fog. Hockbaum[25] has commented that resident birdlife is familiar with all components forming its environment and is not affected by aerial obstruction unless fog reduces visibility severely. Patrols of 115 kV and 345 kV by other utility companies have shown no evidence of collisions with lines extending through forested-agricultural lands. Some evidence has been accumulated showing moderate numbers of avian collisions where power lines cross open water.[26] Since transmission lines for STP will extend over approximately 3 miles of open water, there exists the possibility for some avian mortality along the lines. However, taking the project as a whole and taking into consideration other man-made obstacles which confront avian species, the hazards presented by high-voltage transmission lines is negligible.

5.5.2 Aquatic

Operation of STP will potentially affect the aquatic ecosystems on and near the site through: (1) entrainment and impingement of organisms, (2) blowdown effects (thermal and chemical), and (3) reduction of freshwater inflow to the lower Colorado-Matagorda Bay estuary.

5.5.2.1 Effects of makeup station operation

Makeup water for the cooling lake will be withdrawn intermittently from the Colorado River near mile 14.6 (Fig. 2.7). The intake structure (Fig. 3.4) will consist of coarse trash racks flush with the river banks, stop log guides, and 24 sets of 10-ft-wide vertical traveling screens of 3/8-in. mesh. Intermittent operation of the screens will allow for periodic cleaning by water jets. Trays on the screens will carry trash and impinged organisms to a sluice by which they can be returned to the river. If the trash load is great, both fish and trash would be diverted to a trash basket.

Based on a maximum makeup diversion rate of 1200 cfs and a minimum river elevation of (-)0.95 ft MSL, the staff has calculated the maximum approach velocity to the traveling screens to be 0.55 fps (Table 5.15). Lower makeup diversion rates will result in lower approach velocities. Intake velocities for other makeup diversion rates are presented in Table 5.16. Free passage between the trash racks and screens exists along the entire length (392 ft) of the intake structure to allow fish that enter the trash racks to swim downstream and away from the intake.

Table 5.15. Staff-calculated velocity of makeup water in the intake structure

	Approach velocity of makeup water at the indicated Colorado River level (fps)	
	−0.95 ft MSL	0 ft MSL
Approach to trash rack	0.32	0.29
Through trash rack	0.35	0.32
Approach to traveling screens	0.55	0.50
Through traveling screens	0.97	0.88

Table 5.16. Staff-calculated maximum rate of makeup diversion for given river flows and resulting approach velocities to traveling screens

River flow (cfs)	Maximum makeup flow (cfs)	Maximum percent of river flow diverted	Approach velocities (fps)
300	0	0	0
400	55	13.8	0.03
500	110	22.0	0.05
600	165	27.5	0.08
700	220	31.4	0.10
800	275	34.4	0.12
900	330	36.7	0.15
1000	385	38.5	0.18
1100	440	40.0	0.20
1500	660	44.0	0.30
2000	935	46.8	0.43
2480	1200	48.3	0.55
3000	1200	40.0	0.55
5000	1200	24.0	0.55
7000	1200	17.1	0.55

The rate of makeup diversion will not exceed 55% of that portion of the river flow (measured at the Bay City gauge) in excess of 300 cfs, with an absolute maximum diversion rate of 1200 cfs. The average annual makeup diversion is predicted to be about 54,000 acre-ft over the 40 years of plant operation (ER, Table 10.1-8). The maximum annual diversion allowable is 102,000 acre-ft. On the basis of historical flow data, the annual makeup diversion will average only 3.2% of the average annual flow of the Colorado River (1.7 million acre-ft). However, if river flows are adjusted for anticipated future upstream diversions of water for purposes unrelated to plant operation, the average annual makeup diversion increases to 11.7% of adjusted average annual river flow (470,000 acre-ft). Table 5.17 shows average monthly makeup requirements in relation to average Colorado River flows (both historical and adjusted for future consumption upstream).

Table 5.16 shows the results of staff calculations of maximum instantaneous rates of diversion for various river flows. The maximum instantaneous rate of diversion was calculated to be equivalent to 48.3% of the freshwater river flow (1200 cfs makeup vs 2480 cfs freshwater flow). Mean daily river flows of 2480 cfs or higher have approximately a 22% chance of occurrence, according to USGS data from Bay City (ER, Fig. 2.5-5).

The sedimentation basins between the screenhouse and pumphouse will not assume any special ecological significance since the screens are flush with the river bank and prevent entry of fish. Any colonization of the bottom by benthos will be periodically disrupted by dredging.

Table 5.17. Average monthly makeup requirements, Colorado River flows, and percent of river flow diverted as makeup (1 cfs = 725 acre-ft/year)

Month	Makeup flow (cfs)	Colorado River flow[a] (cfs)	Percent of river flow diverted	Adjusted river flow[b] (cfs)	Percent of adjusted flow diverted
January	154	1960	7.9	540	28.5
February	209	2700	7.7	740	28.2
March	65	2150	3.0	590	11.0
April	50	2450	2.0	670	7.4
May	54	4100	1.3	1130	4.8
June	64	3550	1.8	976	6.6
July	4	1450	0.2	400	1.0
August	0	900	0	250	0
September	17	1800	1.0	500	3.4
October	76	2450	3.1	670	11.3
November	100	2100	4.8	580	17.2
December	121	1800	6.7	500	24.2
Annual	76	2353	3.2	647	11.7

[a]Based on data from USGS Gauge 08-1625, near Bay City, 1948–1970, as presented in ER, Fig. 2.5-4.
[b]Based on anticipated future diversions of river water upstream of STP (ER, p. 3.4-18), assuming that future monthly seasonal distribution of flow follows past patterns.

5.5.2.1.1 Entrainment

Those organisms too small for impingement on the traveling screens of the makeup structure will be subject to entrainment in the makeup line and subsequent introduction into the cooling lake. Although a small percentage of these entrained organisms will eventually find their way back to the Colorado River via the blowdown line, the staff makes the conservative assumption that all organisms entrained in the makeup line will be permanently lost from the lower Colorado ecosystem.

Entrainment of ichthyoplankton and macroinvertebrate larvae

Atlantic croaker (26.0%), Gulf menhaden (18.5%), naked goby (13.8%), and bay anchovy (11.0%) contributed nearly 70% of all ichthyoplankton collected during the baseline study (ER, Suppl. to Amendment 1). The croakers and menhaden are important commercial fish, and the bay anchovy is an important forage fish. The young of crabs and penaeid shrimp are probably the most valuable macroinvertebrates likely to be entrained.

The abundance of ichthyoplankters (fish larvae and eggs) in the study area by month and station is presented in Table 5.18. This table indicates that, during the 1973-74 sampling period, ichthyoplankters achieved their highest densities during October and November at the downriver stations. Lesser peaks appeared in March, April, May, and August. Larval densities were generally much greater than the density of eggs due to the fact that the spawning of many species occurs in the Gulf and consequently most eggs have hatched by the time of entry into the lower Colorado River. Egg densities were highest during March and April. Post-larvae of penaeid shrimp (*Penaeus aztecus*) occurred in densities ranging as high as $2.6/m^3$ at station 4 to $40/m^3$ at station 11, about 1.6 miles upstream of the river's mouth. May, June, August, October, and November samplings yielded the highest densities of penaeid shrimp post-larvae. Crab megalops (last larval stage of crab development) achieved variable densities, ranging as high as 551.3/m^3 at station 11. For all stations, highest densities occurred March-May. Based on data provided by the applicant,[27] a strong possibility exists that a large fraction of the collections are the commercially valuable blue crabs (Callinectes sapidus). Other macrocrustaceans yielding relatively high densities (i.e., 2/m^3 to 4/m^3) included *Lucifer faxoni* and *Alpheus* sp.

Table 5.18. Ichthyoplankton densities (No./m^3) for some species by station and month (STP, 1973–74)

Single tows at surface and bottom[a]

Month			Stations								
			1	2	3	4	5	10	11	12	14
June	*Gobiosoma bosci*		0	0	*b*	0.56	0.65	*b*	*b*	*b*	*b*
	Total		<0.01	0	*b*	0.66	0.74	*b*	*b*	*b*	*b*
July	Total		<0.01	0	<0.01	<0.01	0.1	*b*	*b*	*b*	*b*
August	*Anchoa mitchilli*		0	0	0	0	0.05	1.38	2.04	0.3	*b*
	Gobiosoma bosci		0	0	0	0	1.22	0.05	<0.01	5.97	
	Total		<0.01	0	0	0.02	1.29	1.46	2.11	7.45	*b*
September	Total		0.03	0.03	0	0	0.09	0.01	0.01	0.12	*b*
October	*Micropogon undulatus*	S[c]	0	0	0	0	0	0	0	0	0.01
		B[c]	0	0	0	0	0	0	3.24	0	21.31
	Sciaenops ocellatus	S	0	0	0	0	0	0	0.03	0	0.01
		B	0	0	0	0	0	0	0.49	0	1.13
	Total	S	0.05	0.02	0.02	0	0	0.02	0.06	0	0.31
		B	0.02	0.02	0	0	0.05	0.02	4.29	0.02	23.37
November	*Brevoortia patronus*	S	0.09	0	0	0	0	0.55	22.84	0.26	0
		B	0	0	0.01	0	0	0.14	0.15	0.02	0.36
	Micropogon undulatus	S	0	0	0	0.04	0.01	0	6.20	0.01	0.30
		B	0	0	0	0	0.99	0.07	7.57	0.17	6.22
	Total	S	0.09	0	0	0.04	0.02	0.74	30.99	0.32	0.40
		B	0	0	0.01	0	1.00	0.28	9.08	0.19	7.61
December	Total	S	0	0	0	0	0.03	0.01	0.31	0.09	0.04
		B	0	0	0	0	0.02	0.19	0.37	0.01	<0.01
January	Total	S	0	0	0	0.01	0.02	0.13	1.13	0.89	1.89
		B	0	0	0	0	0.05	0.17	0.32	0.22	0.14
February	Total	S	0	0.06	0.15	0.41	0.03	<0.01	0.01	0.03	0.19
		B	0	<0.01	0.06	0.11	0.06	0	0.34	0.30	1.49
March	*Anchoa hepsetus*	S	0	0	0	0	0.04	0.06	1.29	0.08	0.50
		B	0	0	0	0.01	0.02	0.06	0.19	*b*	2.32
	Anchoa mitchilli	S	0	0	0	0	0	0	0.77	0.06	1.07
		B	0	0	0	0	0.09	0	0.14	*b*	1.38
	Total	S	0	0.03	<0.01	0	0.05	0.13	2.61	0.50	2.17
		B	0.03	0.02	0	0.02	0.24	0.08	0.44	*b*	5.06
April	*Anchoa spp.*	S	0	0	0	0	2.00	0.39	0.02	0.38	0.01
		B	0	0	0	0	3.35	0.05	0	0.12	0
	Total	S	0	0	0.03	0.06	2.20	0.42	0.17	2.12	0.72
		B	0.01	0	0.02	0.04	3.63	0.71	0.07	1.17	2.04
May	Total	S	0.06	0.03	0.02	0.01	0.01	0.02	0.19	0.48	1.07
		B	0.15	0.13	0.03	0	0.06	0.49	1.10	2.43	0.06

[a]June–September densities represent average of surface and bottom samples.

[b]Not sampled.

[c]S = Surface; B = Bottom

Source: ER, supplement to Amendment 1.

Table 5.17 shows monthly average makeup requirements in relation to monthly average flows in the Colorado River. Normally, the monthly rate of withdrawal will be greatest during the winter months of December through February, when average withdrawals will range from 6.7 to 7.9% of the net flow of the Colorado River, or, more importantly, as reflected by future water usage (24.2% to 28.5% of adjusted river flow). Approximately 53% (29,200 acre-ft) of the annual makeup requirements will be withdrawn from the river during these three months. Lowest average monthly withdrawals will occur during July through September, when the percent of net downstream river flow withdrawn monthly will range from 0 to 1.0% (0 to 3.4% of adjusted river flows).

Data presented in the above discussion and in Table 5.18 appear to indicate that periods of maximum makeup withdrawal will not generally coincide with the presence of high densities of ichthyoplankton, postlarval shrimp, and larval crabs.

However, the staff is concerned that flow data expressed as monthly averages do not present a true picture of the potential for entrainment. There exists a distinct possibility that diversion of makeup at relatively low freshwater flows may result in the loss of substantial numbers of ichthyoplankton, young shrimp, and crabs. This latter possibility exists as a result of the preference of young estuarine organisms for brackish waters. As presented in Table 5.19, substantially greater densities of ichthyoplankton, shrimp, and crab young are associated with increased salinities representative of the saltwedge phenomenon. These salinities can occur in the intake area at low flows as shown in Table 5.20 and Fig. 5.9.

Table 5.19. Maximum observed densities (No./m^3) of ichthyoplankton, shrimp, and crab larvae in the Colorado River, and salinities at which they were observed (STP, 1973–74)

Salinity[a] (ppt)	Bay anchovy *(Anchoa mitchilli)*	Gulf menhaden *(Brevoortia patsonus)*	Atlantic croaker *(Micropogon undulatus)*	Anchoa sp.	Brown shrimp postlarvae *(Penaeus aztecus)*	Crab megalops[a]
0–1			3.2; 21.3[b]		6.3[b];3.2	6.9
1–2		0.6				0.8
2/12[c]	1.4					
2–3				2.0	2.9	
3–4						
4–5						
5–6			6.2			
5/15[c]	2.0					
6–7		22.8	1.0		2.0	10.5
7–8						
8–9					16.6	46.9
9–10			7.6			10.7
10–12					20.4	322.0
12–14				3.4	40.0	551.3
15–20	1.4					
20 +			6.2			7.3

[a]Salinities as provided in Table 2.5–10 of the ER and tables 7 and 45 of the supplement to Amendment 1 of the ER.
[b]Questionable since salinity was reported as 25.8 ppt in Table 2.5–10 of ER and as 0.3 ppt in supplement to Amendment 1 of the ER.
[c]Depth at which catch was made is unavailable; therefore, both surface and bottom salinities are given.

Table 5.20. Predicted salinities for various river flow rates at river mile 14

Freshwater flow (cfs)	Percent of net river flow diverted	Approximate percent of time flow expected to be between 300 cfs and given flow	Predicted salinity[a] at mile 14 at surface and at 8-ft depth (surface/8 ft) (ppt)	Salinity adjusted for maximum permitted makeup diversion (ppt)
300	0		3/18	3/18
400	13.8	10	3/14	3/16
500	22.0	15	2/11	2/14
600	27.5	20	1/7	2/13
700	31.4	24	1/4	2/11
800	34.4	29	1/3	2/9
900	36.7	32	<1/2	1/7
1000	38.5	33	<1/2	1/6
1500	44.0	41	<1/1	<1/3
2000	46.8	46	<1/<1	<1/1
2480	48.3	49		
3000	40.0	52		
5000	24.0	60		
7000	17.1	64		

[a]As provided in ER, Fig. 5.1-1.

Entrainment potential will very likely attain problematic proportions with the occurrence of low flow conditions, when high densities of ichthyoplankton, crab, and shrimp young are sustained by virtue of favorable ranges of salinity. The deeper, high-salinity waters with their load of ichthyoplankton and crustacean larvae would tend to flow upstream or remain relatively static, as illustrated in Fig. 5.7. On the other hand, the vertical migration of many planktonic organisms allows them to be alternately swept downstream and upstream as they pass through the different density currents.[28] This type of behavior in the vicinity of the makeup intake, along with ebb and flow of the tide, could result in a school of juveniles being repeatedly exposed to the possibility of entrainment (Fig. 5.8).

Material presented in Table 5.20 serves to illustrate relationships that exist between freshwater flow, planned makeup diversions, and predicted salinities of surface and subsurface (depth = 8 ft) waters at river mile 14 (∿0.6 mile downstream of proposed intake structure). Projected salinity gradients for a net flow of 500 cfs are presented in Fig. 5.9. Considering that makeup could be drawn from the water column down to an approximate 10-ft depth (i.e., the full vertical extent of the makeup intake), it is apparent that under these conditions the makeup water mass will be comprised of a mix of increasing salinities ranging on the order of 1 to 20 ppt, bearing densities of organisms according to the salinity and relative seasonal abundances of the various species.

On the basis of information presented in Tables 5.19 and 5.20, it can be presumed that entrainment losses will be markedly reduced at higher net river flows, as a result of the more saline waters being limited to lower portions of the river. For those intervals when low flow conditions may prevail, entrainment of ichthyoplankton and crustacean young might attain serious proportions.

The applicant has committed to the following makeup limitations:

1. No makeup diversion will be allowed at freshwater flow less than 300 cfs as measured at the Bay City gauging station.

2. Makeup diversion will be allowed when freshwater flow exceeds 300 cfs; diversion will, however, be limited to 55% of net freshwater flow in excess of 300 cfs as determined at the Bay City station.

In addition to conditions 1 and 2 above, the technical bases for which were set forth by the applicant, additional measures may be required to reduce entrainment potential when conditions favoring high densities of ichthyoplankton and shrimp nauplii occur in the zone of influence of the intake. These additional measures, which do not involve a change in plant design, can be varied in nature and could involve limitations on such parameters as intake water salinity. Preliminary staff estimates indicated that a makeup salinity limit of approximately 2 ppt would be effective. The staff considers that an accurate prediction of the potential impact of entrainment will require further information to identify the makeup procedures necessary to reduce entrainment impacts to acceptable levels. Therefore, the applicant will be required to implement a program of studies, as described in Sect. 6.1.3.2 and Appendix E, to develop capabilities for predicting the degree and potential effects of entrainment losses and the defining of acceptable limits of entrainment (i.e., losses which, in the staff's judgement, will not irreversibly affect regional populations to a significant degree). Quarterly reports of the studies findings shall be forwarded to the staff. An interim report of the studies findings and the applicants proposals for makeup procedures to reduce entrainment losses to acceptable levels shall be forwarded to the staff six months prior to commencement of cooling lake filling. A final report shall be forwarded to the staff upon completion of the cooling lake filling phase of the studies. The results of these studies will form a basis for: (1) reaching a final decision on the acceptability of the proposed initial-fill makeup scheme and (2) the development of environmental technical specifications for makeup schemes at the operating license stage.

Entrainment effects on plankton

Assuming a random distribution through space and time of phytoplankton, zooplankton, bacteria, and drifting benthic invertebrates, about 3.2% of these organisms passing the intake structure would be entrained in the makeup line during an average year (average annual makeup diversion of 3.2% of average river flow at Bay City). If maximum future upstream diversions of river flow are realized, then 11.7% of river flow would be diverted in an average year. Based on mean monthly flows and makeup requirements, monthly entrainment losses of plankton would range from 7.9% in January to 0% in August. Maximum entrainment of plankton (up to 48% of plankton passing the intake) would occur during those periods when river flow exceeds 2480 cfs. During low flows and consequent intrusion of the saltwedge, individual plankters will be subject to repeated exposures to the makeup intake as discussed in the previous subsection on fish larvae.

Since the intake structure will be an indiscriminate predator of plankton, no discernible changes in the taxonomic structure of the plankton community would be expected. However, during periods of relatively low river flow and increased bottom salinities, the design of the makeup station

ES-446

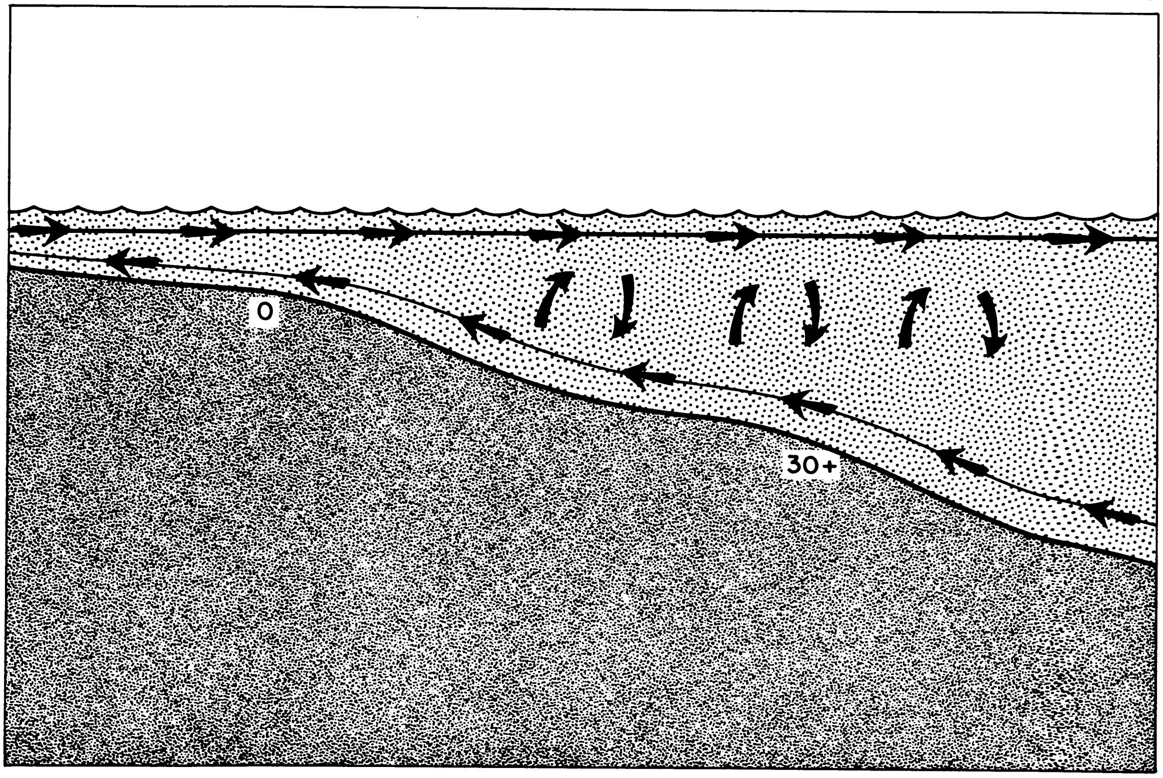

Fig. 5.7. Circulation pattern of lower Colorado River. Source: L. E. Cronin and A. J. Mansueti, "The Biology of the Estuary," pp. 14-39 in *A Symposium on the Biological Significance of Estuaries*, P. A. Douglas and R. H. Stroud, eds., Sport Fishing Institute, 1971. (Fig. 9, p. 20.)

ES-447

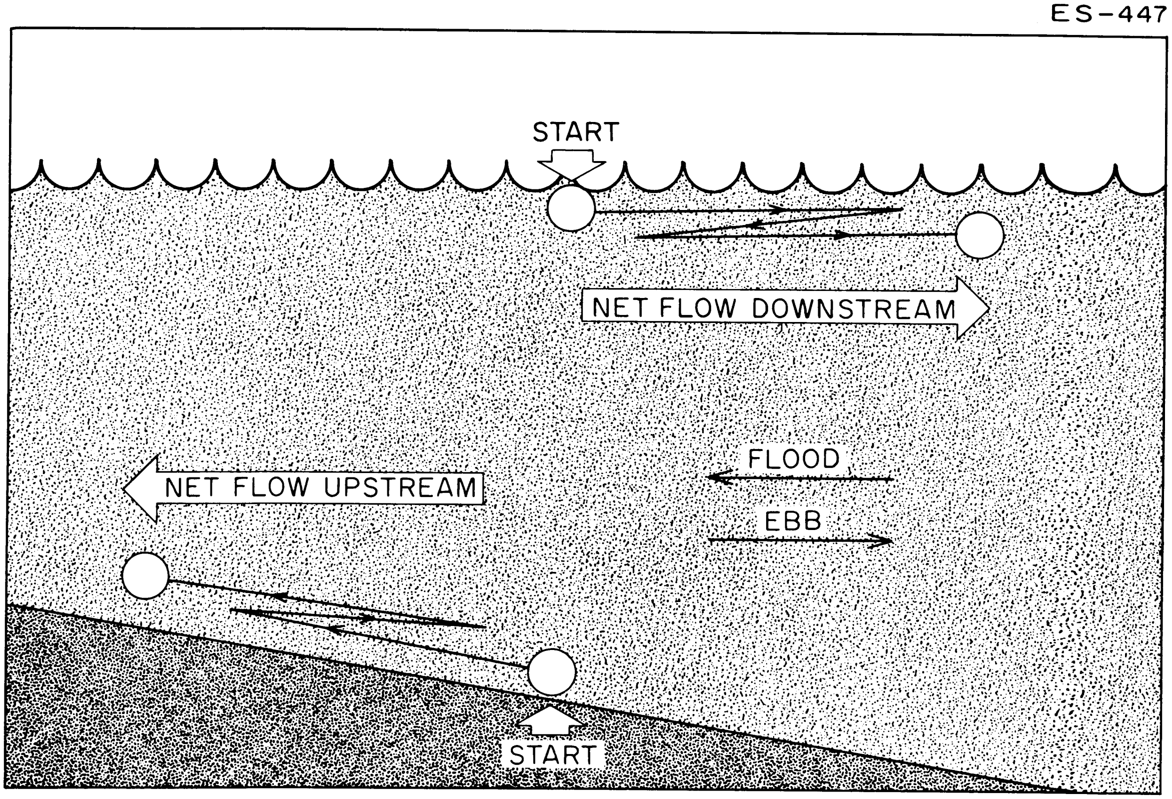

Fig. 5.8. Tidal effects on river flow. Source: L. E. Cronin and A. J. Mansueti, "The Biology of the Estuary," pp. 14-39 in *A Symposium on the Biological Significance of Estuaries*, P. A. Douglas and R. H. Stroud, eds., Sport Fishing Institute, 1971 (Figure 8 on p. 20).

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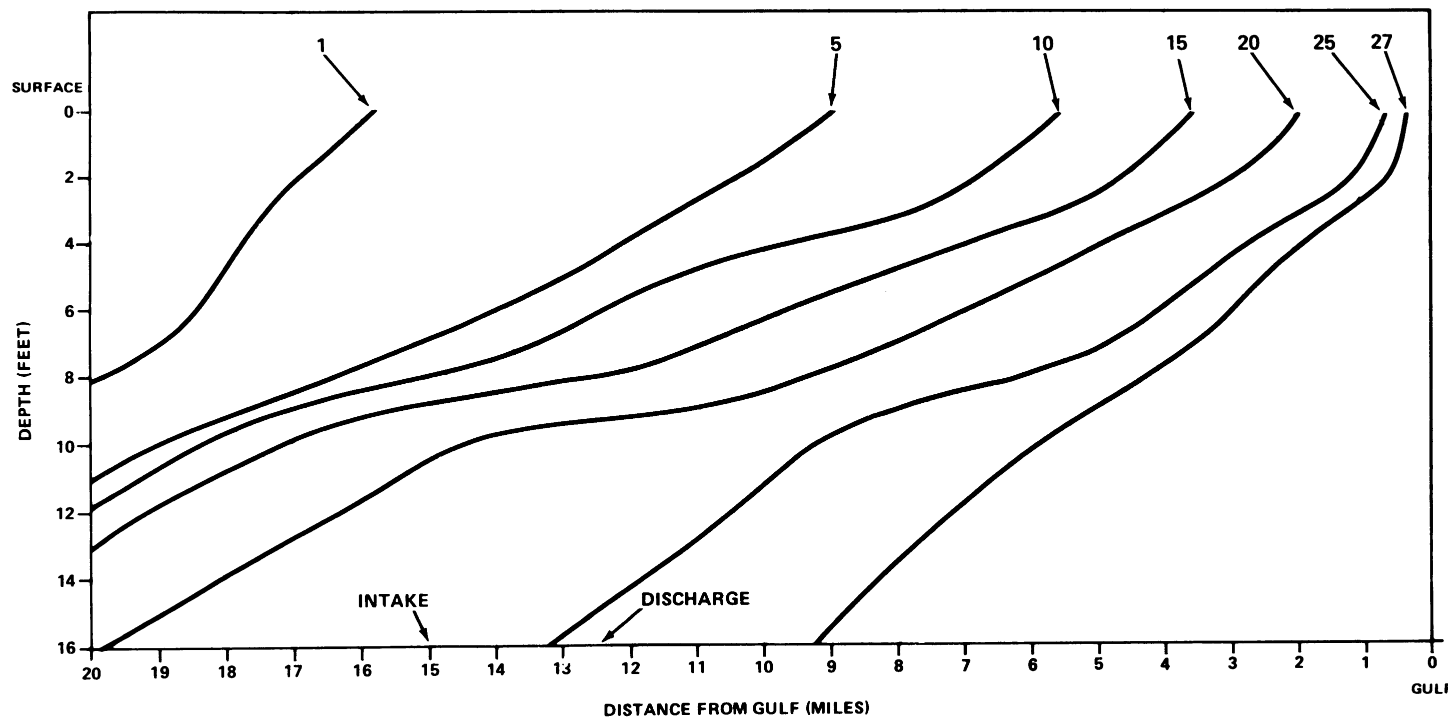

FRESHWATER FLOW RATE = 500 cfs

Fig. 5.9. Simulated salinity isopleths on Colorado River. Source: ER, Fig. 5.1-2.

(Sect. 3.4.3) will result in a somewhat greater removal of freshwater plankton from the upper strata of the river than of the estuarine plankton from the lower strata. This could result in slight shifts toward estuarine plankton communities in the vicinity of the intake structure.

On the basis of relatively low, mean monthly makeup withdrawal rates and the rapid regeneration times of most of the above plankters, the staff expects no significant changes in the planktonic community of the lower Colorado River due to makeup withdrawal.

5.5.2.1.2 Impingement

Those organisms too large to pass through the 3/8-in. mesh traveling screens will be subject to impingement. Once impinged upon intermittently operated screens such as those proposed for the STP makeup intake structure, death often results due either to injury, exhaustion, or suffocation.

The maximum approach velocity to the screens of 0.55 fps should permit most adult fish and shrimp to escape impingement. Placement of the intake structure flush with the riverbank and the provision of free passage between the trash racks and screens along the length of the structure should facilitate the escape of any fish wandering into the trash racks. Further details of the design and operation of the intake structure are provided at the beginning of this section.

Due to their lower swim speeds, juvenile fish will be more subject to impingement. However, during low flows, when the saltwedge is likely to carry high densities of juveniles of the estuarine-dependent fish upriver, the correspondingly lower intake velocities resulting from low diversion rates will probably allow most juveniles to escape (Table 5.16).

The staff does not expect impingement to occur to an extent that would adversely affect fish and shrimp populations of the lower Colorado River. But, due to the above-mentioned factors, regular monitoring of the degree of impingement and subsequent survival of these organisms will be required. Sampling of fish and shrimp populations in the area should be continued, with special emphasis on densities and distribution of small and juvenile fish throughout the year.

5.5.2.1.3 Reduction of freshwater inflow

Operation of STP will result in a net average annual freshwater loss to the Colorado River-Matagordo Bay estuary of 47,000 to 53,000 acre-ft. It is probable that future diversions of water for activities unrelated to STP operation may exert some potentially adverse effects on biota of the lower estuary. However, on the basis of projections of water usage as set forth in Table 5.17, the staff does not anticipate any substantial alterations in physical, chemical, or biological characteristics of the Colorado River-Matagordo Bay estuary resulting from the makeup diversion of fresh water.

5.5.2.2 Blowdown effects

In order to limit TDS concentrations in the cooling lake, blowdown will be discharged to the Colorado River at river mile 12 (Fig. 2.7) through a seven-port diffuser, as shown in Fig. 3.5. Potential adverse impacts result from the thermal and chemical effects of this blowdown.

Thermal effects

Temperature profoundly influences aquatic ecosystems. Physical parameters such as dissolved gases, viscosity, and specific gravity respond to changes in temperature and thus affect the biota. The organisms themselves possess upper and lower temperature tolerance limits and optimum growth, reproduction, and migration temperatures. Species composition often shifts dramatically with small but significant changes in temperature.

The staff has reviewed the applicant's thermal calculations and has concluded that the predictions of thermal dispersion are reasonable (Sects. 5.3.1 and 5.3.2). Accordingly, those results have been used for the following evaluations.

The ΔT of the thermal plume above ambient is not expected to exceed 6.9F° in the winter and 4.3F° in the summer. Blowdown will occur on an intermittent basis, with blowdown rates ranging from 0 to 308 cfs depending upon rate of flow in the Colorado River. No blowdown will be released when the Colorado River flow is less than 800 cfs. Blowdown will be limited to less than 12.5% of net river flow past the point of discharge. Considering these limits, no discharge will occur during 91.6% of the plant's 40-year operating life.

The highest daily maximum blockage temperature (maximum temperature of all isotherms whose cross-sectional areas are greater than or equal to 25% of the cross-sectional area of the river) should not exceed 3.26F° in the winter and 1.10F° in the summer. Both are less than the Texas state criteria of 4.0F° and 1.5F° respectively.[1] Under worst-case conditions, aquatic organisms seeking passage upstream or downstream will find at least 75% of the river's cross-sectional area to be less than 3.26F° above ambient in winter and 1.10F° above ambient in summer. Normally, blockage temperatures will be even lower. Far-field thermal increases will be minimal. ΔT's higher than 1.5F° will not likely extend beyond about 800 ft downstream of the last blowdown diffuser port.

The staff's conclusions regarding the impacts of blowdown on the lower Colorado River are based on the following criteria:

1. No blowdown will be released when net downstream flow of the Colorado River past the point of discharge is less than 800 cfs and 0.4 fps velocity (ER, pp. 3.4-6 and 5.1-13).

2. Blowdown will be limited to no more than 12.5% of net downstream river flow past the point of discharge at all times (ER, p. 5.1-13).

The staff concludes that thermal effects on aquatic biota will be limited to the immediate area of the blowdown diffuser ports, provided the above criteria are met. Here, during the relatively short periods of blowdown, plankton may experience slight increases in productivity during wintertime periods of blowdown and slight depressions during the hottest summer months. The lower Colorado River as a whole will show negligible changes in plankton productivity. A few fish eggs and larvae will be entrained in the small blowdown plume (maximum exit velocity at diffuser port = 6.22 fps), but mortality of those entrained is expected to be minimal. Larger fish and crustaceans can easily bypass the plume. Temperature tolerance data available for many species expected to utilize the lower Colorado indicate that most of these will tolerate the expected low ΔT's with little or no stress (ER, Table 5.1-18). The staff further expects no significant loss due to cold shock since ΔT's will be low and the blowdown plume relatively small.

Chemical effects

Chemicals and biocide wastes expected to be present in the blowdown are enumerated and described in Sect. 3.6. Table 3.9 provides incremental increases in the Colorado River of the more important chemical species under worst-case conditions.

Although TDS levels in the Colorado River could increase from a minimum of 214 ppm to a maximum of 460 ppm due to blowdown, the staff expects no significant adverse impacts on biota in the discharge area since most aquatic organisms can tolerate TDS levels far in excess of 460 ppm.[29] Furthermore, TDS and salinity levels naturally reach several thousand parts per million in the vicinity of the blowdown facilities during periods of low flow.

No estimate was made of the concentration of combined residual chlorine (such as chloramines) in the cooling lake as a result of the two 20-min shock doses administered daily at the circulating water intake. Free residual chlorine, which is to be limited to 0.2 ppm at the circulating system outfall, will rapidly react to form various combined residual chlorine products. Total residual chlorine should be insignificant in the blowdown discharge due to the circulation time between condenser discharge and blowdown station (approximately 20 days).

Phytoplankton in the receiving waters may experience slight increases in productivity during periods of blowdown due to increases in nutrient loading. Nitrate increases of as much as 8.4 ppm and orthophosphate increases of as much as 0.46 ppm may occur during worst-case conditions. The staff foresees no significant adverse effects on biota of the Colorado River from the increased nutrient load.

Under worst-case conditions, blowdown may induce a rise in BOD_5 of as much as 3.3 ppm in the river, with the attendant possibility that dissolved oxygen (DO) levels may drop below the Texas State criterion of 5.0 ppm. Such a development would stress aquatic populations downstream. Therefore, the applicant will have to control blowdown such that Texas State Water Quality Standards are not exceeded.

Blowdown-induced scouring

The diffuser ports (Sect. 3.4.4) will be positioned approximately 6 ft above the river bottom. The staff considers that scouring will be limited to a few feet downstream of each port. No significant adverse impacts from scouring are anticipated.

Conclusion

In summary, the staff expects no significant adverse impacts upon biota of the lower Colorado River due to blowdown effects.

5.5.2.3 Effects of plant operation on the cooling lake

The applicant does not plan to make the cooling lake available for public use or recreation. The staff does not expect the cooling lake to contribute significantly to the biota of adjacent waters, although blowdown will periodically introduce some fish, macroinvertebrates, and plankton into the Colorado River. Therefore, the staff will comment only on those operational impacts that may affect the environment external to the lake.

Wildlife, particularly birds, will utilize the lake as a source of food (fish and invertebrates) and fresh water. The supply of food and fresh water will, of course, vary as the drought conditions change. Drought will result in significant reductions in the volume of water within the cooling lake, with subsequent increases in temperature. TDS may rise from an average 1900 ppm to as high as 12,600 ppm. Staff calculations indicate that approach velocities to circulating water intake traveling screens may rise to 2.1 fps. These developments would probably exact heavy losses on plankton and fish populations. Following drought, the staff expects populations of most species in the cooling lake to slowly regain their former numbers.

5.6 IMPACTS ON PEOPLE

5.6.1 Physical impacts

The site is sufficiently remote that the noise of operating machinery should not be audiele to local residents. The air pollution from occasional operation of the diesel engines on emergency equipment will not be significant.

No pollution of groundwater resources is expected. Surface-water pollution will be controlled and maintained within State standards. During permanent operation of the plant, the sewage treatment unit will operate as an extended aeration system for the effluent. The effluent will also be given treatment consisting of filtration, recirculation, and chlorination. Disposal will be in accordance with Federal, State, and local environmental regulations (ER, Sect. 3.7.2).

Transportation of the operating personnel is expected to have only a minor impact on traffic. The upgrading of roads for construction will be more than adequate for continued use during plant operation. The infrequent use of the railroad spur will have only a minor effect on traffic on the roads that it crosses. There will be some continuing aesthetic impacts where the STP transmission lines are visible from roads and residential areas. Some local fogging will occur near the cooling lake. The occurrence of reduced visibility to less than 1000 m will increase somewhat, but this impact should not significantly affect traffic on the nearby highways.

5.6.2 Population growth and operating personnel income

The operating population is estimated to be 125 persons for a two-unit power plant. The staff estimates that about one-half of the workers will live in Bay City and Palacios. The remainder are expected to settle within a radius of 25 to 40 miles in the intermediate impact area. Using the Texas statewide average of 3.17 persons per household, the increase in population caused by 125 permanent employees will be about 357, considering that about 10% will be prior residents of the county.

These employees in 1980 will earn an average salary of $16,080, resulting in an annual payroll of $2,010,000 (ER, Sect. 8.1.2.2).

5.6.3 Impact on community services

The availability of housing in Matagorda County and the surrounding area was discussed in Sect. 4.4.3. There is expected to be sufficient housing available for the operating force as the construction phase ends.

The availability of domestic water and sewage disposal in Matagorda County was also discussed in Sect. 4.4.3. The increase in these services required during the construction phase should be adequate for the incremental increase required for the STP operating force.

Residences for plant-operating personnel should not add significantly to the police and fire protection requirements in Matagorda County.

5.6.4 Impact on local institutions

The taxes that will be paid by the applicant were discussed in Sect. 4.4.4. Matagorda County and the Palacios Independent School District will be able to tax the project. The estimated tax revenues are considered adequate by the staff to cover the cost of increased county and school services resulting from STP operation. There is, however, no present way that the cities of Palacios and Bay City can tax the plant. The State law that permits a county government to provide a wide range of services, including water and sewer systems, within the boundaries of incorporated communities, may justify some of the STP-generated tax revenues to Matagorda County being used directly in meeting increased community service requirements in Bay City and Palacios generated by STP workers.

5.6.5 Impact on recreational capacity in the area

The STP site is in a remote area. Limited recreational opportunities may be available from an access road provided from FM 521 to the Colorado River. The wilderness area between the cooling lake and the Colorado River will be allowed to remain in its natural state, with a wildlife preserve being established. A visitors' information center will be opened at the site and will include picnic facilities. The visitors' information center and one picnic area will be located north of the essential cooling pond. The second picnic area will be located on the west bank of nearby Kelly Lake. Construction of these areas will provide new recreational and leisure facilities to site visitors. Considering the design of the cooling lake embankments and the fluctuating water levels in the lake itself, the staff agrees with the applicant that limited recreational use can be derived from the cooling lake. Local demand for recreational use of this lake is not anticipated due to the close proximity of existing water bodies.

5.6.6 Conclusions

The staff concludes that the impacts on the community as a result of operation of STP are acceptable.

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6. ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 PREOPERATIONAL PROGRAMS

6.1.1 Hydrological

The physical parameters of Colorado River water near the plant site, such as water temperature, conductivity, pH, dissolved oxygen, turbidity, color, odor, and other chemical properties have been studied since June 1973. Models of salinity and temperature distribution and tidal flow are being used in conjunction with the preoperational field studies to predict the environmental effects of plant operation on the Colorado River. The applicant gives a detailed description of the sampled parameters as well as the sampling locations for the Colorado River (ER, Tables 6.1-1 and 6.1-2, and Fig. 6.1-1 and 6.1-2).

A weekly groundwater-level monitoring program was initiated in July 1973. Piezometer locations are shown in Fig. 6.1-3 of the applicant's Environmental Report. Groundwater quality was determined at three different depths and was analyzed for chemical and bacteriological parameters. Mathematical models are being used in conjunction with the preoperational monitoring program to predict changes in groundwater level, dispersion of contaminants, and transport through aquifers to surface water bodies.

6.1.2 Meteorological

The preoperational onsite meteorological program, initiated in July 1973, consists of a 195-ft tower located about 5000 ft east-northeast of the main reactor complex. Wind speed and direction are measured at 33 ft and 195 ft; vertical temperature gradient is measured between 33 ft and 100 ft and between 33 ft and 195 ft; ambient temperature and dewpoint temperature are measured at 33 ft; solar radiation is measured at 10 ft; and precipitation is measured at the ground. The primary data recording system has used strip charts, although a digital recording system is being installed.

The applicant has submitted onsite data for the period July 20, 1973 through July 20, 1974 in the form of joint frequency distributions of wind speed and direction at the 33-ft level by atmospheric stability (as defined by the vertical temperature gradient between 33 ft and 195 ft) in accordance with the format recommended in Regulatory Guide 1.23. Data recovery was 96%. The applicant has also submitted similar data for Allens Creek (October 1972 through September 1973 and July 20, 1973 through December 31, 1973), Corpus Christi (March 1955 through February 1960), Victoria (September 1953 through August 1958), and for Galveston (October 1953 through September 1958). The staff also had access to similar data from Allens Creek for the period August 1972 through July 1973.

The staff has calculated relative concentration (χ/Q) values using one full year (July 20, 1973 through July 20, 1974) of onsite data. A Gaussian diffusion model with adjustments for building wake effects, described in Regulatory Guide 1.42, was used to make estimates of relative concentrations at various distances and directions as specified in Sect. 5. The relative concentration values calculated using the complete year of onsite data verifies that the values used in the DES were generally conservative, and any minor increases in the χ/Q values do not change the DES conclusions.

6.1.3 Ecological

6.1.3.1 Terrestrial

The applicant has obtained baseline data on terrestrial biota. These studies and subsequent preconstruction studies will be used to assess the effects of site preparation and construction. The baseline study was designed to establish quantitative and qualitative data on the terrestrial ecosystems of the site. Chapter 6 of the Environmental Report contains a summary of the preconstruction terrestrial monitoring program. Additional sampling is recommended in the preoperational terrestrial monitoring program in the estuarine marsh complex south of the site. The staff's assessment of the impact on the marsh due to the reduced freshwater flow is based on all available data. The level of detail for this preoperational baseline study on the coastal marsh complex should be such that any freshwater input needed to maintain an adequate marshland habitat can be determined.

Accordingly, the program should be expanded to include:

1. A vegetational map of the 4343-acre marsh complex delineating freshwater communities (marshes, ponds, seasonal marshes, and wet meadows) and saltwater to brackish communities (salt meadow, salt marsh, brackish ponds) to provide a baseline for future evaluation.

2. Distribution data for hydrophytic plant species of the marsh complex so that the species indicative of salinity ranges may be identified and used as early-warning indicators of changes in the marsh complex.

6.1.3.2 Aquatic

The applicant's consultants made baseline studies of the freshwater and estuarine ecosystems on and near the site beginning in June 1973 and continuing to the present. The purpose of these studies is to enable identification and measurement of ecological changes due to plant construction and operation. Sampling station locations are shown on Fig. 2.7. The applicant plans to establish additional sampling stations within the cooling lake upon its completion. Tables 6.1-1 through 6.1-6 of the Environmental Report list water quality and biological parameters measured during the baseline study. The staff believes that the applicant's preoperational monitoring program will be adequate to assess the impacts of construction and potential impacts of operation if the program is extended to include the following:

1. A study program to collect baseline data on temporal and spatial distributions of species, population sizes, and the existing salinity and nutrient-input regimes in the Little Robbins Slough marsh complex. This data will be used to determine the relative importance of the marsh system as a nursery and the parameters critical for its maintenance. A detailed outline of the study program, to which the applicant has committed, is presented in Appendix E. Construction activities shall be limited so as not to reduce the watershed and freshwater inflow to Little Robbins Slough until after December 1, 1975. This limitation on construction will ensure the validity of the study program. After December 1, 1975 construction activities shall be performed so as to minimize watershed removal until completion of the study program.

2. Initiation of a two-phased studies program to determine the magnitude of entrainment losses that can be expected during plant operation and the need for mitigative measures during makeup operations under actual, low freshwater river flows. Each phase of the program will continue for one year or until sufficient data representative of low river flows have been collected, as determined by the staff from quarterly reports to be provided by the applicant. An interim report of the studies' findings and the applicant's proposals for makeup procedures to reduce entrainment losses to acceptable levels shall be forwarded to the staff six months prior to the commencement of cooling lake fill. A final report shall be forwarded to the staff upon completion of the lake fill. The results of this study will form the basis for development of environmental technical specifications at the operating license stage.

   The staff has determined that the following modifications to the entrainment program outline are required:

   a. The applicant shall initiate intensive sampling when salinities at station 2 at a depth of 8 to 10 feet exceed 3 ppt as determined by a continuously recording salinometer permanently (for the duration of the study program) positioned at this station and depth range. This criterion shall supercede that of 2 ppt at the bottom, provided in the program outline in Appendix E.

   b. Reports to be submitted by the applicant to the staff shall include continuous 24-hr salinity records from the recording salinometer (item a above). Additionally, freshwater flow, tidal excursions, and tidal flow information shall be provided for the 24-hr period during which each sampling effort at station 2 is conducted.

   c. Concurrently with the collection of biological samples at station 2, salinity shall be measured from surface to bottom at depth intervals not exceeding 5 feet.

   d. Midriver sampling for ichthyoplankton and crustacean young shall be performed by horizontal tows (rather than oblique tows) at the surface and at 10-ft and bottom depths to determine the depth at which high densities occur.

e. Beginning with the second phase of the entrainment study and continuing until termination of the study, the applicant shall monitor salinity at the top of the weir (Fig. 3.4) approximately 2 ft below the water surface with a permanently (for duration of study) positioned continuously recording salinometer.

3. Initiation of an impingement monitoring program that will coincide with the entrainment monitoring program during filling of the cooling lake. The program will continue for one year or until sufficient data representative of low river flow conditions have been collected, as determined by the staff from quarterly reports to be submitted by the applicant. A detailed outline of the impingement program is presented in Appendix E.

Final reports on the entrainment and impingement studies shall be submitted to the staff within four months of the termination of each study.

6.1.4 Radiological

The applicant has proposed an offsite preoperational monitoring program to provide background information for the operational radiological monitoring program. A summary description of the applicant's preoperational program is presented in Tables 6.1 and 6.2. The description is not intended to be a complete technical specification of the program. Monitoring and analytical techniques are likely to improve before the program is put into effect. More information is provided in the applicant's Environmental Report, Sect. 6.2.1.

6.2 OPERATIONAL PROGRAMS

The applicant discussed the operational monitoring program in the Environmental Report, Sect. 6.2, and this has been reviewed by the staff. Since the action proposed pertains to issuance of construction permits, detailed staff evaluation of this program will be done at the time of application for an operating license. A more definitive program can subsequently be developed on the basis of the preoperational monitoring results.

Table 6.1. Tentative scheme for the preoperational radiological monitoring program

For discharges to	Sample medium	Number of sampling stations	
		Indicator	Background
Atmosphere	Airborne particulates	9	2
	Airborne iodine	9	2
	Precipitation	1	1
	External radiation	9	4
	Soil	14	
River	Water	2	1
	Sediment	1	1
	Aquatic organisms		
	Fish	1	1
	Plants	1	1
	Shrimp	1	1
Groundwater	Wellwater	2	1

Table 6.2. Sizes and sensitivities of environmental samples[a]

Sample type	Sample size	Analysis	Sample sensitivity
External radiation	1 Quarter	Readout	0.5 mrem/period
Air particulates	300 m^3	Beta	2.7×10^{-3} pCi/m^3
	300 m^3	I-131	1.7×10^{-2} pCi/m^3
	1200 m^3	Gamma spectroscopy	1.5×10^{-2} pCi/m^3
	12 Filters	Sr-90	1 pCi/sample
Water	150 ml	Beta	5.4×10^{-3} pCi/ml
	1 liter	Gamma spectroscopy	8–80 pCi/liter
	1 liter	I-131	10 pCi/liter
	5 ml	H-3	400 pCi/liter
	0.15 liter	Sr-89 and Sr-90	1 pCi/liter
Soil	1000 g	Gamma spectroscopy	30–280 pCi/kg
	500 g	Sr-90	0.3 pCi/g
Flesh and vegetation	1000 g	Gamma spectroscopy	12–120 pCi/kg
Bone	25 g	Sr-89 and Sr-90	4.0×10^{-2} pCi/g

[a]ER, Tables 6.1-17 and 6.1-18.

7. ENVIRONMENTAL EFFECTS OF ACCIDENTS

7.1 ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

A high degree of protection against the occurrence of postulated accidents in the South Texas Project Units 1 and 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 was 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 were used for the purpose of comparing calculated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR 100 siting guidelines. Realistically computed doses that would be received by the population and environment from the postulated accidents would be significantly less than those presented in the Safety Evaluation.

The Commission issued guidance to applicant on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The applicant's response was contained in the Environmental Report submitted by Houston Power and Light Company, docketed July 5, 1974.

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 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, and those on the low-potential-consequence end have a higher 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.

Table 7.1. Classification of postulated accidents and occurrences

Class	NRC description	Applicant's examples
1	Trivial incidents	Containment purge releases
2	Small releases outside containment	Miscellaneous systems releases
3	Radioactive waste system failure	Leakage from waste gas storage tank contents; release of liquid waste storage tank contents
4	Fission products to primary system (BWR)	Not applicable
5	Fission products to primary and secondary systems (PWR)	Fuel cladding defects and steam generator tube leaks; off-design transients that endure fuel failure above those expected and steam generator tube leak; steam generator tube rupture
6	Refueling accident	Fuel assembly drop; heavy object drop onto fuel in core
7	Spent fuel handling accident	Fuel assembly drop in fuel storage pool; heavy object drop onto fuel rack; fuel cask drop.
8	Accident initiation events considered in design-basis evaluation in the Safety Analysis Report	Small reactor coolant system pipe break; large reactor coolant system pipe break; rod ejection accident; small steam line break outside containment; large steam break outside containment
9	Hypothetical sequence of failures more severe than Class 8	Not considered

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 2020.

Table 7.2. Summary of radiological consequences of postulated accidents[a]

Class	Event	Estimated fraction of 10 CFR 20 limit at site boundary[b]	Estimated dose to population in 50-mile radius (man-rems)
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	0.015	1.1
3.2	Release of waste gas storage tank contents	0.06	4.5
3.3	Release of liquid waste storage contents	0.002	0.12
4.0	Fission products to primary system (BWR)	N. A.[d]	N. A.
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	1.5
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.003	0.24
6.2	Heavy object drop onto fuel in core	0.056	4.1
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel rack	0.002	0.15
7.2	Heavy object drop onto fuel rack	0.008	0.6
7.3	Fuel cask drop	0.048	3.6
8.0	Accident initiation events considered in design basis evaluation in the SAR		
8.1	Loss-of-coolant accidents		
	Small break	0.034	4.5
	Large break	0.39	170
8.1(a)	Break in instrument line from primary system that penetrates the containment	N. A.	N. A.
8.2(a)	Rod ejection accident (PWR)	0.039	17
8.2(b)	Rod drop accident (BWR)	N. A.	N. A.
8.3(a)	Steamline breaks (PWR's outside containment)		
	Small break	<0.001	<0.1
	Large break	<0.001	<0.1
8.3(b)	Steamline break (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. The staff's 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 millirems 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 millirems/year to the whole body from either gaseous or liquid effluents).

[d]N. A. = not applicable.

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 that are anticipated during plant operations; 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 NRC is currently performing a study to assess more quantitatively these risks. The initial results of these efforts were made available for comment in draft form on August 20, 1974.[1] 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 accident probabilities. The Commission 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 NRC 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 will 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 which are less than that which would result from a year's exposure to the maximum permissible concentrations (MPC) of 10 CFR 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

The transportation of cold fuel to the plant, of irradiated fuel from the reactor to a fuel reprocessing plant, and of solid radioactive waste from the reactor to burial grounds is within the scope of the NRC report entitled, *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants*, dated December 1972. The environmental risks of accidents in transportation are summarized in Table 7.3.

Table 7.3. Environmental risks of accidents in transport of fuel and waste to and from a typical light-water-cooled nuclear power reactor

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

[1]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.

REFERENCE FOR SECTION 7

1. *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, Draft,* WASH-1400, August 1974.

8. NEED FOR POWER GENERATING CAPACITY

8.1 DESCRIPTION OF THE SYSTEM

8.1.1 Applicants' system and service area

The participants in the South Texas Project, Houston Lighting & Power Company (HL&P), Central Power and Light Company (CPL), the City Public Service Board of San Antonio (CPS), and the City of Austin (COA) serve a combined area of 51,769 sq miles. The service area shown in Fig. 8.1 is described roughly by a triangle with Galveston in the northeast, the Gulf Coast down to Brownsville in the south, along the Rio Grande River northwest to the intersection of an imaginary line joining Houston, San Antonio, and the river. The total population served is about 4.8 million, which is approximately 41% of the population of Texas (ER, Table 1.1-1).

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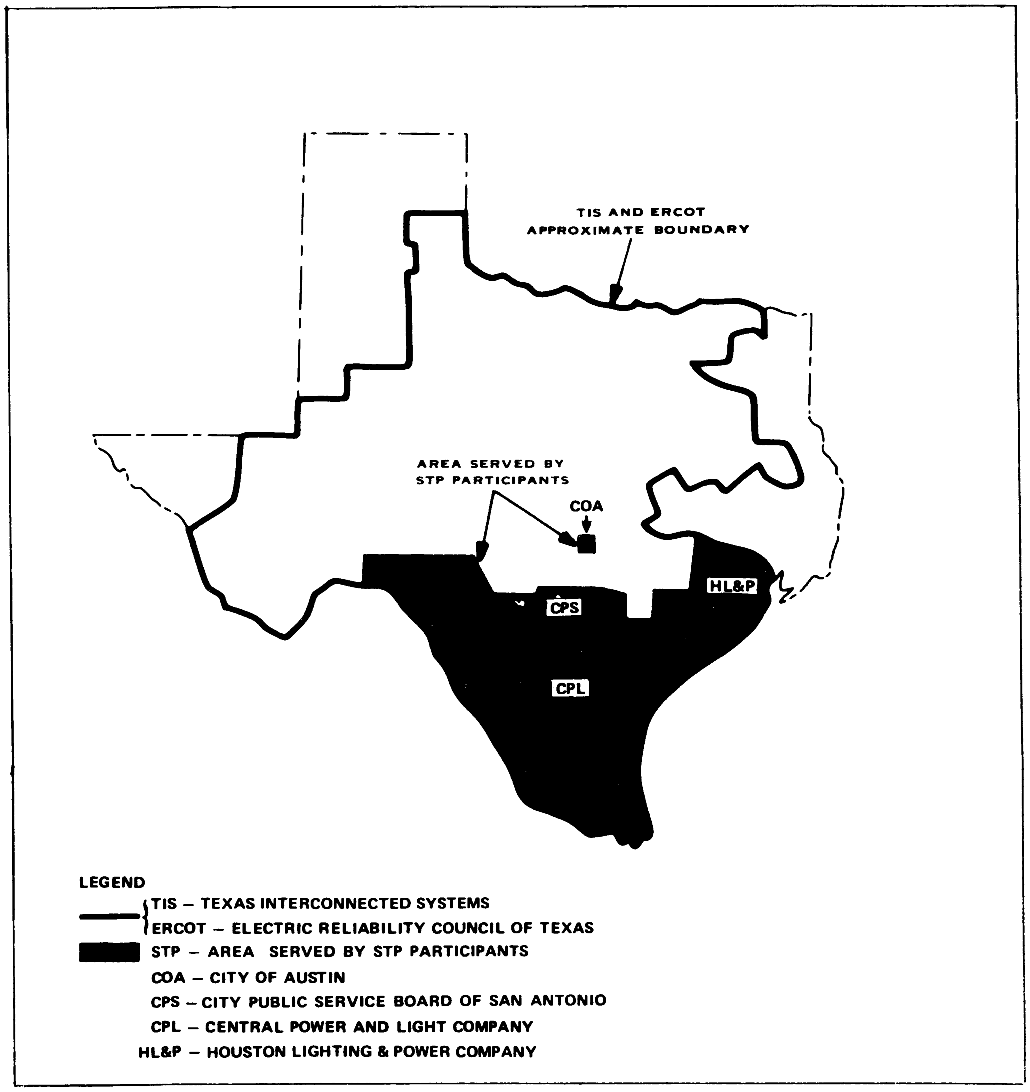

Fig. 8.1. Areas served by the participating utilities of the South Texas Project, the Texas Interconnected Systems and the Electric Reliability Council of Texas. Source: ER, Fig. 1.1-1.

8.1.2 Regional relationships

The STP participants are members of the Texas Interconnected System (TIS), which is a group of ten interconnected utilities serving the bulk of the State of Texas. Six of these systems are investor-owned, and the remainder are publicly owned. This affiliation was established some 30 years ago for reliability purposes, but imposes no obligation on members. Each member is expected, however, on the average, to maintain a minimum capacity reserve of 15% above expected peak load.

The TIS members are also members of the Electric Reliability Council of Texas (ERCOT), which is one of nine regional councils of the National Electric Reliability Council (NERC). Membership of ERCOT is composed of 28 municipalities, 47 cooperatives, 8 investor-owned companies, and 1 state agency. As one of the nine regional NERC councils, ERCOT participates in the review of national planning to solve power problems, considers design and operating criteria to enhance the reliability of service by each member to its customers, and reports annually to the Federal Power Commission (FPC) current and projected data concerning the electric power supply in its region. However, the principal expectation placed upon ERCOT members is that, on the average, reserve margins will be maintained above 15% of expected peak load.

A basic operating philosophy among TIS members is that each member will supply the requirements of its customers without heavy reliance upon interchange, except under abnormal circumstances. Under normal circumstances, interties are operated lightly loaded, which allows the spinning reserves of each member company to be available for contingencies elsewhere within the interconnected system. Interties are not maintained with neighboring power pools. The TIS members have a good record of serving their firm load obligations over the years, and this policy serves to insulate the system from problems of neighboring systems.

8.2 POWER REQUIREMENTS

8.2.1 Energy consumption

The STP participants serve a large and varied load. Generally speaking, COA and CPS serve commercial, educational, and administrative centers in their respective franchise areas. This includes eight military installations in Bexar County, which is served by CPS, as well as the state capital complex and the University of Texas, which are served by COA. On the other hand, HL&P and CPL serve substantial industrial loads and also the needs of agriculture in a large geographical area. Recent sales to the various classes of customers by each of the STP participants are shown in Table 8.1.

Table 8.1. Recent five-year average values of sales to classes of users, GWhr

	CPS[a]	Percent	CPL	Percent	HL&P	Percent	COA	Percent	Total	Percentage
					(GWhr)					
Residential	2,083	36	2,553	24	7,981	23	1,176	41	13,793	25.5
Commercial	868	15	2,234	21	6,940	20	688[b]	48	10,730	19.9
Industrial	2,025	35	5,212	49	17,698	51	688[b]		25,623	47.4
Other	810	14	638	6	2,082	6	315	11	3,845	7.1
Total	5,785		10,637		34,701		2,867		53,991	99.9[c]

[a]For year 1972 only (Source, ER, Table 1.1-1).
[b]Assuming equal distribution between commercial and industrial.
[c]Total is less than 100% because the numbers have been rounded off to the nearest tenth.

It is apparent that in the aggregate the STP participants satisfy a substantial industrial demand. The data show that this sector of customers consumes nearly 50% of the output of the four utilities. In 1973, HL&P and CPL had loads with contract provisions permitting limited interruptibility that represented 3.4% and 7.4% of the peak demands respectively (ER, Table 1.1-2).

Growth in total demand for electricity in the STP service area has increased at an average compound growth rate of 10% (ER, Table 1.1-2 and Refs. 1 and 2) between 1963 and 1973. This varies from a low of 7.8% for CPL to a high of 11.4% for COA. This is consistent with the findings of a recent report[3] issued by the Office of the Governor which indicates that the statewide growth rate in energy demand has been 10% per year.

It is of interest to consider whether the growth is attributable to new customers or to more intensive use by existing customers. Restricting attention only to HL&P and CPL, which serve 75% of the population and supply 84% of the energy demanded in the combined service area, the staff finds that the combined average residential use increased from 6930 kWhr per customer in 1966 to 12,082 kWhr per customer in 1972. It was found earlier that much of this increased usage in the case of HL&P could be attributed to the greater employment of air conditioning.[4] Inasmuch as HL&P and CPL serve very similar loads, the same is very likely true in the case of CPL and, indeed, for the other utilities as well. Thus, the number of residential customers as well as individual demand has increased.

In the commercial and industrial classes, the consumption per customer increased from 135,000 kWhr in 1966 to 221,000 kWhr in 1972. Such customer increase might be brought about because individual customers have expanded the size of their operations, or because customers are making more intensive use of electricity in production, or both reasons may apply. In the case of HL&P it was shown that there was a substantial increase in the use of electricity per dollar of value added in manufacturing during the years 1963 to 1971.[5] In addition, the average rate increase has increased by about a factor of 2 during those years. Thus, it appears that industrial and commercial activities in the STP service area are becoming much more energy-intensive.

8.2.2 Peak load demand

It is to be noted that in the aggregate the STP participants have not simply projected their peak demand in a mechanical fashion but have taken the potential effects of energy conservation into account. Not considering the effects of energy conservation would have required an even greater increased installed capacity to meet the expected demand, as is shown in Table 8.2. The load experience of the STP participants is shown in Fig. 8.2 for the years 1964 to the present, and also the projected loads to 1984. The average annual compound growth rate in peak demand for the past 10 years has been about 9.6%. The applicants forecast a future compound growth rate of 8.5% (average). From 1963 to 1970 inclusive, CPS sold 30,000 kWhr and CPL purchased 52,000 kWhr, which decreased to 32,000 kWhr in 1970. The other utilities neither bought nor sold any capacity nor are projected to do so. Beginning in 1973, CPL began to sell 10,000 kWhr, and sales are projected to increase irregularly settling back to the same value in later years (ER, Table 1.1-2).

Table 8.2. Demand projection using an historical growth rate[a]

Year	Actual projection[b] (MW)	Historical rate projection (MW)	Planned capacity[b] (MW)	Reserve (historical rate projection) (MW)	Reserve (historical rate projection) (%)	Planned reserve[b] (%)
1981	19,182	20,471	22,802	2331	11.4	18.9
1982	20,367	22,436	25,252	2816	12.6	24.0
1983	21,582	24,590	25,252	662	2.7	17.0
1984	22,773	26,950	25,892	−1058	−3.9	13.7

[a]Average compound growth rate for STP participants in the aggregate from 1963 to 1973 (9.6% per year).

[b]ER, Ammendment No. 4, response to question A-10.

Figure 8.3 shows the monthly variation in peak demand as a function of years over the last 10 years. As can be seen, the yearly peak occurs approximately during July and August for each of the STP participants, with elevated demands generally occurring between June and October. This is also true for TIS as a whole.

The predicted annual load durations for STP participants in 1981 (Fig. 8.4) also are in accord with this observation. The combined curves are quite steep, apparently owing to the strong seasonal bias.

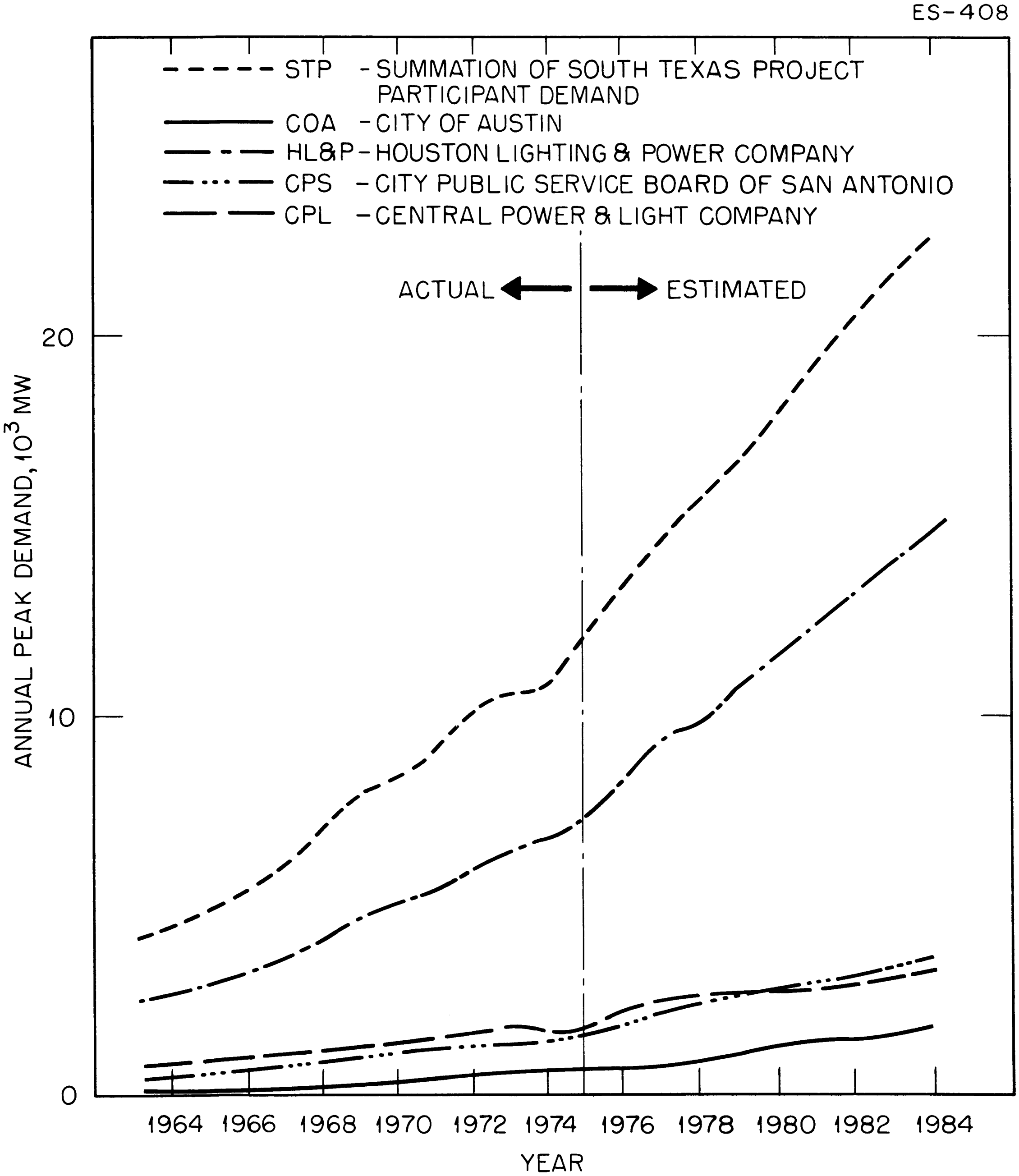

Fig. 8.2. Annual peak demand growth. Source: ER, Fig. 1.1-4.

8.2.3 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.[6] In the following sections, the staff considers conservation of energy as related to the need for the electricity to be produced by the South Texas Project.

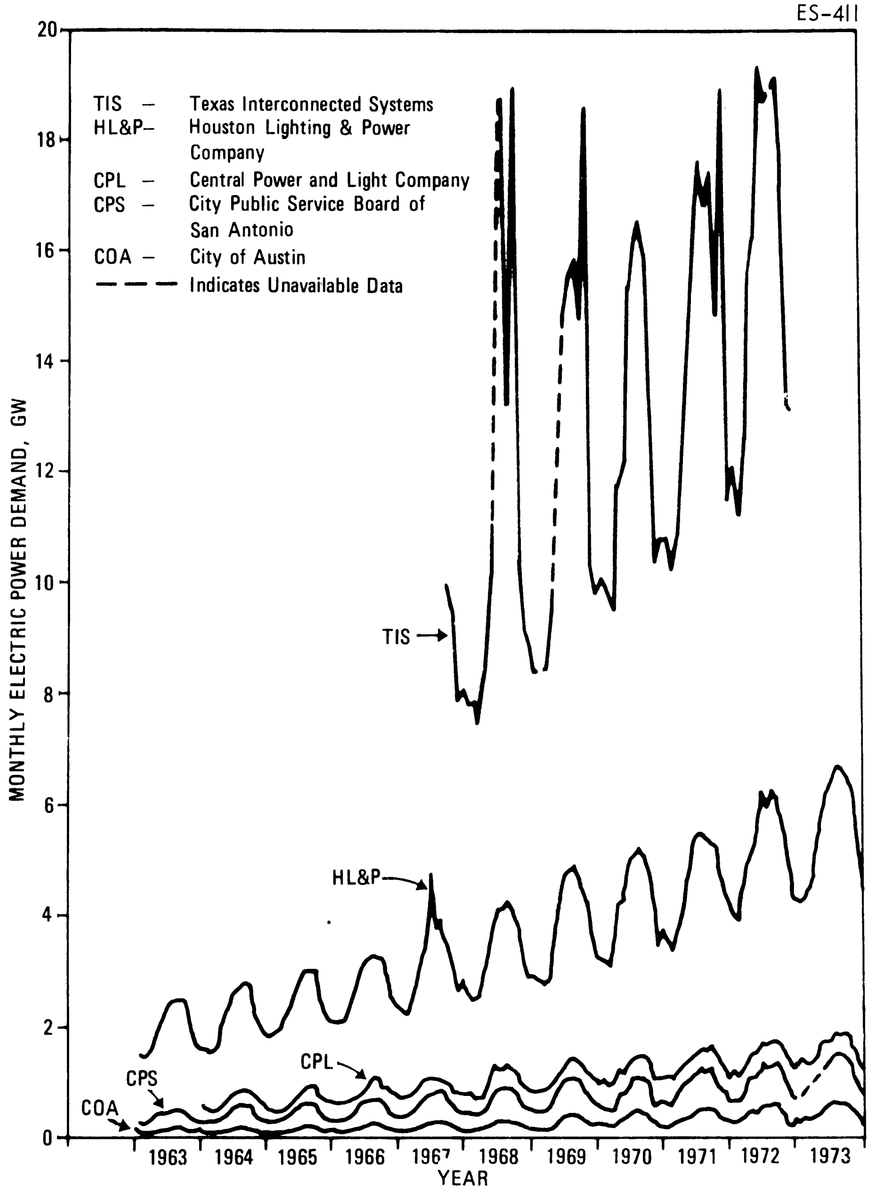

Fig. 8.3. Past monthly power demands. Source: ER, Fig. 1.1-6.

8.2.3.1 Recent experience

Consumption of electricity in the HL&P service area has been less than forecast by an average of 2.2% during the period October 1973 to June 1974. Monthly peak load demand has deviated from forecast by an average of 1.5% during this same period. The warmer than usual winter resulted in higher cooling loads through December and lower heating loads during the months of January through March. This weather was an overriding factor in any energy conservation deviation for the period in question. About 80% of the decreased usage is attributed to decreased industrial activity brought about by the crude oil shortage during the winter.

Consumption of electricity in the CPL service area has been more than forecast by an average of 2.8% for the months January 1974 through June 1974. This increase is attributed to the higher than normal temperature during the April to June period. A calculated decrease in consumption for residential customers of approximately 0.5 kWhr/degree day (or about 23%) from 1972 to 1973 is indicated.

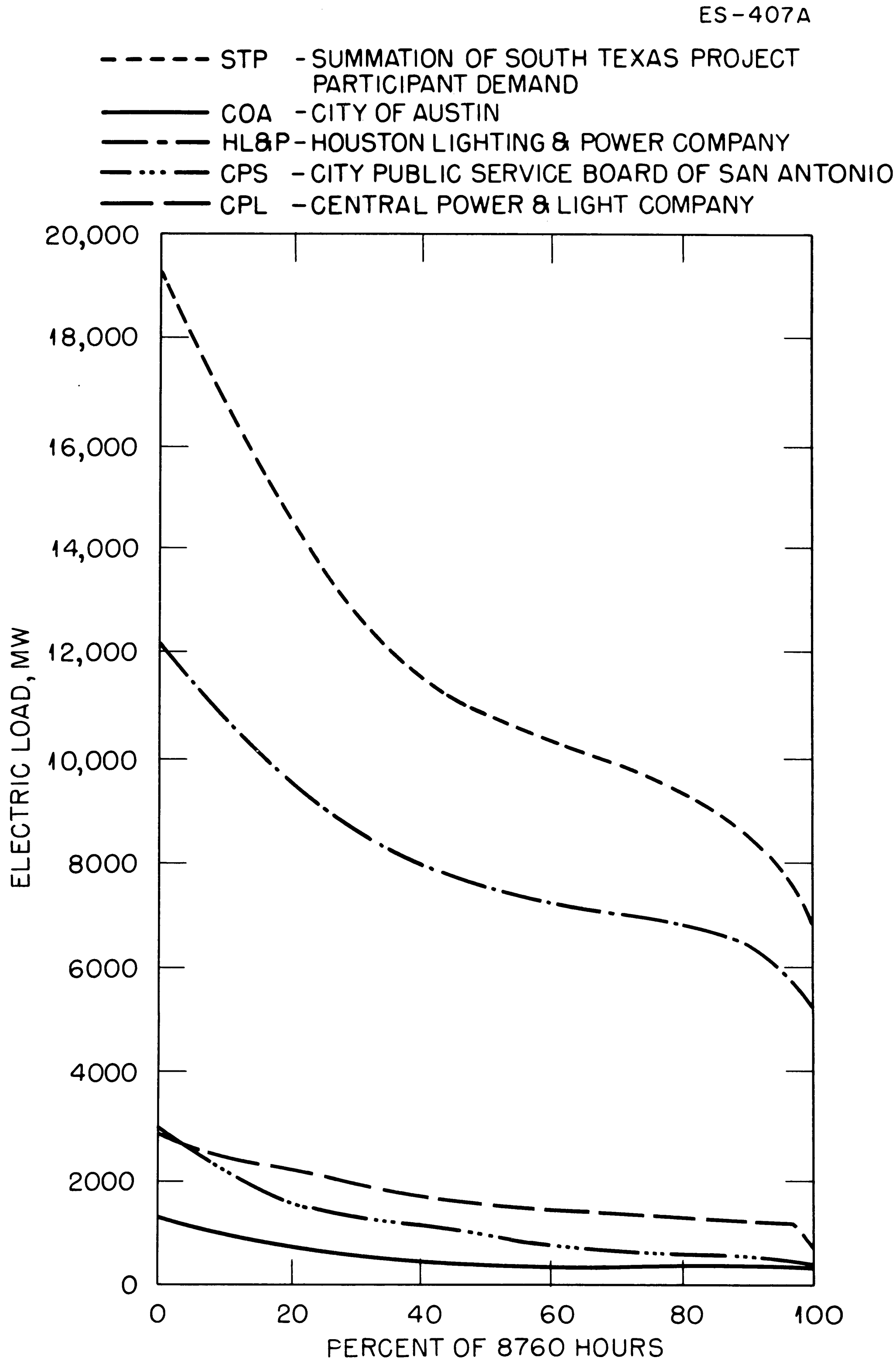

Fig. 8.4. Predicted load durations in 1981. Source: ER, Fig. 1.1-7.

Consumption of electricity in the COA service area has been less than forecast by an average of 12% during the period October 1973 to June 1974. Monthly peak load demand has deviated from forecast by an average of 11% during the same period.

Consumption of electricity in the CPS service area has been less than projections — an average of 7% for the months October 1973 through June 1974. Monthly peak load demand has been less than forecast by an average of about 9% during the same period. Forecasts since January 1974 have been revised to reflect a 10% reduction in normal customer consumption.

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 8.3 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 (1964–1971)[a]

	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	1.20	7.039	42.598	1735.482
1970	2.22	2.08	1.02	6.700	40.480	1695.087
1969	2.21	2.06	0.98	6.246	37.607	1666.019
1968	2.25	2.07	0 97	5.706	35.009	1578.366
1967	2.31	2.11	0.98	5.220	32.234	1481.496
1966	2.34	2.13	0.98	4.931	30.238	1445.802
1965	2.39	2.18	1.00	3.618	28.093	1289.949
1964	2.45	2.26	1.02	4.377	25.450	1217.878

[a]Federal Power Commission, *Northeast Power Failure* U.S. Government Printing Office, Washington, D.C., December 1965.

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.

Each of the STP participants attributes a portion of the deviation from forecast consumption to unusually warm or mild weather. Those who base their conservation estimate on degree-day figures estimate 10% total reduction or 20% for residential reduction attributable to factors other than weather. The interpretation of the significance of such limited data on energy conservation is difficult and its relevance to the forecasted need for power in the general service area over the next 6 to 10 years is highly uncertain. Much will depend, of course, on the future decisions of consumers and governmental agencies in responding to the energy crisis and potential developments in energy supply and demand factors which might ease the energy crisis or cause it to worsen. However, as time progresses historical information of these kinds and the actual data on power demand impacts in the general service area will provide a more significant basis for demand projections.

8.2.3.2 Promotional advertisement and conservation information services

Each STP participant began reducing promotional advertising in 1973 (ER, Amendment 2, Question A-4) and by direct mail and mass media advertising disseminated information designed to promote efficient residential usage of electricity. None of the STP participants now engages in promotional advertising. 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.[7]

The STP participants have programs to promote conservation of electricity. These were initiated in 1972 and include advertising, literature dissemination, and meetings with customers to encourage efficient use of electricity.

8.2.3.3 Change in utility rate structure

The Federal Power Commission regulates the transmission and sale of energy in interstate commerce.[8] There is no sale of power under the rate regulation of the FPC among the participant utilities, and there is no single state-wide regulatory body in Texas having jurisdiction over rates (ER, Amendment 2, Question A-5).

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 electrical energy to each customer. In the past the economic logic for declining block rates was never seriously disputed. 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.

8.2.3.4 Load shedding, load staggering, and interruptible load contracts to reduce peak demand

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.[9] This report identified several areas that are highly impacted by loss of power, such as elevators, traffic lights, subway lighting, prison and communication facilities. The serious impact on areas such as these results in load shedding as only a temporary method of overcoming a shortage of generating capacity during an emergency.

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.

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. However, STP participants do not include interruptible loads in the peak load estimate. The acceptability of interruptible load contracts to industrial customers depends upon balancing the potential economic loss that results from unannounced interruptions against the saving that results 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 STP participants had 1200 MWe of interruptible load, it is speculative to project that customers would continue this contractual relationship if faced with frequent and long periods with no electrical service.

The above measures do little to solve the energy shortage and cannot be considered as viable alternatives for required additional capacity.

8.2.3.5 Factors affecting the efficient utilization of electrical energy

During the past two years much of industry, the Federal Government, and many state and local governments have made the promotion of energy conservation a priority program. The Department of Commerce has developed a department-wide effort to: (1) encourage business firms to conserve energy in the operation of their own processes and building; (2) encourage the manufacture and marketing of more energy-efficient products; and (3) encourage businessmen to disseminate information on energy conservation. The National Bureau of Standards has been given a leading role in promoting the development and implementation of energy saving standards. Programs include: voluntary labeling of household appliances; research, development, and education relative to energy conservation in building; efficient use of energy in industrial processes; and improved energy efficiency in environmental control processes. While considerable efficiencies in electricity usage have already been gained and while further efficiencies will be realized, any present estimates of the magnitude of electricity savings to be realized over a period of time must be treated as tentative and subject to continual reassessment.

The need for generating capacity is based on annual peak load demand and not on the volume of consumption over the year. Any conservation measures that reduce consumption but not peak demand will have little or no impact on the need for capacity. The growth in peak demand will continue to be strongly influenced by installation of air conditioning in an increasing percentage of residences and commercial and industrial buildings. Also, conservation measures are potentially ineffective on peak load reductions because of the tendency to use air conditioning when the weather is hot and to conserve energy when the weather is mild.

Considerable efficiency can be achieved in space conditioning by improved insulation and the use of building materials with better insulation properties as well as by using equipment that transfers or stores excess heat or cold. For example, the seven-story Federal Office Building to be built in Manchester, New Hampshire, illustrates the potential for energy conservation in future commercial buildings using existing technology.[10] For this particular building, energy savings are anticipated to be a minimum of 20 to 25% over a conventionally designed building in the same location. Heat savings alone are expected to be 44% because of better insulated walls, less window area, use of efficient heating and heat storage equipment, and the use of solar collectors on the roof. It must be recognized, however, that these savings result only at certain times of the year, are not a total annual percentage, and are achievable only in the long term.

In 1971, the Federal Housing Administration (FHA) established new insulation standards which were to reduce average residential heating losses by one-third. Studies have shown that it is possible to gain even greater reductions in heat loss through improved insulation at costs which are economical over a period of years.[11] Improved insulation reduces not only the heating burden in winter but also the air conditioning burden in summer.

Lighting, which has accounted for about 24% of all electricity sold nationally, is another area where savings are being realized. Many experts believe recommended lighting levels in typical commercial buildings have been excessive.[12] It has been calculated that adequate illumination in commercial buildings can be achieved at 50% of current levels through various design and operational changes.[12] Another study indicated that if all 1970 households 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%.[13] However, since the majority of residential lighting occurs in off-peak hours, the reduction on peak demand would be less than 1%.

The potential for greater energy efficiency in household appliances is well recognized. The National Bureau of Standards is working with an Industrial Task Force from the Association of Home Appliance Manufacturers in a voluntary labeling program that would provide consumers with energy consumption and efficiency values for each appliance and educate them as to how to use this information. Room air conditioners are the first to be labeled. The next two categories of house appliances which are to be labeled are refrigerators and refrigerator/freezers and hot water heaters.

The importance of energy efficiency labeling of appliances is that it will allow the consumer to select the most energy efficient appliance. A recent study[14] titled "The Room Air Conditioner as an Energy Consumer" has estimated that an improvement in average efficiency from 6 to 10 Btu/Whr could hypothetically save electric utilities almost 58,000 MW in 1980. Air conditioners which are more energy efficient require a combination of increased heat exchanger size and higher efficiency compressors resulting in higher initial cost. The consumer must be convinced that it is profitable for him in the long run to purchase the more expensive machine. Today, however, there is a high degree of uncertainty in predicting to what extent consumers will actually purchase these more expensive appliances. In addition, selection of central air conditioning by developers and many home owners has historically been based on minimizing front end costs consistent with meeting local building codes.

Considerable opportunity for electricity conservation exists in industry, in addition to lighting and air conditioning efficiency already mentioned. Electric motors should be turned off when not in use and should be carefully sized according to the work they are to perform. Small savings can be realized by deenergizing transformers whenever possible. Fuel requirements for vacuum furnaces can be reduced by 75% if local direct-combustion low quality heating is employed rather than high quality electrical resistance heating.[15]

It is possible that some of the above examples of potential energy saving will be realized in the future, but in other instances there will be a substantial shortfall in achieving theoretical potentials due to economic, political, and technological performance considerations. As historical experience accumulates, a better forecast of the extent to which savings for these kinds of conservation measures will be implemented. In addition, the staff is aware that the National Institute of Occupational Safety and Health has recommended a 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.[16] This possible requirement, coupled with the above requirements, makes any significant reduction in the future peak demand for electricity due to this conservation-of-energy measure speculative at this time.

8.2.3.6 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 STP participants' service areas 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. 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 savings from other conservation-of-energy techniques.

A second kind of substitution which is relatively important in considering the need to add the proposed nuclear plant 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 system. This, in turn, will increase the availability of these material resources for other uses for which there is no available substitute.

8.2.3.7 Conclusion (conservation)

Although each of the conservation of energy measures evaluated by the staff 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 action of the public. The staff's 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, 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 these resources for which there are no available substitutes. Each STP participant has all of its base load and intermediate load capacity using oil and gas (minor waste heat contribution through 1980). As was noted in Sect. 8.2.2, the STP participants did not simply project their peak demands in a mechanical fashion but have reduced their aggregate growth rate in a reasonable manner to account for the possible effects of conservation. Based on the foregoing, the staff concludes that the additional capacity of the proposed nuclear plant is warranted.

8.3 POWER SUPPLY

8.3.1 System capability

The power generating capability of STP participants as of December 1973 is shown in detail in Table 8.4. The South Texas Project Units 1 and 2 are scheduled on line in 1981 and 1982, respectively. (ER, Table 1.1-6).

Figure 8.5 shows a comparison of planned capacity and predicted load for the combined STP participants through the year 1984. Also shown are reserve margins for the applicant including STP. If construction of new facilities occurs as planned, STP participants will barely have adequate reserve to meet the TIS Reserve Criteria until after the STP units are on line.

8.3.2 Regional capability

As was mentioned previously, STP participants are members of the Texas Interconnected Systems, a coordinating group which was formed to facilitate energy interchange of emergency power. The reserve margins for this group have ranged from 12% to 29% since 1968. Future reserves are not expected to exceed 22% with the addition of the STP units and will be less than 20% in 1981 after Unit 1 comes on line. It can therefore be concluded that the STP is an essential ingredient in the availability of reliable electrical power for the region in question.

8.4 RESERVE REQUIREMENTS

Capacity in addition to the estimated peak load is required in order to allow for forced outages and other unforeseen load losses. A commonly used value for this reserve margin is 20% of the forecast peak load. The actual value of reserve margin is determined by system reliability criteria, including the size and number of generating units, and whether or not generating units

Table 8.4. Installed generating units (as of December 31, 1973)

Station	Unit Number	Capability (MW)	Fuel[a]	Type[b]
		Central Power and Light Company (CPL)		
Joslin	1	240	G	S
Nueces Bay	3	17	G	S
	4	17	G	S
	5	35	G	S
	6	175	G	S
	7	325	G	S
La Palma	3	10	G	S
	4	27	G	S
	5	27	G	S
	6	150	G	S
Victoria	3	37	G	S
	4	73	G	S
	5	170	G	S
	6	240	G	S
Laredo	1	37	G	S
	2	36	G	S
Lon Hill	1	72	G	S
	2	70	G	S
	3	163	G	S
	4	240	G	S
Bates	1	74	G	S
	2	110	G	S
		City Public Service Board of San Antonio (CPS)		
Mission Road	1	23/20	G/O	S
	2	23/20	G/O	S
	3	100/80	G/O	S
Leon Creek	1	31/26	G/O	S
	2	31/26	G/O	S
	3	69/59	G/O	S
	4	105/85	G/O	S
W. B. Tuttle	1	69/59	G/O	S
	2	100/80	G/O	S
	3	105/85	G/O	S
	4	167/140	G/O	S
Victor Braunig	1	230/200	G/O	S
	2	250/220	G/O	S
	3	405/365	G/O	S
O. W. Sommers	1	440/385	G/O	S
		Houston Lighting & Power Company (HL&P)		
Cedar Bayou	1	750	G	S
	2	750	G	S
W. A. Parish	1	177	G	S
	2	177	G	S
	3	278	G	S
	4	565	G	S
	GT1	14	G	T
P. H. Robinson	1	441	G	S
	2	441	G	S
	3	565	G	S
	4	750	G	S
	GT1	14	G	T
Sam Bertron	1	177	G	S
	2	177	G	S
	3	235	G	S
	4	235	G	S
	GT1	27	G	T
	GT2	14	G	T

Table 8.4 (continued)

Station	Unit Number	Capability (MW)	Fuel[a]	Type[b]
Hiram Clark	1	44	G	S
	2	44	G	S
	3	82	G	S
	4	82	G	S
	GT1	14	G	T
	GT2	14	G	T
	GT3	14	G	T
	GT4	14	G	T
	GT5	14	G	T
	GT6	14	G	T
Deepwater	HP	61	G	S
	7	177	G	S
Gable Street	6	26	G	S
	7	36	G	S
Champion	1	6	G	S
	2	4	G	S
	3	12	G	S
T. H. Wharton	1	71	G	S
	2	234	G	S
	GT1	14	G	T
	31–34, 41, 42	300	G	T
	City of Austin (COA)			
Seaholm	5	20	G	S
	6	20	G	S
	7	20	G	S
	8	20	G	S
	9	40	G	S
Holly	1	100	G	S
	2	100	G	S
	3	165	G	S
Decker	1	325	G	S

[a]Fuel: G-gas, G/O-gas or oil.
[b]Type: S-Steam, T-turbine.

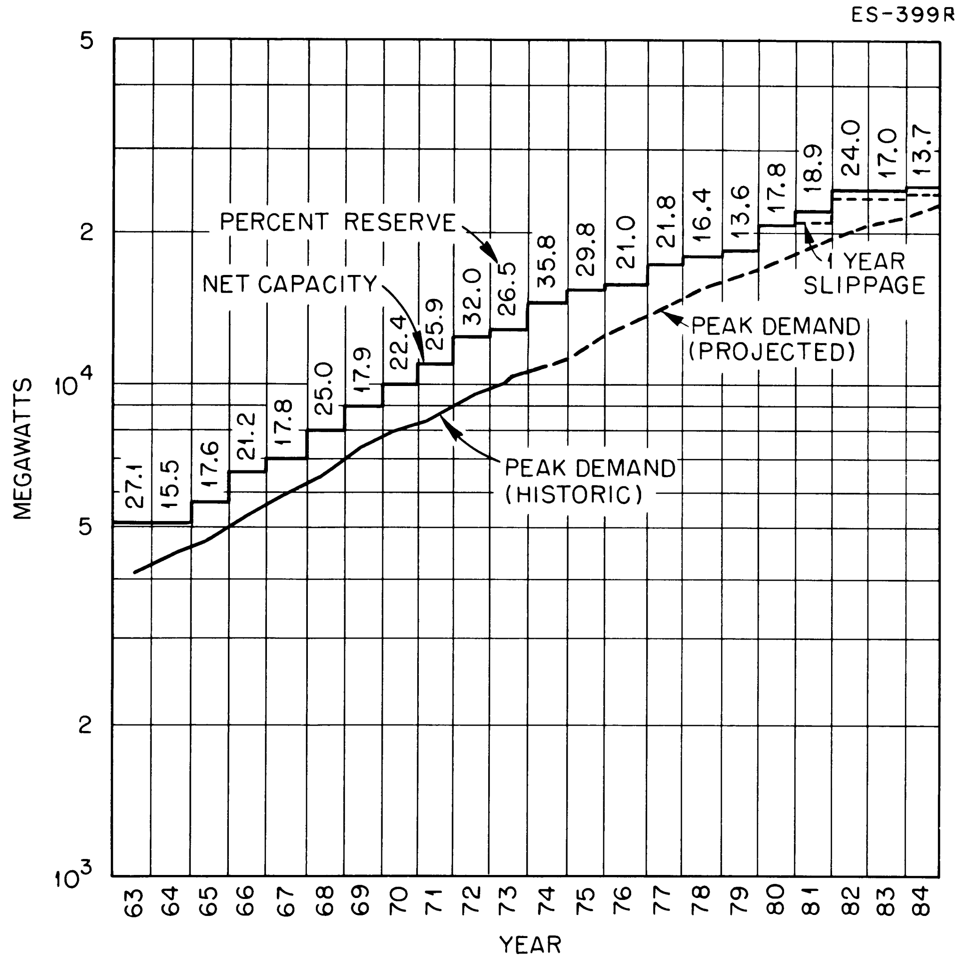

Fig. 8.5. Comparison of capacity and peak load for the South Texas Project participants. Source: ER, 1.1-13.

have to be inoperative during peak load periods. In the case of STP participants, who are members of the Texas Interconnected System (TIS), there is also a TIS Planning Criteria which calls upon each member to maintain a minimum reserve margin of at least 15% of forecasted peak load (ER, 1.1-10).

Estimates of reserve margin with the addition of the South Texas Project (STP) units range from 13.7 to 24% for the period 1981 to 1984. This compares favorably with the commonly used value of 20% for reserve margin. Without the STP units, each STP participant's reserve margin would drop below 15% which would not meet the TIS Planning Criteria in 1984.

As the size of units increase in proportion to the total installed capacity of the system the reserve margin must increase also, since a forced outage of a large generating unit will result in a greater amount of lost capacity. Also newer units will usually have a higher forced outage rate than mature units. These two factors would be justification for a higher reserve margin in the initial years of operation and for a reserve margin higher than the historical one. However, present load estimates indicate that the future reserve margin will remain about the same as the historical one, if not slightly lower.

8.5 SUMMARY AND CONCLUSIONS

The staff has evaluated the historical power demand and energy consumption statistics for service areas and for the ERCOT region. The service area reserve margin with the nuclear plant added on the proposed date of 1982 will be 24%. This is within the range of reserve margins recommended for the TIS of which STP participants are members. The staff also evaluated the predictions of electrical demand for each STP participant's service area and region for the years from the present through 1984. The staff recognizes the obligation of the applicant to plan for sufficient capacity to meet forecasted growth in demand and in energy consumption based on present knowledge of trends in these areas. The extent to which future growth will follow past patterns because of energy conservation decreases and electrical energy substitution increases is difficult to predict at this time.

The staff concludes that predictions of future demand and energy requirement form a reasonable basis for planning capacity requirements for 1981-1982. The staff also concludes that the South Texas Project Units 1 and 2 are a necessary part of the plan for meeting these forecast loads.

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9. BENEFIT-COST ANALYSIS OF ALTERNATIVES

Section 8 established that the applicant will need additional generating capacity of about 2500 MWe for the 1981-1982 period. This section will examine potential sites for the facility, possible energy sources to generate the electricity, and alternative cooling systems.

9.1 ALTERNATIVE ENERGY SOURCES AND SITES

9.1.1 Alternates not requiring creation of new generating capacity

9.1.1.1 Purchased power or diversity exchange

The staff explored in Sect. 8 the applicant's general obligations to the interconnected systems of Texas, basically TIS, and the operating and reserve policies practiced by the utilities of the state. Neighboring utilities must add capacity to maintain their own reserves, and these utilities are all summer-peaking systems. The staff concludes that the purchase or exchange of power is not a viable alternative.

9.1.1.2 Reactivating or upgrading an older plant

The applicant does not have deactivated units of sufficient size to achieve 2500 MWe; the upgrading of existing units is not considered by the staff to be practical. This would require higher pressure or higher capacity boilers, additional or redesigned turbines and condensers, and added capacity to dissipate waste heat. The staff concludes that this is not a viable alternative.

9.1.1.3 Operating peaking units as base load

The applicant does not have sufficient generating capacity to maintain the 15% system reserve criterion beyond 1980. Therefore, new capacity must be installed. The staff concludes that conversion of existing peaking units is not a viable alternative.

9.1.2 Alternatives requiring creation of new generating capacity

9.1.2.1 Alternative energy sources

The selection of a feasible power source as an alternative to the STP requires that a broad range of criteria be satisfied. These criteria for selection are adapted from the *Nation's Energy Future*[1] where they were used in establishing Federal research and development priorities and are listed in Table 9.1. For this particular application, an alternative is considered to be feasible providing it fulfills every one of the criteria and, in addition, has a timing which is rated "near." The latter means that the alternative power source is available for the near term, 1974-1985. This overlaps the 1980-1981 period when the STP is expected to begin operation. The alternatives listed in Table 9.1 were chosen from comprehensive references.[1-5]

Of all the alternatives investigated by the staff, only coal is a feasible alternative and is ranked at the same level as nuclear power. Oil and gas are ranked second because of the uncertainty of the adequacy of the reserves of these resources. At the present time, the applicant, as well as the country as a whole, is experiencing difficulty in obtaining adequate long-range supplies of oil and gas. Additional supplies may become available in the 1980's from the Trans-Alaskan Pipeline, the Outer Continental Shelf, imports, and on-land sources (secondary recovery of oil and deregulation of natural gas). However, quantities of these supplies are very uncertain. In addition, from the overall public interest point of view, it is more desirable to retain oil and gas for premium uses, such as petrochemicals, transportation, space heating, and uses for which there are few, if any, alternatives.

The remaining sources are not feasible for a variety of reasons. For example, hydroelectric sources are not possible because of the lack of water potential in the area to be serviced.

Table 9.1. Selection of feasible power sources for alternatives to the South Texas Project

Type of power	Criteria for selection														
	Adequacy of scientific base	Probability of future technological success	Feasible absorbable investment	Public and government consensus that project is acceptable	Expected price/cost of production	Environmental acceptability	No substantial need for government role	Adequacy of resource reserves	Labor available	Hardware developed	Private capital available	National security	Total	Timing (near, mid, long)[a]	Feasible alternatives
1. Nuclear – STP	x	x	x	x	x	x	x	x	x	x	x	x	12	N	1
2. Coal – conventional	x	x	x	x	x	x	x	x	x	x	x	x	12	N	1
3. Oil	x	x	x	x	x	x	x		x	x	x		10	N	2
4. Gas	x	x	x	x	x	x	x		x	x	x		10	N	2
5. Hydroelectric	x	x	x	x	x	x	x		x	x	x	x	11	N	
6. Shale oil	x	x	x	x	x	x	x				x	x	9	M	
7. Geothermal	x	x		x	x	x	x	x				x	8	M	
8. Nuclear – LMFBR	x	x	x	x	x	x		x				x	8	M	
9. Fuel from wastes	x	x		x	x	x			x			x	7	M	
10. Fuel cells	x	x		x		x		x				x	6	M	
11. Wind	x	x		x		x		x				x	6	M	
12. Coal – binary cycle				x		x		x				x	4	M	
13. Coal – MHD				x		x		x				x	4	M	
14. Solar				x		x		x				x	4	L	
15. Fusion				x		x		x				x	4	L	
16. Ocean thermocline				x		x							2	L	

[a]Timing: Near (N): 1974–1985, Mid (M): 1985–2000, Long (L): 2000+.

The most important reason for dismissing the others as not feasible is for the important criterion of timing. For instance, the recent discovery of geopressured sands off the Texas Gulf Coast present an encouraging outlook for future utilization as an abundant energy source. But the geothermal energy technology necessary to exploit the type of geothermal resources available in this region requires extensive additional research and prototype testing before it could be called reliable. Its feasibility for providing the output capacity required by 1980 is questionable, and therefore the staff eliminated it as a viable alternative.[6]

The coal alternative

A conventional coal-fired power plant is the only serious alternative to the STP since all of the criteria for selection are fulfilled in a broad sense. In order to determine which of the two is more socially desirable, each criterion must be examined and compared. It is the staff's view that the only differences arise from two criteria: expected price cost of production and environmental acceptability.

First, the expected price cost of production will be examined. The staff has estimated the present value (1981) generating cost for a coal-fired power plant using Wyoming coal and compared it with the STP. The results are illustrated as a function of capacity factor in Fig. 9.1. The assumptions used in obtaining these results are listed in Table 9.2. For comparison, the applicant's estimate for the STP is given also. The staff concludes that for capacity factors between about 50 to 80%, nuclear power is more economical than a conventional coal-fired plant using Wyoming coal. (Note that both plants would be expected to operate in the range of 60% to 80% capacity factor.) This conclusion is consistent with two separate independent estimates. One estimate was for Comanche Peak Steam Electric Station near Dallas, Texas,[7] and the other was for Allens Creek Nuclear Generating Station near Houston, Texas.[8] For both cases, the basic assumptions were close enough to the assumptions used in Table 9.2 that in the staff's view the conclusions would be similar. The staff has examined the overall environmental impact of a coal-fired plant compared to a nuclear plant like the STP, as described in a number of reviews,[9-12] and concludes that, in general, both are about equally acceptable as sources of electric power, providing stringent control measures are exercised. If aesthetics are given consideration, then the staff views a nuclear power plant as preferable. Lignite is discussed in Sect. 11.6.1.

On balancing expected price/cost of production with environmental acceptability, the staff concludes that the STP is the more favorable alternative from both economic and environmental considerations.

9.1.2.2 Alternative sites

9.1.2.2.1 Candidate regions

There are a number of potentially suitable sites for a nuclear generating plant within the applicant's service area. Theoretically, any location within the service area, and for a considerable distance beyond, is a candidate site. However, since there are suitable sites in or near the service area, the staff concluded that consideration of other sites was not warranted.

The ownership arrangement of the four parties that make up the applicant was a primary factor in choosing the area to be investigated. Since transmission economics suggest a centrally located plant site, the overall area of interest for this study was defined as the geographic region roughly bounded by an imaginary line from Houston to Austin, to San Antonio to Corpus Christi, and back to Houston. Two important siting parameters were hydrology and geotechnic considerations.

The study area was subdivided by the applicant into river basin (inland) regions and coastal regions to establish regions of hydrologic similarity. A total of 22 different water supply regions resulted from this partitioning. Ratings were developed for each of these regions, giving equal weight to hydrologic and geotechnic factors. Based on this analysis, the most promising regions were identified as those encompassing the Brazos and Colorado River basins and a large part of the coastal area adjacent to the Gulf of Mexico.

From this initial analysis, the ten best regions were subjected to more detailed analyses which considered four additional parameters, including ecology, land use, demography, and meteorology. The staff concluded that the west and east Colorado-Coastal regions (2), the Colorado North Central region, and the Lavaca/Guadalupe-Coastal region were acceptable.

9.1.2.2.2 Candidate site alternatives

Site location efforts concentrated on the five preferred regions noted earlier. The siting factors used for regional evaluations were also used to identify candidate sites, except a

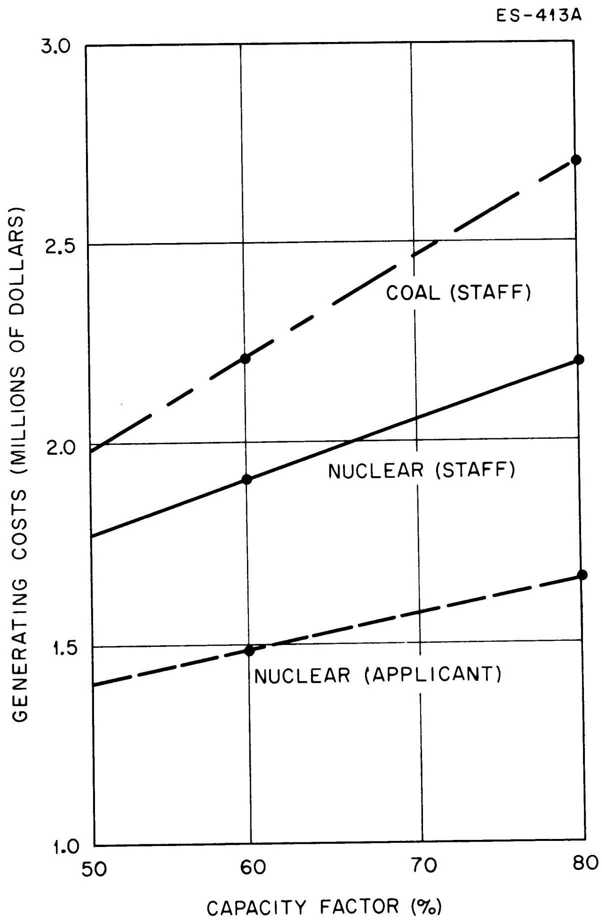

Fig. 9.1. Total generating cost (present value - 1981) of the South Texas Project and a coal-fired power plant vs capacity factor.

more detailed analysis was pursued. Eight potential plant sites were identified as a result of this investigation and are shown in Fig. 9.2. In addition to the land-based sites, offshore nuclear siting concepts were also considered.

The offshore, floating nuclear power plant concept is potentially suitable as a further alternative to land-based siting. However, in the time frame of the probable need for these generating units, the offshore nuclear plant is not a real possibility. Plans for building offshore nuclear stations are well advanced. However, given (1) the need to complete the licensing of the production facility at Jacksonville, Florida; (2) the fact that the first two units scheduled to come off the line are to fill an order for placement off New Jersey; (3) the need to evaluate competing uses of a site; and (4) the requirement to conduct extensive geological, seismological, and meteorological tests to select a specific site preclude the concept from consideration for the current application. A description of the eight candidate site alternatives is given below and is summarized in tabular form in Table 9.3.

Site A

This site is located in the south central part of Matagorda County. It lies east of the Colorado River and is 9 miles northeast of the town of Matagorda. The land is predominantly agricultural, with the major portion being used as temporary pasture for cattle and horses in rotation with rice production. Average annual agricultural production grosses about $485,000.

Approximately 23,570 acres of wetlands are within the site, of which 22,280 acres are coastal estuarine wetlands. To some extent these wetlands will be affected by the removal of watershed. Important aquatic species that may be present include 12 game and 12 commercial species.

Table 9.2. Assumptions and data used to estimate the present value (1981) generating cost for the South Texas Project Nuclear Generating Station and a Wyoming coal-fired power plant alternative

	Nuclear		Coal-fired
	Staff	Applicant	Staff
Capital costs, billion dollars	1.11[a]	1.094	0.794[a]
Operation and maintenance costs, mills/kWhr	1.4[b]	0.351[c]	2.4[b,d]
Fuel costs mills/kWhr	5.2[b]	2.89[c]	9.1[e]
Interest for cost of capital, %	10.0	9.0	10.0
Plant life, years	30	30	30
Capacity factor, %	80	80	80
Generating costs, billion dollars	2.201[f]	1.676[f]	2.694[f]

[a]Estimated from CONCEPT code. See Appendix D.

[b]U.S. Atomic Energy Commission, *The Nuclear Industry 1974,* WASH 1174-74, Government Printing Office, Washington, D.C. Figures have been adjusted to 1981.

[c]ER, Sect. 8.2.

[d]M. L. Meyers, *Cost Estimate for the Limestone Wet Scrubbing Sulfur Oxide Control Process,* ORNL-TM-4142 (July 1973). Cost of operation and maintenance component was adjusted to 1981, which, in turn, was used to adjust the figure from ref. *b.*

[e]ER, p. 9.2–8, assuming a heat rate of 10,000 Btu/kWhr.

[f]Calculated by the staff from the above values.

The incidence of salt domes is quite high in the vicinity of this site, in addition to a high incidence of imagery observed tonal anomalies (IOTAs). Subsidence has been moderate over a 40-year period, and the future potential is also considered moderate. There are also growth faults in close proximity (ER, p. 9.2-33). Owing to these geotechnic considerations, this site was found to be less desirable than all others in this respect.

Natural communities of the site include only 75 acres of scrubland. Important wildlife species that should be present include 41 game, 24 blue list, 7 peripheral, and 2 endangered species.

Site B

This site is located west of the Colorado River in the south central region of Matagorda County. The land is primarily used for agriculture, with rice being the predominant crop grown in rotation with sorghum, or fallowed. Average annual agricultural production grosses approximately $981,000. The most significant environmental impact at this site will be the removal of 27% of the Little Robbins Slough watershed, which will have a significant effect on freshwater input to the adjacent 4275-acre coastal estuarine marshes. Freshwater wetlands within 10 miles of the site include 250 acres of river habitat and 880 acres of ponds and lakes. The number and kinds of important aquatic species are the same as for site A. No natural communities occur on the site due to intense agricultural use. Potentially important species include 46 game, 25 blue list, 8 peripheral, and 2 endangered wildlife species. This site is remote from salt domes, and any growth faults in the vicinity have been inactive during recent geologic periods. Subsidence has been historically somewhat less than that for site A and is judged to have minimal future potential for this activity (ER, p. 9.2-24). The applicant selected this site for the STP.

Site C

This is located east of the Colorado River northwest of site A. The land is used primarily for agriculture, with rice the principal crop and sorghum, hay, and cattle of minor importance. Average annual gross agricultural production is about $863,000. The population within 10 miles of the site is already significantly different from the other coastal sites, and projection to the year 2000 indicates that these differences will increase even more as the population increases. Subsidence has in the past been similar to that of site A but will probably be affected most significantly by the possible growth of Bay City in that direction and the consequent removal of additional groundwater (ER, p. 9.2-25). The site affects about 690 acres of coastal estuaries and 885 acres of freshwater wetlands within 10 miles. The number and kinds of important aquatic species are the same as for site A. Natural communities of the site include 57 acres of scrubland and 165 acres of savannah. Important wildlife potentially present includes 46 game, 24 blue list, 8 peripheral, and 3 endangered species.

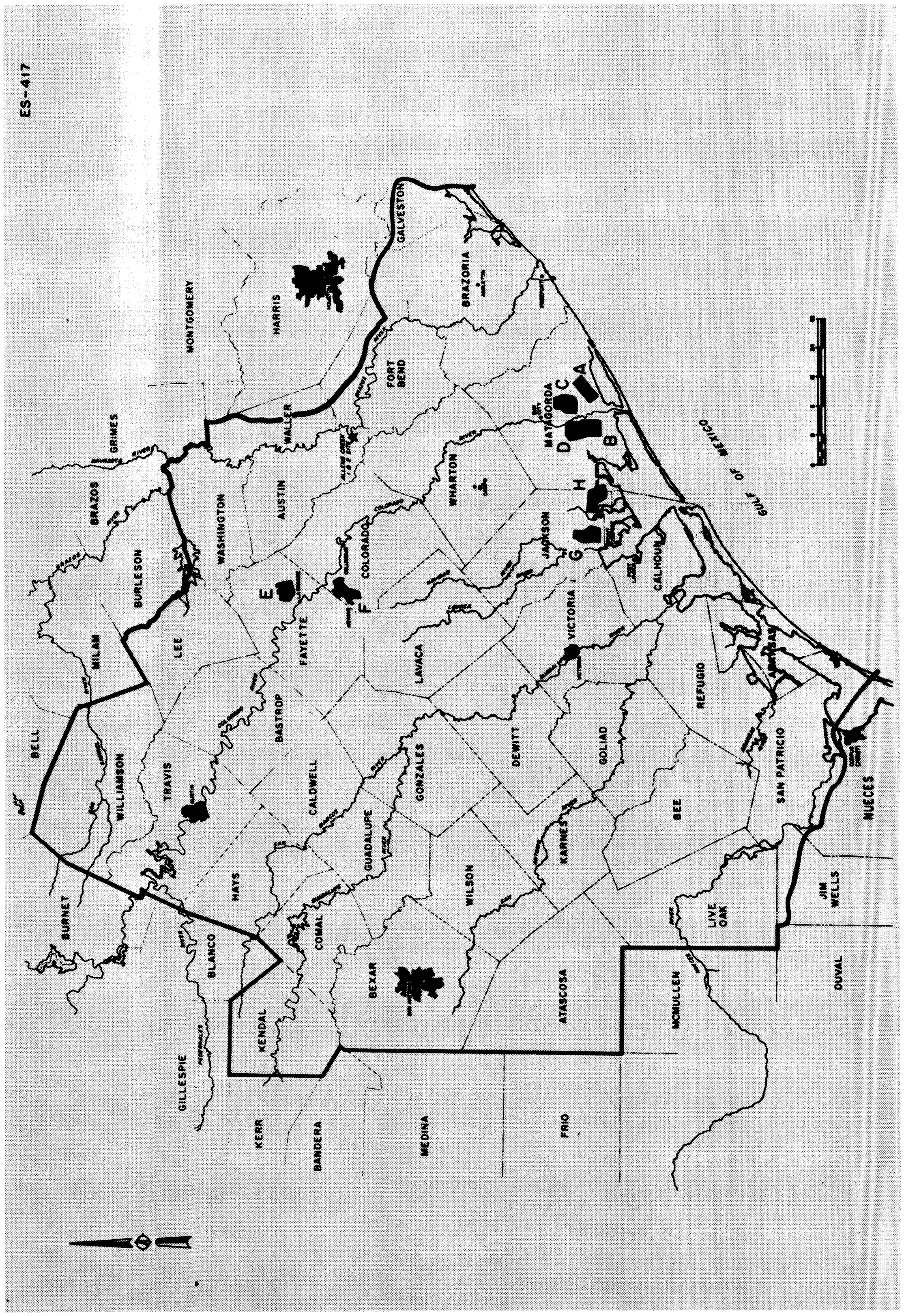

Fig. 9.2. Candidate site locations for the South Texas Project.
Source: ER, Fig. 9.2-6.

Table 9.3. Cost-effectiveness comparison of candidate sites

	Site			
	A	B	C	D
Cost differential	$858,000	$368,000	$1,793,000	BASE
Geotechnic considerations	Coastal Soils and Geology Region. Possible growth "faults" in area. High incidence of IOTAs. Salt domes nearby. Extensive geotechnical program required.	Coastal Soils and Geology Region. Low incidence of IOTAs. Salt dome across Colorado River.	Coastal Soils and Geology Region. Very low incidence of IOTAs. Subsidence possible due to groundwater depletion. Salt dome influence possible.	Coastal Soils and Geology Region. Moderate incidence of IOTAs. Salt dome across Colorado River. Oil and gas fields near site.
Land use	Open land with few trees. Mostly in rice. Some cattle and horses on site. Annual gross production, $485,000. Cooling Lake 7000 ac.	Cattle grazing on fallow fields. Major crop, rice. Annual gross production, $981,000. Cooling Lake 7000 ac.	Land is mostly in rice, with some plowed land and some pasture. Medium size petrochemical plant near site. Annual gross production, $863.000. Cooling Lake 7000 ac.	Southern half in rice. Northern part grazing, hay, and sorghum. Annual gross production, $834,000. Cooling Lake 7000 ac.
Demography	Population within: 1970 / 2020 5 miles 450 / 900 10 miles 1,900 / 3,900 50 miles 203,500 / 955,000	Population within: 1970 / 2020 5 miles 100 / 200 10 miles 2,700 / 6,000 50 miles 170,000 / 770,000	Population within: 1970 / 2020 5 miles 11,000 / 22,500 10 miles 17,100 / 35,000 50 miles 200,000 / 900,000	Population within: 1970 / 2020 5 miles 250 / 500 10 miles 3,000 / 5,800 50 miles 190,000 / 820,000
Terrestrial ecology	Seventy-five acres of scrubland present. Near marshlands. Moderately good habitat for 74 important animal species.	Heavy disturbance due to farming and grazing. Moderately good habitat for 81 important animal species.	Early successional stage, including both scrubland and savannah. Moderately good habitat for 81 important animal species.	Early successional stage due to farming and grazing. Northeastern portion of the site contains bottomland forest. Habitats for 87 important animal species.
Aquatic ecology	High quality water could be drawn from the Colorado River delta, an area of little ecological sensitivity, and discharged downstream into lower quality water without undesirable effects. Controlled release could prove desirable during severe droughts. All four sites are adjacent to coastal estuarine marsh, and loss of watershed will have some impact.			
Meteorology	Moderate frequency of occurrence of stable and very stable conditions. Relatively good diffusion of effluents. Heat dissipation system could cause increased amounts of fog in the vicinity of the site. Low tornado frequency. Magnitude of 100-year wind relatively low.			
Water use	Unappropriated Colorado River water.	Unappropriated Colorado River water.	Unappropriated Colorado River water.	Unappropriated Colorado River water.

Table 9.3 (continued)

	Site			
	E	F	G	H
Cost differential	$3,396,000	$3,699,000	$37,187,000	$28,426,000
Geotechnic considerations	North Central Soils and Geology Region. Favorable foundation conditions. IOTAs and subsidence not present.	North Central Soils and Geology Region. Favorable foundation conditions. IOTAs and subsidence not present.	Coastal Soils and Geology Region. Moderate incidence of IOTAs – including one through the site. Subsidence possible due to oil and gas production and ground water depletion.	Coastal Soils and Geology Region. Low incidence of IOTAs.
Land use	Rolling hills with some open pasture. Cattle production in vicinity. Annual gross production, $92,000. Cooling Lake 4500 ac.	Mostly rolling pastureland with cattle grazing on and near site. Many small ranches. Annual gross production, $87,000. Cooling Lake 5784 ac.	Agricultural crops include rice, sorghum, hay, and cattle. Industrial area nearby. Annual gross production, $499,000.	Open land with few dwellings is used mostly for raising sorghum, rice, and cattle. Surrounded by oil fields. Annual gross production, $719,000.
Demography	Population within: 1970 / 2020 5 miles: 1,250 / 1,000 10 miles: 7,000 / 4,100 50 miles: 149,000 / 281,000	Population within: 1970 / 2020 5 miles: 2,900 / 7,700 10 miles: 5,500 / 16,000 50 miles: 154,000 / 357,000	Population within: 1970 / 2020 5 miles: 450 / 2,700 10 miles: 3,500 / 22,000 50 miles: 148,000 / 350,000	Population within: 1970 / 2020 5 miles: 300 / 1,100 10 miles: 5,400 / 12,000 50 miles: 152,000 / 410,000
Terrestrial ecology	Moderate amount of woodlands and savannah. Houston Toad could be present. Habitats exist for 63 important animal species.	Heavily wooded. Possibility of Houston Toad in area. Habitats exist for 63 important animal species.	Site mainly covered with mesquite. Habitats exist for 77 important animal species.	Plant communities mostly disturbed and in early successional stage. Habitats exist for 96 important animal species.
Aquatic ecology	Colorado River at this level contains no unique fauna and no significant spawning or nursery grounds. Plant discharge into river during low flow might be injurious to existing habitat.		Location close to Bay. Pipeline would pass through important spawning and nursery area in coastal estuarine waters.	
Meteorology	High frequency of occurrence of stable and very stable conditions. Fair diffusion of effluents. Heat dissipation system may increase the amount of fog but not frequently enough to cause adverse environmental effects. Low tornado frequency. Magnitude of 100-y wind high (> 100 mph).		Moderate frequency of occurrence of stable and very stable conditions. Relatively good diffusion of effluents. Heat dissipation system could cause increased amounts of fog in the vicinity of the site. Low tornado frequency. Magnitude of 100-year wind relatively low.	
Water use	Appropriated Colorado River water.	Appropriated Colorado River water.	Salt water from Gulf of Mexico.	Salt water from Gulf of Mexico.

Site D

Site D is located west of the Colorado River and is adjacent to and overlaps site B to some extent. This site is primarily devoted to rice and sorghum production, with 804 acres of lowland woods in the northeast corner. Annual agricultural production grosses about $834,000. Within 10 miles of the site are 1870 acres of estuarine habitat and 847 acres of freshwater rivers, lakes, and pond habitat. Since this site is north of site B, less of the Little Robbins Slough watershed is removed, with a smaller effect upon the coastal estuarine marshlands lying to the south. The number of important aquatic organisms is the same as for site A, but there are more important wildlife species, including three endangered species. The near-surface soils are primarily clays of a type which are moderately compressible so that it might be necessary to introduce special structural techniques to prevent excessive foundation settlement (ER, p. 9.2-26). There is extensive production of oil and gas immediately to the north of the site. Some of the fields are within 2 miles of the site. Another field is within 4 miles in the same direction. This site would require the smallest expenditure to build the plant, though it is not significantly less than the cost for site B (ER, Table 9.3-1).

Site E

Site E is located northeast of the Colorado River within 7.5 miles of the town of LaGrange. The site is located in upland prairies on rolling hills. The general land use is for grazing livestock, with an annual gross agricultural production of about $92,000. Natural communities include 867 acres of woodland and 206 acres of savannah. Important wildlife species potentially present include 39 game, 21 blue list, 2 peripheral, and 1 endangered species. Within 10 miles of the site are 2108 acres of freshwater lakes and river habitat. Important aquatic species that should be present include nine game and nine commercial species. There are no significant ecological effects associated with the construction of the plant at this site. Also, there are no serious population problems, as it is not an area of rapid population growth. The costs for land acquisition, construction, and makeup water purchase are significantly higher than for all other sites except site F (Table 9.3).

Site F

Site F is located south of the Colorado River in gentle sloping hills which are separated by narrow valleys containing intermittent streams. Much of the land is presently grazed, with an annual gross agricultural production of about $87,000, the lowest figure for any of the sites analyzed. About 1600 acres of fairly mature forest and 550 acres of savannah occur in lowlands along streams and in the northeastern portion of the site. The number of important aquatic and terrestrial wildlife species is the same as for site E, less than for any of the coastal sites. Aquatic habitats within 10 miles of the site include about 870 acres of river and 1240 acres of lake and pond habitats. Population levels within 5 miles are higher than for all other sites except C, and growth trends will probably maintain this.

The cost for land acquisition is higher than for site E, and costs for both sites E and F are significantly higher than for all coastal plain sites. Excessive costs in construction and makeup water purchase will be incurred, as for site E (ER, Table 9.3-1).

Site G

Site G is located north of Lavaca Bay and east of the confluence of the Navidad and Lavaca Rivers. The site has the greatest area of natural habitat, with about 3200 acres of the site covered by mesquite which has invaded this former coastal prairie area. Live oak savannah accounts for another 370 acres of the site. Important terrestrial wildlife probably present includes 44 game, 23 blue list, 8 peripheral, and 2 endangered species. Present agricultural crops include rice, sorghum, hay, and cattle, with an annual gross production of about $499,000. Total subsidence due to a combination of natural regional subsidence, groundwater depletion, and oil and gas removal may produce significant future land movements. Surface features (IOTAs) have been found to pass through the center of the site (ER, p. 9.2-30). The most important ecological effect will be upon the early life stages of various commercially important fish and crustaceans in Lavaca Bay. This site has the greatest area of wetland habitat. About 49,000 acres of estuarine habitat and 300 acres of freshwater habitat occur within 10 miles of the site. The number and kinds of aquatic species are the same as for site A. The difference in the cost for installation of plant facilities will be as much as ten times higher than for other sites (ER, Table 9.3-1).

Site H

Site H is near the town of Palacios and northeast of Carancahua Bay. The open, flat land is used for raising sorghum, rice, and cattle, with an annual gross production of about $719,000. Salt water would be obtained from and blowdown would be discharged to the Gulf of Mexico. Pipelines would cross Matagorda Bay and the outer barrier islands. Subsidence is greater for site H than that reported for site G. This is probably due to the oil and gas fields south, west, and northeast of the site. Though the site is an area of general oil and gas production, no salt domes are in the immediate vicinity. Ecological impacts will be similar to those discussed for site G. Natural communities include 28 acres of live oak forest and 156 acres of scrubland. Important terrestrial wildlife potentially present includes 42 game, 44 blue list, 8 peripheral, and 2 endangered species. This site has about 29,700 acres of estuary habitat and 260 acres of freshwater habitat within 10 miles, which is the second highest estuarine acreage for any of the candidate sites. The number and kind of aquatic species are the same as for site A.

9.1.2.2.3 Conclusions

The applicant used a numerical rating system for the final evaluation process which resulted in the selection of site B as the preferred site for the plant (ER Table 9.3-2). The staff believes that the applicants procedure in site selection with the weights and characteristics analyzed appear reasonable for selection of a nuclear plant site. The staff performed an independent evaluation of the alternative sites using the data summarized above and in Table 9.3. Extensive additional information regarding the land use and ecology of alternative sites was utilized by the staff for this evaluation.

In the staff's assessment of the alternative sites, the results indicated that proposed site B and alternative sites D, E and F were most acceptable based on the economic and environmental analysis performed. The subjectivity required in the analysis prevented a finding that any alternative site demonstrated a significant overall advantage to the proposed site. Therefore, inasmuch as proposed site B is found acceptable by the staff, the applicants selection of this site is considered to be reasonable.

9.2 STATION DESIGN ALTERNATIVES

9.2.1 Alternative cooling systems

The staff considered the use of other methods of dissipating waste heat at the selected site. Seven potential alternatives to the proposed cooling lake heat dissipation system were considered: (1) once-through cooling, (2) dry cooling towers, (3) mechanical-draft wet (evaporative) towers, (4) natural-draft (evaporative) towers, (5) wet-dry cooling towers, (6) spray canal, and (7) a small size cooling lake.

In considering alternative cooling systems at the STP, two sources of makeup water for the plant were included in the staff's studies. The first was the use of unappropriated water from the estuarine portion of the Colorado River, as discussed in Sects. 3.4 and 5.2.1. The second was the purchase of water from the upstream reservoirs near Austin. Purchased water would flow from these reservoirs via the Colorado River to the Fabridam at Bay City. There the water would be pumped into a canal and transported to the site (ER, Fig. 10.1-7). The estimated cost of this makeup water would be $15/acre-ft (ER, p. 10.1-9). Assuming about 60,000 acre-ft of makeup water per year would be required, this cost would add $900,000 a year to the operating cost of the plant. This does not include the additional cost of building and maintaining the canal for transporting the makeup water nor does it include the environmental impacts associated with its construction.

If purchased water is used for makeup at the STP, it is likely that it would have to be withdrawn only during the 6-month period from October through March to avoid conflict with the irrigation season (ER, pp. 10.1-11 and 10.1-12).

9.2.1.1 Once-through cooling

Once-through cooling requires a body of water with sufficient volume to support a continuous flow through the condensers and back into the water body without perceptible increase in the water temperature at the circulating water intake. The flow in the Colorado River is not sufficient to provide about 4000 cfs of water continuously required to dissipate the waste heat from the plant.

Water from the Gulf of Mexico could be used to dissipate the plant's waste heat, but this would require pumping about 4000 cfs of water approximately 18 miles. This would not be economical and presents the problem of dispersing the warmed circulating water into the Gulf of Mexico. Therefore, the staff concludes that once-through cooling is not a viable alternative.

9.2.1.2 Dry cooling towers

Dry cooling towers remove heat from the circulating water by radiation and convection to air which is circulated past the heat-exchanger tubes. Because of the poor heat-transfer properties of air, tubes are generally finned to increase the heat-transfer area. Theoretically, the lowest temperature that a dry cooling system can achieve is the dry-bulb temperature of the air. As a result, dry cooling towers are a less efficient cooling system, which leads to increased cost and size of the cooling equipment. Turbine back pressures will be increased, as will the range of back pressures over which the turbines must operate. This will result in a reduced plant capability for a given size reactor.

Dry tower systems are of three different types:

1. Smaller units (up to 300 MW) can be built in which steam is ducted from the turbine to the heat exchanger for direct steam condensing. Very large ducts, operating under substantial vacuum and distributing steam over a large heat-exchanger area, make this system impractical for large nuclear facilities.

2. Direct-contact systems can be built in which the cooling water and steam mix in a direct-contact condenser. This system requires a significant increase in water treatment and storage costs, since the entire cooling system uses steam-generator-quality water.[13]

3. Depending on turbine design, conventional surface condensers (but larger) or multipressure (zoned) surface condensers can also be used, with the dry tower replacing the wet tower in a system similar to existing wet-tower systems. These systems do not require steam-generator-quality water. At this time, this is probably the most practical system to consider for large power plants.[14]

The advantage of a dry cooling tower system is its ability to function without large quantities of cooling water. In theory, this allows power plant siting without consideration of water availability and eliminates thermal and chemical pollution of the aquasphere. In practice, some amount of water will always be required, so that power plant siting cannot be completely independent of water availability. From an environmental and cost-benefit standpoint, dry cooling towers can permit optimum siting with respect to environmental, safety, and load distribution criteria without primary dependence on a supply of cooling water. When considered as a direct alternative to cooling lakes or wet cooling towers, the advantages of dry cooling towers include the elimination of drift problems, fogging, water consumption, and the need for blowdown disposal.

The principal disadvantage of dry cooling towers is economic. For a given reactor size and assuming an optimized turbine design, plant capacity can be expected to decrease by about 5 to 15%, depending on ambient temperatures. Assuming 1980 operation, bus-bar energy costs are expected to be in the order of 20% more than a cooling lake and 15% more than a wet cooling tower system. The effects of heat releases from dry cooling towers have not yet been quantified. Some air pollution problems may be encountered. Noise generation problems for mechanical-draft towers will be equivalent to or more severe than those of wet cooling towers. The aesthetic impact of natural-draft towers, despite the probable absence of a visible plume, will remain. Dry cooling towers are now being used for European and African fossil plants and are limited to plants in the 200-MW or smaller category. The use of dry towers to meet the much larger cooling requirements of 1000-MW-size nuclear stations requires new turbine designs to achieve optimum efficiencies at the higher back pressure and range required of this system.[15]

Mechanical-draft dry cooling towers can be constructed as a series of interconnected modules (a "single" tower) or as separate modules or groups of modules. Selection of the tower configuration will be controlled by plant layout, terrain, piping requirements, etc. The total land area required will be larger than that required for equivalent wet cooling tower units; however, there should be no recirculation problem with dry cooling towers, so that total plant areas required for cooling towers may not be too dissimilar for wet and dry towers.[13] Total area and number of modules required will also be influenced by the type of module selected. For a single-fan design, assuming a 60-ft-diam fan and a module area of about 9200 ft^2, the staff estimates that about 60 to 70 modules would be required for a 1250 MWe unit. Thus, a total area of about 10 acres/unit would be used, which probably represents a minimum area design. Additional area would be required for maintenance access, piping runs, clearance, condensate storage tanks, etc.

After weighing the overall advantages and disadvantages of dry cooling towers, and particularly when comparing the economic penalty associated with their use with the acceptable environmental impact of the proposed cooling lake, the staff concluded that dry cooling towers are not a practical alternative for the South Texas Project.

9.2.1.3 Mechanical-draft wet cooling towers

One viable alternative for dissipating heat from warmed circulating water is mechanical-draft wet cooling towers. This heat-dissipation system, like the cooling lake, would be a closed system, but has the potential of using less water and land. The applicant has optimized a plant using such a cooling tower system, and this plant would require about 3100 acres of land. About 2100 acres of this land would be required for makeup water storage and blowdown water retention ponds (ER, p. 10.1-15 and Table 10.1-19). The studies showed that the optimum cooling tower system would require three 12-cell towers for each reactor unit, and each cooling tower would be 468 ft long, 50 ft wide, and 60 ft high.

The staff estimated the average consumptive water use for wet mechanical-draft towers and a cooling lake for the years 1962 through 1972 as shown in Table 9.4. The assumptions used in these calculations are that the plant is operating at the predicted plant factors shown in Table 3.1 and that the towers are designed for the following conditions: (1) 96°F air temperature, (2) 80°F wet-bulb temperature, (3) 3298 cfs circulating water flow rate, (4) 24°F cooling water range at a plant factor of 1.0, (5) 15°F approach temperature, (6) ratio of 1.6 for water to dry air mass flow rates, and (7) 0.005% drift losses.

Table 9.4. Staff estimates of the average consumptive water use (acre-ft) for mechanical draft, wet cooling towers, and the cooling lake at South Texas Project (1962 – 1972)

Month	Cooling towers				Cooling lake		
	Induced evaporation	Drift	Net natural evaporation in storage and blowdown retention ponds[a]	Total	Induced evaporation	Net natural evaporation[b]	Total
January	2,566	10	−73	2,503	2,414	−241	2,173
February	2,365	9	−62	2,312	2,008	−204	1,804
March	2,729	10	434	3,173	1,982	1,428	3,410
April	2,770	10	238	3,018	2,436	785	3,221
May	3,122	10	299	3,431	2,914	985	3,899
June	3,327	10	476	3,813	2,924	1,568	4,492
July	3,560	10	789	4,359	3,213	2,599	5,812
August	3,562	10	462	4,034	3,487	1,522	5,009
September	3,254	10	−162	3,102	3,754	−532	3,226
October	2.982	10	146	3,138	3,685	481	4,166
November	2,679	10	20	2,709	3,456	65	3,521
December	2,649	10	−274	2,385	3,081	−901	2,180
Total	35,565	119	2,293	37,977	35,354	7,555	42.909
Estimated precipitation runoff at site[c]				2,238			7,370
Effective loss of fresh water to Matagorda Bay				40,215			50,279

[a]Calculated a (2125/7000) of cooling lake net natural evaporation rate.

[b]Difference between the staff estimated gross natural evaporation rate (Table 5.2) and the precipitation values (ER, Table 10.1–8).

[c]Prior to lake or pond construction.

The applicant (ER, Table 10.1-10) calculated that the induced evaporation losses at a plant factor of 1.0 would be 42,670 acre-ft/year. Eighty percent of this is 34,100 acre-ft/year, which is in reasonable agreement with the staff's results. It can be seen that the induced evaporative water losses from the cooling towers and the cooling lake are about the same. As stated in Sect. 5.3.1, a reservoir having the size of the proposed cooling lake would be required for water storage to operate these towers at all times if unappropriated water from the Colorado River is used for makeup. Therefore, the staff concluded that there would be no advantage to using cooling towers with a storage lake having the size of the proposed cooling lake.

As stated in Sect. 9.2.1, water could be supplied to the plant during the winter months from the Colorado River reservoirs near Austin. In addition to the water losses shown in Table 9.4, water must be provided for cooling tower blowdown because of the concentrating effect of evaporation in the towers. Assuming a concentration factor in the towers of 8.9 (ER, p. 10.1-16), about 4500 acre-ft of water per year would be required for blowdown. If 60,000 acre-ft of water per year were withdrawn from upstream reservoirs, an 1800-acre storage reservoir would be required at the site to operate the plant during the summer months, in addition to the 2100-acre makeup water storage and blowdown retention ponds (ER, pp. 10.1-11 and 10.1-12).

Blowdown from the cooling towers would be continuous but it could not be discharged into the Colorado River at all times. Therefore, a 325-acre blowdown water retention pond would also have to be constructed at the site (ER, p. 10.1-12). This retention pond also would help to cool the blowdown water since it is likely that the cooling tower blowdown water would have a higher temperature than the cooling lake blowdown. Thus it is more likely that temperature limitations[16] imposed by state water quality standards would be met for discharge from the retention pond to the river than for direct blowdown into the river.

Since cooling towers add water to the air, there is concern about additional fogging and drift associated with these towers. Calculations were made by the staff of the additional fogging and drift deposition due to these cooling towers using the Oak Ridge Fog and Drift Program.[17] Results of these calculations are shown in Table 9.5.

Table 9.5 Staff estimates of average additional fog and drift deposition from mechanical-draft wet cooling towers for the period 1962 through 1972 (0.005% drift)

Location	Additional fog (hr/year)	Drift (g/m^2 $year^{-1}$)
Farm-to-Market Road 521 (1 mile east, north, and west)	5	55
Farm-to-Market Road 1095 (3 miles west)	4	7
Texas Route 30 (6 miles east)	2	0.5

To use cooling towers at the STP for the purpose of conserving land would require withdrawal of water from upstream reservoirs which could, potentially, be used for irrigation purposes. Since rice production in this section of Texas is more likely to be freshwater-limited than land-limited (Sect. 10.2.2.1), and because of other factors associated with the mechanical-draft wet cooling towers, the staff concludes that a cooling lake would be a better choice for the STP heat dissipation system.

9.2.1.4 Natural-draft wet cooling towers

Heat can also be dissipated from the warmed circulating water in natural-draft wet cooling towers. A plant using this heat dissipation system would require about 3100 acres of land (ER, p. 10.1-15 and Table 10.1-19). As for the mechanical-draft wet cooling tower system discussed in Sect. 9.2.1.3, about 2100 acres of this land would be required for the makeup water storage and the blowdown water retention ponds. Each reactor unit would have a single hyperbolic-shaped cooling tower that would be about 520 ft in diameter and 500 ft high (ER, Table 10.1-4).

The operating characteristics of the circulating water system and the cooling water requirements for a plant using natural-draft wet cooling towers would be about the same as those for a plant using mechanical-draft wet cooling towers, discussed in Sect. 9.2.1.3. Because of this, the problems and methods associated with supplying makeup water to natural-draft wet cooling towers are essentially identical to those for mechanical-draft wet cooling towers.

Because of their height, fogging would be less of a problem with natural-draft wet cooling towers than with the mechanical-draft wet cooling towers. Salt deposition resulting from natural-draft towers would be over a greater area, but of lower magnitude locally, than that resulting from mechanical-draft towers.

Fan-assisted natural-draft wet cooling towers, which are smaller natural-draft wet cooling towers with a fan near the tower exits, were also considered (ER, p. 10.1-8). Studies showed that three hyperbolic-shaped towers, each having a 206 ft diameter and a 176.5 ft height , would be required for each reactor (ER, Table 10.1-6). Again, the operating characteristics of the circulating water system and the method of supplying makeup water to the cooling towers would be similar to a plant using mechanical-draft wet cooling towers. There would be somewhat more fogging associated with these towers than with the natural-draft towers, but less than that associated with the mechanical-draft towers. Also, drift would be spread over a smaller area than for natural-draft towers, but over a larger area than for mechanical-draft towers.

Considering these factors and the requirement for withdrawal of water from upstream reservoirs as discussed in Sects. 9.2.1 and 9.2.1.3, the staff concludes that a cooling lake would be a better choice than natural-draft wet cooling towers for the STP heat dissipation system.

9.2.1.5 Wet-dry cooling towers

One way to reduce the plant water requirements and maintain reasonable turbine back pressures (5 in. mercury) is to use wet-dry cooling towers. These towers consist of two parts: one in which the circulating water is passed through a fin-and-tube heat exchanger where the water is cooled by sensible heat transfer to the air flowing around the outer surfaces of the heat exchanger tubes and one in which the circulating water drops through the air where it is cooled by evaporative and sensible heat transfer to the air. The warmer circulating water usually passes through the heat-exchanger portion before it comes into direct contact with the air.

The amount of heat dissipated in the heat exchanger tubing relative to that dissipated by direct-contact heat transfer can be controlled by design features and/or operational mode. Under optimal control, the annual water consumption in a wet-dry cooling tower could be as low as 20% of that in an evaporative tower.[18] The particular design of a wet-dry cooling tower heat dissipation system presented by the applicant for the South Texas Project would consume about 8% less water than a mechanical-draft wet system (ER, Tables 10.1-10 and 10.1-12). This design could be modified to conserve more water, but this would result in additional capital and operating costs. The staff believes that wet-dry cooling towers optimized to conserve water would be costly, having costs approaching those for dry cooling towers. This would result in a considerable increase in the cost of energy generated by the STP — about 15% more than for the cooling lake.

The makeup water storage and blowdown retention ponds would be somewhat smaller than those required for the other wet cooling towers already described in Sects. 9.2.1.3 and 9.2.1.4. However, after weighing the overall advantages and disadvantages of wet-dry cooling towers, particularly when comparing the economic penalty and limited experience associated with their use, the staff concludes that wet-dry cooling towers are not a practical alternative for the STP.

9.2.1.6 Spray canal

The use of a spray canal, which is smaller in surface area than a cooling lake, is another possibility for dissipating the plant waste heat. However, experience with spray canals is limited.[19] About 3600 acres of land would be required for a plant using a spray canal heat dissipation system (ER, Table 10.1-19). The spray canal itself (ER, Table 10.1-2) would be 200 ft wide and 20,250 ft long. Another 2100 acres of land would be required for the makeup water storage and the blowdown water retention ponds, as would be the case for wet cooling towers discussed in Sects. 9.2.1.3 and 9.2.1.4.

The spray canal system would use 448 spray modules in the canal, each powered by a pump fitted with a 75-hp motor (ER, Table 10.1-2). Water would be pumped from just below the canal surface through nozzles to produce a coarse spray rising to a height of about 20 ft. Heat would be dissipated from the water by evaporation and convection as the spray rises and falls back into the canal.

The operating characteristics of the circulating water system and the cooling water requirements for a plant using a spray canal would be about the same as those for a plant using wet cooling towers, discussed in Sects. 9.2.1.3 and 9.2.1.4.

There will be some fine spray and mist that will invade the immediate area surrounding the spray module. Most of this drift will fall back to the surface within 200 ft of the spray module. Drift beyond 600 ft from the spray module would be very small.[20] Fogging from a spray canal would be less than that from mechanical-draft wet cooling towers.

Considering these factors and the requirement for withdrawal of water from upstream reservoirs, as discussed in Sect. 9.2.1.3, the staff concludes that a cooling lake would be a better choice than a spray canal for the STP heat dissipation system.

9.2.1.7 Smaller size cooling lake

There would be sufficient surface area in cooling lakes smaller than the proposed cooling lake to dissipate the waste heat during the operation of the STP. Staff estimates of the circulating water intake temperatures using various size ponds with the plant operating at 100% plant factor are shown in Fig. 9.3. These estimates show that the circulating water intake temperatures would be about as low for a 3500-acre cooling lake having a greater depth as for the proposed 7000-acre lake. The water intake temperatures would be significantly higher for cooling lakes having surface areas smaller than 3500 acres, particularly in the month of January.

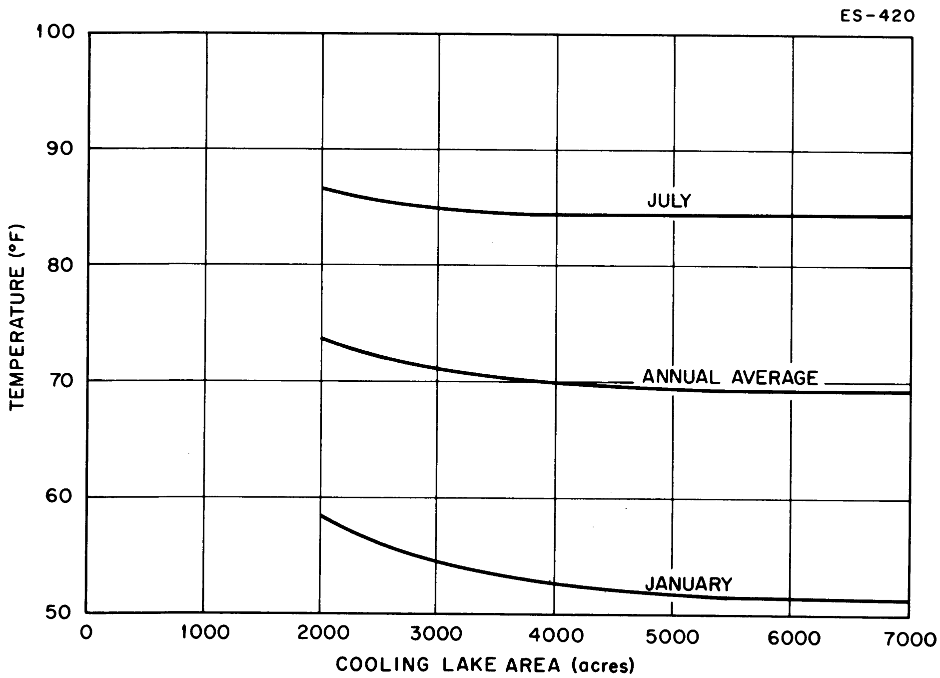

Fig. 9.3. Staff estimates of the average circulating water intake temperature during the period 1962-1972 for various size cooling lakes at the South Texas Project (plant factor of 1.0).

In addition to using less land, a smaller cooling lake would entail reduced water losses due to natural evaporation. The staff estimates that a 3500-acre lake would evaporate on the average 53,600 acre-ft of water per year as compared to 69,600 acre-ft for the proposed cooling lake, as shown in Table 5.2. Rain falling on the cooling lake would reduce these values to 41,200 and 45,000 acre-ft respectively. This is the amount of water that would have to be supplied from an outside source, such as the Colorado River.

However, a smaller cooling lake having the same depths as the proposed cooling lake would not have sufficient storage capacity to allow the plant to operate through the period-of-record drought if unappropriated Colorado River water is used for makeup, as discussed in Sect. 5.3.1. Calculations indicate that the normal maximum water surface level in a 3500-acre cooling lake would have to be 58.3 ft MSL if the plant is to operate through the period-of-record drought (ER, p. 10.1-4). Building embankments high enough for a cooling lake having this surface level would not be economical. Also, there would be limitations on the plant layout and design when considering the potential of a breach in these higher dikes.

An acceptable configuration would be a 49-ft MSL maximum normal water level in a 3500-acre cooling lake, if makeup water could be supplied from upstream reservoirs. The disadvantages (additional operating costs and loss of irrigation water) of this scheme were discussed in Sect. 9.2.1. The staff concludes that the 7000-acre cooling lake is the best choice for the South Texas Project heat dissipation system.

9.2.2 Intake structures

The staff reviewed the design of the circulating water intake structure and concluded that alternative structures offer no significant improvement over the proposed design. The staff reviewed the proposed makeup water intake structure described in Sect. 3.4.3 and an alternative presented by the applicant (ER, p. 10.2-3). The applicants alternative differed from the proposed design only in size and location of component structures. The staff agrees with the applicant's choice except for one item. This is the -2.2-ft MSL weir located between the screens and the pumps in the makeup water structure. The purpose of this weir is to allow withdrawal of the upper layer of water from the river and block the lower highly saline layer, thus improving cooling lake water quality (ER, p. 5.1-3). The analysis of the cooling lake water quality is based on the assumption that the makeup water will be withdrawn from the top 4 ft of the Colorado River (ER, p. 5.1-3).

The proposed makeup water intake structure invert will be at -10-ft MSL, as shown in Fig. 3.4. There will be some mixing of the water when it passes through the trash racks and the traveling screens; therefore, the weir will lose some of its effectiveness. For Colorado River freshwater flows (as measured at the Bay City gauge) greater than 1000 cfs, the makeup water flow rate will be greater than 385 cfs, and the top 10 ft of river water will have a very low salinity (ER, Fig. 5.1-1). At lower freshwater flow rates (above 100 cfs), the salinity in the layer between -10 and -6-ft MSL will be greater than that in the 4-ft surface layer (ER, Fig. 5.1-1).

At a 385-cfs makeup water flow rate, the staff estimates that the velocity of the water passing through the traveling screens will be about 0.3 fps, and proportionately lower at lower makeup rates. Mixing of the water passing through these screens under these conditions probably will be incomplete and there may be some stratification of the water in the settling basin between the screens and the weir.

9.2.3 Discharge structures

The staff reviewed the design of the circulating water discharge structure and concluded that alternative structures offer no significant improvement to the environment.

For releases of water from the cooling lake (blowdown), water could be discharged from the lake to either the Colorado River, Gulf Intracoastal Waterway, or the Gulf of Mexico.

Water could be discharged into the river either through a spillway (ER, p. 10.3-3), a single pipe discharging directly into the river, or a multiport diffuser (Sect. 3.4.4). Discharging the blowdown into the river through a spillway would result in river temperatures exceeding those permitted by the Texas Water Quality Standards,[16] and therefore this method is unacceptable (ER, p. 10.3-5). Discharging the blowdown directly into the river through a single pipe would result in river temperatures equal to or in excess of those produced by a spillway discharge, and this method also would be unacceptable. Discharging the blowdown into the river through a multiport diffuser is acceptable, as shown in Sect. 5.3.2.

The facilities required for discharge into the Gulf Intracoastal Waterway or the Gulf of Mexico would be more expensive to construct and operate and would require more land. In addition, discharge into the Gulf Intracoastal Waterway would cause unacceptable temperature increases even with a multiport discharge (ER, p. 10.3-5).

Due to the additional expense of discharging the blowdown to the Gulf of Mexico, the staff concludes that discharge to the river by means of a multiport diffuser is the most desirable alternative.

9.2.4 Transmission lines

The applicant considered two routes for the site to Lon Hill transmission lines, two for the site to Hill Country line, three for the Danevang Tie point to Glidden, and two for the site to Velasco. These routes are described in detail by the applicant (ER, Sect. 10.9). The staff generally concurred on the route chosen by the applicant. However, the alternate route to Lon Hill appeared to be more acceptable than the applicant's analysis indicated. Therefore, additional information was obtained from the applicant, and a detailed analysis was conducted.

In comparing the alternate with the proposed Lon Hill transmission line, the staff conducted a separate analysis for portions of the two corridors with existing lines and those that would have new rights-of-way. Existing right-of-way accounts for 71 (56%) of the 126 miles of the proposed route, whereas existing right-of-way occurred only along 50 (38%) of the 131 miles of the alternate route. Factors considered were total cost of the line, erosion potential, mileage for which the line is visible from a road or urban area, mileage and kind of agricultural and/or urban land crossed, mileage and kind of sensitive habitat crossed, and numbers of endangered species presently living in the affected areas.

The existing lines found along both the alternate and the proposed route cross Attwater's prairie chicken habitat but the number of the endangered species occurring along the alternate is fewer. The selected route crosses habitat occupied by 60 to 70 birds (42% of the population of Refugio County and 6% of the state of Texas) as well as two known booming grounds. The alternate transmission route crosses habitat occupied by only 5 to 10 birds (6% of the population of Refugio County and 0.6% of the state of Texas) and no known booming grounds. Thus, the existing line along the alternate route has a smaller impact on prairie chicken populations.

The existing line along the proposed route comes within 6 miles of the Arkansas National Wildlife refuge, which is used by the endangered whooping crane, whereas the existing line along the alternate does not come within 20 miles. Between the refuge and the Lon Hill substation the proposed route crosses 2.1 miles of open estuarine water and 10.5 additional miles of marshlands. No open estuarine water is crossed by the existing line along the alternate route, and only 0.4 miles of marshlands is crossed. The total whooping crane population at present consists of 49 individuals, which use the Arkansas refuge during the winter. Whooping cranes frequently leave the refuge and feed along the coast between the refuge and Corpus Christi Bay. Transmission lines present a potential collision hazard, especially during heavy fogs. The alternate route avoids these coastal areas, thus reducing this potential impact.

For the rights-of-way that do not parallel an existing line, visibility of lines was slightly higher for the alternate. With regard to endangered species, the two routes were about identical. The alternate route crosses 7.6 more miles of cropland, 7.9 more miles of grasslands and pastures, but 0.3 miles less of ricelands and 1.8 miles less of urban areas. Transmission lines do not significantly affect agricultural production except where they interfere with the aerial application of fertilizer, herbicides, insecticides, and seeds. Thus, new right-of-way for the proposed route will have a smaller impact on current land uses.

The net amount of sensitive habitat removed along the new right-of-way is approximately 7 miles more for the alternate than for the proposed route. The alternate route crosses 1.8 more miles of woodlands and 5.2 more miles of marshlands than does the proposed route. Thus, along the new right-of-way the impact upon sensitive habitat will be less for the proposed route.

The amount of new corridor that must be built is 26.5 miles longer on the alternate than the proposed route. However, the entire alternate line is 5.5 miles longer and the total cost is $760,000.00 more than for the proposed. Thus, the proposed route has a cost advantage.

Along that portion of the right-of-way where transmission lines presently exist, the alternate route is preferable. However, along the portion of the line where new right-of-way will be constructed, the proposed route is preferable. The resulting economic and environmental evaluations indicated that the alternate and the proposed routes were essentially equal. Since the environmental impacts are much less along corridors that have existing lines than along those that do not, the staff concludes that the proposed route is preferable.

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10. CONCLUSIONS

The conclusions below are based on the plant as modified to meet staff requirements.

10.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

10.1.1 Abiotic effects

10.1.1.1 Land

The construction of any large power plant causes considerable disturbance to and modification of the land. Construction activities at the plant site and cooling lake will affect approximately 8000 acres. This will include 3800 acres of cropland, 3600 acres of ranch land, and 800 acres of natural habitat.

About 400 miles of transmission line will be installed. The major uses for the land crossed by the transmission corridors are pasture, cropland, scrub, woods, marshlands, and prairie. About 15% of the overall corridor mileage passes through wooded areas, 12% through scrub, 23% through pasture, 35% through cropland, 6% through marshland, and 8% through prairie (Table 4.4).

With the construction of a cooling lake, the most significant adverse environmental effect on the land will be the conversion of approximately 7000 acres of land from a terrestrial environment into an aquatic environment and a loss of an additional 600 acres for lake-associated facilities.

10.1.1.2 Water

The necessary water inventory for STP will be drawn from the Colorado River and supplemented with natural precipitation. Approximately 52,000 acre-ft of fresh water per year will be lost to Matagorda Bay due to STP. An annual average of about 54,000 acre-ft of presently unappropriated water will be withdrawn from the Colorado River to make up these losses, and about 13,000 acre-ft/year will be returned as cooling lake blowdown. This represents a net demand of about 12% of the annual river flow. The water quality downstream will be slightly affected due to discharge water from the cooling lake.

Seepage from the cooling lake will increase the total dissolved solids (TDS) level of the existing groundwater, but the slight difference should have little effect on groundwater usage.

10.1.1.3 Air

The construction of the plant will cause some smoke and dust within a few miles of the construction areas. During plant operation the staff believes that there will be no adverse impact on the air quality.

Some local fogging may occur near the cooling lake. The occurrence of reduced visibility to less than 1000 m will increase somewhat, but this impact should not significantly affect traffic on the nearby highways.

10.1.1.4 Radiological effects

The staff does not believe that any adverse effects will occur since the radioactive effluents are reduced to as-low-as-practical. The 900 man-rems/year received as occupational onsite exposure is 2.7% of the annual total to the 1980 population within a 50-mile radius, and the risk associated with this exposure is no greater than those risks normally accepted by workers in other present-day industries.

10.1.2 Biotic effects

10.1.2.1 Thermal effects

Thermal alteration of the Colorado River should have no discernible adverse impacts on aquatic productivity.

10.1.2.2 Chemical effects

The staff anticipates no significant losses of aquatic biota as a result of the discharge of chemicals into the Colorado River, if staff requirements regarding maximum chlorine levels and dissolved oxygen are observed.

10.1.2.3 Mechanical effects

Entrainment losses of ichthyoplankton and crustacean larvae may significantly reduce some fish and crustacean populations in the Colorado River-Matagorda Bay estuary during some years. However, provided the makeup limitations identified in the study described in Sect. 5.5.2.1.1 are complied with, the staff believes the potential for entrainment of large numbers of ichthyoplankton and young shrimp should be reduced to acceptable levels. Impingement losses cannot be predicted, but low intake velocities may minimize impingement mortality to the extent that populations are not significantly affected.

10.1.2.4 Reduction in freshwater flow

Diversion of river water as makeup will reduce freshwater inflow to the Colorado-Matagorda estuary 3 to 6%. The staff foresees no substantial reductions in estuarine populations as a result of this effect. However, future upstream diversions of river water will further reduce freshwater inflow to the estuary. This development could reduce the estuary's suitability as a breeding ground and nursery for some estuarine-dependent species.

10.2 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

10.2.1 Enhancement of productivity

Operation of the South Texas Project will have the primary effect of supplying 2500 MWe of reliable base-loaded electric power to meet the projected needs of industrial, commercial, residential, and other customers within the 51,769-sq mile service area of the combined participating utilities.

10.2.2 Adverse effects on productivity

10.2.2.1 Impacts on land use

The South Texas Project will preempt 12,352 acres of land in Matagorda County, Texas. Present uses of the land on the site are predominantly agricultural. Rice, the highest value crop, was grown on 3738 acres of the proposed plant site in 1973. Sorghum and soybeans were grown on a total of 1401 acres, and 5071 acres were devoted to hay and pasture. The remainder of the land on the site (2142 acres) was devoted to deciduous forest and savannah.

The staff's analysis of the impact of preemption of the site for a nuclear plant is devoted in greatest detail to the impacts on rice, soybeans, and sorghum production, since these are the highest value crops of the region. Hay and pasture constitutes only a minor part of the county cash crop economy, although the production of beef is important. Hay and pasture are used as off-year crops in rotation with rice.

There is considerable public concern that the preemption of productive land for nonfarm uses will have a detrimental effect on the long-term capability of the United States for food and fiber production. This fear is enhanced by current economic difficulties of farmers and high prices for foods at the retail level. Historical data on land-use allocation in the United States,[1] however, show that at the national level the amount of land devoted to various productive categories has been remarkably constant for more than the last half century and that there is no trend in the country towards significant reduction of available productive land. Department of Agriculture projections[2] (Fig. 10.1) show that the stability of land allocation is expected to persist through the year 2000 in most sections of the country. Figure 10.1 shows that for the central plains region of the country, which includes Texas, only minor changes in land-use allocation are expected to occur by the turn of the century.

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LAND THAT MEETS THE CENSUS OF AGRICULTURE DEFINITION OF A FARM: ANY PLACE UNDER 10 ACRES IF ESTIMATED SALES OF AGRICULTURAL PRODUCTS EXCEED $250 A YEAR, OR ANY PLACE OVER 10 ACRES IF SALES EXCEED $50. PASTURES AND OTHER LAND INCLUDES FARMSTEADS, ROADS, AND WASTELAND ON THE FARM. LAND IN FARMS IS THE PREDOMINANT LAND USE IN THE 48 CONTIGUOUS STATES, OCCUPYING SLIGHTLY OVER 1 BILLION ACRES IN 1969 - MORE THAN 65 PERCENT OF TOTAL LAND AREA.

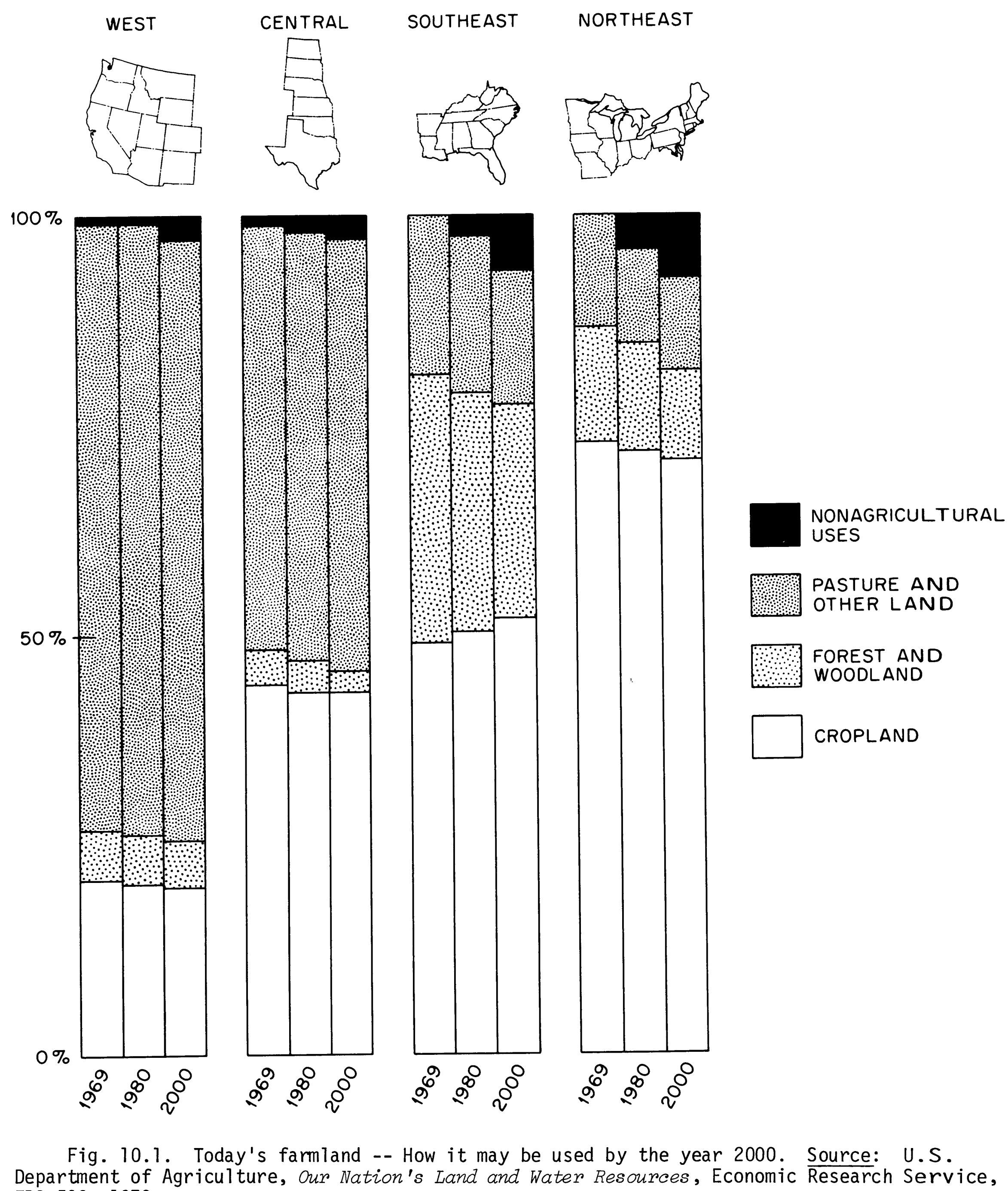

Fig. 10.1. Today's farmland -- How it may be used by the year 2000. Source: U.S. Department of Agriculture, *Our Nation's Land and Water Resources*, Economic Research Service, ERS-530, 1973.

The proportionally small amount of land in nonfarm uses, however, is vital to the welfare of the nation. It is this land which is devoted to cities, highways, airports, wildlife refuges, parks, and other essential urban-industrial-cultural needs. Most of the population of the United States now lives in areas included in the category of nonagricultural land. This may cause a distortion of perspective on the part of some observers since they are witness to the seemingly endless expansion of urban-industrial development in and near the cities. This expansion annually accounts for about one million acres of productive land at the national level, and it often has locally important consequences. However, the United States has somewhat more than one billion acres of land available for productive purposes either as cropland or pasture, and the proportional impact of preemption for urban-industrial-cultural purposes is not expected to create a general disruption of land-use allocation at the national level in the foreseeable future.

Historical United States production data for rice, sorghum, and soybeans are given in Table 10.1. Acreages devoted to rice have been fairly constant in the United States in the post-war era. Fluctuation in acreages have taken place primarily due to market factors, varying water availability, and competition from other crops. Yield per acre of rice, however, has risen steadily during this period. Yield increases have been obtained through research that has lead to improved fertilization, improved crop varieties, and improved pest, weed, and disease control. As a result of these factors, annual United States production of rice has more than doubled in the last two decades.

Table 10.1. U.S. production of some crops impacted by the South Texas Project

	1951–1955	1956–1960	1961–1965	1969	1970	1971	1972	1973	1974
Rice									
Acres, 10^3	2106	1501	1742	2128	1815	1818	1818	2170	2485
Yield, lb/acre	2549	3265	3892	4318	4618	4718	4700	4277	4567
Production, 10^6 cwt	53	49	68	92	89	86	85	93	113
Sorghum									
Acres, 10^3	8955	15,284	12,131	13,437	13,568	16,301	13,368	15,440	13,583
Yield, bu/acre	18.7	32.4	45.0	54.3	50.4	53.7	60.5	58.8	47.5
Production, 10^6 bu	170	506	548	673	730	684	809	937	645
Soybeans									
Acres, 10^3	15,709	22,351	29,694	23,655	41,337	42,249	45,698	56,416	52,410
Yield, bu/acre	20.0	23.2	24.2	27.4	26.7	27.5	27.8	27.8	25.1
Production, 10^6bu	313	520	719	1,133	1,127	1,176	1,271	1,567	1,316

Source: *Crop Production, 1973 Annual Summary,* U.S. Department of Agriculture, Statistical Reporting Service, CrPr2-1(74), 1974 (some data taken from earlier issues of the same publication).

Land devoted to sorghum and soybeans has been on an increasing trend during the past 20 years. This factor combined with improved cultural practice that has lead to increasing yields per acre has resulted in roughly a fourfold increase in the total annual production of these crops since 1951. Similarly, dramatic increases in yield and production have been made for most other major crops grown in the United States during this period.[3]

Comparison of Fig. 10.1 with the data of Table 10.1 permits a perspective on crop production of the United States. While land available to agricultural crop production is expected to change by only a small fraction, yields and the total production of rice, soybeans, and sorghum have increased by factors of 2 to 4 in recent history. Yield increases due to improved cultural practices have more than compensated for small proportions of land preempted for urban-industrial purposes in the past. The potential for this to continue in the future is substantial since most major crops grown in the United States have considerable margin for still further increases in average yield. Table 10.2 shows average and top yields for some major crops grown in the United States.[2] Whether or not any of this yield potential will be realized in the future is not certain. The uncertainty arises not from consideration of land availability but from uncertainty of the future availability of technological inputs required for crop production. Some of these inputs are detailed in Table 10.3. If farmers are unable to obtain machinery, fertilizers, pesticides, and fuels in adequate quantity due to energy shortages, they may be unable to realize even part of the remaining biological potential for increased yields. Indeed, future yields could actually diminish. Historically, yield increases due to technological inputs have more than compensated for marginal diversions of productive land.

Table 10.2. Average, top, and record crop yields in the USA, bu/acre

Crop	1973 Av	Top	Record
Corn	94	230	306
Wheat	32	135	216
Oats	49	150	296
Soybeans	28	80	110
Sorghum	63	200	320
Rice, lb/acre	4277[a]	11,500[b]	

[a] *Crop Production, September 1974,* Statistical Reporting Service, USDA.

[b] From *Tailoring Fertilizers for Rice,* Tennessee Valley Authority, 1972. Top yields were obtained from Peruvian data and are given to indicate the genetic potential of rice. Top domestic yields may currently be closer to 6500 lb/acre due to limitations of climate, disease, insect and weed control, and other unknown factors.

Source: S. H. Wittwer, "Maximum Production Capacity of Food Crops," *Bioscience* 24: 216–224 (1974).

Table 10.3. Index of inputs and outputs in the production of rice in Texas[a]

Average Texas yield = 100

Factor	First and second crop
Labor	7.65
Seed	4.15
Fertilizer	11.00
Herbicide	5.18
Insecticide	0.91
Machinery (operation)	3.38
Irrigation	7.05
Interest	1.27
Harvest	7.47
Transportation	2.24
Drying	7.22
Total	57.52
Yield	100
Output/input	1.74

[a] *Keys to Profitable Rice Production,* Texas Agric. Ext. Rev. No. L-894, January 1970.

The staff does not believe that productive land can be preempted for the indefinite future, however, nor does it believe that yields will increase indefinitely. The day will probably come when the costs of technological input will no longer be repaid in the value of added food output. In that case yields per acre will no longer increase, and the only option for increasing total production will be to increase the acreage under cultivation with full technological input. At that point it would be necessary to review all diversions of productive land carefully if demand for food required continued increases in total production. Comprehensive land-use policy at both state and national levels could be required to strike an appropriate balance between agricultural and urban-industrial uses of land.

The exact future allocation of energy from the STP is not known, but it is reasonable to assume that additional increments of available energy will have a positive effect on production of technological inputs to agriculture. Only an energy rich society can sustain the high yield required to meet current and future demands for food both for domestic consumption and export.

Therefore, it is not clear that the construction of an energy producing facility constitutes an adverse impact on agricultural production even though proportionally small amounts of productive land are preempted.

The relative impact of the facility on production at the national, state, and county levels is shown in Table 10.4. The data show that there would be no detectable change in the annual rice, sorghum, or soybean crop at the state or national levels. Variation caused by the facility is within the normal year-to-year variation in production and is probably within the error of estimate for these crops.

Table 10.4. Crop acreage, yield, production, and value of the South Texas Plant site relative to U.S., Texas, and county totals

	United States	Texas	Matagorda County	South Texas Project	Project impact on county income from crop (%)	Project impact on state income from crop (%)
Rice						
Acres, 10^3	2,485	563	56.7	3.7		
Yield, lb/acre	4,567	4,400	4,400	4,400		
Production, 10^3 cwt	113,491	24,772	2,493	164		
Value,[a] $\$10^6$	1,203	262.5	26.4	1.74	6.58	0.66
Soybeans						
Acres, 10^3	52,410	250	20	0.61		
Yield, bu/acre	25.1	26.0	26.0	26.0		
Production, 10^3 bu	1,315,792	6,500	520	15.9		
Value,[b] $\$10^6$	11,220	55.3	4.42	0.14	3.06	0.25
Sorghum						
Acres, 10^3	13,583	5,900	25	0.79		
Yield, bu/acre	47.5	50.0	50.0	50.0		
Production, 10^3 bu	644,904	295,000	1,250	39.5		
Value,[c] $\$10^6$	1,915	876	3.71	0.12	3.23	0.013
Value of three crops, $\$10^6$	14,338	1,194	34.5	2.0	5.80	0.17

[a] Rice (rough) value $10.60/cwt (September 1974 price).
[b] Soybean value $8.50/bu (September 1974 price).
[c] Sorghum $2.97/bu ($5.30/cwt) (September 1974 price).
Source: *Crop Production,* U.S. Department of Agriculture, Statistical Reporting Service, CrPr2-2(9-74), Sept. 11, 1974.

At the county level, however, the facility will cause a 6.6% reduction in rice income, a 3.1% reduction in income from soybeans, and 3.2% reduction in income from sorghum. The estimated reduction in income from rice amounts to $1.74 million as compared to a total county income of $26.4 million paid to farmers for this crop. There is, therefore, expected to be immediate short-term adverse local effects of the construction of the STP on some individuals whose livelihood is related to the rice industry.

The effect may be short lived, however, because there in considerable opportunity for compensatory increases in rice productivity in the county. Rice yield has historically been increasing on the order of 3%/year, and the losses can, therefore, be recovered in about two years due to normal increases in yield. More importantly, however, rice production in this section of Texas is more likely to be water limited than land limited. The irrigation water presently used for rice on the South Texas property will presumably become available for irrigation of other lands when the property is taken out of production. Therefore, the potential exists for compensatory production almost immediately if the need for it exists. Whether the potential will be realized depends on economic incentives to do so and on negotiations between farmers and State water officials for additional allocations of water to other lands.

As has been indicated, the limitation of water availability for irrigation is more important than scarcity of land in the production of rice. Because of this, the staff has investigated the possibility that water use by the STP could adversely affect rice production in the county. The applicant has made application to the Texas Water Rights Commission for a permit to utilize public water.[3] The application states that the request is for unappropriated flow of the Colorado River. Additionally, the staff has ascertained that discussions between the applicant and officials of the Lower Colorado River Authority have been initiated with the objective of assuring an adequate supply of irrigation water to rice farmers both during the period of lake fill and during normal operation of the plant. The staff concludes that the provisions of the permit application and the actions of the applicant and the Lower Colorado River Authority give reasonable assurance that the present water requirements of rice farmers will not be jeopardized.

The normal expected lifetime of the STP is approximately 40 years. If at the end of that time the food situation in the United States required that the property be reclaimed for agricultural production, it would be technically feasible to do so. Reclamation of the lake bed for rice production would be particularly simple since rice soils are normally flooded during the production of the crop. Thus, construction of the cooling lake is not expected to have an irreversible effect on the soils involved due to flooding. Whether the lake is actually reclaimed or not will depend on the economic feasibility for doing so at the time of decommissioning of the plant.

The staff concludes from the foregoing analysis that (1) the United States is not running short of productive land and is not likely to in the foreseeable future; (2) preemption of the land for the STP will have no detectable effect on United States or State production totals for rice, soybeans, or sorghum during the life of the plant; (3) technological inputs to agriculture are more important than marginal availability of land for sustained high-crop production, and an energy-producing facility contributes to the manufacture of technological inputs to agriculture; (4) irrigation water supply to rice farmers will not be jeopardized by construction or operation of the plant; (5) the land of the site, including the lake, could be reclaimed for agriculture upon decommissioning if needed; and (6) adverse economic impact on the rice-producing industry at the county or local level could occur; however, potential for compensatory production which could alleviate adverse local economic effects exists in the county.

In view of the foregoing, it is the staff's opinion that the use of 12,352 acres of land in Matagorda County, Texas, for the purpose of construction and operation of the STP is justified and that no long-term adverse impacts on the agricultural industry will occur.

10.2.2.2 Impact on water use

Construction and operation of STP should not be detrimental to the commercial use of the Colorado River. The loss of fish that can be anticipated from data currently available does not appear to be extensive or to be commercially important.

The discharge of liquid effluents to the Colorado River should not affect the short- or long-term productivity of aquatic life in the river and its tributaries. The consumptive use of water from the Colorado River will amount to about 2.6% of the river's average annual (historical) flow (ER, p. 10.1-17). Water use by STP is not likely to be competitive with other potential uses in the river basin during the lifetime of the plant. The staff concludes that the impact on water use will be acceptable.

10.2.3 Decommissioning

No specific plan for the decommissioning of the South Texas Project has been developed. This is consistent with the Commission's current regulation which contemplates 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 NRC 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 NRC.

To date, experience with the 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 (CVIR), 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 decomissioning 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. (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 in 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 that all reactor-produced radioactivity has been removed, alternative (3) would not require any subsequent surveillance. Possible effects of erosion or flooding will be included in these considerations.

Estimated costs of decommissioning at the lowest level are about $1 million plus an annual maintenance charge in the order of $100,000.[4] Estimates vary from case to case, a large variation arising from differing assumptions as to level of restoration. For example, complete restoration, including regrading, has been estimated to cost $70 million.[5] At present land values, consideration of an economic balance alone likely would not justify a high level of restoration. However, planning required of the applicant at this stage will ensure that variety of choice for restoration is maintained until the end of useful plant life.

The degree of dismantlement would be determined by an economic and environmental study involving the value of the land and scrap value versus the complete demolition and removal of the complex. In any event, the operation will be controlled by rules and regulations to protect the health and safety of the public which are in effect at the time.

10.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

10.3.1 Introduction

Irreversible commitments generally concern changes set in motion by the proposed action which at some later time could not be altered so as to restore the present order of environmental resources. Irretrievable commitments are generally the use or consumption of resources that are neither renewable nor recoverable for subsequent utilization.

Commitments inherent in environmental impacts are identified in this section, while the main discussions of the impacts are in Sects. 4 and 5. Also, commitments that involve local long-term effects on productivity are discussed in Sect. 10.2.

10.3.2 Commitments considered

The types of resources of concern in this case can be identified as: (1) material resources — materials of construction, renewable resource material consumed in operation, and depletable resources consumed and (2) nonmaterial resources, including a range of beneficial uses of the environment.

Resources that generally may be irreversibly committed by the operation are: (1) biota destroyed in the vicinity; (2) construction materials that cannot be recovered and recycled with present technology; (3) materials that are rendered radioactive but cannot be decontaminated; (4) materials consumed or reduced to unrecoverable forms of waste, including uranium-235 and -238 consumed; (5) the atmosphere and water bodies used for disposal of heat and certain waste effluents to the extent that other beneficical uses are curtailed; and (6) land areas rendered unfit for other uses.

10.3.3 Biotic resources

10.3.3.1 Terrestrial

Approximately 68 acres will be covered with structures, and 7600 acres will be covered with the cooling lake and its associated structures. This acreage represents a habitat loss for a large percentage of wildlife presently using the STP site and will result in a substantial reduction in species richness. The American alligator, an endangered species, will suffer minor population reduction due to a loss of approximately 62% of existing nesting habitat within the site boundary. Due to reduced water flows to offsite freshwater marshlands south of the site, loss of this habitat will affect approximately 24,000 ducks and geese, 170 alligators, and numerous waders, shorebirds, rails, and gallinules. Finally, since the site is located in an important part of the rice-producing area of Matagorda County, about a 6% reduction is anticipated in the county's agricultural production.

10.3.3.2 Aquatic

Approximately 7 stream miles of Little Robbins Slough will be lost as freshwater habitat due to construction of the South Texas Project cooling lake. An undetermined acreage of freshwater marsh in Robbins Slough with its fauna and flora will also be lost due to obliteration of approximately 27% of the slough's total watershed. The slough may become less suitable as a nursery and breeding ground for some estuarine-dependent organisms such as shrimp and Gulf menhaden. Discharge of wastes into Little Robbins Slough will adversely affect populations there.

Less than 2 acres of benthic habitat in the Colorado River will be lost through construction of the makeup intake and discharge facilities, the spillway, and the barge slip.

10.3.4 Material resources

Construction materials are almost entirely of the depletable category of resources. Concrete and steel constitute the bulk of these materials, but there are numerous other mineral resources incorporated in the physical plant. No commitments have been made on whether these materials will be recycled when their present use terminates.

Some materials are of such value that economics clearly promotes recycling. Plant operation will contaminate only a portion of the equipment to such a degree that radioactive decontamination would be needed in order to reclaim and recycle the constituents. Some parts of the plant will become radioactive by neutron activation. Radiation shielding around each reactor and other components inside the dry-well portion of each containment structure constitute the major materials in this category for which it is not feasible to separate the activiation products from the base materials. Components that come in contact with reactor coolant or with radioactive wastes will sustain varying degrees of surface contamination, some of which could be removed if recycling is desired. The quantities of materials that could not be decontaminated for unlimited recycling probably represent very small fractions of the resources available in kind and in broad use in industry.

Construction materials are generally expected to remain in use for the full life of the plant, in contrast to fuel and other replaceable components discussed later. There will be a long period of time before terminal disposition must be decided. At that time, quantities of materials in the categories of precious metals, strategic and critical materials, or resources having small natural reserves must be considered individually, and plans to recover and recycle as much of these valuable depletable resources as is practicable will depend upon need.

10.3.5 Replaceable components and consumable materials

Uranium is the principal natural resource material irretrievably consumed in plant operation. Other materials consumed, for practical purposes, are fuel-cladding materials, reactor control elements, other replaceable reactor core components, chemicals used in processes such as water treatment and ion exchanger regeneration, ion exchange resins, and minor quantities of materials used in maintenance and operation.

The staff estimates that between 12,000 and 16,000 metric tons of contained natural uranium in the form of U_3O_8 must be produced to fuel the two units for 40 years. The assured U.S. reserves of natural uranium, as of January 1, 1973, recoverable at a cost of $8 or less per pound of U_3O_8, are 247,638 metric tons of uranium. A greater reserve exists if more expensively mined ore is considered.

In view of the quantities of materials in natural reserves, resources, and stockpile, and the quantities produced yearly, the expenditure of such material is justified by the benefits of the electrical energy produced.

10.3.6 Land resources

Over 8000 acres of land would be completely committed to the construction and operation of this power plant for the 40 years that the plant would be licensed to operate. The staff does not expect this land to be returned to present uses after decommissioning of the plant. The land would probably continue to be used as a cooling system, or it would be developed into an independent recreation area.

10.4 BENEFIT-COST BALANCE

The benefits and costs are summarized in Table 10.5 and discussed below.

10.4.1 Benefit description of the proposed plant

10.4.1.1 Expected average annual generation

When the plant is operated at 2500 MWe with an annual capacity factor of between 60-80%, the result will be the generation of about 13,100 to 17,500 GWhr of energy. This benefit will be available to the approximately 4.8 million inhabitants of the 52,000 sq miles of service area. In addition, this will be provided at a cost equal to or below that of alternative generation sources and without the substantial quantities of emission products normally released to the air by a fossil-fueled generating station.

Table 10.5. Benefit-cost summary of present design of the South Texas Project

Benefits	
Primary benefits	
Electric energy to be supplied	13,100 to 17,500 GWhr/year based on 60-80% capacity factor (Sect. 8)
Electric capacity contributing to reliability of power supply	2,500,000 kW (Sect. 8)
Secondary local benefits	
Employment of operating staff	125 persons (Sects. 5.6 & 10.4.1.6)
Payments to State and local agencies	$39,000,000/year (Sect. 10.4.1.4)
Visitors' Information Center	50,000 visitors/year (Sect. 10.4.1.5)
Wildlife preserve	1700 acres (Sect. 5.1.1)
Environmental Costs	
Land use	
Natural habitat for plant	1500 acres removed (Sect. 4.3.1)
Man-dominated habitat for plant	6800 acres removed (Sect. 4.3.1)
Right-of-way cleared for transmission lines	870 acres, wooded (Sect. 4.3.1)
Fogging	Some increase in reduced visibility (to <1000 m) near the lake (Sect. 5.6.1)
Water use	
Cooling water (Average, annual use)	Water diverted from Colorado River, about 54,000 acre-ft (Sect. 5.5.2.1) Total freshwater loss to lower Colorado – Matagorda Bay Estuary due to STP, about 52,000 acre-ft (Sect. 9.2.1)
Chemicals discharged to river	Negligible (Sect. 3.6)
Radiological impact (routine operation)	
Cumulative population dose, 50-mile radius, unrestricted areas	6.67 man-rem/year (<2.1 X 10^{-4} % of natural background) (Table 5.12)
Occupational dose	900 man-rems/year (<2.8% of natural background) (Table 5.12)
Accidents during operation or transportation	Annual potential radiation exposure of population from all postulated accidents is small fraction of natural background (Sect. 7).
Biological impact	Biota in the Colorado River, including some commercial fish, will be adversely affected by water intake system (Sect. 5.5.2.1.1). Marsh area south of the site will be adversely affected by reduced surface water inflow (Sect. 4.3.3).
Social and economic effects	
During construction	Disruption of normal traffic by highway and railroad relocation, greatly increased traffic on certain roads, possible social problems in nearby towns connected with some short-term population increase (Sect. 4.4).
During operation	Slight population increase in nearby towns because of plant employment (Sect. 5.6).

10.4.1.2 Expected distribution of electrical energy

The applicant estimates that the use by customer rate class will remain the same as for the recent 5-year average, as follows: residential, 25.6%; commercial, 19.9%; industrial, 47.4%; other, 7.1%.

10.4.1.3 Other products

The applicants do not plan to sell steam or other products from the facility.

10.4.1.4 Taxes

It is estimated that after completion of the plant, Matagorda County's 1970 assessed evaluation will increase by a factor of about 2.3. The total State and local taxes, including revenue transfers to the general funds of Austin ($8.5 million) and San Antonio ($10.4 million), will be about $39 million. The major recipients of property taxes will be the Palacios Independent School District ($4.4 million) and Matagorda County ($2 million).

10.4.1.5 Research and education

The applicant's preconstruction and continuing environmental investigations and monitoring programs are considered by the staff to be valuable. Data generated by the monitoring program concerning surface waters, groundwater, flora, fauna, meteorology, and radiology will be available to interested individuals. Relationships with local universities and colleges will prove to be mutually beneficial and especially to students of the earth and physical sciences. In addition, a visitors' center is to be constructed, which will provide educational benefits to the general public and regional school populations. Approximately 50,000 visitors per year are expected.

10.4.1.6 Employment

During the peak construction year (1978), the construction work force will number 2100 and the estimated man-hours for that year will be about 4 million (ER, Table 8.1-12). The operating force is expected to be about 125 permanent employees with an annual payroll of about $2 million during the first year in which STP is expected to become operational.

10.4.2 Cost description of the proposed facility

10.4.2.1 Power generation costs

The staff estimated the cost of the generating station in 1981 to be $1.1 billion. The annual operating, maintenance, and fuel costs are estimated to be $83 million, assuming an average capacity factor of 80%. Assuming a 30-year life and a discount factor of 10%, the present worth (in 1981 dollars) of the generating cost would be $1.89 billion. The annualized generating cost in 1981 would be $200 million. The staff estimates that the cost of decommissioning would not add significantly to the total generating cost.

10.4.2.2 Social costs other than community service costs

Social impacts were discussed in Sects. 4.4 and 5.6. Matagorda County will experience the greatest effects. Although some of these cannot be quantified, the staff judges that any dollar costs will be more than offset by the tax revenues generated by the power plant on behalf of the county.

10.4.2.3 Community service costs

The increased community service costs were discussed in Sects. 4.4 and 5.6. Matagorda County will experience the greatest impacts associated with the construction and operation of the power plant. This county and the towns of Bay City and Palacias probably will have to provide increased public services. In most instances, such as in education, housing, water, and sewage facilities, the existing services and planned improvements can accommodate the impacts of the construction and operating phases. In general, however, the costs associated with additional facilities and services will be more than compensated for by increased revenues.

10.4.2.4 Environmental costs

The environmental costs have been discussed in previous sections. One of the most significant costs is the loss of approximately 6800 acres of land now in agricultural use. All of the flooded portion of the site and part of the remaining land will be lost to agricultural production. About 6% of the current producing ricelands of Matagorda County will be taken out of production (Sect. 4.3.1) but can be relocated as the water allocated for irrigation needs has not been affected by STP. Two households involving six persons will be displaced by the project, and 26 farm operators will have to give up their operations (ER, Sect. 8.2.2). There are no sites designated as national historic sites within the STP boundaries or selected transmission line corridors. The loss of any other such resources is not considered to be serious.

If a 2500 MWe plant operating at 80% plant factor is assumed, about 50,000 acre-ft/year of water will be evaporated due to the plant. Approximately 54,000 acre-ft/year will be supplied from the Colorado River.

In order to limit salt buildup in the cooling lake, periodic discharge of part of the water by blowdown, and replacement by makeup from the Colorado River will be necessary. Blowdown will increase total dissolved solids in the Colorado River. This is not expected to have serious adverse effects on the Colorado River aquatic organisms.

During construction of the plant, activities will produce some smoke, dust, and noise which will create a nuisance within about a mile of the construction site. The air quality will not be significantly degraded during operation of the plant.

The environmental effects associated with the uranium fuel cycle are sufficiently small as not to significantly affect the conclusion of the cost-benefit balance.

10.4.3 Summary of cost-benefit balance

The staff concludes that the primary benefit of increased availability of electrical energy outweighs the environmental and economic costs of the plant. The staff further concludes that the indirect benefits of increased employment and increased tax revenues outweigh the social costs resulting from construction and operation of the STP.

As indicated in Sect. 9, the staff believes that there would be no reduction in overall costs by the use of an alternate site, the use of an alternate generating system, or any combination of these. The staff concludes that a nuclear station using unappropriated water from the Colorado River in conjunction with a cooling lake is a system with a benefit-to-cost ratio at least as high as that of any alternative system.

In the staff's opinion, the benefits of increased availability of electrical energy and improved system reliability in the applicant's service area outweighs the economic and environmental costs caused by the plant when it is operated in accordance with the conditions listed in the Summary and Conclusions.

REFERENCES FOR SECTION 10

1. *Major Uses of Land in the United States*, U.S. Department of Agriculture, Agricultural Economic Report No. 247, 1969.

2. S. H. Wittwer, "Maximum Production Capacity of Food Crops," *Bioscience* 24: 216-224 (1974).

3. Texas Water Rights Commission, application for permit to appropriate public water, tendered by Houston Lighting and Power Company for the South Texas Project, April 1974.

4. *Atomic Energy Clearing House*, 17(6): 42 (Feb. 8, 1971); 17(18): 7 (May 3, 1971); and 16(35): 12 (Aug. 31, 1970).

5. Pacific Gas and Electric Company, *Supplement No. 2 to the Environmental Report, Units 1 and 2, Diablo Canyon Site,* Docket Nos. 50-275 and 50-323, July 28, 1972.

11. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to 10 CFR 51, the Draft Environmental Statement for the South Texas Project, Units 1 and 2, was transmitted with a request for comments to:

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 Power Commission
Office of the Governor, State of Texas
County Judge, Matagorda County

In addition, the NRC requested comments on the Draft Environmental Statement from interested persons by a notice published in the *Federal Register* (FR DOC 74-27931) on November 29, 1974. Comments in response to the requests referred to above were received from:

Department of Agriculture (AGR)
Department of the Army, Corps of Engineers (ARM)
Department of Commerce (DOC)
Department of Health, Education and Welfare (HEW)
Department of the Interior (INT)
Department of Transportation (DOT), U.S. Coast Guard
Environmental Protection Agency (EPA)
Federal Power Commission (FPC)
Office of the Governor, State of Texas (TEX)
Houston Lighting and Power (HLP)
Sierra Club (SC)
Advisory Council on Historic Preservation (ACHP)
Triangle Cattle Company (TCC)
Southern Methodist University (SMU)

Our consideration of comments received and the disposition of the issues involved are reflected in part by revised text in other sections of this Final Environmental Statement and in part by the following discussion. The following discussion will reference the comments by use of the abbreviations indicated above. The comments are included in this Statement as Appendix A.

11.1 LAND USE

11.1.1 Removal of agricultural land

(TCC A-2)

The staff recognizes that farming involves a commitment to "a way of life" as well as to a strictly economic enterprise. In our assessment, the alteration of the way of life of some individuals, when their land is preempted, is regarded as a limited adverse impact that may not be fully compensable by monetary payments. This is an impact which acrues with practically any large endeavor involving land. The staff found that the alternatives to the proposed action offered no clear advantages with regard to this factor.

The staff did consider the Matagorda County rice income data provided by Mr. Savage ($37,112,000 for 1973). Prices paid for rice have been unstable in recent times, achieving peak values in 1973. In December 1973, for example, the price was about $16/cwt; however, in September 1974 the price was about $10.60/cwt. Mr. Savage's estimate of county income from rice may have been based on the higher 1973 values, while the staff's estimate ($26,400,000) is based on September 1974 values. Since September 1974 the price appears to have stabilized in the interval of $10 to $10.50/cwt.

11.1.2 Projected future development

(AGR A-5)

Electric power plants do not necessarily attract industry in the surrounding area. In nearly all cases (Texas included), rate charges are the same regardless of location within the service area; thus, electricity rates are no incentive to locate nearby. On the other hand, tax payments to Matagorda County by STP are expected to lower tax burdens on other taxpayers (DES, p. 4-15). This could stimulate industries requiring low-cost transportation and a small work force. Tax rates are but one of a number of factors attracting industries. The cost of raw materials, transportation, and labor generally loom much larger.

Changes in industry location occur continuously. It would be very difficult to determine how much is due to the location of a power plant. The staff believes that very little local industrialization will result from locating STP at its proposed site.

11.1.3 Future agricultural needs

(AGR A-21)

The staff has presented a detailed analysis of agricultural land use in Sect. 10.2.2.1. The analysis demonstrates that U.S. crop productivity (production per acre) has risen substantially in recent times (Table 10.1) and that a considerable potential for still further increases exists at present (Table 10.2). The intended inference from these data is that the rising demand for food can reasonably be expected to be met by rising productivity of crops.

Concern for feeding future populations is justified, however, since there are conditions under which the expected productivity gains could fail to materialize. An analysis of this possibility is given on page 10-4. There is now no basis for confidently predicting such a failure; however, the staff has pointed out that the cooling lake site could be reclaimed for agricultural production if unforeseen future stress in food supplies developed.

11.1.4 Land-use priorities

(AGR A-5)

The justification for a higher priority being given a nuclear power plant vs agricultural needs was presented in Sect. 10.2.2. This comment was subsequently deleted by the originator after a review of this section. (See AGR A-30).

11.1.5 Lost agricultural productivity data

(AGR A-5)

The acreage and market value of each crop replaced by the STP was covered in Sect. 10.2.2. This comment was subsequently deleted by the originator after a review of this section. (See AGR A-30).

(AGR A-30)

Due to the length of Sect. 10.2.2, only a cross reference will appear in Sect. 4.3.

11.2 CONSTRUCTION IMPACTS

11.2.1 Construction spoils disposition

(INT A-15)

The applicant states that any suitable material excavated from the plant proper will be used for cooling lake embankment. The balance of the material will be stockpiled or used as fill in the area southeast of the plant. Unused stockpile material will be graded and seeded to harmonize with the existing terrain.

Borrow areas will be designated within the confines of the embankment so that the excavation of earth within will equal the required fill. The side slopes of the embankment will be 3:1 on the exterior and 2.5:1 on the cooling lake side. The average height of the embankment is 44 ft, and the maximum height is approximately 51 ft along the south side of the cooling lake. Details of embankment materials are given in the ER, Sect. 3.4.1.

11.2.2 Acreage disturbed by construction activities

(INT A-16)

Table 4.1 has been corrected. The applicant shall restrict channelization and straightening of Little Robbin Slough to areas within the site boundary. This requirement appears in Sect. 4.5.2.

11.2.3 Relocation of FM 521

(TEX A-34, 38, 39) (HLP A-10)

The staff has considered the rerouting of FM 521 and finds that the rerouted distance around the station to be 1.9 miles. This will require approximately two additional minutes to traverse at the maximum allowable speed of 55 mph. The possibility of induced fogging caused by the operation of the cooling lake has been discussed in Sect. 11.7.10. Noise effects during continuous operation of the plant are discussed in Sect. 5.7.4 of the ER and will probably be undiscernable over the noise level of an automobile.

The increased traffic during construction has been discussed in Sect. 4.1 of the ER. The applicant indicates that no agreement is now in effect between themselves and the Texas Highway Department to reinforce and repair the roads affected by heavy construction vehicles. A study is, however, presently under way which may lead to some modifications of the present arrangements. The relocation of FM 521 will be done in accordance with Texas Highway Department requirements.

11.2.4 Recreational impacts

(INT A-15)

The possible increase in population of 3500 will occur only for approximately a two-year period during the peak construction period. The principal recreational attractions of the site region are water related (e.g., fishing, boating, swimming, etc.), and as such, even that number as indicated above could be absorbed in the extensive waterway and beach areas along the Gulf coast.

(TEX A-34, 40)

The potential use of the STP cooling lake for recreational purposes is discussed in Sect. 5.6.5.

11.2.5 Impacts on local community

(HEW A-31)

The applicant has stated (ER, p. 8.2-6a) that ad valorem taxes will be paid to local jurisdictions during the construction phase, which should provide financial aid in sufficient time to provide services required for construction-related impacts.

(HEW A-31)

The applicant states that consideration will be given to the possibility of charter bus service from appropriate points (such as Bay City) to the site and will encourage the use of car pools.

11.2.6 Transmission line impacts

(AGR A-5)

The presence of transmission lines will interfere with the aerial application of fertilizer, herbicides, and seed and will also interfere with the herding of cattle. This impact is not expected to significantly affect agricultural production. The majority of the 5686 acres of land designated for transmission-line corridors can be productively utilized as pasture or cultivated land. Aerial applications are used mainly for rice production, and presently, approximately 648 acres are cultivated under proposed transmission lines.

(AGR A-21)

Transmission-line routes were specifically selected to avoid forested areas (ER, Sect. 3.9.1), and the proposed routes cross less woodlands than do the alternate routes. Existing transmission corridors were utilized wherever possible. For example, the 125-mile Lon Hill line parallels 71 miles of existing right-of-way.

(INT A-15)

The staff confirmed that whooping cranes are recently extending their range. The staff recommends that the applicant follow the guidelines published in *Environmental Criteria for Electric Transmission Systems*, dated February 10, 1970, by the Departments of Interior and Agriculture. Additionally, the staff recommends that transmission lines which cross open water or estuarine areas be flagged visibly through the use of colored balls, similar to the flagging of transmission lines that are aviation hazards. Such marking may warn whooping cranes in flight and deter them from flying into the lines.

(SMU A-33)

The applicant has committed that no herbicides will be used during the transmission-line construction and initial clearing phase. The herbicides to be used for transmission-line maintenance and the impacts of their use are discussed in Sect. 5.5.1.2.

11.3 ECOLOGICAL IMPACTS

11.3.1 Impacts on Little Robbins Slough

11.3.1.1 Diversion at fresh water to Little Robbins Slough

(INT A-16, EPA A-25, HLP A-6, A-7, A-10, A-11, COM A-45, A-46, TEX A-34, TEX A-38, SMU A-33)

The applicant has agreed to conduct a study of the Little Robbins Slough marsh complex as described in Sect. 6.1.3.2 and Appendix E. Based on the results of this study, a decision will be made concerning the need for mitigative measures such as the diversion of water from the Colorado River to the marsh complex. Data presented in Table 4.6 indicate that diversion from the Colorado River of approximately 5000 acre-ft of fresh water per year would mitigate adverse impacts (due to loss watershed) on the Robbins Slough marsh complex. An annual diversion of this amount would represent 0.3% of the average annual historical flow of the Colorado River and 1.1% of the average annual flows adjusted for future diversions upstream. The impacts on the Colorado River due to diversions of this magnitude would be negligible. Additionally, seepage from the cooling lake estimated at 2 cfs may significantly compensate for this reduction in watershed.

11.3.1.2 Impacts of water storage in the cooling lake

(INT A-15)

The impacts of water use have been addressed in Sect. 5.2.

11.3.1.3 Sewage discharge and construction runoff to Little Robbins Slough

(INT A-16, HEW A-31, SMU A-32, HLP A-10)

The applicant states that construction wastes will be discharged, after treatment, directly to the Colorado River rather than to Little Robbins Slough. In addition, construction site runoff will be treated by the installation of sedimentation basins and will also be directly discharged, after sedimentation, to the Colorado River rather than to Little Robbins Slough.

11.3.1.4 Channelization of Little Robbins Slough

(INT A-16, EPA A-27, HLP A-10)

The applicant will limit the straightening and channelization of Little Robbins Slough to the area within the site boundary rather than 0.75 mile below the site as previously planned.

11.3.1.5 Little Robbins Slough Study Program

(INT A-16, EPA A-25, SMU A-33, TEX A-34, A-40, A-44, HLP A-11)

The study program is described in Sect. 6.1.3.2 and Appendix E.

11.3.2 Impacts on the Colorado River

11.3.2.1 Entrainment potential

(INT A-15, EPA A-26, TEX A-44, HLP A-6)

The staff analysis of entrainment potential was based on high densities of shrimp nauplii occurring in the Colorado River (ER, supplemental data to Amendment 1, Tables 72-89).[1] Subsequent examination of the nauplii by an independent expert in marine zooplankton taxonomy (Mr. Richard Kalke, University of Texas Institute of Marine Science, Port Aransas, Texas) revealed these organisms not to be the commercially important penaeid species (Appendix E). Penaeid shrimp life-cycle data support this new finding.[2] While the exact species remains to be determined conclusively (probably harpacticoid copepod nauplii), the staff agrees that the specimens collected do not belong to the commercially important penaeid group.

The applicant has agreed to conduct a study program to identify entrainment potentials; this program is described in Sect. 6.1.3.2 and Appendix E. The determination of acceptable levels of entrainment will be made upon completion of the staff's analysis of the results of the study program.

11.3.2.2 Impingement potential

(EPA A-26)

The maximum approach velocity to the makeup water intake structure is 0.55 fps, which implies that the maximum water velocity through the traveling screens is greater than 1.0 fps. This occurs when the makeup water pumping rate is 1200 cfs, which is permitted only when the Colorado River flow rate, as measured at the Bay City gage, is at least 2480 cfs. At this flow rate the aquatic organism concentration at the intake structure is very low. Therefore, the staff does not concur with the EPA recommendation that the maximum water velocity through the screen should be 0.5 fps.

11.3.2.3 Blockage of the West Branch of the Colorado River

(COM A-45, A-46)

Cooper and Copeland[3] et al, as discussed in Sect. 4.3.3 of this Statement, have demonstrated the decline of estuarine productivity as a result of reduced freshwater inflows. Furthermore, one of the major reasons reductions in productivity generally follow reductions in freshwater input is the loss of nutrients normally present in freshwater.[3] Significantly, STP will return to the river via blowdown (approximately 13,400 acre-ft/year of nutrient-concentrated water) much of the nutrients withdrawn during makeup operations.

In addition to the Colorado River, Matagorda Bay receives freshwater input from the Lavaca and Navidad Rivers and from numerous smaller streams and creeks. Since about 1925, most of the Colorado River flow has been diverted directly to the Gulf of Mexico, due to man- and nature-caused modifications in the course of the river.[4] Some river flow does enter the bay through the Intracoastal Waterway and Parker's Cut during flood conditions.[4] In light of these facts, the staff concludes that makeup operations, although reducing the river's average annual historical flow by about 3%, will have only a slight adverse impact upon the productivity of Matagorda Bay.

The applicant states that, during construction, the West Branch of the Colorado River will be plugged immediately south of its intersection with the proposed spillway. Water entering the West Branch will be discharged directly into the Colorado River. Therefore, for the duration of construction little or no water will enter Matagorda Bay via the West Branch. Consequently, the eastern arm of Matagorda Bay will probably increase slightly in salinity, making the bay slightly less suitable as a nursery. Upon completion of construction, two 48-in. culverts will pass West Branch flows under the spillway and on to the bay. During flood conditions, flood waters will overflow into the spillway with subsequent discharge to the Colorado River. The staff believes that the impact of interrupting the quite small flow of the West Branch of the Colorado River during construction will be both negligible and reversible.

11.4 WATER QUALITY AND CONSUMPTION

11.4.1 Mercury levels in the Colorado River

(EPA A-26)

Effluents from site dewatering operations will be released to the Colorado River near the location of the barge slip at rates up to 5.6 cfs (ER, p. 4.1-17). Sedimentation basins will be provided as necessary to reduce total suspended solids prior to discharge to the Colorado River.

On one occasion, January 10, 1974, the mercury concentration in Well 115-D was reported to be 20 μg/liter. These other quarterly determinations for the same well yielded mercury concentrations not exceeding 0.4 μg/liter. Other than the single report of 20 μg/liter, the highest concentration reported from three wells sampled quarterly for one year was 1.6 μg/liter, and the mean of all measurements (excluding 20 μg/liter) was less than 0.37 μg/liter (ER, Tables 2.5-25 through 2.5-27). Based on these data, the staff concurs with the applicant's conclusion that the single measurement of 20 μg/liter is in all probability erroneous.

In any event, comparison of mercury concentrations reported for the Colorado River (Table 42, supplemental data to Amendment 1 of the ER) with those reported for groundwater reveal that river concentrations are generally higher.

The staff concludes that mercury discharged to the Colorado River via dewatering effluents will not exceed the mercury effluent standards (5 μg/liter) presently proposed by the EPA.[2] ("Draft Advance Notice of Proposed Rulemaking for Toxic Pollutant Effluent Standards", *Environ. Rep.* 5(35): 1342-1354 (1974).

11.4.2 Dissolved oxygen levels

(EPA A-26, HLP A-10)

The requirement to control blowdown such that Texas State water quality standards are not exceeded is considered by the staff to be sufficient. Additionally, conservative studies indicate that blowdown effects on the Colorado River will result in dissolved oxygen levels of 6.5 ppm in the summer and above 11 ppm in the winter (ER, Sect. 5.1.2.2.5).

11.4.3 Cooling lake blowdown facilities

(ARM A-13)

A minimum freshwater flow of 800 cfs (Bay City gage minus makeup rate) before discharge can occur assures that the blowdown is not recirculated back into the makeup structure and that the same portion of river water does not receive the blowdown more than twice (ER, Amendment 1, p. 3.4-6a). Also, the river must be flowing toward the Gulf at a velocity of at least 0.4 fps at the time of discharge to assure sufficient mixing of the blowdown with the river to meet Texas State water quality standards.[1]

11.4.4 Future diversions of Colorado River water

(INT A-14, A-15, EPA A-25, COM A-46)

Diversions of water from the Colorado River due to future upstream development could reduce the net freshwater input to the estuary and thereby reduce its suitability as a breeding ground and nursery for some estuarine-dependent species. Consideration should be given to this potential impact by the appropriate State agencies who ultimately regulate all freshwater diversions from the river.

11.4.5 Total dissolved solids in groundwater

(EPA A-27)

Studies indicate that cooling lake water will invade the upper parts of the shallow aquifer before it is channeled to the Colorado River in a southeasterly direction. It should be noted that all water used for human consumption comes from the strata constituting the lower aquifer (ER, Sect. 5.1.4.2).

After 27 years of dilution, the dispersion front will reach the top of the fine sand located 23 ft below the ground surface. From this point on, the dispersion moves horizontally in the stratum of fine sand with a constant velocity of 5×10^{-6} fps. The flow will occur in a southeasterly direction parallel to the regional migration in the upper aquifer.

The concentration of total dissolved solids in the fine sand will be approximately 50% of the original value 60 years after the seepage front meets the water table.

The increase in concentration in the layer of fine sand will occur very slowly beyond the median value of 50%. However, if the concentration of total dissolved solids is held constant at 50% of the original value and for a velocity of 5×10^{-6} fps, it is estimated that the dilution front will reach well No. 42 some 185 years after dispersion begins. Well 42 is located 3.5 miles from the geographic center of the pond, measured in a direction parallel to the regional flow, and is the closest existing groundwater use.

Flow from the cooling lake will reach some parts of the Colorado River sooner than well number 42 (approximately 150 years), because of the shorter distance to the river.

11.4.6 Saltwater wedge intrusion

(EPA A-27)

Saltwater intrusion in the Colorado River will occur to a greater extent as a result of makeup water diversion for STP. However, this intrusion will be no greater than has occurred historically, and the resulting impacts should be negligible.

11.4.7 Induced evaporation losses

(TEX A-37)

The staff has refined its analysis of induced evaporation losses from the cooling lake. The new estimates (Tables 5.2, 5.3, and 9.4) are somewhat lower.

11.4.8 Cooling makeup projections

(TEX A-43)

The 3000 cfs freshwater requirement is not necessary on a sustained basis. Blowdown rates will be variable and limited by freshwater flows, as discussed in Sect. 3.4.4. Likewise, makeup rates will also be variable and limited by freshwater flows, as discussed in Sect. 3.4.3. The staff finds no inconsistencies regarding water requirements.

11.4.9 Impacts on public water supplies

(SMU A-33)

The estuarine nature of the Colorado River downstream from the STP site precludes its use as a public water supply. The area is served primarily by groundwater wells. Thus, freshwater withdrawals due to STP should have no significant impact on public water supplies.

11.5 RADIOLOGICAL IMPACTS AND ASSESSMENTS

11.5.1 Radiological monitoring — turbine building

(EPA A-24, A-27)

Many PWRs do not have enclosed turbine buildings; therefore, gaseous releases cannot be monitored. Those PWR plants that have turbine buildings have many openings; as a result, monitoring will not be representative. Since radioactive gaseous releases from a PWR turbine building are limited by primary to secondary system leakage, and then by leaks from the secondary system to the outside, radioactive gaseous releases would normally be very small indeed. Based on these considerations and in order to treat all PWRs alike, turbine building gaseous releases are not required to be monitored.

The turbine building liquid releases will be continuously monitored, which is a requirement listed in Appendix B of the PWR plant technical specification. The applicant will also take samples (at least weekly) from the turbine building floor drain sump for analysis; and, if necessary, the sump contents will be transferred to the LWPS for treatment via the condensate regenerate waste tank.

11.5.2 Radiological monitoring programs

(EPA A-24, A-27)

A periodic census of cows and goats in the area will be required as part of the environmental technical specifications, which will be finalized at the operating license stage. A decision will be made at that time concerning what circumstances would warrant the sampling of milk.

(HEW A-30)

The environmental monitoring program will be delineated before an operating license is issued. Sampling times, locations, and aquatic species will be determined prior to that time. Requirements for sampling of milk or food crops will also be determined by that time.

11.5.3 Radiological assessments

(EPA A-27)

Our reference No. 20 to the HERMES code is incorrect. The correct reference is: D. H. Slade, Ed., *Meteorology and Atomic Energy, 1968,* TID-24190.

(HLP A-10)

The comment is noted. Since we did not refer specifically to radioactive waste storage outside buildings, but to the storage of liquids that might contain radioactive material (such as reserves of primary coolant water), the statement stands.

(INT A-17)

Cumulative radiological effects to aquatic organisms are discussed in Sect. 5.4.1.3.

11.5.4 Liquid radioactive waste system changes

(HLP A-9)

The staff has updated Sect. 3.5 (Radioactive waste systems) and its assessments based on the designs as presented in the PSAR through Amendment 11 and in the ER through Amendment 4.

11.5.5 Radiological impacts caused by severe weather

(HEW A-30)

Section 2.6.3 and the staff's response to comments in this section discuss severe weather recurrence intervals.

Outside tanks that may contain small quantities of radioactive material are limited by technical specifications to quantities which, if accidentally released, would not result in concentrations in unrestricted areas exceeding the limits of 10 CFR, Part 20 "Standards For Protection Against Radiation."

11.5.6 Reactor accident emergency plan

(TEX A-44)

The safety standards and criteria established by the Commission for the review of applications for nuclear power plants include provisions for conservative design and operating margins and for redundancy of components and system to compensate for the fact that no body of knowledge can ever be complete enough to reduce uncertainties and risks to zero. Thus, although the operation of nuclear power plants is not completely risk-free, it is the safety objective of the NRC, through the licensing process, to require applicants and licensees to take those actions necessary to assure that the risk is extremely low. It is in this regard that each applicant for a construction permit is required to submit for Commission approval its preliminary plans for coping with emergencies so that if an emergency situation should occur, appropriate measures can and will be taken to protect public health and safety and prevent damage to property.

An application for a construction permit is required to contain sufficient information to assure the compatibility of proposed emergency plans with nuclear power plant design features, site layout, and site location with respect to such considerations as access routes, surrounding population distributions, and land use. At the operating license stage of the safety review, an applicant is required to submit for Commission approval procedures for notifying, and agreements reached with local, State and Federal officials and agencies for the early warning of the public and for public evacuation or other protective measures should such warning, evacuation, or other protective measures become necessary or desirable.

In addition, power plants licensed to be built and operated undergo periodic inspections by the NRC both during plant construction and throughout plant lifetime for the purpose of assuring compliance with applicable safety and environmental criteria and operating license conditions.

11.5.7 Accident evaluations

(INT A-17)

A comment was made that the Statement should provide an evaluation of the consequences of a class 9 accident at the site. As is stated in the DES, Sect. 7.1, the results of the Reactor Safety Study will be assessed on specific bases as may be warranted after issuance of the final report. However, the Commission's interim position is that the content of the draft study is not an appropriate basis for licensing decisions.

(TEX A-39)

In accordance with Annex A to 10 CFR Part 50, the environmental effects of class 9 accidents need not be evaluated.

(SC A-18)

In the unlikely event of a spill of radioactive material at or near the plant site, it would not endanger any viable aquifers in the area except the very local, low-quality shallow aquifer which is used only occassionally for domestic use. The high-quality aquifer is:

1. under artesian pressure,

2. protected by an impervious aquiclude,

3. has a gradient away from populated areas,

4. has a recharge area upgradient of the plant.

Therefore, the staff does not consider contamination of the higher quality deep aquifer as an unacceptable environmental risk due to its probability for occurrence being sufficiently small.

11.5.8 Fuel cycle and waste management impacts

(TEX A-39)

The environmental effects of the uranium fuel cycle were the subject of recent rulemaking (39 FR 14888). An amendment to subsection 15 of Appendix D to 10 CFR Part 50 reads in part:

" 15. (a) In applicant's environmental reports and the Commission's detailed statement for light-water-cooled nuclear power reactors, the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride isotopic enrichment, fuel fabrication reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor shall be as set forth in the following Table S-3 of the Commission's *Environmental Survey of the Uranium Fuel Cycle*. No further discussion of such environmental effects shall be required."

Based on the above, the staff feels that the discussion in Sect. 5.4.3 (including Table 5.13) is sufficient.

11.6 ALTERNATIVES

11.6.1 Alternative energy sources

(SC A-19)

Alternative energy sources, including coal, are discussed in Sect. 9.1.2. The staff requested the Joint Economic Committee to supply the document containing the statement that it strongly feels nuclear power is less economic than coal. The committee responded that they hold no such position.

The use of lignite was considered for both Comanche Peak and Allens Creek (FESs) and was found to be economically less desirable at those sites than a nuclear plant. This will be true for STP also since it is located further from the lignite fields than the other plants. The lower heating value of lignite in comparison with bituminous coal makes it economically feasible to use as a power plant fuel only where thick seams (over 6 feet) exist and in quantities sufficient for the lifetime of the plant. These reserves must also be reasonably close to a feasible site for a large cooling water reservoir. There are only a few deposits in Texas which meet these requirements. Additionally, the low heat rate of lignite, 70% of that for bituminous coal, would represent a more serious environmental impact.

11.6.2 Alternative cooling sources

(INT A-15)

Only unappropriated water will be drawn from the Colorado River as makeup for the cooling lake (ER, Sect. 9.2.1). None of the water stored in upstream reservoirs will be used as makeup. During drought years, there will be little or no makeup from the river (ER, Fig. 3.4-15).

Salt water from the Gulf of Mexico could be used as makeup for the cooling lake. This would require transporting the makeup and blowdown over a distance of about 18 miles (ER, p. 10.1-5). The high cost of transporting large quantities of water over this distance (ER, Sect. 10.3) and the engineering problems associated with the operation of a saltwater system, eliminated this as a viable alternative.

11.6.3 Alternative sites

(EPA A-23, 25, TEX A-34, 40)

The alternative site analysis presented in the DES was completely reevaluated. Additional information on alternative sites was requested by the staff and provided by the applicant. The staff's conclusions are presented in Sect. 9.1.2.2.

11.6.4 Benefit-cost analysis validity

(SC A-19)

Many issues are not adequately treated by existing methodologies, but NEPA requires that the issues be treated. The approach is to make social, economic, and environmental evaluations of gains and losses by various public interest groups by taking certain actions. Alternatives are considered and tradeoffs evaluated. The staff makes recommendations and states conclusions based on its analysis, and attempts to supply the necessary information in reaching a decision on the proposed project. Although the regulatory staff does not establish the ethical standards of a society, it has a role to evaluate the "good" and "bad" impacts of alternatives as society now perceives them. Moreover, the staff must follow ethical standards of objectivity and fairness by considering all views and the full range of significant factors in evaluating these impacts.

11.7 MISCELLANEOUS

11.7.1 Severe weather recurrence intervals

(HLP A-8)

Statistical data on tornadoes are extremely dependent on human observation and the period of record and area examined. The staff has used a particular data base and calculational procedure in the STP-DES that we consider to be conservative and that is consistent with our evaluation for other nuclear plant sites. HL&P presented, in their Allens Creek Environmental Report, an analysis of tornado recurrence intervals in the southeast Texas area, using the same data base and calculational procedure as the staff. The analysis indicates that the tornado recurrence intervals for the STP site area is 645 years, which is in good agreement with our calculated value of 550 years. The major area of disagreement in the tornado recurrence calculation is in the estimated average tornado path area. HL&P has used a much smaller path area, presumably derived from *Storm Data*, a reference which does not provide detailed information on how the reported path areas were estimated. HL&P does not specify the number of tornadoes that had path length information and what the range of values were. We believe that the tornado recurrence interval presented in the Environmental Statement is conservative, and that the value proposed by HL&P, based on unsubstantiated data, is nonconservative and may be unrealistic.

(AGR A-21)

Section 2.6.3 presents the information that 36 tropical storms, hurricanes, and depressions have passed within 50 miles of the site in the period 1871-1971.

11.7.2 Regional demography

(INT A-14)

Section 2.2.1.1 of the ER states that "Two developments, Selkirk Island and Exotic Isle, are within approximately 4 miles SE of the reactor buildings." The text of Sect. 2.2.1 was modified to clearly indicate the distance stated was referenced to the plant location.

11.7.3 Wildlife Preserve Management

(INT A-15)

The applicant has indicated in response to comments (February 14, 1975) that the wildlife preserve will be left in its natural state. In addition, there will be no hunting permitted. The staff concludes that the area will be permitted to undergo changes in natural successional stages with minimal disturbance. The applicant further states that access to the area will be limited to ecological studies.

11.7.4 Cooling lake embankment failure and flood potentials

(DOC A-45, ARM A-13)

The effects on the site due to extreme floods on the Colorado River or cooling lake embankment failure will be covered in the staff's Safety Evaluation Report on the South Texas Project.

11.7.5 Archaeological surveys

(ACHP A-4, TEX A-35, 40)

No on-ground archaeological surveys have been carried out on the STP transmission line routes. However, a study directed by Mr. David Dibble, acting director of the Texas Archaeological Survey, is presently under way to conduct a field investigation of the transmission line routes, although no archaeological resources were identified in the preliminary study. The Texas Historical Commission will review the results of this survey to insure no unacceptable impacts are incurred.

11.7.6 Geology and seismology

(INT A-14, AGR A-21)

The information on geology in the Environmental Statement is not intended to be sufficient for an independent assessment of the adequacy of the facility design with respect to the geologic environment. Such adequacy is determined by the NRC in its safety evaluation of the proposed plant, which, as presumed in the comment, does include consideration of seismology. The primary purpose of including ecosystem descriptions in the Environmental Statement is to permit an evaluation of how the construction and operation of the proposed plant might have an adverse impact on some element of the ecosystem or its interactions. For this purpose, the staff believes the descriptions of geology and seismology in the Statement are sufficient.

11.7.7 Subsidence

(DOC A-45, 46)

The effects on the site due to subsidence will be covered in the staff's Safety Evaluation Report.

11.7.8 Hydrology

(INT A-14)

The hydrologic information provided in Sect. 2.5 is sufficient to adequately assess the environmental effects of the proposed project. Additional detail is available in the applicant's ER, and hydrology considerations affecting plant safety will be covered in the staff's Safety Evaluation Report.

11.7.9 Decommissioning

(AGR A-21)

Decommissioning is discussed in Sect. 10.2.3. Until a specific plan for the decommissioning of STP is developed, which provides the level of restoration intended, only a range of expected costs can be provided. As discussed in Sect. 10.4.2.1, the staff estimates that the cost of decommissioning would not add significantly to the total generating cost.

11.7.10 Cooling lake fogging potential

(DOC A-45)

Fogging caused by the cooling lake is covered in Sect. 5.6.1 of the Statement and Sect. 5.1.5.1.1 of the applicant's ER. Observations at operational cooling ponds indicate that thin, wispy patches of steam fog over the water surface is a common occurrence, but only rarely does it penetrate inland more than 100 to 300 feet. However, under extreme conditions (very cold, stable air), the fog may extend inland a mile or more. Experience at Dresden cooling lake in Illinois indicates that the visibility within the fog some distance from the shoreline is sufficiently high (greater than 100 feet) so as to create only a minor traffic hazard. Ponds are not a major source of surface fog, despite the release of the water at ground level. As the water droplets move across the nearby land areas, some droplets will be removed by vegetation and other surfaces, causing a local increase in humidity and dew. During periods of subfreezing temperatures, some of the droplets will freeze and create a layer of low density, friable rime ice on nearby vegetation and structures very near the shoreline. Observations at existing ponds indicate that this rarely, if ever, causes damage to plants, or causes problems with power lines.

11.8 LOCATION OF PRINCIPAL CHANGES IN THE STATEMENT IN RESPONSE TO COMMENTS

	Topic	FES Page
11.8.1	Local Meteorology	
	Incorporation of one-year's data (HLP A-8)	2-8, 6-1
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	Ricelands proportion (HLP A-10)	4-4
	Matagorda Bay salinity (ARM A-13)	4-9

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Appendix A

COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

FRANCIS I. SAVAGE
PHONE 245-2733

HARLEY S. SAVAGE

FRANCIS I. SAVAGE, JR.

TRIANGLE CATTLE COMPANY
FRANCIS SAVAGE & SONS
REGISTERED BRAHMAN & BRAFORD CATTLE
ROUTE 2, HIGHWAY 60, SOUTH
BAY CITY, TEXAS 77414

December 4, 1974

Mr. B. J. Youngblood, Chief
Environmental Projects Branch 3
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Sir:

Being one microscopic ion within this vast cosmic system we live in gives one a small voice to speak from, nevertheless, as an individual concerned with production agriculture, I must speak out with concern to the Draft Environmental Statement for the South Texas Project Dockets No. 50-498 and 50-499.

Thus follows: I have endeavered to provide the Atomic Energy Commission with factual data concerning the effect of this project upon the rice industry of Matagorda County, Texas, and seeing that the indication of this document shows no effect of this data, I direct this effort of communication towards feelings, emotions, common sense, and experience.

The evidence as presented in this document is impressive and many man hours of work by specialists put forth their efforts for the sake of credibility. However, to be able to feel, touch, and smell fresh turned earth is an experience enjoyed by few. To plant, nourish, and harvest a crop of grain is a special relationship between man and his creator. Thus, it makes it more difficult to project feelings or expressions to others who are distant from this environmental situation of man and nature.

A concern of agriculture is that most of us are out of touch with the reality of farming, the everyday care and concern for the land from whence all crops must come. The echo chamber of our generation rings too often with the familiar phrase "We have plenty of land". Yes we have millions of acres of land but only a small part of this vastness is suited for growing crops. Rice is one of these crops, in fact, it feeds a large portion of the world, although we in this country don't think of it as a world food staple.

This project sets squarely in the middle of the most productive rice land within Matagorda County. Can we, in the time of mounting grain deficiency, spare one acre of grain producing land? Do we need to look environmentally closer at the impact on food producing areas?

It is important to agriculture and the world that we are certain the decisions we make now do not become disasters in the near future by using our grain producing areas for other than grain production when there are alternatives.

Trusting with unrelenting faith in our system of government and uttering the cry of the great crusades "God help us".

I remain a concerned farmer.

Sincerely,

Harley S. Savage

cc: Mr. Daniel R. Muller, Assistant Director, Atomic Energy Commission
Mr. Earl Butz, Secretary of Agriculture
Mr. John C. White, Commissioner, Texas Dept. of Agriculture
Mr. Aaron Autry, Vice President, Central Power & Light
Mr. Elvin Gentry, President, Bay City Chamber of Commerce
Mr. E. E. Hudson, President, Matagorda County Rice Farmers Cooperative

STN-50-498
STN-50-499

UNITED STATES DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION
WASHINGTON, D.C. 20250

December 10, 1974

Mr. B. J. Youngblood, Chief
Environmental Projects Branch 3
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Youngblood:

As requested in your letter of November 27, 1974, to Dr. Tschirley, we have reviewed the draft environmental statement for the Houston Lighting and Power Company South Texas Project, Units 1 and 2 (Docket Numbers STN 50-498 and STN 50-499), and have no suggestions or comments.

Sincerely,

WALTER J. CLAYTON
Director, Office of Program
Development and Analysis

STN-50-498
STN-50-499

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
NATIONAL PROGRAM STAFF
Beltsville, Maryland 20705

December 11, 1974

Subject: Comments on the Draft Environmental Statement Related to the Proposed South Texas Project, Units 1 and 2.

To: B. J. Youngblood, Chief
Environmental Projects Branch 3
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

I have been asked by Mr. C. W. Carlson to review the subject draft environmental statement. In general, this appears to be a thorough evaluation of the effects of construction and operation of a nuclear power plant on the Gulf Coast of Texas. The known occurrence of violent storms in this area has been noted and planned for. The staff comments concerning retaining Robbins Slough as a freshwater marsh are particularly relevant and should be considered by the applicant. In general, the proposals set forth in the statement should have no adverse impact on agriculture.

Herbert B. Osborn
Staff Scientist
Soil, Water and Air Sciences

Enclosure (1)

cc: C. W. Carlson

Advisory Council
On Historic Preservation
1522 K Street N.W., Suite 430
Washington D.C. 20005

DEC 31 1974

STN-50-498
STN-50-499

Mr. B. J. Youngblood, Chief
Environmental Projects Branch 3
Directorate of Licensing
Atomic Energy Commission
Washington, D.C. 20545

DEC 30 1974

Dear Mr. Youngblood:

This is in response to your request of November 27, 1974, for comments on the draft environmental statement (DES) for the South Texas Project Units 1 and 2, in Matagorda County, Texas. 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 your DES appears adequate. However, the Advisory Council has been informed by staff to the Texas State Historic Preservation Officer that an error appears in section 2.3.2 on page 2-5 of the DES. While this section of the DES appears to state that the South Texas Project plant site and the transmission-line corridors related to the plant site have been surveyed and no archeological resources were located, it has been pointed out to us that on-ground archeological surveys have only examined the plant site.

Because it appears that transmission-line corridors, railroad grades, spoils areas, and other impacted offsite areas have not been surveyed the DES is inadequate regarding our area of expertise as it does not contain sufficient information to enable the Council to comment substantively. Please furnish additional data for those areas other than the plant site impacted by this project indicating:

I. <u>Compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470[f])</u>. The Council must have evidence that the most recent listing of the National Register of Historic Places has been consulted (see <u>Federal Register</u>, February 19, 1974 and monthly supplements each first Tuesday thereafter) and that either of the following conditions is satisfied:

A. If no National Register property is affected by the project, a section detailing this determination must appear in the environmental statement.

B. If a National Register property is affected by the project, the environmental statement must contain an account of steps taken in compliance with Section 106 and a comprehensive discussion of the contemplated effects on the National Register property. (Procedures for compliance with Section 106 are detailed in the <u>Federal Register</u> of January 25, 1974.)

II. <u>Compliance with Executive Order 11593 "Protection and Enhancement of the Cultural Environment" of May 13, 1971</u>.

A. Under Section 2(a) of the Executive Order, Federal agencies are required to locate, inventory, and nominate eligible historic, architectural and archeological properties under their control or jurisdiction to the National Register of Historic Places. The results of this survey should be included in the environmental statement as evidence of compliance with Section 2(a).

B. Until the inventory required by Section 2(a) is complete, Federal agencies are required by Section 2(b) of the Order to submit proposals for the transfer, sale, demolition, or substantial alteration of federally owned properties eligible for inclusion in the National Register to the Council for review and comment. Federal agencies must continue to comply with Section 2(b) review requirements even after the initial inventory is complete, when they obtain jurisdiction or control over additional properties which are eligible for inclusion in the National Register or when properties under their jurisdiction or control are found to be eligible for inclusion in the National Register subsequent to the initial inventory.

C. The environmental statement should contain a determination as to whether or not the proposed undertaking will result in the transfer, sale, demolition or substantial alteration of eligible National Register properties under Federal jurisdiction. If such is the case, the nature of the effect should be clearly indicated as well as an account of the steps taken in compliance with Section 2(b). (Procedures for compliance with the Executive Order are detailed in the <u>Federal Register</u> of January 25, 1974, "Procedures for the Protection of Historic and Cultural Properties," pp. 3366-3370.)

13170

C. Under Section 1(3), Federal agencies are required to establish procedures regarding the preservation and enhancement of non-federally owned historic, architectural, and archeological properties in the execution of their plans and programs.

The environmental statement should contain a determination 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, architectural or archeological significance.

III. The procedures for compliance with Section 106 of the National Historic Preservation Act of 1966 and the Executive Order 11593 require the Federal agency to demonstrate consultation with the appropriate State Historic Preservation Officer. The State Historic Preservation Officer for Texas is Mr. Truett Latimer, Executive Director, Texas State Historical Survey Committee, P. O. Box 12276, Capitol Station, Austin, Texas 78711.

Should you have any questions or require any additional assistance, please contact Brit Allan Storey of the Advisory Council staff at P. O. Box 25085, Denver, Colorado 80225, telephone number (303) 234-4946.

Sincerely yours,

John D. McDermott
Director, Office of Review
and Compliance

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 648 Temple, Texas 76501

December 26, 1974

RECEIVED JAN 3 1975

Mr. B. J. Youngblood, Chief
Environmental Project Branch 3
Directorate of Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Youngblood:

We have reviewed the draft environmental statement for the South Texas Project Units 1 and 2, Houston Lighting and Power Company.

Generally the statement adequately describes the environmental impact of the proposed project, and contains measures to minimize the adverse effects. However, we offer the following comments for your consideration.

1. A section should be included to describe the effect of future development on the agricultural land base. Probably you have developed projections on industrial development which will occur as a result of this project. We believe you will agree additional agricultural land will be replaced by industrial development, at a more rapid rate as a result of your proposed project.

2. The statement should include the number of acres and market value of each crop to be replaced by the project. This is agricultural production lost.

3. Section 5.1.2 Transmission lines
The adverse effects upon farming operations by transmission lines should be discussed in this section. For example, transmission lines will interfere in aerial application of fertilizer and herbicides and in some cases seeding, which is essential in rice farming.

4. This statement could include information to show why a nuclear power plant should have a higher priority for land and water than does the production of food and fiber.

We appreciate the opportunity to review this draft and make appropriate comments.

Sincerely,

For
Edward E. Thomas
State Conservationist

Houston Lighting & Power Company
Electric Tower
P.O. Box 1700
Houston, Texas 77001

January 10, 1975
ST-HL-AE-52

Edson G. Case, Acting Director
Division of Reactor Licensing
Office of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Sir:

South Texas Project - Units 1 & 2
Docket Nos. STN-50-498, STN-50-499

Houston Lighting & Power Company acting as Project Manager of the South Texas Project - Units 1 & 2, on behalf of itself, the City Public Service Board of San Antonio, Central Power and Light Company and the City of Austin hereby submits comments on the Draft Environmental Statement prepared by the United States Atomic Energy Commission, Directorate of Licensing with respect to the proposed South Texas Project.

These comments will be part of Amendment 4 to the Environmental Report to be submitted in the near future.

Very truly yours,

G. W. Oprea, Jr.
Executive Vice President

RDS/cjd
Enclosure

cc: Messrs. C. Thrash (Baker & Botts)
R. Gordon Gooch (Baker & Botts)
J. R. Newman (Lowenstein, Newman, Reis & Axelrad)

339

STP COMMENTS TO THE DES

INTRODUCTION

Houston Lighting & Power Company, acting as Project Manager of the South Texas Project, Units 1 and 2, on behalf of itself, the City Public Service Board of San Antonio, Central Power and Light Company and the City of Austin, hereby submits comments on the Draft Environmental Statement prepared by the United States Atomic Energy Commission, Directorate of Licensing with respect to the proposed South Texas Project.

SUMMARY AND CONCLUSIONS

Item 2
Page iii

Item 2 should reflect that the proposed action is issuance of a construction permit to Houston Lighting & Power Company, acting as Project Manager of the South Texas Project, Units 1 and 2, on behalf of itself, (30.8% ownership) the City Public Service Board of San Antonio (28% ownership), Central Power and Light Company (25.2% ownership), and the City of Austin (16% ownership). (See Part 1 of Formal Application.) In addition, Applicant suggests that all participants should be listed on the cover and title page of the Final Environmental Statement.

Item 3
Page iii

(a) Construction related activities on the site will disturb about 620 acres, not including 7,000 acres inundated by the reservoir and 300 acres occupied by the impoundment structure and diversion dike.

(b) The majority of the 5,686 acres of land designated for the transmission-line corridors can be productively utilized as pasture or cultivated land.

(c) Access roads including the heavy haul road, will affect about 90 acres.

(d) Those adverse impacts as described in the Applicant's Environmental Report are greatly out-weighed by the benefits derived to the local area. (ER Section 11.6)

(f) Applicant concurs that entrainment potential could attain problematic proportions under low flow conditions. However, only limited makeup will be allowed under such conditions, thereby greatly reducing the potential for impact.

(g) Applicant will perform a study to determine the need for diversion of water from the Colorado River to Little Robbins Slough and the parameters required to minimize impacts on the marsh complex.

Item 7
Page iv

Applicant's responses to proposed limitations:

(a) Applicant will implement an environmental control program during the construction period to carry forth those commitments as presented in DES Section 4.5.1 so as to avoid unnecessary adverse environmental impacts from construction activities. Applicant agrees to study and evaluate the additional precautions suggested by the staff and listed in DES Section 4.5.2.

(b) and (c) Applicant will develop programs to address the staff concerns noted in Sections 5.5.2.1.1 and 6.1.3.2 of the DES, and meetings will be held with the staff in order to work out the details of implementing these programs.

(d) A control program to provide a periodic review of all construction activities to assure that those activities conform to the environmental conditions set forth in Section 4.5.1 is being prepared. Other necessary mitigating actions to avoid unnecessary adverse enviromental impacts from construction activities will be included as needed.

(e) Before engaging in a construction activity which may result in a significant adverse enviromental impact that was not evaluated or that is significantly greater than that evaluated in the Enviromental Statement, Applicant will provide written notification to the Director of Licensing.

(f) If unexpected harmful effects or evidence of irreversible damage are detected during facility construction, Applicant will 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.

CHAPTER 1

Section 1.1 The Proposed Project

Page 1-1

Paragraph 1

The statement that the application was filed "jointly" by all participants should be corrected as same was filed by Houston Lighting & Power Company on behalf of itself and the other participants. (See comment under item 2 Summary and Conclusions.)

Page 1-2

Table 1.1 should be modified to remove the statement that permit approval is required for the construction and operation of private sanitary treatment facilities by the Texas State Department of Health. The Texas Water Quality Board is the agency responsible for permitting discharges from sanitary treatment facilities.

CHAPTER 2

Section 2.1 Site Location

Section 2.2 Regional Demography, Land Use, and Water Use

Page 2-1

This section should reflect the changes in population estimates submitted in Figures 2.2-1 through 2.2-6 in Amendment 2 to the ER.

Page 2-3

Figure 2.2 should be replaced with revised Figure 3.4-1 from Amendment 3 to the ER.

Section 2.2.3.2 Surface water

Page 2-5

Paragraph 2

For clarification on water use during operation the statement "and will be used for reservoir makeup over the operating life of the plant" might be added to the last sentence.

Section 2.4.1 Geology

Page 2-6

Paragraph 1

"West Gulf Coastal Plain" should be Lower Gulf Coastal Plain.

The thickness of the three formations referenced should be revised as follows: Beaumont (250 to 1400 ft); Montgomery (40 to 80 ft); and, Goliad (840 to 1050 ft). (ER page 2.4-11)

The last sentence should be revised to read: "The Beaumont formation contains some water-bearing sand beds."

Paragraph 2

"The site has less than 10 ft of relief" should read 15 ft of relief. (ER page 2.4-2)

Section 2.4.2 Seismology

"Faults" when in reference to growth faults should be placed in quotes for clarification to separate these from faults of tectonic origin.

The last sentence would be more accurately stated: "All the growth 'faults' detected below the site die out before reaching the surface."

Section 2.5.1.1 Colorado River

Page 2-6

Paragraph 3

The last paragraph characterizes the authorization for pumping water from the Colorado River as a "contract with" the Texas Water Rights Commission. Applicant anticipates that a "permit will be issued by" the Texas Water Rights Commission. The Commission does not "contract" for water.

Section 2.5.2 Groundwater hydrology

Page 2-7

Paragraph 1

In paragraph one of Section 2.5.2 the statement is made that "this [inland movement of the salt water-freshwater interface] does not appear to be a problem at the STP site area." Applicant concurs and suggests that same is explained by the very slow rate of groundwater movement near the coast.

Section 2.5.3 Water quality

Page 2-7

Paragraph 2

In the last sentence it might be pointed out that the description of well water being "alkaline and generally hard" refers to the shallow aquifer.

Section 2.6.2 Local meteorology

Pages 2-7 & 2-7

This section should be revised to reflect the availability of one year of on-site meteorological data submitted in Amendment 2 to the STP-ER.

Section 2.6.3 Severe weather

Page 2-8

The DES reflects a computed recurrence interval for a tornado at the STP site of 550 years. A recurrence interval of 83,000 years is presented in the ER.

Applicant believes the assessment of tornado recurrence as presented in the ER is more realistic since it is based on a more recent data period and on the tornadoes that occurred in the vicinity of the STP site.

(See Storm Data, National Climatic Center, Asheville, N. C.)

CHAPTER 3

Section 3.4 Heat Dissipation System

Page 3-3, Table 3.2

This table should be revised according to ER Table 3.3-1 as revised in Amendment 3.

Page 3-4, Figure 3.2

This figure should be revised according to ER Figure 3.3-1 as revised in Amendment 3.

Section 3.4.3 Makeup water facilities

Page 3-7

Paragraph 1

The diameter of the pipes directing makeup water to the outfall structure should be listed as 9-ft instead of 11-ft. (ER page 3.4-8a)

Paragraph 4

The screens will not be rotated automatically but will be operated manually by inspection during pumping.

Section 3.4.4 Cooling lake discharge facilities

Page 3-9

Paragraph 1

Sentence 5

The statement "at the point of discharge" should be changed to "as determined by the Bay City gage minus the makeup pumping rate."

Section 3.4.5 Essential Cooling Pond

Page 3-9

This section states that the normal water level in the Essential Cooling Pond will be 28 feet msl. The correct number is 25 ft msl. The embankment surrounding the pond will have a 34-ft msl crest, and the internal dike will have a 38-ft msl crest. (ER Figure 3.4-4, Amendment 3)

Section 3.5 Radioactive Waste Systems

Page 3-11

Due to the design changes of the Applicant's liquid radwaste system, as explained in Amendment 2 to the ER, there are a number of inconsistencies between the staff evaulation and information presented in Amendment 2. Although the design changes are felt to have a relatively insignificant effect on the staff s evaluation, nevertheless such changes should be incorporated into the Final Environmental Statement. Illustrative examples of these changes are presented below:

(a) Section 3.5.1 Liquid wastes

Page 3-11

Paragraph 2

The detergent waste subsystem is actually part of the LWPS, therefore the detergent wastes should not be grouped with the wastes from the turbine building.

With the addition of condensate polishers, steam generator blowdown will not be discharged. The SGB processing system has been deleted.

(b) Section 3.5.1.1 Chemical and volume control system (CVCS)

Page 3-11

In the second sentence, "through the letdown heat exchangers," should be, "through the regenerative and letdown heat exchangers."

Paragraph 2

Reference made to the "56,000-gal. recycle holdup tanks" should be "75,000 gal. recycle holdup tanks."

Page 3-13

Figure 3.7

The SGB processing system (2 mixed bed, 2 cation bed demineralizers) has been removed.

The WPS recycle evaporator size should be changed from 15 gpm to 30 gpm.

The "Laboratory and Chemical Drain Tanks" should be relabeled "Condensate Polishing Regeneration Waste Collection Tank" and resized to 10,000 gallons. Thus the DES should indicate that flow from this tank will be through a filter to an additional Waste Monitor Tank (#3) with optional flow through the WPS Waste Evaporator demineralizer package. (See ER Figure 3.5-2, Amendment #2.)

Page 3-13

In the third sentence the "boric acid makeup tank" should be "boric acid tank."

Page 3-13

The staff assumed 10% of the processed BRS flow was discharged. (Total AEC inlet flow 2740 gpd). In ER Amendment 2, Table 3.5-1 Applicant indicates that 750 gpd of processed BRS flow will be discharged. This 750 gpd is approximately 27% of the 2740 gpd input flow assumed by the AEC.

(c) Section 3.5.1.2 Liquid Waste Processing System (LWPS)

Page 3-14

Paragraph 1

The WPS recycle evaporator size will be 30 gpm, therefore the system processing time should be recalculated for the larger evaporation.

Paragraph 2

This discussion should be expanded to include the addition of the CPRWC tank and associated changes to handle the BRS flow and condensate polisher regeneration waste.

Paragraph 4

Any reference to a .05% assumed operating-power fission-product source term should be deleted. Amendment 2 to the ER presents releases based on a .25% operating-power fission-product source term. This will be changed to correspond to recommendation given in ANSI N-237 (.12%) shortly. (This comment also applies to Section 3.5.1.3, paragraph 1.)

(d) Section 3.5.1.4 Steam Generator Blowdown (SGB)

Page 3-14

Paragraph 1

This discussion should be revised to incorporate condensate polishing. All SGB will be recycled as per ER Amendment 2, page 3.5-6.

Page 3-15

As stated above (Section 3.5.1) there is no mechanism for discharging blowdown from the steam generators and no separate release estimate is possible.

Section 3.6.1 Circulating water system

Page 3-20

Paragraph 1

Applicant will monitor for total residual chlorine and maintain discharge from the cooling lake to the Colorado River such that residual chlorine levels are below detectable limits.

CHAPTER 4

Section 4.1.1 Plant-related facilities

Page 4-1

Paragraph 4

The relocation of FM 521 will be done in accordance with Texas Highway Department requirements. Permanent, in-plant roads will be built in accordance with standard road construction practices.

Section 4.3.1.1 (Producers)

Page 4-4

Paragraph 2

The statement that "Ricelands (rice and fallow) comprise...90% of the properties involved", is not supported by the referenced table (Appendix B, Table 1). Applicant has recalculated the acreage and finds Appendix B, Table 1 to be correct.

4.3.2.1 Construction Impacts on Little Robbins Slough

Page 4-7

Cooling lake construction

Paragraph 3

Straightening required in Little Robbins Slough south of the reservoir will be held to a minimum in order to protect the existing wetland habitat.

Discharge of wastes

Paragraph 2

The Applicant will consider tertiary treatment of sewage, or alternatively, discharge into the Colorado River.

Section 4.3.3.3 Conclusions

Page 4-12

Paragraph 3

The Applicant will conduct a study to determine the need for diversion of water from the Colorado River and the parameters required to minimize impacts on the marsh complex.

Section 4.3.4 Summary of environmental effects of construction

Page 4-13

Table 4.8

Applicant agrees to study and evaluate each of the first three items listed under "Corrective actions available and remarks."

Section 4.4.1 Physical impacts

Page 4-13

Paragraph 3

Last sentence

Applicant will obtain a permit from the Texas Water Quality Board. No permit is required from the Texas State Department of Health.

4.5.2 Staff evaluation

Applicant agrees to study and evaluate each of the additional precautions suggested by the staff.

CHAPTER 5

Section 5.4.2.5.1 Radiation from the facility

Page 5-16

There will be no storage of low-level waste outside the plant as indicated in this section. (ER Figure 3.5-20)

Section 5.5.2.2 Blowdown effects

Page 5-30

Chemical effects

Paragraph 5

In reference to the statement "dissolved oxygen levels may drop below the Texas State criterion of 5.0 ppm," the STP model predicts dissolved oxygen in the Colorado River to be 6.5 ppm in the summer and above 11.0 ppm in the winter. (ER Section 5.1.2.2.5, page 5.1-15 and 5.1-17)

CHAPTER 6

Section 6.1.3 Ecological

Page 6-1 through 6-3

Applicant will develop a program to address the concerns of the staff as explained in section 6.1.3, and meetings will be held with the staff in order to work out the details of the implementation of this program.

CHAPTER 8

Section 8 Need For Power Generating Capacity

Page 8-1 through 8-14

Since the application for the South Texas Project was filed there have been some variations in each of the Project Participant's load projections through 1982, which is the year in which Unit 2 is expected to come on line, and in the planned capabilities of each of those systems at that time. The aggregate effect of these changes is to increase the need for the South Texas Project. Current load projections and planned capabilities will be filed as amendments to Chapter 1 of the Environmental Report about January 20, 1975.

Section 8.1.2 Regional relationships

Page 8-2

The first paragraph of this section discusses the Texas Interconnected Systems (TIS), while the second describes the Electric Reliability Council of Texas (ERCOT). The third paragraph, referring only to ERCOT, discusses interties between members and neighboring power pools. The interties between the Participants in the South Texas Project and between those Participants and other systems are a function of TIS, not ERCOT. Further, any implication that either TIS or ERCOT is a "power pool" in the common sense of the phrase could be somewhat misleading as neither organization affords joint planning of reserves or pooling of costs, and each member system is responsible for maintaining its own capacity requirements. (In this connection it is also noted that Section 9.1.1.1 refers to the "obligations of the interconnected systems of Texas, basically ERCOT,..." This reference in Section 9.1.1.1 should be TIS.)

Section 8.2.3.2 Promotional advertisement and conservation information services

Page 8-8

This section states that, "The STP participants have a program to promote conservation of electricity." (Emphasis added.) There is no single program adopted by all Participants, rather each Participant has in fact adopted and effectuated its own program within its own area of service.

Section 8.2.3.6 Consumer substitution of electricity for scarce fuels

Page 8-10

The second sentence of the first paragraph of Section 8.2.3.6 appears to contain a typographical omission. Perhaps the sentence was intended to read:

"The Staff expects that substitution of electricity for scarce energy sources will likely accelerate in the STP participants service areas 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." (Underscored words added.)

CHAPTER 9

Section 9.1 Alternative Energy Sources and Sites

Page 9-1

The first sentence of Section 9.1.1.1 should be changed to read, "The Staff explored in Section 8 the applicant's general obligation to the Texas Interconnected Systems, and the operating and reserve policies practiced by the TIS members."

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
400 SEVENTH STREET S.W.
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

50-498
499

14 JAN 1975

Mr. B. J. Youngblood
Chief, Environmental Projects
Branch 3
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Youngblood:

This is in response to your letter of 27 November 1974 addressed to Mr. Benjamin O. Davis concerning a draft environmental impact statement for South Texas Nuclear Project, Units 1 and 2, Matagorda County, Texas.

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 this project.

The opportunity to review this draft statement is appreciated.

Sincerely,

W. E. Caldwell

W. E. CALDWELL
Captain, U.S. Coast Guard
Deputy Chief, Office of Marine
Environment and Systems
By direction of the Commandant

A-12

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77550

SWGED-E

21 January 1975

RECEIVED JAN 23 1975

Mr. B. J. Youngblood
Chief, Environmental Projects
Branch 3
Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Youngblood:

This is in response to your letter dated 27 November 1974, requesting comments on the draft environmental statement for the proposed South Texas Project, Units 1 and 2.

The project does not appear to affect any present or proposed project of the Corps of Engineers, and the statement adequately presents the environmental effects of the project; however, a Department of the Army permit will be required for the water intake and discharge structures located in the Colorado River.

Comments on specific items in the draft statement are as follows:

a. Designations of tables in table of contents, text, and appendices should agree.

b. Page 2-6: 2.5.1.2 Other hydrologic features - Salt water. Change Intercoastal to Intracoastal (2 places).

c. Page 2-10: Change to "Corps of Engrs. Dredged Material Area."

d. Page 2-12: Fig. 2.5 clarify arrows depicting Robbins Slough and/or Little Robbins Slough.

e. Page 2-14: 2.7.2.1 Physical - Gulf Intracoastal Waterway GIWW. Give date of June through December sampling period.

SWGED-E
Mr. B. J. Youngblood

21 January 1975

f. Page 3-7: Table 3.4 added "Maximum" between "Normal" and "operating" since 49 ft msl is the normal maximum operating level stated in 3.4.4.

g. Page 3-9: 3.4.4 Cooling lake discharge facilities. A minimum discharge and velocity (in Colorado River towards the Gulf) of 800 cfs and 0.4 fps, respectively, must be met before water can be discharged from the cooling lake. An explanation of criteria establishing these limits would prove meaningful.

h. Page 4-9: 4.3.3.2 Biological. Fourth paragraph, first sentence, range of salinity, 27 to 29 ppt, appears high for Matagorda Bay. The range of salinity is previously referred to as 17 to 30 ppt in 1962 and 3.6 to 12.9 ppt in Matagorda Bay (Sta 13) under fairly typical weather and discharge conditions (2.7.2.1 Physical - Matagorda Bay).

i. Page 7-1: 7.1 Environmental Impact of Postulated Accidents. Assessment of environmental impact produced by failure of the embankment of the essential cooling pond and cooling lake should be presented. It is assumed the site location is above the flood levels of the maximum probable flood and maximum probable hurricane. It is also assumed that design criteria of the cooling lake embankment considered hurricane surge produced by the maximum probable hurricane.

Appendix B: Page B-13, Table B.4. The date and time of sampling should be given since the data presented in this table have been referred to as showing the "position" of the saltwater wedge. Samples at all stations would have to be taken within a relatively short time period to establish the "position."

Sincerely yours,

Martin W. Teague

MARTIN W. TEAGUE
LIEUTENANT COLONEL, CE
DEPUTY DISTRICT ENGINEER

2

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER 74/1471

STN-50-498
STN-50-499

JAN 31 19

Dear Mr. Youngblood:

Thank you for your letter of November 27, 1974, transmitting copies of the Atomic Energy Commission's draft environmental impact statement for South Texas Project, Units 1 and 2, Matagorda County, Texas.

Our comments are presented according to the format of the statement or according to subjects.

Regional Demography

The distance of 4 miles from the 2 developments, Selkirk Island and Exotic Isle to the project disagrees with the distance given as 2 miles in Amendment 2 to the Draft Report. The discrepancy should be resolved in the final statement.

Geology

The brief section of geology is lacking information on the physical properties of the materials on which the plant and appurtenant structures would be founded. For example, no mention is made in the environmental statement of the character of surficial deposits, which appear to have a potential close relationship to environmental impact of construction in view of the large areas to be disturbed by shallow excavations associated with the cooling lake, relocated stream channel, and cooling-water pipelines. Information provided in the applicant's environmental report indicates that shallow excavations would most commonly encounter poorly drained clay soils characterized by pronounced shrink-swell characteristics, and comprising a "churned" surface layer four to eight feet thick without distinct layering (ER, fig. 2.4-4, etc.). These properties should be summarized in the environmental statement and evaluated in relation to potential environmental problems of erosion, stabilization of cuts and embankments, and suitability of surficial deposits for use as embankment material.

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

1105

2

Hydrology

In general, the hydrological aspects of this site are sufficiently complex as to require a more elaborate presentation of data than has been given in the draft statement. In particular, it is felt that at least a brief resume of the basic data should be incorporated in the report, rather than making continuous reference to the applicant's report. It is nearly impossible to assess the surface hydrology of the river reach where the plant is to be located on the basis of the data provided in the draft statement.

Water Quality

We are aware of the following activities and responsibilities on the lower Colorado River as follows: The Lower Colorado River Authority (LCRA) is the agency assigned the responsibility by the State of Texas for water management of the Colorado River downstream from Austin. We understand the U.S. Army Corps of Engineers has at least one project proposed for the lower Colorado River. The Department's Bureau of Reclamation will initiate a feasibility-grade investigation entitled "Colorado Coastal Plains Project, Texas" in January 1975. The purpose of this investigation will be to study methods for increasing the water yield of the present LCRA system by managing the Colorado River downstream from Austin, Texas, in order to meet anticipated future water needs. The study will include various alternatives for meeting these future needs and the impacts of these alternatives on the environment. Effects from water usage and/or water quality could be influenced by or interrelated among all these projects. The final statement should describe such possible effects and impacts.

We note on page 2-7 that the salt-water wedge reaches up to 29 miles upstream from the mouth of the Colorado River, while it is stated on page 2-11 that its extent is 24 miles upstream. This discrepancy should be resolved in the final statement. The draft also recognizes that data collected on the aquatic ecosystem were obtained during one of the wettest years of record. It follows that as a result of future decreased flows in the Colorado River, salt-water intrusion into the Colorado River may be greater than that which now exists and which existed during the data collecting. As depicted in Table 5.17 these projected flow alterations could have significant adverse impact upon the downstream areas as well as result in a greater percentage of those organisms, which are dependent upon an optimum salinity gradient being concentrated in the Colorado River. In view of these considerations and the Atomic Energy Commission's statement, Summary f. page iii, "Operation of the STP cooling lake makeup will be conditioned to reduce entrainment losses of icthyoplankton and crustacean larve to acceptable levels," the final statement should state what the acceptable level of entrainment will be, and how this level was determined.

Cooling Water

In areas of fresh-water scarcity, consideration should be given to selecting salt-water sources for cooling purposes. Also, if salt-water usage is not possible, we suggest the cooling method chosen should be one of least fresh-water consumption. It does not appear that related fresh-water conservation criteria have received sufficient consideration in the selection of both the cooling water source (Colorado River) and the cooling method, an artificial lake.

We note that on pages 5-22 and 10-2 adjustments have been made for future upstream diversions of water for purposes unrelated to plant operation. A brief discussion of the impacts from these anticipated diversions of water should be presented in the final statement.

Impact on Recreational Capacity of Area

The draft statement concludes that there will be no significant impact on recreation during construction. Since there will be a population increase of 3,500 as a direct result of construction, we believe there will be an increased demand on existing recreation facilities in the area that should be evaluated in the final statement.

Cooling Lake

No details have been provided in the draft statement on the proposed composition of the 20 miles of embankments and dikes that would be constructed, other than the fact that they would be of rolled earth (p. 4-2). The proposed source, depth, and properties of the embankment material should be clarified, particularly in view of their great length (20 miles) and large volume (23 million cubic yards.) Little or no information

has been provided on proposed plans or impacts with regard to spoils disposal of any excavated materials unsuitable for use as cooling-lake embankments. The applicant's description of the widespread "gilgaies" (ER, p. 2.4-2) within the site suggest that the surficial material comprising such areas would probably be removed prior to emplacement of embankment fill. However, no acreage has been allotted for spoilage of this or other material as shown on Table 4.1 in the draft statement. No spoil areas appear to have been delineated on maps; however, the area on figure 2.4 designated "Corps Engrs. Soil Area" may have been intended to read "spoil area."

It is also noted that the 13 miles of perimeter embankments would evidently have an average height of over 40 feet above the 23-foot average level of the terrain and would impount waters having an average depth of at least 26 feet at normal operating levels. Effects and impacts from water storage should be presented in the final statement.

We suggest doubt about the actual status of the cooling lake is created by a reference to the "newly constructed offstream cooling lake" (p. iii, paragraph #2), while it is stated on page 3-6 that the cooling lake itself will be constructed "

Effects on Ecological Systems

In view of the destruction of approximately 9,000 acres of upland wildlife habitat through inundation by the cooling pond and construction of other facilities, as described in Sections 4.3.1.1 and 4.3.1.2, the final statement should indicate the type and magnitude of wildlife management practices which will be implemented on the approximately 1,700-acre wildlife refuge as well as the kind of hunting which will be permitted. In this respect we find that the draft statement does not address itself to the comments and recommendations contained in the Department's Fish and Wildlife Service letter of September 5, 1974 (ER 74/890) to you. A copy of the letter is enclosed for reference.

Ecological Effects to Avian Species

With reference to the endangered whooping crane, in the concluding paragraph it states, "The staff concluded that the proposed right-of-way is sufficiently distant to avoid any detrimental impacts on this refuge." While there may be no direct affects on the refuge, whooping cranes recently have been observed as far south as Corpus Christi Bay. It also is known that cranes are expanding their winter range in a manner which conceivably could extend quite some distance up and down the coast from the Aransas National Wildlife Refuge. Any transmission line crossing open water or estuarine areas should be flagged visibly through use of colored balls similar to flagging of transmission lines which are aviation hazards. Such markings may warn whooping cranes in flight and deter them from flying near the lines. To that end, the final statement should indicate the guidelines entitled, "Environmental Criteria for Electric Transmission Systems," published on February 10, 1970, by the Departments of the Interior and Agriculture will be followed during construction.

Impacts on Little Robbins Slough

The final statement should describe and discuss the sampling program for the Slough. No information was noted in the draft statement on the proposed dimensions or design of the 23,000-foot relocated channel of Little Robbins Slough. In addition, the acreage to be disturbed by the channel construction is not identifiable on the tabulation of areas affected by construction activities on table 4.1. Also, with regard to acreage of construction disturbance, it is stated on page 5-1 that "of the 12,352-acre site, approximately 4,127 acres will not be altered by construction." However, Table 4.1 shows the total acreage to be disturbed by construction activities within the site boundary to be 7,664, presumably leaving 4,688 acres undisturbed. The 561 acres of disturbance unaccounted for on Table 4.1 should be explained, as this may be partly attributable to excavation of the new stream channel. We note the AEC staff considers the proposed straightening and deepening of 0.75 mile of the slough south of the cooling lake to be "unwarranted and recommends minimal straightening to protect the existing wetland habitat" on page 4-7. That recommendation does not appear among the 42 specific measures and controls to limit adverse effects during construction on pages 4-16 to 4-18. This item should apparently be added to the precautions enumerated on page 4-18, as we believe the habitat loss cannot be replaced by a drainage ditch. It is seldom possible to replace a stream with a ditch. A ditch environment is far inferior to that of a live stream for productivity.

We note the statement, "Relatively high chlorine and BOD_5 levels will curb inhabitation of the disturbed portion of the slough by some of the more sensitive aquatic organisms." Measures should be taken to treat the high chlorine and BOD_5 levels to neutralize them prior to discharge into the slough. We believe high discharge levels of chlorine will damage the slough environment. In a recent doctoral dissertation by Robert L. Jolley at the University of Tennessee, over 50 chlorine containing compounds were described as separated from chlorinated secondary effluents and the toxicity of such effluents to aquatic biota was firmly established. Consideration should be given to the use of alternatives to chlorine, also. The conclusions about impacts to the slough are tentative because of lack of sufficient data regarding groundwater flow, enumeration of species present and their distribution in time and space, and populations. A lack of salinity data correlation between the Gulf Intracoastal Waterway and the freshwater portions of the slough is noted.

Additional data should be obtained and discussed in the final statement. Further considerations relating to the estuarine habitat and organisms which inhabit it involve the marsh just downstream from and immediately adjacent to Robbins Slough. The reduction of approximately 65 percent of the freshwater inflow into this area as well as the loss of freshwater through evaporation will eliminate some existing habitat and reduce the quality of the remaining habitat. To offset some of these losses the final statement should show that provisions have been made to divert water from the Colorado River and spill it into Robbins Slough and/or the West Branch as well as the Colorado River.

Operational Programs

No data are given concerning monitoring programs; rather, the reader is referred to the applicant's environmental report and to future staff evaluations in connection with the issue of the operating license. We believe the draft statement should be sufficiently complete to cover, if only briefly, all aspects related to the plant's operations. This is particularly true for the plant under review, because the plant will need to maintain an elaborate operational monitoring program in order to determine when to withdraw and/or discharge water from and into the Colorado River, in accordance with the proposed cooling operations.

Discussions of those mitigation proposals which could be adopted if the continuing studies indicate adverse effects upon the biotic community should also be presented in the final statement.

Environmental Effects of Accidents

The environmental consequences and risks of the most serious (Class 9) postulated accident have not been evaluated. Instead, reference has been made to the recently released draft of the Reactor Safety Study (p. 7-3, paragraph 2), which includes a quantitative evaluation of the probable consequences and risks of such accidents. However, that study has evaluated environmental impacts of Class 9 accidents on the basis of average conditions at 100 reactor sites. We believe that any site posing special problems or potential risks in the event of a core melt-through accident should be individually evaluated. We believe the draft statement for the South Texas Project, Units 1 and 2, should provide an evaluation of whether the consequences of a Class 9 accident at that site would be more severe than at the average site considered in the Reactor Safety Study, and if so, should provide an evaluation of site-specific probable consequences and risks.

Radiological Effects

The staff believes that adverse effects will not occur since the radioactive effluents are reduced to as-low-as-practical to man. It may be that cumulative adverse effects could occur to aquatic organisms and to fish and wildlife food chains. We suggest these effects be described in the final statement.

We hope these comments will be helpful to you in the preparation of a final statement.

Sincerely yours,

Stanley D. Doremus

Deputy Assistant Secretary of the Interior

Mr. B. J. Youngblood
Chief, Environmental Projects,
Branch 3, Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Enclosure

FILE COPY
Surname:
Huber 9/5/74

South Texas
74/1471

In Reply Refer To:
FWS/ES

SEP 5 1974

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

The U.S. Fish and Wildlife Service has reviewed the Environmental Report for the Houston Lighting and Power Company's South Texas Project, Units 1 and 2, Matagorda County, Texas (50-498 and 50-499), forwarded to the Department of the Interior by your July 5, 1974, letter. This letter constitutes our report in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

In general, the information contained in the environmental report for the proposed South Texas Project provides an adequate evaluation of the flora and fauna of the area as well as the project impact on the environment.

However, measures need to be developed to improve habitat conditions on the wildlife preserve which is provided for as a part of project development as well as means of compensation for project-caused losses of habitat, public access, and fish and wildlife resources. These measures can best be implemented through the development of an overall fish and wildlife management plan.

Since the project site contains important fish and wildlife resources, and opportunities to develop and improve these resources appear to be favorable, we recommend that a fish and wildlife management and public-use plan along with a proposed implementation schedule for the site and transmission line rights-of-way be prepared by the applicant in concert with this agency and other appropriate Federal, State, and local agencies. The plan should include preservation of natural areas to the fullest extent possible, development and enhancement of additional habitat to mitigate fish and wildlife losses, and provision for adequate facilities for public use, including access to assure maximum public benefit for fishing and hunting and related recreational uses. This plan and proposed implementation schedule should be developed as a project feature and included in the draft environmental statement.

We would appreciate being advised of what actions are taken with regard to our recommendations.

Sincerely yours,

/s/ F. Eugene Hester

Director

cc:
Directorate Reading File
Fort Worth, Texas AO
Reg. Dir., Albuquerque
EEP
ES-Br. of Coordination

ES:RHuber:mhc 9/4/74

Sierra Club

LONE STAR CHAPTER

...TO EXPLORE, ENJOY, AND PROTECT THE NATION'S SCENIC RESOURCES...

January 17, 1975

JAN 20 1975

U.S. Atomic Energy Commission
Washington, D.C. 20545
Attention: Deputy Director for Reactor Projects
Directorate of Licensing

Re: Draft Environmental Statement related to proposed South Texas Project, Units 1 and 2, to be constructed by the Houston Lighting and Power Company in Matagorda County, Texas.

Gentlemen:

The Sierra Club, Lone Star Chapter hereby states it is in opposition to the proposed South Texas Project, Units 1 and 2, to be constructed by the Houston Lighting and Power Company in Matagorda County, Texas. We believe there must be a halt in the licensing of this nuclear power plant because of the proximity of this site to Houston, the largest city in the State of Texas and the largest population center in the south. Plant malfunction, "a reactor incident" could be sudden, catastrophic and concentrated in this highly populated area.

The license for this nuclear power plant must not be granted because Matagorda County is located on the Texas gulf coast an area of critical environmental importance. The flat land is broken by bays -- the great migratory flyway of the North American continent. It contains many different soils, drains to the Colorado River creeks and coast rich in estuarine species. The Colorado River, largest within Texas flows 600 miles -- all sources, with only one exception, originate in the Edwards Plateau. A portion of this massive limestone formation forms the Edwards Underground Reservoir (Aquifer), which is the sole source of drinking water for over a million people from Uvalde to San Antonio to Austin. It is spring fed and perenially flowing. "Nuclear incident" on this land and waters could cause poisoning by thermal effluent for extended periods and the genetic integrity of future generations could be jeopardized. Further, the adjoining coastal Brazoria County has the third largest Texas river, the Brazos, flowing to the main stream at the Gulf. The total watershed resource area of these rivers.-- 82,700 miles are high risk in the gamble with people's lives.

Mr. Michael McCloskey, Executive Director of Sierra Club said in a speech to the American Nuclear Society in Portland, Oregon, August 26, 1974: "We do not think it is responsible to proliferate radioactive wastes whose safekeeping cannot be guaranteed by those who benefit from their production. We believe society should have satisfying answers for these problems before it permits more nuclear plants to be built."

Sierra Club

LONE STAR CHAPTER

...TO EXPLORE, ENJOY, AND PROTECT THE NATION'S SCENIC RESOURCES...

The Joint Economic Committee of Congress feels strongly that nuclear power is less economic than coal and other sources of energy. Some alert non-Texas utilities are already getting out of the atomic fission business. Donald C. Cook of American Electric Power Company largest private utility in the U.S. says that the only feasible way of developing a power supply on schedule is by using conventional facilities fueled by coal.

The State of Texas has 10 to 20 billion short tons of lignite and 100 billion tons of bituminous coal which could fuel the Texas power industry longer than our strippable coal and far longer than the projected 50 years remaining life span of oil and gas, and the 30 year projected life span of the proposed atomic fission plants. Texas Utilities today holds extensive leases to these ground resources. Additionally, this state has natural energy potentials of deep geothermal, solar and windpower that must be researched and developed now.

In a statement bearing an abstract title, "Benefit-Cost Analysis and Unscheduled Events in the Nuclear Fuel Cycle", Allen V. Kneese, Director of Resources for the Future, Inc., began with a quotation from Thoreau's Walden:

> The cost of a thing is the amount of what I will call life which is required to be exchanged for it, immediately or in the long run.

Mr. Kneese then stated, "It is my belief that benefit-cost analysis cannot answer the most important policy questions associated with the desirability of developing a large-scale, fission-based economy. To expect it to do so is to ask it to bear a burden it cannot sustain. This is so because these questions are of a deep ethical character. Benefit-cost analyses certainly cannot solve such questions and may well obscure them." The known and potential dangers to the future are an ethical gamble where winning would gain little and losing would be unparalleled disaster.

With deep concern for the quality of our environment,

Yours very truly,

Mary Bresler

Ms. Mary Bresler, Chairperson
Inland Conservation
Sierra Club
Lone Star Chapter

500 Copper Ridge Drive
Richardson, TX 75080

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

JAN 29 1975

Mr. B. J. Youngblood
Chief, Environmental Projects
Branch No. 3
Division of Reactor Licensing
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Youngblood:

This is in response to your letter dated November 27, 1974, requesting comments on the Draft Environmental Statement issued November 1974 by the U.S. Atomic Energy Commission, related to the proposed issuance of a construction permit to the Houston Lighting and Power Company, Central Power and Light Company, the City of San Antonio, and the City of Austin, hereinafter collectively referred to as the Applicant, for the construction of the South Texas Project Units 1 and 2 (Docket Nos. STN 50-498 and STN 50-499) in Matagorda County, Texas. The 1,250-megawatt Units 1 and 2 are scheduled for commercial operation in 1981 and 1982, respectively.

These comments by the Federal Power Commission's Bureau of Power staff, made in compliance with the National Environmental Policy Act of 1969 and the August 1, 1973, Guidelines of the Council on Environmental Quality, are directed to the need for the capacity represented by the South Texas Project Units 1 and 2 and related bulk electric power supply matters.

In preparation of these comments, the Bureau of Power staff has considered the Draft Environmental Statement; the Applicant's Environmental Report and amendments thereto; related reports made in compliance with the Commission's Statement of Policy on 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 lives of the South Texas Project units are expected to be 30 years or more. During that period, the units are expected to make a significant contribution to the reliability and adequacy of the electric power supply in the Applicant's service area.

The Applicant companies are members of the Electric Reliability Council of Texas (ERCOT), which coordinates the planning of the 84 members' bulk electric power supply facilities for the regional area which includes most of the State of Texas, excluding only the extreme northern, eastern, and western portions of the state. ERCOT utilizes a planning criterion for system reliability of capacity reserves of at least 15 percent of forecasted maximum hour demand of the interconnected system. ERCOT has no transmission ties with adjacent regions. Operating philosophy is based on system planning and operation wherein each entity provides adequate generation to supply its own load and necessary reserve capacity.

The following tabulations show the effect of the capacity of the proposed South Texas Project units on the capabilities and reserve margins of ERCOT and the Applicant's system for the 1981 and 1982 summer peak periods, which are the peak periods immediately following the initial operation of these units:

1981 SUMMER PEAK LOAD-SUPPLY SITUATION

With South Texas Project Unit 1 (1,250 Megawatts)	Applicant's System	ERCOT
Total Capability - Megawatts	26,007	53,171
Load Responsibility - Megawatts	21,709	45,082
Reserve Margin - Megawatts	4,298	8,089
Reserve Margin - Percent of Peak Load	19.8	17.9
Desired Reserve Margin - Megawatts 1/	3,256	6,762
Reserve Deficiency - Megawatts	-	-
Without South Texas Project Unit 1		
Reserve Margin - Megawatts	3,048	6,839
Reserve Margin - Percent of Peak Load	14.0	15.2
Desired Reserve Margin - Megawatts 1/	3,256	6,762
Reserve Deficiency - Megawatts	208	-

1/ Desired reserve margin for Applicant's system and ERCOT is 15 percent of forecast annual peak load.

1982 SUMMER PEAK LOAD-SUPPLY SITUATION

With South Texas Project Units 1 and 2 (2,500 Megawatts)	Applicant's System	ERCOT
Total Capability - Megawatts	28,457	58,384
Load Responsibility - Megawatts	23,332	48,747
Reserve Margin - Megawatts	5,125	9,637
Reserve Margin - Percent of Peak Load	22.0	19.8
Desired Reserve Margin - Megawatts 1/	3,500	7,312
Reserve Deficiency - Megawatts	-	-
Without South Texas Project Units		
Reserve Margin - Megawatts	2,625	7,137
Reserve Margin - Percent of Peak Load	11.3	14.6
Desired Reserve Margin - Megawatts 1/	3,500	7,312
Reserve Deficiency - Megawatts	875	175

1/ Desired reserve margin for Applicant's system and ERCOT is 15 percent of forecast annual peak load.

Given the timely commercial operation of the proposed South Texas Project units, the Applicant's projected reserve margins at the 1981 and 1982 summer peak periods would be 19.8 and 22.0 percent of projected peak load. Without the units, the projected reserve margin would be reduced to 14.0 and 11.3 percent of peak load, respectively, and reserve deficiencies of 208 and 875 megawatts would occur on the Applicant's system.

ERCOT projects reserve margins of 17.9 and 19.8 percent of peak load at the 1981 and 1982 summer peak periods which would be reduced to 15.2 and 14.6 percent without the capacity of the South Texas Project units. A reserve deficiency of 175 megawatts would occur at the 1982 summer peak without the proposed units.

The analysis indicates a significant reserve deficiency will occur on the Applicant's system during the 1982 summer peak period. The capacity available to the Applicant and ERCOT is subject to further uncertainties due to fuel availability. The ERCOT report submitted to the Commission on April 1, 1974, in compliance with FPC Order 383-3, Docket No. R-362, reported that in excess of 95 percent of generation in Texas was dependent on natural gas as boiler fuel. Since the submission of that report, some generating capacity has been converted to utilize oil fuel. However, such use results generally in reduced unit capacity, increased forced outages and maintenance periods longer than when natural gas is fired. Curtailment of natural gas supplies would affect the availability of generating capacity and have a significant impact upon ERCOT bulk power supply. It has been noted that the Texas systems have modified their generation planning by scheduling coal and nuclear-fueled units to reduce the use of natural gas and oil as boiler fuel. The proposed South Texas Project units are part of this plan.

The Bureau of Power staff concludes that the capacity equivalent to that of the South Texas Project is needed on the Applicant's system and ERCOT to provide reserve capacity to meet their stated generating reserve criteria for adequate bulk power supply reliability while conserving fossil fuels.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

50-498
499

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
Atlanta, Georgia 30309

January 22, 1975

8420

Mr. B. T. Youngblood, Chief
Environmental Projects Branch 3
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Youngblood:

Here are U. S. Forest Service, State and Private Forestry comments on the draft environmental statement covering South Texas Project, Units 1 and 2.

Generally, the environmental values of forests woodlands are lightly regarded in the statement. Forest and woodland acreages consumed by the project (from a limited state acreage) are not considered significant or an impact worthy of mitigation. Figure 10.1 (page 10.3) points out that the Central U. S. Zone (containing Texas) has the smallest percentage of forests and woodlands in the Nation - and projects that the relatively small acreage of forest land in the zone will be further reduced by one half by year 2000. This loss of forests and woodlands must be mitigated if this generation is to fulfill it's responsibilities as trustee of the environment for succeeding generations.

The preemption of agricultural lands for project works is rationalized by USDA projections (Fig. 10.1) that the amount of land devoted to agricultural uses is expected to remain constant through year 2000. Even if it does, the population will continue to grow. Therefore, public concern that a 1975 agricultural land base will not feed year 2000 populations is justified.

Some 41% of the 398 miles of transmission line R/W is in a natural state or heavily wooded. What effort has been made to route these new transmission lines along existing or common utility corridors?

What are seismic risks and the frequency of hurricanes in the plant site area?

It's assumed that decommissioning costs are project costs which will be recovered during the productive life of the facility. Without a decommissioning plan, how is the amount determined? How much of the cost of decommissioning will be bourne by subsequent, non-benefitting generations?

Thank you for the opportunity to review and comment on this good draft environmental impact statement.

Sincerely,

PAUL E. BUFFAM
Area Environmental Coordinator

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 31 1975

OFFICE OF THE ADMINISTRATOR

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 issued in conjunction with the application by Houston Power and Lighting Company for a construction permit for the proposed South Texas Project, Units 1 and 2. Our detailed comments are enclosed.

The proposed project will result in a significant impact upon Little Robbins Slough and tidal marshlands within the site boundary. Because EPA recognizes the importance of such wetlands, we have serious environmental reservations about the acceptability of the chosen site for this project. We ask that thorough consideration be given to an alternative location.

In light of our review and in accordance with procedures, we have rated the project "ER" (Environmental Reservations) and rated the draft statement Category 2. 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
Director
Office of Federal Activities

Enclosure

EPA No. D-AEC-A06144-TX

ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

JANUARY 1975

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

South Texas Project, Units 1 and 2

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency has reviewed the draft environmental statement issued by the U.S. Atomic Energy Commission in conjunction with the application of Houston Lighting and Power Company for a construction permit to build South Texas Project, Units 1 and 2. This plant will be located in Matagorda County, Texas near the Colorado River. The following are our major conclusions:

1. The proposed project will result in a significant impact upon Little Robbins Slough and tidal marshlands within the site boundary. EPA recognizes the importance of wetlands and their sensitivity to changes induced by man. Therefore, we have serious environmental reservations about the acceptability of the chosen site and ask that thorough consideration be given to an alternative location. In this regard, the final statement should include a full evaluation of site alternatives and the rationale used for site selection.

2. Although we believe an alternative site may well prove necessary for the South Texas Project, the proposed cooling lake system conforms with requirements for such lakes under Section 301 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA). However, releases from the lake to the Colorado River will have to comply with effluent limitations on chemicals. In addition, the makeup water intake system will be reviewed under Section 316(b) of the Act to determine if it represents the "...best technology available to minimize adverse environmental impact." These and other requirements of the FWPCA will be considered by EPA prior to issuance of a discharge permit under the National Pollutant Discharge Elimination System (NPDES, Section 402 of the Act).

3. The proposed gaseous and liquid waste treatment systems are expected to be capable of limiting radionuclide releases, and therefore, the related off site doses to levels within the guidance of proposed Appendix I to 10 CFR Part 50.

4. In our opinion, in order to comply with the requirements of Regulatory Guide 1.21, radiation monitors should be placed on the turbine building ventilation system discharge and the turbine building floor drain wastes discharge.

5. The applicant should include as part of the pre-operational radiological monitoring program a cow and goat surveillance and milk sampling program. This program should be extended through the entire operating phase of the plant to assure that the actual doses are maintained within the provisions of applicable regulatory limits and guides.

NON-RADIOLOGICAL ASPECTS

General

It is proposed that condenser cooling at the South Texas Project, Units 1 and 2, be accomplished using a closed-cycle system, employing a 7300-acre cooling lake. The lake is to be formed by inundation of cropland and portions of Little Robbins Slough west of the Colorado River. The applicant proposes to relocate, just to the outside of the western boundary of the lake, that portion of Little Robbins Slough which will be inundated. Initial filling of the cooling lake will require 187,000 acre-ft of unappropriated Colorado River water over a three-year period.

Plant operation will require a condenser cooling water flow from the lake of 4044 cfs. To control concentration of total dissolved solids within the cooling lake, the applicant will divert water from the Colorado River, at a maximum instantaneous rate of 1200 cfs and a maximum annual rate such that total withdrawal will not exceed 102,000 acre-ft per year. Cooling lake blowdown will be discharged to the Colorado River (only when Colorado River flow at the discharge point exceeds 799 cfs) at a flow rate varying from 80 to 308 cfs.

Biological and Ecosystem Effects

The proposed project's cooling lake will utilize 7300 acres of productive cropland and remove some 5800 acres (representing 27 percent) of the total Little Robbins - Robbins Slough watershed. According to the draft statement, this would mean the estimated average annual discharge through the upper reaches will drop from 11,240 to 3,950 acre-ft/year -- a 65% reduction. Although it is possible that groundwater flow could offset this loss to some degree, little data is available to gauge this potential. It seems certain, however, that there will be a substantial decrease in total flow and we agree with the AEC staff that this will lead to a conversion of freshwater marsh to less productive brackish water marsh, a drying of other wetland areas, and a reduced desirability of the slough as a nursery for organisms. Destruction of this habitat will result in diminished animal and plant populations and a shift in biota to a brackish water community, thus affecting animals such as the American alligator -- an endangered species. It is predicted in the draft statement that nesting areas for the alligators will be reduced by 62%. Numerous wading birds, waterfowl, and other wetland inhabitants will be adversely affected.

The overall impression left by the draft statement is that there will likely be significant impacts on the Robbin Slough system. However, the extent of these impacts is not certain, because of "...insufficient data regarding groundwater inflow, enumeration of species present and their distributions in time and space, and population sizes." In our opinion, it is essential that adequate biological and hydrological data be gathered and studies conducted before any decision is made on the proposed project. This is based on EPA's recognition of the importance of wetlands and estuarine waters and their sensitivity to changes induced by man. It is EPA policy that close scrutiny be given to any proposal that has the potential to damage wetlands and every reasonable measure be taken to preserve and protect them. Thus we agree with the AEC staff's statement that "...the high intrinsic value of [these] marshes and waters...requires special consideration be given to them."

In the case of the proposed project, we believe consideration should be given not only to more thorough studies and data gathering, but should also extend to a reevaluation of alternative sites and mitigative measures. Because of the projected adverse impact on wetlands and aquatic habitat, we have serious environmental reservations about the acceptability of the chosen site and ask that thorough consideration be given to an alternative location with less environmental impact. The draft statement lists several sites which were considered by the applicant, but only provides a brief discussion of their features and no clear indication as to how selection of the present site was made. A thorough review of alternative sites is important to the environmental assessment of any nuclear power plant, but it is essential for plants located in environmentally sensitive and important areas such as estuaries and wetlands. This review, and the rationale for site selection should be provided in the final statement for the South Texas Project.

Although we believe location at an alternative site may well prove necessary for this plant, it is important that the final statement address mitigative measures that could be adopted (and the extent of their benefits), if the plant were to be sited as proposed. For example, one such measure, mentioned briefly in the draft statement (Table 4.8), is the routing of water from the Colorado River to supplement the

reduced flow into Robbins Slough. Analyses should be made of the rate of flow diversion necessary to maintain the wetlands in their present condition, and the impacts upon the Colorado River of the diversion should be carefully considered. For example, the planned diversion of makeup water for the cooling lake will reduce freshwater inflow to the Colorado Matagorda Estuary by 3 to 6%. At present, no adverse effects are anticipated; however, further decreases in flow (e.g., due to diversion to the Robbins Slough area) could have significant adverse impacts. The draft statement addresses the potential adverse impact of freshwater inflow reduction to the estuary that could result from upstream development and subsequent increased water withdrawals from the Colorado River. Similarly, the final statement should address any potential impact of additional water withdrawal in the Lower Colorado River Basin.

The final statement should address the following comments which are directed to the plant and site as proposed. If an alternative site is selected, similar analyses and considerations should be made for the plant at the new site.

Cooling System Design and Requirements of the FWPCA

Section 301 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA) stipulates that effluent limitations for various point sources discharging into navigable waters shall require the application of "Best Practicable Control Technology Currently Available" no later than July 1, 1977, and "Best Available Technology Economically Achievable" no later than July 1, 1983. The levels of technology corresponding to these terms were defined in EPA regulations entitled "Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category" as published in the Federal Register of October 8, 1974, (40 CFR Part 423). With respect to thermal components, Section 423.13 states that:

> "There shall be no discharge of heat from the main condensers except:
>
> ...(3) Heat may be discharged where the owner or operator of a unit otherwise subject to this limitation can demonstrate that a cooling pond or cooling lake is used or is under construction as of the effective date of this regulation to cool recirculated cooling water before it is recirculated to the main condensers."

Although the proposed cooling lake falls within this category, it should be noted that releases from the lake to the Colorado River will have to comply with effluent limitations on chemicals. In addition, the makeup water intake system will be reviewed under Section 316(b) of the FWPCA which requires that "...the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact." These and other requirements of the FWPCA will be considered by EPA prior to issuance of a permit under the National Pollutant Discharge Elimination System (NPDES, Section 402 of the Act).

Intake Structure and Chemical Effects

As indicated in the draft statement, the cooling lake makeup water intake structure will lie flush with the Colorado River bank. Provisions will be made for free passage between the bar racks and fine mesh screens which protect the pumps from entry of debris and larger aquatic organisms. Although estimated maximum approach velocity to the 3/8 inch mesh screens is 0.55 fps (p. 5-29), the maximum velocity through the screens is 1.0 fps. EPA has recommended that, for the protection of aquatic biota, intake velocities through the screens be maintained as low as practicable but not exceed 0.5 fps. In light of Section 316(b) of the FWPCA (mentioned above), EPA will, when reviewing an application for an NPDES permit, give consideration to the appropriateness of intake velocities and other parameters of the intake structure design in terms of meeting requirements of this section of the Act.

We concur with the AEC staff's concern that flow data expressed as monthly averages are not representative of the potential for entrainment. Accordingly, the applicant will be required by the AEC staff to implement a study as described in Section 6.13.2 of the draft statement. This information will be forwarded to the AEC staff six months prior to commencement of lake filling with a final report due after the lake is filled. Should the project proceed as proposed, we request that this information be made available to EPA as soon as it is collected so that a determination may be made on the impacts of makeup water withdrawal and the effectiveness of mitigative

measures employed by the applicant to reduce entrainment losses.

The draft statement estimates (p. 5-30) that blowdown to the Colorado River (under worst case conditions) could increase BOD levels with a resultant decrease in DO to below the minimum allowable level of 5.0 ppm as specified in the federally approved Texas Water Quality Board Standards. Remedial measures available for the alleviation of environmental impacts resulting from lowered DO levels should be presented in the final statement.

The applicant will be required to perform dewatering operations prior to construction of the main project facilities. Dewatering will affect the shallow aquifer zone and extend to a depth of 80 ft below ground surface. Of concern to EPA is the proposed dumping of mercury-laden dewatering effluents into the Colorado River. Mercury concentrations 10 to 100 times greater than the maximum recommended levels for public water supplies and for the protection of aquatic biota now occur in the groundwater. Although the draft statement indicates that similar concentrations occur in the Colorado River and contends that additional toxicity is, therefore, not anticipated if dewatering discharges do not exceed 5.6 cfs, this contention should be supported in the final statement with relevant data. In addition, we recommend that a program be implemented to monitor mercury concentrations in the Colorado River during the 3.5 years of the dewatering operation. If mercury levels in the Colorado River exceed background concentrations as a result of dewatering effluent, mitigative actions should be initiated. Possible mitigative actions that could be taken should be discussed in the final statement.

Additional Comments

1. Initial fill of the proposed cooling lake and subsequent makeup water withdrawals could increase total dissolved solids in the groundwater as well as the frequency and severity of salt water wedge intrusion in the Colorado River. This should be discussed in the final statement.

2. The applicant has proposed to straighten and deepen 0.72 miles of Little Robbins Slough south of the lake. We concur with the AEC staff that the benefit derived from increased flow capability in the ditch would probably be outweighed by the impact of removal of additional wetlands habitat.

3. There is some confusion in the draft statement concerning sampling of shrimp at the site. On page 2-15 it is indicated that "Brown shrimp occurred in greatest numbers during middle and late spring, while white shrimp demonstrated maximum abundance during August through November." It seems apparent, therefore, why no shrimp were caught in the applicant's single reconnaissance sampling of Robbin Slough during 1974 -- the sampling was conducted in June. Thus the significance of the point made on page 4-11 is questionable.

RADIOLOGICAL ASPECTS

Radioactive Waste Treatment

The proposed gaseous and liquid waste treatment systems are representative of "state-of-the-art" effluent control technology. As a consequence, the quantities and concentrations of radionuclides expected to be released from South Texas Project, Units 1 and 2, are expected to achieve the "as low as practicable" design objectives as defined by the proposed Appendix I to 10 CFR Part 50.

Dose Assessment

The calculated doses to individual receptors from radionuclides assumed to be discharged from the South Texas Project, Units 1 and 2, are within the design basis objectives given in proposed Appendix I to 10 CFR Part 50. Thus, the plant is acceptable based on its expected radiological impacts. However, in order to provide some verification that the thyroid doses are maintained within the provisions of the proposed Appendix I during plant operations, the applicant should include a periodic audit of the location of, and a milk sampling program for, the nearest lactating cow or goat so that the critical pathway will be known throughout the plant lifetime.

EPA has noted in its review of the plant that the turbine building ventilation system and the turbine building floor drain wastes are discharged without treatment or monitoring. We feel that the lack of radiation monitors on these two potential effluent streams is in violation of section C-2 of Regulatory Guide 1.21 which states that "potentially significant paths for release of radioactive material during normal reactor operation, including anticipated operational occurrences, should be monitored." In order to insure that liquid discharges are "as low as practicable," the applicant should provide a means of routing turbine building floor drain wastes to the liquid waste processing systems should treatment be necessary.

The AEC, in its analysis of the plant, used the HERMES code to calculate the dose at the nearest farm with a milk producing animal, and not Regulatory Guide 1.42 or the method described in interim Regulatory Guide 1.AA, recently commented on by EPA. We believe this descrepancy should be resolved by the AEC so that uniform methodology is utilized throughout the design and review of the plant. If the HERMES code is to be used on a regular basis for the review of nuclear power plants, then the pertinent pathway transport parameters and internal dose parameters that are utilized for the iodine pathway analysis should be presented in the final statement so that an evaluation of the iodine pathway dose model can be made.

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 processes 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 letter and by an appearance at the public hearing on April 2, 1973.

EPA is also continuing to evaluate this source of potential radiation exposure on a generic basis and has reviewed its efforts with the AEC. We agree that until such time as a generic rule is established, the AEC should continue to estimate the environmental radiation impact resulting from transportation on a case-by-case basis. Based on preliminary findings of the generic evaluations, the estimates provided for this station are deemed adequate.

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 issues are common to all nuclear plants of a given type, EPA concurs with the AEC's approach to evaluate the environmental risk for each accident class on a generic basis. The AEC continues to devote extensive efforts to assure safety through plant design and accident analyses in the licensing process on a case-by-case basis.

For the past two years, the AEC has sponsored an effort to examine reactor safety and the resultant environmental consequences and risks on a more quantitative basis. We have strongly encouraged this effort and continue to do so. On August 20, 1974, the AEC issued for public comment the Reactor Safety Study, which is the culmination of the extensive effort to quantify the risks associated with light-water-cooled nuclear power plants. EPA is conducting a review of this document, including in-house and contractual efforts which will continue through April 1, 1975, after which we will issue a final set of comments. Initial comments, issued November 27, 1974, indicate the AEC's efforts represent an innovative step forward in concept and methodology in the evaluation of risks associated with nuclear power plants. The study appears to provide an initial meaningful basis for obtaining useful assessments of accident risks.

If future AEC efforts in this area indicate unwarranted risks are being taken at the South Texas Project Units 1 and 2, we are confident that AEC will assure appropriate corrective action. Similarly, if EPA efforts identify any environmentally unacceptable conditions related to reactor safety, we will make our views known. Until our review of the Reactor Study is completed, we believe there is sufficient assurance that no undue risks will occur as a result of the continued planning for the South Texas Project Units 1 and 2.

Fuel Cycle

The AEC has issued a document entitled, "Environmental Survey of the Uranium Fuel Cycle" in conjunction with a regulation (10 CFR 50, Appendix D) for application in completing the cost-benefit analyses for individual light-water reactor environmental reviews (39 FR 14188). The information therein is employed in AEC draft statements to assess the incremental environmental impacts that can be attributed to fuel cycle components which support nuclear power plants. In our opinion, the estimates of such incremental impacts for the South Texas Project are reasonable and, therefore, this approach appears adequate for plants currently under consideration. However, as suggested in our comments on the proposed rulemaking (January 19, 1973), if this is to continue for future plants, it is important for the AEC to periodically review and update the information and assessment techniques used. EPA intends to monitor developments in the fuel cycle area closely and will bring to the AEC's attention any factor or concerns we believe relevant to continued improvement in assessing environmental impacts.

The concept of environmental dose commitment is a recent development which we believe should be included in the assessment of the environmental impact of the fuel cycle. The information presented in the draft statement indicates the "Maximum Effect" in terms of annual person-rems (man-rems) within a 50-mile radius. As many of the radionuclides involved persist in the environment over extremely long periods, their impact is not adequately represented by an annual dose. Instead, we recommend that the maximum effect for fuel cycle releases be indicated by an environmental dose commitment, that is, by the projected person-rems which will be accumulated over several half-lives of the radioisotopes released annually from these facilities. (This would involve decades for every long-lived isotope.) Also, such evaluation should be done for the total U.S. population exposure. Radionuclides of importance in this approach include Dr-85, I-129, tritium, radium, carbon-14, and the actinides.

High-Level Waste Management

Environmental impacts will arise as a consequence of the techniques and procedures utilized to manage high-level radioactive wastes. These impacts have some relevance to the radioactive wastes. These impacts have some relevance to the environmental considerations regarding each nuclear power plant in that the reprocessing of spent fuel from each will make some contribution to the total waste. EPA concurs,

however, with the AEC's approach of handling waste management impacts on a generic basis rather than by including a specific in-depth analysis in each nuclear power plant environmental statement. As part of this effort the AEC, on September 10, 1974, issued for comment a draft statement entitled "The Management of Commercial High-Level and Transuranium-Contaminated Radioactive Waste" (WASH 1539).

Though a comprehensive long-range plan for managing radioactive wastes has not yet been fully demonstrated, acceptance of the continued development of commercial nuclear power is based on the belief that the technology to safely manage such wastes can be devised. EPA is available to assist the AEC in their efforts to assure that an environmentally acceptable waste management program is developed to meet this critical need. In this regard, EPA provided extensive comments on WASH 1539 on November 21, 1974. Our major point of criticism was that the draft statement lacked a program for arriving at a satisfactory method of "ultimate" high-level waste disposal. We believe this is a problem which should be resolved in a timely manner, since the country is committing an increasingly significant portion of its resources to nuclear power and wastes from operating plants are already accumulating.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P.O. Box 648
Temple, Texas 76501

January 27, 1975

FEB 3 1975

Mr. B. J. Youngblood, Chief
Environmental Project Branch 3
Directorate of Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Youngblood:

We would like to offer the following changes in our comments dated December 26, 1974, on the draft environmental statement for the Proposed Nuclear Generating Station Project Units 1 and 2, Matagorda County, Texas:

Comment No. 2 in our December letter is adequately covered in Section 10, "Conclusions." Inadvertently we overlooked this data primarily because it is normally found under impacts on land use. We suggest you duplicate this information in the section "Impacts on Land Use."

Comment No. 4 should be deleted.

Sincerely,

Edward E. Thomas
Edward E. Thomas
State Conservationist

1194

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

FEB 5 1975

FEB 7 1975

Mr. B. J. Youngblood
Chief, Environmental Projects Branch 3
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Youngblood:

We have reviewed the draft Environmental Impact Statement for the South Texas Project, Units 1 and 2. Our comments are as follows:

1. It may be presumed that the plant and its supporting facilities are being designed to take into account the possibility of tornadoes and hurricanes. However, we feel the final EIS should include a discussion on the environmental effects resulting from these phenomenons occuring in the area of the proposed project, taking into account the frequency of these conditions in the area.

2. The description of the radiological monitoring program is not considered to be adequate. There is no information concerning what exactly will be sampled; at what intervals or at what times of the year. Oysters and blue crabs from Matagorda Bay should be included in the sampling of aquatic organisms. Also, there should be some indication that both fresh and salt water fish will be sampled.

   There is no indication that food crops will be sampled, particularly rice. This as well as the other grain crops that are raised in the county should be sampled.

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Additionally, it would seem appropriate to sample beef cattle, game animals, and birds in the vicinity.

A milk sampling program should be initiated to include milk produced from those cows closest to the plant, as well as from other herds at different compass locations from the station so as to obtain information on possible variation with wind direction. Such samplings should be done on a monthly basis and subjected to gamma scan and strontium-89 and 90 analysis.

Also, green vegetables grown in the area, even if grown for home consumption, should be sampled at the time of harvest.

3. With regard to the provision of sewage treatment facilities during the construction phase, it would seem preferable from a public health standpoint to provide some tertiary treatment to the effluent rather than discharging partially treated sewage directly to the Colorado River. Sewage oxidation lagoons have been used with success, and may be applicable for use in this case.

4. During the construction phase, traffic and its increased safety hazards will undoubtedly be a problem. We suggest that the applicant give consideration to the provision of charter bus service for the workers to travel to and from the plant so as to reduce the volume of private vehicular traffic.

5. The South Texas Project site will ultimately provide a considerable increased tax revenue to the State of Texas as well as to Matagorda County and special purpose districts in the County. The critical factor is that local jurisdictions be provided with financial aid in sufficient time to provide the services required for construction-related impacts.

   As shown in Table 4.10 the hospital district within Matagorda County will receive additional tax revenue. This should enable the hospital district to improve its facilities and provide the emergency

medical services needed for persons injured, contaminated, or who have suffered radiation injury in the event of an accident at the reactor plant.

Thank you for the opportunity to review this draft statement. We hope our comments will be helpful in preparing the final impact statement.

Sincerely,

Charles Custard
Director
Office of Environmental Affairs

SOUTHERN METHODIST UNIVERSITY
Environmental Clinic
SCHOOL OF LAW
DALLAS, TEXAS 75275

B, E

OK PWS

STATEMENT REGARDING DRAFT ENVIRONMENTAL
IMPACT STATEMENT ON HL&P SOUTH TEXAS
PROJECT (Atomic Power Plant)

February 6, 1975

Bay City, Texas

Prepared by

Elise Moss, student
Environmental Clinic

Although several problems exist with regard to the proposed South Texas Project Units 1 & 2, there arethreewhich we shall focus upon today. They are (1) the future of the Little Robbins Slough marsh complex, (2) the use of as yet unnamed herbicides to clear transmission lines rights-of-way, and (3) the consumptive use of the water supply, principally from the Colorado.

With regard to the proposed relocation of Little Robbins Slough, we object stringently to any channelization such as is proposed. The plan under consideration which would channelize over six stream miles is quite unnecessary. This would not only change the course of the stream, but the alteration in the rate of the current would virtually eliminate most forms of life in that segment of the stream. Further, this would lead to increased siltation and a higher concentration of suspended solids in the upper reaches of the stream. While some small amount of relocation might be unavoidable, there is no need to channelize to the extent proposed. It would be advisable to require that channelization be kept to a minimum in order to preserve the wetlands before licensing.

Objection must be made to the proposal to dump sewage into Little Robbins Slough. The treated wastes would raise the BOD_5 level and chlorine level above that which will support life. Due to the shallowness of the water in the slough, sufficient dilution would not occur until sometime after the waste reaches the undisturbed areas. Some form of tertiary treatment of the sewage should be required. If this is insufficient to eliminate the danger to the life in the slough, then the waste should be transported to and dumped into the Colorado River.

This should be required by the license as a mere suggestion to this effect would not be sufficent to insure that all precautions are taken.

In general, the data available concerning the Little Robbins marsh complex is much too sketchy. Insufficient sampling has been done to assure that the statements made by the applicant are indeed true. More data should be gathered, especially regarding groundwater inflow, enumeration of species present and their distributions in time and space and population sizes, and salinity data fro the area between the GIWW and the freshwater portion of the slough.

As it stands, serious effects to the marsh can be expected. One way to possibly alleviate this problem would be through the diversion of water into the marsh from the Colorado River. The need for this should be determined by a through study, and the results made known to the public. If found to be advisable, then this should be required in the license.

We must also object to the use of herbicides to clear rights-of-way for the transmission lines, as is proposed. Although selective basal application is preferable to aircraft application, unless it is clear which chemicals will be used and in what proportions, it is impossible to know what potential dangers there are to the wildlife which might come into contact with them. As yet, there has been no disclosure of chemicals to be used, and until that is done, this practice should not be allowed.

It is also a matter of grave concern to us that there is to be an estimated loss of between 47,000 and 53,000 acre feet per year from the Colorado River. The possibility that this will divert an excessive amount

from the public water supply is not to be ignored, as this amount could be particularly crucial in periods of drought. Until the applicant makes a more specific statement concerning potential effect upon the public water supply by this diversion into a private lake, the EIS is not acceptable and a license should not be granted.

In summary it should be emphasized that our requests that specific requirements be inserted into the license are reflective not so much upon the good faith of Houston Power and Light as to emphasize the necessity for such requirements to be included where projects of the size and with the potential for harm that nuclear plants have are concerned. This is particularly true with regard to the Little Robbins Slough. Marshlands are among the most biologically productive ecotypes. The high degree to which our irreplaceable, finite amount of marshland has been and is being diminished is critical and we are opposed to any additional losses to these areas. We strongly suggest that a means of bringing such damage to an absolute minimum be found.

It is requested that these comments be made a part of the record and all future AEC publications pertaining to the Draft Environmental Statement and all public notices on the project. The opportunity to comment on this proposal is appreciated.

DOLPH BRISCOE
GOVERNOR

OFFICE OF THE GOVERNOR
DIVISION OF PLANNING COORDINATION

JAMES M. ROSE
DIRECTOR

February 7, 1975

Mr. Daniel R. Muller
Assistant Director
for Environmental Projects
Directorate of Licensing
Washington, D. C. 20545

STN 50-498/499

Dear Mr. Muller:

The Draft Environmental Statement (DES) for the South Texas Project, submitted by the U. S. Atomic Energy Commission (AEC), has been reviewed by the Governor's Division of Planning Coordination and by other interested State agencies, pursuant to the provisions of the National Environmental Policy Act of 1969.

State agencies that possess individual expertise in meteorological, hydrological and other areas have conducted an extensive review of this DES, and have submitted the following comments for your consideration:

1. The Texas Air Control Board (TACB) indicated that a permit will be required to construct, install and operate the diesel-powered generating sets, diesel fire pumps and auxiliary boiler. This Division notes that the TACB also has jurisdiction over such other non-nuclear sources of air pollution including construction machinery, dust and incineration. Table 1.1 of the DES should reflect this additional permit requirement.

2. The Texas Water Quality Board (TWQB) has noted that the proposed effluent of the project appears to be compatible with stream standards; however, formal endorsement will not be made until appropriate public hearings have been conducted on the project. The TWQB also indicated that it will conduct an extensive monitoring program of water quality standards during the construction and operation stages of the South Texas Project.

P. O. BOX 12428, CAPITOL STATION, AUSTIN, TEXAS 78711
Phone 512/475--2427 Offices Located in Sam Houston State Office Building

3. The Texas Water Development Board (TWDB) submitted comments pertaining to the induced evaporation rates, projected water diversions, and the attendant impacts on Little Robbins Slough. Specifically, the TWDB suggested that due consideration be given to the possibility of periodic releases of water from the cooling lake into the marsh complex, in order to prevent loss of prime marsh habitat. It is our understanding that the site has been designed to accommodate only Units 1 and 2, with the cooling lake capacity being predicated on the most severe drought conditions and on maximum upstream appropriations. We concur in the suggestion of the TWDB and with the AEC staff recommendation that the applicant conduct a study to determine the mitigative relief necessary to minimize adverse impacts on the marsh complex.

4. Comments from the Texas Highway Department (THD) noted that the DES provided only a brief discussion of relocating F.M. 521. The THD suggested that the Final Environmental Statement contain appropriate information concerning the environmetnal impact of this relocation, with emphasis on air quality, noise, additional mileage and time loss to the traveling public. Increases in the volume and weight of traffic on F.M. 521 may necessitate strengthening that portion between S.H. 35 and S.H. 60. The THD also stated that adequate warning protection or grade separation will be necessary where the proposed railroad spur crosses the relocated F.M. 521. This Division recommends that the applicant be cognizant of and observe the weight limitations of F.M. 521 and other highways, and that an agreement be reached between the applicant and the THD concerning the sharing of cost to reinforce and repair roads impacted by heavy loads, in the event that weight limitations are exceeded as indicated in the Environmental Report, Section 4.1 (p. 4.1-13, Amendment 3). Concerning the necessity of providing safe crossing of the railroad spur and F.M. 521, this Division concurs with the THD, and suggests that Table 1.1 of the DES be amended to reflect this additional permit requirement.

5. The Texas Parks and Wildlife Department (TP&WD) indicated that their major concern is the adverse impacts of the proposed project on the estuarine areas, particularly Little Robbins Slough, with a suggestion that a coordinated effort be made to minimize the damage to the estuarine area. Also included in the TP&WD letter are comments related to management of the wildlife preserve and to the possibility of using the cooling lake for fish, wildlife and public recreation. The TP&WD indicated that alternate site D would be a better compromise between meeting project requirements and minimizing damage to the natural ecosystems involved. This Division supports the concept of a coordinated program designed to mitigate adverse impacts on Little Robbins Slough. Concerning alternative site locations, it was noted in the Environmental Report, Section 9.3, that site D was not chosen due to a moderate incidence of imagery observed tonal anomalies (IOTA), a higher population within the area, the proximity of oil and gas fields, and to the elimination of some bottomlands.

6. Comments from the Texas Historical Commission (THC) indicated that the transmission-line corridors have not been subjected to an archeological survey, although this type of investigation is being considered by the applicant. The THD also suggested that a minor editorial change be made in the DES, Section 2.3.2.

7. In the opinion of the Texas State Department of Health (TSDH), the proposed nuclear power plant can be constructed and operated without significant radiological impact on either the public or the environment, as long as an independent agency provides monitoring and surveillance of the operational releases of radioactivity from the plant. The TSDH also intends to perform such monitoring activities.

8. The Texas Department of Agriculture (TDA) concurred in the assessment that the project is needed and justified. However, certain specific comments related to the availability of water supplies and on the development of an emergency plan are submitted. After consultation with the staff of the TDA, Houston Lighting and Power Company, and the AEC, it has been determined that the DES adequately discusses the availability, use, and disposal of water for this project. This Division also notes that development and implementation of the emergency plan will be discussed in the Final Safety Analysis Report, as required by AEC guidelines.

9. Other State agencies that have submitted comments on the DES are the Texas Water Rights Commission (TWRC) and the Texas State Soil and Water Conservation Board (TSS&WCB). The TWRC indicated that an application to appropriate State water had been filed, and the DES adequately fulfills the provisions of the National Environmental Policy Act of 1969. The TSS&WCB noted that the project's impact on land resources has been thoroughly discussed in the DES.

The Governor's Division of Planning Coordination is in agreement with the AEC staff assessment that the primary benefits of increased availability of electrical energy and the improved reliability of the various utilities' systems outweigh the environmental and economic costs of the project. We agree further that the increased employment benefits and tax receipts to the local economy outweigh the social costs to the local area from construction and operation of the facility. Consistent with the limitations imposed by the AEC staff and the comments submitted by this Division, we recommend that a Construction Permit be issued for the South Texas Project.

Enclosed are the comments from the review participants; these comments are submitted with the constructive intent of enhancing the project. If we can be of further assistance, please advise us accordingly.

Sincerely,

JAMES M. ROSE
Director

JMR/wsb

Enclosures
cc: Mr. Charles R. Barden, Texas Air Control Board
Mr. Hugh C. Yantis, Jr., Texas Water Quality Board
Mr. Harry P. Burleigh, Texas Water Development Board
Mr. B. L. DeBerry, Texas Highway Department
Mr. Clayton T. Garrison, Texas Parks and Wildlife Department
Mr. Truett Latimer, Texas Historical Commission
Mr. Joe D. Carter, Texas Water Rights Commission
Mr. Harvey Davis, Texas State Soil and Water Conservation Board
Dr. Fratis Duff, Texas State Department of Health
Dr. William L. Fisher, Bureau of Economic Geology
Mr. Robert Pendergraft, Attorney General's Office
The Honorable John C. White, Texas Department of Agriculture
Mr. Royal Hatch, Houston-Galveston Area Council

TEXAS AIR CONTROL BOARD

PHONE 512/451-5711
8520 SHOAL CREEK BOULEVARD
AUSTIN, TEXAS – 78758

CHARLES R. BARDEN, P. E.
EXECUTIVE DIRECTOR

December 16, 1974

Mr. Wayne N. Brown, Chief
State Planning and Development
Office of the Governor
Division of Planning Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

In regard to the Environmental Report, South Texas Project, Units 1 and 2, we have previously commented on this document in which we stated the diesel-powered generating sets, diesel fire pumps and auxiliary boiler will be required to file for a permit to construct. They will be required to comply with Texas Air Control Board Regulations I and II.

We appreciate the review opportunity and if we can be of further assistance, please contact me.

Sincerely yours,

Bill Stewart, P.E.
Director
Control and Prevention

cc: Mr. Lloyd Stewart, Regional Supervisor, Houston

TEXAS WATER QUALITY BOARD

1700 NORTH CONGRESS AVE. 78701
P.O. BOX 13246 CAPITOL STATION 78711
AUSTIN, TEXAS

HUGH C. YANTIS, JR.
EXECUTIVE DIRECTOR
PH. (512) 475-2651

January 7, 1975

Re: Draft Environmental Statement, Houston Lighting and Power Co. South Texas Project Units 1 and 2

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Cap. Sta.
Austin, Texas 78711

Dear General Rose:

The staff of the Texas Water Quality Board has reviewed the draft environmental statement for the Houston Lighting and Power Company South Texas Project Units 1 and 2 in accordance with the request of December 6, 1974 from Mr. Wayne H. Brown of your staff, and the following comments are offered concerning the statement.

The Houston Lighting and Power Company is scheduled to submit their application on January 13, 1975 for permission to discharge effluent to the Colorado River from an off-channel cooling reservoir impounded on Little Robbin Slough. The proposed effluent appears to be compatible with the stream standards established for this river segment by this agency; however, the Texas Water Quality Board does not desire to formally endorse or indicate action on the project until Public Hearings are held and public criticism or endorsements are made on the project.

General James M. Rose
Page 2
January 7, 1975

We have noted the commitments made by the applicant to specific measures and controls to limit adverse affects during construction. This agency will also instigate an extensive monitoring program for adherance by the applicant to water quality standards.

In connection with the radioactive waste that may be discharged to the air and water, the State Department of Health has concluded, as set forth in the attached letter, that these discharges meet the requirements of Texas Regulations for Control of Radiation and the release limits of the U.S. Atomic Energy Commission.

We appreciate the opportunity to review and comment on this environmental statement. If we can be of further assistance, please let us know.

Sincerely,

Emory G. Long

Emory G. Long, Director
Administrative Operations Division

cc: Houston Lighting and Power Co.
TWQB District 12

Texas Water Development Board

HARRY P. BURLEIGH
EXECUTIVE DIRECTOR

P.O. BOX 13087
CAPITOL STATION
AUSTIN, TEXAS 78711

AREA CODE 512
475-3571
1700 NORTH CONGRESS AVENUE

January 10, 1975

IN REPLY REFER TO:
TWDBP-O

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Re: Draft Environmental Statement, South Texas Project, Units 1 and 2.

Dear Jim:

Our staff has carefully reviewed the Draft Environmental Statement for the South Texas Project (Units 1 and 2) prepared by the Directorate of Licensing, Atomic Energy Commission. The following comments are offered on this document.

Careful attention has been given to the projections of water use and water consumption (evaporation) by the project. We feel that the AEC staff's projections of forced (induced) evaporation by the project, as presented in Table 5-2, are approximately 20 percent higher than should be expected on the basis of our calculations. Otherwise, we concur in general with the water use projections cited in the report.

On pages 2-5 and 5-1, it is indicated that the applicant has filed an application for a permit from the Texas Water Rights Commission to divert unappropriated water from the Colorado River at a rate of 102,000 acre-feet per year for the purposes of initial filling of the cooling lake(s) and as make-up water for evaporation losses and water quality control. It is not clear whether such a diversion would supply sufficient water for operation of four 1,250 MW units, which the site is designed to ultimately accommodate, or

General James M. Rose
January 10, 1975
Page 2

whether this application provides sufficient water supply for only Units 1 and 2.

Considerable attention has been focused on the impact of the project on Little Robbins Slough. Section 4.3.3 of the report indicates that construction of the cooling lake will result in as much as a 65 percent reduction in the flow of Little Robbins Slough within its upper reaches and a net reduction of about 27 percent of the total fresh water inflow into the Robbins Slough marsh complex at the eastern end of Matagorda Bay. In order to prevent loss of prime marsh habitat, it is suggested that the applicant give consideration to the possibility of periodic releases of water from the cooling lake into this marsh complex as a part of the AEC staff's conclusion of page 4-12 that the applicant conduct a study to determine the need for diversion of water from the Colorado River to minimize impacts on the marsh complex.

We appreciate the opportunity to review and comment on the draft statement.

Sincerely,

Harry P. Burleigh

COMMISSION
REAGAN HOUSTON, CHAIRMAN
DEWITT C. GREER
CHARLES E. SIMONS

TEXAS HIGHWAY DEPARTMENT
11TH AND BRAZOS
AUSTIN, TEXAS 78701

STATE HIGHWAY ENGINEER
B. L. DEBERRY

January 8, 1975

IN REPLY REFER TO
FILE NO.
D8-P 454

U.S. Atomic Energy Commission
Draft Environmental Statement
Matagorda County

South Texas Project
Units 1 and 2

Mr. Wayne N. Brown, Chief
State Planning and Development
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Sir:

Reference is made to your memorandum dated December 6, 1974, transmitting the subject draft environmental statement for review and comment.

A proposed agreement between the State of Texas and the South Texas Group for relocating F.M. 521 in the vicinity of the South Texas Project, will specify that the South Texas Group identify, evaluate and act on social, economic and environmental impacts of the relocation of F.M. 521 as part of the project and will publicize the relocation of F.M. 521 and its alternates at public hearings, securing public involvement to such extent as to require no separate public hearing or environmental impact studies by the State.

It is noted that there is little discussion in the EIS concerning the environmental impact regarding the relocation of F.M. 521. It is suggested that the final environmental statement contain sufficient discussion concerning air quality, noise and serviceability of F.M. 521 with reference to its relocation around the generating plant. The proposed relocation of F.M. 521 causes considerable indirection to traffic. The additional mileage required and the time loss for the traveling public should be quantified and stated in the FEIS. Alternate locations of the proposed relocation should be discussed.

The volume of traffic presently carried by this highway will be required to travel a longer distance to its destination outside the limits of the proposed project or must find other routes. This impact upon the traveling public should be evaluated and justified. Prior to and during the construction of F.M. 521, the Texas Highway Department had no opportunity to plan for an increase of volume and weight of traffic that will be associated with plant construction. It appears that because of the increased volume and weight of the traffic, strengthening of F.M. 521 between S.H. 60 and S.H. 35 will be necessary and should be considered as part of the power plant construction.

While various parts of the EIS recognize the increased traffic load on the highway network because of the plant construction and because of the transportation of nuclear fuel and waste materials, no provision is made to upgrade the approaching roads or to alleviate the added maintenance costs. The Granbury project in Hood and Somervell Counties is cited where the power company upgraded the existing roads leading to the plant to handle the anticipated heavier traffic volume. There will be increased traffic on S.H. 35 and S.H. 60 and probably "super heavy" loads on these two facilities which may lead to distress.

A new railroad spur is proposed into the plant which would cross the relocated F.M. 521. Adequate warning protection or a grade separation at this location, depending upon rail and highway traffic volumes, will be necessary.

We appreciate the opportunity to review the draft environmental statement and extend the Department's cooperation in the development of the proposed project.

Sincerely yours

B. L. DeBerry
State Highway Engineer

By: R. L. Lewis

R. L. Lewis, Chief Engineer
of Highway Design

cc: Federal Highway Administration

TEXAS
PARKS AND WILDLIFE DEPARTMENT

CLAYTON T. GARRISON
EXECUTIVE DIRECTOR
JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

January 15, 1975

Mr. Wayne N. Brown, Chief
State Planning and Development
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Attention: Brice Barnes

Dear Mr. Brown:

The Texas Parks and Wildlife Department has reviewed the draft environmental statement on the Houston Lighting and Power Company's proposed South Texas Project, Units 1 and 2.

It is felt that the statement is well prepared and presents most of the ramifications dealing with the impact of the project on natural ecosystems. We are concerned, however, about the detriment to the native biota which the project will cause. Such detriment is of even greater significance than indicated in the statement, in light of the cumulative effects which may occur from atomic power plants which are planned for the future and from other development of natural areas.

This holistic rather than an atomistic aspect should be mentioned in the document. Further, it is felt that it should be made explicit (page 7-1 through 7-3) the degree of damage which might occur from the most severe power plant accident which could occur. Additionally, environmental damage which might occur from accidents during shipment of radioactive materials and problems associated with the disposal of solid wastes should be more clearly presented in the statement (page 7-3, paragraph 7.2). Presentation of this information is necessary to facilitate a determination from perusing the statement of the possible impacts of the project on the natural environment.

A major concern to this Department is the adverse effects which the project will have on estuarine areas, particularly on Little Robins Slough. We suggest that the project sponsors, U.S. Fish and Wildlife Service, National Marine Fisheries Service and this Department, coordinate efforts to devise a means of bringing such damage to an absolute minimum. Marshlands are among the most biologically productive ecotypes. The high degree to which our irreplaceable, finite amount of marshland has been and is being diminished is critical and this Department is opposed to any additional losses of these wetland areas. The social, economic and environmental values of such wetlands are reflected in the following abstract from the article "The Value of the Tidal Marsh" by James Gosselink, Eugene Odum and R.M. Pope:

> "Natural tidal marshes are evaluated in monetary terms. By-product production (fisheries, etc.) on a per-acre basis yields a value of only about $100 per year, even when the whole value of the fishery is imputed to the marsh. More intensive uses, such as oyster aquaculture, which preserve many of the natural functions of the marsh-estuarine ecosystem, have a potential up to $1,000 per acre per year. The potential for waste assimilation is much higher, about $2,500 per acre per year for tertiary treatment. Summation of the noncompeting uses approaches an ecological life-support value of about $4,000 per acre per year, based on the gross primary productivity (in energy terms) of the natural marsh, using a conversion ratio from energy to dollars based on the ratio of Gross National Product to National energy consumption. When these annual social values of $2,500-$4,000 are income capitalized at 5 per cent interest the estimated total social values are $50,000-$80,000 per acre. Some estuaries, such as the Potomac or the Hudson, are now performing waste assimilation work of even greater value, but such estuaries are overloaded to the point of degradation. Analysis based on the total value of the life support role of a natural tidal marsh-estuary suggests that a strategy of optimization in land use planning should replace, or supplement, reliance on the pricing system which is inadequate for preservation of natural systems that increase in value with the intensity of adjacent development."

A plan of management for the 1,700-acre area proposed to be set aside for wildlife should be elaborated upon.

Possibilities for use of the 7,000-acre cooling lake for benefits to fish and wildlife and public recreation should be presented.

With respect to alternate sites as they are presented in the document, this Department feels that Site D for construction of the power plant would be the better compromise between meeting project requirements and minimizing damage to the most productive of the natural ecosystems involved.

Sincerely,

CLAYTON T. GARRISON
Executive Director

CTG:HS:__

Texas Historical Commission
Box 12276, Capitol Station
Austin, Texas 78711
Truett Latimer
Executive Director

12 December 1974

Mr. Wayne N. Brown, Chief
State Planning and Development
Office of the Governor
Division of Planning Coordination
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Re: Draft Environmental Statement: South Texas Project, Units 1 and 2

Dear Mr. Brown:

Pursuant to your request concerning the above-referenced project area, we have examined the D.E.S. and offer the following comments:

1) In section 2.3.2., the D.E.S. reads "The report on archaeological investigations states that 'with the careful application of standard archaeological survey field techniques no archaeological sites or features could be isolated'" while it should read "The report on archaeological investigation *of the STP area* states that with the ....

2) The transmission-line corridors have not been subjected to an archaeological survey to locate, record and identify cultural resources. It is our understanding, however, that the transmission-line corridors are being considered for this type of investigation. The Texas Historical Commission will review the data resultant of this survey as it is made available to us and will assess the impact of these modifications on cultural resources at that time.

Thank you for the opportunity to comment on this D.E.S. If we may be of further service, please advise.

Sincerely,

Truett Latimer
Executive Director

By

Alton K. Briggs
Archeologist

AKB:pc

cc: Mike Bureman
David S. Dibble
B.B. Aufill

TEXAS WATER RIGHTS COMMISSION

STEPHEN F. AUSTIN STATE OFFICE BUILDING

January 3, 1975

Brigadier General James M. Rose
Director, Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Attention: Mr. Wayne N. Brown

Re: U.S. Atomic Energy Commission, Draft Environmental Statement on South Texas Project, Units 1 and 2, November 1974.

Dear General Rose:

By letter of December 6, 1974, you requested that the Texas Water Rights Commission review and comment on the referenced document pursuant to the provisions of Office of Management and Budget Circular No. A-95.

The Texas Water Rights Commission's technical staff confirms the fact indicated on page 10-6 that the applicant, the Houston Lighting and Power Company, has submitted an application for a permit to appropriate State of Texas water from the Colorado River. This application is now being processed by the Texas Water Rights Commission.

The staff finds that the referenced document and the supporting 26-volume Environmental Report and Safety Analysis Report, transmitted earlier by letter of July 23, 1974, from the Division of Planning Coordination, Office of the Governor of Texas, adequately fulfills all the major requirements of the National Environmental Policy Act of 1969. Review by the staff indicates that all major aspects of water use and rights impacts have been comprehensively analyzed in the above mentioned documents.

Sincerely yours,
TEXAS WATER RIGHTS COMMISSION

By: Alfred J. DiArezzo, Ph.D., (C.E.)
Special Analyst for Environment and Interagency Coordination

AJD:ll

AREA CODE 512 — AUSTIN, TEXAS 78711

TEXAS STATE SOIL AND WATER CONSERVATION BOARD

1018 First National Building
Temple, Texas 76501
AREA CODE 817. 773-2250

January 2, 1975

Mr. Wayne N. Brown, Chief
State Planning & Development
Office of the Governor
Division of Planning Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

The draft environmental statement for the South Texas Project, Units 1 and 2, has been forwarded for our review and comment.

Our concern is the impact that this project will have on land resources. Review of the statement indicates that the authors have done an unusual amount of study in this area. We believe that project's impact on land resources has been thoroughly outlined and reasonably stated. A similar analysis in other statements forwarded for our review would be helpful.

Sincerely yours,

Harvey Davis
Executive Director

HD/lc

Ross

Texas State Department of Health

JAMES E. PEAVY, M.D., M.P.H.
COMMISSIONER OF HEALTH

FRATIS L. DUFF, M.D., Dr. P.H.
DEPUTY COMMISSIONER

AUSTIN, TEXAS 78756

January 21, 1975

Honorable Dolph Briscoe
Governor of Texas
State Capitol
Austin, Texas 78711

Attention: Mr. James M. Rose, Director
Division of Planning Coordination

Dear Governor Briscoe:

The Division of Occupational Health and Radiation Control has reviewed the Draft Environmental Statement, South Texas Project, and the Environmental Report prepared by Houston Lighting and Power Company as these documents relate to radioactivity and radiation exposure to the public.

It is our opinion that the proposed nuclear power plant can be constructed and operated without significant radiological impact on either the public or the environment, as long as an independent agency provides monitoring and surveillance of the operational releases of radioactivity from the plant.

It is this Department's intention to do such monitoring.

Accidents which may occur at the proposed plant, up through a Class 8 accident, pose no serious threat to the population and can be handled with preparation and implementation of an Emergency Plan. Accidents more severe than a Class 8 accident are not considered likely, however the Emergency Plan will lessen the effects of them.

This Department will cooperate extensively with Houston Lighting and Power on the development and implementation of the Emergency Plan.

If further information is needed concerning this review, you may contact Mr. Martin C. Wukasch or Mr. Lewis M. Cook in the Division of Occupational Health and Radiation Control.

Sincerely,

G. R. Herzik, Jr., P.E.
Deputy Commissioner
Environmental and Consumer
Health Protection

THE UNIVERSITY OF TEXAS AT AUSTIN
BUREAU OF ECONOMIC GEOLOGY
AUSTIN, TEXAS 78712

University Station, Box X
Phone 512—471-1534

December 19, 1974

Mr. Wayne N. Brown, Chief
Division of Planning Coordination
P. O. Box 12428
Austin, Texas 78711

Dear Mr. Brown:

The staff of the Bureau of Economic Geology has reviewed the following:

(1) revised draft environmental statement: Corpus Christi Beach, Texas (restoration project)
(2) review of the Texas Outdoor Recreation Plan
(3) draft environmental statement: South Texas Project, Units 1 and 2.

We have no negative comments concerning these projects. Thank you for the opportunity to respond.

Sincerely,

W. L. Fisher
Director

WLF:wll

EDMUND L. NICHOLS
Assistant Commissioner

December 20, 1974

Mr. Wayne N. Brown, Chief
State Planning & Development
Office of the Governor
Capitol Station
Austin, Texas

Dear Wayne:

This is in response to your letter of December 6, 1974, requesting the Texas Department of Agriculture review and comments on the Draft Environmental Statement, South Texas Projects, Units 1 and 2.

We have reviewed this statement and generally concur in its conclusions that the project is needed, justified and that the environmental result can be kept to within acceptable limits. However, it appears to us that a few items need either correction or furhter study.

The most serious problem with this statement is the discussion of the freshwater requirement and the availability of water from the Colorado River. Section 2.5.1.1 indicates the average Colorado River flow is 2353 cfs. Figure 3.6 shows a possible freshwater requirement of nearly 3000 cfs. This requirement obviously could not be met on any sustained basis. The more detailed data in Table 5.16 show river flows up to 7000 cfs and makeup water flows up to 1200 cfs. These appear to be compatible; unfortunately, they don't necessarily agree with the earlier citations. The water requirement should be reviewed not only for internal consistency but also to assure that adequate water will be available for the plant operation. It may even be necessary to select an alternative cooling system design which requires less water.

The text in Section 3 consistently refers to the water flow diagram as Figure 2.2. It should be Figure 3.2. This needs to be corrected.

Section 4.3.2.1 states that the waste discharges during construction will be treated to comply with state and local laws. The federal law, PL-92-500 may be applicable and should not be ignored.

Item 18 in Section 4.5.1 states that at any point where rights of way cross surfaced roads, brush or trees will be arranged to screen the cleared rights of way. This appears to have aesthetic attraction, but it could create a real traffic hazard.

Item 19, also in 4.5.1, is a gross overstatement. It says no herbicides will be used during construction thus avoiding any contamination or danger to wildlife. Not using herbicides can at most remove this as a possible source of contamination and danger to wildlife. Such overstatements should be avoided.

The discussion in Section 7.1 is clearly worded to be reassuring that the likelihood of a significant incident involving release of radioactive materials is slight. This is undoubtedly correct. However, at a trivial cost and minimal effort an emergency plan could be developed to have in readiness in the unlikely event an incident involving the release of radioactive materials did occur. To many this would be more reassuring than generalized conclusions drawn from statistical analyses. It is suggested that such a plan be developed and included in the operating procedures of the plant.

We appreciate the opportunity to review this important project.

Sincerely,

Edmund L. Nichols

ELN:am

HOUSTON-GALVESTON AREA COUNCIL

21 January 1975

Mr. G.W. Oprea, Jr.
Executive Vice President
Houston Lighting & Power Company
P.O. Box 1700
Houston, Texas 77001

Re: 501-17016
South Texas Project
Units 1 and 2
Draft Environmental Statement

Dear Sir:

The Project Review Committee of the Houston-Galveston Area Council has reviewed the Draft Environmental Statement on the proposed South Texas Project, Units 1 and 2. We greatly appreciate the opportunity to comment on matters which affect the environment of our region. Many of the projects which occur in our region have an impact upon our planning for this region.

The following comments are offered in an effort to avoid any unnecessary environmental damage:

1. Because the cooling pond will remove about 65% of the fresh water inflow into Little Robbins Slough and since the marshy area located below the proposed cooling pond is valuable in terms of faunal production, a study should be made to determine the necessary release of fresh water inflow into Little Robbins Slough to keep this marshy area in its relatively natural state.

2. Significant changes in construction plans or other related activities which may have adverse environmental impacts should be submitted to the Council for approval.

3. Following the beginning of operations, studies should be conducted on the effects of entrainment of nekton and plankton. Also the effects of any biocides used should be determined.

P. O. BOX 22777
[illegible] WEST ALABAMA
713-[illegible]
HOUSTON, TEXAS [illegible]

575-0203-050

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

February 14, 1975

RECEIVED
FEB 18 1975
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

Mr. B. J. Youngblood, Chief
Environmental Projects Branch #3
Division of Reactor Licensing
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Youngblood:

The draft environmental impact statement for South Texas Project, Units 1 and 2, Houston Lighting and Power Co., has been received by the Department of Commerce for review and comment.

General Comments

We share the general concern expressed in the impact statement for the effects of reduced freshwater inflow on the marshes fed by Little Robbins Slough. We also believe that great concern should be indicated for the reduction of total flows to Matagorda Bay through consumption and blockage of the West Branch distributary of the Colorado River by the Spillway Discharge Canal. The feasibility of maintaining, or even increasing, the average low flow volumes of Colorado River water reaching Matagorda Bay should be thoroughly explored.

The statement makes no reference to historical or potential flood conditions in the vicinity of the plant or the relationship of the plant elevation to such conditions. It is important to know that the plant design and location has considered this hazard and if so, it should be documented in this report.

Because of the high incidence of "heavy fog" in the area, a more thorough discussion of the cooling lakes fogging potential is needed. The applicant appears to already have the necessary data, thus only the analysis and discussion are required.

Fairly substantial subsidence has been observed along the Texas coast. Since this could be an important consideration

1812

Again, we appreciate the opportunity to comment on the draft environmental statement. If we can be of further assistance to you, please do not hesitate to contact me.

Cordially,

Royal Hatch
ROYAL HATCH
Executive Director

RH:jr

in construction of the proposed nuclear power plant, it is recommended that the National Geodetic Survey (NGS) be contacted for specific information on subsidence in this area.

There are no tidal bench marks or geodetic control survey monuments located in the plant site area as described in the subject document. There may be geodetic control survey monuments in the transmission line routes.

If there is any planned activity along the transmission line routes which will disturb or destroy these monuments, NGS requires not less than 90 days notification in advance of such activity in order to plan for their relocation. NGS recommends that funding for the project include the cost of any relocation required for NGS geodetic monuments.

Tidal data given on pages 2-6 through 2-14 are confirmed according to NGS records and documents.

Specific Comments

Page 2-3. The West Branch of the Colorado River, shown to flow across the proposed route of the Spillway Discharge Channel, should be labeled.

Page 2-13. The map could be made more accurate and explicit by showing that the upper reaches of the West Branch of the Colorado River flow across the proposed location for the Spillway Discharge Canal. Another source of fresh water inflow to Matagorda Bay -- Tiger Island (Parkers) Cut, located at Aquatic Sampling Station 11 -- should be labeled as such. The openings shown between the Gulf and Bay between Aquatic Sampling Stations 14 and 15 and at three other points west of that location do not exist and therefore should not be shown.

Page 5-29, paragraph 5. It is stated that "Operation of STP will result in a net average annual freshwater loss to the Colorado River-Matagorda Bay estuary of 47,000 to 53,000 acre-ft." The AEC staff then concludes that since other future activities will possibly divert flows from the Colorado River, the effect of makeup diversion of freshwater for this project on the estuary will be minimal. However, it should be emphasized that studies in Texas (Cooper and Copeland 1973;

Copeland et al. 1972; Copeland 1966) have shown that reduction of freshwater inflows significantly reduces the productivity of the estuary. These reports should be discussed in the final impact statement. The effect that the proposed location of the Spillway Drainage Channel would have on the West Branch of the Colorado River also should be thoroughly reviewed. Apparently the upper reaches of the West Branch would be crossed and dammed, thereby eliminating Colorado River inflows. It should be noted that all flows down the West Branch enter Matagorda Bay, whereas only 40 to 60 percent of the flows down the main channel of the Colorado River enter the Bay /through Tiger Island (Parkers) Cut/; the remainder flows directly into the Gulf. The possibility of increasing the flows down the West Branch, to mitigate for project-caused losses of Colorado River flows through Tiger Island (Parkers) Cut, should be explored.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving a copy of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure

LITERATURE CITED

Cooper, D.C. and B.J. Copeland. 1973. Response of continuous-series estuarine microecosystems to point source input variations. Ecological Monographs. 43:213-236.

Copeland, B.J. 1966. Effects of decreased river flow on estuarine ecology. Jour. Water Pollution Control Federation. 38(11):1831-1839.

Copeland, B.J., H.T. Odum, and D.C. Cooper. 1972. Water quantity for preservation of estuarine ecology. pp. 107-126 *in*: Gloyna. E.F. and W.S. Butcher (eds.), Conflicts in water resources planning. Water Resources Symposium No. 5, Center for Research in Water Resources, University of Texas, Austin

Appendix B

BIOTA OF THE TERRESTRIAL AND AQUATIC ENVIRONS

Table B.1. Summary of land use of plant association of the STP site

Classification	Land	
	Acres	Percent
Coastal Prairie[a]		
Natural communities		
Tall grass prairie	382	3
Natural hay	120	1
Unimproved pasture		
Rattail smutgrass	278	2
McCartney rose/bushy bluestem	347	3
Deciduous scrubland savanna		
Sea-myrtle/bushy bluestem	397	3
Sea-myrtle/dallisgrass	49	<1
Kellylake and ponds	36	≤1
Subtotal	1,609	13
Man-dominated communities		
Cropland		
Rice	3,738	30
Sorghum	791	6
Soybean	610	5
Seeded hay	181	1
Improved pasture	1,430	12
Fallow		
Forbs and grasses	706	6
Sedges/marsh-elder/fall panicum	341	3
Marsh-elder/bermuda/white spike sedge	1,180	10
Recently plowed, revegetating	106	<1
Residential	11	<1
Barren	11	≤1
Subtotal	9,105	74
Total	10,714	87
Southern floodplain forest[b]		
Natural Communities		
Deciduous forest		
Bottomland -- red ash	760	6
Riparian -- sycamore/pecan/sugarberry	273	2
Mixed broadleaf evergreen – deciduous	417	3
Evergreen broadleaf scrubland	55	≤1
Subtotal	1,505	12
Man-dominated Communities		
Spoil area	133	1
Subtotal	133	1
Total	1,638	13
Grand total	12,352	100

[a]Detailed species composition is provided in Tables 1–6 through 1–26 and 1–42 through 1–46 of the source reference.

[b]Detailed species composition is provided in Tables 1–27 through 1–41 of the source reference.

Source: NUS Corporation, *An Ecological Study of the Lower Colorado River–Matagorda Bay Area of Texas* and Amendments 1, 2, and 3, R-24-05-04-606, Docket Nos. STN-50-498 and STN-50-499, July 25, 1974.

Table B.2. Plant species with ranges that overlap the site and/or transmission-line corridors and that are rare, endangered, or restricted to a simple plant association

Species	Status[a]	Distribution[b]
Rare and endangered species listed by rare plant study center, University of Texas, Austin		
Andrachne phyllanthoides, Missouri maidenbush	5	E, B, TR
Chloris texensis, Texas windmill grass	6	E, S, TR
Coursetia axillaris, baby-bonnets	5	F, B, TR
Dasistoma macrophylla, mullen foxglove	5	F, B, TR
Hoffman seggia tenella, slender rushpea	6/7	I, TR
Iva imbricata, Mustang Island sumpweed	6	I, B, TR
Lophophora williamsii, peyote	5	D, B, TR
Notholaena schaffneri, schaffner cloak fern	5	D, B, TR
Prunus minutiflora, Texas almond	5	D, TR
Scirpus cubensis, Cuban bulrush	6/7	I, B, TR
Scleria minor, nutrush	6	E, B, S, TR
Selenia jonesii, Jones selenia	6	I, E, TR
Stenandrium fascicularis, brush stenandrium	6/7	I, B, TR
Tetramerium platystegium, montell fourwart	6	E, TR
Tripogon spicatus, American tripogon	6	E, A, TR
Wolffiella gladiata, sword bog-mat	6	I, B, E, TR
U.S.D.A. Soil Conservation Service, rare and endangered Texas plants		
Clitoria mariana, pigeon wings		OS
Elymus canadensis, Virginia wild rye		OS
Eryngium yuccifolium, button-snakeroot		OS
Justicia americana, American water willow		OS
Sorghastrum nutans, Indian grass		OS
Trachypogon secundus, crinkle weed		OS
Species restricted to a single plant association		
Coastal prairie species		
Andropogon tener, slender bluestem		S, TR
Southern cordgrass prairie species		
Panicum repens, torpedograss		M, TR
Spartina cynosuroides, saltgrass		M, TR
Zizaniopsis miliacea, marsh millet		TR, OS, OM
Mesquite Acacia Savanna species		
Acacia berlandieri, guajillo		TR
Acacia malacophylla, softleaf scacia		TR
Setaria macrostachya, plains bristlegrass		TR
Southern floodplain forest species		
Forestiera acuminata, swamp privet		OS, TR
Fraxinus profunda, red ash		S, TR
Planera aquatica, water elm		S, TR
Quercus falcata pagodaefolia, cherry-bark oak		S, TR
Quercus michauxii, swamp chestnut oak		S, TR

[a]Status:
5 – Scarce, endangered in Texas.
6 – Very rare, acutely endangered in Texas.
7 – Presumed extinct, with no records since 1930 from Texas.

[b]The extent of the known distribution is indicated by the following letter-symbols:
A – Distributed widely on the continent or in the world.
B – Distributed broadly but regionally in North America and extending into Texas.
[If the letter A or B is not given in the symbolic notation, it is implied that the species is endemic to Texas (i.e., it occurs only in Texas).]
C – Distributed widely in Texas.
D – Distributed over several of the vegetational areas of Texas.
E – Distributed in two of the vegetational areas of Texas.
F – Distributed in one vegetational area of Texas.
G – Distribution limited to 4 to 8 counties in one vegetational area.
H – Distribution limited to 1 to 3 counties in one vegetational area.
I – Known only from one or a few populations; explicit information occasionally provided.
TR – Potentially occurring along transmission line row.
OTR – Observed along transmission line row.
S – Potentially occurring at site.
OS – Observed on the site.
M – Potentially occurring in marshland south of site.
OM – Observed in marshlands south of site.

Table B.3. Wildlife species with ranges that overlap the site and/or transmission-line corridors

	Status[a]	Regional geographical distribution	Regional use[c]	Areas[d] observed
Generally ubiquitous species				
Rocky mountain toad, *Bufo woodhousei woodhousei*		R	P	S
Gulf coast toad, *Bufo valliceps*		R	P	S
Texas toad, *Bufo compactilis*		W	P	
Blanchard's cricket frog, *Acris crepitans blanchardi*		R	P	S
Upland chorus frog, *Pseudacris triseriata feriarum*		R	P	S
Eastern narrow-mouthed toad, *Gastrophryne carolinensis*		R	P	S
Great plains narrow-mouthed toad, *Gastrophryne olivacea olivacea*		R	P	S
Gulf coast box turtle, *Terrapene carolina major*		E	P	
Green water snake, *Natrix cyclopion cyclopion*		NE	P	S
Broad-banded water snake, *Natrix sipedon confluens*		R	P	S
Mexican milk snake, *Lampropeltis doliata annulata*		W	P	
Slender flat-headed snake, *Tantilla gracilis gracilis*		R	P	
Texas coral snake, *Micrurus fulvius tenere*		R	P	
Western cottonmouth, *Agkistrodon piscivorus leucostoma*		R	P	S
Western massasauga, *Sistrurus catenatus tergeminus*		R	P	S
Western pigmy rattlesnake, *Sistrurus miliarius streckeri*		R	P	S
Common opossum, *Didelphis marsupialis*	G	R	P	S
Least shrew, *Cryptotis parva*		R	P	S
Shorttail shrew, *Blarina brevicauda*		R	P	S
Golden eagle, *Aquila chrysaetos*		R	W	
Louisiana heron, *Hydranassa tricolor*		C	P	S, E
Little blue heron, *Florida caerulea*		R	P	S, E
White ibis, *Eudocimus albus*	BL	C	P	S, E
Sandhill crane, *Grus canadensis*		W	S	S, E
American golden plover, *Pluvialis dominicus*		R	M	S
Long-billed curlew, *Numenius americanus*	U	WC	W	S, E
Common snipe, *Capella gallinago*	G	R	W	S
Black-chinned hummingbird, *Archilochus alexandri*		W	M	
Eastern kingbird, *Tyrannus tyrannus*		R	S	S
Horned lark, *Eremophila alpetris*		R	P	S
Purple martin, *Progne subis*		R	S	S, E
Common crow, *Corvus brachyrhynchos*		R	P	S
Mockingbird, *Mimus polyglottos*		R	P	S
Robin, *Turdus migratorius*		R	W	S
Ruby-crowned kinglet, *Regulus calendula*		R	W	S
Nashville warbler, *Vermivora ruficapilla*		R	M	S
Yellow warbler, *Dendroica petechia*		R	M	S
Red-winged blackbird, *Agelaius, phoeniceus*		R	P	S, E
Rusty blackbird, *Euphagus carolinus*		R	W	
Boat-tailed grackle, *Cassidix mexicanus*		C	P	S, E
Common grackle, *Quiscalus quiscula*		R	P	S
Painted bunting, *Passerina ciris*		R	S	S
Slate-colored junco, *Junco hyemalis*		R	W	S
White-crowned sparrow, *Zonotrichia leucophrys*		R	W	
Lincoln's sparrow, *Melospiza lincolnii*		R	W	S
Song sparrow, *Melospiza melodia*		R	W	
Cropland–wetland species				
Texas garter snake, *Thamnophis sirtalis annectens*		R	P	S
Eastern harvest mouse, *Reithrodontomys humulis*		E	P	
Rice rat, *Oryzomys palustris*		R	P	S
Hispid cotton rat, *Sigmodon hispidus*		R	P	S
Canada goose, *Branta canadensis*	G	R	W	S, E
White-fronted goose, *Anser albifrons*	G, T	C	W	S, E
Blue goose, *Chen caerulescens*	G	C	W	
Snow goose, *Chen hyperborea*	G	C	W	S, E
Mallard, *Anas platyrhynchos*	G	R	W	S
Pintail, *Anas acuta*	G	R	W	E
American widgeon, *Mareca americana*	G	R	W	S, E
Fulvous tree duck, *Dendrocygna bicolor*	G, BL	C	S	S, E
White-tailed kite, *Elanus leucurus*		SW	P	S
Marsh hawk, *Circus cyaneus*	BL	R	W	S, E
Common egret, *Casmerodius albus*		R	P	E
Snowy egret, *Leucophoyx thula*		R	S	S, E

Table B.3 (continued)

	Status[a]	Regional geographical distribution	Regional use[c]	Areas[d] observed
Cattle egret, *Bubulcus ibis*		C	P	S
White-faced ibis, *Plegadis chihi*	U, BL	C	S	S
Sora, *Porzana carolina*	G	C	W	S
Yellow rail, *Coturnicops noveboracensis*	G	C	W	S
King rail, *Rallus elegans*	G	C	P	S
American coot, *Fulica americana*	G	R	W	E
Black-necked stilt, *Himantopus mexicanus*		C	S	S
Semipalmated plover, *Charadrius semipalmatus*		C	W	S
Killdeer, *Charadrius vociferus*		R	P	S, E
Marbled godwit, *Limosa fedoa*		C	W	S
Hudsonian godwit, *Limosa haemastica*		R	M	S
Willet, *Catoptrophorus semipalmatus*		C	P	S, E
Baird's sandpiper, *Erolia bairdii*		R	M	S
Least sandpiper, *Erolia minutilla*		R	W	S
Herring gull, *Larus argentatus*		C	W	E
Ring-billed gull, *Larus delawarensis*		C	W	S, E
Franklin's gull, *Larus pipixcan*	BL	R	M	S
Gull-billed tern, *Gelochelidon nilotica*	BL	C	P	
Domestic pigeon, *Columba livia*		R	P	S, E
Short-eared owl, *Asio flammeus*		R	W	S
Eastern phoebe, *Sayornis phoebe*		R	P	S
Barn swallow, *Hirundo rustica*		R	M	S
Cliff swallow, *Petrochelidon pyrrhonota*		R	M	S
Bank swallow, *Riparia riparia*		R	S	S, E
Water pipit, *Anthus spinoletta*		R	W	
Eastern meadowlark, *Sturnella magna*		R	P	S
Brewer's blackbird, *Euphagus cyanocephalus*		R	W	
Savannah sparrow, *Passerculus sandwichensis*		R	W	S, E
LeConte's sparrow, *Passerherbulus caudacutus*		R	W	
Swamp sparrow, *Melospiza georgiana*		R	W	S
Chestnut-collared longspur, *Calcarius ornatus*		W	W	S
Ubiquitous—terrestrial species				
Hurter's spadefoot toad, *Scaphiopus hurteri*		R	P	
Eastern green toad, *Bufo debilis debilis*		W	P	
Squirrel treefrog, *Hyla squirella*		R	P	
Crawfish frog, *Rana areolata areolata*		R	P	S
Three-toed box turtle, *Terrapene carolina triunguis*		N	P	S
Ornate box turtle, *Terrapene ornata ornata*		R	P	S
Texas spiny lizard, *Sceloporus olivaceus*		R	P	
Six-lined racerunner, *Cnemidophorus sexlineatus*		R	P	
Ground skink, *Lygosoma laterale*		R	P	S
Broad-headed skink, *Eumeces laticeps*		W	P	S
Great plains skink, *Eumeces obsoletus*		W	P	
Western slender glass lizard, *Ophisaurus attenuatus attenuatus*		R	P	S
Rough earth snake, *Haldea striatula*		R	P	
Eastern hognose snake, *Heterodon platyrhinos*		R	P	S
Prairie ringneck snake, *Diadophis punctatus arnyi*		N	P	
Eastern yellow-bellied racer, *Coluber constrictor flaviventris*		R	P	S
Rio grande racer, *Coluber constrictor stejnegerianus*		R	P	
Western smooth green snake, *Opheodrys vernalis blanchardi*		R	P	
Texas indigo snake, *Drymarchon corais erebennus*		SW	P	
Bullsnake, *Pituophis melanoleucus sayi*		W	P	
Speckled kingsnake, *Lampropeltis getulus holbrooki*		R	P	
Louisiana milk snake, *Lampropeltis triangulatum amaura*		R	P	
Prairie kingsnake, *Lampropeltis calligaster calligaster*		R	P	S
Eastern pipistrel, *Pipistrellus subflavus*		R	P	
Big brown bat, *Eptesicus fuscus*		N	P	
Red bat, *Lasiurus borealis*		R	P	
Seminole bat, *Lasiurus seminolus*		R	P	
Longtail weasel, *Mustela frenata*	F	R	P	
Spotted skunk, *Spilogale putorius*	F	R	P	S
Striped skunk, *Mephitis mephitis*	F	R	P	S
Coyote, *Canis latrans*		R	P	S
Red fox, *Vulpes fulva*	G,F	R	P	
Thirteen-lined ground squirrel, *Citellus tridecimliniatus*		R	P	

Table B.3 (continued)

	Status[a]	Regional geographical distribution	Regional use[c]	Area[d] observed
South Texas picket gopher, *Geomys personatus*		SW	P	
Deer mouse, *Peromyscus maniculatus*		R	P	
House mouse, *Mus musculus*	PE	R	P	S
Eastern cottontail, *Sylvilagus floridanus mallurus*	G	R	P	S
Wild boar, *Sus scrofa*	G	R	P	S
Turkey vulture, *Cathartes aura*		R	P	S, E
Black vulture, *Coragyps atratus*		R	P	S, E
Swainson's hawk, *Buteo swainsoni*	BL	W	M	S
Peregrine falcon, *Falco peregrinus*	E	R	W	S
Sparrow hawk, *Falco sparverius*	BL	R	W	S
Bob-white, *Colinus virginianus*	G	R	P	S
Ring-necked pheasant, *Phasianus colchicus*	G	L	P	S
White-winged dove, *Zenaida asiatica*	G	SW	S	
Mourning dove, *Zenaidura macroura*	G	R	P	S
Ground dove, *Columbigallina passerina*	G	C	P	S
Roadrunner, *Geococcyx californianus*		W	P	
Barn owl, *Tyto alba*	BL	R	P	S
Burrowing owl, *Speotyto cunicularia*	U, BL	W	W	
Pauraque, *Nyctidromus albicollis*		SW	P	
Common nighthawk, *Chordeiles minor*		R	S	S
House wren, *Troglodytes aedon*		R	W	S
Bewick's wren, *Thryomanes bewickii*	BL	R	W	
Catbird, *Dumetella carolinensis*		R	W	S
Blue-gray gnatcatcher, *Polioptila caerulea*		R	P	S
Loggerhead shrike, *Lanius ludovicianus*	BL	R	P	S, E
Starling, *Sturnus vulgaris*		R	P	S
White-eyed vireo, *Vireo griseus*		R	P	S
Bell's vireo, *Vireo bellii*	BL	W	S	
Tennessee warbler, *Vermivora peregrina*		R	M	S
Myrtle warbler, *Dendroica coronata*		R	W	S
Pine warbler, *Dendroica pinus*		C	P	
Palm warbler, *Dendroica palmarum*		C	W	
Brown-headed cowbird, *Molothrus ater*		R	P	S
Indigo-bunting, *Passerina cyanea*		R	S	S
American goldfinch, *Spinis tristis*		R	W	S
Rufous-sided towhee, *Pipilo erythrophthalmus*		R	W	
Lark sparrow, *Chondestes grammacus*		R	P	
Bachman's sparrow, *Aimophila aestivalis*	BL	R	P	
Field sparrow, *Spizella pusilla*		R	W	S
White-throated sparrow, *Zonotrichia albicollis*		R	W	S
Urban—woodland species				
Screech owl, *Otus asio*		R	P	
Yellow-shafted flicker, *Colaptes auratus*		R	P	S
Red-bellied woodpecker, *Melanerpes carolinus*		R	P	S
Red-headed woodpecker, *Melanerpes erythrocephalus*		R	P	S
Downy woodpecker, *Dendrocopos pubescens*		R	P	S
Kiskadee flycatcher, *Pitangus sulphuratus*		SW	P	
Great creasted flycatcher, *Myiarchus crinitus*		R	S	S
Eastern wood pewee, *Contopus virens*		R	S	S
Blue jay, *Cyanocitta cristata*		R	P	
Carolina chickadee, *Parus carolinensis*		R	P	S
Tufted titmouse, *Parus bicolor*		R	P	S
White-breasted nuthatch, *Sitta carolinensis*		R	P	
Red-breasted nuthatch, *Sitta canadensis*		R	P	
Brown creeper, *Certhia familiaris*		R	W	
Carolina wren, *Thryothorus ludovicianus*		R	P	S
Wood thrush, *Hylocichla mustelina*		R	S	S
Hermit thrush, *Hylocichla guttata*		R	W	
Eastern bluebird, *Sialia sialis*		R	P	S
Golden-crowned kinglet, *Regulus satrapa*		R	W	S
Cedar waxwing, *Bombycilla cedrorum*		R	W	
Yellow-throated vireo, *Vireo flavifrons*		R	S	
Red-eyed vireo, *Vireo olivaceus*		R	S	S
Warbling vireo, *Vireo gilvus*		R	S	
Parula warbler, *Parula americana*		R	S	S

Table B.3 (continued)

	Status[a]	Regional geographical distribution	Regional use[c]	Area[d] observed
Magnolia warbler, *Dendroica magnolia*		R	M	S
Black-poll warbler, *Dendroica striata*		E	M	S
Ovenbird, *Seiurus aurocapillus*		R	M	S
American redstart, *Steophaga ruticilla*		R	M	S
Orchard oriole, *Icterus spurius*		R	S	S
Baltimore oriole, *Icterus galbula*		R	S	S
Summer tanager, *Piranga rubra*		R	S	S
Cardinal, *Richmondena cardinalis*		R	P	S
Rose-breasted grosbeak, *Pheucticus ludovicianus*		R	M	S
Purple finch, *Carpodacus purpureus*		R	W	
Chipping sparrow, *Spizella passerina*		R	W	S
Fox sparrow, *Passerella ilkaca*		R	W	
Urban–cropland species				
South Texas ground snake, *Sonora episcopa taylori*		SW	P	
Eastern mole, *Scalopus aquaticus*		R	P	
Plains pocket gopher, *Geomys bursarius*		R	P	S
Hispid pocket mouse, *Perognathus hispidus*		R	P	
Fulvous harvest mouse, *Reithrodontomys fulvescens*		R	P	S
Pygmy mouse, *Baiomys taylori*		R	P	S
Upland plover, *Bartramia longicauda*		R	M	S
Sprague's pipit, *Anthus spragueii*		R	W	S
Western meadowlark, *Sturnella neglecta*		W	W	
Dickcissel, *Spiza americana*		R	S	S
Grasshopper sparrow, *Ammodramus savannarum*	BL	R	P	
McCown's longspur, *Rhynchophanes mccownii*		W	W	
Urban–farmyard species				
Cave myotis, *Myotis velifer*		W	P	
Evening bat, *Nycticeius humeralis*		R	P	
Mexican freetail bat, *Tadarida brasiliensis*		R	P	
Norway rat, *Rattus norvegicus*	PE	R	P	S
Black rat, *Rattus rattus*	PE	R	P	
Chimney swift, *Chaetura pelagica*		R	S	S
Ruby-throated hummingbird, *Archilochus colubris*		R	S	S
House sparrow, *Passer domesticus*		R	P	
Cropland–brushland species				
Texas rose-bellied lizard, *Sceloporus variabilis marmoratus*		SW	P	
Northern fence lizard, *Sceloporus undulatus hyacinthinus*		R	P	
Five-lined skink, *Eumeces fasciatus*		E	P	S
Southern prairie skink, *Eumeces septentrionalis obtusirostris*		N	P	
Western coachwhip, *Masticophis flagellum testaceus*		R	P	
Texas patch-nosed snake, *Salvadora lineata*		W	P	
Great plains rat snake, *Elaphe guttata emoryi*		W	P	
Texas glossy snake, *Arizona elegans elegans*		W	P	
Badger, *Taxidea taxus*		W	P	
Scissor-tailed flycatcher, *Muscivora forficata*		R	S	S
Blue grosbeak, *Guiraca caerulea*		R	S	
Vesper sparrow, *Pooecetes gramineus*		R	W	
Cropland species				
Henslow's sparrow, *Passerherbulus henslowii*	R	R	W	
Grassland–brushland species				
Couch's spadefoot, *Scaphiopus couchi*		W	P	
Texas horned lizard, *Phrynosoma cornutum*		R	P	
Eastern spotted whiptail, *Cnemidophorus sacki gularis*		R	P	
Plains blind snake, *Leptotyphlops dulcis dulcis*		W	P	
Long-nosed snake, *Rhinocheilus lecontei tessellatus*		W	P	
Ord kangaroo rat, *Dipodomys ordi*		SW	P	
Northern grasshopper mouse, *Onychomys leucogaster*		W	P	
Black-tailed jackrabbit, *Leupus californicus*	G	R	P	S
White-tailed hawk, *Buteo albicaudatus*	P	SW	P	S
Caracara, *Caracara cheriway*	U, BL	C	P	S

Table B.3 (continued)

	Status[a]	Regional geographical distribution	Regional use[c]	Area[d] observed
Lesser nighthawk, *Chordeiles acutipennis*		SW	S	
Ladder-backed woodpecker, *Dendrocopos scalaris*		W	P	
Verdin, *Auriparus flaviceps*		SW	P	
Cassin's sparrow, *Aimophila cassinii*		SW	S	
Prairie species				
Spotted chorus frog, *Pseudacris clarki*	R	R	P	
Dusty hognose snake, *Heterodon nasicus gloydi*	R	N	P	
Merriam pocket mouse, *Perognathus merriami*	R	W	P	
Greater prairie chicken, *Tympanuchus cupido attwateri*	E,G,R	L	P	T
Whooping crane, *Grus americana*	E, R	SW	W	T
Shrubland–woodland–wetland species				
Small-mouthed salamander, *Ambystoma texanum*		R	P	
Central newt, *Diemictylus viridescens louisianensis*		R	P	
Strecker's chorus frog, *Pseudacris streckeri*		R	P	
Texas brown snake, *Storeria dekayi texana*		R	P	
Rough green snake, *Opheodrys aestivus*		R	P	S
Texas rat snake, *Elaphe obsoleta lindheimeri*		R	P	S
Beaver, *Castor canadensis*	F	R	P	
Red-tailed hawk, *Buteo jamaicensis*		R	P	S, E
Pigeon hawk, *Falco columbarius*	U, BL	R	W	S
Lesser yellowlegs, *Totanus flavipes*		C	W	S
Bonaparte's gull, *Larus philadelphia*		C	W	
Yellow-billed cuckoo, *Coccyzus americanus*	BL	R	S	S
Great horned owl, *Bubo virginianus*		R	P	S
Pileated woodpecker, *Dryocopus pileatus*		R	P	S
Winter wren, *Troglodytes troglodytes*		R	W	S
Yellow-throated warbler, *Dendroica dominica*		R	S	
Maryland yellowthroat, *Geothlypis trichas*		R	P	E
Yellow-breasted chat, *Icteria virens*		R	S	S
Harris' sparrow, *Zonotrichia querula*		W	W	
Shrubland–woodland species				
Hognose skunk, *Conepatus leuconotus*		R	P	
Red wolf, *Canis niger*	E	E	P	
Gray fox, *Urocyon cinereoargenteus*	F	R	P	S
Bobcat, *Lynx rufus*	F	R	P	S
White-footed mouse, *Peromyscus leucopus*		R	P	S
Eastern woodrat, *Neotoma floridana*		R	P	
Peccary, *Pecaria angulatus*	G	W	P	
Whitetail deer, *Odocoileus virginianus*	G	R	P	S
Armadillo, *Dasypus novemcinctus*	G	R	P	S
Mississippi kite, *Ictinia misisippiensis*		R	S	S
American woodcock, *Philohela minor*	G	R	P	
Golden-fronted woodpecker, *Centurus aurifrons*		SW	P	
Veery, *Hylocichla fuscescens*		R	M	S
Swainson's warbler, *Limnothylpis swainsonii*		R	S	
Orange-crowned warbler, *Vermivora celata*		C	W	
Wilson's warbler, *Wilsonia pusilla*		R	M	S
Olive sparrow, *Arremonops rufivirgata*	P	L	P	
Shrublands species (deserts, brushlands, and thickets)				
Southern spot-tailed earless lizard, *Holbrookia lacerata subcaudalis*		W	P	
Texas night snake, *Hypsiglena tonquata texana*		W	P	
Western diamondback rattlesnake, *Crotalus atrox*		R	P	
Southern plains woodrat, *Neotoma micropus*		W	P	
Harris' hawk, *Parabuteo unicinctus*	BL	SW	P	S
Brown thrasher, *Toxostoma rufum*		R	P	S
Black-capped vireo, *Vireo atricapilla*	U	W	S	
Desert species				
Texas tortoise, *Gopherus berlandieri*	R	W	P	
Brushland species				
Ringtail, *Bassariscus astutus*	R	R	P	

Table B.3 (continued)

	Status[a]	Regional geographical distribution	Regional use[c]	Area[d] observed
Woodland species (thickets, openwoods, forests, swamps and/or bogs)				
Green anole, *Anolis carolinensis carolinensis*		R	P	S
Mississippi ringneck snake, *Diadophis punctatus stictogenys*		R	P	
Southern copperhead, *Agkistrodon contortrix contortrix*		R	P	S
Broad-banded copperhead, *Agkistrodon controtrix laticinctus*		W	P	
Canebrake rattlesnake, *Crotalus horridus atricaudatus*		N	P	
Raccoon, *Procyon lotor*	F	R	P	S
Eastern fox squirrel, *Sciurus niger*	G	R	P	S
Southern flying squirrell, *Glaucomys volans*		R	P	
Sharp-shinned hawk, *Accipiter striatus*	BL	R	W	S
Broad-winged hawk, *Buteo platypterus*		R	S	
Wild turkey, *Meleagris gallopavo*	G	L	P	
Yellow-bellied sapsucker, *Sphyrapicus varius*		R	W	S
Acadian flycatcher, *Empidonax virescens*		R	S	S
Solitary vireo, *Vireo solitarius*		R	W	S
Black-and-white-warbler, *Mniotilta varia*		R	S	
Worm-eating warbler, *Helmitheros vermivorus*		E	M	S
Blue-winged warbler, *Vermivora pinus*		R	M	S
Black-throated green warbler, *Dendroica virens*		R	M	S
Blackburnian warbler, *Dendroica fusca*		R	M	S
Kentucky warbler, *Oporornis formosus*		R	S	S
Hooded warbler, *Wilsonia citrina*		E	S	S
Forest species				
Hoary bat, *Lasiurus cinereus*	R	N	P	
Eastern yellow bat, *Lasiurus intermedius*	R	R	P	
Eastern gray squirrel, *Sciurus carolinensis*	R	R	P	S
Cooper's hawk, *Accipiter cooperii*	BL, R	R	P	
Red-shouldered hawk, *Buteo lineatus*	U, BL, R	R	P	S
Barred owl, *Strix varia*	R	R	P	S
Chuck-will's widow, *Caprimulgus carolinensis*	R	R	S	
Whip-poor-will, *Caprimulgus vociferus*	R	C	W	S
Red-cockaded woodpecker, *Dendrocopos borealis*	E, R	R	P	
Hairy woodpecker, *Dendrocopos villosus*	R	R	P	
Ubiquitous—wetland species				
Western lesser siren, *Siren intermedia nettingi*		R	P	S
Black-spotted newt, *Diemictylus meridionalis*		SW	P	
Green treefrog, *Hyla cinerea cinerea*		R	P	S
Bullfrog, *Rana catesbeiana*		R	P	S
Rio Grande leopard frog, *Rana pipiens berlandieri*		R	P	S
American alligator, *Alligator mississipiensis*	E	R	P	S
Common snapping turtle, *Chelydra serpentina serpentina*	G	R	P	
Stinkpot, *Sternothaerus odoratus*		R	P	S
Mississippi mud turtle, *Kinosternon subrubrum hippocrepis*		R	P	S
Red-eared turtle, *Pseudemys scripta elegans*		R	P	S
Texas slider, *Pseudemys concinna texana*		R	P	
Western chicken turtle, *Deirochelys reticularia miaria*		R	P	
Diamond-backed water snake, *Natrix rhombifera rhombifera*		R	P	S
Blotched water snake, *Natrix erythrogaster transversa*		R	P	S
Gulf salt marsh snake, *Natrix sipedon clarki*		R	P	
Graham's water snake, *Natrix grahami*		R	P	S
Western ribbon snake, *Thamnophis sauritus proximus*		R	P	S
Western mud snake, *Farancia abacura reinwardti*		R	P	S
Mink, *Mustela vison*	F	R	P	
River otter, *Lutra canadensis*	F	R	P	
Muskrat, *Ondatra zibethicus*	F	E	P	
Nutria, *Myocastor corypus*		R	P	S
Swamp rabbit, *Sylvilagus aquaticus*	G	R	P	S
Common loon, *Gavia immer*		C	W	E
White pelican, *Pelecanus erythrorhynchos*	BL	C	W	E
Double-crested cormorant, *Phalacrocorax auritus*	BL	C	W	S, E
Olivaceous cormorant, *Phalacrocorax olivaceus*		C	W	
Anhinga, *Anhinga anhinga*		R	P	E
Black duck, *Anas rubripes*	G	R	W	

Table B.3 (continued)

	Status[a]	Regional geographical distribution	Regional use[c]	Area[d] observed
Mottled duck, *Anas fulvigula*	G	C	P	S, E
Gadwall, *Anas strepera*	G	R	W	S, E
Cinnamon teal, *Anas cyanoptera*	G	W	M	S, E
Green-winged teal, *Anas carolinensis*	G	R	W	E
Wood duck, *Aix sponsa*	G	R	P	S
Redhead, *Aythya americana*	G	C	W	
Canvasback, *Aythya valisineria*	G	C	W	
Ring-necked duck, *Aythya collaris*	G	R	W	
Greater scaup, *Aythya marila*	G	C	W	
Common goldeneye, *Bucephala clangula*	G	R	W	S
Bufflehead, *Eucephala albeola*	G	R	W	E
Ruddy duck, *Oxyura jamaicensis*	G	C	W	E
Common merganser, *Mergus merganser*	G	N	V	E
Red-breasted merganser, *Mergus serrator*	G	C	M	
Hooded merganser, *Lophodytes cucullatus*	G	E	W	S
Bald eagle, *Haliaeetus leucocephalus*	E	R	W	
Osprey, *Pandion haliaetus*	U, BL	R	M	E
Great blue heron, *Ardea herodias*		R	P	S, E
Reddish egret, *Dichromanassa rufescens*	P	SW	P	E
Green heron, *Butorides virescens*		R	S	S, E
Black-crowned night heron, *Nycticorax nycticorax*	BL	R	P	S
Yellow-crowned night heron, *Nyctanassa violacea*		R	P	S, E
Least bittern, *Ixobrychus exilis*		R	S	S
Wood ibis, *Mycteria americana*	U, BL	C	M	S
Roseate spoonbill, *Ajaia ajaja*	P	SW	S	S, E
Purple gallinule, *Porphyrula martinica*	G	R	P	S
American avocet, *Recurvirostra americana*		W	W	S
Black-bellied plover, *Squatarola squatarola*		C	W	S, E
Piping plover, *Charadrius melodus*	BL	C	W	
Snowy plover, *Charadrius alexandrinus*	U, BL	C	W	
Wilson's plover, *Charadrius wilsonia*		C	P	
Solitary sandpiper, *Tringa solitaria*		SW	M	S
Spotted sandpiper, *Actitis macularia*		SW	M	S, E
Greater yellowlegs, *Totanus melanoleucus*		C	W	S, E
Stilt sandpiper, *Micropalama himantopus*		R	M	S
Short-billed dowitcher, *Limnodromus griseus*		C	W	
Long-billed dowitcher, *Limnodromus scolopaceus*		C	W	S
Ruddy turnstone, *Arenaria interpres*		C	W	
Dunlin, *Erolia alpina*		C	W	S, E
Sanderling, *Crocethia alba*		C	W	S
White-rumped sandpiper, *Erolia fuscicollis*		R	W	S
Semipalmated sandpiper, *Ereunetes pusillus*		C	W	S, E
Western sandpiper, *Ereunetes mauri*		C	W	S
Laughing gull, *Larus stricilla*		C	P	S, E
Least tern, *Sterna albifrons*	BL	C	S	
Common tern, *Sterna hirundo*		C	M	S, E
Forster's tern, *Sterna forsteri*		C	W	S, E
Caspian tern, *Hydroprogne caspia*		C	W	
Belted kingfisher, *Megaceryle alcyon*		R	P	S, E
Vermilion flycatcher, *Pyrocephalus rubinus*		SW	P	S
Tree swallow, *Iridoprocne bicolor*		C	W	S, E
Rough-winged swallow, *Stelgidopterx ruficollis*		R	P	S, E
Prothonotary warbler, *Prothonotaria citrea*		R	S	S
Swamp species				
Southern gray treefrog, *Hyla versicolor chrysoscelis*	R	R	P	
Swallow-tailed kite, *Elanoides forficatus*	R	R	S	
River—stream species (lotic)				
Eastern checkered garter snake, *Thamnophis marcianus marcianus*		R	P	
River species				
Smooth softshell, *Trionyx muticus*	R, G	R	P	
Texas softshell, *Trionyx spinifer emoryi*	R	R	P	
Fish crow, *Corvus ossifragus*	R	R	P	S

Table B.3 (continued)

	Status[a]	Regional geographical distribution	Regional use[c]	Area[d] observed
Stream species				
Sonora kingsnake, *Lampropeltis getulus splendida*	R	W	P	
Lentic wetland species (ponds, fresh marshes, lakes, salt marshes, ocean bays, and ocean)				
Western grebe, *Aechmophorus occidentalis*	BL	V	V	E
Horned grebe, *Podiceps auritus*		C	W	
Pied-billed grebe, *Podilymbus podiceps*		R	P	E
Shoveler, *Spatula clypeata*	G	C	P	S,E
Lesser scaup, *Aythya affinis*	G	R	W	S
American bittern, *Botaurus lentiginosus*		R	P	S
Virginia rail, *Rallus limicola*	G	C	W	
Black rail, *Porzana jamaicensis*	G	C	W	S
Clapper rail, *Rallus longirostris*	G	C	P	E
Pectoral sandpiper, *Erolia melanoto*		R	M	S
Black tern, *Chlidonias niger*		R	M	S
Long-billed marsh wren, *Telmatodytes palustris*		R	P	S
Short-billed marsh wren, *Cistothorus platensis*		C	W	S, E
Sharp-tailed sparrow, *Ammospiza caudacuta*		C	W	E
Seaside sparrow, *Ammospiza maritima*		C	P	
Pond–freshwater marsh species				
Blue-winged teal, *Anas discors*	G	C	W	S, E
Common gallinule, *Gallinula chloropus*	G	R	P	E
Jacana, *Jacana spinosa*	P	L	M	
Pond species				
Barred tiger salamander, *Ambystema tigrinum mavortium*	R	W	P	
Ubiquitous marine species				
Texas diamondback terrapin, *Malaclemys terrapin littoralis*		C	P	
American oystercatcher, *Haematopus palliatus*	BL	C	P	
Sandwich tern, *Thalasseus sandvicensis*		C	S	
Royal tern, *Thalasseus maximus*		C	P	S, E
Black skimmer, *Rynchops nigra*		C	P	
Marine bay species				
Brown pelican, *Pelecanus occidentalis*	E, R	C	W	
Coastal dune species				
Keeled earless lizard, *Holbrookia propinqua propinqua*	R	SW	P	

Table B.3. Footnotes

[a]Status categories:

T – threatened (Source reference 1).
E – endangered (Source reference 2).
U – status-uncertain (Source reference 1).
P – peripheral (Source reference 1).
BL – 1974 National Audubon "Blue List" (Source reference 3).
G – game species.
F – fur bearing mammals of economical importance.
PE – pest species.
R – species restricted to a single habitat.

[b]Regional geographical distribution:

R – throughout the area being affected by the site and all transmission line corridors.
C – occurring along the coast.
W – occurring in western part of region.
WC – occurring along western coastal part of region.
E – occurring in eastern part of region.
NE – occurring in northeastern part of region.
L – localized populations.
N – occurring in northern part of region.
SW – occurring in southwestern part of region.

[c]Regional use:

S – summer resident.
W – winter resident.
M – migrant.
V – visitor.
P – permanent year around resident.

[d]Areas observed in:

S – observed on the site.
E – observed in the Marshland complex. South of the site.
T – observed along the transmission line corridors.

Sources:

1. U.S. Department of Interior, Bureau of Sport Fisheries and Wildlife, Office of Endangered Species and International Activities, *Threatened Wildlife of the United States,* U.S. Government Printing Office, Washington, D.C., 1973.

2. National Audobon Blue List, *American Birds,* vol. 27, No. 6, National Audobon Society (December 1973).

3. United States Department of Interior, Fish and Wildlife Service, *United States List of Endangered Fauna,* U.S. Government Printing Office, Washington, D.C., 1974.

Table B.4. Mean value of triplicate water samples for salinity (ppt) calculated from laboratory measurements of specific conductance (μmhos at 25°C) South Texas Project, 1973–1974

Station		June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1	S[a]	0.2	0.3	0.2	0.2	<0.2	0.2	<0.2	<0.2	0.3	0.4	0.4	0.2
	B[b]	0.2	0.2	0.2	0.2	<0.2	0.2	<0.2	<0.2	0.3	0.4	0.2	0.2
2	S	0.2	0.2	0.2	0.2	<0.2	<0.2	<0.2	<0.2	0.3	0.4	0.2	0.2
	B	0.2	0.2	0.2	0.2	<0.2	0.2	<0.2	<0.2	0.3	1.8	0.2	0.2
3	S	0.3	0.2	0.2	0.3	<0.2	<0.2	<0.2	<0.2	0.4	0.8	0.3	0.2
	B	0.4	3.1	0.2	0.3	<0.2	0.4	<0.2	<0.2	0.4	10.2	0.7	0.2
4	S	0.3	0.3	0.2	0.4	<0.2	0.2	<0.2	<0.2	0.5	1.2	0.5	0.2
	B	8.8	5.8	0.2	0.7	<0.2	0.2	<0.2	<0.2	0.8	14.3	1.3	0.2
5	S	1.6	0.6	0.6	2.6	<0.2	0.5	0.5	<0.2	5.4	6.9	2.4	1.0
	B	10.6	5.8	1.0	3.2	<0.2	7.4	7.6	<0.2	8.7	12.1	14.2	5.3
10	S	2.8	15.3	1.8	3.5	0.2	1.6	0.9	<0.2	3.2	9.7	2.9	1.8
	B	3.2	12.7	11.8	4.4	0.2	8.0	17.5	1.5	21.4	13.7	15.6	8.0
11	S	13.6	5.7	5.0	4.0	0.2	5.6	3.6	6.4	20.4	16.5	16.6	13.5
	B	24.0	11.0	14.4	–[c]	0.2[d]	9.2	10.0	18.6	22.1	16.4	17.3	13.7
12	S	17.0	6.8	5.1	4.1	0.4	6.9	7.4	0.3	10.7	10.8	12.4	8.8
	B	21.7	7.0	5.1	–	1.4	11.8	9.4	–	–	–	–	–
13	S	10.5	–	8.1	4.4	0.3	11.6	–	0.2	22.0	16.6	17.6	16.5
	B	10.1	–	–	–	–	–	–	–	–	–	–	–
14	S	–[c]	–	11.1	–	0.3	16.5	3.2	20.9	20.1	16.6	18.4	11.4
	B	–	–	–	–	0.3	22.0	17.6	20.8	20.8	16.4	18.3	12.8
16	S	–	–	0.2	–	–	–	–	–	0.8	0.4	0.4	0.2
	B	–	–	–	–	–	–	–	–	–	–	–	–

[a]Surface.
[b]Bottom.
[c]Station or depth not sampled.
[d]Only two replicates were analyzed.

Source: ER, Suppl. to A 1.

Table B.5. Staff summary of dominant divisions and densities (No. of 100 cells/ml) in surface phytoplankton samples taken at STP site, June 1973—May 1974[a]

Month	Station										
	Upriver				Midriver		Downriver		Matagorda Bay		Robbins Slough
	1	2	3	4	5	10	11	14	12	13	16
June 1973	D	D	D	D	D	D	D	—	D	D	—
	1	<1	<1	<1	3	6	2		3	1	
July	P	G	P	G	G	G	G	D	B	—	—
	2	6	7	3	8	7	13	1	1		
Aug.	D	D	P	D	D	D	D	D	D	D	D
	12	15	10	15	27	8	16	3	2	6	<1
Sept.	G	B	G	G	G	B	B	—	D	B	—
	15	14	12	9	15	14	15		5	24	
Oct.	D	D	D	B	D	B	D	D	B	D	—
	4	2	2	3	2	6	2	<1	4	4	
Nov.	D	D	D	D	D	D	D	D	D	D	D
	7	7	6	9	14	9	7	2	5	14	7
Dec.	D	D	D	D	D	D	B	D	D	D	—
	5	2	4	5	11	8	10	4	1	5	
Jan. 1974	D	D	D	D	D	D	D	D	D	D	—
	4	3	4	5	4	5	13	46	3	3	
Feb.	D	D	D	P,D	P	D	D	D	D	D	D
	85	160	160	125	76	36	4	7	4	3	2
Mar.	D	D	D	D	P	P,D	D	D	D	D	D
	124	57	142	15	80	90	105	73	11	97	9
Apr.	D	D	D	D	D	D,G	D	D	D	D	E
	117	77	80	84	56	57	163	63	2	20	7
May	G	G	G	G	B	B	D	D	D	D	B
	13	11	35	39	107	22	88	32	20	8	216

[a]Key:
E = Euglenophyta.
D = Chrysophyta (mainly diatoms).
B = Cyanophyta (blue-green algae).
G = Chlorophyta (green algae).
P = Pyrrhophyta (dinoflagellates).

Table B.6. Relative abundance (number per cubic meter of water sampled) of eggs and young fish for June 1973—May 1974 at the South Texas Project

(Number collected in parentheses)

Station number	Total volume of water sampled (m^3)	Average number of young per m^3	Percent total catch	Average number eggs per m^3	Percent total catch
1	2498.83	0.0108(27)	0.20	0.0096(24)	1.33
2	2483.71	0.0109(27)	0.20	0.0060(15)	0.83
3	2159.91	0.0194(42)	0.36	0.0005(1)	0.07
4	2282.65	0.0920(210)	1.71	0.0039(9)	0.54
5	2467.68	0.4791(1183)	8.88	0.0117(29)	1.62
10	2036.90	0.2867(584)	5.31	0.0319(65)	4.41
11	1683.15	2.1532(3625)	39.91	0.1390(234)	19.23
12	1750.64	0.9454(1655)	17.52	0.0006(1)	0.08
14	1709.57	1.3982(2390)	25.91	0.5195(888)	71.88

Source: NUS Corporation, *An Ecological Study of the Lower Colorado River—Matagorda Bay Area of Texas,* Amendment 1, R-24-05-04-606, Docket Nos. STN-50-498, STN-50-499, August 5, 1974.

Table B.7. List of species in phylogenetic order taken at gill net, seine, and trawl stations during June 1973—May 1974 at the South Texas Project site[a]

Common name	Scientific name	Common name	Scientific name
Bull shark (M)	*Carcharhinus leucas*	White crappie (F)	*Pomoxis annularis*
Smalltail shark (M)	*Carcharhinus porosus*	Black crappie (F)	*Pomoxis nigromaculatus*
Spotted gar (C,E)	*Lepisosteus oculatus*	Crevalle jack (E)	*Caranx hippos*
Longnose gar (F)	*Lepisosteus osseus*	Atlantic bumper (E)	*Chloroscombrus chrysurus*
Alligator gar (C,E)	*Lepisosteus spatula*	Bluntnose jack (E)	*Hemicaranx amblyrhynchus*
Ladyfish (E)	*Elops saurus*	Leatherjacket (E)	*Oligoplites saurus*
Tarpon (M)	*Megalops atlantica*	Florida pompano (E)	*Trachinotus carolinus*
American eel (M)	*Anguilla rostrata*	Gray snapper (E)	*Lutjanus griseus*
Speckled worm eel (E)	*Myrophis punctatus*	Spotfin mojarra (E)	*Eucinostomus argenteus*
Skipjack herring (E)	*Alosa chrysochloris*	Mottled mojarra (E)	*Eucinostomus lefroyi*
Gulf menhaden (C,E)	*Brevoortia patronus*	Sheepshead (E)	*Archosargus probatocephalus*
Gizzard shad (C,E)	*Dorosoma cepedianum*	Pinfish (E)	*Lagodon rhomboides*
Threadfin shad (E)	*Dorosoma petenense*	Freshwater drum (F)	*Aplodinotus grunniens*
Striped anchovy (E)	*Anchoa hepsetus*	Silver perch (E)	*Bairdiella chrysura*
Bay anchovy (C,E)	*Anchoa mitchilli*	Sand seatrout (C,E)	*Cynoscion arenarius*
Carp (F)	*Cyprinus carpio*	Spotted seatrout (C,E)	*Cynoscion nebulosus*
Speckled chub (F)	*Hybopsis aestivalis*	Banded drum (M)	*Larimus fasciatus*
Red shiner (F)	*Notropis lutrensis*	Spot (C,E)	*Leiostomus xanthurus*
Silverband shiner (F)	*Notropis shumardi*	Southern kingfish (E)	*Menticirrhus americanus*
Bullhead minnow (F)	*Pimephales vigilax*	Atlantic croaker (C,E)	*Micropogon undulatus*
Blue sucker (F)	*Cycleptus elongatus*	Black drum (C,E)	*Pogonias cromis*
Smallmouth buffalo (C,F)	*Ictiobus bubalus*	Red drum (C,E)	*Sciaenops ocellata*
Blue catfish (C,F)	*Ictalurus furcatus*	Star drum (E)	*Stellifer lanceolatus*
Channel catfish (C,F)	*Ictalurus punctatus*	Atlantic spadefish (E)	*Chaetodipterus faber*
Flathead catfish (F)	*Pylodictis olivaris*	Striped mullet (C,E)	*Mugil cephalus*
Sea catfish (C,E)	*Arius felis*	White mullet (E)	*Mugil curema*
Gafftopsail catfish (C,E)	*Bagre marinus*	Atlantic threadfin (E)	*Polydactylus octonemus*
Gulf toadfish (E)	*Opsanus beta*	Southern stargazer (M)	*Astroscopus y-graecum*
Atlantic midshipman (E)	*Porichthys porosissimus*	Fat sleeper (E)	*Dormitator maculatus*
Skilletfish (E)	*Gobiesox strumosus*	Emerald sleeper (E)	*Erotelis smaragdus*
Diamond killifish (E)	*Adinia xenica*	Darter goby (E)	*Gobionellus boleosoma*
Sheepshead minnow (E)	*Cyprinodon variegatus*	Sharptail goby (E)	*Gobionellus hastatus*
Gulf killifish (E)	*Fundulus grandis*	Freshwater goby (E)	*Gobionellus shufeldti*
Bayou killifish (E)	*Fundulus pulvereus*	Naked goby (E)	*Gobiosoma bosci*
Longnose killifish (E)	*Fundulus similis*	Atlantic cutlassfish (E)	*Trichiurus lepturus*
Rainwater killifish (E)	*Lucania parva*	Spanish mackerel (M)	*Scomberomorus maculatus*
Mosquitofish (E)	*Gambusia affinis*	Bighead searobin (E)	*Prionotus tribulus*
Sailfin molly (E)	*Poecilia latipinna*	Bay whiff (E)	*Citharichthys spilopterus*
Rough silverside (E)	*Membras martinica*	Fringed flounder (E)	*Etropus crossotus*
Tidewater silverside (E)	*Menidia beryllina*	Gulf flounder (M)	*Paralichthys albigutta*
Chain pipefish (E)	*Syngnathus louisianae*	Southern flounder (C,E)	*Paralichthys lethostigma*
Green sunfish (F)	*Lepomis cyanellus*	Lined sole (E)	*Achirus lineatus*
Warmouth (F)	*Lepomis gulosus*	Hogchoker (E)	*Trinectes maculatus*
Bluegill (F)	*Lepomis macrochirus*	Blackcheek tonguefish (E)	*Symphurus plagiusa*
Longear sunfish (F)	*Lepomis megalotis*	Least puffer (E)	*Sphoeroides parvus*
Bantam sunfish (F)	*Lepomis symmetricus*		

[a]C denotes important forage, sport and/or commercial species. E, F, and M denote estuarine, freshwater and marine species, respectively.

Table B.8. Summary of land changes within the region

Type	Plant association: Acres of: In Texas	In Matagorda County	Within 5-mile radius	At site	Percentage of total plant association: In Texas[a]: 1[b]	2[c]	3[d]	4[e]	In the county: 2[c]	3[d]	4[e]	Within a 5-mile radius: 2[c]	3[d]	4[e]	At site: 2[c]	3[d]	4[e]
Southern floodplain forest	2,487,500	216,600	12,806	1,638	6	0.085			0.79	73	0.2	13	61	3	100	72	16
Oak–hickory forest	8,500,000	N[f]	N	N	8	0.005			N	N	N	N	N	N	N	N	N
Juniper–oak savanna	24,000,000	N	N	N	100	0.001			N	N	N	N	N	N	N	N	N
Mesquite–acacia brushlands	15,950,000	N	N	N	100	0.005			N	N	N	N	N	N	N	N	N
Blackland prairie	9,000,000	N	N	N	95	0.002			N	N	N	N	N	N	N	N	N
Fayette prairie	1,825,000	N	N	N	100	0.002		0	N	N	N	N	N	N	N	N	N
Coastal prairie	6,055,277	473,000	37,409	10,714	79	0.227	20	0.10	3	40	0.7	29			100	15	81
Southern coastal marsh	1,812,500	40,000	30	N	27	0.256			11			40	100	0	N	N	N

[a] If values are not given information was not available.

[b] Presettlement percentage of the system found in Texas (acres in subdivision in Texas/total acres in United States X100).

[c] Percent of system involved in the South Texas Project (total acres involved within that subdivision/original acres of subdivision).

[d] Preconstruction percentage of system remaining in natural vegetation (acres presently occupied by natural communities for subdivision/original acres of subdivision.

[e] Post-construction percentage of loss of natural vegetation (acres of natural communities altered within subdivision/preconstruction acreage of natural communities for subdivision).

[f] N – none.

Sources:

1. A. W. Kuchler, "Potential Natural Vegetation of the Coterminous U.S.," *Amer. Geog. Soc. Pub.* 36 (1964).
2. W. C. Brownlee, *Attwater's Prairie Chicken,* Federal Aid Project, W-100-R-4, Texas Parks and Wildlife Department, 1972.
3. ER, Suppl. to A 1.

Table B.9. List of plant species known to occur on the STP site whose status is rare, endangered, or restricted to a single habitat

Species	Acres of habitats at site	% of acreage to be altered by STP	Impact on species[a]
Rare and endangered in Texas[b]			
Elymus canadensis, Virginia wildrye;	95	46	SL
Sorghastrum nutans, indian grass;	95	46	SL
Trachypogon secundus, crinkleawn;	95	46	SL
Clitoria mariana, pigeon-wings;	95	46	SL
Eryngium yuccifololium, button-snake-root;	95	46	SL
Justicia americana, American water willow	95	46	SL
Restricted to a single plant association			
Zizaniopsis miliacea, marsh millet (coastal marshes)	138	97	SL
Forestiera acuminata, swamp privet (southern floodplain forest)	767	2	P

[a]SL, losses of site significance only; P, protection of habitat, beneficial.

[b]USDA Soil Conservation Service, "Rare and endangered native plants of Texas: Soil Conservation Service, Temple, Texas," 1972; Rare Plant Study Center, "Rare and endangered plants native to Texas," University of Texas at Austin, Austin, Texas, 1974.

Table B.10. Numbers of observed and potential wildlife species of ecological groups at the STP site and along the transmission line corridors (%)

Ecological group (species)	Total	Barn yard	Crop-land	Rice field	Pasture	Prairie	Brush-land	Thickets	Open woods	Forest	Swamps	River	Streams	Ponds	Fresh water marsh	Cooling lake	Salt water marsh	Matagorda Bay	Coastal beaches	% potential	% observed	% of group present
Generally ubiquitous	46.33	22.17	14.9	6.6	14.11	16.9	15.10	3.2	14.12	19.15	27.23	18.16	23.17	15.11	24.19	12.10	15.12	4.4	9.7	10	13	72
Cropland–wetland	47.39	15.13	27.20	4.4	12.9	19.14						21.19	17.16	22.20	40.34	27.24	20.18	18.15	12.9	11	15	83
Ubiquitous terrestrial	73.38	42.26	28.19	0.0	26.13	27.12	36.19	13.9	38.25	50.28	25.16									16	14	52
Urban–woodland	36.24	34.24						7.5	33.22	33.22	24.16									8	9	67
Urban–cropland	12.6	5.2	10.5	0.0	8.5	12.6														3	2	50
Urban–farmyard	8.3	8.3																		2	1	38
Cropland–brushland	12.2	5.2	6.0	0.0	10.2	8.2	4.2	1.0												3	>1	17
Cropland	1.0		1.0																	>1	0	0
Grassland–brushland	14.3					13.3	5.2	0.0												3	1	21
Prairie	5.1					5.1														1	>1	20
Shrubland–woodland–wetland	19.11						8.6	6.4	7.6	15.9	9.4	7.6	9.6	2.1	7.5	4.2	4.3	1.0	3.1	4	4	58
Shrubland–woodlands	17.8						17.8	3.1	7.2	14.7	10.5									4	3	47
Shrubland	7.2						7.2	2.1												2	>1	29
Desert	1.0						1.0													>1	0	0
Brushland	1.0						1.0													>1	0	0
Woodland	21.14							5.4	14.11	18.13	15.10									4	5	67
Forest	11.4									11.4										2	2	36
Ubiquitous wetland	82.59										62.49	50.38	57.42	s 61.46	52.38	61,42	36.26	26.17	23.16	18	22	72
Swamp	2.0										2.0									>1	0	0
River–stream	1.0											1.0	1.0							>1	0	0
River	3.1											3.1								>1	>1	33
Stream	1.0												1.0							>1	0	0
Lentic wetland	15.12													4.3	13.11	6.5	11.8	4.3	0.0	3	5	80
Pond–freshwater marsh	3.2													3.2	3.2					>1	>1	66
Pond	1.0													1.0						>1	0	0
Ubiquitous marine	5.1																2.0	2.0	4.1	1	>1	20
Marine–bay	1.0																	1.0		>1	0	0
Coastal–dune	1.0																		1.0	>1	0	0
Totals	446.263	131.87	86.53	10.10	70.40	100.47	94.49	40.26	113.78	160.98	174.123	100.80	108.81	108.83	139.109	110.83	88.67	56.39	52.34	100	100	59
% potential species for each habitat		29	19	2	16	22	21	9	25	36	39	22	24	24	31	25	19	13	12			
% observed species for each habitat		33	20	4	15	18	19	10	30	37	47	30	9	32	41	32	25	15	13			
% habitat utilization		66	62	100	57	47	52	65	69	61	71	80	75	77	78	75	76	69	65			

Table B.11. Status of wildlife known to occur on the proposed South Texas Plant site

Species	Status[a]	Maximum number observed[b]	Acreage of habitat	% of site used	Use[c] of site	Impact on species[d]
Generally ubiquitous						
White ibis	BL	61	4,566	37	V	N
Long billed curlew	U	25	4,955	40	WV,SM	N
Cropland–wetland						
Fulvous tree duck	BL	12	196	2	PB,V	SL
Marsh hawk	BL	17	11,070	90	WV	N
White faced ibis	U,BL	250	4,058	33	V	N
Franklin's gull	BL	275	6,418	52	SM	N
Ubiquitous terrestrial						
Swainson's hawk	BL	2	1,494	12	SM	N
Sparrow hawk	BL	15	7,835	63	WV	N
Barn owl	BL	1	3,064	25	V	N
Loggerhead shrike	BL	5	11,494	93	WV	N
Prairie–brushland						
Caracara	U,BL	3	1,258	10	WV	N
Whitetailed hawk	P	1	5,556	45	WV	N
Shrubland–woodland–wetland						
Pigeon hawk	U,BL	2	7,717	62	WV	N
Yellow billed cuckoo	BL	10	983	8	PB,SM	SL
Forest						
Eastern gray squirrel	R	6	845	7	B,PR	P
Red shoulder hawk	U,BL,R	4	943	8	B,PR	P
Barred owl	R	10	900	7	B,PR	P
Whip-poor will	R	1	900	7	V	N
Ubiquitous wetland						
American alligator	E	8	396	3	B,PR	SL
Double creasted cormorant	BL	2	727	6	WV	P
Osprey	U,BL	1	228	2	WV	P
Black crown night heron	BL	1	541	4	PB	P
Roseate spoonbill	P	28	4,289	35	V	N
River						
Fish crow	R	1	357	3	WV	N

[a]Status of species:
E – endangered (Source reference 1).
U – uncertain (Source reference 2).
P – peripheral (Source reference 2).
BL – "Blue List" (Source reference 3).
R – species restricted to a single habitat.
[b]At any one time in a single location on the site.
[c]Site usage code:
PB – probable breeder
B – breeder
PR – permanent resident
WV – winter visitor
V – visitor
SM – spring migrant
[d]Impact code:
SL – losses of site significance only.
N – no effect.
P – protection of habitat, beneficial.

Sources:

1. (USDI, 1974) United States Department of Interior, "United States List of Endangered Fauna," Fish and Wildlife Service, United States Government Printing Office, Washington, D.C., 1974.
2. United States Department of Interior, Bureau of Sport Fisheries and Wildlife, Office of Endangered Species and International Activities, *Threatened Wildlife of the United States,* U.S. Government Printing Office, Washington, D.C., 1973.
3. National Audubon Blue List, *American Birds,* vol. 27, No. 6, National Audubon Society (December 1973).

Appendix C

COMMUNICATION FROM THE TEXAS STATE HISTORICAL SURVEY COMMITTEE

Texas State Historical Survey Committee
Box 12276, Capitol Station, Austin, Texas 78711
Truett Latimer
Executive Director

November 12, 1973

Mr. Grant D. Hall
Research Archeologist
Balcones Research Center
Route4, Box 189
Austin, Texas 78757

Dear Mr. Hall:

This is the reply to your letter dated November 8, 1973 pertaining to the investigated area of approximately 12,000 acres along the Colorado River in Matagorda, Texas. No sites in the stated study area are listed on, or under consideration as nominations for the National Register of Historic Places.

Please do not hesitate to contact this agency, if we can be of additional assistance.

Sincerely,

Duncan G. Muckelroy

Duncan G. Muckelroy
Historic Preservation
Coordinator

DGM/dra

Appendix D

COST ESTIMATES FOR ALTERNATIVE BASE-LOAD GENERATION SYSTEMS

The staff elected to use a recently developed computer program to rough check the applicant's capital cost estimate for the South Texas Project and to estimate the costs for coal-fired alternative generation systems.

This computer program, called CONCEPT[1-3] was developed as part of the program analysis activities of the AEC Division of Reactor Research and Development, and the work was performed in the Studies and Evaluations Program at the Oak Ridge National Laboratory. The code was designed primarily for use in examining average trends in costs, identifying important elements in the cost structure, determining sensitivity to technical and economic factors, and providing reasonable long-range projections of costs. Although cost estimates produced by the CONCEPT code are not intended as substitutes for detailed engineering cost estimates for specific projects, the code has been organized to facilitate modifications to the cost models so that costs may be tailored to a particular project. Use of the computer provides a rapid means of calculating future capital costs of a project with various assumed sets of economic and technical ground rules.

DESCRIPTION OF THE CONCEPT CODE

The procedures used in the CONCEPT code are based on the premise that any central station power plant involves approximately the same major cost components, regardless of location or date of initial operation. Therefore, if the trends of these major cost components can be established as a function of plant type and size, location, and interest and escalation rates, then a cost estimate for a reference case can be adjusted to fit the case of interest. The application of this approach requires a detailed "cost model" for each plant type at a reference condition and the determination of the cost trend relationships. The generation of these data has comprised a large effort in the development of the CONCEPT code. Detailed investment cost studies by an architect-engineering firm have provided basic cost model data for light water reactor nuclear plants,[4-5] coal-fired plants,[6] and oil-fired plants.[7] These cost data have been revised to reflect plant design changes since the 1971 reference date of the initial estimates.

The cost model is based on a detailed cost estimate for a reference plant at a designated location and a specified date. This estimate includes a detailed breakdown of each cost account into costs for factory equipment, site materials, and site labor. A typical cost model consists of over a hundred individual cost accounts, each of which can be altered by input at the user's option. The AEC system of cost accounts[8] is used in CONCEPT.

To generate a cost estimate under specific conditions, the user specifies the following input: plant type and location, net capacity, beginning date for design and construction, date of commercial operation, length of construction workweek, and rate of interest during construction, If the specified plant size is different from the reference plant size, the direct cost for each two-digit account is adjusted by using scaling functions which define the cost as a function of plant size. This initial step gives an estimate of the direct costs for a plant of the specified type and size at the base date and location.

The code has access to cost index data files for 20 key cities in the United States. The data for Dallas were used for the South Texas Project cost estimates. These files contain data on cost of materials and wage rates for 16 construction crafts as reported by trade publications over the past fourteen years. These data were used to determine historical trends of site-related material costs, providing an estimate for the site material costs as of January 1974. Cost escalation after January 1974 was based on labor rates and escalation rates provided by the staff.

This technique of separating the plant cost into individual components, applying appropriate scaling functions and location-dependent cost adjustments, and escalating to different dates is the heart of the computerized approach used in CONCEPT. The procedure is illustrated schematically in Fig. 1.

ESTIMATED CAPITAL COSTS

The assumptions used in the CONCEPT calculations are listed in Table 1. Table 2 summarizes the total plant capital investment estimates for the South Texas Project with a man-made cooling reservoir. The estimate includes allowances, which were provided by the staff, of $38,500,000 for labor and $40,710,000 for materials for development of the cooling reservoir. Table 3 compares this reference system with cost estimates for the nuclear plant with different condenser cooling systems.

Estimated costs for alternative fossil-fired plants are presented in Table 4. The estimated costs for SO_2 removal equipment are based on a study performed by Oak Ridge National Laboratory.[9] The assumptions used in that study are summarized in Table 5.

As stated previously, the above cost estimates produced by the CONCEPT code are not intended as substitutes for detailed engineering cost estimates, but were prepared as a check on the applicant's estimate and to provide consistent estimates for the nuclear plant and fossil-fired alternatives.

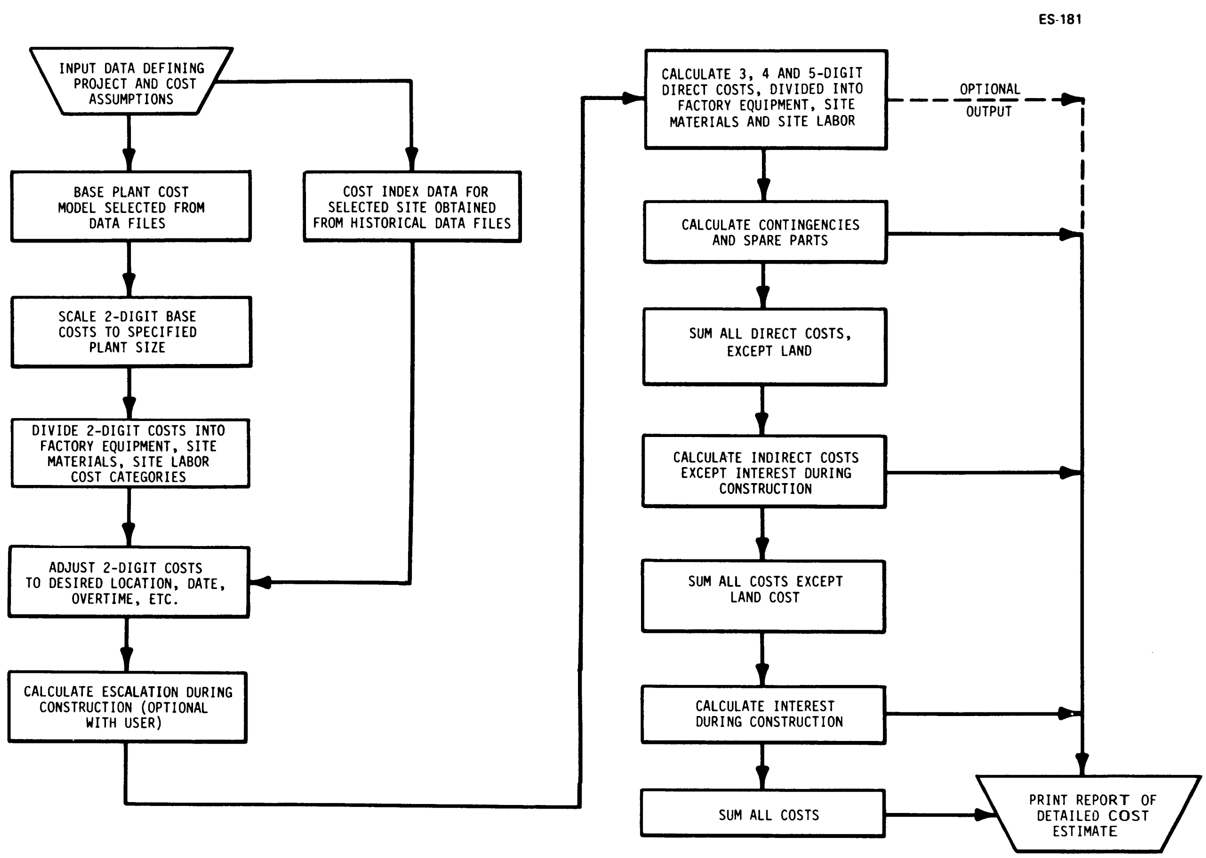

Fig. 1. Use of the CONCEPT program for estimating capital costs.

Table 1. Assumptions Used in CONCEPT Calculations for the South Texas Project

Plant type	Two-unit PWR with cooling reservoir
Alternate plant types	Two-unit coal-fired
Unit size	1250 MW(e)-net, each unit
Plant location	South Texas area
Start of construction date	
NSSS ordered	January 1974
Fossil alternatives	October 1974
Commercial operation date	
Unit 1	October 1980
Unit 2	March 1982
Length of workweek	40 hours
Interest during construction	6.5%/year, simple
Escalation rates	
Labor	7%/year
Materials	7%/year
Equipment	5%/year
Site labor requirements	7 manhours/kW(e)

Table 2. Plant Capital Investment Summary for a 2500-MW(e) Pressurized Water Reactor Nuclear Power Plant with a Cooling Reservoir (Houston Lighting & Power Company, South Texas Project)

	Unit 1	Unit 2	Total
Direct Costs (Millions of Dollars)			
Land and land rights	10	0	10
Physical plant			
Structures and site facilities	125	39	164
Reactor plant equipment	82	80	162
Turbine plant equipment	82	79	161
Electric plant equipment	24	21	45
Miscellaneous plant equipment	5	3	8
Subtotal (physical plant)	318	222	540
Spare parts allowance	2	2	4
Contingency allowance	21	13	34
Subtotal (total physical plant)	341	237	578
Indirect Costs (Millions of Dollars)			
Construction facilities, equipment and services	21	11	32
Engineering and construction management services	52	30	82
Other costs	16	9	25
Interest during construction	88	67	155
Total Costs			
Total plant capital cost at start of project			
Millions of dollars	528	354	882
Dollars per kilowatt	422	283	353
Escalation during construction	124	105	229
Total plant capital cost at commercial operation			
Millions of dollars	652	459	1111
Dollars per kilowatt	522	367	444

Table 3. Plant Capital Investment Summary for the South Texas Project with Alternative Heat Rejection Systems

	Nat. Draft Evap. Towers	Mech. Draft Evap. Towers	Cooling Reservoir
Plant Net Capability, MW(e)	2450	2450	2500
Direct Costs (Millions of Dollars)			
Land and land rights	5	5	10
Physical plant			
Structures and site facilities	75	75	164
Reactor plant equipment	162	162	162
Turbine plant equipment	171	163	161
Electric plant equipment	46	47	45
Miscellaneous plant equipment	7	7	8
Subtotal (physical plant)	461	454	540
Spare parts allowance	4	4	4
Contingency allowance	28	28	34
Subtotal (total physical plant)	493	486	578
Indirect Costs (Millions of Dollars)			
Construction facilities, equipment and services	28	27	32
Engineering and construction management services	71	70	82
Other costs	22	22	25
Interest during construction	132	131	155
Total Costs			
Total plant capital cost at start of project			
Millions of dollars	751	741	882
Dollars per kilowatt	306	302	353
Escalation during construction	193	191	229
Total plant capital cost at commercial operation			
Millions of dollars	944	932	1111
Dollars per kilowatt	385	380	444

Table. 4. Total Plant Capital Inves nt Cost Estimated for a 2500-MW(e) Coal-Fired Plant as an Alternative to the South Texas Project

	Without SO_2 Abatement System			With SO_2 Abatement System		
	Cooling Reservoir	Natural Draft Towers	Mechanical Draft Towers	Cooling Reservoir	Natural Draft Towers	Mechanical Draft Towers
Direct Costs (Millions of Dollars)						
Land and land rights	10	5	5	10	5	5
Physical plant						
Structures and site facilities	133	44	44	144	53	53
Boiler plant equipment	144	146	146	187	191	191
Turbine plant equipment	124	139	131	126	142	133
Electric plant equipment	24	24	25	34	34	35
Miscellaneous plant equipment	5	5	5	5	5	5
Subtotal (physical plant)	430	358	351	496	425	417
Spare parts allowance	3	3	3	4	3	3
Contingency allowance	27	22	21	31	26	25
Subtotal (total physical plant)	460	383	375	531	454	445
Indirect Costs (Millions of Dollars)						
Construction facilities, equipment and services	23	20	20	40	35	34
Engineering and construction management services	38	32	31	43	37	37
Other costs	14	12	12	18	16	16
Interest during construction	123	102	100	146	124	122
Total Costs						
Total plant capital cost at start of project						
Millions of dollars	668	554	543	788	671	659
Dollars per kilowatt	267	222	217	315	268	264
Escalation during construction	126	105	103	148	127	125
Total plant capital cost at commercial operation						
Millions of dollars	794	659	646	936	798	784
Dollars per kilowatt	318	264	258	374	319	314

Table 5. Basis for SO_2-Removal Equipment Cost Estimate

Type of process	Wet scrubbing of flue gas by a limestone slurry	
Cost basis	Integrated installation in a new plant (no backfitting required)	
Fuel Composition (Design Values)	Coal-Fired	Oil-Fired
Sulfur content, % by weight	5	3
Ash content, % by weight	25	0.3
Energy value	10,000 Btu/lb	150,000 Btu/gal
Abatement level, % SO_2-removal (minimum)	76	80
Plant Operating Data*		
Net plant heat rate without SO_2 control, Btu/kWh(e)	9000	9200
Capability loss due to SO_2 control, %	2.5	2.5
Net plant heat rate, Btu/kWh(e)	9230	9430
Assumed plant load factor	0.80	0.80
Annual Mass Flows*		
Fuel consumption	3230 tons/MW(e) net	10,460 bbl/MW(e)
Limestone used, tons/MW(e) net	790	790
Sulfur removed, tons/MW(e) net	120	40
Waste disposal, tons/MW(e) net		
Slurry	900	900
Fly ash	720	0

*With once-through cooling; evaporative cooling towers will increase heat rate and mass flows by about 2%.

REFERENCES

1. *CONCEPT: A Computer Code for Conceptual Cost Estimates of Steam-Electric Power Plants — Status Report,* USAEC Report WASH-1180 (April 1971).

2. R. C. DeLozier, L. D. Reynolds, and H. I. Bowers, *CONCEPT: Computerized Conceptual Cost Estimates for Steam-Electric Power Plants — Phase I User's Manual,* USAEC Report ORNL-TM-3276, Oak Ridge National Laboratory, October 1971.

3. H. I. Bowers, R. C. DeLozier, L. D. Reynolds, and B. E. Srite, *CONCEPT II: A Computer Code for Conceptual Cost Estimates of Steam-Electric Power Plants — Phase II User's Manual,* USAEC Report ORNL-4809, Oak Ridge National Laboratory, April 1973.

4. *1000-MWE Central Station Power Plant Investment Cost Study, Volume I, Pressurized Water Reactor Plant,* USAEC Report WASH-1230 (Vol. I), United Engineers and Constructors, Inc., Philadelphia, Pa., June 1972.

5. *1000-MWE Central Station Power Plant Investment Cost Study, Volume II, Boiling Water Reactor Plant,* USAEC Report WASH-1230 (Vol. II), United Engineers and Constructors, Inc., Philadelphia, Pa., June 1972.

6. *1000-MWE Central Station Power Plant Investment Cost Study, Volume III, Coal-Fired Fossil Plant,* USAEC Report WASH-1230 (Vol. III), United Engineers and Constructors, Inc., Philadelphia, Pa., June 1972.

7. *1000-MWE Central Station Power Plant Investment Cost Study, Volume IV, Oil-Fired Fossil Plant,* USAEC Report WASH-1230 (Vol. IV), United Engineers and Constructors, Inc., Philadelphia, Pa., June 1972.

8. *Guide for Economic Evaluation of Nuclear Reactor Plant Designs,* USAEC Report NUS-531, NUS Corporation, January 1969.

9. M. L. Myers, *Cost Estimate for the Limestone— Wet Scrubbing Sulfur Oxide Control Process,* USAEC Report ORNL-TM-4142, Oak Ridge National Laboratory, July 1973.

Appendix E

APPLICANT'S MONITORING PROGRAM

Monitoring Program for the Little Robbins Slough Marsh Complex

Scope of work

a. Duration of program

The field sampling program will extend over a one-year period to document seasonal changes. Field studies will begin during April 1975.

b. Sampling stations

Thirteen stations will be sampled including ten stations in the Little Robbins Slough marsh complex and three stations in Matagorda Bay (Fig. 1). Stations 12, 13, and 16 were sampled during the June 1973-May 1974 baseline environmental survey; numerical designations for these stations will be retained. Other stations will be numbered station 90 through station 99 (Fig. 1).

c. Parameters

- Salinity, specific conductance, water temperature, pH, DO and water level and fluctuation will be measured in the field concurrently with collection of biological samples at each station.

- Water samples for nutrient levels including nitrates, orthophosphate, inorganic carbon, total organic carbon and total carbon will be taken monthly during collection of biological samples at eight stations (stations 16, 91, 92, 93, 94, 95, 96, and 97 — see Fig. 1). Samples will be collected with an all-plastic Kemmerer water sampler and analysis will be according to accepted methodology.[1] One replicate per station for each parameter will be analyzed.

- Fish, ichthyoplankton, crustaceans, and macrozooplankton will be sampled monthly at all stations, with frequency increasing to biweekly at the station in Crab Bayou (station 98), and stations 12, 13, and 99 during March through May and August through December. These periods of intensive sampling are representative of the expected highest influx of estuarine-dependent organisms. Sampling gear will be bag seines (0.25-in. mesh) and Renfro beam trawls (0.5-mm mesh). The shallow nature of the water column at these stations will prevent the use of other gear types. One seine sample per station will be collected. Each seine sample will consist of the combined catch of tows parallel and perpendicular to the shoreline. Renfro beam trawl collections will consist of one tow of the trawl at each station for a measured distance. The distance trawled may vary from station to station but will remain constant at a given station for the duration of the study.

- Benthos, phytoplankton, periphyton, macrophyton, and microzooplankton will be sampled quarterly at all stations. Quarterly sampling trips will be conducted in May, August, November, and February. Gear used to sample benthos will include the Ponar grab for infauna and epifauna and insect light traps for emergent adults. Duplicate Ponar samples will be analyzed for each station. Light traps will be set only at stations 16 and 97. Drifting benthos will be analyzed monthly using Renfro beam trawl samples. Phytoplankton and microzooplankton will be sampled in duplicate by taking whole water samples. Microzooplankton samples will be concentrated through a No. 2 (80-μm) net. Qualitative analysis of periphyton communities will be madeusing a diatometer. Duplicate slides will be removed from the diatometer each quarter. Macrophyton studies will include quarterly sampling of any forms present and qualitative estimates of dominant forms and their relative abundance. Qualitative observations will be made during other trips. Emergent hydrophytes will be included in a terrestrial survey of the marsh ecosystem.

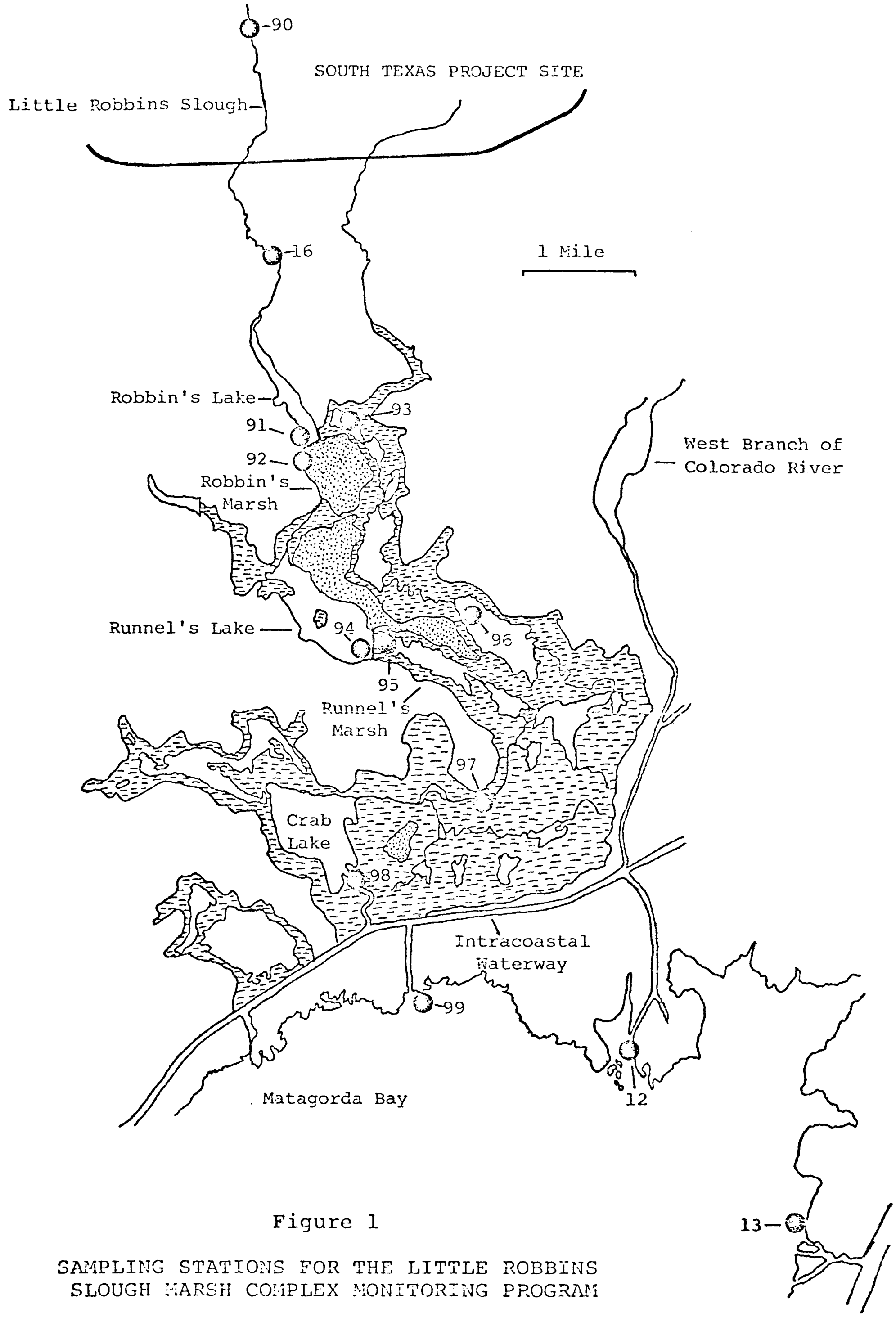

Figure 1

SAMPLING STATIONS FOR THE LITTLE ROBBINS SLOUGH MARSH COMPLEX MONITORING PROGRAM

Reports

All data and conclusions therefrom will be presented in a final report to be submitted some 90 days following the last field collection of samples.

Entrainment Monitoring Program

Scope of work

a. Duration of program

The program will be divided into two phases: the first phase will be prior to actual pumping and the second phase will be during cooling lake filling operations. The first phase will begin during April 1975 and continue for one year or until adequate data have been acquired during low river flow conditions. The second phase will begin upon initiation of cooling lake fill operations and continue for one year, or until adequate data have also been acquired for low-river-flow conditions. Filling of the cooling lake is estimated to begin during 1978.

b. Sampling stations

During the initial sampling prior to cooling lake fill, four stations in the Colorado River will be sampled (stations 1, 2, 3, and 5 — Fig. 2) to enable characterization of population densities in the Colorado River under various flow conditions. The distance between stations 1 and 2 and 2 and 3 is not considered sufficient for intermediate stations. During the second phase, emphasis will be on documentation of actual entrainment under various flow-salinity conditions, and sampling will thus be limited to station 2 and the siltation basin.

c. Parameters

- Salinity, specific conductance, water temperature, pH and dissolved oxygen will be measured in the field concurrently with the collection of biological samples at each station.
- Freshwater flow, tidal excursion and tidal flow information will be available on a continuous basis for the duration of the sampling program from a permanent monitor, USGS, and field records.
- Fish, ichthyoplankton, crustaceans, and macrozooplankton will be sampled at each station at least quarterly (May, August, November, and February) during the first phase. Additional samples will be taken when a salt wedge is present in the vicinity of the makeup pump station, as evidenced by bottom salinities of 2 ppt or greater. Bottom salinity will be checked daily at station 2 by onsite personnel to determine the need for intensive sampling. Intensive sampling will not exceed weekly intervals during March through May and August through December and will not exceed biweekly intervals during January, February, June, and July. An intensive sampling frequency will be followed only for the duration of low-flow conditions (i.e., bottom salinity at station 2 is 2 ppt or greater). Bottom-fishing otter trawls and bag seines* will be used to sample fish and crustaceans. One trawl and one seine sample will be taken per station. Single, oblique ichthyoplankton tows (0.5 mm) at midstream and nearshore will be used to sample ichthyoplankton and larval crustaceans. During cooling lake filling operations, sampling procedures and frequency will be as during the initial phase except for the following: (1) Sampling will be conducted only during periods of actual pumping during which the above salinity and sampling interval guidelines will be applicable; (2) Exact sampling procedures (i.e., use of trawls, seines, and ichthyoplankton nets) in the siltation basin will be adjusted as necessary to meet physical sampling restrictions.

Reports

Periodic reports will be prepared containing all data and conclusions regarding entrainment potential. When sufficient data have been obtained during low river flow conditions, the monitoring program will be terminated and a final report prepared.

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*Seining will be conducted as close as possible to stations 1, 2, 3, and 5; exact locations will be determined on the basis of suitability (water depth, bank slope, etc.).

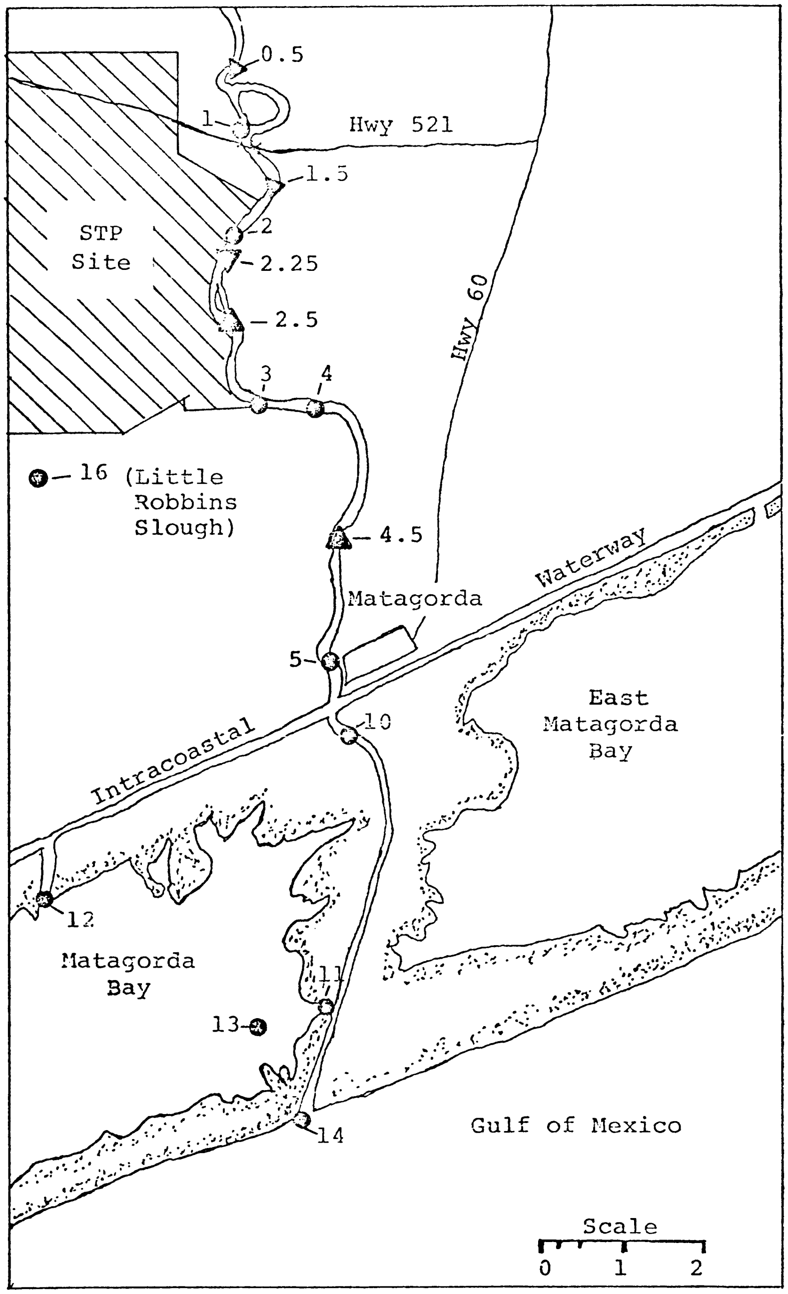

FIGURE 2

MAP SHOWING SAMPLING STATIONS OCCUPIED DURING BASELINE STUDY (1 THROUGH 5, 10 THROUGH 14, AND 16) PLUS STATIONS SAMPLED BY GILL NETTING ONLY (STATIONS 0.5, 1.5, 2.25, 2.5 AND 4.5). STATIONS 1, 2, 3 AND 5 WILL BE SAMPLED DURING THE INITIAL ENTRAINMENT STUDY.

Impingement Monitoring Program

Scope of work

a. Duration of program

The impingement monitoring program will coincide with the second phase of the entrainment monitoring program during cooling lake fill operations and will continue for one year or until adequate low flow data have been obtained. The study program is expected to begin sometime during 1978.

b. Sampling stations

Two revolving screens will be monitored separately for impingement rates.

c. Parameters

- Freshwater flow in the Colorado River, makeup salinity and makeup volume will be monitored concurrently with collection of screen samples. Field measurements and pump station records will be utilized for these data.
- Fish, shrimp, crabs and other organisms impinged on two revolving screens will be identified and counted in samples collected at the initiation of each pumping period. During extended periods of continuous pumping, sampling will be conducted every seven days. Samples will consist of 30-min counts on each of two screens every 8 hr during a 24-hr period. When possible, impingement sampling will coincide with entrainment studies.

Reports

All data will be presented and discussed in periodic reports. Upon collection of sufficient data, the sampling program will be terminated and a final report submitted.

REFERENCES FOR APPENDIX E

1. Environmental Protection Agency (Water Programs), "Guidelines Establishing Test Procedures for Analysis of Pollutants," *Fed. Regist.* 38(199): 28759-28760 (1973).