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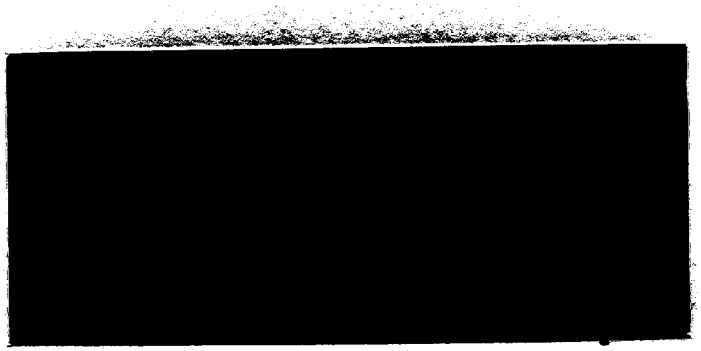

Texas Coastal Management Program

Texas General Land Office.

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Texas Coastal Management Program
Technical Paper No. 18

A CASE STUDY OF NUCLEAR FACILITY SITING:

THE SOUTH TEXAS PROJECT

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The General Land Office of Texas
Bob Armstrong, Commissioner

RPC, Inc.
Austin, Texas

August 1978

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This paper was prepared under contract with the General Land Office of Texas, Coastal Management Program. The report was partially funded through financial assistance provided by the Coastal Zone Management Act of 1972, administered by the Office of Coastal Zone Management, U.S. Department of Commerce.

FOREWORD

This technical paper is one of four papers which provide additional information relevant to the study entitled Siting Industrial Facilities on the Texas Coast. Many individuals assisted in the production of these technical papers. Public officials, private citizens, and industrial representatives provided invaluable assistance.

The principal-in-charge was Ron Luke. Project managers were Leah Pagan and Frank Sturzl. The principal research was conducted by Jim Kimmel with assistance from Barbara Haefeli. The technical editor was Nancy Grona. Production assistance was provided by Kyle Pierce and David Fox.

Bob Armstrong

Bob Armstrong, Commissioner
General Land Office of Texas

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1. INTRODUCTION

The rural Texas coastal plain, predominantly rice fields and pastures, is increasingly the selected site for industrial development. Basic to industrial development is adequate and dependable electric power. Four South Texas utilities elected to build a major nuclear generating plant, the South Texas Project, in Matagorda County, Texas. This case study examines the public and private policies, requirements, and constraints that influenced the siting decisions for the South Texas Project. It is the siting process which is detailed here. Many related issues are not discussed, including the economic feasibility of the nuclear power plant, the efficiency of nuclear power as compared to other types of power, and the moral and environmental issues concerning the advisability of the use of nuclear energy. The study uses information from South Texas Project documents, published information, and personal interviews. That information is organized in the following way. The first three sections of the case study provide a description and history of the project and a description of the area and site, while the next section describes the siting process. A section on the suitability of the Matagorda County site describes governmental, social, environmental and economic factors and how they were met by the South Texas Project site. The next three sections describe site acquisition, opposition to the project, and public announcements and hearings. The last section discusses local impacts of the project. An appendix lists and describes federal and state permitting agencies and processes and also includes permits issued.

2. DESCRIPTION OF THE SOUTH TEXAS PROJECT

The South Texas Project, when completed in the early 1980s, will consist of two 1,250-megawatt nuclear powered electric generating units. These units will be cooled by water circulated through a 7,000-acre reservoir, constructed especially for the project. The lake will receive make-up water from the Colorado River, immediately adjacent to the plant site. The generating units, cooling lake, switch yard, exclusion area, and all additional roads, storage areas, pump stations, and waste treatment stations are being constructed on a 12,352-acre tract of land owned by the project. The South Texas Project is owned jointly by Houston Lighting and Power (30.8%), City Public Service of San Antonio (28%), Central Power and Light (25.2%), and the city of Austin (16%). The project is managed by Houston Lighting and Power. Two of the owners, the city of Austin and City Public Service of San Antonio, are municipalities and currently claim exemption from taxation.

3. BRIEF HISTORY OF THE SOUTH TEXAS PROJECT

In 1971, various members of the Texas Interconnected System, including Houston Lighting and Power, Central Power and Light, the city of Austin, the Lower Colorado River Authority, and the city of San Antonio, recognized the need for more generating capacity. Since they also recognized the efficiency of scale of a large generating facility, joint development of a major four-unit generating plant came under consideration. It was evident at the time that fossil fuel probably would not be a good choice, and a nuclear plant was considered.

Selection of nuclear fuel over fossil fuel was based on a projected life-of-plant cost per kilowatt hour. Other costs such as the disposal of nuclear waste and the decommissioning of the plant at the end of its lifetime were considered in the initial decisions on whether to construct a nuclear plant or not. These considerations are not pertinent to the siting process as discussed here.

The prospective participants in the South Texas Project sought guidance on joint-development projects, especially those complicated by participation of both public and private entities. No such development had previously taken place in Texas. Representatives of the participants went to Page, Arizona, to tour the Navajo Project. Though coal fired, the Navajo Project is owned by a combination of public and private interests, including the city of Los Angeles. The organizational structure and legal relationships of the participants of the Navajo Project served as a model for the South Texas Project (Hancock, 1977).

By the fall of 1973, the organizational and legal arrangements had been set, and several candidate sites were selected. However, several of the original participants had considered withdrawing from the project, and the Lower Colorado River Authority did withdraw after the initial planning phase was completed.

4. AREA AND SITE DESCRIPTIONS

TEXAS GULF COAST

The Texas Gulf coast has been the site of major industrial development and urban growth since the end of World War II, and the petroleum industry has been the primary stimulus of that development. However, the availability of transportation, energy, capital, and sites, plus favorable labor relations, tax rates, and minimal restrictions have attracted a broad range of industries to the area. While the Houston, Corpus Christi, and Beaumont/Port Arthur/Orange areas have been the focal points of this industrial development, in the early 1950s some plants were located in nonurban areas of the coast. Refineries and petrochemical plants that did not depend on adjacent plants for feedstocks were free to locate away from industrial centers. Advantages included less expensive land and fewer zoning regulations.

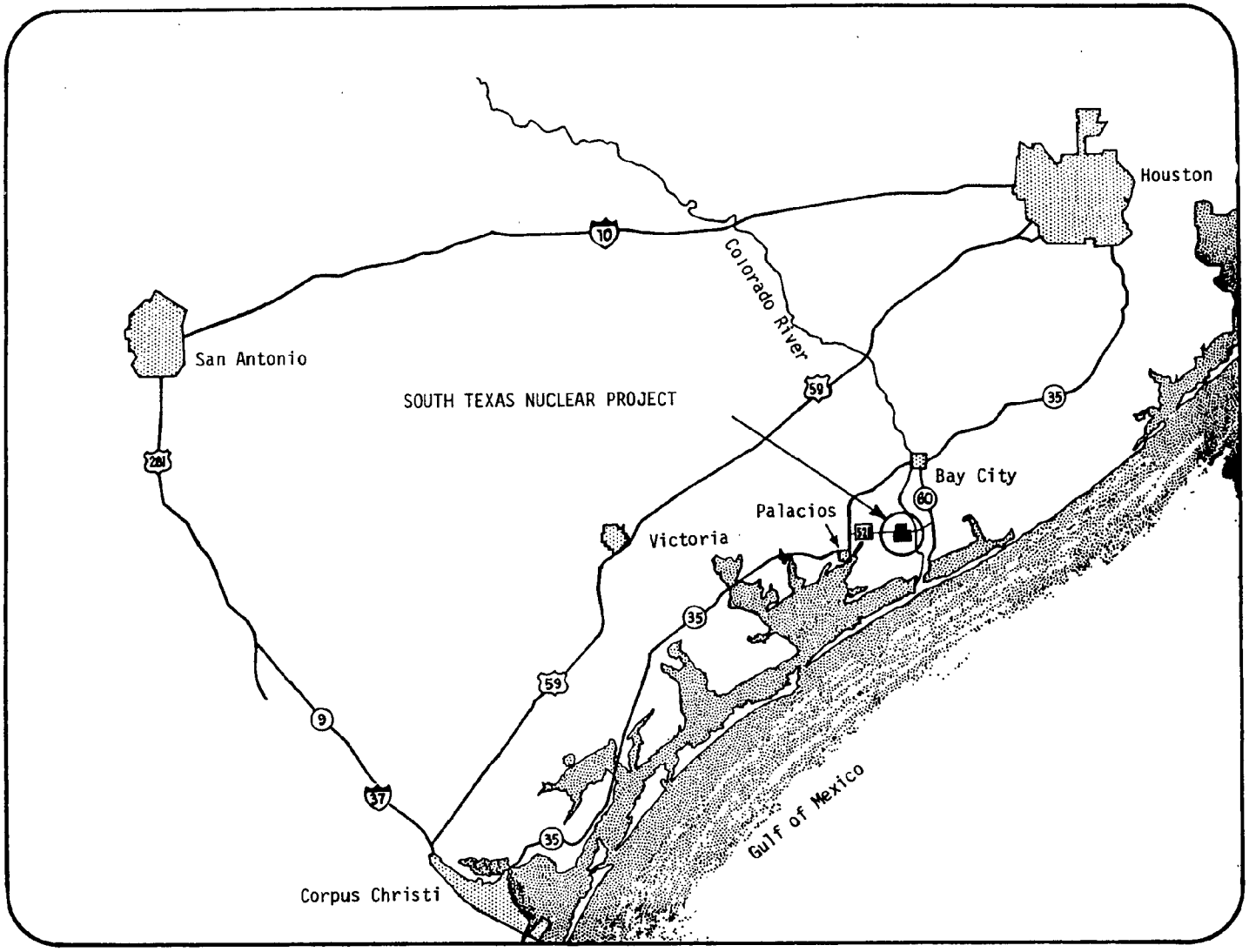
Geographically, the Texas Gulf coast is hospitable to industrial development. The climate is mild, and even major storms have not been a deterrent to development. The terrain is almost completely flat and poses few problems for construction or transportation, though subsidence has been a problem in certain areas.

MATAGORDA COUNTY

Matagorda County is located in the area commonly referred to as the "middle coast" (see Map 1). The county covers 1,157 square miles and had a 1972 estimated population of 29,400 people. Over 17,000 of those residents live in Bay City, the county seat. Matagorda County has 55 oil and gas fields, and it is the site of seven major petrochemical and related industrial facilities. The Celanese Plant, which employs over 400 people, is the largest of those facilities. The most obvious activity in Matagorda County, however, is agriculture. Rice is the major crop, with 57,000 acres planted annually, while soybeans are important as alternate year crops (South Texas Project Environmental Report, 1974).

Map 1

TEXAS MIDDLE COAST AREA



Source: South Texas Project Media Information Kit.

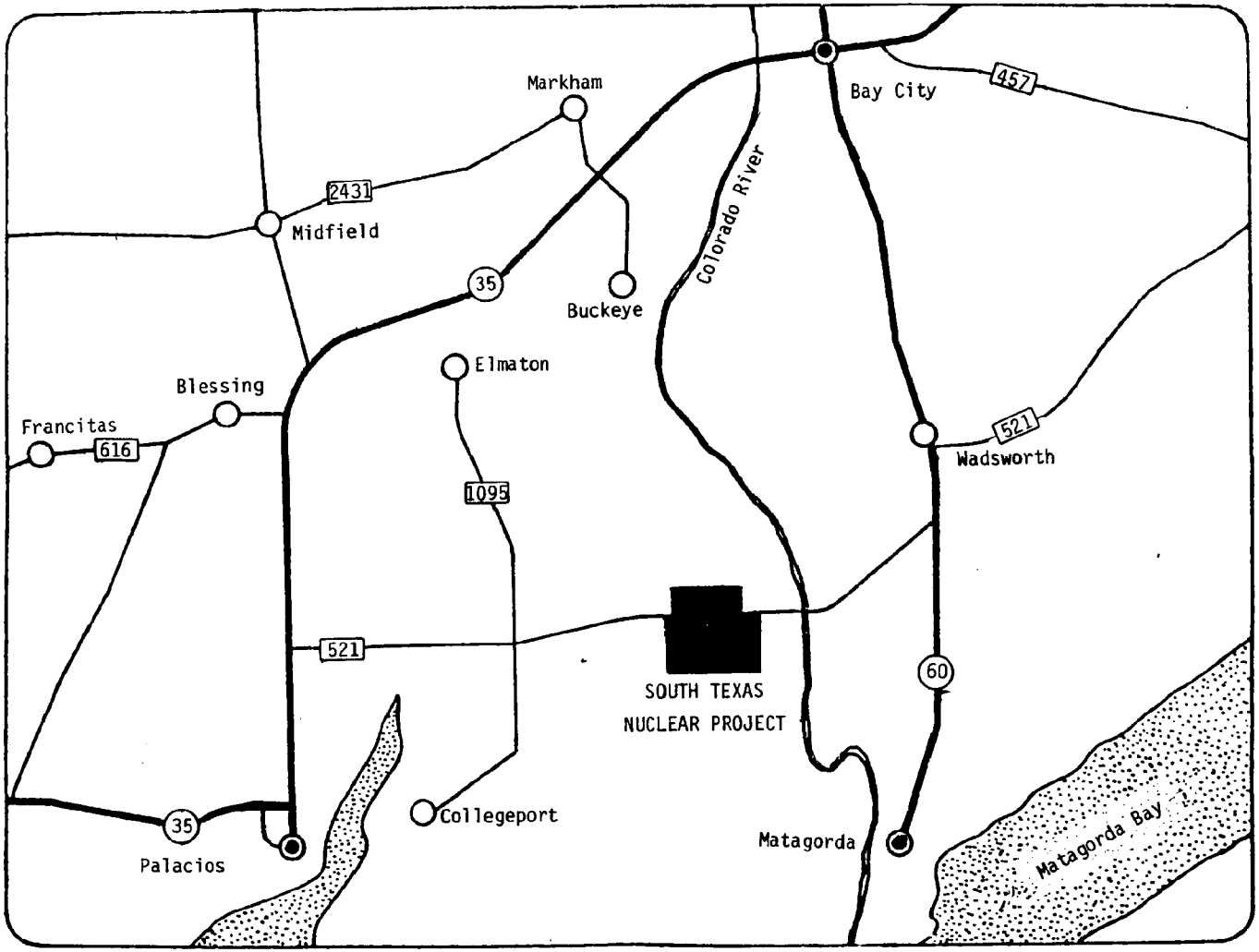
Matagorda County is flat, and its shore is broken by Tres Palacios Bay, Matagorda Bay, and East Matagorda Bay. The Matagorda Peninsula forms a barrier between the open Gulf of Mexico and the Matagorda County mainland. The Colorado River, which bisects the county, is navigable to barge traffic from the Gulf Intracoastal Waterway upstream approximately 20 miles to the Port of Bay City. Several industries have sited along this stretch of river. Matagorda County is served by a good network of paved state highways and farm to market roads.

SOUTH TEXAS PROJECT SITE

The South Texas Project site covers 12,352 acres located approximately 12 miles southwest of Bay City (see Map 2). Most of the site had previously been agricultural land; it had contained only one occupied residence and had no other development. The Colorado River, which forms a portion of the eastern boundary of the project site, will be used for make-up water for the cooling reservoir and as a receptacle for blowdown water and treated waste water. A barge slip to serve the project will be built on the Colorado River (see Map 3).

Map 2

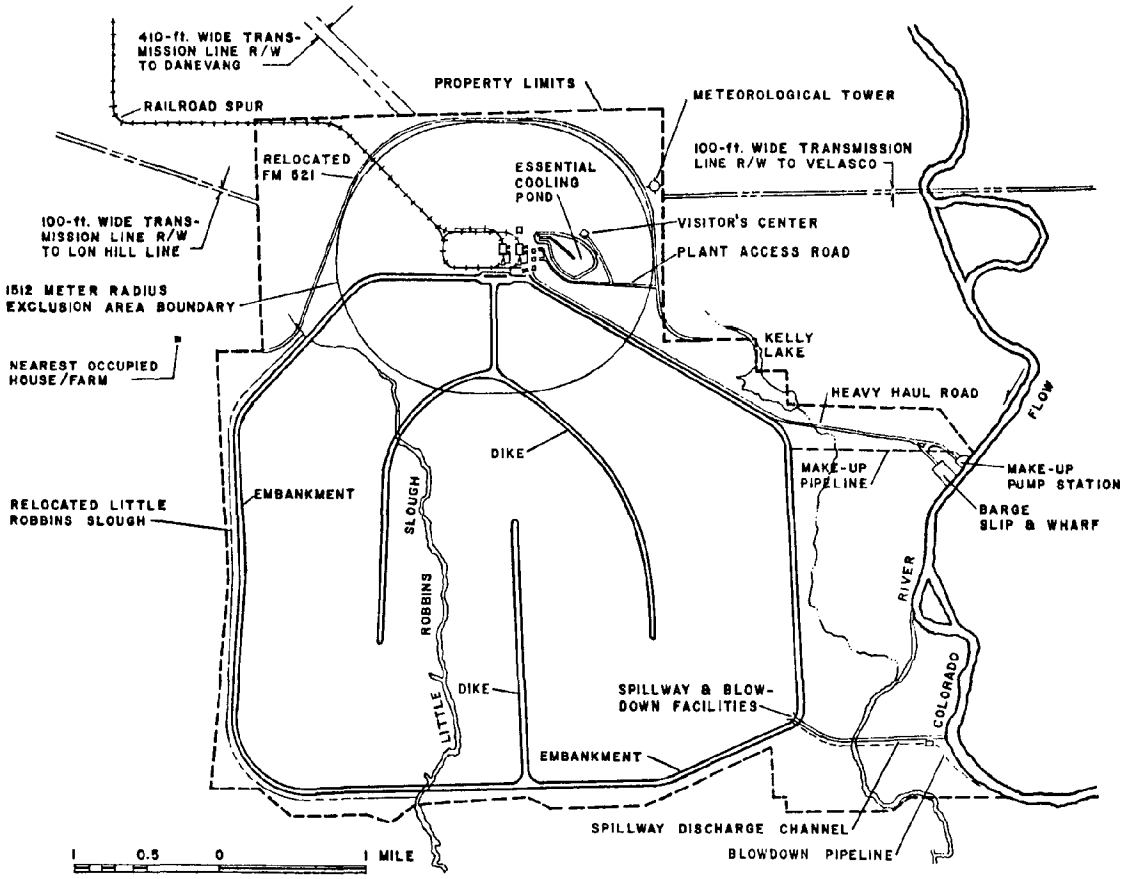
SOUTH TEXAS PROJECT SURROUNDING AREA



Source: South Texas Project Media Information Kit.

Map 3

SOUTH TEXAS PROJECT SITE



(Modified from U.S.A.E.C. Draft Environmental Impact Statement, South Texas Project Units I and II)

5. SITING PROCESS

Siting of the South Texas Project was a process of elimination, using evaluation criteria established by the guidelines of various permitting agencies and by operational requirements. Criteria mandated by permitting agencies included geotechnic, demographic, land use, ecoological, and meteorological characteristics. Operational criteria included hydrological characteristics (for cooling water) and economic factors.

The siting process proceeded from general areas to specific sites (using the factors listed above) to judge the suitability of regions and sites for both regulatory and operational requirements. After specific sites were selected using this process, final site selection was made on the basis of cost effectiveness comparisons.

Though the South Texas Project siting process appears to be cut and dried, there was a degree of flexibility that is not evident in a superficial description of the process. Since the siting process used increasingly specific criteria, there was always the possibility that a region or a site might ultimately prove unsuitable, even if it had met all previous standards. In addition, in the words of D. R. Betterton of Houston Lighting and Power, siting involves many subjective factors in a "fine balance of judgments" that cannot be made simply by "adding things up."

The prime contractor for the project, Brown and Root, performed the siting study, though supplementary studies were made by other consulting firms. The study involved preliminary selection of candidate regions, final evaluation of candidate regions, site selection, and cost comparison of candidate sites. A numerical rating system was used for each level of the site selection process and for each factor considered. The rating system assigned a value of 0 to conditions not presently feasible from engineering or economic standpoints, and ranged incrementally to a value of 5 for particularly favorable conditions.

Preliminary selection of candidate regions was based on the presence of adequate water supplies (hydrological characteristics) and lack of serious geotechnic problems within the 52,000 square mile combined service area of the owners of the South Texas Project. This geographic region, roughly bounded by an imaginary line from Houston to Austin, to San Antonio, to Corpus Christi and back to Houston, including the offshore portion of the Texas Gulf coast between Corpus Christi and

Houston, was divided into inland and coastal water regions. Rating of inland regions was based on sufficiency and availability of fresh surface water, while rating of coastal regions considered fresh, brackish, or saltwater availability and accessibility.

Initial geotechnic evaluation of candidate regions focused on soil, stratigraphic, and seismic characteristics of the regions. An evaluation was made of typical soil conditions related to the dominant geologic formation and the suitability of subsurface materials for nuclear power plant foundations. Notation was made of any geologic features which might make nuclear power plant siting significantly less desirable. General assessments were made of foundation design and construction requirements for each region, including probable seismic design criteria.

Preliminary screening of candidate regions produced 10 areas with hydrologic and geotechnic characteristics that seemed to warrant further investigation. Those areas were:

1. Colorado River East Coastal
2. Colorado River North Coastal
3. Colorado River West Coastal
4. Lavaca/Guadalupe Rivers Coastal
5. Brazos River West Valley
6. Lower Colorado River Valley
7. Lower Brazos River Valley
8. Brazos/Galveston Valley
9. Guadalupe River North Central
10. Lavaca River East Coastal

Final evaluation of candidate regions used more specific hydrologic and geotechnic characteristics than were used in preliminary evaluation. Final evaluation was also based on ecology, land use, demography, and meteorology. Descriptions of aquatic and terrestrial ecology in each of the candidate regions were developed. Predominant land uses within the entire region were considered as well as specific land uses (i.e. oil and gas production, recreation, etc.) applicable to sizeable portions of each region. Four principal demographic factors were looked at: (1) 1970 population density, (2) 2020 population density, (3) projected population growth rate between 1970 and 2020, and (4) the proximity of the region to the nearest metropolitan area (i.e. city of 25,000). The meteorological factors considered included topography, ventilation, dispersion, and annual average relative humidity (South Texas Project Environmental Report, 1974).

These evaluation criteria were weighted as follows: hydrology, 25 percent; geotechnic considerations, 25 percent; ecology, 15 percent; land use, 15 percent; demography, 10 percent; and meteorology, 10 percent. Screening of the 10 candidate regions using these evaluation factors allowed rational selection of five regions (defined as counties) for

an even more specific site search. Those counties were Calhoun, Colorado, Fayette, Jackson, and Matagorda (South Texas Project Environmental Report, 1974).

Site selection within the five counties used the same factors employed in screening of candidate regions, but in greater detail. Candidate counties were considered in order of preference. Matagorda County was considered first due to particularly favorable hydrological characteristics. Fayette and Colorado Counties were considered next. Jackson County was considered fourth in priority, primarily for testing using saline water for cooling a plant some distance from the shore. Calhoun County sites were not actively pursued due to limitations of fresh water availability and lack of access to the southern part of the region. Offshore siting was considered, but it was not pursued due to uncertainties of the feasibility of offshore floating power plants.

Initial site identification was made through use of topographic maps, aerial photographs, and other published data. Eight potential sites were identified: four in Matagorda County, one in Fayette County, one in Colorado County, and two in Jackson County. After this identification of eight candidate sites was made, a team of ecology, land use, and construction specialists visited each candidate site to gather necessary data for final site selection. In addition to the land-based sites, offshore nuclear siting concepts were also considered.

The final part of the site selection process was a cost comparison of candidate sites. Acquisition costs for each site were estimated by professional real estate appraisers. Differential construction and operating costs were estimated through preliminary designs for each site. Construction personnel visited each site to assess further the differential construction costs. Transmission costs were estimated for each site. (The city of Austin was not a participant at that time and was not figured into transmission cost estimates.) Detailed technical and environmental evaluations were made for each site to quantify major factors and to allow cost effectiveness comparisons. Those factors and their relative weights were: cost differential, 50 percent; geotechnic considerations, 10 percent; land use, 10 percent; demography, 5 percent; terrestrial ecology, 10 percent; aquatic ecology, 10 percent; meteorology, 5 percent. Two Matagorda County sites ranked first and second on the basis of the cost-effectiveness evaluation. The site ranked number one was selected for the project.

6. SUITABILITY OF THE MATAGORDA COUNTY SITE

This chapter describes the characteristics of the South Texas Project site in Matagorda County in regard to each of the factors used in the selection process. Because five of the seven factors (geotechnic, demographic, land use, ecological, and meteorological factors) are mandated by Nuclear Regulatory Commission requirements, brief descriptions of those requirements are included.

HYDROLOGIC FACTORS

Eichholz (1976) makes the following point:

> Adequate cooling water must be available and the site must be suitable for dissipating the heat in an environmentally acceptable fashion . . .. Within a given geographical area access to cooling water may often be a dominant selection criterion, but the type of cooling used will usually be determined by the site selected, not the other way around.

Four alternative cooling methods were considered for the South Texas Project. The methods considered were cooling reservoir, spray canal, mechanical draft wet cooling towers, and natural draft cooling towers. Once-through cooling with Colorado River water was not considered because the temperature and salinity of blowdown waters could exceed standards allowed for discharges by the Texas Water Quality Act and the Federal Water Pollution Control Act. Likewise, dry cooling towers were not considered because the technology for their use had not been sufficiently developed, and there were no cases of dry cooling towers having been used on power plants the size of the South Texas Project. The point is made in the South Texas Project Environmental Report that local environmental factors did not provide a clear choice between the various cooling alternatives. However, economic factors and the capability to handle two additional units swayed the decision toward the cooling reservoir.

GEOTECHNIC FACTORS

Nuclear Regulatory Commission guidelines (10 C.F.R. 100, Amendment A) require two types of geotechnic investigations. First, all recorded earthquakes in the region in a radius of up to 100 miles must be listed. Second, where appropriate, geologically recent faulting in surface and bedrock must be located. The proposed plant design is tested on the criterion of the design earthquake, which is the combination of the most severe motions from any earthquake which may affect the site.

The geological characteristics of the Gulf Coastal Plain Physiographic Province, in which Matagorda County is located, do not give rise to serious seismic problems. According to the South Texas Project Draft Environmental Impact Statement:

> 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. Although faults do occur within the site area, there is very little seismic activity related to faulting.

Summarizing Amendment A of 10 C.F.R. 100, Eichholz (1976) says:

> Natural disasters such as earthquakes, volcanic action, landslides, flooding, and tsunamis are potentially so catastrophic that their possible occurrence at any site could be considered as sufficient cause to exclude the site from further consideration.

Flooding, particularly due to hurricanes, was the only one of these factors considered to be a possible hazard at the South Texas Project site. The plant was, therefore, designed with the intention of being able to withstand any such natural catastrophe which might occur in the area.

DEMOGRAPHIC FACTORS

A rural, low-density population area is dictated by Nuclear Regulatory Commission (NRC) guidelines for location of a nuclear generating plant. In order to ensure low population exposure to the "design-basis accident," NRC exercises three requirements of nuclear plant siting in respect to population. Those requirements involve the "exclusion area," "the low population zone," and the "population center."

The exclusion area is defined as "that area surrounding the reactor in which the reactor licensee has the authority to determine all activities including exclusion or removal of personnel or property from that area" (10 C.F.R. 100). The exlusion area is determined to be:

> an area of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure. (10 C.F.R. 100)

The exclusion area for the South Texas Project comprises a 1,512-meter radius around the reactor area (see Map 3).

> The low population zone is defined to be:
>
> of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure. (10 C.F.R. 100)

Though documents for the South Texas Project do not specify a boundary for the low population zone, radiation exposure levels for normal plant operation and for postulated accidents were calculated for cumulative population in concentric zones from one to 50 miles from the plant. Figure 1 shows annual cumulative doses from normal operation, and Figure 2 lists estimated doses to population in a radius of 50 miles of the plant resulting from various classes of postulated accidents. The estimated 1980 population in the 50-mile radius is approximately 265,000 people.

The final NRC requirement relating to population in the plant area is that the nearest population center should be at least 30 percent farther than the distance to the outer boundary of the low population zone. The nearest population center is defined as any densely populated area containing more than about 25,000 people. The city nearest the South Texas Project which meets that definition is Victoria, 59 miles away. However, since the population of Bay City for the year 2020 is projected to be about 24,000, Bay City was designated the population center. The corporate limits of Bay City are 12 miles from the site boundary. This distance met NRC criteria as sufficient distance between the plant and the nearest population center.

Figure 1

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	Annual cumulative dose (man-rem)	Average annual dose (millirem)
1	0	0.0	0.0
2	0	0.00	0.0
3	66	0.00	6.1×10^{-3}
4	575	0.00	1.9×10^{-3}
5	1,206	0.00	1.7×10^{-3}
10	4,281	0.01	1.3×10^{-3}
20	31,085	0.02	4.8×10^{-4}
30	56,200	0.02	3.4×10^{-4}
40	159,961	0.03	2.0×10^{-4}
50	264,852	0.04	1.4×10^{-4}

Source: United States Atomic Energy Commission. 1974. South Texas Project Draft Environmental Impact Statement.

Figure 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.

Source: United States Atomic Energy Commission. 1974. South Texas Project Draft Environmental Impact Statement.

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LAND USE FACTORS

The location of a nuclear generating plant must meet several land use guidelines set by the Nuclear Regulatory Commission. The 10 C.F.R. 100 regulations for the low population zone indicate that it should not contain concentrations of people such as major military installations, prisons, or educational institutions. None of these existed closer than eight miles from the South Texas Project site. In addition, it must be shown that the probability of an airplane crash affecting the plant in such a way as to cause release of radioactive materials in excess of 10 C.F.R. 100 guidelines is less than 1 in 10,000,000 per year. With no scheduled commercial flights and no military aircraft bases in the county, the project site was considered to be within acceptable limits of probability.

Potentially hazardous industrial facilities and activities within five miles of the site were identified. The Celanese petrochemical plant is the only major industrial facility located in the vicinity of the South Texas Project. This plant is located approximately five miles from the site, a distance considered sufficient to provide required safety. New plants within the low population zone are not automatically precluded. However, the South Texas Project is continually monitored by the Nuclear Regulatory Commission to ensure that no design-based accident will occur. In addition, other agencies require environmental reviews that would scrutinize the South Texas Project and might provide a factor limiting development. Such cases would be judged individually.

In accordance with NRC guidelines, aesthetic and recreation values were considered in site layout, selection of cooling method, and selection of transmission routes. No land used for the South Texas Project had previously been used expressly for recreation. However, the project will provide a visitor center, a picnic area, and a public boat ramp for access to the Colorado River. In addition, a nuclear plant cannot supplant any place of significant historical or archeological interest. An archeological survey was made of the area, and the Texas State Historical Survey Commission certified that the proposed facility would not affect historical or archeological resources.

Preemption of land from other productive uses is another important land use question. Eichholz (1976) says that for prospective nuclear sites "to keep land costs reasonable, previous land use may include marginal farming, wood lots or open pasture." The only major local opposition to the South Texas Project was from rice farmers who resisted taking several thousand acres of land from production. A study was made to show that significant amounts of unused land capable of supporting rice production were available in the county. Nevertheless, the local opposition continues to maintain that highly productive land should not have been used for an industrial site (United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards Public Hearings).

METEOROLOGICAL FACTORS

The three major meteorological concerns of the Nuclear Regulatory Commission are dispersion of the radioactive cloud in the event of a major accident, fogging and icing resulting from cooling water evaporation, and storm damage to the plant resulting in radiation loss. The meteorological factors considered for the South Texas Project were topography, ventilation, dispersion, annual average relative humidity, extreme wind speed expected once in 100 years, and frequency of tornado occurrence. The only specific meteorological problem that had to be dealt with in the South Texas Project site was that of high water from tidal backwash and rain from hurricanes. These were handled by appropriate drainage modifications.

ECOLOGICAL FACTORS

Nuclear Regulatory Commission guidelines require that an applicant for a construction permit for a nuclear generating facility must describe existing environmental conditions of the proposed plant area and make an assessment of the environmental impact of the planned facility. The summary preliminary environmental assessment of the Matagorda County area was as follows:

> Wildlife habitat conditions are poor to fair; vegetation is sparse because of extensive agricultural activity. The coastal area is marshy and terminates in Matagorda Bay, a sensitive estuarine zone. The region is in the range of wolf, coyote, fox and deer. Ducks and geese winter in the area. The present stress level is fairly high due to the agricultural activity. Due to the poor habitat conditions in the agricultural areas, removal of several thousand acres would have minimal impact on the regional ecology. Pipelines to the Gulf would cross the sensitive estuarine zone but adverse effects would be limited to the construction period. Indiscriminate withdrawal of make-up water from the Colorado River could impact the aquatic biology of the river and Matagorda Bay.
> (South Texas Project Environmental Report)

The only rare or endangered species directly affected by the project is Attwaters Prairie Chicken, whose range is crossed by some of the transmission lines. The Draft Environmental Impact Statement outlined mitigative actions to reduce this impact.

The South Texas Project site, complete with the cooling reservoir, consists of approximately 12,352 acres. This includes 3,800 acres of farmland, 3,600 acres of ranch land, and 1,700 acres of natural habitat. A large portion of the watershed for Little Robbins Slough will be preempted by the cooling reservoir.

Transmission lines will total 398.7 miles, with right-of-way between 100 and 400 feet wide. Approximately 123 miles of transmission lines will be visible from highways. Of the total transmission line right-of-way, 14.3 percent passes through wooded areas, 16.7 percent through scrub areas, 29.3 percent through pasture, 33.1 percent through cropland, and 5.1 percent through marshland. A total of 720 acres of woodland will be cleared for transmission lines (South Texas Project Environmental Report).

ECONOMIC FACTORS

(The economic values discussed below are those of 1974-75, when siting decisions were being made.)

The site for the South Texas Project cost $11,952,144.49, including mineral rights (city of Austin, Electric Utility Department, 1976). That averages approximately $970 per acre for the 12,352 acres. At the time of acquisition, land in this area of Matagorda County was selling for approximately $350 per acre without mineral rights, according to County Judge Bert Huebner.

Construction material costs will total approximately $638 million, of which an estimated $82 million will be spent locally. Construction labor for Units I and II will cost an estimated $158 million (South Texas Project Environmental Report, 1974).

The primary transportation needs for nuclear power plants include heavy-duty roads and navigable water or rail access for shipment of large reactor parts (Gifford, 1974). Transportation of fuel and wastes requires heavy-duty roads, but the volume of this transportation is minimal compared to that required by a coal-fired plant. The South Texas Project has good road and water access. The plant will require 398.7 miles of transmission lines with an estimated cost of $63,434,000, including right-of-way.

Among other reasons, the South Texas Project was sited in Matagorda County on the Colorado River in order to have a source of water for its cooling lake. When Houston Lighting and Power (acting for the South Texas Project) applied to the Texas Water Rights Commission for water allocation, the application was challenged by the Lower Colorado River Authority on the grounds that insufficient unappropriated water existed in the river. Houston Lighting and Power entered into a contract with the Lower Colorado River Authority to buy up to 102,000 acre-feet of water per year at $10 per acre-foot per year. The contract was approved by the Texas Water Rights Commission. The Lower Colorado River Authority holds an allocation of up to 102,000 acre-feet of water per year to sell to the South Texas Project. Texas Attorney General John Hill challenged the decision of the Water Rights Commission to issue a permit based on the contract and brought suit against the Commission. The

Water Rights Commission subsequently agreed to a rehearing on the matter, but after 17 months of hearings the Water Rights Commission issued a permit based on the contract between the Lower Colorado River Authority and Houston Lighting and Power. This second decision by the Water Rights Commission was reached on June 20, 1977. Attorney General Hill has again brought suit against what is now the Texas Department of Water Resources, Water Rights Division. A subsequent Texas Supreme Court decision ruled that the attorney general could not bring suit against a state agency, which had the effect of voiding the attorney general's suit against the Water Rights Commission.

The South Texas Project has removed 3,800 acres of cropland and 3,600 acres of grazing land from production. This resulted in a loss of about $2.4 million per year in farm products and wages. Discounted over the life of the project, this value is estimated to be $24.3 million (South Texas Project Environmental Report).

At the time of land acquisition for the plant, land in Matagorda County was selling for an average of $350 per acre. In the fall of 1977 land was selling for approximately twice that figure. Local explanations of this increase range from the inflationary effects of the South Texas Project to the observation that rice and soybeans have increased in value and restrictive allotments have been removed, stimulating more production and increasing the competition for land.

It was estimated in the South Texas Project Environmental Report (January 20, 1975) that the project would pay an estimated $565 million in discounted lifetime tax payments to local, state, and federal taxing bodies. That estimate was made on the assumption that the shares of the plant owned by the cities of Austin and San Antonio would not be taxed. However, in January of 1978, Matagorda County filed suit against Austin and San Antonio for payment of property taxes in the hopes of being able to tax the additional 44 percent of the project owned jointly by Austin and San Antonio. That question has not been resolved as of September 1978.

Employment resulting from the South Texas Project is projected to involve 16,385,600 man-hours of employment in construction, with an income value of $158 million. Operation and maintenance over the projected 30-year life of the plant will generate 7,500,000 hours of employment, with a discounted lifetime income value of $19.7 million. In addition to this direct employment, it is projected that approximately 80 service-oriented jobs will develop as a result of plant construction and operations. The lifetime value of these jobs was estimated to be $7 million (South Texas Project Environmental Report).

7. SITE ACQUISITION

The process of site acquisition for the South Texas Project used two levels of local contact. First, throughout the project, local negotiations have been handled by Central Power and Light (CP&L), since the South Texas Project is located in CP&L's service area. Second, a local attorney was retained to act as trustee for CP&L in land acquisition; agents acting for this trustee contacted landowners and made their offers. It was necessary to use condemnation proceedings against two of the owners involved. The acquisition process was simplified in that one 5,500-acre tract needed for the project was already on the market (Gwin, 1977). Public announcement of the impending project was not made until about 75 percent of the land was acquired. The county judge was not consulted about the project by the companies involved until the land had already been acquired and the formal public announcement was made on June 6, 1973.

8. OPPOSITION TO THE SOUTH TEXAS PROJECT

Opposition to nuclear power plant siting has received dramatic publicity in several instances. However, opposition to the South Texas Project was minimal. The opposition that did arise focused on nuclear power in general, the cost of the project, and the specific site. Opposition to nuclear power in general was based on safety and environmental problems. People in Matagorda County had an underlying apprehension of the nuclear plant, but these fears were relieved by explanations from CP&L officials who are highly trusted by the community concerning safety precautions (Huebner, 1977). Though opposition to nuclear power plants was vocal, the only lasting voice of that opposition was the Lone Star Chapter of the Sierra Club. Included in the Final Environmental Statement for the South Texas Project is a letter from the Lone Star Chapter of the Sierra Club which details the club's objections to the use of nuclear power and the chosen location of the South Texas Project.

The strongest opposition to the project came in Austin and focused on the cost of the project. Of the four project participants, the city of Austin is the only one that had to go to the voters for authorization to participate in the project. The debate surrounding the referenda necessary to this process raised questions concerning project costs. However, these questions were largely unique to Austin's participation and had no bearing on plant siting.

The major opposition to siting the South Texas Project in Matagorda County came from a few rice farmers who were directly affected by the project. Their specific objection was that the site chosen for the project contained some of the most productive rice land in the county. They thought the project should be built on less productive ground. A special study on the agricultural impacts of the project was included in public hearing testimony. This study indicated that the approximately 3,800 acres taken out of production would have no measurable effect on food supplies of the nation, nor would the local seven-county area be affected economically. The study pointed out that Matagorda County has large reserves of Classes I, II, and III land which are suitable for rice production. However, the study said that availability of water for rice irrigation was the main limiting factor. The study did not quantify the amount of suitable land with water that is available in the county. Local rice farmers still feel the plant should have been sited elsewhere (Savage, 1977).

9. PUBLIC ANNOUNCEMENTS AND HEARINGS

The first public announcement about the South Texas Project was made at an invitational gathering of community leaders and electric company officials at the Oasis Motor Hotel in Bay City on June 6, 1973. Mr. Barney M. Davis, President of Central Power and Light Company, delivered the address. Mr. Davis described the project and its benefits to Matagorda County. He mentioned some of the reasons for selecting Matagorda County for the plant location and explained the rationale, including safety precautions, in selecting nuclear power. At the time of this announcement, approximately 75 percent of the land for the project had been acquired.

Three hearings were held by the Nuclear Regulatory Commission in Bay City. The first, on Tuesday, April 22, 1975, was attended primarily by local businessmen and officials, plus a number of other individuals. Responses of business and community leaders were typified by that of W. C. Jackson, mayor of Palacios. Jackson said:

> It (South Texas Project) is the greatest thing that's happened to Matagorda County since the discovery of oil and gas forty years ago. One final word to the Commission. The back of our hand to the so-called environmentalists who put the environment of alligators and crickets above improving the environment of mankind. We feel that an abundance of energy is necessary to maintain our way of life and standard of living. (NRC Hearing Transcripts)

Mr. E. L. Gentry, vice-president of Bay City Bank and Trust, and immediate past president of the Bay City Chamber of Commerce, reported on a questionnaire mailed to 420 members of the Chamber of Commerce. Mr. Gentry reported that 68 percent of the questionnaires were returned, and 86 percent of these were in favor of the project, 6 percent were undecided, and 8 percent were opposed.

Six individuals spoke in opposition to the project. James Hughes, representing Friends of the Earth, called for "small independent energy sources," while James Morgan Scott questioned compliance of the South Texas Project with the Federal Flood Insurance Act. George Bunk ("I am a nobody and my following is all other nobodies back in the woodwork.") and Harley Savage protested the removal of agricultural land from production. Eugene Mueller and Randall Bailey expressed concerns about the safety of the plant.

The second public hearing in Matagorda County was held by the Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, J. G. Arnold, chairman. The hearing was held at the Oasis Motor Hotel on August 27, 1975. This hearing was attended primarily by representatives from various agencies and Houston Lighting and Power and served the purpose of publicly describing reactor safeguards. The third public hearing was held on November 12, 1975. Additional hearings on reactor safety and antitrust concerns were held in Washington, D.C., and Bethesda, Maryland.

10. LOCAL IMPACTS

The Nuclear Regulatory Commission's regulations require projections of expected social and economic impacts resulting from construction and operation of a nuclear power plant. A detailed socioeconomic impact assessment of the South Texas Project was prepared by the NUS Corporation (U.S. NRC Hearings, 1975). This assessment dealt with the major factors of population, housing, schools, hospital and medical facilities, transportation, public safety, recreation, water and sewerage capacity, and economic benefits to the community. The socioeconomic impact report said that in each of these cases the area would be able to absorb the impacts of the plant without great difficulty. Current local assessment of impacts substantiate the projections of the socioeconomic study except for a few major areas. A description of the results of the socioeconomic impact assessment follows, as well as a discussion of some of the immediate impacts of and reaction to the siting process.

Projected maximum employment for construction of the South Texas Project was 2,108 workers during 1978. Average employment for 1977 was projected to be 1,621 workers. However, by the end of August 1977, 3,100 workers were employed by the project. Mr. D. R. Betterton, manager of the Environmental Protection Department of Houston Lighting and Power, explained that employment in excess of projected levels is difficult to avoid since timely completion of the South Texas Project generating facility is crucial in order to be "on line" to meet peak loads in its scheduled completion year. Consequently, the contractor takes all necessary steps to ensure timely completion of the project. These steps include increasing the work force. Mr. Betterton made the point that studies are made of the capacity of the area to absorb workers in addition to the original projected levels of employment.

In order to help Matagorda County officials prepare for the possible impacts of the South Texas Project on their county, the South Texas Project arranged for them to visit with officials in three other counties where nuclear plants are located. However, these trips were not made until after June 6, 1973.

County Judge Bert Huebner (Houston Post, August 28, 1977, and personal communication) stated that the most noticeable impacts of the project have been on the highways and the jail. The socioeconomic

impact assessment noted that automobiles of workers and trucks hauling construction materials would have major impacts on the roads in the county. A 9.5 mile stretch of U.S. Highway 71 in the northern part of the county has been "wrecked." The judge said that if more "lead time" had been given, the county could have responded to expected impacts in order to prevent current problems such as these and to deal with the situation more effectively. At the same time, however, he would not have considered halting the project in order to get more lead time. Other roads in the county have required increased maintenance, but they are generally in good condition.

Economic impacts described by the socioeconomic impact assessment were discussed previously. The socioeconomic impact assessment also described characteristics of law enforcement agencies in the county. The study made the point that law enforcement personnel would be increased as population grew. No projections were made of crime rates. County Sheriff Sam Hurta (Houston Post, August 28, 1977) indicated that crime rates have increased between 75 percent and 100 percent since plant construction began. Judge Huebner stated that the dollar figure of fines through the county court has almost doubled for 1977, compared to 1976. In addition, Judge Huebner reported that the county parole officer has received approximately 50 parole referrals of individuals employed to work on the project who are on parole in some other county.

The characteristics of the region surrounding a nuclear plant are important to the smooth, successful completion of the project and to the viability of communities located in the project area. Since construction of a nuclear project requires five years or more and employs upwards of 3,000 workers, the magnitude of impact on rural areas is great. Siting a nuclear facility in an area with little capacity to absorb a major population increase would produce problems for successful completion of the project. Specifically, an area without sufficiently large towns and cities within reasonable driving distance would not provide essential services for a major work force. The South Texas Project is located between Bay City and Palacios in Matagorda County. These cities, particularly Bay City, were seen to be sufficiently large to absorb the impact of the 3,100 construction workers currently employed by the project. However, even though Bay City had a 1970 population of nearly 12,000, housing shortages have occurred, and housing is inflated in cost.

Introduction of several thousand workers into a rural community had obvious impacts. According to the Matagorda County judge, abrupt declines in economic activity did not occur when the workers withdrew from the three areas he visited where nuclear plants were already located. However, withdrawal of those workers and their families could have profound effects. Texas has not yet seen the completion of a nuclear facility, and longitudinal studies of communities with completed facilities are not available. Thus, it is impossible to determine whether the hopes of continued development will materialize.

11. SUMMARY

Nuclear Regulatory Commission guidelines, along with other federal, state, and local requirements, govern the siting of nuclear facilities. The South Texas Project, owned jointly by Houston Lighting and Power, Central Power and Light, City Public Service of San Antonio, and the city of Austin, is a case in point. This study has detailed the steps of the siting process from the initial decision to locate along the Texas Gulf coast due to the need for more generating capacity, to the selection of the specific site in Matagorda County near Bay City. It thus serves as an illustration of the procedures necessary to the siting of any such facility. In addition, local reaction to the process as well as immediate local impacts were detailed. No attempt has been made to discuss other related issues such as the economic feasibility of the nuclear power plant, the efficiency of nuclear power as compared to other types of power, and the moral and environmental issues concerning the advisability of the use of nuclear energy.

Appendix

NUCLEAR PLANT SITING CONSTRAINTS

NUCLEAR REGULATORY COMMISSION

Due to the potential danger of radiation, the undetermined effects of radiation from nuclear plants, and the publicly dictated necessity to take every precaution, nuclear power plants are governed by more exhaustive regulations than perhaps any other civilian activity. In addition to the usual environmental impact assessment required for most major installations, nuclear plants are governed by the Nuclear Regulatory Commission guidelines, especially those outlined in Title 10, C.F.R. Part 50, Licensing of Production and Utilization Facilities; Title 10, C.F.R., Part 51, Licensing and Regulating Policy and Procedures for Environmental Protection; and Title 10, C.F.R. Part 100, Reactor Site Criteria. Furthermore, the 1971 Calvert Cliffs decision in the District of Columbia Court of Appeals requires the Nuclear Regulatory Commission to ensure that nuclear plants meet environmental protection criteria, not simply to ensure that other federal and state agencies are monitoring the facility. The Nuclear Regulatory Commission guidelines both proscribe and prescribe the location of a nuclear site. Simultaneously, however, state and local governments maintain their authority to prevent or halt construction of a nuclear facility, as for any facility which does not meet legal requirements.

Issuance of permits by the NRC depends on the resolution of four main problem areas during construction and operation. Those are (1) prevention of undue risk to public health and safety, (2) resolution of environmental impacts to the extent that environmental damage is outweighed by the benefits of the plant, (3) prevention of sabotage and loss of fissionable material, and (4) prevention of violation of antitrust laws.

OTHER FEDERAL AGENCIES

CORPS OF ENGINEERS

Under the Rivers and Harbors Act of 1889, Section 10 (33 U.S.C. 403), the Corps of Engineers is responsible for issuing permits for modifications to navigable waterways. Intake and discharge structures for cooling water and pilings for monitoring devices in waterways must be licensed by the Corps of Engineers. In its permitting process, the Corps of Engineers submits applications to the Environmental Protection Agency and the Department of the Interior, in addition to state agencies, for their review.

ENVIRONMENTAL PROTECTION AGENCY

At the present time, the Environmental Protection Agency, acting under the Federal Water Pollution Control Act Amendments of 1972, has not approved the amended provisions of the Texas Water Quality Act. Consequently, the Texas Department of Water Resources is not authorized to approve applications for discharge, and approval must be sought from EPA. Such approval was obtained by Houston Lighting and Power Company on behalf of itself and the other participants of the South Texas Project with NPDES Permit No. TX0064947. However, amendments to the Federal Water Pollution Control Act are expected soon. These amendments will probably clear the way for the Texas Department of Water Resources to issue permits for discharge.

FEDERAL AVIATION ADMINISTRATION

It is necessary under article 77.13 of the Federal Aviation Regulations that the Federal Aviation Administration be notified of construction of the containment building for the nuclear reactor.

STATE AGENCIES

TEXAS DEPARTMENT OF WATER RESOURCES, WATER RIGHTS DIVISION

Section 5.121 of the Texas Water Code requires the issuance of a permit by the Water Rights Division for the appropriation and diversion of waters from rivers and streams in the state of Texas. In addition, the Water Rights Division must approve construction of intake and discharge structures and the cooling water reservoir for the project. Permits obtained by Houston Lighting and Power Company on behalf of itself and the other participants of the South Texas Project are Permit No. 3233, which has since been signed over to the Lower Colorado River Authority, and Permit No. CP-327.

TEXAS DEPARTMENT OF WATER RESOURCES, WATER QUALITY DIVISION

The Texas Water Quality Act and its amendments charge the Water Quality Division with enforcement of water quality standards in streams, rivers, lakes, underground water, and estuaries within the territorial limits of the state. A nuclear power plant which discharges cooling blowdown water into a body of water which falls under the jurisdiction of the Water Quality Division must apply for a permit for that discharge.

Likewise, discharge of sanitary wastes into such waters must be permitted by the Water Quality Division. Since the Texas Department of Water Resources has not received permitting authority from the Environmental Protection Agency (see discussion above) these applications must be sent to EPA for their approval. The permit obtained by Houston Lighting and Power Company from the Texas Water Quality Board was Permit No. 01908.

TEXAS PARKS AND WILDLIFE DEPARTMENT

The Texas Parks and Wildlife Department enforces the provisions of the Texas Water Quality Act involving effects on aquatic life or wildlife in violation of the Texas Water Quality Act.

TEXAS DEPARTMENT OF HEALTH RESOURCES

The Texas Department of Health Resources makes recommendations to the Texas Department of Water Resources about water quality and solid waste disposal matters. The Texas Department of Health Resources must license use of nuclear material for calibration of nuclear equipment. This licensing is carried out through the Radiation Control Agency, which is part of the Department of Health Resources. The Radiation Control Agency coordinates and approves emergency plans for evacuation in the event of accident, and it monitors emissions outside the plant boundaries. If these emissions violate standards, the Radiation Control Agency contacts the Nuclear Regulatory Commission, which has enforcement powers.

TEXAS AIR CONTROL BOARD

Under provisions of the Texas Clean Air Act, the Texas Air Control Board issues permits for construction of facilities which may affect air quality. The major air pollutant from a nuclear plant is from testing of emergency diesel power generators. However, the Texas Air Control Board exempts standby generators. Thus, no TACB permit was required for operation of the facility. However, a permit to burn waste during construction was obtained.

PUBLIC UTILITIES COMMISSION

The Public Utilities Commission requires certification of all power generation facilities, including nuclear plants. Though guidelines have not yet been developed, the certification process through the Public Utility Commission requires engineering reviews and justification

of need. The Public Utility Commission Examiner calls hearings and makes a determination on whether or not certification should be awarded.

OTHER STATE AGENCIES WITH REVIEW RESPONSIBILITIES

Texas State Department of Highways and Public Transportation

Texas Railroad Commission

Texas Industrial Commission

Texas State Soil and Water Conservation Board

Texas State Historical Survey Committee

General Land Office

Texas Department of Agriculture

Texas Forestry Service

Bureau of Economic Geology

Governor's Office of Budget and Planning

LOCAL AGENCIES AND GROUPS

Texas counties generally have no permitting or land use regulatory powers, nor do regional agencies or associations. However, it is usual for private builders to consult with county officials, the council of governments, area council or regional planning commission, city officials, the local office of the Soil Conservation Service, and any local interest groups including chambers of commerce.

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